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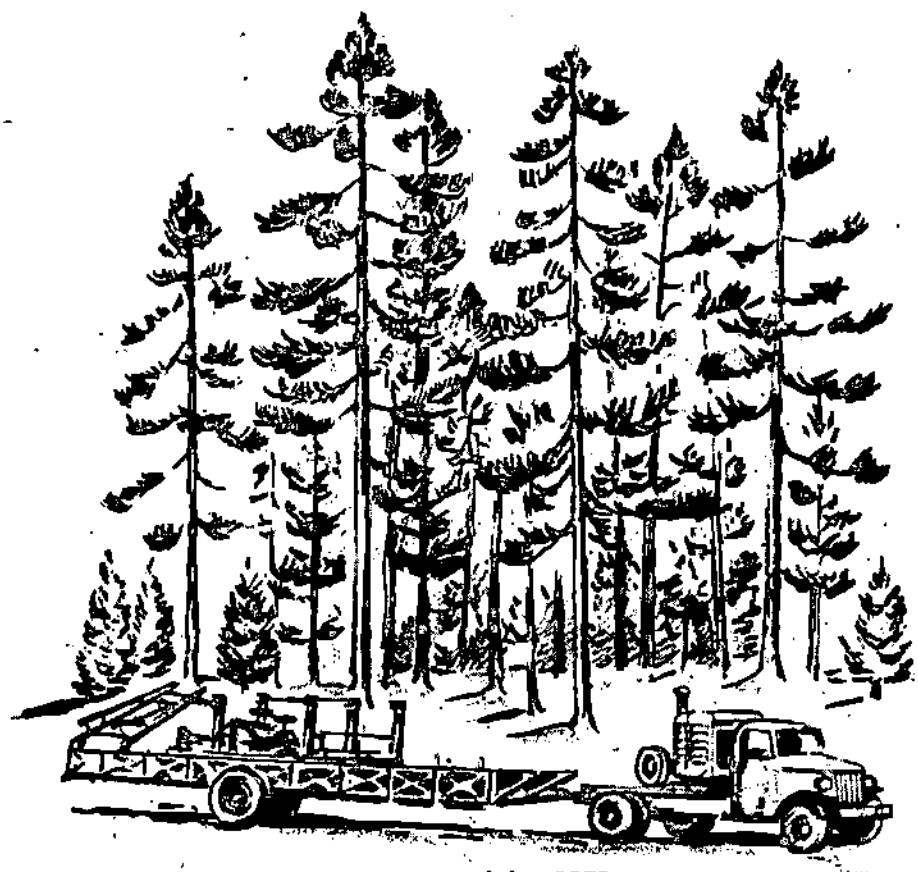
JACKSON "LUMBER HARVESTER" OPERATOR'S MANUAL

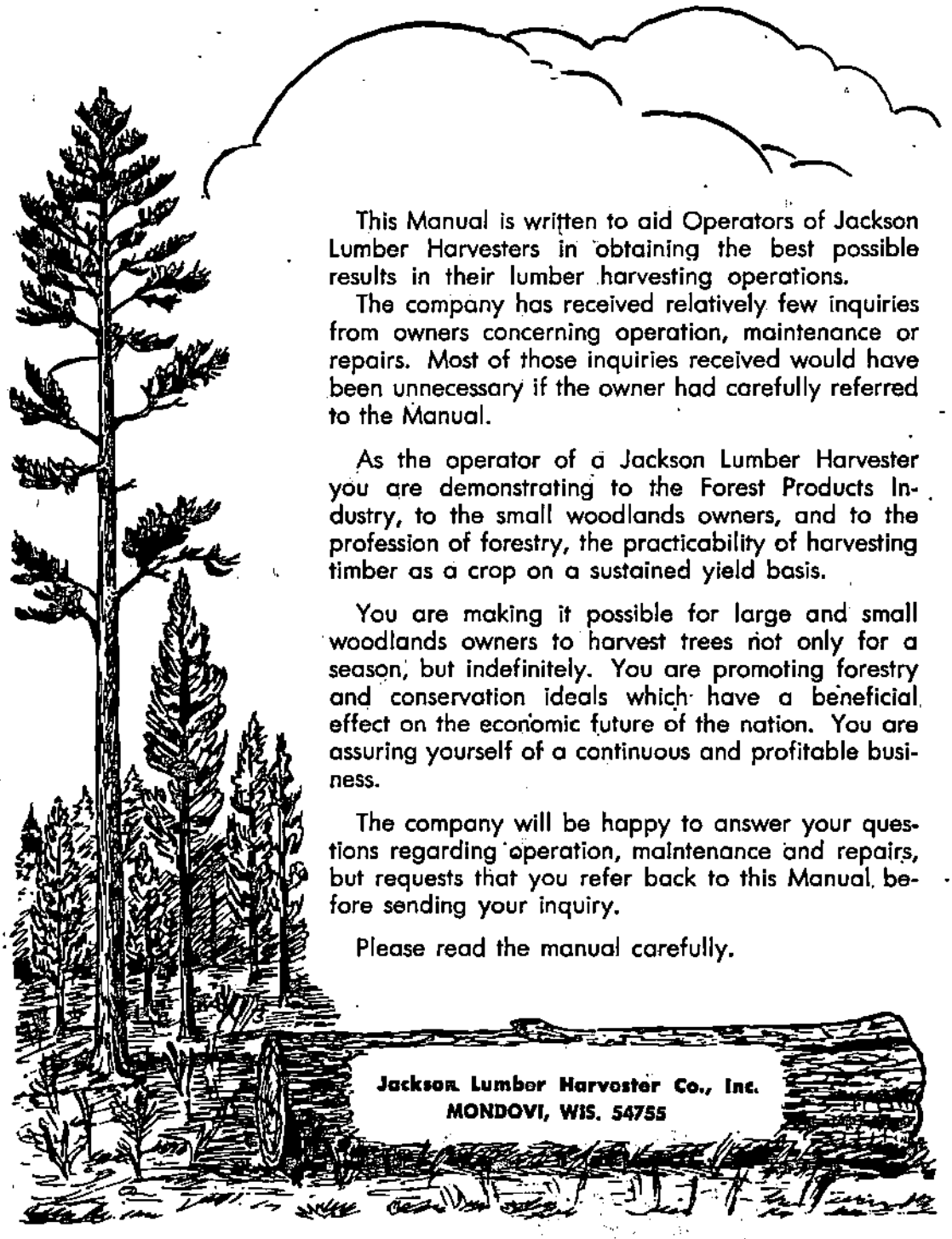


JACKSON LUMBER HARVESTER COMPANY, INC.
MONDOVI, WIS. 54755
Price ~~$3.00~~

(1)

CLINTON D. JACKSON
Inventor of the Jackson Lumber Harvester

TO OUR OPERATORS_



This Manual is written to aid Operators of Jackson Lumber Harvesters in obtaining the best possible results in their lumber harvesting operations.

The company has received relatively few inquiries from owners concerning operation, maintenance or repairs. Most of those inquiries received would have been unnecessary if the owner had carefully referred to the Manual.

As the operator of a Jackson Lumber Harvester you are demonstrating to the Forest Products Industry, to the small woodlands owners, and to the profession of forestry, the practicability of harvesting timber as a crop on a sustained yield basis.

You are making it possible for large and small woodlands owners to harvest trees not only for a season, but indefinitely. You are promoting forestry and conservation ideals which have a beneficial effect on the economic future of the nation. You are assuring yourself of a continuous and profitable business.

The company will be happy to answer your questions regarding operation, maintenance and repairs, but requests that you refer back to this Manual before sending your inquiry.

Please read the manual carefully.

Jackson Lumber Harvester Co., Inc.
MONDOVI, WIS. 54755

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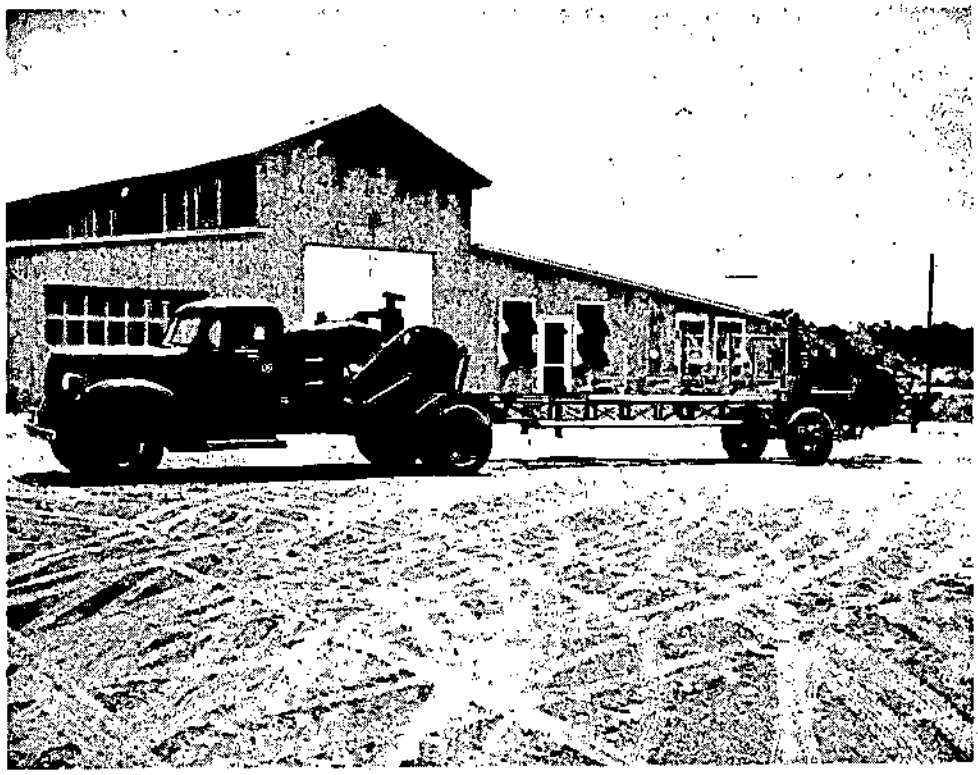
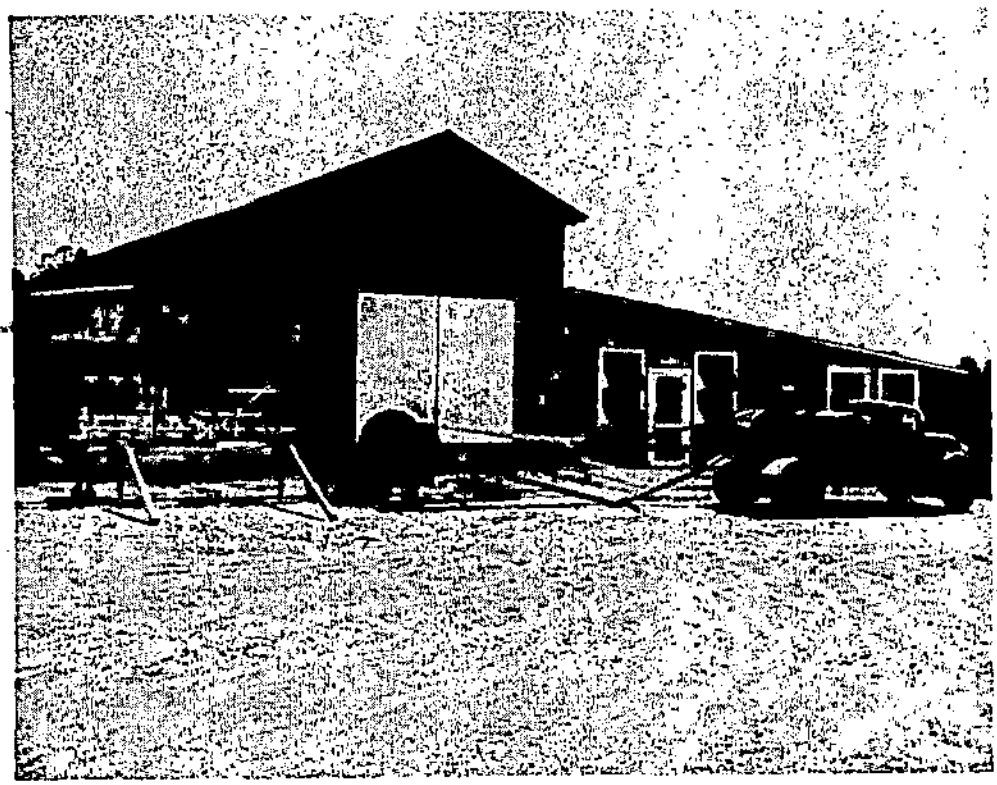


Unit in Position for Travel

Lumber Harvester Specifications

(STANDARD MODEL)

Horse power required	50 to 100
Power Transmission belt speed	Approximately 4,600′ a minute
Weight of Complete Lumber Harvester	4,000 pounds
Maximum length when folded for transport	26′
Maximum length when set up for operation	32′
Maximum width when set up for operation	8′
Minimum width with bolted husk removed	4′ 10″
Maximum height when set up for operation	6′ 10″
Approximate crating dimensions	5′ 4″ x 5′ 7″ x 26′
Maximum saw size	54″
Minimum saw size	48″
Total length of carriage travel	25′
Maximum feed per saw revolution with 40-tooth saw	4½″
Maximum gig per saw revolution with 40″-tooth saw	7″
Maximum length of logs handled	22′
Recommended length for top efficiency	16′
Maximum headblock opening	26″
Minimum headblock opening	1″



Unit in Position for Sawing

When Your Harvester Arrives

Check Packing List of loose components packaged separately.
(See Page 8)

Lubricate according to Instruction Pages 10, 11 and 12.

Scrape light protection coat of paint from face of feed drums and dog bar slides.

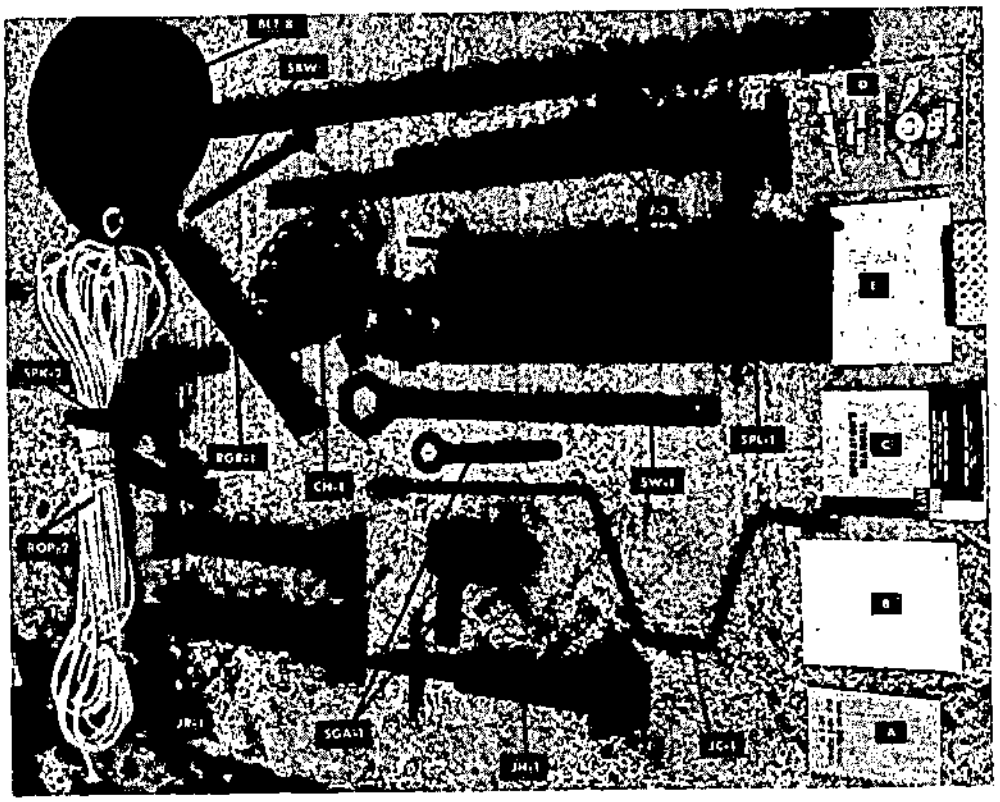
If packed for export shipping:
Replace and align knees as numbered.
Bolt Axle, Husk, Folding End, and Draw Bar in place as numbered.

Use 4" x 6" x 9' timber to act as skid bar, and drill ⅝" holes for rods. (These can be made from the first log sawn).

Use two 8' saplings and taper ends to fit 1½" pipe of V-shaped bracket for outer sawdust assembly.
Use rope, cable or chain and stake to anchor.

Use 2" pipe or tapered-end 4 x 4 of proper length to fit 2½" pipe and Handyman Jack for tightening transmission belt.

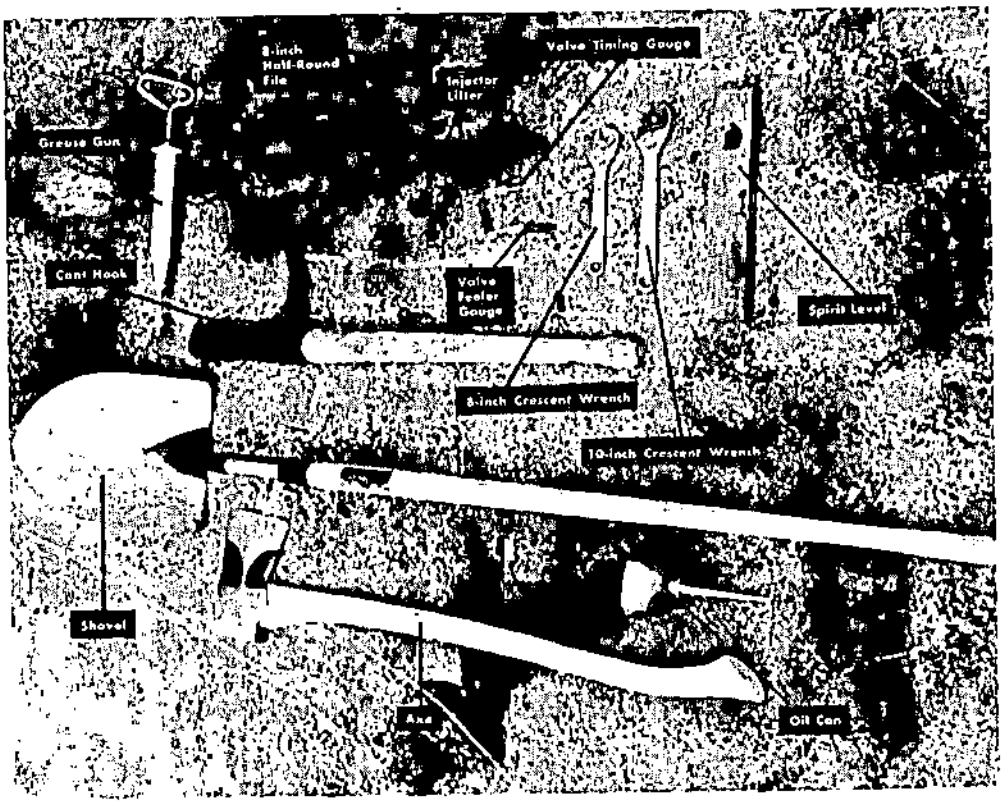
Use pieces of timbers as footing for Leveling Jacks.



Loose Components

These Components are loose parts of the Lumber Harvester and Powerunit. They are shipped in a separate box, and usually are carried on the truck when the unit is moved.

JR-1	2—Jacks, for Log Ramp.
JH-1	1—Jack for Husk (For armed service units only).
J-3	1—Handyman Jack with pipe for tightening drive belt.
JC-1	1—Jack Crank.
SGA-1	1—Saw Guide Assembly Including Wrench.
CH-1	1—Sawdust Chain with attachment links (20').
SPK-2	1—19 tooth sprocket with V-bracket for outer sawdust assembly.
ROP-2	2—Lengths ½" Sisal Rope (65' each).
RGR-1	1—Length Removable Carriage Guide Rail.
SPL-1	1—Sawyer's Platform; Removable. (For use in sawing large logs.)
SW-1	1—Saw mandrel nut wrench.
BLT-10	1—Belt, '50' Endless, flat, 6".
A	1—Jackson Lumber Harvester Operator's Manual.
B	1—Jackson Lumber Harvester parts list.
C	1—GMC, Detroit Diesel Engine Operator's Manual.
D	1—GMC, Detroit Diesel Engine Parts Book.
E	1—Wiring Diagram for Detroit Diesel Engine.



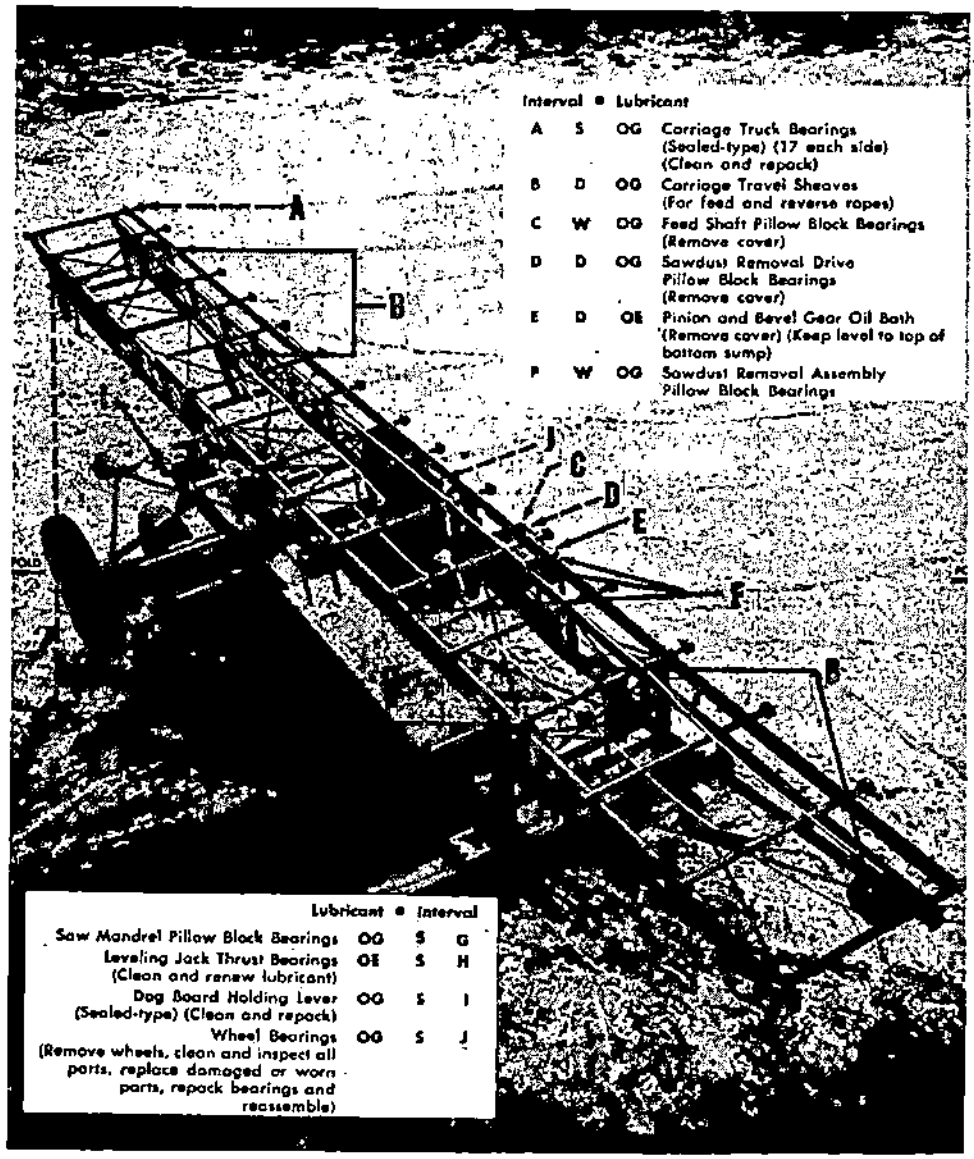
Hand Tools

REQUIRED FOR OPERATION

These hand tools are considered essential to operation of a Lumber Harvester unit:

1—Axe
1—Shovel
1—Oil Can
1—Cant Hook
1—Grease Gun
2—8-inch Half-Round Files or Saw Filer
1—Injector Lifter
1—Valve Feeler Gauge
1—Valve Timing Gauge
1—8-inch Crescent Wrench
1—10-inch Crescent Wrench
1—Spirit Level

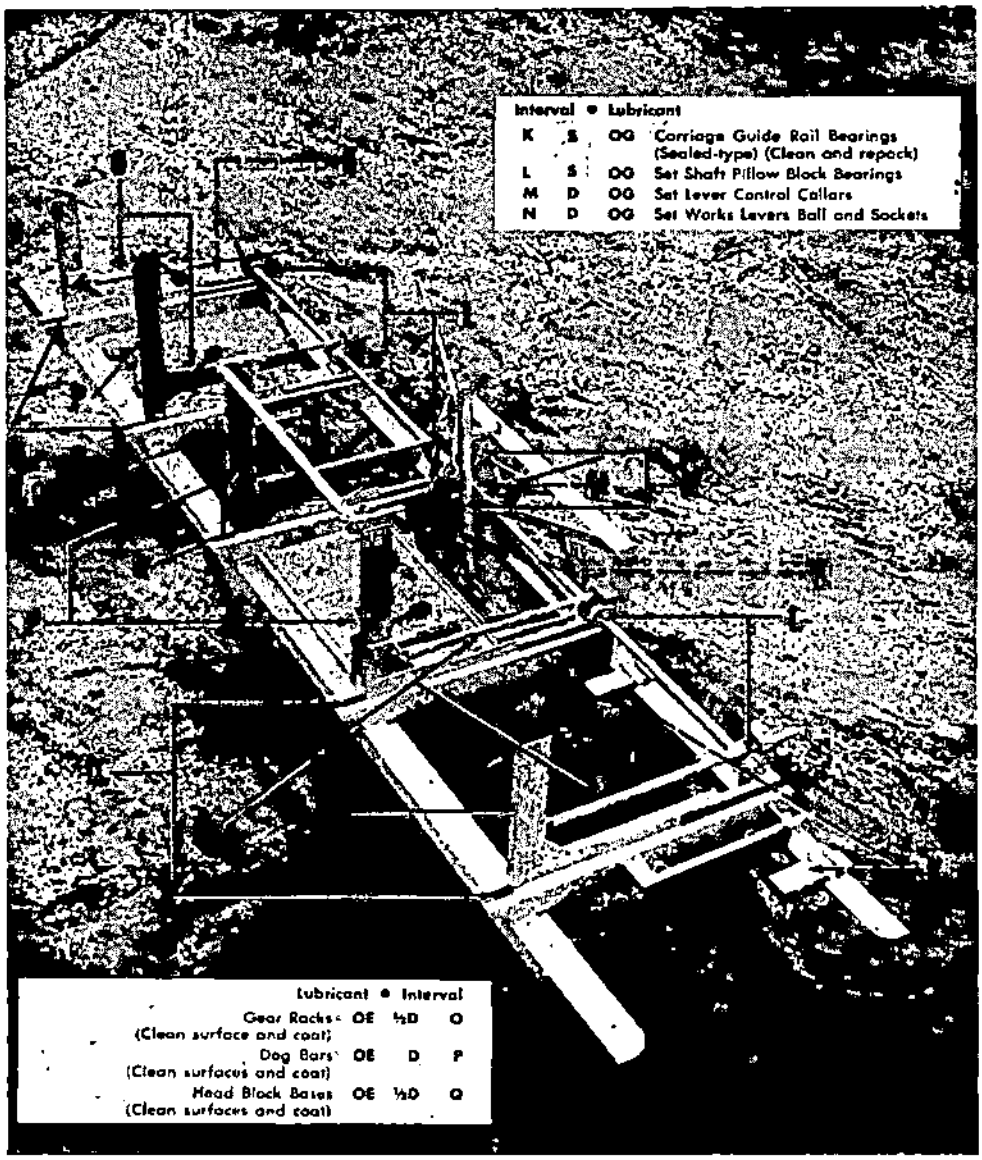
Lubrication



Lumber Harvester Main Frame

These are NOT government lubrication specifications.—Obtain from Office of Chief of Engineers. Probably No. LO5-9232

See Page 12 for key to symbols.



Lumber Harvester Carriage

These are NOT government lubrication specifications.—Obtain from Office of Chief of Engineers. Probably No. LO5-9232

See Page 12 for key to symbols.

Key to Lubrication Symbols

Intervals given are maximums for normal 8-hour day operation. For abnormal conditions or activities, intervals should be shortened to compensate.

Clean fittings before lubricating.

Relubricate after washing or fording.

Clean parts with SOLVENT, dry-cleaning; or with OIL, fuel, Diesel. Dry before lubricating.

Lubricate points indicated by dotted arrow shafts on both sides of the equipment.

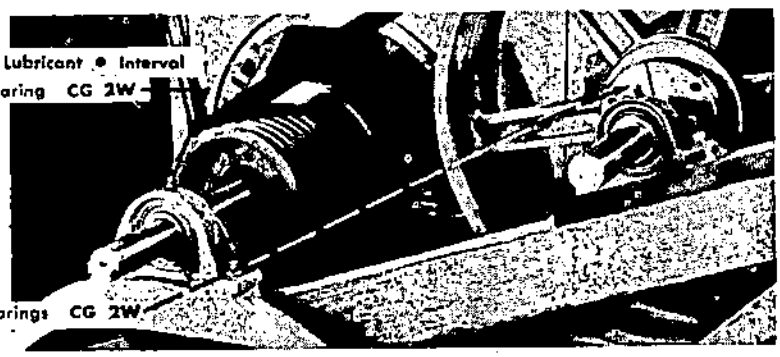
Drain crank and gear cases only when hot after operations; check level and replenish when cool.

– KEY –

LUBRICANT	CAPACITY	EXPECTED TEMPERATURE			INTERVALS
		Above +32°F	+32°F to –10°F	Below –10°F	
OE—OIL, engine					½D—Twice Daily
Crankcase	15 qts	OE 30	OE 10	See Engine Op. Manual	D—Daily
Air Cleaner		OE 30	OE 10		W—Weekly
Other Points					2W—Two Weeks
CG—GREASE, low temperature		CG 1	CG 0	OGOO	S—Semi-annually
GO—LUBRICANT, gear, universal		GO 90	GO 75	GO-A	
RL—OIL, recoil, light					
OG 00—GREASE, low temperature					

These are NOT government lubrication specifications.—Obtain from Office of Chief of Engineers. Probably No. LO5-9232.

Speed Reduction Gear Lubrication Specification



These are NOT government lubrication specifications.—Obtain from Office of Chief of Engineers. Probably No. LO5-9232.

For lublication specifications for diesel or gasoline engines, see manufacturer's Operator's Manual.

Power Units

A large percentage of sawmill troubles are due to lack of sufficient power, or in transmitting available power to the saw. The same is true in the case of the Lumber Harvester.

In securing a powerunit, regardless of make or type, be sure to have a surplus of power rather than a shortage. Sixty to one hundred horsepower is necessary on the Lumber Harvester for efficient production. Necessity of more or less horsepower will depend upon the type of timber primarily sawn. The effective horsepower available to most mills is far below what the operator supposes. For instance you may have an engine of 100 indicated horsepower, while the effective power for sawing may be only 75 h. p., owing to excessive friction, bad governing, leaking cylinder or valves, or ratio of transmission of power is too sharp.

With the Harvester, it is economical and practical to have your Powerunit permanently mounted on the rear of a 1-1½ ton Truck, which Truck can also tow the Harvester between set ups. This also provides sufficient load to give the Truck traction for towing in difficult terrain. However, where Lumber Harvesters are used for commercial production and it is necessary to move the machine into the deep woods, it may be desirable to mount your Powerunit on a trailer, moving both trailer and Harvester into the woods with the caterpillar tractor used in skidding logs.

Diesel industrial units have been found to be exceptionally economical to operate with the Harvester and are primarily recommended. Use a suitable speed reduction gear to obtain 500-550 RPM at the saw.

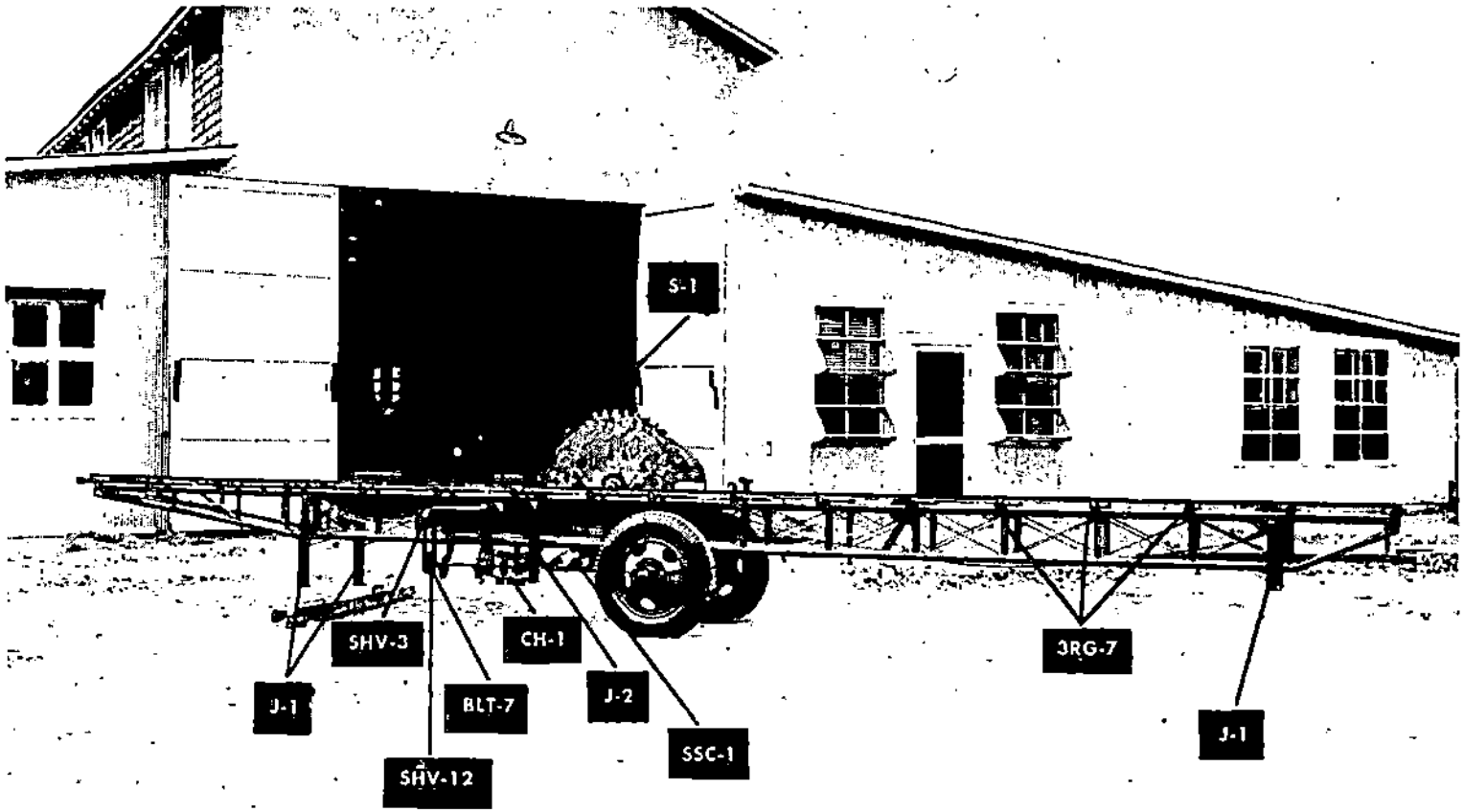
PNEUMATIC DRIVE PULLEYS

All Lumber Harvesters are provided with a Pneumatic Drive Pulley and it is very essential that your Powerunit also have the same type of drive pulley. This perhaps would not be necessary if your entire operations were permanently set up on a concrete floor such as large mills are. But with the extremely portable Lumber Harvester it is necessary because it is difficult to obtain sufficient traction to transmit the horsepower to the Saw, as the Harvester is usually set up on loose ground. Also, the inflated tire as a Drive Pulley cushions the shock and strain of the comparatively large horsepower expended through such a light machine. It is impossible to attain the records we have set and maintained without this system of transmitting the power from your engine to the Saw.

Identification of Components

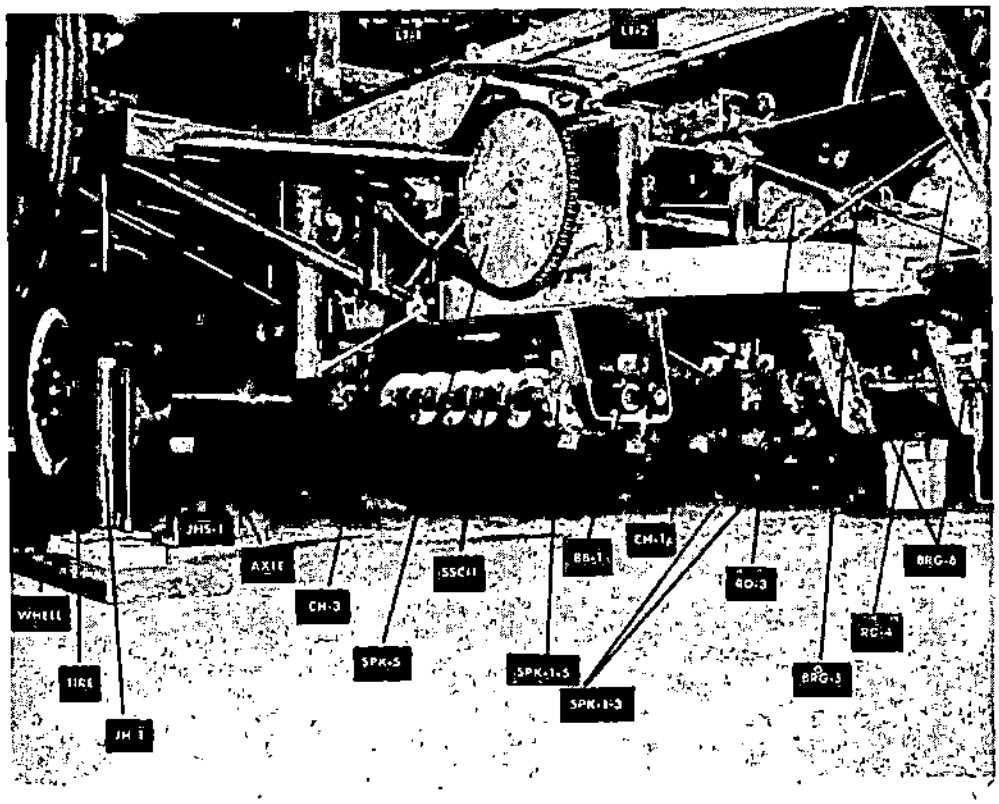
Identification Lists--Main Frame Assemblies

Fig. No.	ILH Co. Part No.	DESCRIPTION	Qty in Assy.	Qty. in Harv.
		MAIN FRAME		
1		Electric-welded steel and pipe members		
1-2b-3	BRG-7	Bearings, ball, for carriage travel	34	43
	BRG-8	Bearings, ball, for carriage travel (RMJ Models)		
	RGR-1	Removable Guide Rail, 23½"	1	1
1-5	S-1	Splitter	1	1
2a	LT-1	Lumber Table, hinged	1	1
2a	LT-2	Lumber Table, welded	1	1
	LTR-1	Lumber Table Roller (Including brackets)	1	1
P7	SKB-1	Skid Bar—4" x 6" x 9' Creosoted, drilled	1	1
P57	LR-LH	Lifting Ring, welded to frame (Government specifications only)	3	3
		LEVELING JACK ASSEMBLIES		
1	J-1	End Leveling Jack—15" (Complete, including Inner Member, Case, Screw, Nut and bearing)		4
	J-1-C	Jack, 15", Case	1	4
	J-1-IM	Jack, 15", Inner Member—(Including, 2" pipe guide pin, and nut)	1	4
	JS-1	Screw for Jack—1"x15" cold rolled steel (Threaded, including nut)	1	4
	BRG-9	Thrust ball bearing—7/8" IDxl ¾" OD	1	8
1-2b-5	J-2	Center Leveling Jack—20"		2
	J-1-C	Jack, 20", Case	1	2
	J-2-IM	Jack, 20", Inner Member—(Including 2" pipe, guide pin, and nut)	1	2
	JS-2	Screw for Jack—1" x 15" CR Steel—(Threaded, including nut)	1	2
	BRG-9	Thrust ball bearing—7/8" ID x 1¾" OD	1	8
2a	JH	Jack for Husk—15" (Government specification only)		1
2a	JHS-1	Screw for Jack for Husk—1" x 18" CR Steel (Threaded, including nut)	1	2
P8	JC-1	Jack, Crank	1	
P8	JR-1	Jack, (For skid bar)	2	2
P8	J-3	Jack, Handyman (For tightening drive belt)	1	1
		TOW BAR ASSEMBLY		
14	TBB-1	Tow bar bracket—Blueprint No. 03011-Y (Government specifications only)		1
14	TBL-1	Tow bar Lunette Eye—Blueprint No. 03007-W (Government specifications only)		1



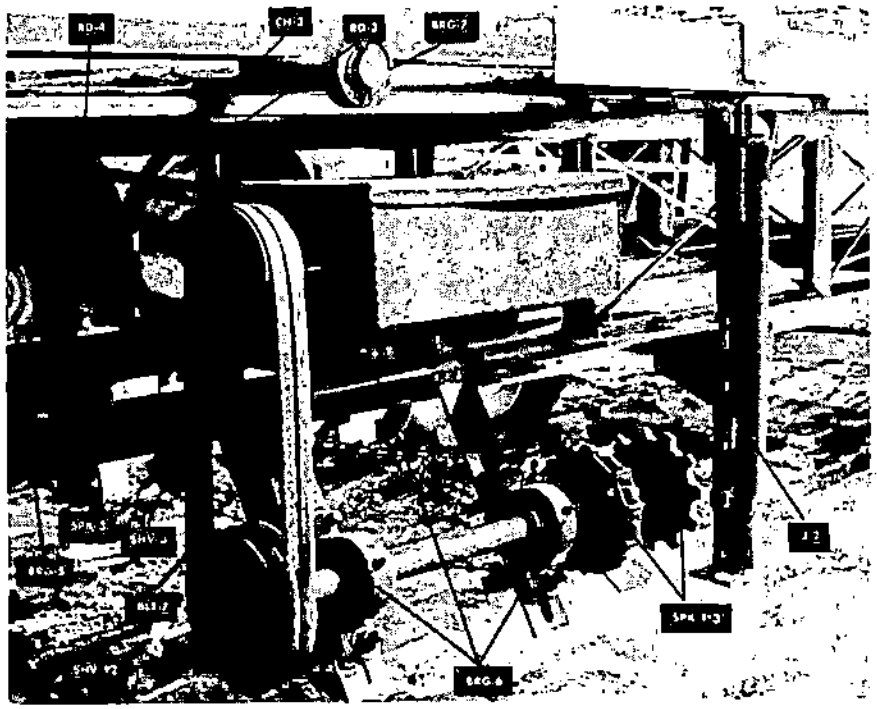
MAIN FRAME ASSEMBLY
Figure 1

Fig. No.	JLH Co. Part No.	DESCRIPTION	Qty in Assy.	Qty in Haro.
		AXLE ASSEMBLY		
	AX-1	Axle—5½ ton capacity—4½" heavy duty tubing, 48½" track, with hubs for Ford Wheels, not including spring seats, brakes or flanges (For standard unit)		
2a	AX-2	Special Axle with 62" track, less springs, 4" OD x ½" wall tube, ¾ ton spindle size, complete with hydraulic brakes and ¾ ton hubs, drums and bearings	1	1
14	BL-1	Brake Lever less assembly (Government Specifications only)	1	1
2a	WT-1	Wheel, Transportation—20x5.00 (For standard unit)		
2a	WT-2	Wheel, Transportation—16x6.50 to meet Army Specifications No. DA-7888462		2
	T-1	Tire-8 ply, 7.00x20 (For Standard unit)		
2a	T-2	Tire-8 ply, 9.00x16, Non-directional tread (Government specifications only)	2	2
	TUB-1	Tube-7.00x20 (For standard Unit)		
	TUB-2	Tube-9.00x16 (Government specifications only)	2	2
		SAWDUST REMOVAL ASSEMBLY		
1-2a	SSC-1	Screw, Sawdust Conveyor—6" x 30"	1	1
2a	BB-1	Babbitt Bearing—1 5/16" I. C.	1	1
2a-2b	SPK-1-3	Sprocket—11-tooth for No. 45 sawdust chain, 1 3/8" bore	2	2
2a	SPK-1-5	Sprocket—11-tooth for No. 45 sawdust chain, 1 5/16" bore	1	1
2a-2b-2c	BRG-6	Pillow blocks-self aligning ball bearing—1 3/8" I. D.	4	10
1-2b-2c	SHV-12	Sheave—6", 2-groove, B Section—1⅞" bore, ⅜" x 3/16" keyway	1	1
1-2b	SHV-3	Sheave-5", 2-groove, B Section-1 3/8" bore	1	1
	SHV-1	Sheave-12", single groove, 1 7/16" bore (For rope-driven sawdust removal assembly)		
	SHV-2	Sheave-6", single groove, 1⅞" bore (For rope-driven sawdust removal assembly)		
1-2b-2c	BLT-7	V-Belt—42", B-Section (Matched)	2	2
2c	BGR-1-1	Bevel Gears—(Set) 11-tooth pinion; 19-tooth bevel gear—sets required	1	1
	BGR-1-2	Bevel Gears-(Set) 18- and 36-tooth, steel		
P8	SPK-2	Sprocket-19-tooth for No. 45 sawdust chain, including V-bracket	1	1
1-2a-3	CH-1	Chain—No. 45 with sawdust paddles	30'	30'
	CH-2	Chain Link—No. 45, with sawdust paddles		
	BLT-2	Belt—144", Round (For LH Models prior to 1951). Rope drive		

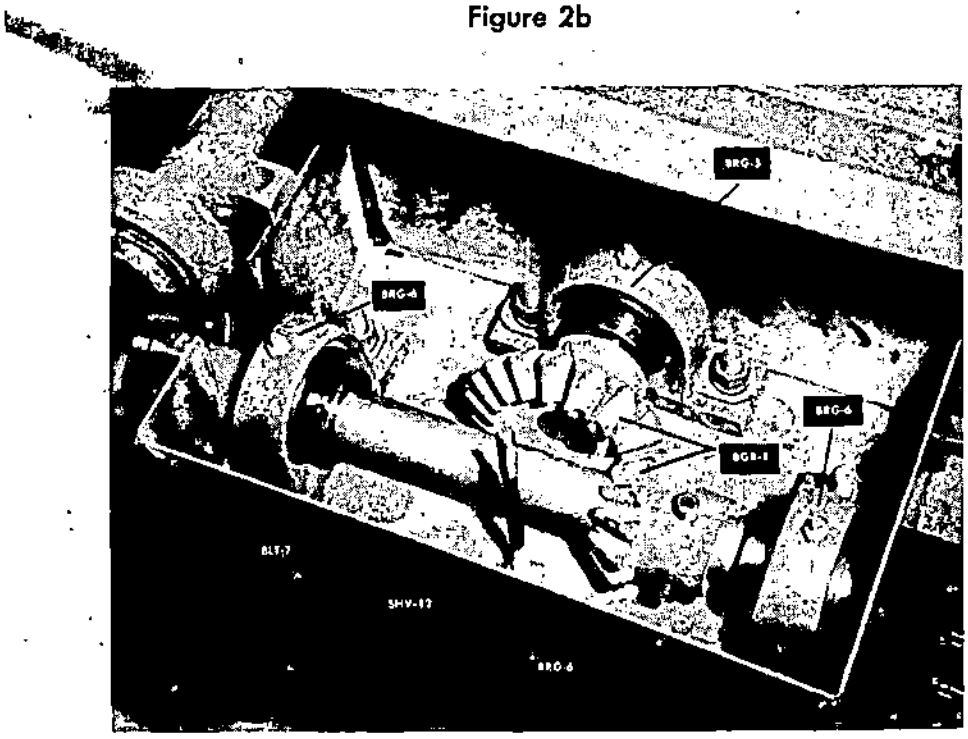


AXLE AND SAWDUST REMOVAL ASSEMBLY
Figure 2a

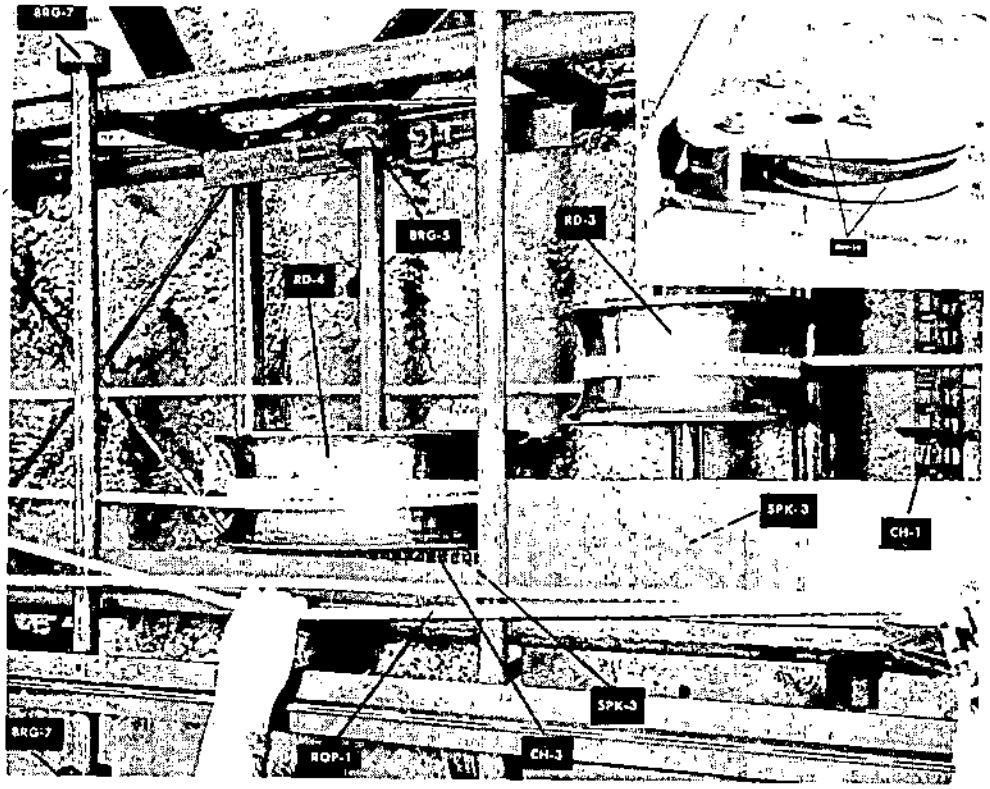
Fig. No.	JLH Co. Part No.	DESCRIPTION	Qty in Assy.	Qty in Harv.
		FEED WORKS ASSEMBLY		
2a-3-5	CH-3	Roller Chain-No. 50—feet required	13	13
	CH-4	Connecting link, for No. 50 Roller chain		
	CH-5	Offset link (half-link) for No. 50 roller chain		
3	FS-1	Feed Shaft—53" x 1 7/16" cold rolled shafting with ¼" and 3/8" keyway (For Reverse Drum)	1	1
2a-5	SPK-5	Sprocket—72-tooth for No. 50 Roller Chain, 1 7/16" bore	1	1
2a-2b-3	RD-3	Drum, Reverse—5¼" x 10" diameter—1 7/16" bore	1	1
	FDA-P-1	Feed Drum Assembly—Packaged. (Including one RD-4, one FS-2, two BRG-5, one SPK-3, one SPK-8, 5' CH-3, angle iron drilled and slotted, 10ur set screws, four nuts (For replacement on LH units prior to 1951)		
3	SPK-8	Sprocket—20-tooth for No. 50 Roller Chain 1 7/16" bore	1	2



SAWDUST REMOVAL ASSEMBLY
Figure 2b



GEAR BOX FOR SAWDUST ASSEMBLY
Figure 2c

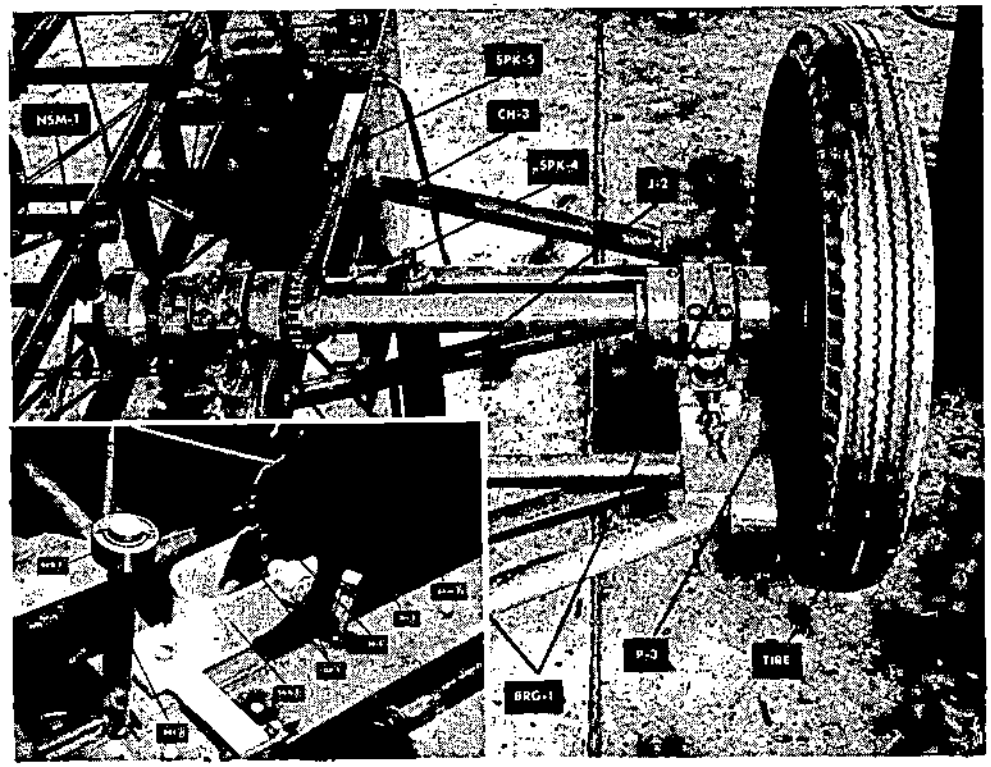


FEED WORKS ASSEMBLY

Figure 3 Figure 4

Fig. No.	*JLH Co. Part No.*	*DESCRIPTION*	*Qty in Assy.*	*Qty in Harv.*
		FEED WORKS ASSEMBLY (Continued)		
	FS-2	Feed Shaft—27" x 1 7/16" cold rolled shafting ½" x ⅜" keyways (For Feed Drum)	1	1
2b-3	SPK-3	Sprocket—54-tooth for No. 50 Roller Chain, 1 7/16" bore	1	1
2a-2b-3	RD-4	Drum, Feed—5¼" x 15" diameter—1 7/16" bore	1	1
2a-2b-2c-3	BRG-5	Pillow Block bearings—1 7/16" ID	4	4
	ROP-1	Rope, Sisal hemp, oiled—½"—feet required	130	130
P3-3	ROP-2	Rope—Sisal hemp, ½"		
	ROP-3	Rope—Sisal hemp, 5/8"		
4	SHV-10-1	Sheave—7", cable pulley, cast iron, oil-filled bronze bushing, with bracket	4	4
	SHV-10-2	Sheave—7" steel, roller bearings, with bracket		
	SHV-10-3	Sheave—7", steel, roller bearings, less bracket		
	SPK-6	Sprocket—80-tooth for No. 50 Roller Chain—1 7/16" bore (For LH units prior to 1951)		

Fig. No.	JLH Co. Part No.	DESCRIPTION	Qty in Assy.	Qty in Mach.
		MANDREL ASSEMBLY		
5	SAA-1	Saw Arbor Assembly—(Including, 2¼" cold rolled shafting, two collars, nut—machined)	1	
5	SMA-1	Saw Mandrel Assembly—(Including SAA-1, two BGR-1, one SPK-4, one P-3, with key stock,—Machined)		1
	SMP-1	Saw Mandrel Pin—9/16" x 1¾"	2	2
5	NSM-1	Nut, Saw Mandrel	1	1
	SW-1	Saw Mandrel Nut Wrench	1	1
5	BRG-1	Pillow blocks, double row, self-aligning 2½"	2	2
	HB-1	Hanger bearings, with Jackson-made bracket 2¼"		
	BRG-2	Replacement bearings for above housings	4	
5	SPK-4	Sprocket—20-tooth for No. 50 roller chain, 2¼" bore	1	1
5	P-3	Pneumatic Pulley driven, 20" (Less tire and tube)	1	1
5	T-3	Tire, 6.00 x 20, 6-ply	1	1
	TUB-3	Tube, 6.00 x 20	1	1
		DOG BOARD LEVER ASSEMBLY		
6	DBL	Dog Board Lever Assembly		1
6	BRG-7	Bearing, Ball	1	43
		SAW ASSEMBLY		
6	SAW-1	Saw—50", 5/16" kerf, 7-8 gauge, 500-550 RPM, left hand		1
	SAW-2	Saw—48", ¼" kerf, 9-10 gauge, hoe style No. 2½, 500 RPM, left hand, PHS 2-5/8-3		
6	ST-1	Saw teeth—Style B & F, 5/16" kerf, 8-gauge	40	40
	ST-2	Saw Teeth, Style B & F, or ABC, 9/32" or 17/64" kerf		
	ST-3	Saw Teeth—hoe style No. 2½, 10-gauge ¼" kerf		
6	STH-1	Saw Teeth Holders, (Shanks)—Style B & F	40	40
	STH-2	Saw Teeth Holders, (Shanks)—Style ABC		
	SH-3	Saw Teeth Holder, (Shanks)—Hoe style No. 2½		
		SAW GUIDE ASSEMBLY		
6	SGA-1	Saw Guide Assembly (Including pins and Nuts)		1
6	SGP-1	Saw Guide Pins	2	2
	SGN-1	Saw Guide Assembly Locknut	2	2
P8	SGW-1	Saw Guide Assembly Wrench	1	1

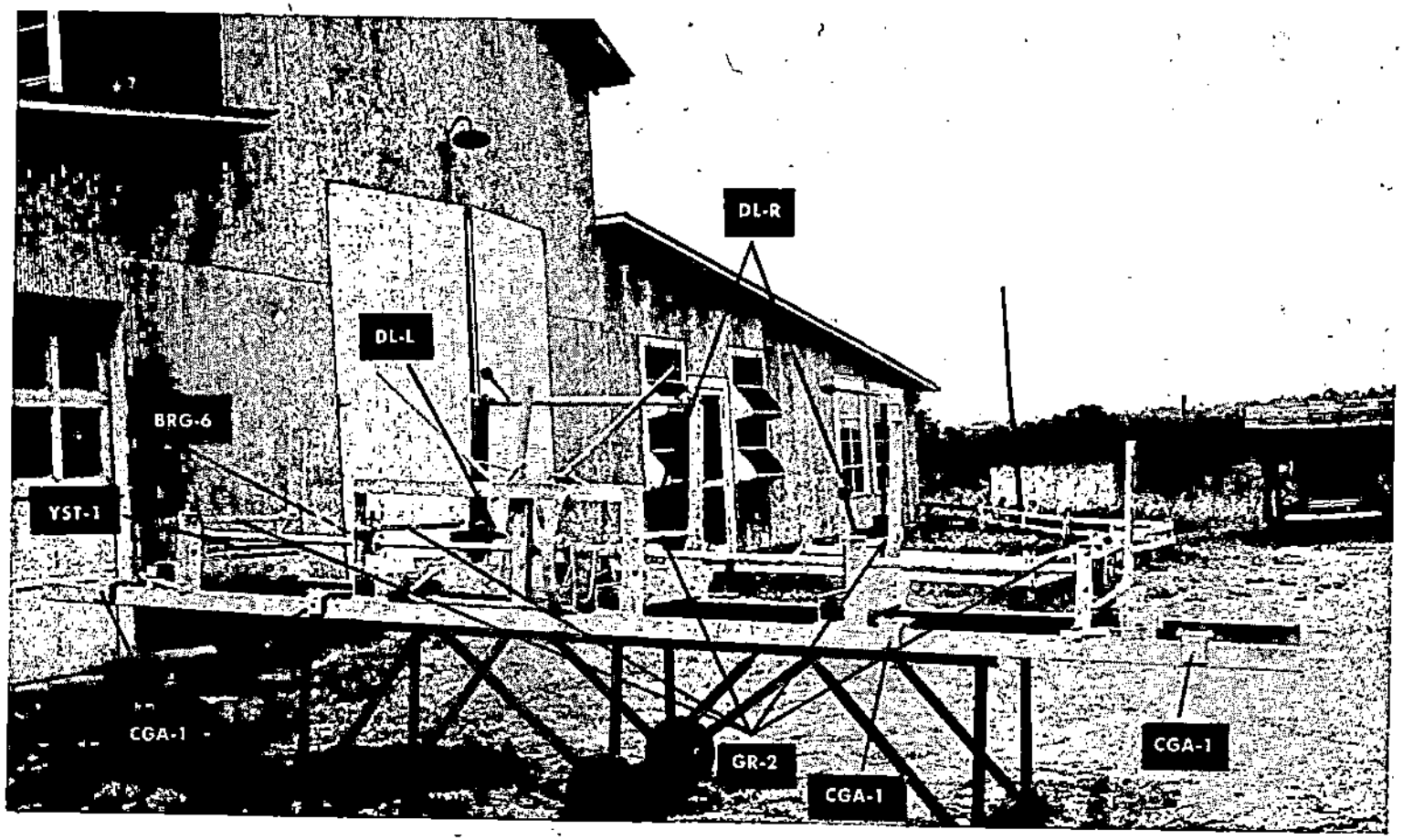


MANDREL ASSEMBLY
Figure 5

SAW ASSEMBLY
Figure 6

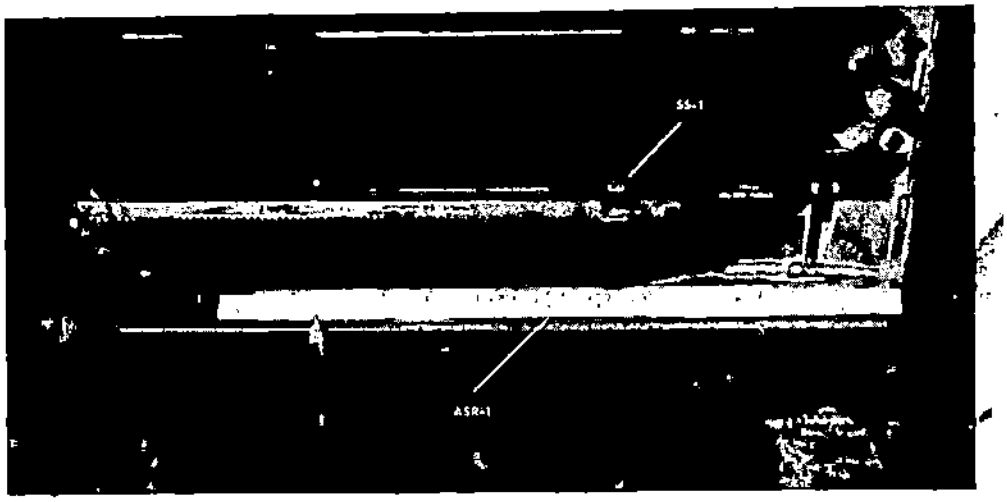
Identification Lists--Carriage Assemblies

Fig. No.	JLH Co. Part No.	DESCRIPTION	Qty in Assy.	Qty in Harv.
		CARRIAGE ASSEMBLY		
7		Electric-welded steel and pipe members		
7	YST-1	Yardstick (Wooden Sawyers Rule)	1	1
11	ASR-1	Aluminum Sawyer's Rule	1	1
P8	SPL-1	Sawyer's Platform (For use in sawing large logs	1	1
8	CBA-1	Carriage Brake Assembly, complete	1	1
	DS-1	Dog Slide for Second and Third Knees—30" cold rolled flat ⅝" x 2"; drilled and milled	2	2
	DS-2	Dog Slide for fourth Knee—30" cold rolled flat, ⅝" x 2", drilled and milled	1	1
		DOGGING ASSEMBLY		
9	JD-1	Dog, Jackson, Chisel and Bar	3	3
9	DBB-1-L	Dog Bar Box, Left Hand	1	1
7-9	DL-L	Drop Lever, Left Hand	1	1
7-9	DL-R	Drop Lever, Right Hand	1	2
9	DBB-1-R	Dog Bar Box, Right Hand	2	2
		SET SHAFT ASSEMBLY		
7-8-9	SSA-1	Set Shaft Assembly, Complete		1
		Shafting—1 3/8" cold rolled round, 13' 4"	1	1
7-8-9	GR-3	Gear—40-tooth, 1 3/8" bore, 1¼" face, 10 DP (Welded to shaft)	5	5
7-8-9	BRG-6	Pillow Block Bearing—1 3/8" I. D.	6	10
8-9	GR-1	Gear—132-tooth, 10 DP, 1⅜" bore, ½" face, 2½" hub	1	1
7-8-9	TRE-1	Tie Rod Ends	2	4
8		Bendix Frame, Bendix U Frame, braces		

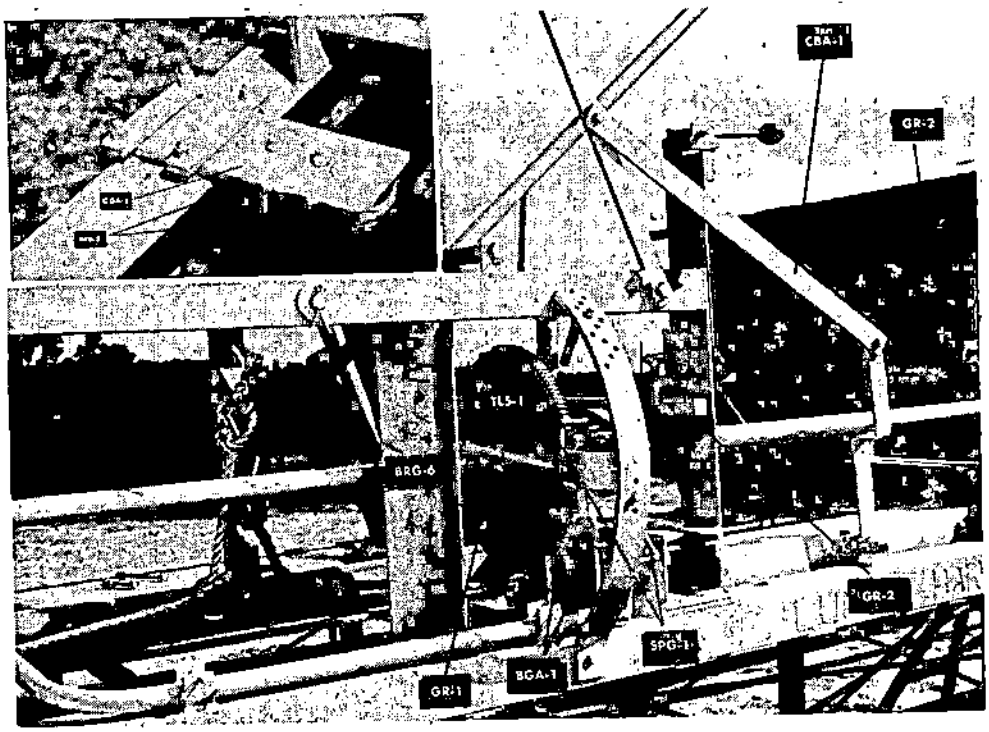


CARRIAGE ASSEMBLY
Figure 7

Fig. No.	JLH Co. Part No.	DESCRIPTION	Qty in Assy.	Qty in Mach.
		SET WORKS ASSEMBLY		
8	BGA-1-U	Bendix Gear Assembly, Upper		1
		Gear—33-tooth	1	2
		Bendix Drive and gear pin—No. 93 C	1	2
8	BGA-1-L	Bendix Gear Assembly, Lower		1
		Gear—33-tooth	1	2
		Bendix Drive and gear pin—No. 93 C	1	2
7-8-9-11	GR-2	Gear Rack—1" x 1" x 10 DP, 8' long (Including adjusting bolt)	5	5
8-9	TLS-1	Trip Latches—set of three—sets	1	1
8	SPG-1	Coil Springs for trip latches	3	3
9	TL-1	Trip Latch	3	3
11	SS-1	Safety Stop	1	1
8	SLA-1	Set Lever Assembly (Including tie-rod ends)	1	1
8	RLA-1	Receding Lever Assembly (Including tie-rod ends)	1	1
	TRE-1	Tie Rod Ends	2	4
8	CBA-1	Carriage Brake Assembly		1
		CARRIAGE GUIDE ASSEMBLY		
7-10	CGA-1	Carriage Guide Assembly (Complete)		4
10	BRG-7	Bearings	2	43

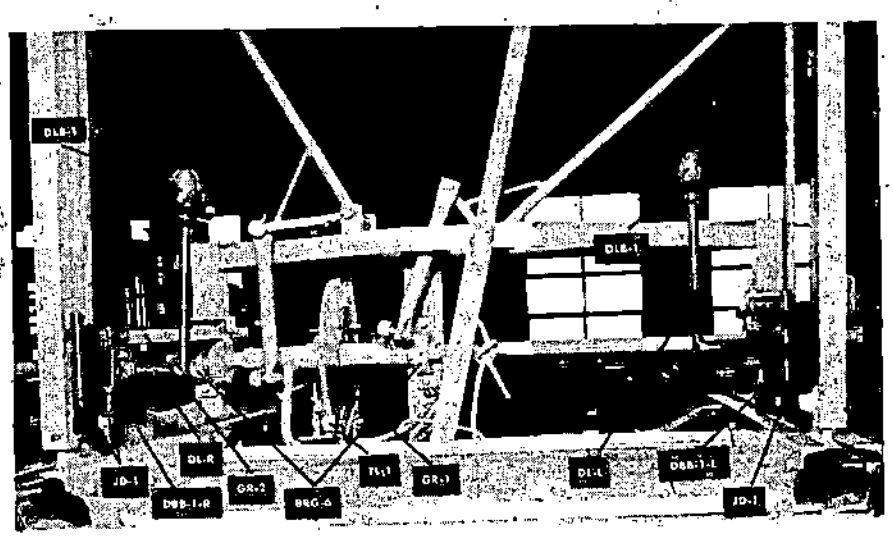


SAWYER'S RULE AND SAFETY STOP
Figure 11



SET WORKS ASSEMBLY
Figure 8—Rear View

CARRIAGE GUIDE ASSEMBLY
Figure 10—Insert



SET WORKS ASSEMBLY
Figure 9—Front View

Fig. No.	JLH Co. Part No.	DESCRIPTION	Qty in Assy.	Qty in Haro.

SPECIFICATIONS FOR DIESEL ENGINE FOR POWERUNIT

General Motors Detroit Diesel Engine

Model 3029 C—3-Cylinder, 2-cycle as described in brochure

Optional Equipment Specified
- 70 Cu. mm. Injectors
- Variable Speed Hydraulic Governor
- 12-Volt Battery Charging Generator and Regulator, 600W (Standard)

Additional Equipment
- 24-Volt Battery Charging Generator, 600W (Government Specifications only)
- Air Heater and Pump for Cold Weather Starting (Government Specifications Only)

Identification Lists--Powerunit Assembly

FRAME FOR SPEED REDUCTION ASSEMBLY

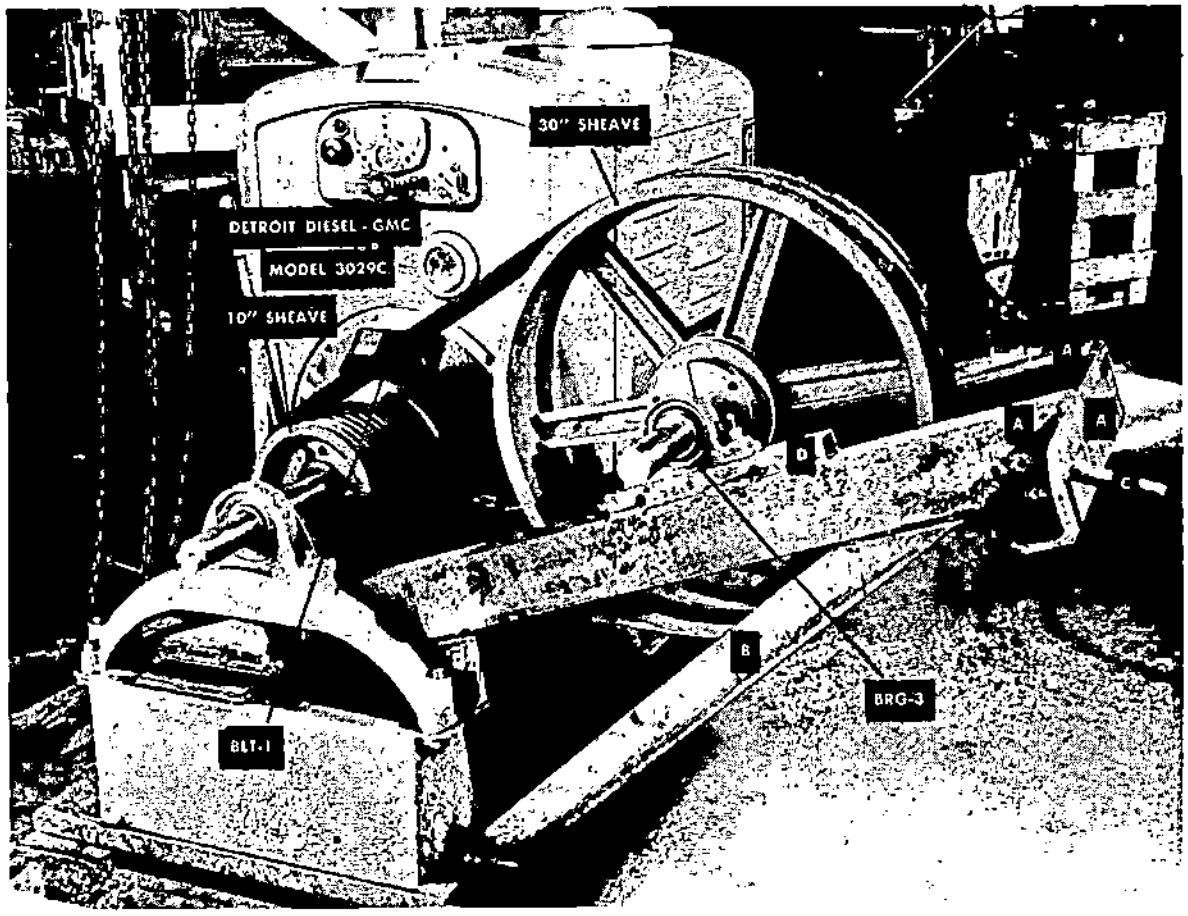
12	A	Diagonal members		
12	B	Braces—2 pieces 3" x 3" x 5/8" angle iron		
12	C	Holder for Belt Tightener—4" 1" Round mild steel		
	D	Base for pillow block—3" x 16" channel iron		
Not shown		Guard for V-Belts—16-gauge plate		

SPEED REDUCTION ASSEMBLY

12	SHV-13	Sheave—10", 7-groove, C-section, 2 1/8" bore..	1	1
12	SHV-14	Sheave—30", 7-groove, C-section, 2 3/16" bore	1	1
12		Reduction Shaft—2 3/16" x 26" ground and polished cold rolled shafting—5/8" keyseat	1	1
12	BLT-1	V-Belts 128" C-section (Matched)	7	7
12	BRG-3-1	Pillow block bearing—2 3/16" I. D.	2	2
	BRG-3-2	Pillow block bearing—1 15/16" I.D. (For Reduction Gear—model prior to 1951)		
	P-4	Pneumatic Drive Pulley—16 x 4.50 rim with plate and hub welded (Less tire and tube)	1	1
Not shown	T-4	Tire—6.00 x 16 4-ply	1	1
Not shown	TUB-4	Tube—6.00 x 16	1	1

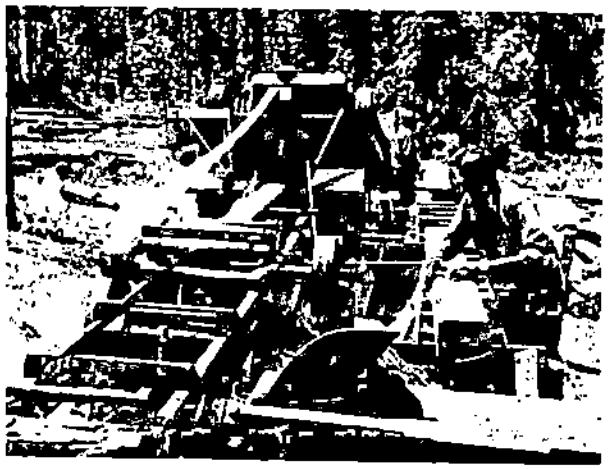
STARTING ASSEMBLY

Not shown		6 or 12 Volt Battery	2	2
Not shown		Battery fittings and belt assembly cables	2	2
Not shown	BLT-8	Belt—Power transmission—50' endless, 6" flat, 7-ply (Government specifications)	1	1
	BLT-9	Belt—Power transmission—50' endless, 6" flat, raw-edge, 4-ply		
	BLT-10	Belt—Power Transmission—50' endless, 6", flat, raw-edge, 4-ply		



SPEED REDUCTION GEAR FOR POWERUNIT
Figure 12

Methods of Power Transmission

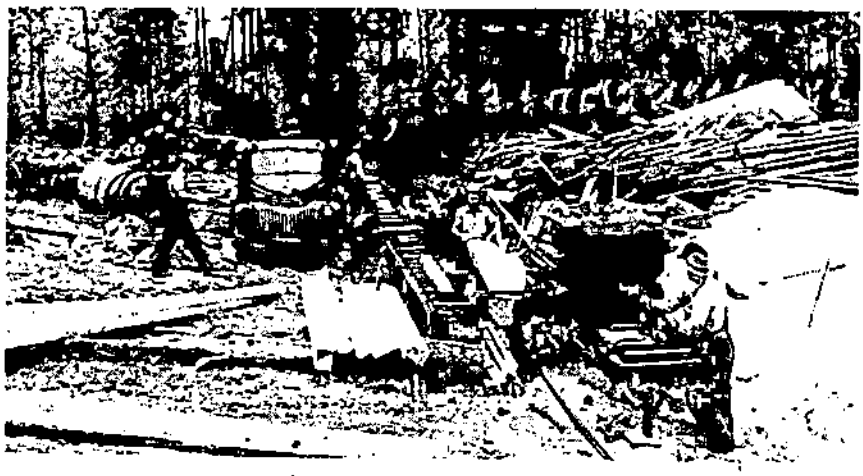


Example A—Long Jack Shaft Allows Use of Straight Belt

By using a longer Jack Shaft extending the length of the powerunit, it reverses the rotation of the pneumatic pullly from that shown on Page 7 and in Examples B and C. This allows the truck to be driven frontwards closer to the Skidway, and use of a short, straight belt. A pulley on the Jack Shaft (minimum size 28") can be used to power the edger. In some cases the services of one man can be eliminated by this set-up by having the Lumber Harvester off-bearer act as operator of the edger.

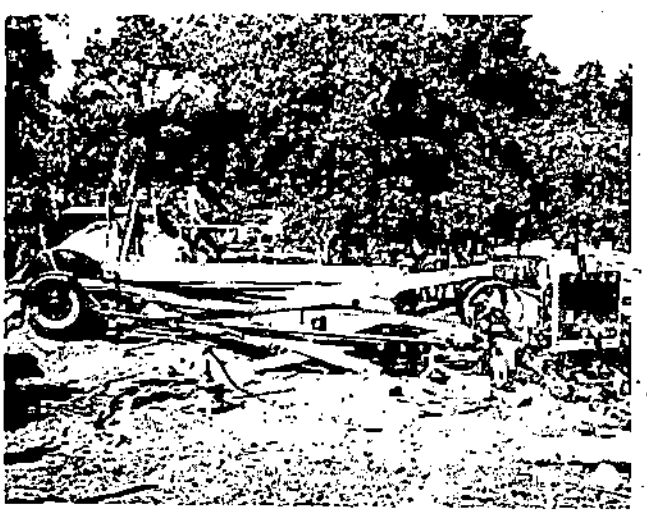
Example B—Same as Shown on Page 7

In the above photo the edger is directly beyond the lumber roller tables. Edged boards are loaded on a truck, while sawn boards are slid down a ramp for later pickup. With the edger in the above position it could be powered by a pulley on a long shaft of the diesel engine.



Example C—Same as Shown on Page 7

In the above example, extensions are used on each end of the Lumber Harvester to saw timbers up to 36 feet. This unit moves away from the accumulation of slabs, sawdust and edgings every week or two. A Jackson Trimsaw is placed between the roller tables. The trailer edger with its own powerunit can be placed at any convenient position.



Example D—Powerunit Mounted on a Trailer.

In the above example the powerunit is mounted on a trailer. The powerunit trailer and Jackson Lumber Harvester are towed by tractors or trucks used in other parts of the logging and milling operation. Notice the pipe used as a brace, and the handyman jack used to tighten the transmission belt.

Skidway

Line up your sawing sites in advance of actual sawing, to determine **exact location** of logs, **accessibility** by Truck, and to **check Skidways.** Skidways should be made in convenient locations in woodlots or near farm buildings. Often it is advisable to have several in one woodlot. If possible they should be made on a gentle slope (as shown in the picture of the Harvester below), leaving sufficient space to pile lumber, slabs, and sawdust. Lumber and slabs can then be carried down grade, lessening the labor involved tremendously. It is also advantageous to have the logs piled on one roll-way as the limit of the Harvester Carriage does not permit the taking-on of logs from two roll-ways. Logs should be received on the Carriage with butt-end toward the Saw.

A 20-inch log (diameter) placed longitudinally 6 to 8 feet from the main frame of the Lumber Harvester, on which rests, two full length medium size logs placed 7-8 feet apart, makes a desirable arrangement when short skids are used between the log resting on the ground and the Harvester support, forming a "deck" from which the Cant Turners work. If the Harvester set in this position becomes too high for convenience of the Cant Turners, a low stand can readily be made up from the first lumber sawn. Also it may be necessary to saw out more skids if they are needed after setting up.

Sometimes a tractor with a finger lift can be used to great advantage with a Lumber Harvester. It can load and even turn large logs at the skidway, and load lumber on trucks. In large commercial operations or where the timber stands are thick and the logs large, Lumber Harvesters can be used in pairs. A tractor with finger lift can be kept busy at the skidways, at the slab piles, and loading lumber at the trucks; as many as six men can be eliminated by this method.

Build Skidway on a Gradual Slope.

Setting Up the Lumber Harvester

It is found practical in most cases to set up **once** a day and it is seldom advantageous to remain over two days at one setup. It is preferable to move the Lumber Harvester away from material accumulated rather than move the lumber, slabs and sawdust. On large set-ups the Harvester simply moves ahead progressively to other skidways and away from the accumulated material. 10 to 20 thousand board feet is the average cut per setting. After considerable practice you should be able to set up the Harvester in 30 minutes. **Remember, time lost in setting up means dollars lost.**

To set up the Harvester, place it within three feet of its desired position longitudinally. Dig a hole in front of each wheel, about 6 inches deep on level ground, so that when the Harvester is leveled up **fifty per cent of its weight will be removed from the tires.** If this is not done, the Harvester will not set rigidly enough. Pull the Harvester ahead to fit in the holes. **Be careful not have the holes so deep that the Sawdust conveyor rests on the ground when the Harvester is pulled ahead into the holes.** Unhitch the Truck or Powerunit from the Harvester and place it in a relative position to the Harvester. At this time ascertain that no difficulties will prevent proper alignment for the Drive Belt from the Powerunit to the Harvester.

Leveling: Proceed with leveling of the Harvester to remove weight from wheels as above stated. Place the two center Legs down first and level the Harvester crosswise at this point. Place the two Legs on the log-end next and level at that point, letting the two Legs on the lumber-end down last, with just enough tension to give adequate support. (See Page 50 "Leveling".) It will be necessary to slide the Carriage forward in order to use the Crank to adjust the Legs. Thus it is necessary to have a relatively level position to the frame before releasing the Carriage so it can be moved for the final adjustment of the Legs as previously stated. **Be sure that some material, such as a plank or timber, is placed on the ground underneath each Leg to prevent them from setting into the soil as operations proceed.**

Bracing: Now secure a Brace against the frame of the Harvester and to the ground or Powerunit, to compensate for Drive Belt tension. If this brace is connected between the Harvester and the Powerunit, you should have some means of increasing its length; the Handyman Jack will provide proper belt tension. Where longer Drive Belts are used and the brace extends from the Harvester to a stake driven in the ground, this tightening adjustment should be provided between the Powerunit and the stake driven in to secure it, as the Powerunit is the more movable.

Sawdust Conveyor: Set up Sawdust Chain and anchor it. Secure one-half of truck axle or similar bar and sharpen end, to use as anchor.

Threading Feed Rope: You are now ready to thread the Feed Rope. One end of the Rope is first secured by passing the end through the loop at the bottom of the Feed Lever (which is the free Lever in the center of the Carriage), and hook the end of the Rope securely on one of the Hooks provided for it on the side of the Lever. (Several Hooks are provided for convenience in tightening the Rope.)

Next, pass the free end of the Feed Rope **toward** the log-end of the frame **under** the Carriage but **above** the cross-shafts, passing it down through the Pulley on the extreme log-end, and **back** toward the center **through** the Idler loop and **over** the top of the large Feed Drum, then making **two complete coils around the Feed Drum,** leading off on the side of the Drum **toward** the Saw. This will bring it in alignment with the Pulley near where the frame hinges. Pass Ropes **up through** this Pulley, then **back** toward the log-end of the frame again. Being sure that the Feed Rope is now above the cross-shafts and **under** the Carriage to the extreme log-end of the Carriage, pass it **up through** the loop provided and secure through the Hook-bolt in the Pipe Winch. By tightening this Winch, the Rope can be adjusted to proper length.

Threading Reverse Rope: To thread the Reverse Rope, proceed as with the Feed Rope, except that you go in the **opposite** direction and use **two** coils around the Drum. **The Reverse Rope is fed onto the Drum from the bottom** whereas the Feed Rope is fed onto the Drum from the top.

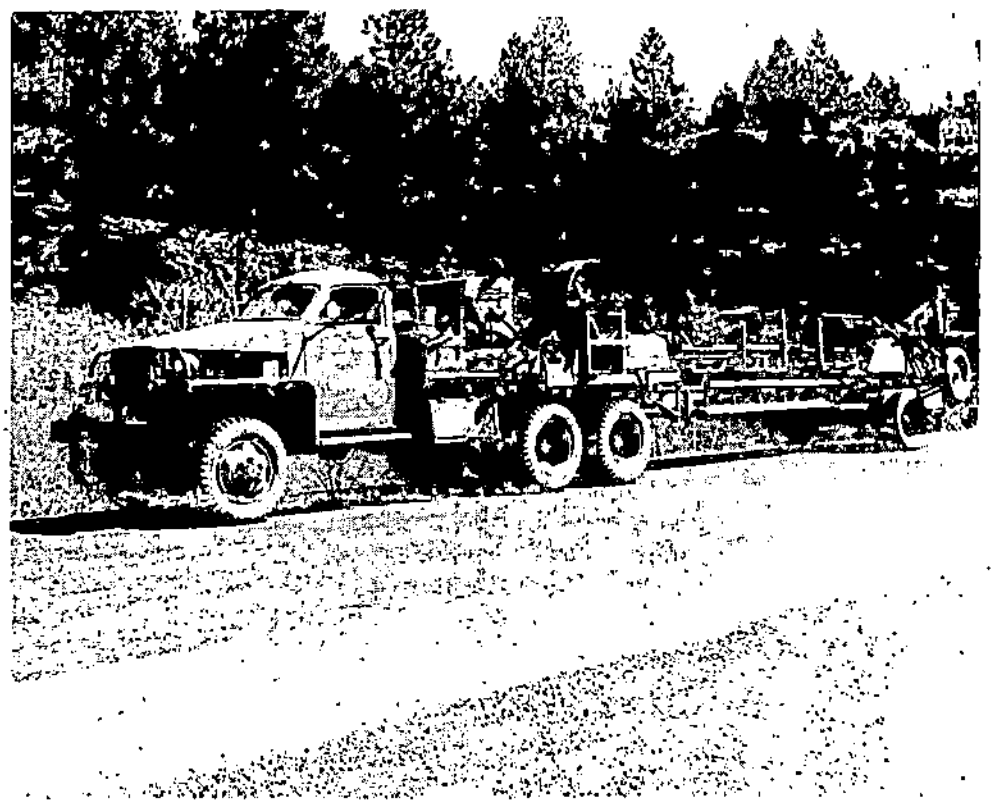
When both Feed Rope and Reverse Rope are threaded, tighten the Winch on each end of the Carriage **until the Feed Lever is in a vertical position, with slack enough to leave at least one foot of movement,** (not over two and one-half feet) **to the Lever when a reasonable pressure is applied.** If leaving the Ropes in over night, **be sure to slacken them at each end.**

The Feed Rope is usually 64 feet long and the Reverse Rope 56 feet. In this way, the Feed Rope, after worn in the middle, can be spliced into a 56' and used as a Reverse Rope, thereby obtaining maximum life from a set of Ropes. One set of Ropes should last through 40 M. b. f. of sawing or one week's sawing, after Drums are worn in smooth. Use **one-half inch Sisal Hemp Rope** for replacement.

After threading the Ropes into the Harvester and checking the tension, and **before** putting the Powerunit and Harvester in operation, **be sure that the Lock Pin which prevents the Carriage from traveling is in a locked position,** and set the hand brake; release Pin only **after** you are in position on the Carriage with Feed Lever in your right hand and have tested the slack in your Feed Lever and have noticed a slight forward or backward movement of the Carriage as you move the Set Lever. With a little ex-

perience you will soon know the proper tension to have in the Ropes before releasing the Lock Pin.

Make several short travels of the Carriage, increasing the length of travel until you have made several **full length** travels of the Carriage **before** attempting to take on the first log. **This should be practiced after every shut-down of the Lumber Harvester,** to assure yourself that the Carriage is in the clear, that the Ropes are properly threaded, with the proper tension.



Heavy Truck Used in Mountainous Regions

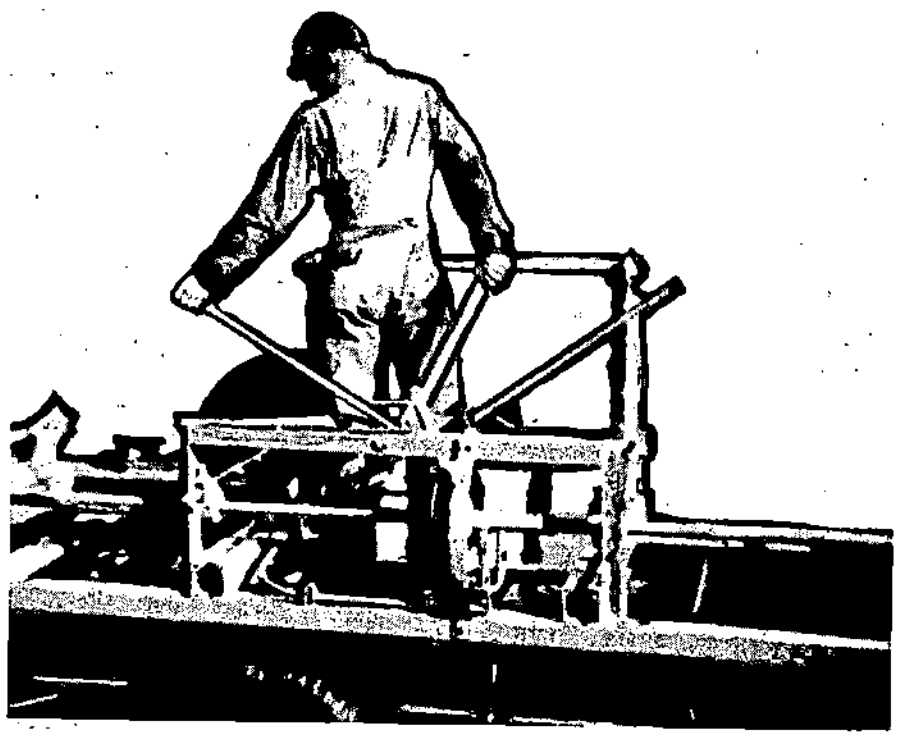
Proper Procedure of Breaking Down Log on Lumber Harvester

Before you, as an Operator, attempt to break down a log on the Lumber Harvester, it would be well to read the following paragraphs carefully, and fix in your mind a mental picture of just what takes place as each operation is performed.

Operators Position:

First, you must acquaint yourself with the Operator's or Sawyer's position and stance on the Carriage, so that you have the "feel" of the moving Carriage, and that you may make the movements most natural to you.

Stand on the Operator's Platform facing the Skidway with feet far enough apart so that a sudden movement of the Carriage will not unbalance you. Put on your "sea legs", so to speak! Bring your right hand to the back of the body, slightly across the righ hip, and grasp the Feed Lever lightly. This permits your left hand to operate the Set Lever (which is on your left) with a straight pull that can soon become very accurate.



Operator's Position—Rear View

To recede the Headblocks, take a backward step with the left foot and catch the Trip Release Lever with the heel. At the same time, change the Feed Lever from the right hand to the left, behind the back, after the "dog board" is dropped and as the Carriage is returning to its original position parallel with the Skidway. This permits you to catch the Receding Lever with your right hand.

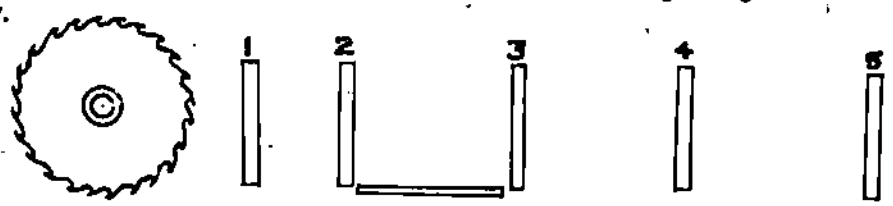
Go through these various movements a number of times before attempting to place the first log on the Carriage.

Operator's Position—Front View

Carriage Position:

You must now acquaint yourself with the relative dimensions of the Carriage, as to length and distance between head blocks (or bunks), so that you can properly position the Carriage, by means of the Feed Lever, to receive the log that is approaching on the Skidway. **This cannot be overemphasized.** Due to the fact that all logs are different, no set rule can be given, but, you should **always** strive to work from the center of the log and Carriage.

Mentally number the Head Blocks from 1 to 5, beginning nearest the Saw.

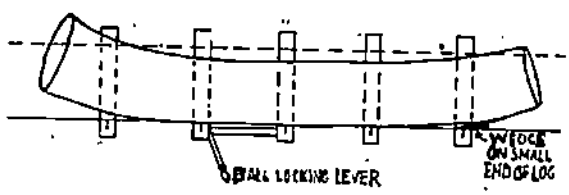


A 4 to 6 foot log should be placed on Head Blocks No. 2 and 3. An 8 to 10 foot log on Nos. 2-3-4. A 12 foot log on Nos. 1-2-3-4. A 14 to 18 foot on Nos. 1-2-3-4-5, and extending the same distance over each end. A 22 foot log should extend slightly more toward the Saw. Twenty-

two foot logs are maximum length you should attempt to cut on the Lumber Harvester.

You must consider as the log is being brought up in readiness to be placed on the Carriage, the presence of extending knots or other obstructions that could prevent the log from laying **firmly** on the Carriage, or **obstruct its passage over the Arbor** as the Carriage is brought forward. In some cases it is best to have the obstruction rest on the Head Blocks, especially is this true in the case of a "swell" or "churn butt". (Encountered frequently in cypress logs and the like.)

Also, you must consider the crook and sweep of the log. The tendency for a new Operator is to place the bow or "belly" of the log **up or down.** In fact, many old Sawyers want the bow up and slightly out. **We have found by careful check as to the quality of lumber produced, that this procedure is definitely wrong.** Perhaps more so on a Lumber Harvester, because it is built so the log **can be placed correctly.** The right position is: With the bow of the log on a horizontal plane **toward the Knees,** and resting on **all** the Head Blocks over which it extends.



In this position, it can easily be brought out on either end by use of a wedge or pryed out with a Cant Hook, **so that the line of cut will be equal on each end.**

Logs should be received on the Carriage with butt-ends toward the Saw, especially in long logs, as the heavy butt on the overhanging end will have a tendency to tip up the Carriage. Also, the Saw is less apt to run "out" following the grain of the wood.

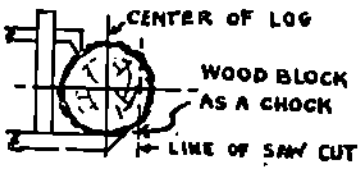
Dogging The Log:

"Dogging" is the term given to the act of securing the log on the Carriage, and is **very important** because of the fact that improperly dogged logs (or cants) may result in accidents, and usually result in damage to your Saw, which in turn means loss of time and money.

In setting the Dogs, hold the Ball Lever vertically, with Dog projecting the desired amount. Then send the slide Ball and Dog Assembly down into the log with a **brisk movement,** letting loose of the Ball Levers as the Dog "bits" penetrate the wood. The weight of the Ball Levers is sufficient to lock the Dog and hold it while the Ball Locking Lever on the top bar between Head Blocks 2 and 3 is brought into locked position, forcing the Dog "bits" still further into the wood. **It is not necessary to press down on the Ball Levers and this practice should be avoided.**

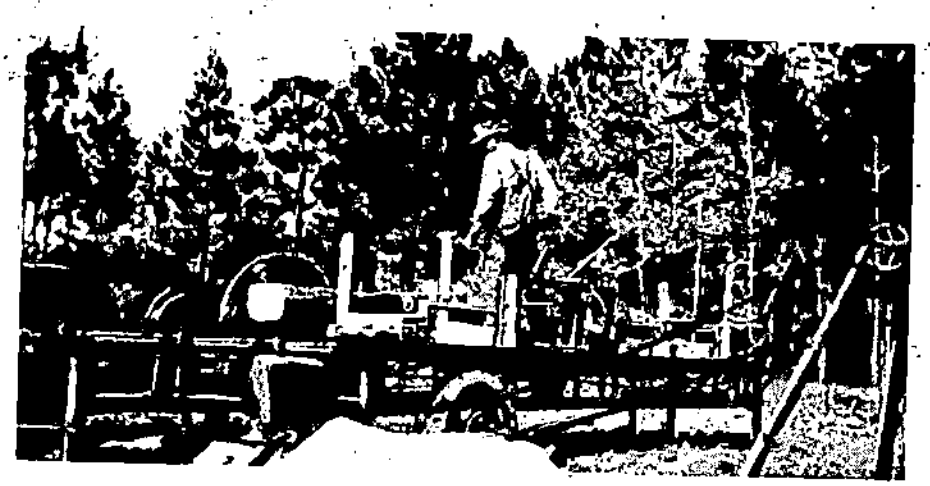
Before sawing very large logs use a small wood block to chock the log on at least one head block. This will prevent the possibility of the log rolling as the saw pulls down in making the first cut.

Before staring to saw the first log, Dogs must be set securely about midway between the Head Block and the center of the log, on the average log. Just where to set your Dogs will of course vary with the curve or amount and size of knots in the log, as you will want to take a narrower or thicker slab board off of the first cut. Learn to judge where your saw-cut is going to come in comparison with where your Dogs are set into the log.



Be sure that the Dogs are set back far enough so that the Saw will not hit them, at the same time far enough in towards the center of the log to hold the log tightly. Also, be certain that the hook on the Dog **penetrates well into the log, especially when the log is completely round and resting on its curved surface,** as the Dogs will not sink in as readily as in the sawed surface of the log, resulting after one cut is made. When dogging the log on the sawed surface, you must also use careful judgment, so as to dog it securely and still have a reasonable margin for the saw-cut. However, it is not necessary to use as much force in driving the Dogs into the sawed surface as is necessary when dogging the log when completely round and with the bark on.

In hardwoods, when the Ball Locking Lever is locked, it may cause undue pressure on the Head Black where the Knees slide, **making it difficult to move the Set Lever** and bring the Knees out. When this occurs, grasp the Ball Locking Lever in the right hand and Set Lever in the left hand, and release the pressure so exerted by an upward movement of the Ball Locking Lever, **until the set is made.** The left hand can then



Securely Brace Outer Sawdust Sprocket

return the Ball Locking Lever to its former position, as the right hand grasps the Feed Lever.

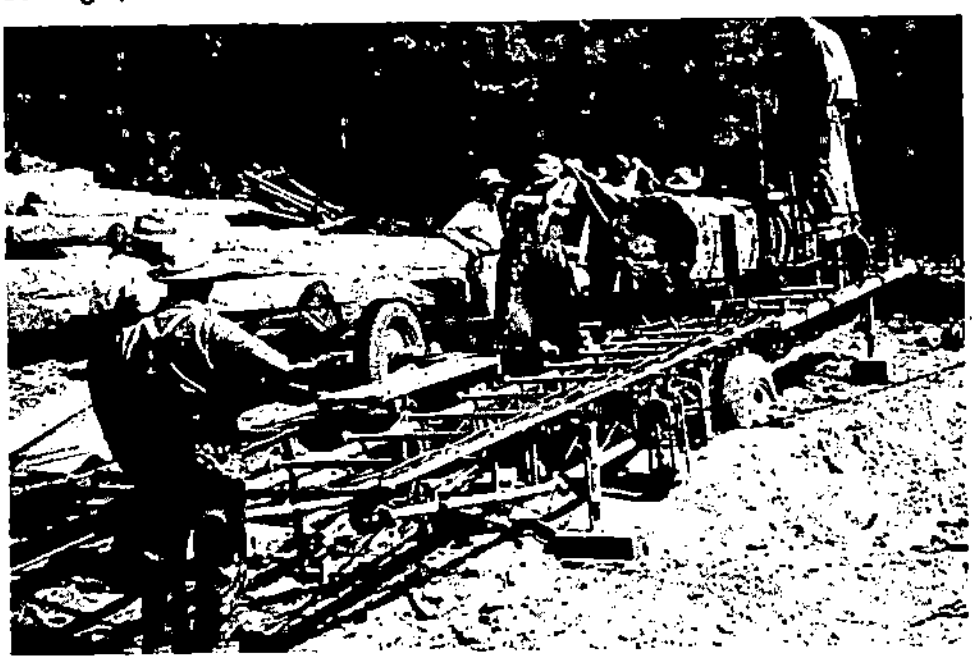
As a rule, it is not necessary to use No. 4 Dog on No. 4 Head Block on logs shorter than 12 feet. However, this practice can be determined by the Sawyer.

Setting the Head Blocks:

After the Dogs are set on Head Blocks 2-3-4, the log is brought out by use of the Set Lever, until the Head Block that shows the most just passes out of view. (Usually No. 3 Head Block on the first cut, and No. 4 or 5 after the log has been turned 180 degrees.) Then one or two pulls of the Set Lever will bring the log into the proper position for the first slab-cut. The amount of set given after the last Head Block slips from view will depend on the height of the Operator and the natural position he takes on the Operator's Platform. This judgment must be gained from experience but is not difficult to acquire. Sometimes it is necessary at this point to consider the position of the Pointer on the Rule in order to divide the dimension of the log between the two slabs to secure the required size of cant when certain specific material is requested. You are now ready to make the first cut.

Sawing Lumber:

Assuming you are in proper position on the Carriage (See Page 34, "Operator's Position") while your left hand grasps the Ball Locking Lever, for support your right hand should press the Feed Lever away from the Saw, causing the Carriage to move forward. (The natural weight of your body will be thrust in the opposite direction of the movement of the Carriage.)



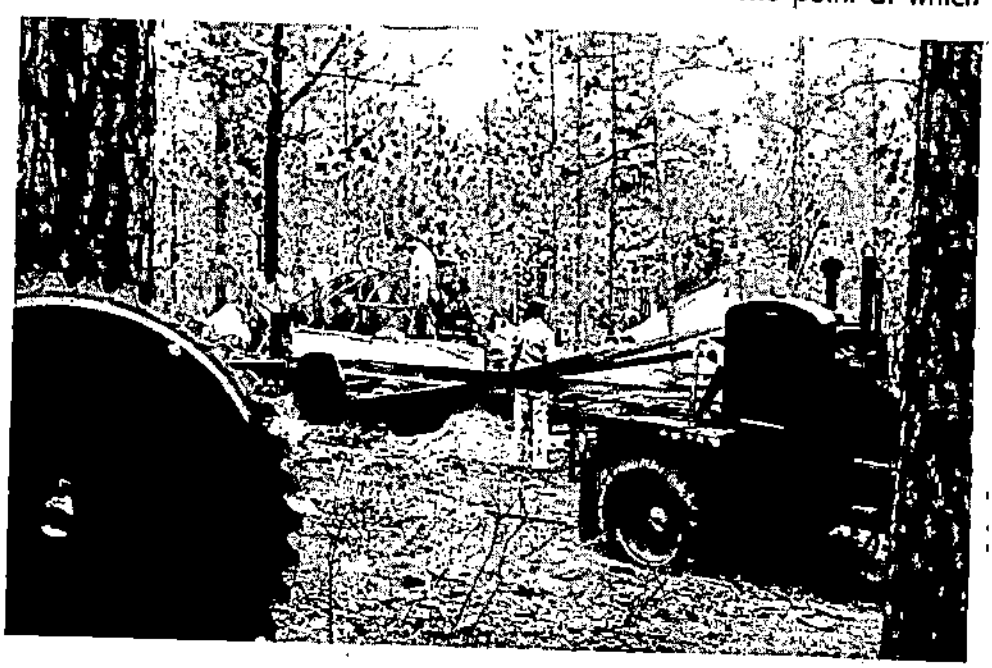
Place Chock Under Large Logs.

When the first cut is nearly completed, thrust your right hand (which is on the Feed Lever) gently in the opposite direction, so that by the time the cut is completed the Carriage will come to a stop, and immediately start the reverse travel. Before the log has cleared the Saw, your right hand is again brought away from the Saw with a certain full movement of the body (which will be acquired naturally), and which permits your left hand to grasp the Set Lever, giving a pull . . . up and back . . . . which is also a natural movement, and brings the log or cant out for the next cut. This movement comes at the same time the right hand presses the Feed Lever away from the Saw to end the Reverse travel of the Carriage, and starts the logs again toward the Saw. This should not be done until the log has cleared the cutting edge of the Saw however.

The sequence of these movements is the same for all sawing and will not be repeated. You should strive to make these movements with an easy natural swing of the body and arms, and the better coordination you can acquire in this connection, will increase your production accordingly.

You have now cut off your first slab-board. When it is released from the log it should be tipped with the side next to the Saw up. This allows you to view and judge the face of the log from the appearance of the slab-board.

When you have again set the Dogs properly (See Page 36, "Dogging the Log") your Pointer (on the Rule) now shows you the dimension in inches of the logs that you have left to work with. You must now determine what final thickness the cant shall be. From this point you must count inches for each slab-board you expect to cut off, adding one quarter inch (¼") for each cut to allow for Saw kerf. The point at which



Use Twisted Belt Within This Set-up.

you start to saw must be **the thickness of the slab less the dimension of your log inches.** Set your Pointer at a number which will allow the desired number of boards to be taken from the cant. Proceed to saw in the manner before outlined.

When the desired "cant thickness" is reached, and you have the Carriage again back to the log-end of the frame, your left heel operates the Receding Trip Release, and a slight pull on the Receding Lever will permit the Cant Turner to easily tip the cant backward to a flat position. (With the cant in this position, experienced Operators will dog the small end of the cant out in such a manner as to divide the taper of the cant.)

With the cant in the above position, it is usually well to cut to a point **nearing the heart of the log, or to a point where the timber strain causes excessive bowing of the cant.** Now rest the Carriage at the log-end while the Cant Turners again turn the cant 180 degrees.

At this time, the final yield of the cant must be calculated in your mind before the proper setting can be made, in order to provide the saw kerf and complete the breaking down procedure so that the final "dog board" is left in a **standard dimension piece.** With this procedure, the final "dog board" will be the heart of the log and the heart will grade higher as dimension lumber. Therefore, it is recommended that you leave at least a two inch cant as a "dog board". This lessens the danger of sawing into the Dogs, and relieves the necessity of slowing down to make the last cut, which in turn increases your production.

Dog Board Release:

After the last cut is completed and the "dog board" **is to be released** on the lumber end of the Harvester, **do not release the "dog board" to Off-Bearers until all boards formerly cut are back of the Splitter.** This is very important as a safety precaution, in preventing the Saw from catching boards and throwing them. "Dogs boards" that are too long to clear the Splitter should not be released until the Head Blocks are receded, which will permit the "dog board" to lie flat on the Head Blocks and be dropped end-wise without lifting it over rotating Saw. This is a definite advantage for you as the Operator of a Lumber Harvester, because **you are in a position to control the release of the "dog board" in a safe, satisfactory manner.**

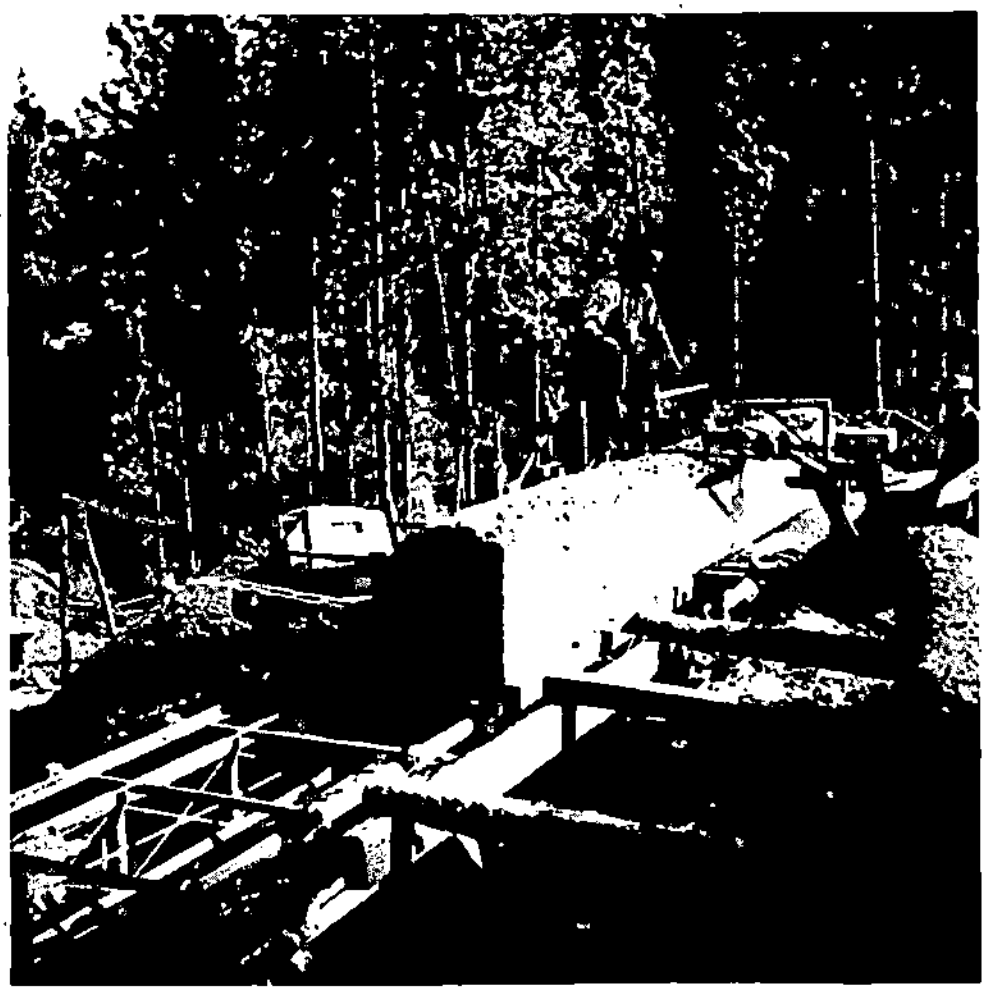
Unusual Logs:

Logs that are too large to be turned up 180 degress as indicated previously, must be turned down to permit the Saw to cut through. The following procedure should be used.

After the Operator recedes the Head Blocks, the Cant Turners push the log back in a manner so that it follows the Head Blocks back without turning. Then turn the log down, and when it is at a balance, push it back at the bottom. When sufficient slab boards are removed to secure the proper face, this procedure is repeated, receding the Head Blocks each time to allow the outside corner of the log to be brought back onto

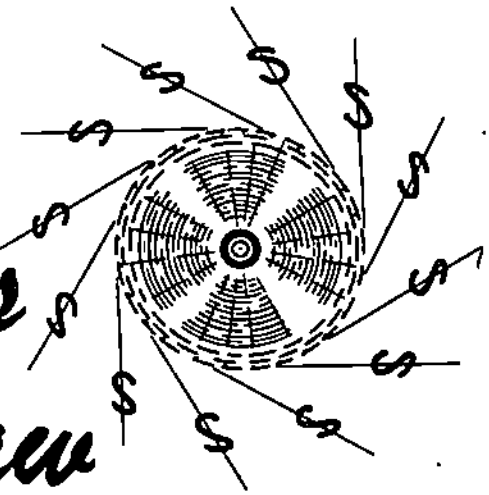
the head Blocks, so that in turning the log it will not have a tendency to slide back onto the skids. After the second such turn is made, the dimension of the log must be computed the same as it was in the former paragraph after the 180 degree turn. In this manner boards are continuously taken off around the log until it is small enough for the Saw to reach through, when it can be further broken down in the desired manner.

It is often advisable in sawing extremely large logs when the Saw does not cut through, to release the slab and turn the log up about one-sixteenth of a turn, continuing to take diagonal slices or slabs until the Saw will cut through sufficiently to remove the slab. This is called "beavering" the log and should be practiced only in extreme cases and on extremely large logs that cannot be cut ony other way. It is a much better practice to refuse to saw logs of this size.



Use a Jackson Grit Gouger in Dirty Logs

Your Precious Saw



It is impossible to place enough emphasis on the **care of your Saw.** It can truthfully be said that it is the most important part of any type of machine which converts logs into lumber, whether it be the conventional portable Sawmill, or a Jackson "Lumber Harvester". If not properly taken care of, it can slash your production, ruin accuracy of your lumber, empty your pocketbook, and leave you in the depths of despair.

It is obvious that there is nothing on the Lumber Harvester that takes as much abuse as your Saw, inasmuch as it is expected to dissipate upwards of 100 horsepower through one edge of it in the process of its operation. For instance, should a log come loose from the Dogs while this tremendous strain is on the Saw, it will very likely "kink" it, bringing a halt to operations and resulting in the loss of time and money. All Saws vary considerably, and like people, have certain personalities and require different methods of handling. This is partly due to the hardness or mildness of the steel from which they are made. Therefore, the following treatise will deal with all Saws in a general way. (Occasionally one will possibly find a Saw where certain explanations given here will not apply.) Inasmuch as it is impossible to carry a "filing room" around with a Lumber Harvester, we recommend only the use of inserted tooth Saws, and will deal only with this type.

Teeth: A new Saw, or a new set of Teeth, will always run well for the first five thousand feet of cutting. They may make a rather rough cut, but will always run approximately this long if the Saw is tensioned for the proper speed and the natural lead is properly set. This fact assures you, that if the Teeth can be kept properly sharpened (like a new Tooth), the Saw will continue to run and cut in a true line. Thus, when you find that it does not, it usually indicates that something is lacking in the man who is sharpening the Teeth and his methods. A very good way to check this is to put in a new set of Teeth and check the results. (Cases have been cited by Mr. Jackson, where attempts to run the Saw when improperly sharpened, have continued so long that the Saw lost the proper tension, and has sometimes been carried to a point where blisters develop.) If such a case develops, it will be necessary to have a **competent** Saw expert

retension the Saw by hammering it. Hammering a Saw is an art and **should under no circumstances be attempted by anyone with limited experience.** When your Saw ceases to cut properly, **stop your operations and sharpen it.**

It might be well to know just how a chisel tooth Saw works. (All inserted tooth Saws used to cut wood lengthwise of the grain are swedge-set chisel tooth Saws. Saws used to cut acrosswise of the grain are spring-set pointed tooth Saws.) A spring set cut-off Saw cuts the sides free and **tears out the portion between the two edges** that are cut free by the sharp points. Thus, as soon as the points become dull and do not cut the edges free, further sawing is difficult and the Saw is said to be dull. Sharpening the points will again correct this and work can be resumed. In as much as the center is torn out, any slight increase in the kerf will increase the amount to be thus torn, and will increase the power accordingly.

A chisel tooth rip Saw cuts **across** the center and **tears out the two corners.** For this reason, the width of kerf does not materially affect the power required. The two edges have to be torn free regardless of how narrow the kerf is, and this is what consumes your power. The center being cut, the amount of material cut varies power consumption very slightly. The corners being the part of the tooth that do the tearing it naturally follows that the things which would lessen the tearing-effect of the corners, will effect the power consumption immediately, and cause a corresponding increase in the power dissipated through each tooth; and can cause plenty of trouble in so doing. The chisel tooth saw is the type used on a Lumber Harvester. The condition of the corners of the teeth is, therefore, of great importance.

Still further, if one corner of the Tooth becomes more dull than the other, it naturally follows that the one causing the greater resistance will have tendency to force the Saw the opposite way, which will cause the side of the Saw to rub on the side of the log. This rubbing will do one of two things: (1) If the log is moving end-ways slowly, and the Saw is rotating as it rubs the slowly moving log, it will generate heat in the Saw causing the metal to expand. The Saw will thus lose the stiffness required to run straight. **The further this condition is allowed to develop, the harder it becomes to remedy.** (2) On the other hand, if the log is passing the Saw at a higher rate of speed, the log being cool in the inside will have a tendency to cool the Saw as it rubs against it, causing the metal to shrink and stiffen, which is necessary to off-set the rubbing caused by one corner of the Tooth being more dull than the other.

From the above we conclude, that, it is first necessary as far as possible, **to keep the corners of the Teeth out full and sharp.** Secondly, if the corners are becoming dull, it is better to increase the speed of the feed, if the power will permit, in order to keep cool lumber passing the Saw. Also, your Saw may appear sharp, but if the corners are not keen and are not **projecting beyond the edge of the Tooth** (like new Teeth), it is **still a dull Saw.**

Another factor, which will cause your Saw to run "in" or "out" as the case may be, is an **improper angle to the front of the Tooth.** The cutting edge should be **straight across.** (Some Sawyers prefer having the log-side of the Tooth slightly longer. The idea is, that this will counteract the tendency of the logside corner wearing faster because it cuts more lumber due to the curve of the log. If this is practiced, it should be very slightly.)

The "hook" or bevel of the underside of the Tooth is very important. New Teeth usually have a maximum of "hook". A good rule to follow is to set the main frame of the Harvester slightly higher on the lumber-end. In fact, as much higher as you can and still have the Carriage remain at rest with the Saw running and the Feed Lever unattended.. Then give the Teeth all the "hook" they will take without picking up the feed, due to their extensive draft. (See Page 45 "Filing".) If a mechanical Filer is used, it can be set in this position and will maintain this proper 'hook' for the half the life of the Tooth. However, after the Tooth is half worn out, it will be found necessary to round out the throat of the Tooth to keep a sharp "groove" from forming as the metal is filed away. This is important because a "groove" at this point will cause an "eddy current" in the flow of chips as they come from the keen point, obstructing in turn the flow of sawdust from the kerf, which causes the Saw to dodge "in" and "out". **Plenty of "hook" will pull the front edge of the Saw into the wood, while a lack of "hook" will cause the Saw to dodge sideways instead of cutting forward down a straight line.**

Number of Teeth and Guage: The majority of Saws on the Jackson "Lumber Harvester" are 50" diameter with 36 to 46 inserted Teeth, 7 gauge at center and 8 gauge at rim, 5/16" or 9/32" kerf, speed of 500-550 R. P. M., and lefthand. (A mill on which the log passes the Saw on the lefthand side as it is being cut, is a "lefthand mill", and thus carries a lefthand Saw.)

It may be well to remember that a Saw with insufficient Teeth is wasteful on a Lumber Harvester with a good Powerunit, because it is unable to take full advantage of the power. On the other hand, light power is over-burdened by a Saw with too many Teeth. Also, fast feed, backed up by ample power, requires a fine-toothed Saw, especially in small logs where large gullet capacity is not required. A fast feed requires **enough Teeth to do the cutting.** A slow feed does not require as many Teeth. (Too many Teeth at a slow feed do not get a large enough "bite" and cut too fine sawdust and waste power grinding the wood.)

We do not recommend thin Saws. A 7-8 gauge is naturally able to stand more crowding and abuse, as well as being a longer wearing Saw than a 8-9 gauge. **A 7-8 gauge Saw should be used especially in frozen timber and on machines where the power is over 80 h. p. diesel.** The standard kerf for 8 gauge Saw is 9/32" while the standard kerf for 9 gauge is 17/64", only 1/64" difference. When for instance, only 6 to 10 cuts are made in a log, there is little saving in kerf, considering that

any saving made would not be enough for a full one inch board and therefore would go into slab.

Speed: The speed of the Saw on a Jackson "Lumber Harvester" should be the greatest which can be maintained **both in and out of the cut.** A usual mistake of Operators is to try to operate their Saw at too great a speed. **A regular uniform speed both in and out of the cut insures more lumber and more accurate lumber.** Speed should be governed by the available horsepower, of course, and must be increased as the power to drive the Saw is increased. The 50" inserted Tooth Saw most commonly used on the Harvester should run at 500 R. P. M. When ordering new Saws, be sure and advise the speed at which your Saw is operated both in and out of cut. Do not guess at this but take it with a speed indicator.

Kerf: Nothing is gained by attempting to use inserted Teeth too narrow on the cutting edge. New teeth which are too narrow become entirely too narrow to clear the Saw properly after one or two filings, resulting in the heating and buckling of the Saw, and a **"snaking" Saw will waste more lumber than a wide kerf.** However, when cutting a frozen timber, it is possible to use a trifle narrower Tooth.

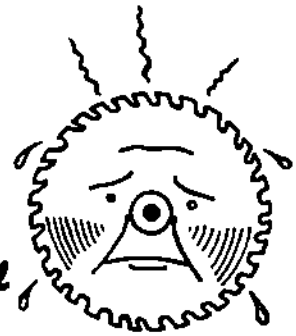
Frozen Timber: As stated above, the kerf may be slightly narrower in cutting frozen timber because frozen timber cuts very clean. Short points generally do better than points of the full length and for this reason, Teeth which have been discarded in the summer can be used in the winter, but be sure to select Teeth in sets of **one length.** Also be **certain that your Teeth are properly filed and that the corners are sharp at all times** so that the Saw will not dodge in the first cut. Be sure that you have good Holders to chamber the fine frozen sawdust which will otherwise frequently cake on the side of log, forcing the Saw out of true line of cut.

Hardwood: In sawing hardwood extensively, the kerf may be a trifle narrower than for soft or fibrous timber. Red Elm sometimes presents difficulty when trying to cut a thin slab because of a tough inner bark. Either cut a thick slab or file the Saw, as only a very keen edge can cut through this tough bark when it comes in contact with the Saw at a sharp angle.

Filing: As previously stated, (See Page 42, "Teeth") more hook can be used on the saw Teeth on a Jackson "Lumber Harvester" than is commonly recommended by Sawyers of the conventional portable Sawmill, because it is possible to readily adjust the frame of the Lumber Harvester longitudinally, whereas the conventional mill rests solidly on mud sills and is not readily adjustable. **Place the maximum hook on the Teeth that can be used without the Saw "grabbing"** or seemingly picking the feed away from the Operator. The position of the machine will make a difference. Lower the log-end of the Carriage to a point above which the Carriage ceases to stand at rest when the Feed Lever is released. The lowering of

the log-end of the Harvester causes the Carriage to run up hill toward the Saw, facilitating the return movement of the Carriage and lessening the possibility of the Saw "grabbing" or picking up the Feed when encountering knots or cross-grain sections in the log, as would be the case when extreme hook is used. **Do not file "lead" in the Saw.** It will have a tendency to cause the Saw to run in when sharp and out as the Teeth became dull. **Do not file backs of Teeth** as this will reduce back clearance and make the Saw run hard, if it will run at all. (See P. 47, "Dull Teeth".)

Don't Ever Saw With a Hot Saw



If Saw runs hot, check and **double-check** the following **carefully,** starting with the first item and continuing down the list until the difficulty is ascertained.

1. Hot Mandrel Bearing. Be sure the Saw is not absorbing heat from the mandrel. Bearings should not be much above blood temperature which can be judged by contact with the hand. Do not use too much grease in mandrel bearings.

2. Dull Teeth. Never saw with dull Teeth. You will save time and money by stopping and sharpening the Teeth. If logs are dirty and difficult to cut, it will be necessary to sharpen Teeth 4-5 times a day. Take special notice of the points, corners, and sides of new Teeth, and endeaver to **keep** them in that condition. Do not remove Teeth to sharpen.

A 50" Saw can be filed in 20-30 minutes on the Harvester and the greatest value will be secured from the Teeth. When filing, **be sure that you file the tips of the Teeth square.** If tips are longer on one edge it will cause the Saw to run in and out (See P. 42, "Teeth"), further causing the Saw to rub against one of the Guide Pins and heat in the rim even though the Saw has the proper lead. (See P. 49, "Lead".) Squareness of points can be determined by placing a short straight edge, like a 12" rule, against the tip of the Tooth and sighting across the Arbor to see that it is straight with the Arbor.

3. New Teeth. If filing does not remedy heating of the Saw put in a new set of Teeth. In many cases new Teeth will make a new Saw. Also, you can determine here and now if the actual heating is caused from the Teeth or the Saw itself. Take special notice of type and style of Teeth in Saw and secure same kind if possible. When securing new Teeth do not get Teeth which are too narrow, as they become entirely too narrow after one or two filings, causing Saw to heat. (It is possible to swedge narrow Teeth but we do not recommend this practice as it is apt to cause Holders to loosen and Teeth will not be held securely.)

Before inserting new Teeth, the V in the plate and Holder (or Shank) should be **wiped perfectly clean** and **well oiled.** After dipping the Tooth in oil, hold it in your left hand in position with the Holder, keeping it even with the side of the Holder. While holding the Tooth evenly with side of the blade, press the wrench downward until the stops meet. **Do not use undue force.** Let the stops meet lightly and when the Tooth is in place no further pressure is necessary. If Teeth incline to one side of the Holder or Shank, use the wrench as an anvil on one side and a hammer on the other, to line up the Tooth and force it to its proper position. **Teeth and Holders must be in line and must be kept in line to insure better and smoother lumber.** The Saw will also run better. When inserting teeth do not permit Holder to ride up out of the bottom of the socket or ride on the head of the Holder. If held properly, and if wrench is pulled down as well as turned with the socket, the Tooth should move in easily. If a Tooth rides, raise the wrench and so bring the head of the Holder up until it again assumes its proper place in the recess of the Tooth. It will then turn readily.

In removing Teeth which are tight and are immovable with the wrench, **never hammer the wrench or the Tooth.** Place a blunt cold chisel on the heel of the Holder, **being careful not to touch the Saw** and tap **lightly** with a hammer. This will start the Tooth and Holder and enable you to remove it easily with the wrench.

4. Holders. Keep Holders or Shanks tight by all means, as they should maintain practically the same pressure on the Teeth at all times, and constant changing of Teeth will set or crimp the Holders. **At all times keep them as tight as when they were new.** Tightness can be determined by the feel of the wrench when Teeth are changed. Peen the loose Holders with a hammer on inside edge of gullet, **but be careful not to hammer more on one side than the other and do not bend the Holder in doing this.** This will retain the tension in your Saw the same as when new and in some cases will save a hammering job. When putting in half set of Holders be sure to put in every other one.

5. Rubbing. Do not allow Saw to rub the log while backing up. The log corner will soon become rounded and it will be hard to hold the Saw in the log. Do not allow chips to rub your Saw. **Keep apron clean of chips constantly. Keep Saw clean from pitch.**

6. Guides. Check for Guides being set wrong. **Do not attempt to set Guides while Saw is hot.** Cool Saw down by applying water **while Saw is running** until it is **thoroughly** cooled. Then ascertain if the Saw has proper natural Lead (See P. 49, "Natural Lead and Arbor Alignment"). If lead is correct, set Guides equally, leaving a clearance the thickness of a post card on the side of the Saw.

7. Mandrel. Saw Mandrel may be running untrue on Harvesters after seeing considerable hard use. To determine this, remove nut and loose

Collar and check the face of the stationary Collar for a wobble or uneven surface. If so, remove entire Mandrel or Arbor and have it remedied by a competent machinist. When aligning the collar be sure to support the Mandrel in the bearing on the Collar end—not at the center of the shaft.

8. Natural Lead and Arbor Alignment. To check your Lead and alignment of the Arbor, run Carriage to extreme log-end and back out Guide Pins from contact with the Saw. Then place a mark on the Saw, near the rim and just above the Saw Guide. Measure the distance from the mark to the Guide Rail. Rotate the saw **180 degrees** (or one-half turn) and measure to the Guide Rail again. It should be 1/32" more in the second measurement. **Be sure that the Saw Guides are backed away so that they do not touch the Saw at all when doing this. Also be sure that both measurements are made in level position or on the same plane.** When this adjustment has been made, bring the Guide Pins up from each side **equally**, leaving a clearance of the thickness of a post card. If the Saw is properly tensioned and has the proper hook to the Teeth, it should run cool.

If above rule is carefully followed and a Gauge provided for this use, you can easily check Arbor alignment and natural Lead any time you have Saw trouble and know that the Lead and Arbor alignment are correct before proceeding further to correct Saw difficulties.

9. Proper Lead. Another way to test proper Lead is to slacken both Guide Pins in manner outlined above (See P. 49, "Natural Lead and Arbor Alignment"), and with the Saw running full speed, hold a small stick on the Block. Move the Carriage ahead letting the Saw cut the stick in two. When at the back of the Saw, the stick should clear by about 1/16-inch. Proper Lead can also be checked with the Saw still, by marking a Tooth and measuring exactly the distance from the marked Tooth to the end of the Block. Then move Carriage ahead and back the Saw until the marked Tooth is in exactly the same position to the end of the Block. The measurement this time should be 1/32" more. You may run less Lead than this in hardwood and a trifle more in softwood. **When your Saw wears bright near the Collar on the log-side, it indicates too little lead** providing the Saw is correct otherwise. This friction will cause the Saw to heat. A Saw with too much Lead is apt to become "dished" into the log if run in such condition for very long. **Don't crowd or force a new or repaired Saw until the Lead is correct. A Saw which heats at the center requires more Lead. Heat at the rim indicates there is too much lead.**

Some Operators prefer to use enough Lead so that it is necessary to hold the Saw slightly out of the log when the Teeth are sharp and as the Teeth continue to lose their keenness, adjusting the Guide toward the log by means of the Set Screws, until a reasonable pressure ceases to keep the Saw running straight. When the Saw is again sharpened, the Guides are again adjusted to hold the Saw slightly out of the log, and the process is repeated.

10. Too slow. It is a known fact, if an Operator saws too slowly, or if the log moves into the Saw too slowly because of lack of horsepower, inefficient drive, ineffective governor, or lack of aggressiveness on the part of the Operator, the Saw rubbing on the logs or boards will cause the Saw to heat and to run in and out. More horsepower or better drive to secure faster feed, thereby dissipating the heat by the cool lumber as it passes the Saw, will correct this. In other words, **too slow sawing will cause a Saw to heat, while fast sawing will cool down a hot Saw.** This is especially true in hot weather.

11. Leveling. Check the Harvester to determine that it is level **crosswise and lengthwise,** by placing the Level on the Arbor for the check crosswise and on the Carriage main frame **at the center** for the check lengthwise. Be sure and check **both** ends of the main frame to make sure that the Level registers the **same on each end.** This is done by placing the Level on the cross-shafts that support the ball-bearings on which the Carriage travels. This also checks for square lumber, preventing it from being thin on the top edge. If your last board or cant is thin on the top edge put a shim under the Arbor Box next to the Saw. This will cause the Knees on the log-end to appear high when Level is placed on the Head Block and on the Arbor. Remember, **that a Saw that runs "in" at the front will make the last piece of lumber cut,** (the dog board"), **thin at the top. A Saw that runs "out" at the front will make the "dog board" thick at the top.**

Efficiency

Initial Operations: Always put the Lumber Harvester through its operations in some secluded place. Too often, because the machine is something "new and different" in the community, crowds gather around to "see" . . . making comments pro and con . . . checking production, accuracy of cut, etc., irritating the new Operator to a point where he is not in a position to do his best . . . or give the Lumber Harvester a chance. On the other hand, if the Harvester is placed in the hands of careful workmen in a secluded spot, letting the new Operator become "acquainted" with the Harvester, with just enough help to "get along" . . . in a few days he will come through with much better satisfaction for all.

Patience: Operator must have patience until acquainted with the Harvester and has the "feel" of the machine. Remember, this machine is not a Sawmill but is a "Lumber Harvester," and is designed somewhat differently than a Sawmill. Therefore, if the new Operator is an "old hand" with Sawmills it will require additional patience on his part to master this machine. But once he is thoroughly acquainted with the Lumber Harvester, we doubt that he will go back to operating a Sawmill. It has been our experience to have the Lumber Harvester thoroughly condemned, when all that was necessary was a **competent** Operator, to change the condemnation to the highest praise.

Figuring: As the Operator, familiarize yourself with log scales, scaling of logs, lumber grade, and figuring cuts and volume quickly and accurately **before** starting sawing operations.

Peak Production: For continuous efficiency and peak production, and after considerable experience, some owners use two **trained** Operators, who change off sawing every hour. It has been proven that after an hour's sawing, an Operator's production gradually decreases. While the one Operator is sawing, the other should check on the machine's operation as a millwright, checking production and lubrication on parts of the Harvester as well as the Powerunit. Never simply stand around.

For added production, and especially for public demonstrational purposes, one should have a trained Cant Turner cooperating with the Sawyer.

Size of Logs: Do not be afraid to establish a precedent on size of logs sawn in custom sawing, and the sooner, the better.

We do not recommend using a Saw larger than 48 or 50 inches on the Harvester. Also, second-growth timber, if properly harvested, should come

within the scope of a 50" saw. Further, logs that are larger than a 50" saw will take, are too large to be handled manually, as is definitely necessary in the extremely portable operations of the Lumber Harvester.

It is generally considered in the operations of the Lumber Harvester, that **logs from 16 to 24 inches (diameter) are handled most efficiently and most profitably. From 24 to 30 inches, one is making less profit as the diameter of the log increases.**

Peeling Logs: When accepting jobs where the majority of the logs have been hauled through gravel, mud and sand, and are heavily coated, you should use a Grit Gouger. This saves your precious Saw and produces better lumber.

Accuracy and Speed: You, as the Operator or Sawyer, are responsible for the production and accuracy of the lumber produced. A good Operator will size up a log at one glance and cut it to produce the highest grade lumber in the shortest possible time with least waste. From your position on the Carriage you can direct operations, while also having at your convenience the Feed Lever, Set Lever, Trip Release Lever, Head Blocks, Dogs, and Ball Locking Lever.

Remember that you are the one who "sets the pace" of the entire operation, and if the Harvester is set up properly with plenty of power available, but production is lagging, it is your fault. You should require that the Cant Turner have the next log rolled into position, ready to roll onto the Carriage when you are making the last cut in the preceding log. Also, as you return the Carriage to the log-end and tip the Ball Locking Lever into release position, the Cant Turner should be ready to make the required turn of the log **as soon as you reach the log-end.** Also require that the Off Bearers take lumber away as fast as it comes off the Carriage. Do not slow down to accommodate the Cant Turner of Off Bearers except in unusual conditions. If Cant Turners and Off Bearers are unable to work at your speed, insist that more help be added, and if necessary, **stop operations** until such is had and you are able to proceed **efficiently and profitably.** Further, when you slow down a great amount for any length of time you are very apt to have a "hot Saw" on your hands. (See Pg. '50. "Don't Ever Saw With a 'Hot Saw,' Too Slow".)

Major Dismantling Points

1. Dig sawdust out from under Sawdust Auger before retracting Legs to eliminate the possibility of bending the Screw-Conveyor on the Sawdust mechanism.

2. Take out the removable section of the Guide Rail before attempting to fold up the folding end of the frame.

3. Remove the sawdust and soil from in front of the wheels to facilitate forward movement of the Harvester.

4. Be sure that Carriage is **securely locked before attempting to move out of the setup.**

5. Be sure that Head Blocks are well advanced to a position which will eliminate projection of the Gear Racks and provide proper clearance for road travel.

Lock Carriage Securely Before Transporting.

Summary of Important Do's and Dont's

Greasing:

1. Apply heavy oil to two Bevel Gears of Sawdust Conveyor **Twice a day.**

2. Use soft light pressure gun grease.

3. Use **only Pressure Gun Grease in Grease Gun.**

4. Lubricate the Kneeslides and Gear Rack slides, and other moving parts **frequently** with **light machine oil.** Some Operators make a practice of lubricating the surface of the Knees on which the log rests., when taking on an usually large log, as it facilitates turning. (Some Operators use powdered graphite on the Head Block Slides instead of oil.)

5. Ball Bearings on which Carriage slides should be removed, washed out with gasoline, and repacked with pressure gun grease **once a year.**

Saw:

1. **Don't ever saw with a "hot saw".** See Page 47 on Saw heating.

2. **Never saw with dull Teeth, it doesn't pay.** If difficulty continues after sharpening, put in a new set of Teeth to determine whether trouble is in Teeth or in Saw. If trouble is in the Saw start checking on **your method of sharpening Saw.** Learn **proper** filing of saw Teeth. There is a rotary Filer on the market now which is very portable and is therefore well adapted for use with the Harvester, and has been highly recommended by many Harvester Operators in various states, working with various species of timber. The main factor to remember when using any portable Filer is to **make certain that you are filing the tips of the Teeth square.** (See Pg. 42 "Teeth")

3. Do not allow chips to rub Saw. **Always keep apron clean of chips.**

4. Keep Saw clean of pitch. Pitch sticks only to a hot saw.

5. **Always carry extra saw Teeth** and be sure to lace them in oil before putting them in Saw. (See Pg. 47, "New Teeth")

Carriage:

1. **Be sure Carriage is level crosswise.** Start leveling main frame from center Legs to front end. Tighten Legs on lumber-end **just enough to take up slack.** Center Legs should carry at least 50% of the weight on the tires. (See Pg. 31 and 50, "Leveling")

2. **Set Harvester slightly low on log-end.** Govern lowness by ability of Carriage to remain at rest when Feed Lever is in neutral position.

3. **Always check Carriage before starting to saw** by running up and down track 2-3 times to determine that Ropes are in order and Saw is in the clear.

4. **Always check Dogs when not sawing,** especially on the "return" after the last board is cut from the log, keeping them **well back from the Saw.**

5. **Always keep Saw Guides properly adjusted,** with just enough space for Saw to run free. (See Pg. 48, "Guides")

6. **Always LOCK CARRIAGE when days work is finished or whenever machine is not in operation,** and **NEVER release Lock until Operator is on Carriage with Feed Lever in hand and has proper tension obtained on Ropes.**

7. **Always put in Carriage Bolt and Lock Pin when moving, and set the hand brake.**

Ropes:

1. Always take Ropes out, or cover them, when rain comes up or at night when leaving machine outside. If Ropes can be covered but left in position on machine they may last longer than if taken out too often. If Ropes are left over night **be sure and slacken them at each end.**

2. Always carry extra set of Ropes.

3. **Never attempt to Operate with wet Ropes.**

4. Give Rope Drums squirt of oil **in morning** and **at noon** when machine is new or until Drums are worn smooth.

5. When Feed Rope is worn in center, splice good ends together and use for Reverse Rope.

6. Change Ropes as soon as broken strand warns Operator by slight jerk on Feed Lever.

7. **Keep sawdust clear of Ropes underneath Carriage,** as pitch and moisture from sawdust accumulated on Ropes will cause them to run jumpy. Especially true when sawing frozen timber.

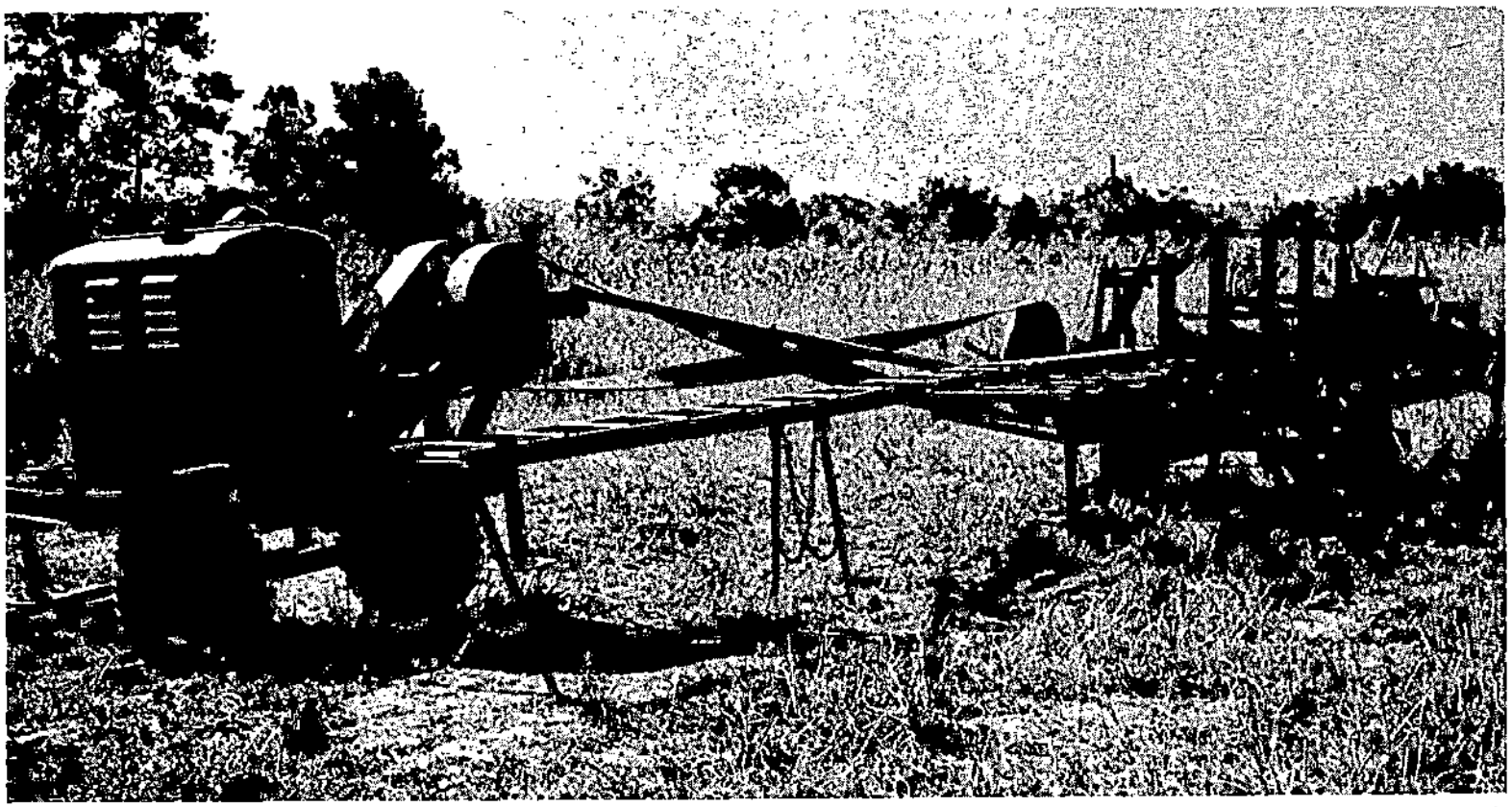
8. Rope Drums are more or less coated with paint and dust on new machines and should be oiled with **thin** oil quite liberally for first few hours of operation, or when Ropes seem damp. After Drums are worn in they work best when kept free from oil, moisture, and pitch.

Sawdust Conveyor:

1. Secure one-half of truck axle, or similar bar, and sharpen end to use as anchor for sawdust chain.

Rotary Log Scale

Diameter In Inches	8'	10'	12'	14'	16'	18'	20'	22'
6	8	11	13	15	17	19	21	23
7	16	20	24	28	32	36	40	44
8	20	25	31	36	41	46	51	56
9	24	31	36	42	48	54	60	66
10	35	44	53	61	70	79	88	97
11	41	52	62	72	82	93	103	113
12	52	65	79	92	105	118	131	144
13	60	75	90	105	120	135	150	165
14	72	91	109	127	145	163	181	199
15	83	103	124	144	165	186	206	227
16	96	121	145	169	193	217	241	265
17	109	137	164	191	218	246	273	300
18	122	152	183	213	244	274	305	335
19	140	175	210	245	280	315	350	385
20	155	194	233	271	310	349	388	427
21	169	211	254	296	338	381	423	465
22	191	239	287	334	382	430	478	526
23	205	257	308	359	410	462	513	564
24	229	285	343	400	457	514	571	628
25	248	310	372	434	496	558	620	682
26	270	338	405	472	540	607	675	742
27	291	636	436	508	581	654	726	799
28	316	396	475	554	633	712	791	870
29	336	420	504	588	672	756	840	924
30	361	452	542	632	722	813	903	993

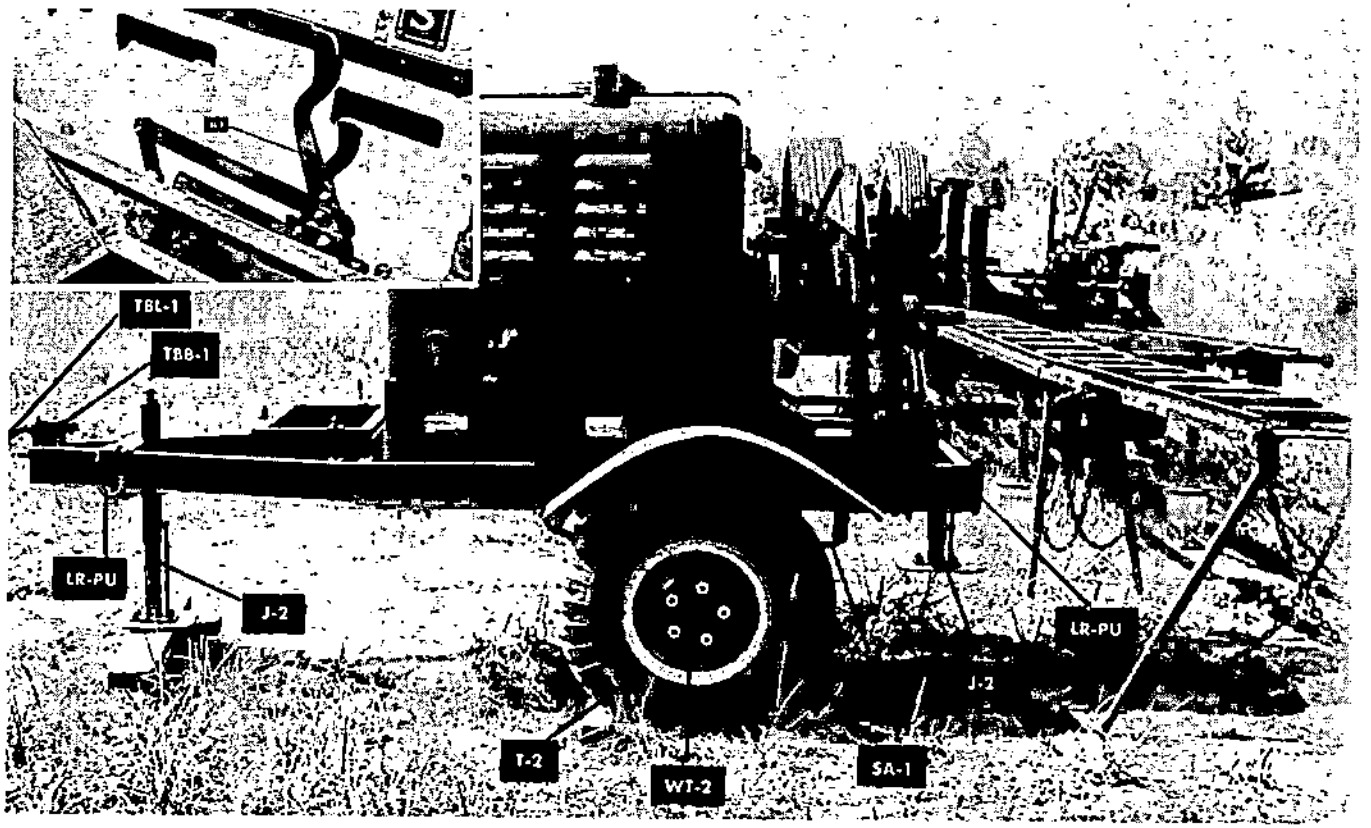


LUMBER HARVESTER, POWERUNIT, LUMBER TABLES AND GRIT GOUGER SET UP FOR OPERATION.
(Government specifications only.)

Identification Lists--Powerunit Trailer

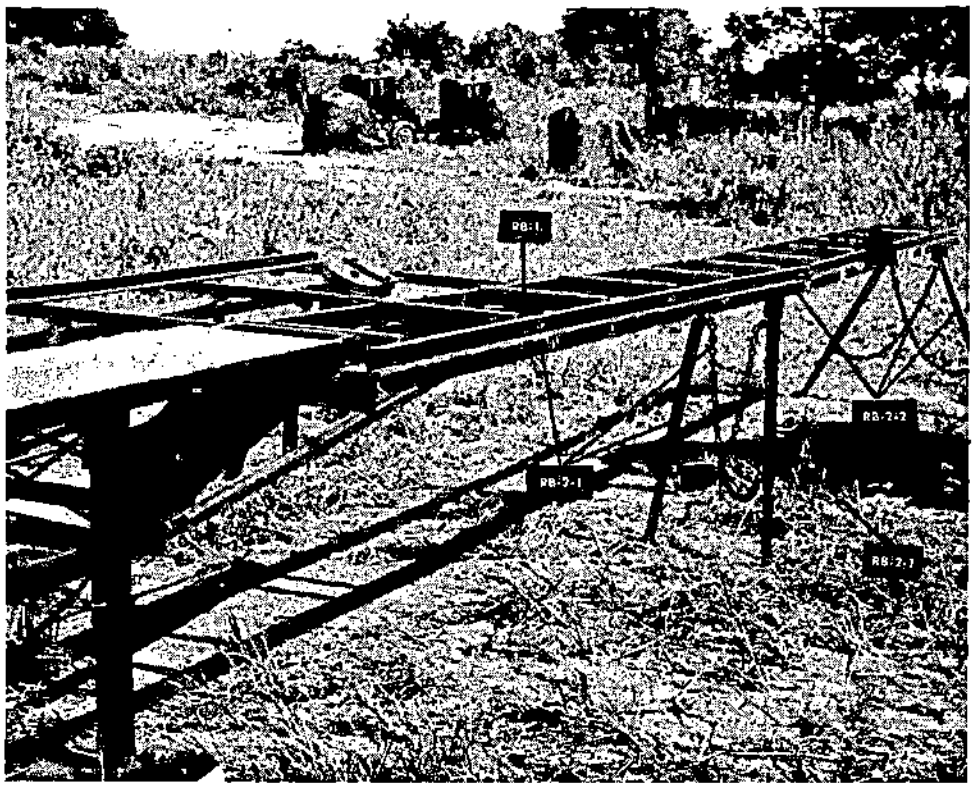
POWER UNIT TRAILER ASSEMBLY
(Government Specifications Only)

Fig. No.	JLH Co. Part No.	DESCRIPTION	Qty in Assy.	Qty in Harn.
13	PUT-1	Electric-welded channel iron, angle iron, flat mild, round mild, and plate members		
	AX-2	Special Axle with 62" track, less springs, 4" OD x ⅛" wall tube, ¾ ton spindlesize, complete with hydraulic brakes and ¾ ton hubs, drums and bearings	1	2
13	SA-1	Spring, with pads	2	2
14	BL-1	Brake Lever	1	2
13	WT-2	Wheel, Transportation—16 x 6.50 to meet Army Specifications no. DA-7388452	2	4
13	T-2	Tire—8 ply, 9.00 x 16, Non-directional tread	2	4
	TUB-2	Tube—9.00 x 16	2	4
13	LR-PU	Lifting Ring for Powerunit	4	4
13		Battery Frame	1	1
13	TBB-1	Tow bar bracket—Blueprint No. 08011-Y	1	2
13	TBL-1	Tow bar Lunette Eye—Blueprint No. 08007-"	1	2
13	J-2	Leveling Jack—20"	2	4



POWERUNIT ON TRAILER
Figure 13

BRAKE LEVER
Figure 14



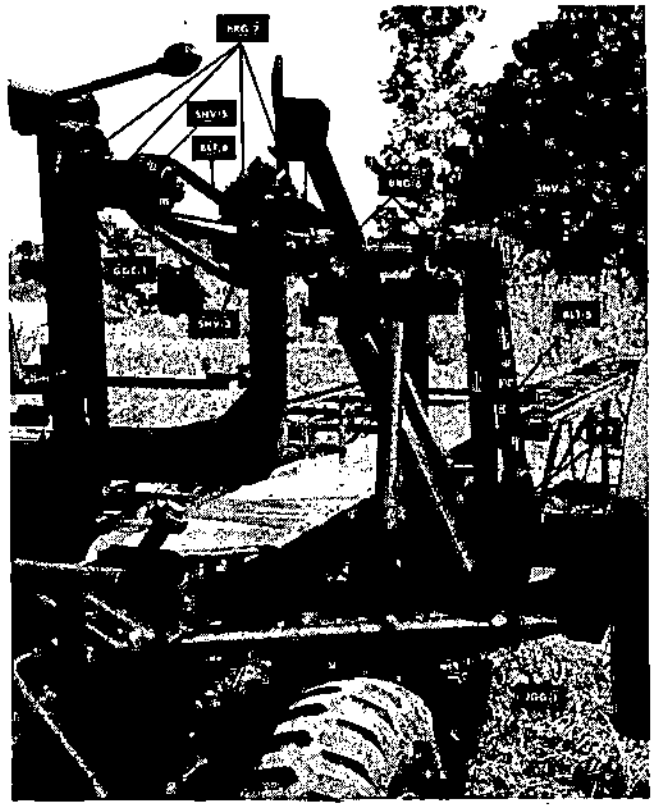
LUMBER ROLLER BEDS
Figure 15

Fig. No.	JLH Co. Part No.	DESCRIPTION	Qty in Assy.	Qty in Harv.

Identification Lists-- Lumber Roller Bed Assembly

LUMBER ROLLER BED ASSEMBLY
(Government Specifications Only)

15	RB-2-1	Lumber Roller Bed, Complete with retractable legs and chain—To hitch to Lumber Harvester Lumber Table	1	1
15	RB-2-2	Lumber Roller Bed, Complete with retractable legs and chain—To hitch to RB-2-1	1	1
15		Electric-welded angle iron, round mild, flat mild, and 60" ¼" chain		
15	RB-1	Roller Bed—Style K, 2¼" roller, 16-gauge, 15" roller on 17" centers, 10' sections		
15	RB-2-L	Lumber Roller Bed Leg	2	4



JACKSON GRIT GOUGER
Figure 16

Fig. No.	JLH Co. Part No.	DESCRIPTION	Qty in Assy.	Qty in Harv.
		JACKSON GRIT GOUGER ASSEMBLY		
16		Electric-welded black pipe, angle iron, cold rolled, spring steel, mild steel and tubing members		
16	JGG-1	Jackson Grit Gouger, complete	1	1
16	BRG-6	Pillow blocks—self-aligning ball bearing—1⅜" ID	2	12
16	BRG-7	Bearings, ball	4	47
16	P-2	Pulley—Split, 2¼" bore, 12" x 4" straight face	1	1
16	SHV-3	Sheave—5", 2-groove, B-Section, 1⅜" bore	1	1
16	SHV-5	Sheave—4", 2-groove, B-Section, 1⅜" bore	1	1
16	SHV-6	Sheave—4", 3-groove, B-Section, 1⅜" bore	1	1
16	BLT-5	V-Belt, 81", B-Section, (Matched)	3	3
16	BLT-6	V-Belt, 55", B-Section, (Matched)	2	2
16	GGC-1	Grit Gouger Cutter	1	1

Index of Parts and Assemblies

Index

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PARTS BOOK

INDUSTRIAL
IN-LINE 71 ENGINES

DETROIT DIESEL ENGINE DIVISION
GENERAL MOTORS CORPORATION
DETROIT, MICHIGAN

Printed in U.S.A.

6 SP 35
REV. 8-65

(68)

Option Plate Record

UNIT No. _____ RATED HP _____ @ _____ CUSTOMER'S NAME _____

MODEL No. _____ CONT. HP _____ @ _____ ADDRESS _____

APPLICATION _____ MAX. NO LOAD RPM _____ ENGINE LOCATION _____

EQUIPMENT	TYPE	EQUIPMENT	TYPE	EQUIPMENT	TYPE
Engine Base		Water Bypass Tube		Accessory Drive	
Engine Lifter Brkt.		Thermostat		Battery Chrg. Generator	
Flywheel Housing		Water Filter		Starter	
Vibration Damper		Exhaust Manifold		Hyd. Starter Acces.	
Flywheel		Air Cleaner or Silencer		Starting Aid	
Flywheel Hsg. Adptr.		Fuel Pump		Air Heater	
Oil Pan		Injector		Marine Gear	
Oil Pump		Blower		Torque Converter	
Oil Distribution		Blower Drive Shaft		Torque Converter Lines	
Dipstick		Turbocharger		Gear Box	
Oil Filler Tube		Fuel Filter		Muffler & Conn.	
Oil Cooler		Fuel Lines		Engine Hood	
Oil Filter		Air Inlet Housing		Wiring Harness	
Oil Lines		Alarm or Shutoff		Instruments	
Ventilating System		Throttle Controls		Tach. Drive	
Crankshaft Cover		Injector Controls		Radiator	
Balance Wgt. Cover		Governor		Heat Ex. or Keel Cooling	
Fan		Engine Mounts		Raw Water Pump	
Crankshaft Pulley		Power Take-off		Bilge Pump	
Crankshaft Pulley Belt		Vacuum Pump		Power Generator	
Fan Shroud		Hydraulic Pump		Control Cabinet	
Water Connections		Air Compressor			
Water Pump Cover		Camshaft & Gear Train			
Water Manifold		Rocker Cover			

UNIT No. _____ RATED HP _____ @ _____ CUSTOMER'S NAME _____

MODEL No. _____ CONT. HP _____ @ _____ ADDRESS _____

APPLICATION _____ MAX. NO LOAD RPM _____ ENGINE LOCATION _____

EQUIPMENT	TYPE	EQUIPMENT	TYPE	EQUIPMENT	TYPE
Engine Base		Water Bypass Tube		Accessory Drive	
Engine Lifter Brkt.		Thermostat		Battery Chrg. Generator	
Flywheel Housing		Water Filter		Starter	
Vibration Damper		Exhaust Manifold		Hyd. Starter Acces.	
Flywheel		Air Cleaner or Silencer		Starting Aid	
Flywheel Hsg. Adptr.		Fuel Pump		Air Heater	
Oil Pan		Injector		Marine Gear	
Oil Pump		Blower		Torque Converter	
Oil Distribution		Blower Drive Shaft		Torque Converter Lines	
Dipstick		Turbocharger		Gear Box	
Oil Filler Tube		Fuel Filter		Muffler & Conn.	
Oil Cooler		Fuel Lines		Engine Hood	
Oil Filter		Air Inlet Housing		Wiring Harness	
Oil Lines		Alarm or Shutoff		Instruments	
Ventilating System		Throttle Controls		Tach. Drive	
Crankshaft Cover		Injector Controls		Radiator	
Balance Wgt. Cover		Governor		Heat Ex. or Keel Cooling	
Fan		Engine Mounts		Raw Water Pump	
Crankshaft Pulley		Power Take-off		Bilge Pump	
Crankshaft Pulley Belt		Vacuum Pump		Power Generator	
Fan Shroud		Hydraulic Pump		Control Cabinet	
Water Connections		Air Compressor			
Water Pump Cover		Camshaft & Gear Train			
Water Manifold		Rocker Cover			

Your series 71 Diesel engine was manufactured by Detroit Diesel Engine Division. The finest quality of material selected through years of research and experience have been combined with precision workmanship and careful inspection to provide you with many hours of dependable trouble-free operation.

This parts book has been prepared as an aid to you in determining parts which may be required in the maintenance of your engine. All parts listed herein are "Factory Engineered Parts" and are manufactured to the same precision standards as the original equipment.

For your own protection, always insist on Detroit Diesel "Factory Engineered Parts" for your engine.

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GROUP INDEX

HOW TO LOCATE PARTS

Parts may readily be located in this book by the following method. Refer to the Group Index on page 4 and determine the group in which the desired part appears and the page on which the group is shown. Numerous illustrations are included in this publication to further aid you in identifying parts.

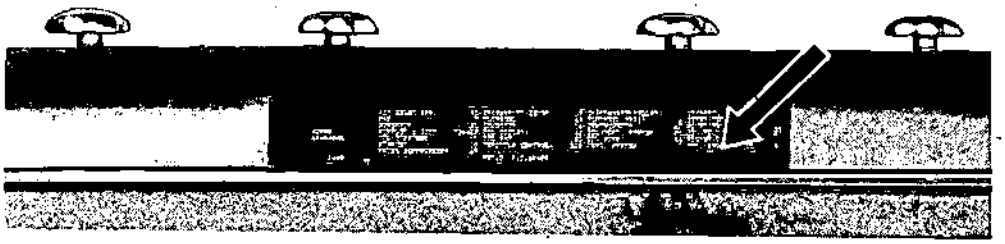
The Alphabetical Index in the back of the book lists all major parts alphabetically, by noun name, and the page on which the part is shown. This may be used as an alternate to the above method.

HOW TO ORDER PARTS

All parts orders should be placed with your nearest Detroit Diesel Sales and Service Outlet. Do not place orders directly with the factory.

Always give the model and serial number of your engine. This is stamped on the Option Plate on the valve rocker cover on your engine; if a type number is shown covering the equipment required, be sure to include this number on your order.

The Option Plate (shown below) on your engine is an exclusive Detroit Diesel feature. It lists any special equipment which may be on your engine and facilitates locating the required replacement part for your engine. Record the engine Option Plate information on page 2 for handy reference. Your Detroit Diesel Sales and Service Outlet has a record of this information and by furnishing him with the type number shown he can properly interpret your requirements.



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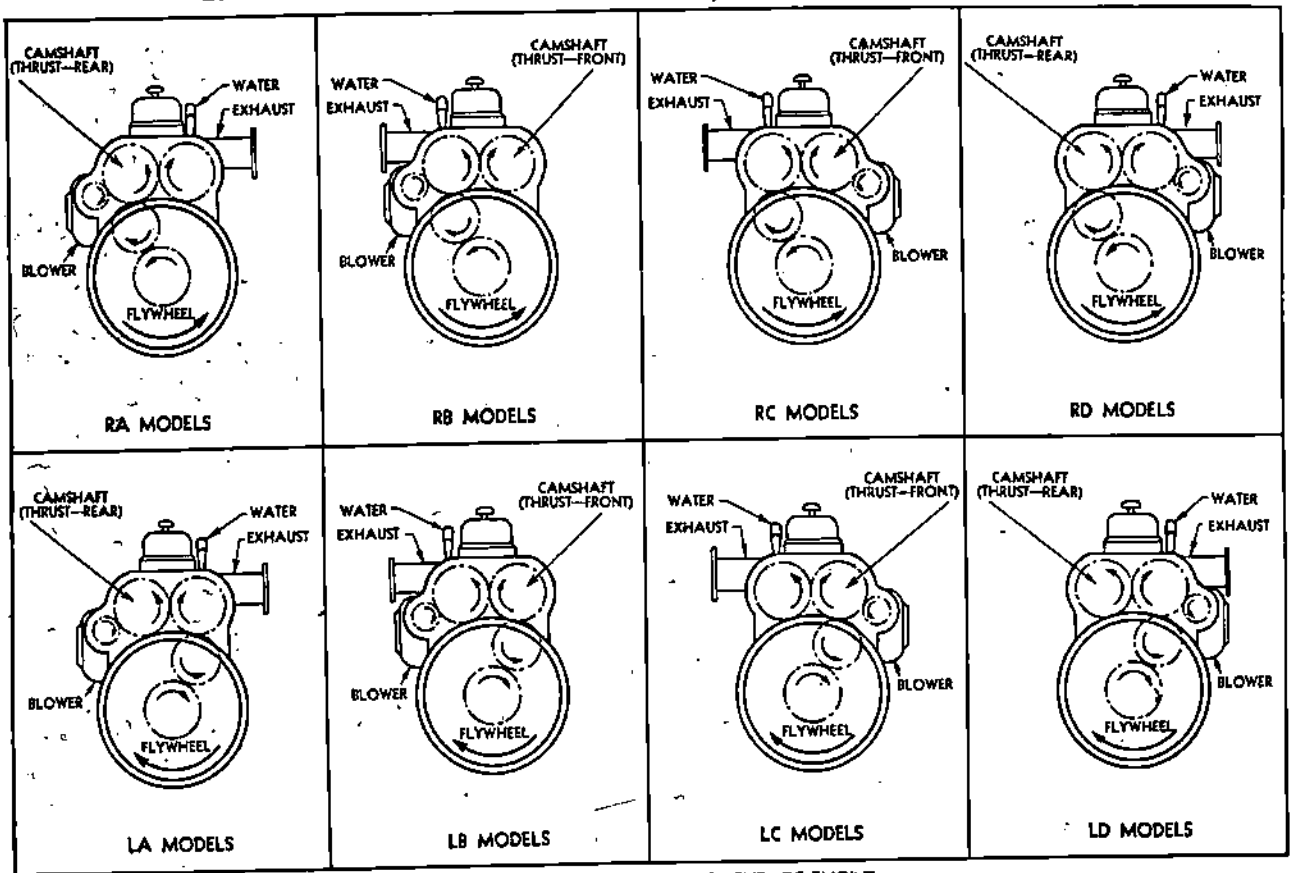
ABBREVIATIONS

AC.....AC Spark Plug Div.
adj.....adjustable
adptr.....adaptor
amp.....ampere
AR.....as required
assy.....assembly
bal.....balancer
batt.....battery
B.C.....bolt circle
br.....brass
brg.....bearing
brkt.....bracket
CCW.....counter clockwise
CFM.....cubic feet per minute
chrg.....charging
com.....commercial
comp.....compressor
conn.....connection(s)
ctsk.....countersunk
cvr.....cover
CW.....clockwise
cyl.....cylinder
D.C.....direct current
dev.....developed
dia.....diameter
dist.....distribution
drv.....drive, driving
eng.....exhaust
exh.....exhaust
expan.....expansion
fl.....flared or flat
flex.....flexible
fig.....figure
fil.....fillister
gen.....generator
G.M.....General Motors
gov.....governor
hd.....head
hdls.....headless
H.E.....heat exchanger
hex.....hexagon
HP.....horsepower
hsg.....housing
hyd.....hydraulic
I.D.....inside diameter
inj.....injector
instr.....instrument(s)
int.....internal
inv.....inverted
L.....length
lb.....pound
L.H.....left hand
lim.....limiting
man.....manifold
max.....maximum
mech.....mechanical
mod.....moderate
mtd.....mounted
mtg.....mounting
no.....number
O.D.....outside diameter
O.S.....oversize
press.....pressure
pt.....point
P.T.....pipe thread
PTO.....power take-off
rad.....radiator
rd.....round
red.....reducing or reduction
R.H.....right hand
RPM.....revolutions per minute
sl.....slotted
sm.....small
spd.....speed
std.....standard
tach.....tachometer
T/C.....torque converter
temp.....temperature
turbo.....turbocharger
U.S.....undersize
V.....volt
vari.....variable
vent.....ventilating
W.....watt

BASIC ENGINE ARRANGEMENTS — MODELS 3-71, 4-71, 6-71



ALL VIEWS FROM FLYWHEEL (REAR) END OF ENGINE.
ENGINE ROTATION DETERMINED BY VIEWING ENGINE FROM BALANCE WEIGHT COVER (FRONT) END.

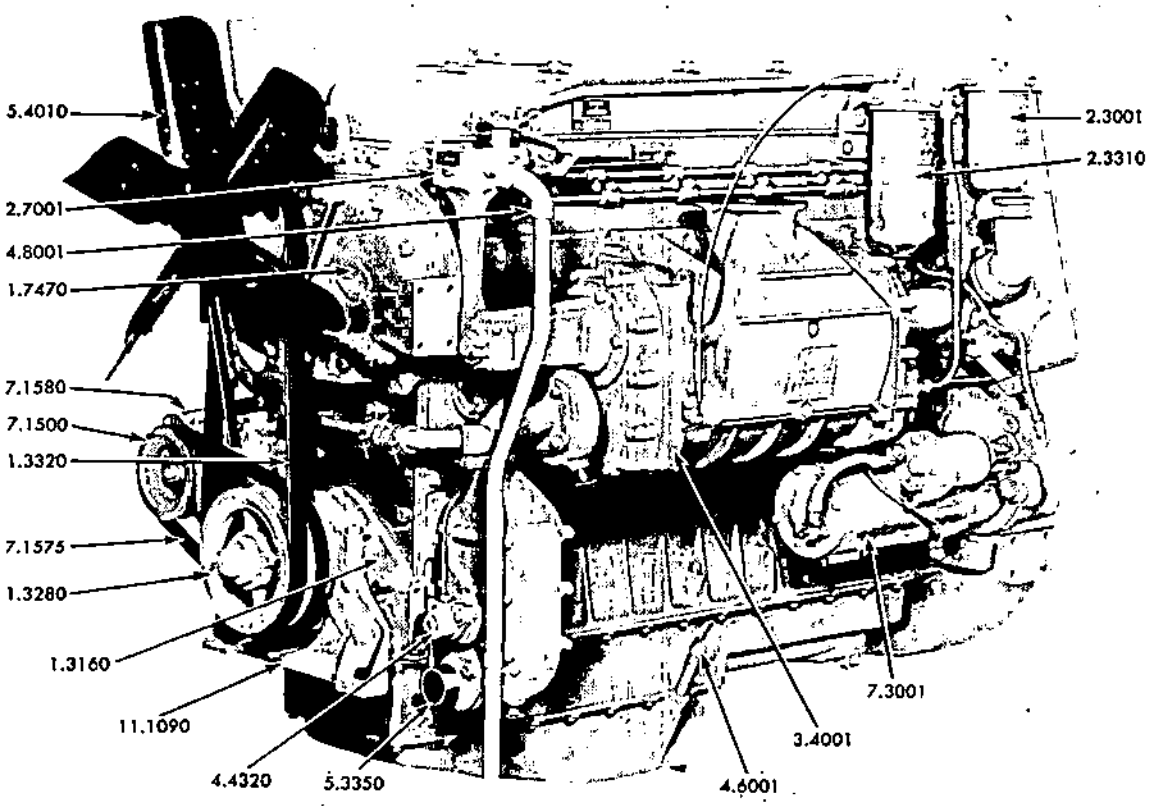


Fig. 1 - Typical Fan to Flywheel Unit

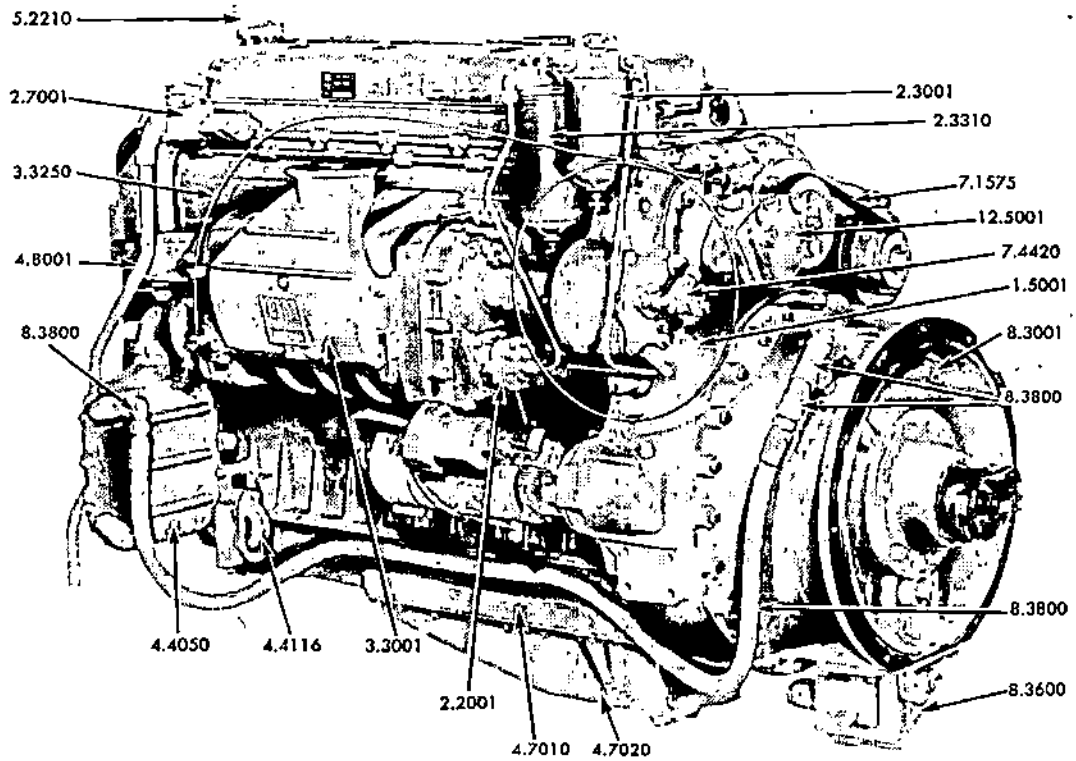


Fig. 2 - Typical Torque Converter Unit

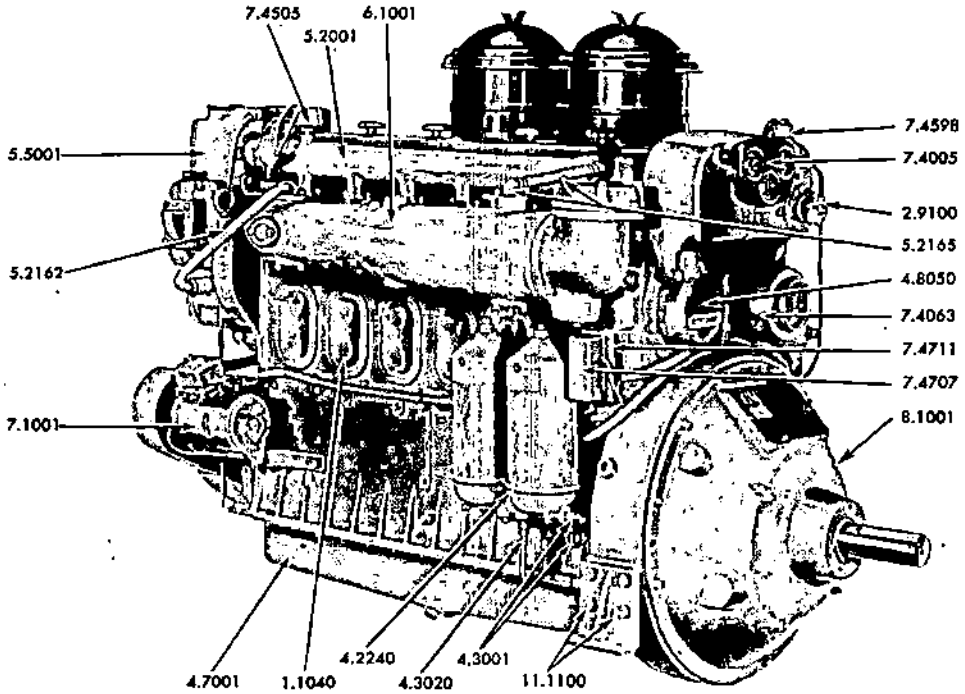


Fig. 3 – Typical Power Take-Off Unit (Heat Exchanger Cooled)

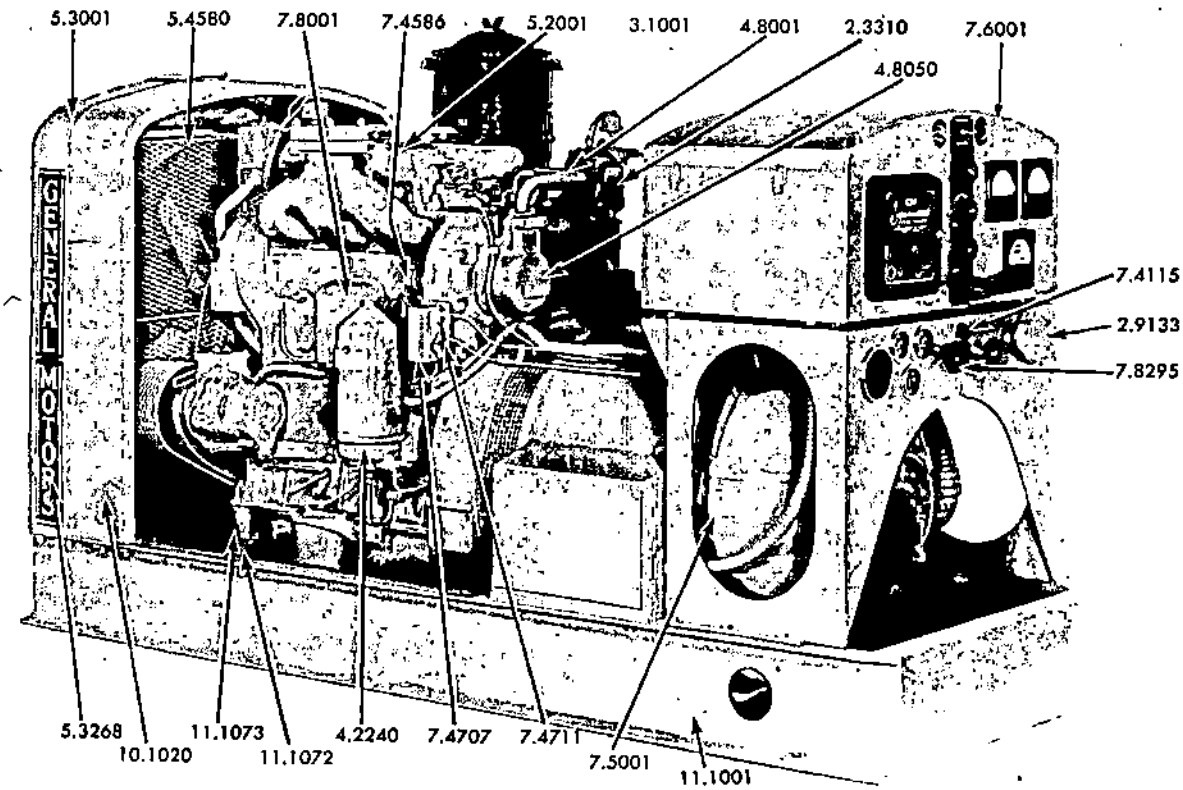


Fig. 4 – Typical Power Generator Set

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
			CYLINDER BLOCK			
5	1.1001	5197273	Block Assy., cylinder (includes main bearing caps, pins, bolts	1		
5	1.1001	5194900	Block Assy., cylinder and lockwashers, cylinder head studs, end		1	
5	1.1001	5195150	Block Assy., cylinder dowels, plugs and cylinder liner inserts)			1
-	-	103877	Plug, 1/4" pipe	2	2	2
-	-	444687	Plug, 1/8" hex socket head pipe	4	8	7
-	-	444692	Plug, 1/4" hex socket head pipe	2	3	3
-	-	103878	Plug, 1/4" pipe	5	6	10
-	-	444867	Plug, 3/8" hex socket head pipe	1	1	1
-	-	5115214	Plug, 1/2" hex socket head pipe	4	4	4
-	-	9409961	Plug, 3/4" pipe	1	2	2
-	-	5111798	Plug, 1" pipe	4	6	10
-	-	5178998	Plug, 1 3/4"-16 (core hole)	4	4	4
-	-	5154319	Plug, 1/4"x5/16" (oil hole)	3	3	3
-	-	5150014	Plug, 1 1/4" (core hole)	2	2	2
-	-	5150130	Plug (oil hole - cylinder block ends)	2	2	2
-	-	5151122	Plug (balance shaft drain holes on B & D engines)	2	2	2
-	-	5178997	Gasket, plug	4	4	4
5	1.1001	5151576	Dowel, cylinder block to flywheel housing and front cover	4	4	4
-	-	5193113	Gasket Kit, engine overhaul (contains the necessary gaskets	AR		
-	-	5193114	Gasket Kit, engine overhaul for a complete engine overhaul)		AR	
-	-	5193115	Gasket Kit, engine overhaul			AR
5	1.1010	5152878	Plate, cylinder block front end	1	1	1
5	1.1020	5150060	Plate, cylinder block rear end	1	1	1
5	1.1020	5189582	Plate, cylinder block rear end (tractor units)	1		
5	1.1010	179839	Bolt, 3/8"-16x1" hex. hd.	12	12	12
-	-	179882	Bolt, 1/2"-13x1 1/8" hex. hd. (front end only)	2	2	2
-	-	103321	Lockwasher, 3/8"	12	12	12
-	-	103323	Lockwasher, 1/2" (front end only)	2	2	2
5	1.1030	5177798	Gasket, cylinder block end plate	2	2	2
5	1.1040	5153117	Cover, cylinder block hand hole (plain)	3	4	8
5	1.1040	5164052	Cover, cylinder block hand hole (1/8" tapped hole)	AR	AR	AR
75	1.1040	5180189	Cover, cylinder block hand hole (3/4" pipe tap, 2 holes)	1	1	1
75	1.1040	9409961	Plug, 3/4" pipe	1	1	1
5	1.1040	108608	Bolt, 3/8"-16x2 1/8" hex. hd.	3	4	8

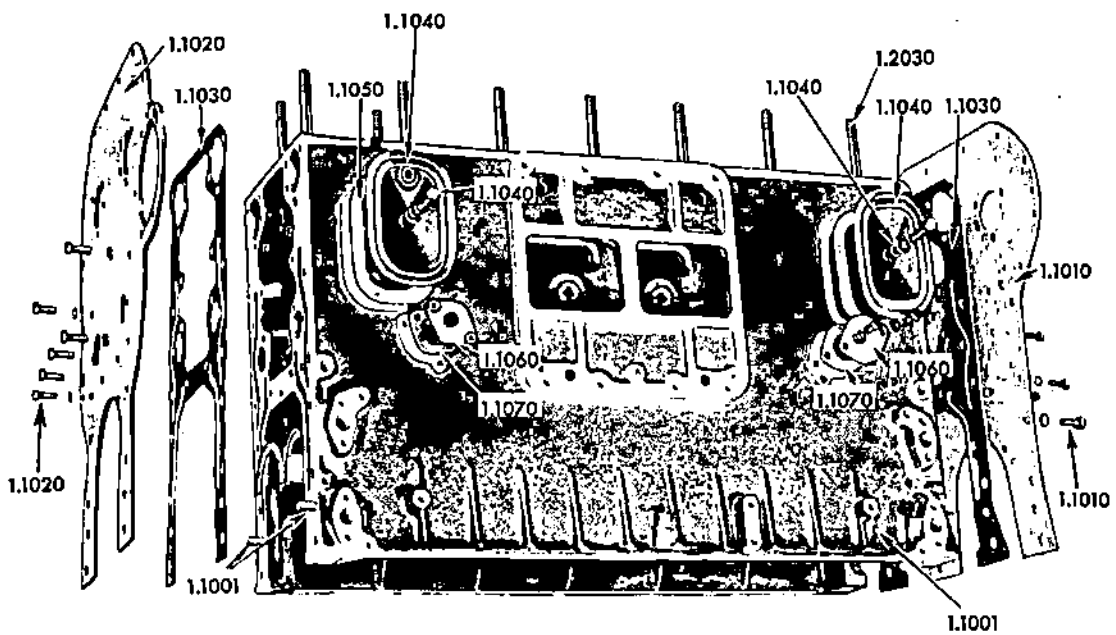


Fig. 5 – Cylinder Block

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
-	-	103341	Washer, 3/8" flat	3	4	6
5	1.1040	105451	Gasket, 3/8" copper	3	4	6
5	1.1050	5150020	Gasket, cylinder block hand hole cover	3	4	6
5	1.1060	5150023	Cover, cylinder block water hole (plain)	1	-	1
5	1.1060	5164190	Cover, cylinder block water hole (1/4" tapped hole)	AR	AR	AR
75	1.1060	5115097	Cover, cylinder block water hole (3/8" tapped hole)	1	1	1
-	-	148344	Draincock, 1/4" (cylinder block water drain)	AR	AR	AR
-	-	189691	Bolt, 5/16"-18x3/4" hex. hd. (with lockwashers)	2	2	2
5	1.1070	5116357	Gasket, cylinder block water hole cover	1	1	1
			AIR BOX DRAINS			
-	-	5158825	Tube Assy., air box drain (dev. L. 4 1/4")	2	2	2
-	-	5171500	Tube Assy., air box drain (dev. L. 13 7/8")	-	2	2
-	-	137422	Elbow, 5/16" inv. fl. tube 90°	2	2	2
			CYLINDER HEAD			
6	1.2001	5198218	Head Assy., cylinder (2 valve)	1	-	-
6	1.2001	5198216	Head Assy., cylinder (2 valve)	-	1	-
6	1.2001	5198217	Head Assy., cylinder (2 valve)	-	-	1
6	1.2001	5197423	Head Assy., cylinder (4 valve)	1	-	-
6	1.2001	5197421	Head Assy., cylinder (4 valve)	-	1	-
6	1.2001	5197422	Head Assy., cylinder (4 valve)	-	-	1

(see footnote §)

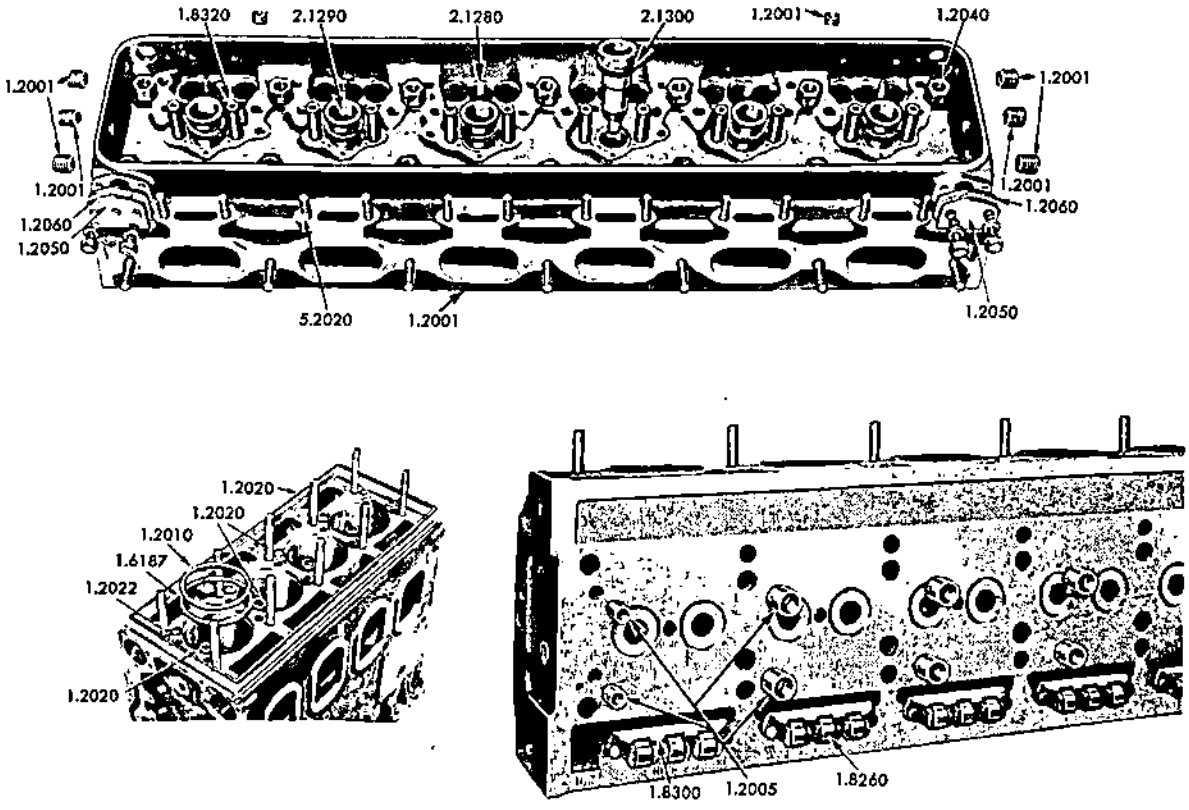


Fig. 6 - Cylinder Head

§ Includes plugs, nozzles, valve guides and inserts, injector hole tubes and seal rings and manifold studs.

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
-	-	5121182	Plug, 1/4" pipe	7	9	13
-	-	5125237	Plug, (1/4"x.320" L. hex. socket head)	5	5	5
-	-	444867	Plug, 3/8" allen head pipe (oil gallery)	3	3	3
-	1.2001	5154453	Plug, 3/8"-16 slotted headless	4	4	4
-	1.2001	9409961	Plug, 3/4" pipe	4	4	4
-	-	5193116	Gasket Kit, cylinder head (contains gaskets required for cylinder head replacement)	AR		
-	-	5193117	Gasket Kit, cylinder head (contains gaskets required for cylinder head replacement)		AR	
-	-	5193118	Gasket Kit, cylinder Head (contains gaskets required for cylinder head replacement)			AR
6	1.2005	5172874	Nozzle, cylinder head water (single outlet)	4	4	4
6	1.2005	5172875	Nozzle, cylinder head water (double outlet, 2 valve head)	4	6	10
6	1.2005	5111332	Nozzle, cylinder head water (double outlet, 4 valve head)		6	10
6	1.2010	5183330	Gasket, cylinder head compression	3	6	6
6	1.2020	5119972	Ring, cylinder head oil seal	1		
6	1.2020	5119973	Ring, cylinder head oil seal		1	
6	1.2020	5119974	Ring, cylinder head oil seal			1
6	1.2020	5186579	Ring, cylinder head water hole seal	4	6	10
6	1.2020	5186577	Ring, cylinder head end water hole seal	2	2	2
6	1.2022	5183305	Gasket, cylinder head water and oil	2	2	2
-	-	5117003	Bolt, cylinder head	4	6	10
5	1.2030	5183329	Stud, cylinder head	4	4	4
6	1.2040	5150013	Nut, cylinder head	4	4	4
6	1.2050	5150268	Cover, cylinder head governor hole (plain)	3	3	3
6	1.2050	5164062	Cover, cylinder head governor hole (tapped)	AR	AR	AR
-	-	180016	Bolt, 1/4"-20x1/2" hex. hd.	6	6	6
-	-	103319	Lockwasher, 1/4"	6	6	6
6	1.2060	5123812	Gasket, cylinder head governor hole cover	4	4	4
			ENGINE LIFTER BRACKET			
-	-	5167776	Vent (front bracket) (less lifting eye)	1	1	1
27	1.2070	5150050	Bracket, engine lifter - front or rear	1	1	1
24,26	1.2080	5150051	Bracket, engine lifter - rear	1	1	1
-	-	179862	Bolt, 7/16"-14x1 1/2" hex. hd.	8	8	8
-	-	186725	Bolt, 1/2"-13x1 1/2" hex. hd. (to expansion tank)	2	2	2
-	-	103322	Lockwasher, 7/16"	8	8	8
-	-	103323	Lockwasher, 1/2"	2	2	2
-	-	5150052	Gasket, engine lifter bracket	2	2	2
-	-	5151476	Bolt, eye (1/2"-13)	2	2	2
-	-	5176601	Bolt, eye (3/4"-10)		1	1
-	-	123550	Nut, 1/2"-13 hex. thin	2	2	2
-	-	102640	Nut, 3/4"-10 hex.		1	1
			CRANKSHAFT			
7	1.3001	5184215	Crankshaft Assy. (includes plug and dowel)	1		
7	1.3001	5182941	Crankshaft Assy. (includes plug and dowel)		1	
7	1.3001	5179068	Crankshaft Assy. (includes plug and dowel)			1
-	-	444687	Plug, 1/8" pipe	3	4	6
7	1.3001	5177528	Dowel, crankshaft	2	2	2
7	1.3040	5115454	Seal, crankshaft oil (front)	1	1	1
7	1.3050	5150175	Slinger, crankshaft oil (front)	1		
7	1.3050	5150174	Slinger, crankshaft oil (front)		1	1
7	1.3055	5151475	Spacer, crankshaft front oil seal (7/8" long)	1		
7	1.3055	5109215	Spacer, crankshaft front oil seal (1.10" long)	1		
7	1.3055	5151420	Spacer, crankshaft front oil seal (2 13/16" long)		1	1
7	1.3060	5114335	Seal, crankshaft oil - rear	1	1	1
7	1.3060	5197860	Seal, crankshaft oil - rear (oversize, use with sleeve)	AR	AR	AR
-	-	5197159	Sleeve, crankshaft rear oil seal (use with oversize oil seal)	AR	AR	AR
7	1.3090	5192874	Shell Set (standard) (includes one upper and one lower shell)	4	5	7
7	1.3090	5192875	Shell Set (.002" U.S.) (includes one upper and one lower shell)	AR	AR	AR

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
7	1.3090	5192876	Shell Set (.010" U.S.)	AR	AR	AR
7	1.3090	5192877	Shell Set (.020" U.S.) (includes one upper and one lower shell)	AR	AR	AR
7	1.3090	5192878	Shell Set (.030" U.S.)	AR	AR	AR
7	1.3100	5159353	Washer, crankshaft main bearing thrust (standard)	4	4	4
7	1.3100	5160542	Washer, crankshaft main bearing thrust (.005" O.S.)	AR	AR	AR
7	1.3100	5192111	Washer, crankshaft main bearing thrust (.010" O.S.)	AR	AR	AR
7	1.3100	141346	Pin, 3/16"x1/2" dowel	4	4	4
7	1.3140	5152149	Bolt, crankshaft main bearing cap	8	10	12
7	1.3140	103334	Lockwasher, 5/8"	8	10	14
7	1.3145	5113815	Gear, crankshaft timing (L.H. helix) (LA-LB-LC-LD engine)	1	1	1
7	1.3145	5113814	Gear, crankshaft timing (R.H. helix) (RA-RB-RC-RD engine)	1	1	1
-	-	5150271	Bolt, crankshaft gear	6	6	6
-	-	103321	Lockwasher, 3/8"	6	6	6

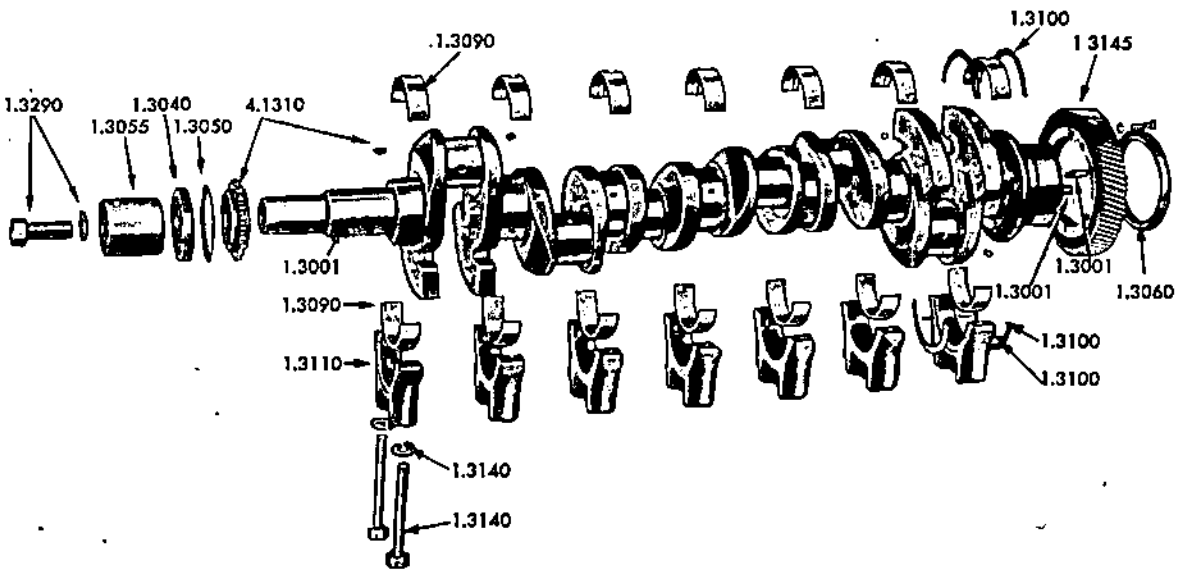


Fig. 7 - Crankshaft

CRANKSHAFT FRONT COVER

-	-	5175939	Cover, crankshaft front (stationary mounting)	1	1	1
1	1.3160	5175941	Cover, crankshaft front (trunnion mounting)	1	1	1
-	-	181360	Bolt, 3/8"-24x3/4" hex. hd.	3	3	3
-	-	181370	Bolt, 3/8"-24x1 1/4" hex. hd.	3	3	3
-	-	186631	Bolt, 1/2"-13x2 1/4" hex. hd.	2	2	2
-	-	19C770	Bolt, 1/2"-13x3 1/4" hex. hd.	4	4	4
-	-	179891	Bolt, 1/2"-13x2 1/2" hex. hd.	2	2	
-	-	186659	Bolt, 1/2"-13x3 3/4" hex. hd.	2	2	2
-	-	103321	Lockwasher, 3/8"	3	3	3
-	-	103323	Lockwasher, 1/2"	4	4	4
-	-	5150181	Gasket, crankshaft front cover	1	1	1

VIBRATION DAMPER

8	1.3210	5156286	Damper, light vibration (rubber)			1
8	1.3210	5156285	Damper, heavy vibration (rubber)			1
8	1.3210	5176767	Damper, light vibration (rubber)			1
8	1.3210	5177763	Damper, light vibration (viscous)		1	1
8	1.3210	5177764	Damper, heavy vibration (viscous)		1	1

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
-	-	181394	Bolt, 7/16"-20x7/8" hex. hd. (single damper)			6
-	-	181397	Bolt, 7/16"-20x1 1/4" hex. hd. (double damper)			6
-	-	103322	Lockwasher, 7/16"			6
8	1.3230	5156296	Hub Assy., vibration damper (rubber) (includes short dowel)			1
8	1.3230	5179243	Hub Assy., vibration damper (viscous)			1
8	1.3230	5186050	Hub Assy., vibration damper (viscous) (includes long dowel)			1
8	1.3230	5156295	Dowel, vibration damper hub (1" L.)			2
8	1.3230	5175641	Dowel, vibration damper hub (1 3/8" L.)			2
-	-	5177550	Clip, vibration damper ground			1
-	-	9409256	Bolt, 7/16"-20x1/2" hex. hd.			2
-	-	103342	Washer, 7/16" flat			1
8	1.3240	5158641	Cone, vibration damper - front (17/32" long)			1
8	1.3240	5151344	Cone, vibration damper - front (13/16" long)			1
8	1.3250	5158640	Cone, vibration damper - rear (2 1/8" long)			1
8	1.3250	5153144	Cone, vibration damper - rear (1 13/32" long)			1
-	-	5179588	Spacer, vibration damper (viscous)			1

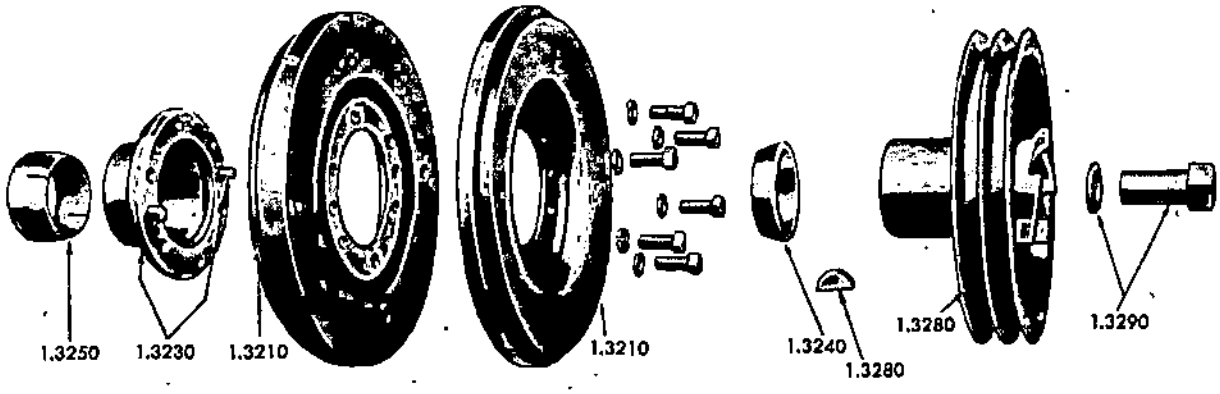


Fig. 8 – Vibration Damper

CRANKSHAFT PULLEY

9	1.3280	5177046	Pulley, crankshaft (1 groove) 7 1/2" dia., 13/16" wide			1
-	-	5159188	Pulley, crankshaft (1 groove) 7 1/2" dia., 13/16" wide	1	1	1
9	1.3280	5159187	Pulley, crankshaft (1 groove) 7 1/2" dia., 1" wide	1	1	1
-	-	5124508	Pulley, crankshaft (2 grooves) 7" dia., 21/32" wide			1
-	-	5128954	Pulley, crankshaft (2 grooves) 7 21/64" dia., 25/32" wide		1	1
9	1.3280	3224321	Pulley, crankshaft (2 grooves) (1) 7 1/2" dia., 13/16" wide, (1) 7 1/2" dia., 1" wide	1	1	1
9	1.3280	3222873	Pulley, crankshaft (2 grooves) (1) 7 1/2" dia., 13/16" wide, (1) 9" dia., 15/16" wide	1	1	1
9	1.3280	3224295	Pulley, crankshaft (2 grooves) (1) 7 1/2" dia., 13/16" wide, (1) 7 1/2" dia., 1" wide	1	1	1
-	-	5124104	Pulley, crankshaft (2 grooves) 8" dia., 21/32" wide			1
8	1.3280	5110496	Pulley, crankshaft (2 grooves) 8" dia., 21/32" wide			1
9	1.3280	5175057	Pulley, crankshaft (2 grooves) 9" dia., 21/32" wide	1	1	1
8	1.3280	5186871	Pulley, crankshaft (2 grooves) 9" dia., 21/32" wide			1
8	1.3280	5181743	Pulley, crankshaft (2 grooves) 9" dia., 21/32" wide			1
9	1.3280	5178965	Pulley, crankshaft (2 grooves) 9" dia., 13/16" wide			1
-	-	5189563	Pulley, crankshaft (2 grooves) (1) 9 1/4" dia., 1" wide, (1) 5 1/2" dia., 13/16" wide	1	1	1
-	-	5130942	Pulley, crankshaft (3 grooves) 7 1/2" dia., 1/2" wide, solid hub			1
-	-	5109010	Pulley, crankshaft (3 grooves) 7 1/2" dia., 1/2" wide, solid hub	1	1	
-	-	5100231	Pulley, crankshaft (3 grooves) 7 1/2" dia., 1/2" wide, insulated hub			1
-	-	5100222	Pulley, crankshaft (3 grooves) 7 1/2" dia., 1/2" wide		1	1
9	2.3280	5172779	Pulley, crankshaft (3 grooves) (1) 7 1/2" dia., 13/16" wide, (2) 9" dia., 21/32" wide	1		

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
-	-	5178905	Pulley, crankshaft (3 grooves) (1) 7 1/2" dia., 13/16" wide, (2) 9" dia., 21/32" wide		1	1
-	-	5100223	Pulley, crankshaft (4 grooves) 7 1/2" dia., 1/2" wide, solid hub			
-	-	5108909	Pulley, crankshaft (4 grooves) 7 1/2" dia., 1/2" wide	1		
-	-	5108618	Pulley, crankshaft (4 grooves) 7 1/2" dia., 1/2" wide, insulated hub		1	1
9	1.3280	5172766	Pulley, crankshaft (4 grooves) (2) 7 1/2" dia., 13/16" wide, (2) 9" dia., 21/32" wide			
9	1.3280	5174736	Pulley, crankshaft (4 grooves) (2) 7 1/2" dia., 13/16" wide, (2) 9" dia., 21/32" wide	1		
-	-	5178443	Pulley, crankshaft (4 grooves) (2) 7 1/2" dia., 13/16" wide, (2) 9" dia., 21/32" wide	1		
8	1.3280	117982	Key, 3/8" x1 1/4" woodruff	2	2	2
9	1.3285	5176178	Clip, crankshaft pulley grounding (forked)		1	1
-	-	5177550	Clip, crankshaft pulley grounding (angle)	1	1	1
7,8	1.3290	5157930	Retainer; crankshaft pulley	1	1	1
7,8	1.3290	5153623	Bolt, crankshaft pulley retainer (1" -14x2 1/4")	1	1	1
7,8	1.3290	5160266	Bolt, crankshaft pulley retainer (1" -14x2 3/4")	1	1	1
7,8	1.3290	5120016	Bolt, crankshaft pulley retainer (1" -14x3 1/2")	1	1	1

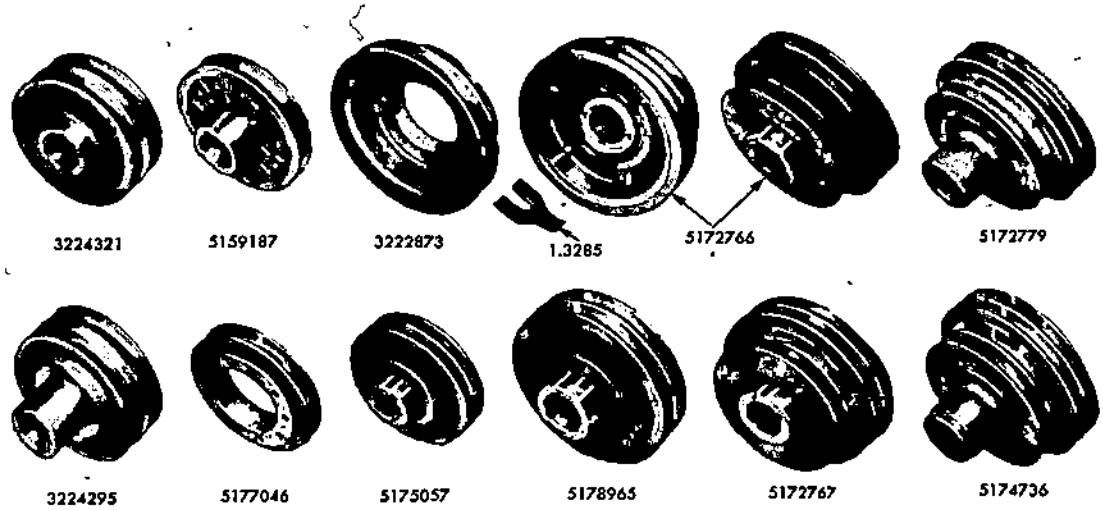


Fig. 9 - Crankshaft Pulley (Item 1.3280)

CRANKSHAFT PULLEY BELT

1	1.3320	5126405	Belt, crankshaft pulley drive (47.16" L., .785" W.)	1	1	
1	1.3320	5129262	Belt, crankshaft pulley drive (49.96" L., .910" W.)	1		
1	1.3320	3224368	Belt, crankshaft pulley drive (54.64" L., .910" W.)	1	1	1
1	1.3320	5136259	Belt, crankshaft pulley drive (70.00" L., .910" W.)	1	1	1
1	1.3320	5130525	Belt Set, crankshaft pulley drive (42.00" L., .50" W.)	1		
1	1.3320	5109014	Belt Set, crankshaft pulley drive (42.00" L., .50" W.)	1	1	1
1	1.3320	5126767	Belt Set, crankshaft pulley drive (42.62" L., .50" W.)	1	1	
1	1.3320	5170972	Belt Set, crankshaft pulley drive (45.44" L., .597" W.)	1	1	1
1	1.3320	5134212	Belt Set, crankshaft pulley drive (48.00" L., .50" W.)	1		
1	1.3320	5127669	Belt Set, crankshaft pulley drive (53.00" L., .50" W.)		1	1
1	1.3320	5131363	Belt Set, crankshaft pulley drive (55.25" L., .50" W.)		1	
1	1.3320	5136281	Belt Set, crankshaft pulley drive (56.00" L., .50" W.)	1	1	1
1	1.3320	5176420	Belt Set, crankshaft pulley drive (58.44" L., .597" W.)	1	1	1
1	1.3320	5167565	Belt Set, crankshaft pulley drive (59.92" L., .50" W.)			1
1	1.3320	5136260	Belt Set, crankshaft pulley drive (74.00" L., .660" W.)	1	1	1

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
			FLYWHEEL			
			The proper flywheel for your engine can be interpreted by the identifying type number on the Option Plate on your engine. Your Detroit Diesel dealer or distributor will interpret the flywheel type number into the part number.			
10	1.4001	-	Flywheel Assy. (includes ring gear)	1	1	1
10	1.4001	5176322	Flywheel Assy. (includes ring gear - power generator sets only)	1	1	1
-	-	5120753	Plate, scuff (bolt retainer)	1	1	1
10	1.4001	9409532	Bolt, flywheel (2" L.)	6	6	6
10	1.4001	9410925	Bolt, flywheel (2 1/4" L.)	6	6	6
10	1.4001	9412015	Bolt, flywheel (2 1/2" L.)	6	6	6
10	1.4001	9411631	Bolt, flywheel (2 3/4" L.)	6	6	6
10	1.4001	9409606	Bolt, flywheel (2 7/8" L.)	6	6	6
10	1.4040	904983	Bearing, clutch pilot (0.9843 I.D. x 2.0472 O.D. x 0.5906)	1	1	1
10	1.4040	907302	Bearing, clutch pilot (0.9843 I.D. x 2.4409 O.D. x 0.6693)	1	1	1
10	1.4040	906986	Bearing, clutch pilot (1.1811 I.D. x 2.4409 O.D. x 0.6299)	1	1	1
10	1.4040	907594	Bearing, clutch pilot (1.1811 I.D. x 2.8346 O.D. x 0.7480)	1	1	1
10	1.4040	907295	Bearing, clutch pilot (1.1811 I.D. x 2.8346 O.D. x 1.1875)	1	1	1
10	1.4040	907084	Bearing, clutch pilot (1.3780 I.D. x 2.8346 O.D. x 0.6693)	1	1	1
10	1.4040	907593	Bearing, clutch pilot (1.3780 I.D. x 2.8346 O.D. x 1.0625)	1	1	1
10	1.4040	7451256	Bearing, clutch pilot (roller)	1	1	1
-	-	5162779	Seal, grease (use with 7451256 Bearing)	1	1	1
10	1.4045	5187146	Retainer, clutch pilot bearing (1 5/8" I.D.)	1	1	1
10	1.4045	5176427	Retainer, clutch pilot bearing (1 15/16" I.D.)	1	1	1
10	1.4045	5110784	Retainer, clutch pilot bearing (2 3/4" I.D.)	1	1	1

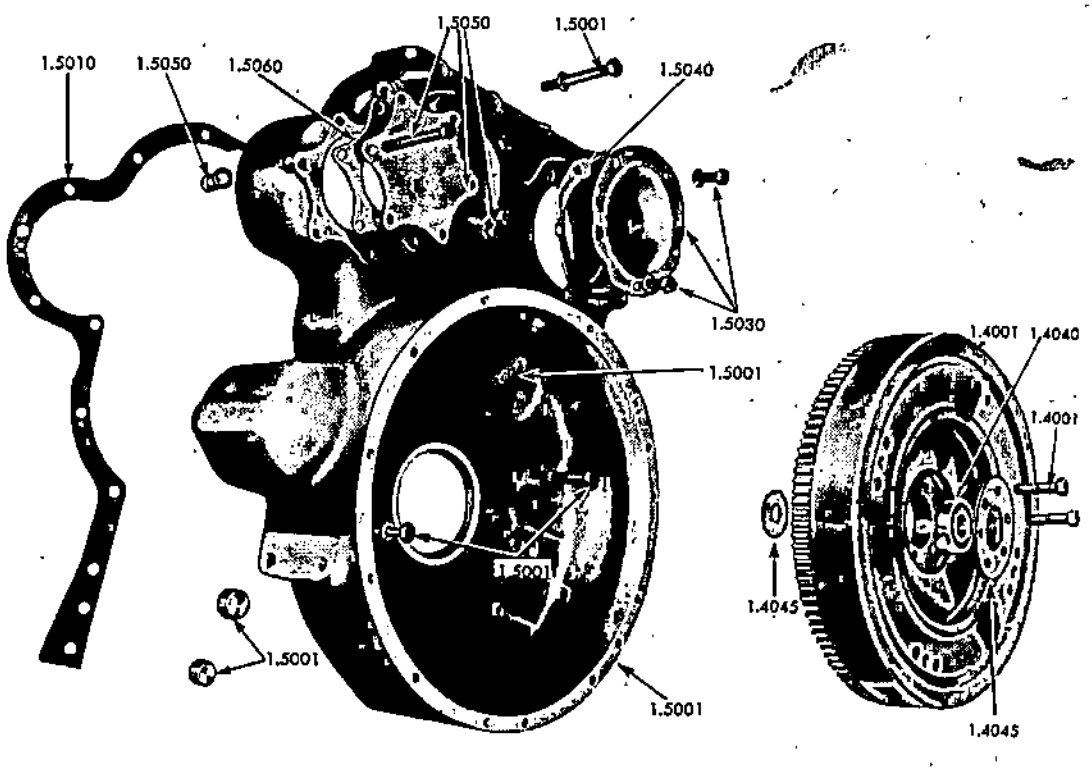


Fig. 10 – Flywheel and Flywheel Housing

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
			FLYWHEEL HOUSING			
			The proper flywheel housing for your engine can be interpreted by your Detroit Diesel dealer or distributor. Furnish him with the model and type number, if shown, on the Option Plate on your engine.			
10	1.5001	-	Housing, flywheel	1	1	1
-	-	103880	Plug, 1/2" pipe	AR	AR	AR
-	-	9409961	Plug, 3/4" pipe	AR	AR	AR
10	1.5001	5111798	Plug, 1" pipe	AR	AR	AR
-	-	144017	Plug, 1 1/4" pipe	AR	AR	AR
10	1.5001	9409028	Bolt, 3/8"-16x1" hex. hd. lock	6	6	6
-	-	179839	Bolt, 3/8"-16x1" hex. hd.	2	2	2
10	1.5001	186309	Bolt, 3/8"-24x3 1/4" hex. hd.	AR	AR	AR
-	-	186310	Bolt, 3/8"-24x3 1/2" hex. hd.	AR	AR	AR
-	-	186312	Bolt, 3/8"-24x4" hex. hd.	1	1	1
-	-	186314	Bolt, 3/8"-24x4 1/4" hex. hd.	3	3	3
-	-	188146	Bolt, 3/8"-24x4 5/8" hex. hd.	1	1	1
10	1.5001	190770	Bolt, 1/2"-13x3/4" hex. hd.	6	6	6
-	-	103322	Lockwasher, 1/2"	6	6	6
-	-	103321	Lockwasher, 3/8"	10	10	10
-	-	103341	Washer, 3/8" flat	6	6	6
-	-	117049	Nut, 3/8"-24 hex.	5	5	5
10	1.5010	5150054	Gasket, flywheel housing	1	1	1
10	1.5010	5189560	Gasket, flywheel housing (tractor units only)	1		
10	1.5030	5122281	Cover, flywheel housing large hole	AR	AR	AR
10	1.5030	179857	Bolt, 7/16"-14x7/8"	AR	AR	AR
10	1.5030	179882	Bolt, 1/2"-13x1 1/8" hex. hd.	AR	AR	AR
-	-	103322	Lockwasher, 7/16"	AR	AR	AR
-	-	103323	Lockwasher, 1/2"	AR	AR	AR
13	1.5040	5117061	Gasket, flywheel housing large hole cover	AR	AR	AR
10	1.5050	5154669	Cover, flywheel housing small hole	1	1	
-	-	5173465	Cover, flywheel housing small hole (with air compressor)		1	1
10	1.5050	179838	Bolt, 3/8"-16x7/8" hex. hd.	2	2	2
10	1.5050	186317	Bolt, 3/8"-24x5" hex. hd.	4	4	4
-	-	103321	Lockwasher, 3/8"	6	6	6
10	1.5050	117049	Nut, 3/8"-24 hex.	4	4	4
10	1.5060	5113061	Gasket, flywheel housing small hole cover	1	1	1
			FLYWHEEL HOUSING ADAPTOR			
-	-	3224296	Adaptor (No. 1 to No. 2 SAE, flush)	1	1	1
76	1.5130	5174313	Adaptor (No. 1 to No. 3 SAE, flush)	1	1	1
-	-	3229281	Adaptor (No. 1 to No. 2 SAE, 1/4" offset)	1	1	1
-	-	5173389	Adaptor (No. 1 to No. 3 SAE, 5/16" offset)	1	1	1
-	-	5130293	Bolt, flywheel hsg. adaptor (7/16"-14x1 1/4" hex. hd.)	12	12	12
-	-	103322	Lockwasher, 7/16"	12	12	12
			CONNECTING ROD AND PISTON			
			2 VALVE CYLINDER HEAD ENGINES			
11	1.6001	5135515	Rod Assy., connecting (includes cap which is not sold separately, plus indented items)	3	4	6
11	1.6001	5125036	Bolt, connecting rod	6	8	12
11	1.6001	5117629	Nut, connecting rod	6	8	12
11	1.6001	103373	Pin, 3/32"x3/4" cotter	6	8	12
11	1.6100	5192895	Shell Set, connecting rod bearing (standard)	3	4	6
11	1.6100	5192896	Shell Set, connecting rod bearing (.002" U.S.) (includes one upper and one lower shell)	AR	AR	AR
11	1.6100	5192897	Shell Set, connecting rod bearing (.010" U.S.) (includes one upper and one lower shell)	AR	AR	AR
11	1.6100	5192898	Shell Set, connecting rod bearing (.020" U.S.) (includes one upper and one lower shell)	AR	AR	AR

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
11	1.6110	5189054	Piston Assy. (standard) } (includes bushings and piston pin retainers)	3	4	6
11	1.6110	5189055	Piston Assy. (.010" O.S.)	AR	AR	AR
11	1.6110	5189056	Piston Assy. (.020" O.S.)	AR	AR	AR
11	1.6110	5189057	Piston Assy. (.030" O.S.)	AR	AR	AR
11	1.6115	5193477	Ring Set (standard) } (includes rings for one cylinder)	3	4	6
11	1.6115	5193648	Ring Set (.010" O.S.)	AR	AR	AR
11	1.6115	5193649	Ring Set (.020" O.S.)	AR	AR	AR
11	1.6115	5193650	Ring Set (.030" O.S.)	AR	AR	AR
11	1.6140	5188406	Pin, Piston (standard)	3	4	6
11	1.6140	5194543	Pin, Piston (.010" O.S)	AR	AR	AR
11	1.6150	5188405	Retainer, piston pin (standard)	6	8	12
11	1.6180	5188868	Liner, cylinder (standard)	3	4	6
11	1.6180	5194448	Liner, cylinder (.005" O.S., O.D.)	AR	AR	AR
11	1.6180	5194449	Liner, cylinder (.010" O.S., O.D.)	AR	AR	AR
11	1.6180	5194450	Liner, cylinder (.020" O.S., O.D.)	AR	AR	AR
-	-	5194496	Cylinder Kit (includes one standard size liner, piston assy., piston pin and ring set)	AR	AR	AR
6	1.6187	5184484	Insert, cylinder liner (standard and .005" O.S. liner)	3	4	6
6	1.6187	5193316	Insert, cylinder liner (.010" to .030" O.S. liner)	AR	AR	AR
			4 VALVE CYLINDER HEAD ENGINES, "E" MODELS			
11	1.6001	5135515	Rod Assy., connecting (includes cap which is not sold separately, plus indented items)	3	4	6
11	1.6001	5125036	Bolt, connecting rod	6	8	12
11	1.6001	5117629	Nut, connecting rod	6	8	12
11	1.6001	103373	Pin, 3/32"x3/4" cotter	6	8	12
11	1.6100	5192895	Shell Set, connecting rod bearing (standard) } (includes one upper and one lower shell)	3	4	6
11	1.6100	5192896	Shell Set, connecting rod bearing (.002" U.S.)	AR	AR	AR
11	1.6100	5192897	Shell Set, connecting rod bearing (.010" U.S.)	AR	AR	AR
11	1.6100	5192898	Shell Set, connecting rod bearing (.020" U.S.)	AR	AR	AR
11	1.6110	5195735	Piston Assy. (standard) } (includes bushings and piston pin retainers)	3	4	6
11	1.6110	5195781	Piston Assy. (.010" O.S.)	AR	AR	AR
11	1.6110	5195783	Piston Assy. (.030" O.S.)	AR	AR	AR
11	1.6115	5196366	Ring Set, piston (standard) } (includer rings for one cylinder	3	4	6
11	1.6115	5196363	Ring Set, piston (.010" O.S.)	AR	AR	AR
11	1.6115	5196364	Ring Set, piston (.020" O.S.)	AR	AR	AR
11	1.6115	5196365	Ring Set, piston (.030" O.S.)	AR	AR	AR
11	1.6140	5188406	Pin, piston (standard)	3	4	6
11	1.6140	5194543	Pin, piston (.010" O.S.)	AR	AR	AR
11	1.6150	5188405	Retainer, piston pin (standard)	6	8	12
11	1.6180	5113953	Liner, cylinder (standard)	3	4	6
11	1.6180	5197565	Liner, cylinder (.001" O.S., O.D.)	AR	AR	AR
11	1.6180	5193732	Liner, cylinder (.005" O.S., O.D.)	AR	AR	AR
11	1.6180	5193733	Liner, cylinder (.010" O.S., O.D.)	AR	AR	AR
11	1.6180	5193734	Liner, cylinder (.020" O.S., O.D.)	AR	AR	AR
11	1.6180	5193735	Liner, cylinder (.030" O.S., O.D.)	AR	AR	AR
-	-	5196367	Cylinder Kit (includes one standard size liner, piston assy., piston pin and ring set)	AR	AR	AR
11	1.6187	5184484	Insert, cylinder liner (standard and .005" O.S. liner)	3	4	6
11	1.6187	5193316	Insert, cylinder liner (.010" to .030" O.S. liner)	AR	AR	AR
			4 VALVE CYLINDER HEAD ENGINES, "N" MODELS			
11	1.6001	5135515	Rod Assy., connecting (includes cap which is not sold separately, plus indented items)	3	4	6
11	1.6001	5125036	Bolt, connecting rod	6	8	12
11	1.6001	5117629	Nut, connecting rod	6	8	12
11	1.6001	103373	Pin, 3/32"x3/4" cotter	6	8	12
11	1.6100	5192895	Shell Set, connecting rod bearing (standard) } (includes one upper and one lower shell)	3	4	6
11	1.6100	5192896	Shell Set, connecting rod bearing (.020" U.S.)	AR	AR	AR
11	1.6100	5192897	Shell Set, connecting rod bearing (.010" U.S.)	AR	AR	AR
11	1.6100	5192898	Shell Set, connecting rod bearing (.020" U.S.)	AR	AR	AR

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
11	1.6110	5197920	Piston Assy. (standard) (includes bushings and piston pin retainers)	3	4	6
11	1.6115	5197933	Ring Set (standard) (includes rings for one cylinder)	3	4	6
11	1.6140	5188406	Pin, piston (standard)	AR	AR	AR
11	1.6140	5194543	Pin, piston (.010" O.S.)	AR	AR	AR
11	1.6150	5188405	Retainer, piston pin	6	8	12
11	1.6180	5113953	Liner, cylinder (standard)	3	4	6
11	1-6180	5197565	Liner, cylinder (.001" O.S., O.D.)	AR	AR	AR
11	1.6180	5193732	Liner, cylinder (.005" O.S., O.D.)	AR	AR	AR
11	1.6180	5193733	Liner, cylinder (.010" O.S., O.D.)	AR	AR	AR
11	1.6180	5193734	Liner, cylinder (.020" O.S., O.D.)	AR	AR	AR
11	1.6180	5193735	Liner, cylinder (.030" O.S., O.D.)	AR	AR	AR
-	-	5197934	Cylinder Kit (includes one standard size liner, piston assy., piston pin and ring set)	AR	AR	AR
11	1.6187	5184484	Insert, cylinder liner (standard and .005" O.S. liner)	3	4	6
11	1.6187	5193316	Insert, cylinder liner (.010" to .030" liner)	AR	AR	AR

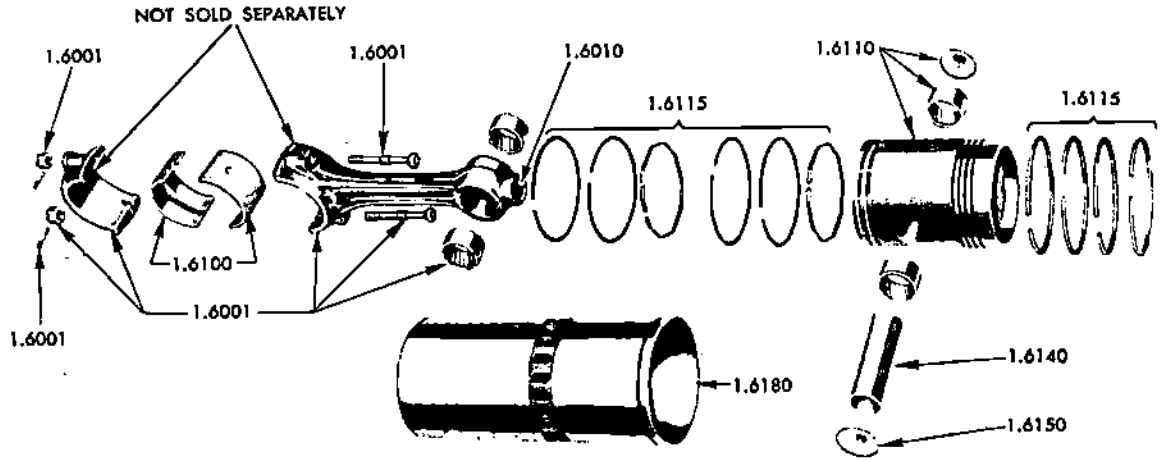


Fig. 11 - Connecting Rod and Piston

			CAMSHAFT AND GEAR TRAIN			
12	1.7001	5185745	Camshaft (LA-LD-RB-RC engine) (stamped 5185746)	1		1
12	1.7001	5183954	Camshaft (LB-LC-RA-RD engine) (stamped 5183936)	1		1
12	1.7001	5179961	Camshaft (LA-LB-LC-LD engine) (stamped 5179959)		1	
12	1.7001	5122487	Camshaft (RA-RB-RC-RD engine) (stamped 5122203)		1	
12	1.7001	5179962	Camshaft (LA-LB-LC-LD engine) (stamped 5179960)			1
12	1.7001	5122486	Camshaft (RA-RB-RC-RD engine) (stamped 5122202)			1
12	1.7010	5111422	Bearing, cam and balancer shaft end (standard)	4	4	4
12	1.7010	5194858	Bearing, cam and balancer shaft end (.010" U.S.) (includes bushing)	AR	AR	AR
12	1.7010	5194859	Bearing, cam and balancer shaft end (.020" U.S.)	AR	AR	AR
12	1.7010	5197236	Bearing (.010" O.D. with standard I.D.)	AR	AR	AR
12	1.7010	5197237	Bearing (.010" O.D. with .010" I.D.) (includes bushings)	AR	AR	AR
12	1.7010	5197238	Bearing (.010" O.D. with .020" I.D.)	AR	AR	AR
12	1.7010	186622	Bolt, 3/8" - 16x1 1/4" hex. hd.	12	12	12
-	-	103321	Lockwasher, 3/8"	12	12	12
12	1.7030	5111424	Washer, cam and balancer shaft end bearing thrust (standard)	4	4	4
	1.7030	5194826	Washer, cam and balancer shaft end bearing thrust (.005" O.S.)	AR	AR	AR
12	1.7030	5194827	Washer, cam and balancer shaft end bearing thrust (.010" O.S.)	AR	AR	AR

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	QUANTITY PER 4-71	QUANTITY PER 6-71
12	1.7040	5196022 ¶	Bearing Set, camshaft intermediate (standard)	2	3	
12	1.7040	5196025 ¶	Bearing Set, camshaft intermediate (.010" O.S. on O.D.)	AR	AR	AR
12	1.7040	5196023 ¶	Bearing Set, camshaft intermediate (.010" U.S. on I.D.)	AR	AR	AR
12	1.7040	5196024 ¶	Bearing Set, camshaft intermediate (.020" U.S. on I.D.)	AR	AR	AR
12	1.7050	5115572	Ring, camshaft intermediate bearing lock	4	6	10
12	1.7050	5123383	Bolt, camshaft intermediate bearing lock	2	3	5
12	1.7080	5158671	Shaft, balancer	1		
12	1.7080	5158672	Shaft, balancer		1	
12	1.7080	5158673	Shaft, balancer			1
-	-	5153000	Weight, front balancer	2		
-	-	5153001	Weight, front balancer		2	
12	1.7140	5114031	Weight, front balancer			2
12	1.7140	5153914	Key, 1/4"x1" woodruff	2	2	2
-	1.7190	5177769	Lockwasher	2	2	2
12	1.7190	5150087	Nut, 1 1/8"-18	2	2	2
12	1.7190	5121968	Weight, rear balancer	2		
12	1.7190	5121969	Weight, rear balancer		2	
12	1.7190	5121970	Weight, rear balancer			2
12	1.7190	181365	Bolt, 3/8"-24x1 1/8" hex. hd.	4		
12	1.7190	181371	Bolt, 3/8"-24x1 3/8" hex. hd.		4	
12	1.7190	181370	Bolt, 3/8"-24x1 1/4" hex. hd.			4
12	1.7200	5121815	Gear, camshaft (LA-LD-RA-RD engines)	1	1	1
12	1.7200	5121816	Gear, camshaft (LB-LC-RB-RC engines)	1	1	1
12	1.7200	5121816	Gear, balancer shaft (LA-LD-RA-RD engines)	1	1	1
12	1.7200	5121815	Gear, balancer shaft (LB-LC-RB-RC engines)	1	1	1
12	1.7200	5153914	Key, 1/4"x1" woodruff	2	2	2
12	1.7200	5150087	Nut, 1 1/8"-18	2	2	2
12	1.7207	5172734	Retainer, cam and balancer shaft gear nut	2	2	2
12	1.7207	186627	Bolt, 3/8"-24x1" hex. hd.	8	8	8
-	-	103321	Lockwasher, 3/8"	8	8	8
12	1.7222	5113818	Gear, idler R.H. helix (LA-LB-LC-LD engines)	1	1	1

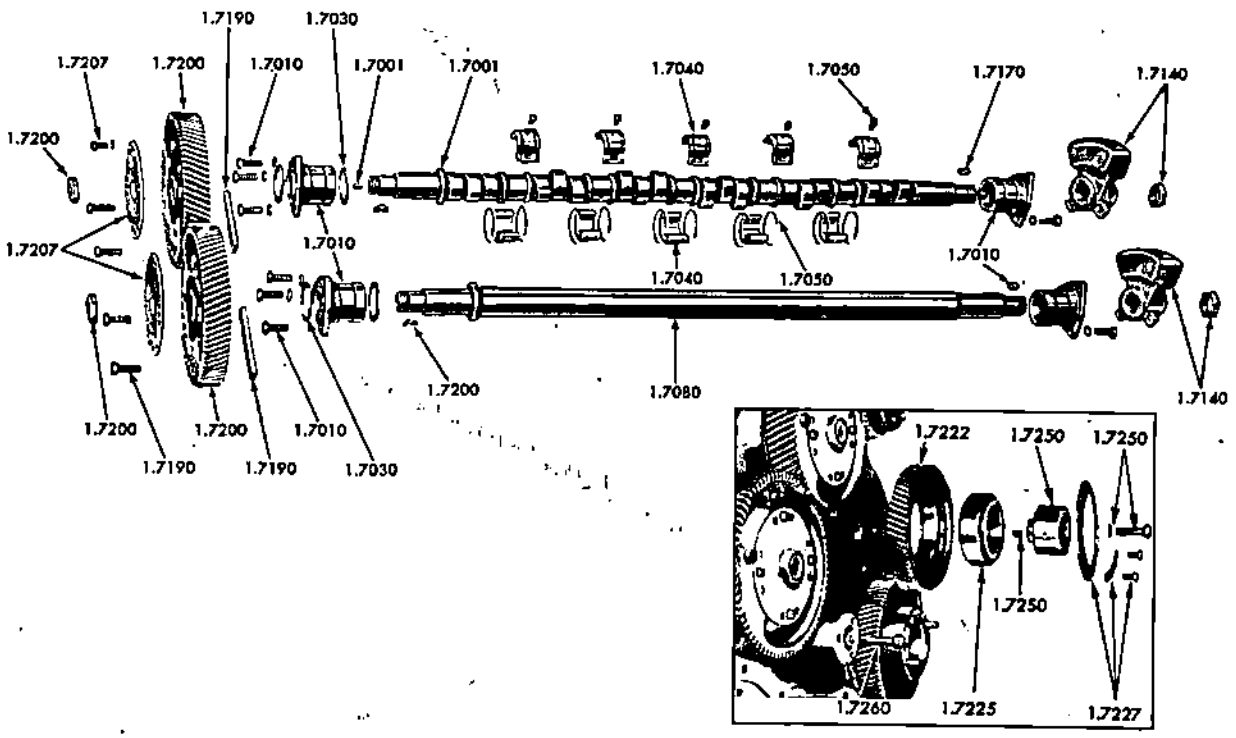


Fig. 12 - Camshaft and Gear Train

¶Consists of one (1) upper and one (1) lower bearing.

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
12	1.7222	5113817	Gear, idler L.H. helix (RA-RB-RC-RD engines)	1	1	1
12	1.7225	7451142	Bearing Assy., idler gear	1	1	1
12	1.7227	5176998	Retainer, idler gear bearing	1	1	1
12	1.7227	5176999	Lock, bolt	3	3	3
12	1.7227	446072	Bolt, 5/16"-24x1/2" hex. hd.	6	6	6
12	1.7250	5130135	Hub Assy., idler gear (includes dowel)	1	1	1
12	1.7250	5151444	Dowel, idler gear hub	1	1	1
12	1.7250	454992	Bolt, 1/2" - 13x2 1/2" hex. hd.	1	1	1
12	1.7250	5167714	Washer	1	1	1
12	1.7260	5131719	Spacer Assy., idler gear hole (includes dowel)	1	1	1
-	1.7260	5151444	Dowel, idler gear hole spacer	1	1	1
12	1.7260	454992	Bolt, 1/2" - 13x2 1/2" hex. hd.	1	1	1
12	1.7260	5167714	Washer	1	1	1
			BALANCE WEIGHT COVER			
1	1.7470	5118553	Cover, balance weight (fan cooled units, no drive holes)	1	1	1
1	1.7470	5118895	Cover Assy., balance weight (fan cooled units, with drive holes)	1	1	1
-	-	5159440	Cover, balance weight (heat exchanger cooled units)	1	1	1
-	-	5162790	Cover, balance weight (fan cooled units, no drive holes)	1	1	1
-	-	5162850	Cover, balance weight (fan cooled units, with drive holes)	1	1	1
-	-	179846	Bolt, 3/8"-16x1 7/8" hex. hd.	2	2	2
-	-	186283	Bolt, 3/8"-16x3 1/2" hex. hd.	2	2	2
-	-	181374	Bolt, 3/8"-24x1 1/2" hex. hd.	1	1	1
-	-	181385	Bolt, 3/8"-24x3" hex. hd.	10	10	10
-	-	186309	Bolt, 3/8"-24x3 1/4" hex. hd.	2	2	2
-	-	112609	Bolt, 3/8"-16x3 3/4" hex. hd.	2	2	2
-	-	103321	Lockwasher, 3/8"	15	15	15
-	-	5121753	Gasket, balance weight cover	1	1	1

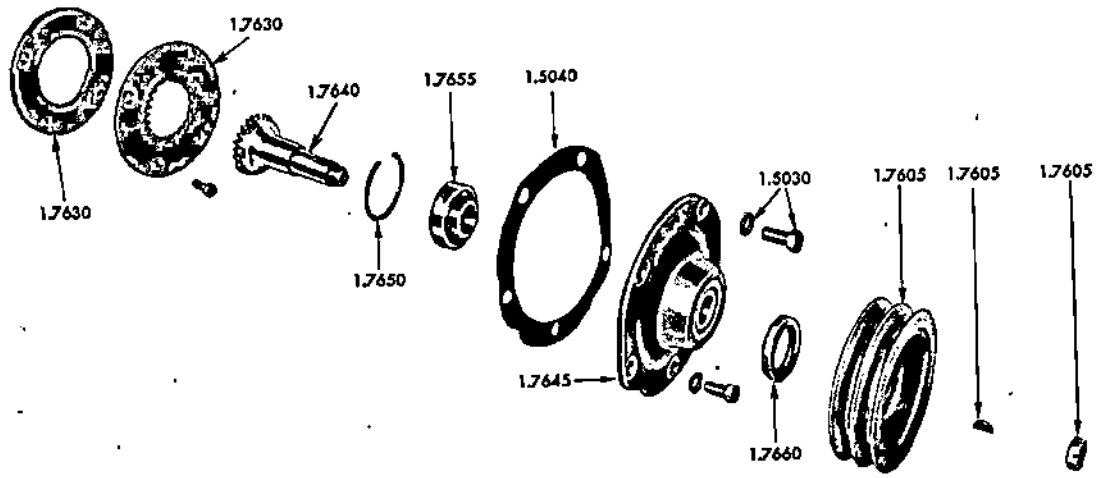


Fig. 13 - Accessory Drive

			ACCESSORY DRIVE			
14	1.7605	5164291	Pulley, accessory drive (5 1/2" dia., single groove)	1	1	1
13	1.7605	5168696	Pulley, accessory drive (5 1/2" dia., double groove)	1	1	1
14	1.7605	124548	Key, 5/32"x3/4" woodruff	1	1	1
13	1.7605	106751	Key, 3/16"x3/4" woodruff	1	1	1
14	1.7605	100146	Bolt, 7/16"-14x1" hex. hd. (pulley to shaft)	1	1	1
13	1.7605	451082	Nut, 3/4"-16 hex. lock	1	1	1
14	1.7605	5132987	Washer (single groove pulley)	1	1	1
-	-	103322	Lockwasher, 7/16"	1	1	1

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
14	1.7610	5164286	Hub, drive pulley	1	1	1
14	1.7610	5176474	Bolt (hub to gear)	4	4	4
-	-	103321	Lockwasher, 3/8"	4	4	4
14	1.7615	5123115	Retainer Assy., drive pulley hub oil seal (includes seal)	1	1	1
14	1.7620	5155445	Seal, drive pulley hub oil	1		
13,15	1.7630	5131627	Plate, accessory drive	1	1	1
13,15	1.7630	5177026	Spacer, accessory drive plate	1	1	1
15	1.7630	5176474	Bolt (plate to gear)	4	4	4
15	1.7635	5133710	Coupling, accessory drive	1	1	1
13	1.7640	5168697	Shaft, accessory drive	1	1	1
13	1.7645	5123116	Retainer Assy., accessory drive (includes indented items)	1	1	1
13	1.7650	5155783	Lockring, accessory drive	1	1	1
13	1.7655	954469	Bearing, accessory drive	1	1	1
13	1.7660	5131329	Seal, accessory drive oil	1	1	1

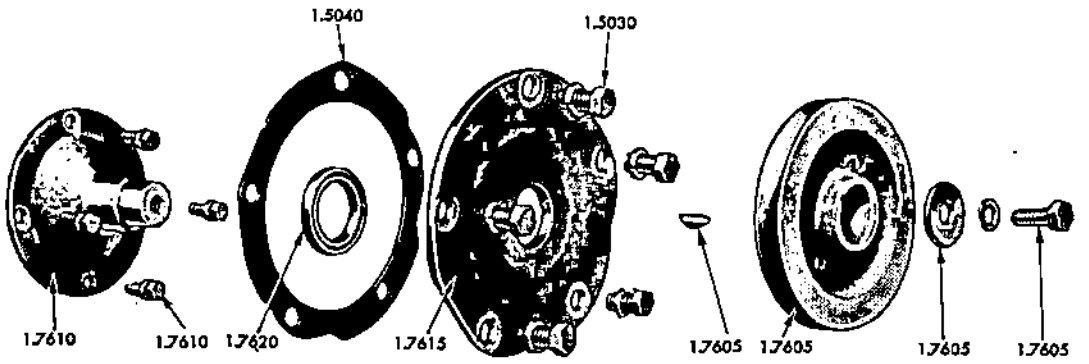


Fig. 14 - Accessory Drive

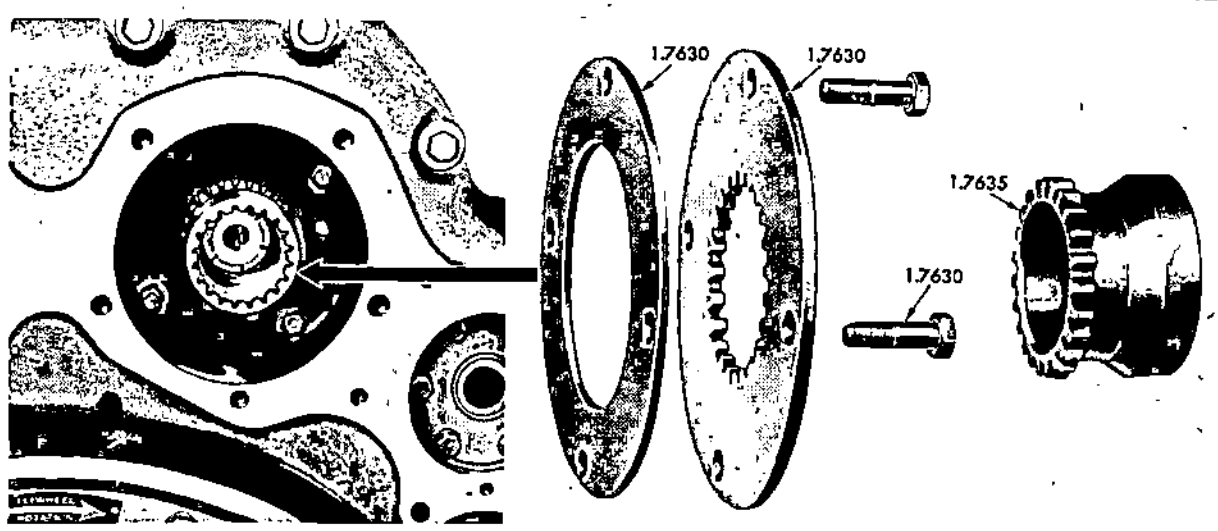


Fig. 15 - Accessory Drive

VALVE OPERATING MECHANISM

16	1.8060	5150304	Arm Assy., exhaust valve rocker (left, 2 valve head)	(includes bushings, clevis and clevis pins)	3	4	6
16	1.8060	5150305	Arm Assy., exhaust valve rocker (right, 2 valve head)		3	4	6
16	1.8060	5111340	Arm Assy., exhaust valve rocker (left, 4 valve head)			4	6
16	1.8060	5111343	Arm Assy., exhaust valve rocker (right, 4 valve head)			4	6
16	1.8080	5179954	Arm Assy., injector rocker		3	4	6
16	1.8130	5150312	Clevis, injector and exhaust valve rocker arm		9	12	18
16	1.8150	5150314	Pin, injector and exhaust valve rocker arm clevis		9	12	18

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
16	1.8160	5150322	Shaft Assy., rocker arm	3	4	6
16	1.8170	5150324	Bracket, rocker shaft	6	8	12
16	1.8170	5150325	Bolt, rocker shaft bracket	6	8	12
16	1.8180	5128640	Rod, push	9	12	18
16	1.8180	5151601	Locknut, push rod	9	12	18
16	1.8190	5186858	Spring, push rod	9	12	18
16	1.8200	5150302	Seat, push rod spring - upper	9	12	18
16	1.8210	5123250	Seat, push rod spring - lower	9	12	18
16	1.8250	5150303	Retainer, push rod (snap ring)	9	12	18
16	1.8260	5115087	Follower Assy., cam	9	12	18
-	-	5195220	Roller set, cam follower (includes roller with bushing and pin)	3	4	6
16	1.8300	5150298	Guide, cam follower	6	8	12
16	1.8300	443603	Bolt, 1/4"-20x3/4" hex. hd.	6	8	12
-	-	103319	Lockwasher, 1/4"	6	8	12
16	1.8310	5193197	Valve, exhaust (30° plain) (includes locks) (2 valve head)	6	8	12
16	1.8310	5193666	Valve, exhaust (30° jet blade material) (includes locks) (2 valve head)	12	16	24
16	1.8310	5195167	Valve, exhaust (30°) (includes locks) (4 valve head)	6	8	12
16	1.8320	5120930	Guide, exhaust valve (2 valve head)	AR	AR	AR
16	1.8320	5192717	Guide, exhaust valve (2 valve head, .016" O.S. on O.D.)	12	16	24
16	1.8320	5129919	Guide, exhaust valve (4 valve head)	6	8	12
16	1.8330	5185326	Insert, exhaust valve (30°, 2 valve head)	AR	AR	AR
16	1.8330	5193215	Insert, exhaust valve (.010" O.S., 30°, 2 valve head)	12	16	24
16	1.8330	5109027	Insert, exhaust valve (30°, 4 valve head)	12	AR	AR
16	1.8330	5197505	Insert, exhaust valve (.010" O.S., 30°, 4 valve head)	6	8	12
16	1.8340	5150289	Spring, exhaust valve (2 valve head)	12	16	24
16	1.8340	5117561	Spring, exhaust valve (4 valve head)	6	8	12
16	1.8343	5117565	Bridge, exhaust valve (4 valve head)	6	8	12
16	1.8343	5129101	Screw, exhaust valve bridge adjusting	6	8	12
16	1.8343	5151601	Nut, exhaust valve bridge adjusting	6	8	12
16	1.8345	5117564	Guide Assy., exhaust valve bridge			

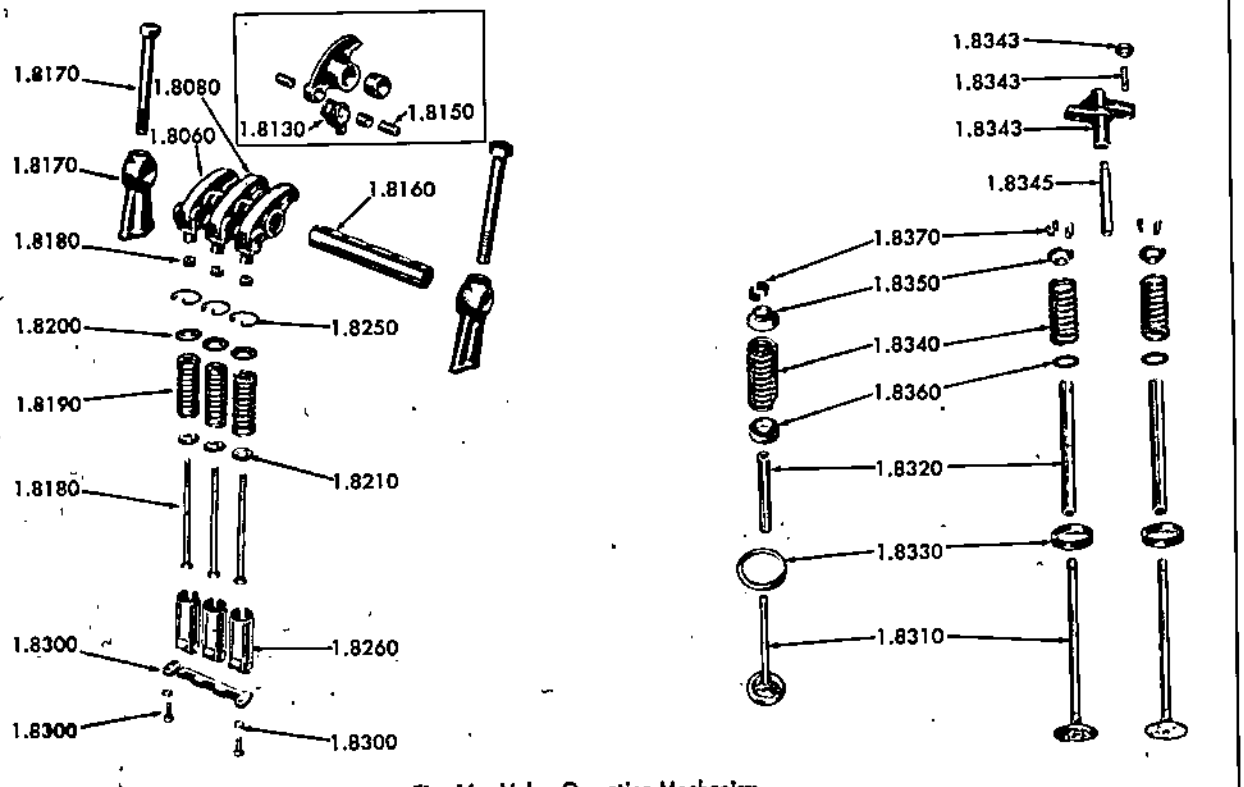


Fig. 16 - Valve Operating Mechanism

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
16	1.8350	5150291	Cap, exhaust valve spring (2 valve head)	6	8	12
16	1.8350	5117563	Cap, exhaust valve spring (4 valve head)	12	16	24
16	1.8360	5150292	Seat, exhaust valve spring	6	8	12
16	1.8360	5117562	Washer, exhaust valve spring (seat) (4 valve head)	12	16	24
16	1.8370	838029	Lock, exhaust valve spring (halves) (2 valve head)	12	16	24
16	1.8370	5111337	Lock, exhaust valve spring (halves) (4 valve head)	24	32	48
			ROCKER COVER			
-	1.8450	5178381	Cover Assy., rocker (plain)	1		
45	1.8450	5178541	Cover Assy., rocker (breather hole)	1		
-	1.8450	5178382	Cover Assy., rocker (plain)		1	
45	1.8450	5178542	Cover Assy., rocker (breather hole)		1	
-	-	5196748	Cover Assy., rocker (with oil filler hole)		1	
-	1.8450	5178383	Cover Assy., rocker (plain)			1
45	1.8450	5178543	Cover Assy., rocker (breather hole)			1
-	-	5110545	Cover Assy., rocker (with oil filler hole)			1
-	-	5150327	Gasket, rocker cover	1		
-	-	5150328	Gasket, rocker cover		1	
-	-	5150329	Gasket, rocker cover			1
-	-	5157194	Bolt, rocker cover	2	2	4
-	-	5150333	Washer, rocker cover bolt	2	2	4
-	-	455532	Pin, 1/8" x 1" roll	2	2	4
-	-	5157192	Stud, rocker cover	2	2	4
			FUEL INJECTOR			
20	2.1001	5228310	Injector Assy. (HV6) (2 valve head)	3	4	6
20	2.1001	5228305	Injector Assy. (HV7) (2 valve head)	3	4	6
20	2.1001	5228523	Injector Assy. (S70) (4 valve head)		4	6
20	2.1001	5228110	Injector Assy. (HV8) (2 valve head)	3	4	6
20	2.1001	5228524	Injector Assy. (S80) (4 valve head)		4	6
20	2.1001	5228522	Injector Assy. (S60) (4 valve head)		4	6
20	2.1001	5228521	Injector Assy. (S55) (4 valve head)		4	6
20	2.1001	5228760	Injector Assy. (N60) (4 valve head)	3	4	6
20	2.1001	5228765	Injector Assy. (N65) (4 valve head)			6
20	2.1001	5228770	Injector Assy. (N70) (4 valve head)			6
-	-	5226414	Cap, injector shipping	AR	AR	AR
20	2.1270	5121259	Clamp, injector	3	4	6
20	2.1270	5150250	Washer, injector clamp	3	4	6
20	2.1280	179847	Bolt, 3/8"-16x2" hex. hd.	3	4	6
6	2.1290	5150041	Tube, injector hole	3	4	6
6	2.1300	5160037	Ring, injector hole tube seal	3	4	6
			FUEL PUMP			
17,21	2.2001	5184532	Pump Assy., fuel (C & D engines, 1/4" inlet) (includes indented items)	1	1	1
17,21	2.2001	5184531	Pump Assy., fuel (A & B engines, 1/4" inlet) (includes indented items)	1	1	1
17,21	2.2001	5134705	Pump Assy., fuel (A & B engines, 3/8" inlet) (includes indented items)			1
17,21	2.2001	5134706	Pump Assy., fuel (C & D engines, 3/8" inlet) (includes indented items)			1
-	-	5195078#	Overhaul Kit, fuel pump	AR	AR	AR
-	-	5118219	Bolt (with seal-washer)	3	3	3
17	2.2007	5150193	Gasket, fuel pump to blower	1	1	1
17	2.2070	5230007	Seal, fuel pump oil	2	2	2
17	2.2089	5181747	Shaft and Gear, fuel pump driven	1	1	1
17	2.2093	5181746	Shaft and Gear, fuel pump drive	1	1	1
17	2.2130	5174973	Valve, fuel pump	1	1	1
17	2.2130	103709	Pin, 5/32" x 1" straight	1	1	1
17	2.2160	5184530	Spring, fuel pump valve retaining	1	1	1
17	2.2170	5174971	Plug, fuel pump valve	1	1	1
17	2.2180	5161003	Gasket, fuel pump valve plug	1	1	1
17	2.2220	5150199	Fork, fuel pump coupling	1	1	1

Includes two oil seals, one each drive shaft, driven shaft, valve assy., valve pin, valve spring, valve gasket, pump to blower gasket and two shipping caps.

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
			FUEL PUMP DRAIN			
17	2.2300	5158825	Tube Assy., fuel pump drain (dev. L. 4 1/4")	1	1	1
-	-	137406	Connector, 5/16" inv. fl. tube	1	1	1

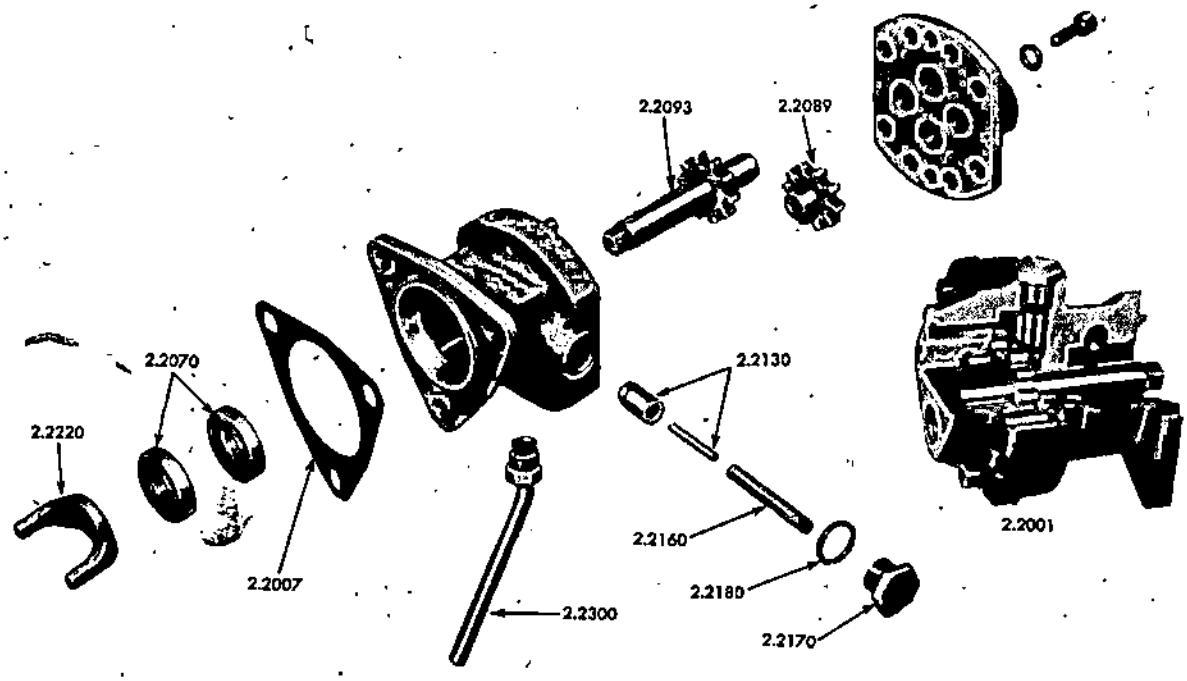


Fig. 17 - Fuel Pump and Drain

			FUEL FILTER			
2,74	2.3001	5575568	Strainer Assy., fuel (6" element, use with 1/4" pump inlet) (includes in-	1	1	1
2,74	2.3001	6436075	Strainer Assy., fuel (8" element, use with 3/8" pump inlet) dented items)			1
18	2.3010	6574961	Element, fuel strainer (6", includes gasket)	1	1	1
18	2.3010	5575032	Element, fuel strainer (8", includes gasket)			1
18	2.3050	5577586	Shell, fuel strainer	1	1	1
18	2.3050	5575056	Shell, fuel strainer (8")			1
18	2.3090	5574161	Gasket, fuel strainer cover	1	1	1
18	2.3100	103878	Plug, 1/4" pipe	2	2	2
18	2.3100	103879	Plug, 3/8" pipe (8")			1
18	2.3120	5575790	Bolt, fuel strainer cover	1	1	1
18	2.3120	6435793	Bolt, fuel strainer cover (8")			2
18	2.3130	1503536	Gasket, fuel strainer cover screw	1	1	1
18	2.3130	6435794	Gasket, fuel strainer cover screw (8")			1
74	2.3310	5573949	Filter Assy., fuel (4" element) (includes indented items)	1	1	
1,2	2.3310	5574533	Filter Assy., fuel (8" element) (includes indented items)			1
19	2.3320	5573261	Element, fuel filter (4", includes gasket)	1	1	
19	2.3320	5574508	Element, fuel filter (8", includes gasket)			1
19	2.3380	5574125	Shell Assy., fuel filter (4")	1	1	
19	2.3380	5575169	Shell Assy., fuel filter (8")			1
19	2.3400	5574161	Gasket, fuel filter cover shell	1	1	1
19	2.3410	5574118	Screw, fuel filter cover	1	1	1
19	2.3410	5574121	Snap Ring	1	1	1
19	2.3420	1503536	Gasket, fuel filter cover screw	1	1	1
19	2.3500	103647	Draincock, 1/4"	1	1	1

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
			FUEL MANIFOLD			
20	2.4020	5151121	Pipe Assy., fuel (inlet and outlet, 2 valve head)	6	8	12
-	-	5111526	Pipe Assy., fuel (long, 4 valve head)		4	6
-	-	5111527	Pipe Assy., fuel (short, 4 valve head)		4	6
20	2.4030	5117369	Connector, fuel pipe	6	8	12
20	2.4030	5125108	Washer, fuel pipe connector	6	8	12

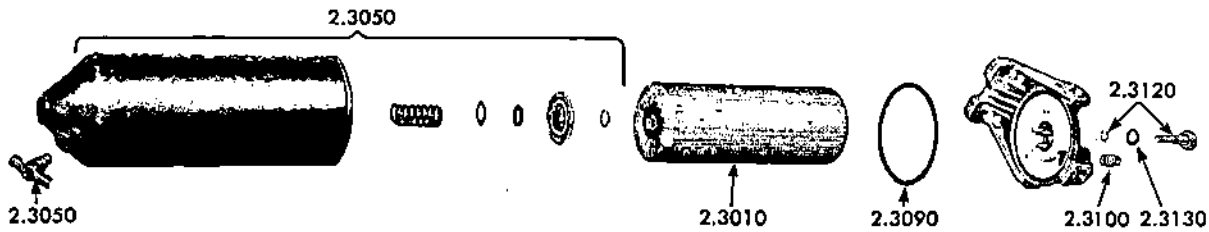


Fig. 18 - Fuel Strainer

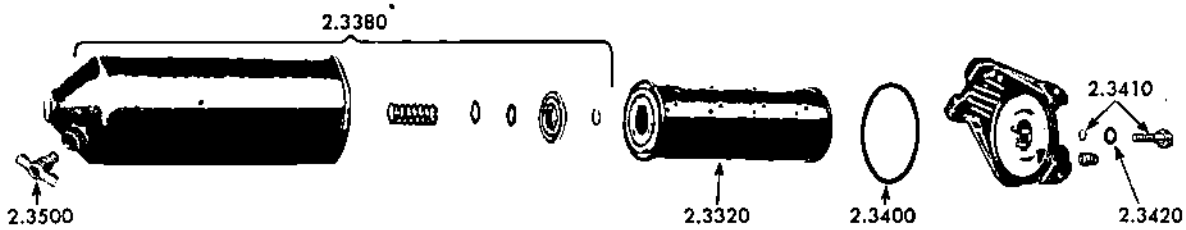


Fig. 19 - Fuel Filter

			FUEL LINES			
			The part number of the fuel lines which are not listed may be obtained from your Detroit Diesel dealer or distributor. It is necessary to furnish him with the model, unit number and type number (if shown) on the Option Plate on your engine.			
-	-	5122279	Valve, fuel supply check	1	1	1
-	2.5050	-	Tube, strainer to fuel pump	1	1	1
-	2.5050	5179969	Elbow, 3/8" tube (sealastic)	1	1	1
-	-	5179936	Connector, 3/8" tube (sealastic)	1	1	1
-	- -	5179938	Seal Ring, 3/8" tube (sealastic)	2	2	2
-	2.5050	5179937	Nut, 3/8" tube (sealastic)	2	2	2
-	2.5100	-	Tube, fuel pump to filter	1	1	1
-	2.5100	5179969	Elbow, 3/8" tube (sealastic)	1	1	1
-	2.5100	5179936	Connector, 3/8" tube (sealastic)	1	1	1
-	-	5179938	Seal Ring, 3/8" tube (sealastic)	2	2	2
-	2.5100	5179937	Nut, 3/8" tube (sealastic)	2	2	2
-	2.5150	-	Tube Assy., fuel filter to manifold	1	1	1
-	2.5150	137423	Elbow, 3/8" inv. fl. tube 90°	1	1	1
-	2.5210	-	Tube Assy., fuel drain	1	1	1
-	-	187343	Connector, 5/16" inv. fl. tube	1	1	1
-	2.5210	137414	Union, 5/16" inv. fl. tube	1	1	1

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
			MECHANICAL GOVERNOR			
			The variety of Mechanical Governors available makes it impractical to list part numbers. For complete interpretation of parts requirements, furnish your Detroit Diesel dealer or distributor the model, unit number and governor type number.			
1	2.7001	-	Governor Assy., mechanical	1	1	1
21	2.7001	5118219	Bolt (with seal-washer)	6	6	6
21	2.7001	443603	Bolt, 1/4"-20 x 3/4" hex. hd.	2	2	2
-	-	103319	Lockwasher, 1/4"	2	2	2
-	-	3223193 +	Cover, governor breather hole	1	1	1
-	-	120687 +	Screw, #10-24 x 1/2" fil. hd.	2	2	2
-	-	120217 +	Lockwasher, #10	2	2	2
-	-	5150900 +	Gasket, governor breather hole cover	1	1	1
21	2.7010	5150246	Gasket, governor to blower	1	1	1
21	2.7020	5123812	Gasket, governor to cylinder head	1	1	1
-	-	5150512	Spacer, governor to cylinder head (B and D engine)		1	1
			START OF GOVERNOR ASSEMBLIES			
			The part number of governor cover assembly which are not listed may be obtained from your Detroit Diesel dealer or distributor. It is necessary to furnish him with model, unit number and type number (if shown) on the Option Plate on your engine.			
-	-	-	Cover Assy. (includes cam and bearings)	1	1	1
21	2.7045	132264	Screw, 1/4"-20 x 3/4" fil. hd. sl.	4	4	4
-	-	5183701	Bolt, drilled head			1
-	-	103319	Lockwasher, 1/4"	4	4	4
21	2.7051	5150889	Gasket, governor cover	1	1	1
21	2.7095	5174425	Shaft Assy., governor throttle (variable)	1	1	1

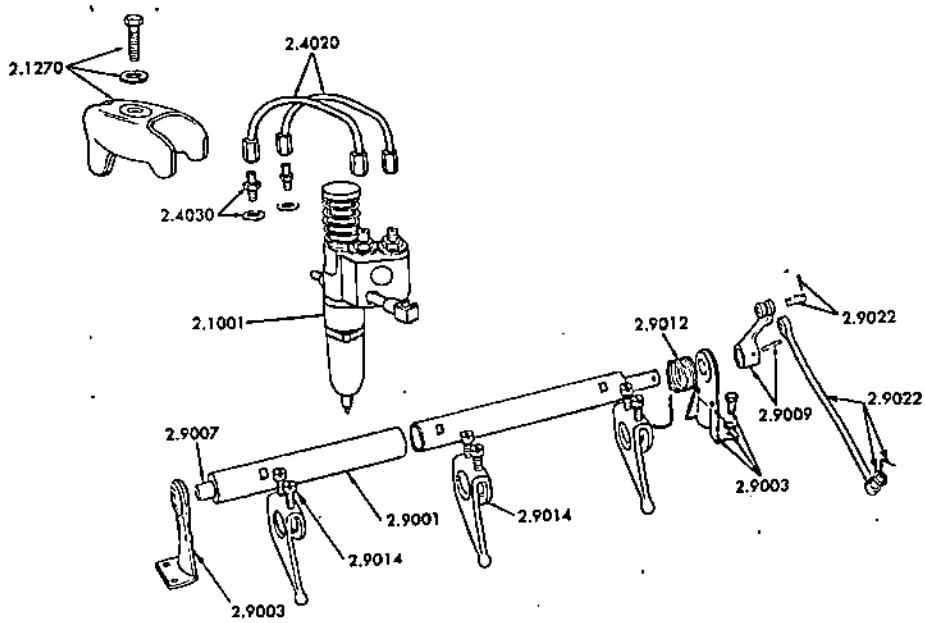


Fig. 20 - Injector Controls

+Not required when breather attaches to governor.

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
-	-	5110661	Shaft Assy., governor throttle (limiting)	1	1	1
21	2.7095	5174431	Shaft & Lever Assy., governor throttle (A & B eng., limiting speed)	1	1	1
21	2.7095	5174432	Shaft & Lever Assy., governor throttle (C & D eng., limiting speed)	1	1	1
21	2.7100	148402	Bearing, governor throttle shaft	2	2	2
-	-	5150959	Pin, governor throttle accelerator lever stop	1	1	1
-	-	5174435	Pin, governor throttle shaft fulcrum lever	1	1	1
22	2.7140	5176557	Seal, governor throttle shaft (.487" I.D. x .693")	1	1	1
-	-	5182977	Seal Ring, governor throttle shaft (.364" I.D. x .500" O.D.)	1	1	1
21	2.7150	5153060	Retainer, throttle shaft packing	2	2	2
-	-	5153060	Retainer, throttle shaft packing		1	1
-	-	5174429	Ring, throttle shaft packing retainer snap	1	1	1
21	2.7170	5158432	Lever, governor throttle shaft (2 1/4" L.)	1	1	1
-	-	5126992	Lever, governor cover throttle shaft (2 1/16" L.)			1
-	-	5183042	Lever, governor throttle shaft (1 3/4" L.)		1	
21	2.7175	5159003	Cam, governor cover (limiting, A & B eng.)	1	1	1
21	2.7175	5159004	Cam, governor cover (limiting, C & D eng.)	1	1	1
-	-	5151518	Cam, governor cover (limiting, C & D eng.)		1	
-	-	5110659	Shaft Assy., gov. shutdown (limiting)	1	1	1
21	2.7175	5150946	Washer, governor cover cam (3/8" plain) (limiting speed governor)	1	1	1
21	2.7175	142583	Retainer, 13/64" spring (limiting speed governor)	1	1	1
-	-	5178581	Retainer Ring, governor cover cam (limiting speed governor)	1	1	1
21	2.7178	5151737	Spring, governor cam control (limiting speed, governor)	1	1	
21	2.7178	5160880	Spring, governor cam control (limiting speed, governor)			1
-	-	5158903	Housing Assy., gov. control (A & B eng.)	1	1	1
-	-	5158904	Housing Assy., gov. control (C & D eng.)	1	1	1
-	-	5110753	Housing Assy., gov. control (limiting speed, with shutdown lever, A eng.) (includes indented items)	1	1	1
-	-	5110754	Housing Assy., gov. control (limiting speed, with shutdown lever, C eng.) (includes indented items)	1	1	1
21	2.7230	142656	Plug, 3/4" expansion	1	1	1
-	-	5150942	Pin, housing to cover	2	2	2
-	-	5154437	Shaft Assy., governor operating (A & B) (includes shaft)	1	1	1
-	-	5154438	Shaft Assy., governor operating (C & D) (includes shaft)	1	1	1
21	2.7255	5154435	Shaft, governor operating	1	1	1
21	2.7260	457187	Bearing, governor operating shaft (upper)	1	1	1
21	2.7260	5159080	Washer, upper shaft bearing	1	1	1
21	2.7260	113903	Screw, #10-24 x 7/16" rd. hd. sl.	1	1	1
-	-	115545	Lockwasher, #10 int. tooth	1	1	1
21	2.7260	120391	Washer, #10 flat	1	1	1
21	2.7270	5188611	Bushing, governor operating shaft oilite (lower)	1	1	1
21	2.7280	5154403	Lever, governor operating shaft (A & B engine)	1	1	1
21	2.7280	5154422	Lever, governor operating shaft (C & D engine)	1	1	1
21	2.7280	5150898	Screw, gap adjusting	1	1	1
21	2.7280	122161	Nut, 1/4"-28 hex.	1	1	1
21	2.7290	5185605	Fork, governor operating shaft	1	1	1
21	2.7300	5150943	Pin, governor operating shaft lever	1	1	1
21	2.7310	5150394	Lever Assy., governor differential	1	1	1
-	-	5110666	Lever Assy., governor differential (limiting speed, with shutdown lever)	1	1	1
21	2.7310	5150941	Washer, governor differential lever	1	1	1
-	-	5183654	Roller, cam			1
21	2.7310	142583	Retainer, 13/64" spring	1	1	1
21	2.7315	5150894	Pin, governor differential lever (1/4" O.D. x 25/32")	1	1	1
-	-	5110648	Pin, limiting speed governor differential lever (1/4" O.D. x 1 1/32")	1	1	1
-	-	5174443	Housing and Weight Assy., governor (single weight) (includes indented items)	1		
-	-	5174444	Housing and Weight Assy., governor (single weight) (includes indented items)		1	
-	-	5183610	Housing and Weight Assy., governor (double weight) (includes indented items)		1	
-	-	5174445	Housing and Weight Assy., governor (single weight) (includes indented items)			1
-	-	5111373	Housing and Weight Assy., governor (double weight) (includes indented items)			1
-	-	5183612	Housing and Weight Assy., governor (double weight) ("E" engine) (includes indented items)			1
-	-	5150942	Pin, weight housing to control housing	2	2	2
-	-	5174447	Carrier and Weight Assy., governor (includes shaft)	1		
-	-	5174448	Carrier and Weight Assy., governor (includes shaft)		1	

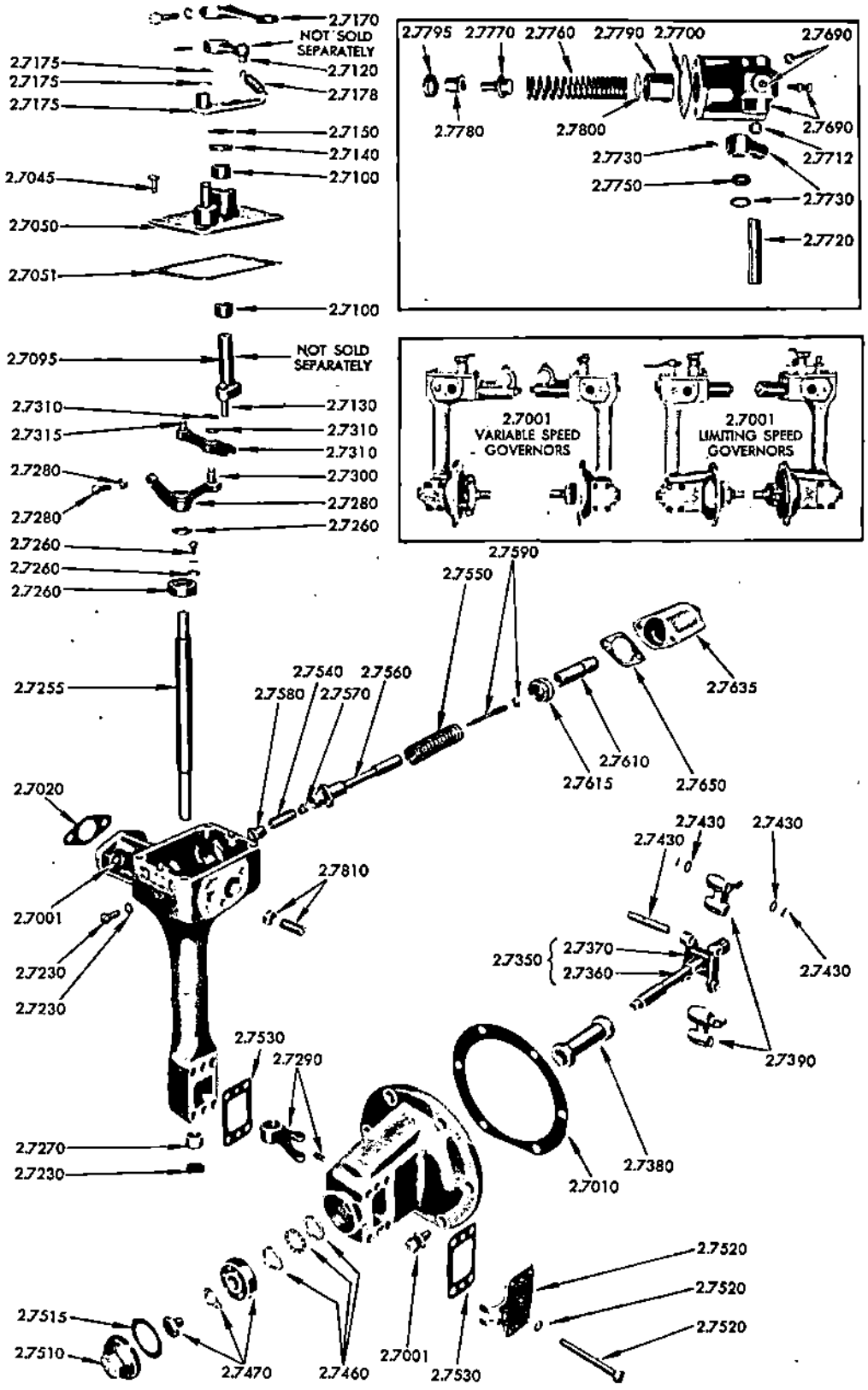


Fig. 21 – Governor – Mechanical

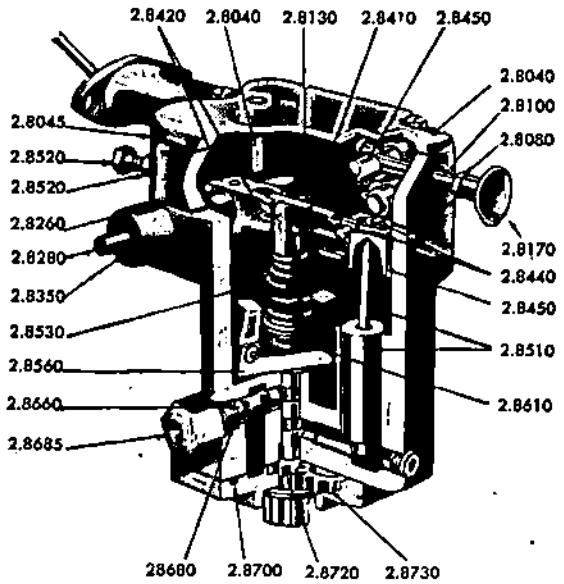
FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
-	-	5183629	Carrier and Weight Assy., governor (includes shaft) (double weight) ..			1
-	-	5111978	Carrier and Weight Assy., governor (includes shaft) ("E" engine)		1	
-	-	5174449	Carrier and Weight Assy., governor (includes shaft)			1
-	-	5183630	Carrier and Weight Assy., governor (includes shaft) (double weight) ("E" engine)			1
21	2.7380	5154501	Riser, governor	1		
21	2.7380	5154502	Riser, governor		1	
21	2.7380	5154503	Riser, governor			1
-	-	5117737	Weight and Bushing Assy., governor		2	2
21	2.7390	5174455	Weight Assy., governor (includes bearing 447196)	2	2	2
-	-	5111979	Weight and Bearing Assy., governor (variable speed)	2	2	2
21	2.7430	5185154	Shaft, governor weight (1.84" L. x .375" O.D.)	2	2	2
21	2.7430	5183632	Shaft, governor weight (1 13/16" L. x .375" O.D.)	2	2	2
21	2.7430	5151487	Washer, governor weight pin	8	8	8
21	2.7430	5178581	Ring, governor weight pin retainer	4	4	4
-	-	447196	Bearing, governor weight needle (3/8" long)	4	4	4
-	-	451995	Bearing, governor weight needle (1/2" long)		2	2
21	2.7460	451905	Bearing, governor weight riser thrust (ball) (1 3/16" O.D.x.354" W.)	1	1	1
21	2.7470	954716	Bearing, governor weight shaft end (ball) (.472" W.x1.456" O.D.)	1	1	1
21	2.7470	5150884	Screw, bearing retainer	1	1	1
21	2.7470	5150897	Lockwasher, bearing retainer	1	1	1
21	2.7510	5183268	Cap, governor weight housing	1	1	1
21	2.7515	5165221	Gasket, governor weight housing cap	1	1	1
21	2.7520	5163514	Cover, governor weight housing (plain)	1	1	1
21	2.7520	5176837	Cover, governor weight housing (tapped)	1	1	1
21	2.7520	190910	Bolt, 1/4"-20 x 2 3/8" hex. hd.	4	4	4
21	2.7520	103319	Lockwasher, 1/4"	4	4	4
-	-	5111196	Spring, governor high speed (limiting speed, blue stripe)		1	1
21	2.7530	5150890	Gasket, governor weight housing cover	2	2	2
21	2.7540	5183704	Spring, low speed (limiting speed, 2 yellow stripes)	1	1	1
21	2.7550	5182560	Spring, high speed (limiting speed red stripe)	1	1	1
21	2.7560	5182555	Plunger, limiting speed governor low speed spring	1	1	1
21	2.7570	5150892	Seat, limiting speed governor low speed spring	1	1	1
21	2.7580	5150899	Cap, limiting speed governor low speed spring	1	1	1
21	2.7590	5182556	Screw, limiting speed governor low speed spring adjusting	1	1	1
21	2.7590	122161	Nut, 1/4"-28 hex.	1	1	1
-	-	5150947	Shim, governor high speed spring (.010")	AR	AR	AR
-	-	5151249	Shim, governor high speed spring (.078")	AR	AR	AR
21	2.7610	5182557	Retainer, limiting speed governor high speed spring	1	1	1
21	2.7615	5182558	Locknut, limiting speed governor spring retainer adjusting screw	1	1	1
21	2.7635	5182559	Housing, limiting speed governor spring adjusting screw	1	1	1
-	-	445520	Bolt, 5/16"-18 x 3 1/2" hex. hd.	2	2	2
-	-	103320	Lockwasher, 5/16"	2	2	2
21	2.7650	5152944	Gasket, governor spring housing	1	1	1
-	-	5127655	Housing Assy., gov. variable speed spring (A & B eng.)	1	1	1
-	-	5126842	Housing Assy., gov. variable speed spring (roller) (C & D eng.)	1	1	1
21	2.7680	5127654	Housing Assy., gov. variable speed spring (C & D eng.)	1	1	1
21	2.7680	5126841	Housing Assy., gov. variable speed spring (roller) (C & D eng.)	1	1	1
-	-	445520	Bolt, 5/16"-18 x 3 1/2" hex. hd.	2	2	2
-	-	103320	Lockwasher, 5/16"	2	2	2
21	2.7690	5179613	Bolt, (idler speed adjusting screw) (variable speed governor)	1	1	1
-	-	123390	Nut, 1/4"-20 hex.	1	1	1
21	2.7690	142656	Plug, 3/4" expansion	1	1	1
21	2.7690	444687	Plug, 1/4" pipe	1	1	1
21	2.7700	5152944	Gasket, governor spring housing	1	1	1
21	2.7712	148402	Bearing, governor variable speed spring lever	2	2	2
21	2.7720	5173964	Shaft, governor variable speed spring	1	1	1
21	2.7730	5176629	Lever, governor variable speed spring (pallet)	1	1	1
-	-	5179102★	Lever Assy., governor variable speed spring (includes roller)	1	1	1
21	2.7730	5152932	Washer, spring lever	1	1	1

(includes indented items)

★May be used in place of pallet type lever.

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
21	2.7730	223065	Screw, 5/16"-24 x 1/4" hex. socket hd. set	1	1	1
-	-	5179105	Bearing (roller contactor)	1		
-	-	5179104	Pin	1		
-	-	5185305	Washer	1		
-	-	5193544	Lever Kit (consists of plug, gasket, bearing, lever assy., packing and retainer)	1	1	1
21	2.7750	5153007	Packing, variable speed governor lever shaft	1	1	1
21	2.7760	5152940	Spring, governor variable speed (yellow stripe)	1	1	1
-	-	5111981	Spring, governor variable speed (2 white stripes)			1
21	2.7770	5152938	Plunger, governor variable speed spring	1	1	1
21	2.7780	5152939	Guide, variable speed spring plunger	1	1	1
21	2.7790	5152941	Retainer, variable speed spring	1	1	1
21	2.7795	5171784	Stop, variable speed spring retainer (with step)	1	1	1
21	2.7795	5174430	Stop, variable speed spring retainer (with gap)	1	1	1
21	2.7800	5152962	Shim, variable speed spring (.010")	AR	AR	AR
21	2.7800	5153904	Shim, variable speed spring (.078")	AR	AR	AR
21	2.7810	5177083	Screw Assy., governor buffer (with spring)	1	1	1
			END OF GOVERNOR ASSEMBLY			
-	-	5176834	Tube Assy., governor bearing lubrication	1	1	1
-	-	5183994	Tube Assy., governor bearing lubrication	1	1	1
-	-	5177752	Elbow, lubrication tube	1	1	1
-	-	5166265	Elbow, lubrication tube restriction (stamped "R")	1	1	1
-	-	137405	Connector, 1/4" inv. fl. tube	1	1	1
-	-	143342	Elbow, 1/4" inv. fl. tube	1	1	1
-	-	596330	Seal, governor		AR	AR
			HYDRAULIC GOVERNOR			
-	-	5108296	Governor Assy., hydraulic (A engine) (includes indented items)	1	1	1
-	-	5108295	Governor Assy., hydraulic (C engine) (includes indented items)	1	1	1
-	-	5108314	Governor Assy., hydraulic (T/C output shaft gov.) (includes indented items)	1	1	1
-	-	186647	Bolt, 1/4"-20 x 1" hex. hd. (gov. to cyl. head)	2	2	2
-	-	186624	Bolt, 5/16"-18 x 1 1/4" hex. hd. (gov. to drive)	4	4	4
-	-	103319	Lockwasher, 1/4"	2	2	2
-	-	103320	Lockwasher, 5/16"	4	4	4
22	2.8035	5150246	Gasket, governor to blower	1	1	1
-	-	5123812	Gasket, governor to cylinder head	2	2	2
22	2.8040	5197607	Screw, governor cover (with lockwasher)	3	3	3
22	2.8045	3249110	Gasket, governor cover	1	1	1
-	-	5197118	Rod, governor fuel (C engine)	1	1	1
-	-	5197097	Rod, governor fuel (A engine)	1	1	1
-	-	5193028	Rod, governor guide spring (T/C output shaft gov.)	1	1	1
22	2.8080	120614	Nut, #10-32 hex.	1	1	1
-	-	5193030	Cover, governor fuel rod spring (T/C output shaft gov.)	1	1	1
-	-	120217	Lockwasher, #10	2	2	2
-	-	120216	Bolt, #10-32 x 1/2" hex. hd.	2	2	2
-	-	5193033	Gasket, governor fuel rod spring cover (T/C output shaft gov.)	1	1	1
-	-	3249112	Seal, governor fuel rod oil	1	1	1
22	2.8100	5197099	Spacer, governor fuel rod	1	1	1
-	-	3249166	Disc, governor fuel rod	1	1	1
-	-	3249117	Spring, governor fuel rod-short	1	1	1
-	-	5197125	Spring, governor fuel rod-short (T/C output shaft gov.)	1	1	1
22	2.8130	5197516	Spring, governor fuel rod-long	1	1	1
-	-	5197290	Retainer, governor fuel rod spring (T/C output shaft gov.)	1	1	1
-	-	5197292	Collar, governor fuel rod	1	1	1
-	-	3249144	Plug, governor sub-cap	1	1	1
-	-	5193031	Plug, governor sub-cap (T/C output shaft gov.)	1	1	1
22	2.8170	3292009	Knob, governor fuel rod	1	1	1
-	-	120614	Nut, #10-32 hex.	1	1	1
-	-	5197259	Screw, governor load limit	1	1	1
-	-	5194069	Washer, copper	1	1	1
-	-	122161	Nut, 1/4"-28 hex. (jam)	1	1	1

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
-	-	5197052	Plug, governor housing dummy hole	1		
-	-	5197094	Plug, governor housing hole (T/C output shaft gov.)	1		
-	-	5197066	Gasket, governor housing dummys hole plug	1		
22	2.8260	3249110	Gasket, governor sub-cap to housing	1		
22	2.8280	5197072	Shaft, governor speed adjusting	1		
-	2.8280	5197846	Pin, 1/8" x 1/2" roll	1		
22	2.8350	5197065	Seal, governor speed adjusting shaft oil	2		
-	-	5197064	Spring, governor speed adjusting shaft torsion	1		
-	-	5197059	Bushing, governor speed adjusting shaft sleeve	2		
22	2.8410	5197013	Lever, governor speed adjusting floating	1		
-	-	5197006	Stop, governor speed adjusting floating lever	1		
22	2.8420	5197015	Lever, governor speed adjusting	1		
-	-	5197016	Pin, governor speed adjusting lever	1		
-	-	5197014	Fork, governor speed adjusting linkage spring	1		
22	2.8440	5197046	Bracket, governor speed adjusting lever	1		
-	-	446142	Washer, #10 flat	1		



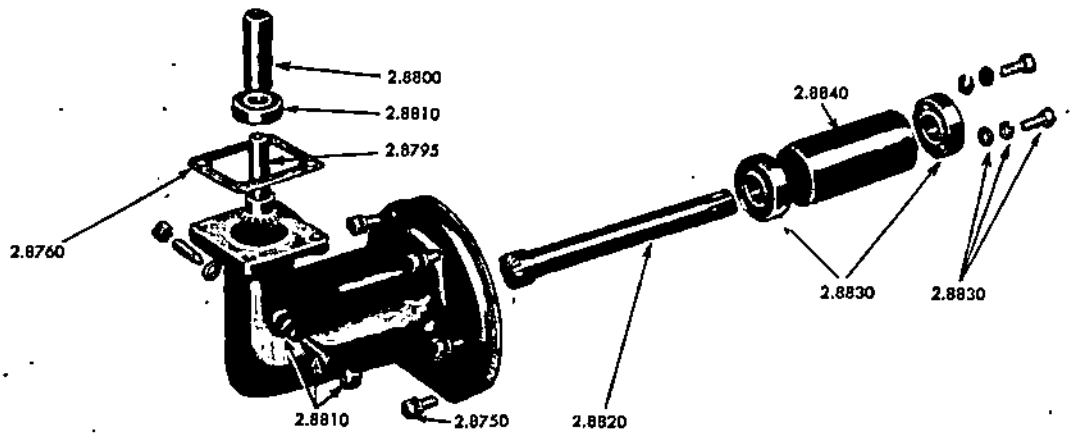


Fig. 22 - Governor - Hydraulic

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
-	-	115545	Lockwasher #10 int. tooth	1	1	1
-	-	100660	Bolt, #10-32 x 1/2" hex. hd.	1	1	1
22	2.8450	5197047	Lever, governor speed adjusting terminal	1	1	1
-	-	5197288	Pin, governor speed adjusting terminal lever	1	1	1
-	-	137171	Pin, 3/32" x 1" cotter	2	2	2
-	-	5197045	Shaft, governor speed adj. terminal	2	2	2
-	-	5197045	Shaft, governor speed adj. terminal-long (T/C output shaft gov.)	1	1	1
-	-	5197084	Shaft, governor speed adj. terminal-short (T/C output shaft gov.)	1	1	1
-	-	5197058	Bushing, governor speed adjusting terminal sleeve	2	2	2
-	-	5197060	Plug, governor speed adjusting terminal sleeve (cup)	2	2	2
22	2.8510	5197019	Piston, governor servo motor	1	1	1
-	-	5197062	Pin, (piston to terminal lever)	1	1	1
22	2.8520	3304053	Screw, governor hi-speed stop	1	1	1
-	-	5194070	Washer, #10 copper	1	1	1
-	-	120614	Nut, #10-32 hex.	1	1	1
22	2.8530	5194255	Spring, governor speeder	1	1	1
22	2.8560	5197011	Ball Head Assy., governor	1	1	1
-	-	5190710	Plunger, governor pilot valve (includes seat which is not sold separately)	1	1	1
22	2.8610	5157328	Bearing, governor pilot valve plunger thrust	1	1	1
-	-	5192787	Ring, governor drive shaft	1	1	1
-	-	5197054	Plunger, governor relief valve	1	1	1
22	2.8660	5197055	Sleeve, governor relief valve	1	1	1
22	2.8660	5197095	Sleeve, governor relief valve (T/C output shaft gov.)	1	1	1
22	2.8680	5197067	Spring, governor relief valve (outer)	1	1	1
22	2.8680	5197068	Spring, governor relief valve (75 p.s.i.)	1	1	1
22	2.8680	5197067	Spring, governor relief valve (T/C output shaft gov.)	2	2	2
22	2.8685	5197056	Plug, governor relief valve (T/C output shaft gov.)	1	1	1
-	-	5197066	Gasket, governor relief valve plug (T/C output shaft gov.)	1	1	1
-	-	5197847	Pin, governor base	2	2	2
-	-	132188	Bolt, #12-24 x 1/2" fil. hd.	3	3	3
22	2.8700	3307753	Ring, governor oil pump housing seal	1	1	1
22	2.8720	5197018	Gear, governor oil pump drive	1	1	1
22	2.8730	5197017	Gear, governor oil pump driven	1	1	1
-	-	5193653	Spacer, governor oil pump driven gear (T/C output shaft gov.)	1	1	1
-	-	5197057	Stud, governor oil pump driven gear to base	1	1	1
-	-	3249147	Stud, governor oil pump driven gear to base (T/C output shaft gov.)	1	1	1
-	-	3290175	Drive Assy., governor (includes indented items)	1		
-	-	3290176	Drive Assy., governor (includes indented items)		1	
-	-	3290177	Drive Assy., governor (includes indented items)			1
22	2.8750	5118219	Bolt, governor drive to blower (with seal-washer)	4	6	6
22	2.8750	179826	Bolt, 5/16"-18 x 2" hex. hd.	2		
-	-	5155596	Washer, governor drive to blower	2		
22	2.8760	3224773	Gasket, drive to governor	1	1	1
22	2.8795	3224084	Shaft, governor driven	1	1	1
22	2.8800	3224085	Sleeve, governor driven shaft	1	1	1
-	-	142494	Pin, 5/32" x 7/8" groove	1	1	1
22	2.8810	954498	Bearing, governor driven shaft	1	1	1
-	-	5169866	Gasket, governor driven shaft spacer set screw nut	1	1	1
-	-	5169864	Screw, governor driven shaft set	1	1	1
-	-	274856	Nut, governor driven shaft spacer set screw	1	1	1
22	2.8820	3222490	Shaft, governor drive	1		
22	2.8820	3222893	Shaft, governor drive		1	
22	2.8820	3222844	Shaft, governor drive			1
22	2.8830	954499	Bearing, governor drive thrust	1	1	1
22	2.8830	186618	Bolt, 5/16"-18 x 5/8" hex. hd.	2	2	2
22	2.8830	5171344	Washer	2	2	2
22	2.8830	103320	Lockwasher, 5/16"	2	2	2
22	2.8840	3222845	Spacer, governor drive shaft bearing			1
-	-	3229477	Tube, governor operating pressure (C engine)	1		
-	-	3223112	Tube, governor operating pressure (C engine)		1	1
-	-	3224751	Tube, governor operating pressure (A engine)		1	1
-	-	5110604	Tube, governor operating pressure (flex. hose) (T/C output shaft governor)	1	1	1

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
-	-	137422	Elbow, 5/16" inv. fl. tube 90°	1	1	1
-	-	143343	Elbow, 5/16" inv. fl. tube 90°, 1/4" PT.	1	1	1
-	-	190367	Elbow, 1/4" street 90°	1	1	1
-	-	118749	Connector, 5/16" fl. tube	1	1	1
-	-	189060	Bushing, 3/4" x 1/4" red pipe	1	1	1
-	-	5155879	Bracket Assy., governor (includes bushing) (C engine) (between governor and cylinder head)	1	1	1
-	-	5155880	Bracket Assy., governor (includes bushing) (A engine) (between governor and cylinder head)	1	1	1
			INJECTOR CONTROLS			
20	2.9001	5195521	Tube Assy., injector control (A eng.)	1		
20	2.9001	5195533	Tube Assy., injector control (C eng.)	1		
20	2.9001	5195522	Tube Assy., injector control (A eng.)		1	
20	2.9001	5195531	Tube Assy., injector control (B eng.)		1	
20	2.9001	5195534	Tube Assy., injector control (C eng.)		1	
20	2.9001	5195526	Tube Assy., injector control (D eng.) (includes indented items)		1	
20	2.9001	5195523	Tube Assy., injector control (A eng.)			1
20	2.9001	5195532	Tube Assy., injector control (B eng.)			1
20	2.9001	5195535	Tube Assy., injector control (C eng.)			1
20	2.9001	5195527	Tube Assy., injector control (D eng.)			1
20	2.9003	5120687	Bracket, injector control tube	2	2	2
20	2.9003	186630	Bolt, 1/4"-20 x 5/8" hex. hd.	4	4	4
20	2.9003	103319	Lockwasher, 1/4"	4	4	4
20	2.9007	5150259	Pin, injector control tube end	1	1	1
20	2.9009	5150263	Lever, injector control tube	1	1	1
20	2.9009	142487	Pin, 1/8" x 7/8" groove		1	1
20	2.9009	142486	Pin, 1/8" x 3/4" groove	1	1	1
-	-	5150843	Spacer, injector control tube lever (B & D engine only)	1	1	1
-	-	5180122	Spacer, (1/2" I.D. x 11/16") (injector control tube) (B & D eng. only) (turbo)		1	1
20	2.9012	5115922	Spring, injector control tube	1	1	1
20	2.9014	5115322	Lever, injector control	3	4	6
20	2.9014	5176228	Screw, injector control lever	6	8	12
20	2.9022	5150990	Link; injector control tube to governor (mechanical gov., A & C eng.)	1	1	1
20	2.9022	5150996	Link, injector control tube to governor (mechanical gov., B & D eng.)		1	1
20	2.9022	5150265	Pin, injector control tube link	1	1	1
20	2.9022	103361	Pin, 1/16" x 1/2" cotter	2	2	2
20	2.9022	32917248	Link (hydraulic governor, A engine)	1	1	1
20	2.9022	32917258	Link (hydraulic governor, C engine)	1	1	1
			THROTTLE CONTROLS (Variable Speed Mechanical Governor)			
23,27	2.9100	5174103	Knob, throttle control	1	1	1
23,27	2.9100	5126312	Lever, throttle control	1	1	1
24	2.9105	3222756	Washer, throttle control tube	1	1	1
24	2.9106	5173992	Shaft, throttle control knob (4 1/2" L.)	1	1	1
24	2.9106	5174104	Shaft, throttle control knob (5 25/32" L.)	1	1	1
-	-	5187628	Washer, throttle control knob	1	1	1
-	-	5175079	Collar, throttle control knob shaft	1	1	1
24	2.9106	443136	Pin, 1/8" x 1 1/4" groove	1	1	1
-	-	139009	Screw, 1/4" - 28 x 1/4" hex. socket cup pt. set	1	1	1
24	2.9108	5174105	Spring, throttle control shaft tension (2" L.)	1	1	1
-	-	5175073	Bracket Assy., throttle control knob shaft (includes bushing)	1	1	1
-	-	3222765	Bushing, throttle control knob shaft bracket	2	2	2
24	2.9170	5168685	Plate, throttle control indicator	1	1	1
-	-	100987	Screw, #12-24 x 3/4" oval hd. sl.	3	3	3
-	-	120391	Washer, 3/16" flat	3	3	3
-	-	103089	Nut, #12-24 hex.	3	3	3
-	-	5166494	Coupling, throttle control shaft	1	1	1

§ Part of hydraulic governor assembly listed for reference only.

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
-	-	5171039	Bracket, governor control shaft (rear) (includes bushing)	1	1	1
24	2.9240	5173993	Bracket Assy., throttle control shaft to flywheel housing (includes bushing)	1	1	1
-	-	3222765	Bushing, throttle control shaft to flywheel housing bracket	2	2	2
23	2.9280	5173995	Rod, throttle control (5 1/4" L.)	1	1	1
-	-	5175086	Rod, throttle control (link) (2 13/16" L.)	1	1	1
23	2.9280	5172547	Rod, throttle control (stud) (1 1/4" L.)	1	1	1
23	2.9280	5118951	Joint, 5/16"-24 ball	2	2	2
-	-	103495	Pin, 5/16" clevis	2	2	2
-	-	103362	Pin, 1/16" x 3/4" cotter	2	2	2
-	-	103320	Lockwasher, 5/16"	2	2	2
-	-	121917	Nut, 5/16"-24 hex.	4	4	4
23	2.9290	5126312	Lever, throttle control rod (lower) (2 1/4" L., 7/16" shaft)	1	1	1
-	-	3224741	Lever, throttle control rod (rear)	1	1	1
-	-	5164318	Lever, throttle control rod (lower)	1	1	1
-	-	5126312	Lever, throttle control rod (rear) (2 1/4" L.)	1		
-	-	5113360	Bracket, throttle control cross shaft			2
23	2.9310	5175083	Shaft, throttle control cross (15 5/8" L.)	1	1	1
23	2.9310	3290823	Shaft, throttle control cross (8 5/8" L.)	1	1	1

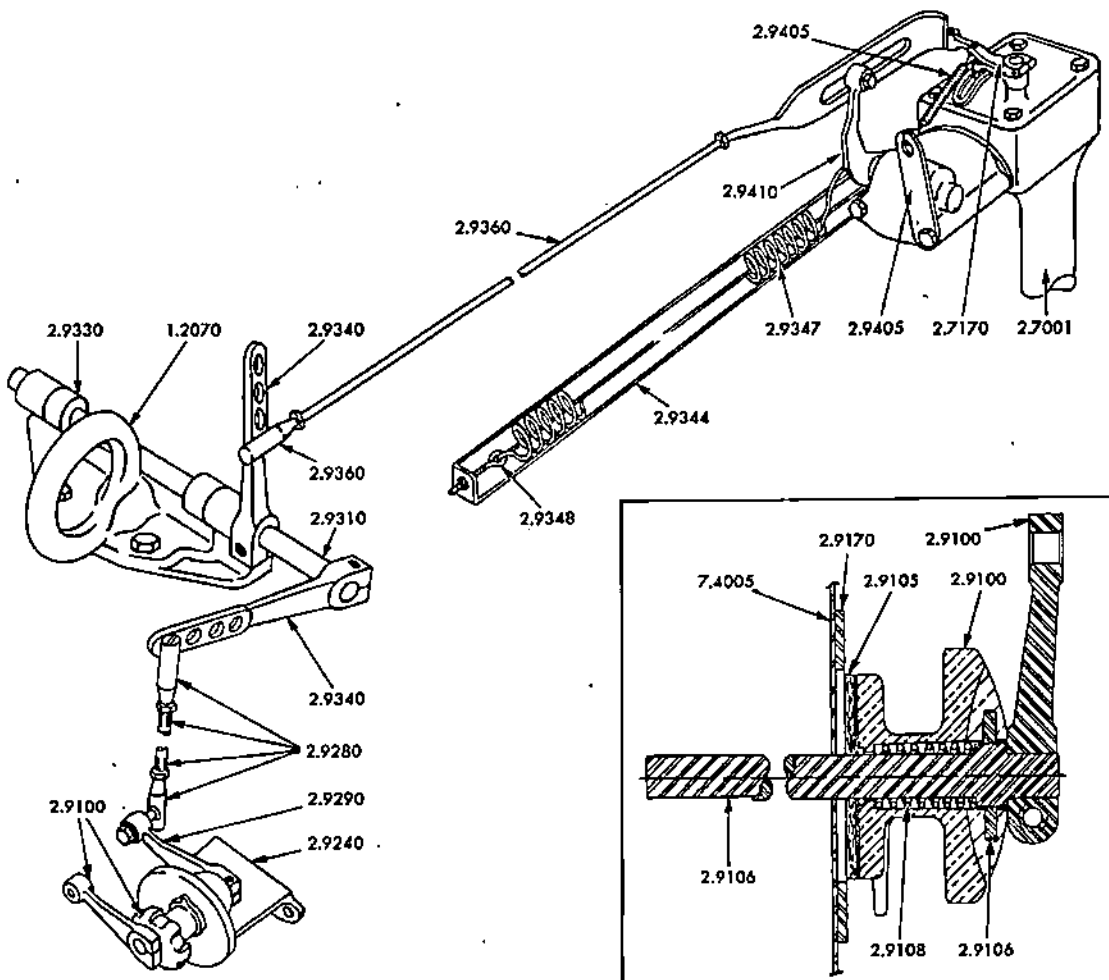


Fig. 23 - Throttle Controls (Variable Speed Governor)

Fig. 24 - Throttle Control Knob

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
23	2.9310	5171324	Shaft, throttle control cross (10" L.)	1	1	1
-	-	5168212	Shaft, throttle control cross (8 3/4" L.)	1	1	1
-	-	5113386	Shaft and Lever Assy., throttle control cross			1
-	-	5113378	Pad, throttle control cross shaft			1
-	-	5113377	Disc, throttle control cross shaft			1
-	-	5113355	Tube, throttle control cross shaft			1
-	-	5113359	Spacer, throttle control cross shaft (1/8" wide)			1
-	-	5113358	Spring, throttle control cross shaft			1
-	-	5113397	Bushing, throttle control cross shaft			2
23	2.9330	5164320	Collar, throttle control cross shaft	AR	AR	AR
-	-	139009	Screw, 1/4"-28 x 1/4" hex. socket cup point set	AR	AR	AR
23	2.9340	5164318	Lever, throttle control cross shaft (4" L., 1/2" shaft)	AR	AR	AR
-	-	5158432	Lever, throttle control cross shaft (2 1/4" L., 1/2" shaft)	2	2	2
23	2.9344	5174110	Bracket, throttle booster spring	1		
23	2.9344	5172501	Bracket, throttle booster spring		1	1
-	-	5113365	Bracket, throttle booster spring			1
23	2.9347	5125716	Spring, throttle booster	1		
23	2.9347	5172499	Spring, throttle booster		1	1
23	2.9348	5173036	Eye, throttle booster adjusting	1		
23	2.9348	5172502	Eye, throttle booster adjusting		1	1
-	-	123179	Nut, 1/4" - 20 hex.	2	2	2
-	-	5186749	Nut, throttle control booster support (spring hanger, 19/32" L.)	1	1	1
-	-	5171429	Nut, throttle control booster support (spring hanger, 13/32" L.)	1	1	1
-	-	5171045	Bolt, throttle control booster support	1	1	1
-	-	5175085	Shaft, throttle control (7 7/16" L.)	1	1	1
-	-	5175087	Shaft, throttle control (10" centers)	1	1	1
23	2.9360	5174122	Shaft, throttle control (link end) (10 7/8" L.)	1		
23	2.9360	5166960	Shaft, throttle control (clevis end) (12 3/4" L.)	1		
-	-	5171571	Shaft, throttle control (rear of engine to governor) (22 3/8" L.)	1		
23	2.9360	5174123	Shaft, throttle control (link end) (16 9/16" L.)		1	
23	2.9360	5166961	Shaft, throttle control (clevis end) (18 1/2" L.)		1	
23	2.9360	5174124	Shaft, throttle control (link end) (27 15/16" L.)			1
-	-	5113379	Shaft, throttle control (rear of engine to governor) (22 7/8" L.)			1
-	-	5166962	Shaft, throttle control (clevis end) (30" L.)			1
-	-	5172654	Link, throttle control shaft to lever	1	1	1
-	-	5120854	Bolt, link	1	1	1
-	-	116535	Clevis, 5/16"-24	1	1	1
-	-	103495	Pin, 5/16" clevis	AR	AR	AR
-	-	103372	Pin, 3/32" x 1/2" cotter	AR	AR	AR
23	2.9360	5118951	Joint, 5/16"-24 ball	1	1	1
-	-	5113488	Spacer, 21/64" I.D. x 5/16" L.			1
-	-	121917	Nut, 5/16"-24 hex.	3	3	3
-	-	122193	Nut, 5/16"-24 hex. thin	3	3	3
-	-	121928	Nut, 5/16"-24 hex. L.H. thd. (link end shaft)	1	1	1
-	-	3222760	Lever, governor control shaft	1	1	1
-	-	3222744	Link, governor control shaft lever	1	1	1
-	-	5172205	Link, governor control shaft lever	1	1	1
-	-	5118951	Joint, 5/16"-24 ball	2	2	2
23	2.9405	5169253	Spring, governor lever retracting	1	1	1
23	2.9405	5169235	Clip, retracting spring	1	1	1
-	-	5175081	Lever, governor control	1	1	1
23	2.9410	5123881	Lever, governor control	1	1	1
25	2.9410	5123880	Lever, governor control	1	1	1
-	-	3249132	Lever, governor control	1	1	1
-	-	5113385	Lever, governor control			1
-	-	1990892	Wire Assy. (90") (governor control)	1	1	1
-	-	1990891	Wire Assy. (50") (governor control)	1	1	1
-	-	5184255	Plate, name (governor control wire)	1	1	1
-	-	5166957	Tube, governor control wire (11 11/16" L.)	1		
-	-	5166958	Tube, governor control wire (20 9/16" L.)		1	
-	-	5166959	Tube, governor control wire (32 1/16" L.)			1
-	-	5161464	Pin, governor control wire swivel	1	1	1
-	-	5150941	Washer, governor control wire swivel	1	1	1
-	-	142583	Retainer, 13/64" (spring)		1	1

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
-	-	100659	Screw, #10-32 x 3/8" fil. hd.	1	1	1
-	-	3290569	Clip (1 3/16" L. - 3/8" bolt)		1	1
			THROTTLE CONTROLS (Limiting Speed Mechanical Governor)			
24	2.9100	5174103	Knob, throttle control	1	1	1
24	2.9100	5126312	Lever, throttle control	1	1	1
24	2.9105	3222756	Washer, throttle control tube brake	1	1	1
24	2.9106	5174104	Shaft, throttle control knob (5 25/32" L.)	1	1	1
24	2.9106	5173992	Shaft, throttle control knob (4 1/2" L.)	1	1	1
-	-	5187628	Washer, throttle control knob	1	1	1
24	2.9106	443136	Pin, 1/8" x 1 1/4" groove	1	1	1
24	2.9108	5174105	Spring, throttle control shaft tension (2" L.)	1	1	1
24	2.9170	5168685	Plate, throttle control indicator	1	1	1
-	-	100987	Screw, #12-24 x 3/4" oval hd. sl.	3	3	3
-	-	120391	Washer, 3/16" flat	3	3	3
-	-	103089	Nut, #12-24 hex.	3	3	3
23	2.9240	5173993	Bracket Assy., throttle control shaft to flywheel housing (inc. bushing)	1	1	1
-	-	3222765	Bushing, throttle control shaft to flywheel housing bracket	2	2	2
23	2.9280	5173995	Rod, throttle control (5 1/4" L.)	1	1	1
74	2.9280	5110635	Rod Assy., throttle control (20 1/4" L.) (tail shaft governor)	1	1	
23	2.9280	5172547	Rod, throttle control (stud) (1 1/4" L.)	1	1	1
23	2.9280	5118951	Joint, 5/16"-24 ball	2	2	2
23	2.9290	5126312	Lever, throttle control rod (lower)	1	1	1
-	-	5113360	Bracket, throttle control cross shaft			2
-	-	5182674	Bracket Assy., throttle control cross shaft (eng. lifter, inc. bearing)	1	1	
-	-	148403	Bearing, needle	2	2	
23	2.9310	5168212	Shaft, throttle control cross (8 3/4" L.)		1	1
23	2.9310	3290823	Shaft, throttle control cross (8 5/8" L.)	1	1	1
25	2.9310	5171324	Shaft, throttle control cross (10" L.)	1	1	1
23	2.9310	5110625	Shaft, throttle control cross (10 1/2" L.)	1	1	

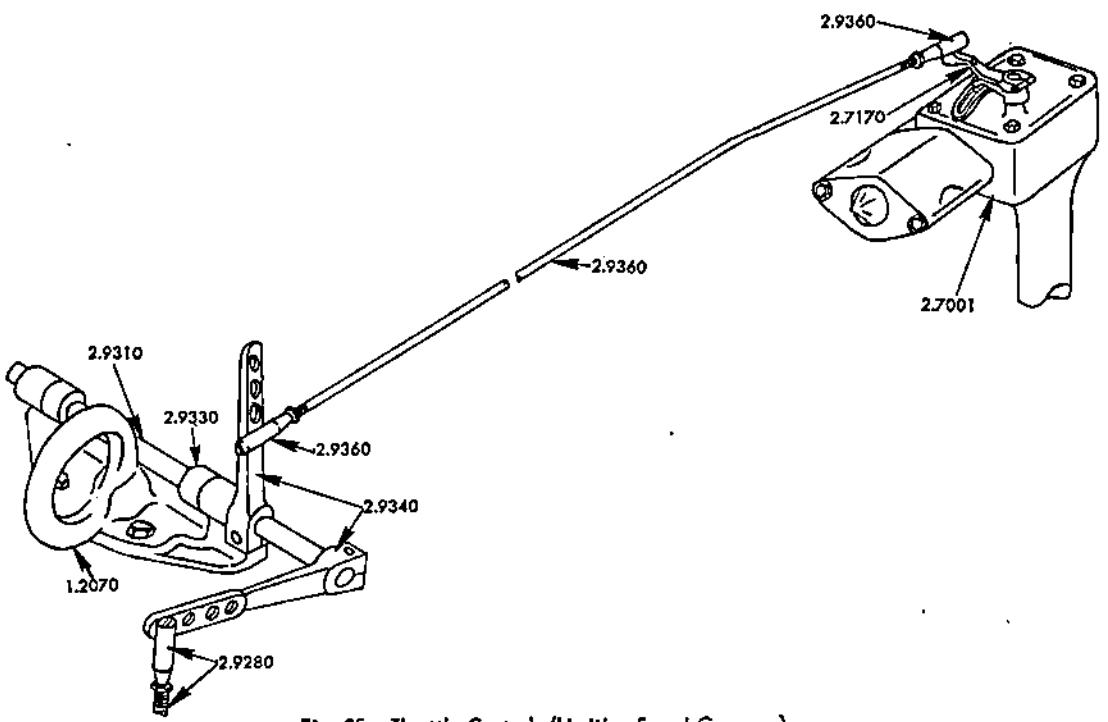


Fig. 25 – Throttle Controls (Limiting Speed Governor)

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
25	2.9310	5112716	Shaft, throttle control cross (15 1/2"L.)	1	1	1
-	-	5113386	Shaft and Lever Assy., throttle control cross (17 9/16")			1
-	-	5113378	Pad, throttle control cross shaft			1
-	-	5113377	Disc, throttle control cross shaft			1
-	-	5113359	Spacer, throttle control cross shaft (1/8" W.)			2
-	-	5113358	Spring, throttle control cross shaft			1
-	-	5113397	Bushing, throttle control cross shaft			2
25	2.9330	5164320	Collar, throttle control cross shaft (1/2" I.D. x 5/8" L.)	2	2	2
-	-	139009	Screw, 1/4"-28 x 1/4" hex. socket cup pt. set	AR	AR	AR
25	2.9340	5154448	Lever (offset) (1 hole)		1	1
25	2.9340	5164318	Lever, throttle control cross shaft (4 hole, front and rear)	2	2	2
25	2.9340	5158432	Lever, throttle control cross shaft (rear)	1	1	
25	2.9360	3290825	Shaft, throttle control (16 1/8" L.)	1		
25	2.9360	5110629	Shaft, throttle control (23 5/16" L.) (L.H. offset)		1	
25	2.9360	5110627	Shaft, throttle control (17 9/16" L.) (L.H. offset)	1		
25	2.9360	5110628	Shaft, throttle control (17 9/16" L.) (R.H. offset)	1		
24	2.9360	5119653	Shaft, throttle control (21 5/8" L.)		1	
25	2.9360	3290826	Shaft, throttle control (21 7/8" L.)			1
-	-	5113387	Shaft, throttle control (5 7/16" L.)			1
25	2.9360	3290828	Shaft, throttle control (33 3/8" L.)			1
23	2.9360	5181931	Shaft, throttle control (34 5/16" L.)			1
25	2.9360	5118951	Joint, 5/16"-24 ball	2	2	2
-	-	103320	Lockwasher, 5/16"	2	2	2
-	-	121917	Nut, 5/16"-24 hex.	4	4	4
-	-	5110624	Lever, governor control	1	1	
-	-	5184098	Lever, governor control	1	1	
-	-	954952	Bearing, governor control lever	1	1	
-	-	274844	Snap Ring, governor control lever	2	2	
-	-	1990800	Wire Assy. (57") (governor control)		1	1
-	-	5161464	Pin, governor control wire swivel			1
-	-	5150941	Washer, governor control wire swivel			1
-	-	142583	Retainer, 13/64" (spring)			1
-	-	5155782	Clip			1
-	-	5157809	Clip (15/16" L. - 7/16" bolt)			1
-	-	142583	Retainer, spring (13/64")			1
-	-	5150941	Washer			1
-	-	5161464	Pin, swivel			1
-	-					
			THROTTLE CONTROLS (Hydraulic Governor)			
24	2.9100	5174103	Knob, throttle control	1	1	1
24	2.9100	5126312	Lever, throttle control	1	1	1
25	2.9105	3222756	Washer, throttle control tube brake	1	1	1
27	2.9106	5174104	Shaft, throttle control knob (5 25/32" L.)	1	1	
24	2.9106	5173992	Shaft, throttle control knob (4 1/2" L.)	1	1	1
-	-	5187628	Washer, throttle control knob	1	1	1
24	2.9106	443136	Pin, 1/8" x 1 1/4" groove	1	1	1
24	2.9108	5174105	Spring, throttle control shaft tension (2" L.)	1	1	1
-	-	3292337	Control Assy., vernier throttle (includes indented items)	1	1	1
28	2.9135	3224408	Knob, vernier throttle control	1	1	1
28	2.9138	3291979	Spring, vernier throttle control lock	1	1	1
28	2.9138	112871	Screw, #6-32 x 5/16" rd. hd. sl.	2	2	2
28	2.9139	3224425	Worm, vernier throttle control	1	1	1
28	2.9140	3224405	Shaft, vernier throttle control	1	1	1
28	2.9141	3224410	Gear, vernier throttle control worm	1	1	1
-	-	106958	Key, 1/16" x 1/2" woodruff	1	1	1
28	2.9142	3224409	Bushing, vernier throttle control worm	1	1	1
28	2.9142	106498	Lockwasher, #12	1	1	1
28	2.9142	103089	Nut, #12-24 hex.	1	1	1
28	2.9145	3224407	Button, vernier throttle control lock	1	1	1

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
28	2.9146	3224406	Pin, vernier throttle control lock button	1	1	1
28	2.9147	3224413	Spring, vernier throttle control lock button pin	1	1	1
28	2.9149	3292336	Cover, vernier throttle control	1	1	
-	-	3292274	Plate, throttle control indicator (with vernier control)	1	1	1
-	-	133046	Bolt, 1/4" - 20 x 7/8" rd. hd. sl.	3	3	3
-	-	103319	Lockwasher, 1/4"	3	3	3
-	-	3292280	Bracket Assy.	1	1	1
-	-	123179	Nut, 1/4"-20 hex.	3	3	3
24	2.9179	5168685	Plate, throttle control indicator	1	1	1
-	-	3292274	Plate, throttle control indicator	1	1	1
-	-	100987	Screw, #12-24 x 3/4" oval hd. sl.	3	3	3
-	-	120391	Washer, 3/16" flat	3	3	3
-	-	103089	Nut, #12-24 hex.	3	3	3
-	-	5163911	Shaft, throttle control (31 3/8" L.)	1	1	
-	-	5171476	Shaft, throttle control (36 15/16" L.)			1
26	2.9180	5166494	Coupling, control shaft to knob shaft	1	1	1
-	-	139069	Screw, 1/4" -28 x 1/4" set	4	4	4
-	-	5171513	Shaft (4 3/8" L.)	1	1	1
-	-	5171514	Bolt Assy. (to flywheel housing)	1	1	1

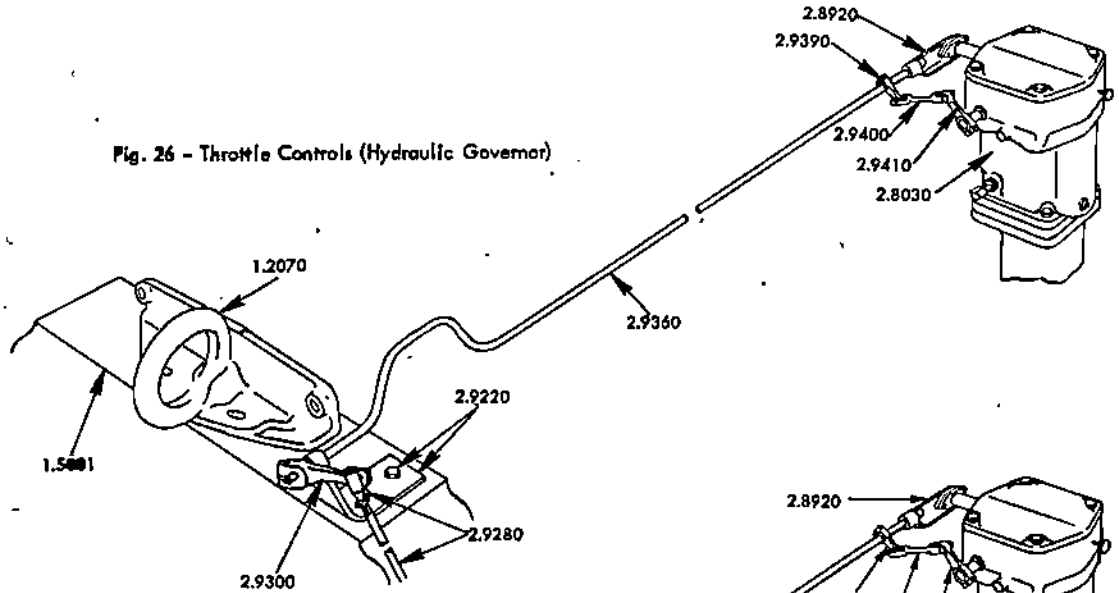


Fig. 26 - Throttle Controls (Hydraulic Governor)

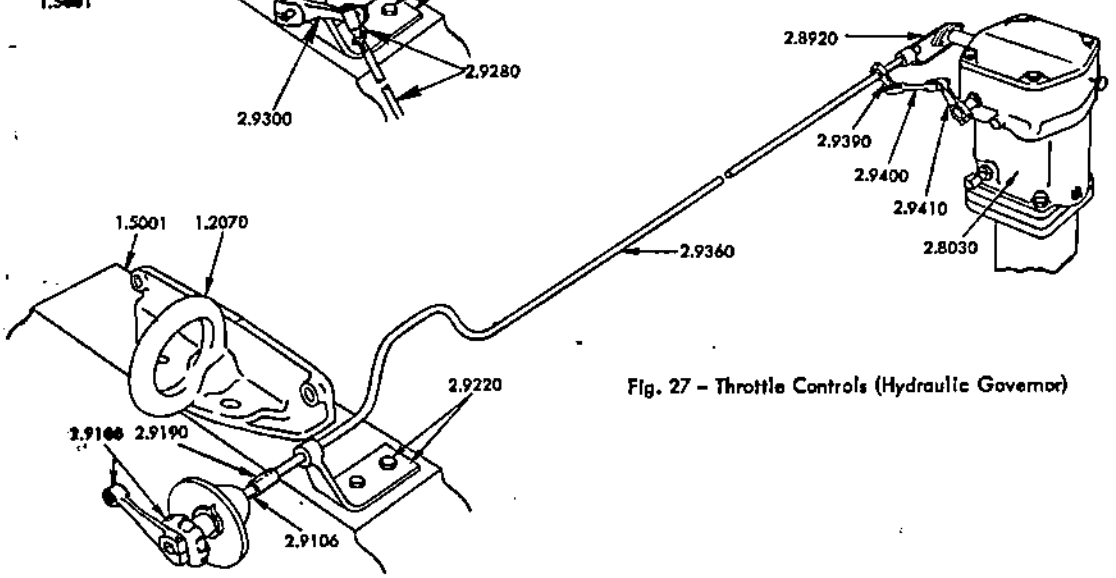


Fig. 27 - Throttle Controls (Hydraulic Governor)

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
26,27	2.9200	5171039	Bracket Assy., governor control shaft (inc. bushing 3 5/16" L.)	1	1	1
26,27	2.9220	5171486	Bracket Assy., governor control shaft (inc. bushing 4 9/16" L.)	1	1	1
26,27	2.9220	179839	Bolt, 3/8"-16 x 1" hex. hd.	2	2	2
-	-	103321	Lockwasher, 3/8"	2	2	2
-	-	3222765	Bushing, control shaft bracket	1	1	1
23	2.9240	5173993	Bracket Assy., control shaft to flywheel housing (inc. bushing)	1		1
-	-	3222765	Bushing, bracket	2	2	2
-	-	5184887	Rod Assy., throttle control (output shaft governor) (21 3/16")	1		
23	2.9280	5173995	Rod, throttle control (stud) (5 1/4" L.)	1	1	1
74	2.9280	5110636	Rod Assy. (output shaft governor)	1		
-	-	5171516	Rod, throttle control (clevis) (3 7/16" L., 1/4"-28 tap)	1		1
23	2.9280	5118951	Joint, 5/16" ball	2	2	2
-	-	103320	Lockwasher, 5/16"	2	2	2
-	-	121917	Nut, 5/16"-24 hex.	4		4
23	2.9290	5126312	Lever, throttle control rod (lower) (1 hole)	1	1	1
-	-	3222760	Lever, throttle control rod (1 hole, 7/8" L.)	1	1	1
-	-	3224741	Lever, throttle control rod (rear)	1	1	1
27	2.9300	5123612	Lever, throttle control (rear)	1	1	1
-	-	5182674	Bracket Assy., engine lifter (includes bearing)	1	1	1
-	-	148403	Bearing, needle	2	2	2
-	-	5182447	Lever, throttle control cross shaft (short) (rear) (.375" ream hole)	1	1	1
-	-	5182843	Lever, throttle control cross shaft (1 hole front)	1		
-	-	5182437	Shaft, throttle control (10" L.) (front)	1		
-	-	5182438	Shaft, throttle control (11 5/8" L.) (rear)	1		
-	-	5110625	Shaft, governor output shaft (10 1/2" L.)	1		
-	-	5164320	Collar, throttle control cross shaft	2		
-	-	5156432	Lever, throttle control cross shaft (rear)	1		
-	-	5164318	Lever, throttle control cross shaft (4 hole front)	2		
26,27	2.9360	5171571	Shaft, throttle control (22 3/8" L.)	1		
26,27	2.9360	5166493	Shaft, throttle control (21 9/16" L.)	1		
27	2.9360	5171610	Shaft, throttle control (22 7/8" L.)	1		
26,27	2.9360	5171572	Shaft, throttle control (28 1/8" L.)			
26,27	2.9360	5168465	Shaft, throttle control (27 5/16" L.)			1

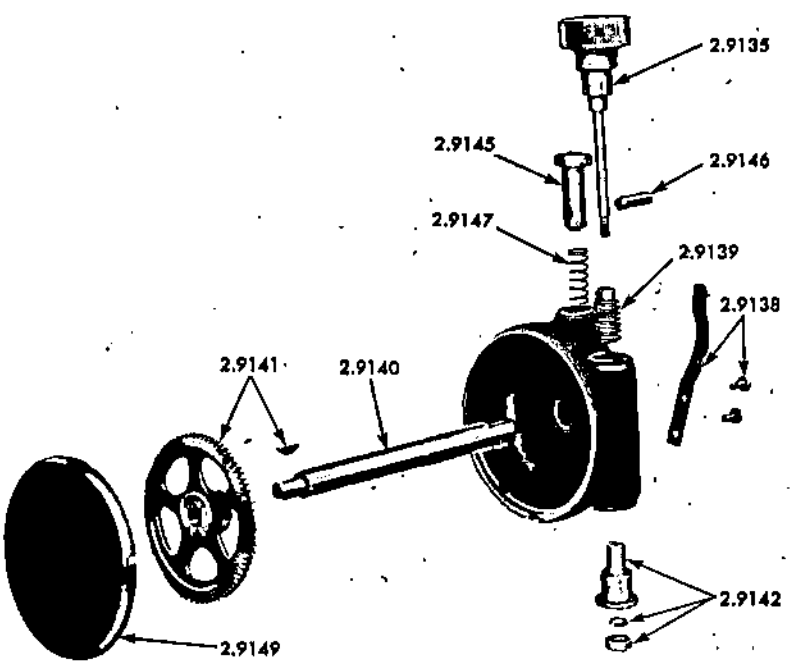


Fig. 28 - Vernier Throttle Control Knob

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
27	2.9360	3290477	Shaft, throttle control (25 1/8" L.)		1	
27	2.9360	5171511	Shaft, throttle control (28 5/8" L.)		1	
-	-	5182448	Rod Assy., throttle control (rear of engine to governor)	1		
26,27	2.9360	5174023	Shaft, throttle control (39 5/8" L.)			1
-	-	5171512	Shaft, throttle control (40 1/8" L.)			1
26,27	2.9360	5167287	Shaft, throttle control (38 13/16" L.)			1
26	2.9360	5168687	Shaft, throttle control (37 1/8" L.)			1
-	-	5178006	Turnbuckle, throttle control shaft	1	1	1
-	-	5177401	Bearing, throttle control shaft	3	3	3
26,27	2.9390	3222760	Lever, throttle control shaft	1	1	1
26,27	2.9400	5174111	Link, throttle control shaft lever	1	1	1
-	-	5182459	Bearing, rod end	1	1	1
-	-	114783	Pin, 1/4" clevis	2	2	2
-	-	5182454	Bolt	1	1	1
-	-	103361	Pin, 1/16" x 1/2" cotter	2	2	2
-	-	5156530	Spring, governor lever retracting	1	1	1
-	-	5188844	Spring, output shaft governor return	1	1	1
26,27	2.9410	3249132	Lever, governor control (1 3/4" L., 3/8" shaft hole)	1	1	1
-	-	5110624	Lever, governor control (output shaft, adjustable)	1	1	1
-	-	5175081	Lever, hydraulic governor control (1 3/4" L., 5/16" shaft hole)	1	1	1
-	-	274844	Snap Ring	2	2	2
-	-	954952	Bearing, governor	1	1	1
-	-	5182684	Quadrant, hydraulic governor control lever	1	1	1
-	-	5170765	Spacer (11/32" I.D. x 21/32" L.)	1	1	1
-	-	5182699	Stud	1	1	1
-	-	5176267	Lock (lever) throttle control (master)	1	1	1
			AIR CLEANER			
30	3.1001	5183248	Air Cleaner Assy., light duty	1	1	2
30	3.1001	5119046	Air Cleaner Assy., 10" dia. heavy duty	1		
30	3.1001	5120143	Air Cleaner Assy., 12" dia. heavy duty (4" dia. outlet)		1	
29	3.1001	5123051	Air Cleaner Assy., 13" dia. (includes indented items)		1	
30	3.1001	9178764	Air Cleaner Assy., 14" dia. heavy duty (5 1/2" outlet)		1	1
29	3.1001	5114214	Air Cleaner Assy., 12" dia. light duty (4" outlet)			2
30	3.1001	5113180	Air Cleaner Assy., 12" dia. heavy duty (4" outlet)			2
29	3.1001	5123925	Air Cleaner Assy., 12" dia.			2
29	3.1001	5129861	Air Cleaner Assy., 14" dia. heavy (4" outlet)			1
29	3.1010	5195334	Cup, air cleaner (12" dia., 3 1/2" deep)		1	2
30	3.1010	5193152	Cup, air cleaner (light duty)	1	1	2
-	-	5196152	Cup, air cleaner (10" dia., heavy duty)	1		
-	-	9024612	Cup, air cleaner (14" dia., 5 7/32" deep)		1	1
-	-	5195329	Cup, air cleaner (12" dia., 5 1/4" deep)		1	2
-	-	5196943	Cup, air cleaner (13" dia., inner)		1	2
-	-	5196944	Cup, air cleaner (13" dia.)		1	2
-	-	5196951	Cup, air cleaner (14" dia., inner oil)			1
-	-	5196952	Cup, air cleaner (14" dia.)			1
-	-	1543005	Gasket, air cleaner cup	1	1	2
-	-	5196151	Screen, air cleaner (10" dia., heavy duty)	1		
-	-	5195328	Screen, air cleaner (12" dia., 3 1/2" deep)		1	2
-	-	9024611	Screen, air cleaner (14" dia., 4" deep)		1	1
30	3.1045	5193150	Baffle, air cleaner (light duty)	1	1	2
30	3.1045	5193149	Ring, air cleaner baffle snap (light duty)	1	1	2
29	3.1050	5196950	Element, air cleaner (14" dia. air cleaner)			1
29	3.1050	5196942	Element, air cleaner (13" dia. air cleaner)		1	2
29	3.1050	5195333	Element, air cleaner (12" dia. air cleaner)		1	2
-	-	5193157	Gasket, air cleaner screen (10" dia.)	2		
-	-	5193289	Gasket, air cleaner screen (12" dia., heavy duty)	1	2	4
-	-	5193159	Gasket, air cleaner screen (14" dia., heavy duty)		2	2
30	3.1070	5193669	Bolt, air cleaner (light duty) (includes gasket and retainer)	1	1	2
-	-	5195335	Rod Assy.			4
29	3.1070	5196945	Rod Assy., air cleaner side (4 1/2" L.) (includes nut)	2	2	2
-	-	5196945	Rod Assy. (includes nut)			4
-	-	5192998	Rod Assy., air cleaner side (5 1/2" L.)	2	2	4

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
-	-	9024610	Rod Assy., air cleaner side (6" L.)		2	2
29	3.1070	5197637	Band Assy., air cleaner rod (13" cleaner)(includes screw and nut)		1	
29	3.1070	5197634	Band Assy., air cleaner rod (14" cleaner)			1
29	3.1100	5183230	Hood, air cleaner air inlet (3 3/4" pipe dia.)	1		
29	3.1100	5110226	Hood, air cleaner air inlet (4 1/2" pipe dia.)		1	2
29	3.1100	5110225	Hood, air cleaner air inlet (5" pipe dia.)			1
29	3.1200	5174842	Elbow, air inlet (3 1/2" dia. pipe)	1	1	
29	3.1200	5174844	Elbow, air inlet (4" dia. pipe)			1
29	3.1220	5183229	Strap, air cleaner mounting (10" cleaner)	2		
29	3.1220	5185800	Strap, air cleaner mounting (12" cleaner)		2	4
29	3.1220	9138823	Strap, air cleaner mounting (13" cleaner)		2	
30	3.1220	5185801	Strap, air cleaner mounting (14" cleaner)			2
-	-	5174842	Pipe, air cleaner to inlet housing (open units)	1	1	
30	3.1260	5174854	Pipe, air cleaner to inlet housing (open units)	1	1	
30	3.1260	5183872	Pipe, air cleaner to inlet housing (units with hoods)	1		
30	3.1260	5174855	Pipe, air cleaner to inlet housing (open units)		1	

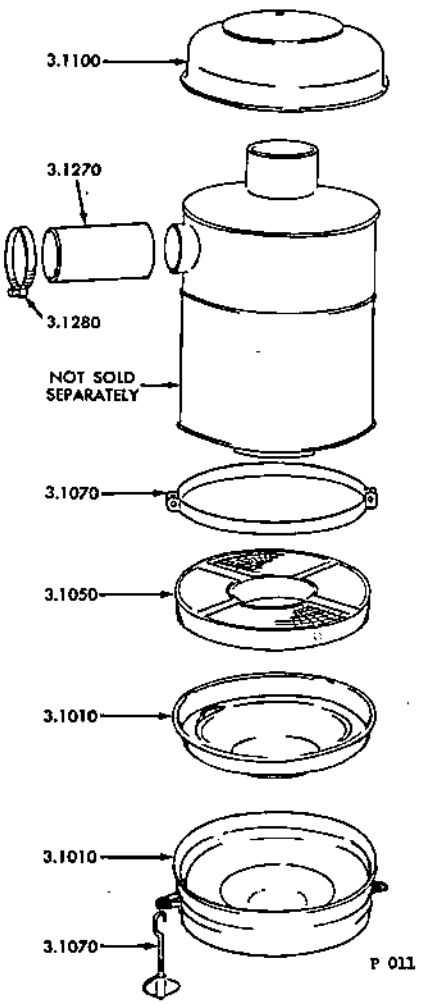


Fig. 29 – Air Cleaner (Heavy Duty)

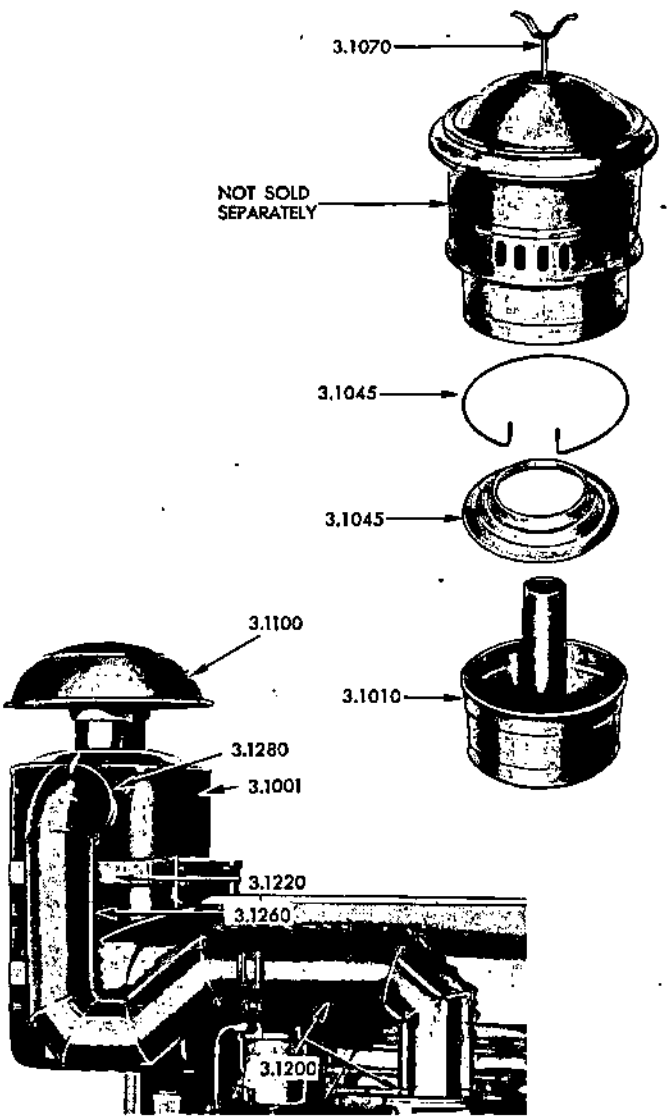


Fig. 30 – Air Cleaner (Light Duty)

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
30	3.1260	5183873	Pipe, air cleaner to inlet housing (units with hoods)			
-	-	5174844	Pipe, air cleaner to inlet housing (open units)			1
30	3.1260	5183874	Pipe, air cleaner to inlet housing (units with hoods)			
-	-	5183904	Hose, air cleaner inlet pipe (4" I.D. x 4 1/2" L.)	AR	AR	AR
-	-	5185782	Hose, air cleaner inlet pipe (4" I.D. x 2 1/4" L.)	AR	AR	AR
30	3.1280	5113246	Clamp, air cleaner inlet pipe hose	AR	AR	AR
			AIR INLET HOUSING			
1,2	3.3001	5166894	Housing Assy., air inlet	1		
-	-	5181831	Housing Assy., air inlet		1	
1,2	3.3001	5166893	Housing Assy., air inlet		1	
-	-	5116818	Housing Assy., air inlet (includes indented items)			1
1,2	3.3001	5166773	Housing Assy., air inlet (single inlet)			1
1,2	3.3001	5166951	Housing Assy., air inlet (dual inlet)			
-	-	186619	Bolt, 3/8"-16 x 1 1/8" hex. hd.		4	
31	3.3001	179844	Bolt, 3/8"-16 x 1 5/8" hex. hd.	4		4
31	3.3001	179847	Bolt, 3/8"-16 x 2" hex. hd.			1
31	3.3001	179848	Bolt, 3/8"-16 x 2 1/4" hex. hd.			1
-	-	103321	Lockwasher, 3/8"	4	4	6
-	-	5113493ø	Housing and Shutdown Valve Assy., air inlet			1
31	3.3003	5166713	Housing, air inlet	1		
31	3.3003	5166742	Housing, air inlet		1	
-	-	5114965	Housing, air inlet		1	

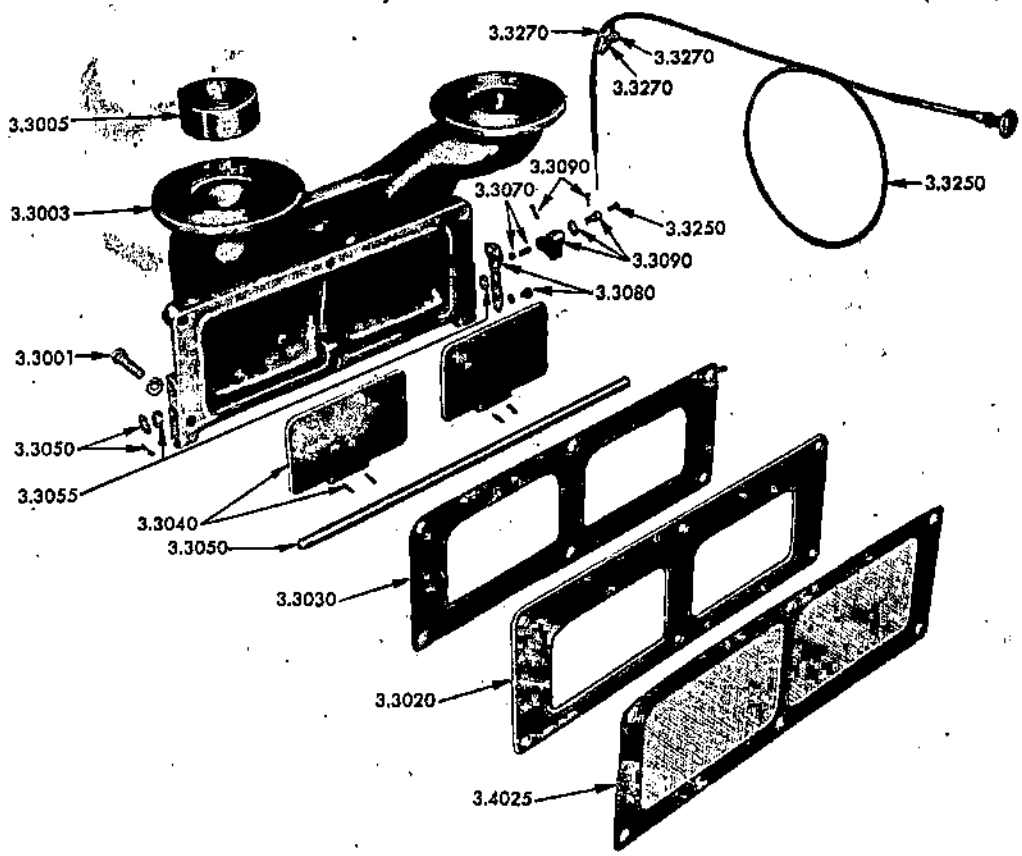


Fig. 31 - Air Inlet Housing

ø Part of shutdown assy. 5116818.

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
31	3.3003	5166763	Housing, air inlet (single inlet)			1
31	3.3003	5163202	Housing, air inlet (dual inlet)			1
-	-	5112902	Housing, air inlet (part of assy. 5112927)			1
31	3.3005	5158616	Tube, air cleaner mounting	1	2	2
31	3.3005	5166913	Tube, air cleaner mounting		1	
-	-	5166716	Gasket, air inlet housing flange	1	1	
-	-	5124405	Gasket, air inlet housing flange			1
31	3.3020	3290576	Plate, air inlet housing striker	1		
31	3.3020	3290611	Plate, air inlet housing striker		1	
31	3.3020	3290399	Plate, air inlet housing striker			1
31	3.3030	3290577	Gasket, air inlet housing striker plate	1		
31	3.3030	3290612	Gasket, air inlet housing striker plate		1	
31	3.3030	3290572	Gasket, air inlet housing striker plate			1
31	3.3040	5172029	Valve, air inlet housing shutdown	1		
31	3.3040	5172030	Valve, air inlet housing shutdown		1	
31	3.3040	5172031	Valve, air inlet housing shutdown			2
31	3.3040	273436	Pin, 1/8" x 11/16" roll	2	2	4
31	3.3050	3290578	Shaft, air inlet housing shutdown valve	1		
31	3.3050	3290613	Shaft, air inlet housing shutdown valve		1	
31	3.3050	3290567	Shaft, air inlet housing shutdown valve (15 1/4" L.)			1
-	-	5112971ø	Shaft, air inlet housing shutdown valve			1
31	3.3050	103341	Washer, 3/8" flat	1	1	1
-	-	273436ø	Pin, 1/8" x 11/16" roll			1
31	3.3050	107762	Pin, 3/32" x 5/8" cotter	1	1	1
31	3.3055	5182977	Seal Ring, air inlet housing shutdown valve shaft	2	2	2
31	3.3070	3291796	Spring, air inlet housing shutdown valve tension	1	1	1
31	3.3070	104919	Ball, 5/16" dia. steel	1	1	1
-	-	5111904ø	Spring, air inlet housing shutdown valve tension		1	1
-	-	5112787ø	Spring, air shutdown latch		1	1
31	3.3080	5168276	Lockplate, air inlet housing shutdown	1	1	1
31	3.3080	180016	Bolt, 1/4"-20 x 1/2" hex. hd.	2	2	2
31	3.3090	3290624	Lever, air inlet housing shutdown valve	1	1	1
-	-	5112785ø	Latch, air shutdown cam release			1
31	3.3090	5168374	Nut	1	1	1
31	3.3090	103361	Pin, 1/16" x 1/2" cotter	1	1	1
31	3.3090	273436	Pin, 1/8" x 11/16" roll	1	1	1
-	-	121926ø	Bolt, 1/4"-20 x 1 1/2" hex. hd.			1
31	3.3090	120392	Washer, 1/4" flat	1	1	1
-	-	5122623	Cam, air shutdown			1
-	-	5114974ø	Handle, air shutdown cam pin			1
-	-	5113633ø	Spacer, air shutdown cam release latch			1
31	3.3250	1990891	Wire Assy., air inlet housing shutdown control (L. 50")	1	1	1
31	3.3250	1990892	Wire Assy., air inlet housing shutdown control (L. 90")	1	1	1
31	3.3250	100659	Screw, #10-32 x 3/8" fil. hd.	1	1	
31	3.3270	3290569	Clip, air inlet housing shutdown control wire	1	1	1
31	3.3270	123298	Bolt, 1/4"-28 x 3/8" hex. hd.	1	1	1
31	3.3270	121902	Nut, 1/4"-28 hex.	1	1	1
			BLOWER			
1	3.4001	5120991	Blower Assy. (C & D eng.)	1		
1	3.4001	5120994	Blower Assy. (A & B eng.)	1		
1	3.4001	5120992	Blower Assy. (C & D eng.)		1	
-	3.4001	5120995	Blower Assy. (A & B eng.) (includes indented items)		1	
1	3.4001	5120993	Blower Assy. (C & D eng.)			1
1	3.4001	5120996	Blower Assy. (A & B eng.)			1
-	3.4001	5114475	Blower Assy. (C & D "E" eng.)			1
34	3.4001	179866	Bolt, 7/16"-14 x 2" hex. hd.	4	4	8
34	3.4001	5150238	Washer, blower attaching bolt	4	4	8
-	-	5192752	Blower Kit, installation	AR		
-	-	5192753	Blower Kit, installation (includes all parts required for installation)		AR	
-	-	5192754	Blower Kit, installation			AR

ø Part of shutdown assy. 5116818.

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
-	-	5192796	Blower Kit, repair (includes rotor bearings, shims, end plate seals, spacer and cover gaskets	AR	AR	AR
34	3.4010	5150235	Gasket, blower	1		
34	3.4010	5115657	Gasket, blower		1	
34	3.4010	5115656	Gasket, blower			1
34	3.4020	5155865	Housing, blower	1		
34	3.4020	5114200	Housing, blower		1	
34	3.4020	5111715	Housing, blower			1
31,32	3.4025	5150779	Screen, blower	1		
31,32	3.4025	5150780	Screen, blower		1	
31,32	3.4025	5111861	Screen, blower			1
31,32	3.4030	5179047	Rotor Assy., blower (L.H. helix, lower)	1		
32	3.4030	5158142	Rotor Assy., blower (R.H. helix, upper)	1		
32	3.4030	5179048	Rotor Assy., blower (L.H. helix, lower)		1	
32	3.4030	5158144	Rotor Assy., blower (R.H. helix, upper)		1	
32	3.4030	5179049	Rotor Assy., blower (L.H. helix, lower)			1
32	3.4030	5157232	Rotor Assy., blower (R.H. helix, upper)			1
32	3.4030	5114749	Rotor Assy., blower (L.H. helix, lower, "E" eng.)			1
32	3.4030	5114746	Rotor Assy., blower (R.H. helix, upper, "E" eng.)			1
-	-	5165289	Plug, blower rotor	1	6	1
-	-	142522	Pin, 1/4" x 1 3/4" groove	1	4	1
32	3.4035	5179046	Shaft Assy., blower rotor front	1	1	1
32	3.4040	7451054	Bearing, blower rotor front	2	2	2
32	3.4050	5179017	Retainer, blower rotor front bearing	2	2	2
32	3.4050	443603	Bolt, 1/4"-20 x 3/4" hex. hd.	6	6	6

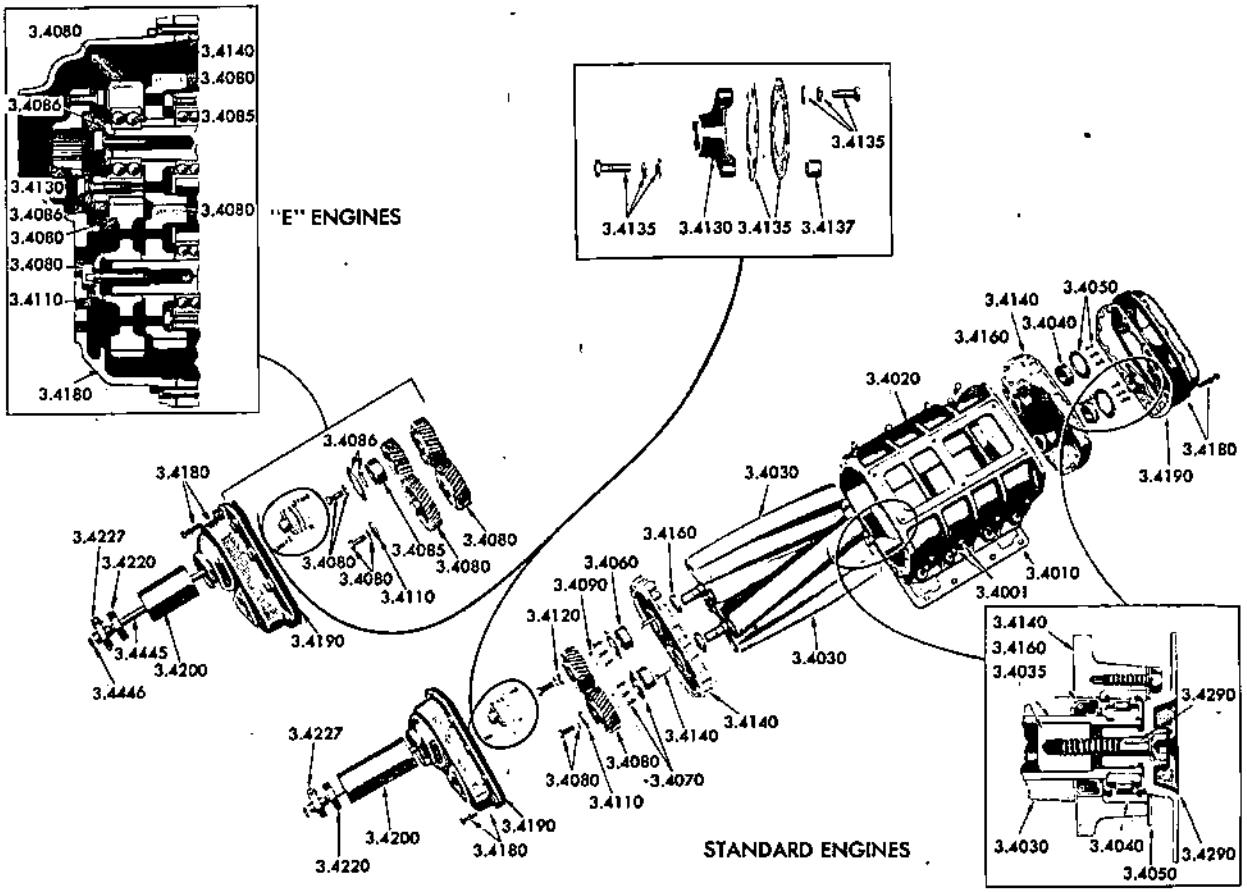


Fig. 32 – Blower

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
-	-	103319	Lockwasher, 1/4"	6	6	6
32	3.4060	954418	Bearing, blower rotor rear	2	2	2
32	3.4070	5179017	Retainer, blower rotor rear bearing	2	2	2
32	3.4070	443603	Bolt, 1/4"-20 x 3/4" hex. hd.	6	6	6
-	-	103319	Lockwasher, 1/4"	6	6	6
32	3.4080	5192234	Gear Set, blower rotor timing	1	1	1
32	3.4080	5194805	Gear Set, blower rotor (reduction) ("E" engine)			1
32	3.4080	182776	Bolt, 1/4"-20 x 1 1/4" hex. hd.	2	2	2
32	3.4080	5154398	Lockwasher, blower rotor gear	2	2	2
32	3.4090	5150372	Shim, blower rotor gear (.002")	AR	AR	AR
32	3.4090	5153938	Shim, blower rotor gear (.003")	AR	AR	AR
32	3.4090	5150855	Shim, blower rotor gear (.005")	AR	AR	AR
32	3.4090	5150856	Shim, blower rotor gear (.010")	AR	AR	AR
32	3.4110	5154401	Disc, blower rotor fuel pump coupling	1	1	1
32	3.4120	5154400	Washer, blower rotor gear retaining	1	1	1
32	3.4130	5173366	Hub, blower rotor gear	1	1	1
32	3.4135	5173365	Plate, blower rotor gear hub	1	2	2
32	3.4135	5173362	Bolt (plate to hub)	3	3	3
32	3.4135	5173363	Bolt (plate to gear)	3	3	3
32	3.4135	103320	Lockwasher, 5/16"	6	6	6
32	3.4135	120393	Washer, 5/16" flat	6	6	6
32	3.4137	5173364	Spacer, blower rotor gear hub	3	3	3
32	3.4140	5193719	Plate Assy., blower housing end (includes dowels)	2	2	2
32	3.4140	5114528	Pin (dowel)	4	4	4
32	3.4140	117296	Bolt, 5/16"-18 x 1 1/2" fil. hd.	4	4	4
32	3.4160	5150220	Seal, blower housing end plate (standard)	4	4	4
32	3.4160	5192438	Seal, blower housing end plate (oversize, use with spacer)	AR	AR	AR
-	-	5192439	Spacer, blower end plate oil seal (wear ring, use with oversize seal)	AR	AR	AR
32	3.4180	5114442	Cover, blower housing end plate (front)	1	1	1
32	3.4180	5120726	Cover, blower housing end plate (rear)	1	1	1
32	3.4180	5115164	Cover, blower housing end plate (rear, "E")		1	1
32	3.4180	179828	Bolt, 5/16"-18 x 3 1/2" hex. hd.	20	20	20
-	-	103320	Lockwasher, 5/16"	20	20	20
32	3.4190	5114726	Gasket, blower housing end plate cover	2	2	2
32	3.4200	5118354	Cover, blower drive (1 1/2" L.)		1	
32	3.4200	5118353	Cover, blower drive (4 3/4" L.)			1
32	3.4200	5112904	Cover, blower drive ("E" eng.) (3 1/2" L.)			1
32	3.4200	5118219	Bolt (with seal-washer)	6	6	6
32	3.4210	5150246	Gasket, blower drive cover	1	1	1
32	3.4220	5172865	Seal, blower drive cover	1	2	2
32	3.4227	5173695	Clamp, blower drive cover packing	2	2	2
32	3.4290	5122069	Coupling, blower to water pump intermediate drive	1	1	1
32	3.4290	138234	Bolt, 5/16" - 24 x 1 1/2" hex. socket hd.	1	1	1
33	3.4300	5122910	Gear, blower drive (R.H. helix) (LC-LD-RC-RD engine)	1	1	
33	3.4300	5122911	Gear, blower drive (L.H. helix) (LA-LB-RA-RB engine)	1	1	1
33	3.4310	5150279	Hub, blower drive gear	1	1	1
33	3.4310	169067	Ball, 7/32" dia. steel	1	1	1
33	3.4320	5156901	Washer, blower drive gear hub thrust	1	1	1
33	3.4330	5152804	Nut, blower drive gear hub	1	1	1
33	3.4340	5150281	Lockwasher, blower drive gear	1	1	1
33	3.4350	5122528#	Support Assy., blower drive gear hub (includes bushing 5122530)	1	1	1
33	3.4350	5129884+	Support Assy., blower drive gear hub (includes bushing 5122530)	1	1	1
33	3.4350	181361	Bolt, 3/8"-24 x 7/8" hex. hd.	2	2	2
-	-	103321	Lockwasher, 3/8"	2	2	2
33	3.4350	444687	Plug, 1/8" pipe	1	1	1
-	-	5122530	Bushing, blower drive gear hub support	2	2	2
-	-	5122529	Washer, blower drive gear hub support thrust	1	1	1
33	3.4360	5150286	Gasket, blower drive gear hub support	1	1	1
-	-	5150344	Coupling Assy., blower drive (includes indented items)	1	1	1
33	3.4370	5150350	Bolt, blower drive coupling	6	6	6
-	-	103320	Lockwasher, 5/16"	6	6	6
33	3.4380	5150345	Support, blower drive coupling	1	1	1

+ Has no provision for oil filler tube. # Has provision for oil filler tube.

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
33	3.4390	5150348	Cam, blower drive coupling	1	1	1
33	3.4400	5196314	Spring Pack, blower drive coupling (includes 42 springs and 2 spring seats)	1	1	1
33	3.4410	5150346	Seat, blower drive coupling spring	4	4	4
33	3.4420	5150349	Retainer, blower drive coupling	1	1	1

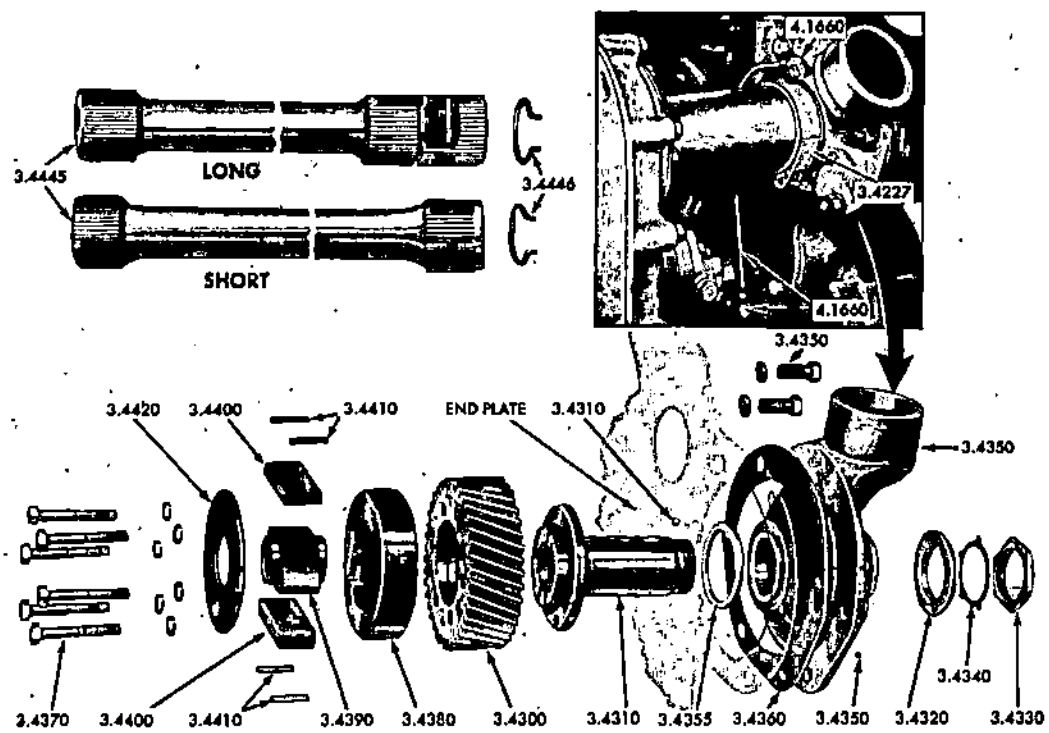


Fig. 33 – Blower Drive

			BLOWER DRIVE SHAFT			
33	3.4445	5154638	Shaft, blower drive (short) (6 3/16" L.)	1		
33	3.4445	5154639	Shaft, blower drive (short) (7 13/16" L.)		1	
33	3.4445	5189977	Shaft, blower drive (short) (6 15/16" L.)		1	
33	3.4445	5164640	Shaft, blower drive (short) (11 1/16" L.)			1
33	3.4445	5189970	Shaft, blower drive (short) (10 3/16" L.)			1
33	3.4445	5168129	Shaft, blower drive (long) (7 1/16" L.)	1		
33	3.4445	5168130	Shaft, blower drive (long) (8 11/16" L.)		1	
33	3.4445	5110798	Shaft, blower drive (long) (7 9/16" L.)		1	
33	3.4445	5193476	Shaft, blower drive (long) (11 15/16" L.)			1
33	3.4445	5110799	Shaft, blower drive (long) (10 13/16" L.)			1
33	3.4446	5167727	Ring, blower drive shaft	1	1	1
			OIL PUMP			
-	-	5175985	Pump Assy., oil (L.H. engine rotation)	1	1	
-	-	5175986	Pump Assy., oil (R.H. engine rotation)	1	1	
-	-	5177349	Pump Assy., oil (R.H. engine rotation)	1	1	
-	-	5175988	Pump Assy., oil (R.H. engine rotation) (includes indented items)			1
-	-	5175987	Pump Assy., oil (L.H. engine rotation)			1
-	-	5175980	Pump Assy., oil (R.H. engine rotation)			1
-	-	5175979	Pump Assy., oil (L.H. engine rotation)			1
34	4.1001	186627	Bolt, 3/8"-24 x 1" hex. hd.	4	4	4

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
-	-	103321	Lockwasher, 3/8"	4	4	4
-	-	5192106	Gasket Kit, oil pump overhaul } (includes gaskets required to replace pump)	AR	AR	AR
-	-	5192107	Gasket Kit, oil pump overhaul } (includes gaskets required to replace pump)		AR	AR
-	-	5192108	Gasket Kit, oil pump overhaul } (includes gaskets required to replace pump)			AR
-	-	5194800	Overhaul Kit, oil pump } (includes shaft, gears, bushings, valve spring and gaskets)	AR	AR	AR
-	-	5194801	Overhaul Kit, oil pump } (includes shaft, gears, bushings, valve spring and gaskets)			AR
-	-	5176119	Shim, oil pump (.005")	AR	AR	AR
-	-	5153257#	Spacer, oil pump body			1
34	4.1070	5153309	Shaft, oil pump drive (8 31/32" L.)	1	1	1
34	4.1070	5153258#	Shaft, oil pump drive (10 29/32" L.)			1
34	4.1080	5153310	Shaft, oil pump driven gear (3 7/32" L.)	1	1	1
34	4.1080	5153146#	Shaft, oil pump driven gear (5 5/32" L.)			1
34	4.1090	5166650	Gear, oil pump drive (1 1/4" wide)	1	1	
34	4.1090	5153260	Gear, oil pump drive (1 3/4" wide)			1
34	4.1090	5153260#	Gear, oil pump drive (1 3/4" wide)			2
34	4.1090	103905	Key, 1/8" x 5/8" woodruff	1	1	AR
34	4.1200	5166649	Gear Assy., oil pump driven (1 1/4" wide) } (includes bushings)	1	1	
34	4.1200	5153617	Gear Assy., oil pump driven (1 3/4" wide) } (includes bushings)			1
34	4.1200	5153617#	Gear Assy., oil pump driven (1 3/4" wide) } (includes bushings)			2
34	4.1220	5154252	Cover Assy., oil pump (R.H.)	1	1	1
34	4.1220	5154251	Cover Assy., oil pump (L.H.)	1	1	1
34	4.1220	186624	Bolt, 5/16" - 18 x 1 1/4" hex. hd.	4	4	4
-	-	103320	Lockwasher, 5/16"	4	4	4
34	4.1250	5153247	Valve, oil pump relief	1	1	1
34	4.1260	5155765	Spring, oil pump relief valve	1	1	1
34	4.1270	5152613	Plug, oil pump relief valve	2	2	2
34	4.1280	105456	Gasket, oil pump relief valve	2	2	2
34	4.1290	5153311	Cover, oil pump pad (2 1/8" bolt center)	1	1	1
34	4.1290	5156955	Cover, oil pump pad (1 7/8" bolt center)	1	1	1
34	4.1290	179816	Bolt, 5/16" - 18 x 3/4" hex. hd.	4	4	4
-	-	103320	Lockwasher, 5/16"	4	4	4
34	4.1300	5151370	Gasket, oil pump pad cover (1 7/8" bolt center)	1	1	1
34	4.1300	5153313	Gasket, oil pump pad cover (2 1/8" bolt center), (inlet)	1	1	1
7	4.1310	5166821	Gear, oil pump drive (on crankshaft)	1		
7	4.1310	5156532	Gear, oil pump drive (on crankshaft)		1	1
7	4.1310	124549	Key, 3/16" x 3/4" woodruff	1	1	1
34	4.1335	5169195	Support, oil pump idler gear	1	1	1

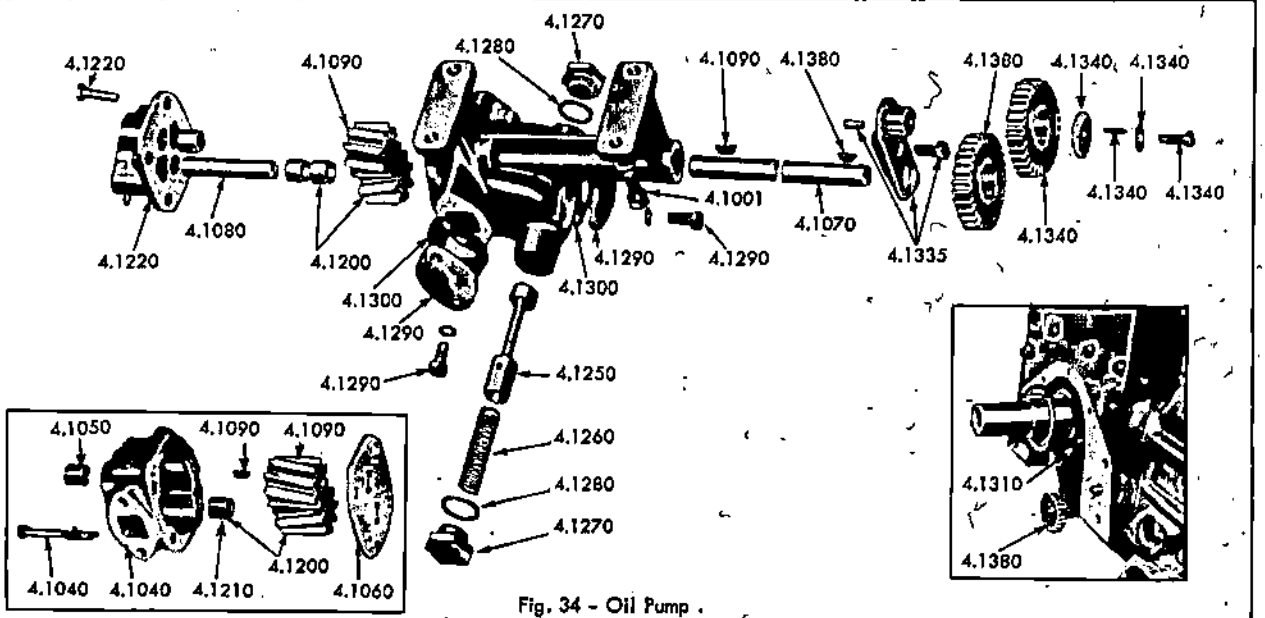


Fig. 34 - Oil Pump

For pumps 5177349, 5175987 and 5175988 only.

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
34	4.1335	5176035	Dowel, oil pump idler gear support	1	1	1
34	4.1335	9409079	Bolt, 3/8" - 16 x 7/8" hex. hd.	1	1	1
34	4.1340	5156683	Gear Assy., oil pump idler (includes bushing)	1	1	1
34	4.1340	5169197	Washer, oil pump idler gear (large)	1	1	1
34	4.1340	5175944	Washer, oil pump idler gear (small)	1	1	1
34	4.1340	186625	Bolt, 5/16" - 18 x 7/8" hex. hd.	1	1	1
34	4.1340	443230	Pin, 1/8" x 3/8" groove	1	1	1
34	4.1380	5156528	Gear, oil pump drive (on pump)	1	1	1
34	4.1380	103905	Key, 1/8" x 5/8" woodruff	1	1	1
			OIL DISTRIBUTION SYSTEM			
35	4.1510	5166871	Pipe, oil pump inlet (piece 1)	1		
35	4.1510	5166848	Pipe, oil pump inlet (piece 2)	1	1	
35	4.1510	5177346	Pipe, oil pump inlet (piece 18)	1		
35	4.1510	5166847	Pipe, oil pump inlet (piece 3)		1	
35	4.1510	5174129	Pipe, oil pump inlet (piece 4)		1	
-	-	5174131	Pipe, oil pump inlet		1	
35	4.1510	5177842	Pipe, oil pump inlet (piece 11)		1	1
35	4.1510	5159408	Pipe, oil pump inlet (piece 5)			1
35	4.1510	5174987	Pipe, oil pump inlet (piece 6)			1
35	4.1510	5174988	Pipe, oil pump inlet (piece 7)			1
35	4.1510	5153943	Pipe, oil pump inlet (piece 8)			1
35	4.1510	5153643	Pipe, oil pump inlet (piece 9)			1
-	-	5189912	Pipe, oil pump inlet			1
-	-	5174981	Pipe, oil pump inlet			1
-	-	5111188	Pipe, oil pump inlet (scavenging)			1
35	4.1510	5153828	Pipe, oil pump inlet (piece 12)			1
-	-	5111190	Pipe, oil pump inlet			1
35	4.1510	5153815	Pipe, oil pump inlet (scavenging) (piece 13)			1
35	4.1510	5159413	Pipe, oil pump inlet (piece 14)			1
35	4.1510	5159415	Pipe, oil pump inlet (scavenging) (piece 15)			1
35	4.1510	5154509	Support (piece 16)		1	
-	-	5185435	Support			1
-	-	5151241	Lockwire	1	1	1
35	4.1560	5153284	Retainer, oil pump inlet screen (7 5/16" L.)	1	1	AR
-	-	5163124	Retainer, oil pump inlet screen (4 3/4" L.)	1	1	
-	-	5155664	Clip, oil pump outlet pipe (1" dia., 3/8" bolt)			2
-	-	5169476	Clip, oil pump outlet pipe (1" dia., offset, 7/16" bolt)		1	
35	4.1575	5166935	Bracket, oil pump outlet pipe (piece 17)		1	
-	-	5177844	Bracket, oil pump outlet pipe		1	
-	-	5159393	Bracket, oil pump outlet pipe			1
35	4.1580	5110126	Pipe, oil pump outlet (LC or RA engines) (piece 24)	1	1	1
-	-	5153627	Gasket, oil pump inlet (at pump) (15/16" x 1 3/16" slotted hole)	1	AR	1
-	-	5153902	Gasket, oil pump inlet (at pump) (1 1/16" hole)			AR
-	-	5153313	Gasket, oil pump inlet (at pump) (1 1/16" sq. hole)		1	2
-	-	5167380	Gasket, oil pump inlet (1 11/16" hole)			1
35	4.1530	5153286	Screen, oil pump inlet (6 3/4" dia.) (piece 31)	1	1	AR
35	4.1530	5155830	Screen, oil pump inlet (4 1/2" dia.) (piece 32)			1
35	4.1530	5154457	Screen, oil pump inlet (3 3/4" dia.) (piece 33)		1	
-	-	5164754	Screen, oil pump inlet (4 3/8" dia.)	1	1	
35	4.1540	5166935	Bracket, oil pump screen support (piece 17)		1	
35	4.1540	5166868	Bracket, oil pump screen support (piece 18)	2	2	
35	4.1540	5174125	Bracket, oil pump screen support (piece 19)		2	
35	4.1540	5153829	Bracket, oil pump screen support (piece 20)			1
35	4.1540	5159398	Bracket, oil pump screen support (piece 21)			1
35	4.1540	5153317	Bracket, oil pump screen support (piece 22)			2
35	4.1540	5159396	Bracket, oil pump screen support (piece 23)			2
-	-	5177336	Bracket, oil pump screen support	1		
-	-	5177843	Bracket, oil pump screen support		1	
-	-	5189936	Bracket, oil pump screen support			1
35	4.1550	5175611	Cover, oil pump inlet screen (7 1/4" dia.)	1	1	1
-	-	5177338	Cover, oil pump inlet screen (4 3/4" dia.)	1	1	
-	-	5118302	Cover, oil pump inlet screen	1	1	AR

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
-	-	9417889	Bolt, cover (5/16" - 24 x 1 1/8") (hex. washer hd.)			2
-	-	5155605	Bolt, cover (5/16" - 18 x 11/16")	2	2	SR
35	4.1580	5110126	Pipe, oil pump outlet (LC or RA engines) (piece 24)	1	1	1
35	4.1580	5159387	Pipe, oil pump outlet (LA engines) (piece 26)	1	1	1
35	4.1580	5159388	Pipe, oil pump outlet (RC engines) (piece 25)	1	1	1
35	4.1580	5159399	Pipe, oil pump outlet (scavenging) (piece 27)			1
35	4.1580	5156994	Pipe, oil pump outlet (scavenging) (piece 28)			1
35	4.1580	5177342	Pipe, oil pump outlet (scavenging) (piece 29)	1		
35	4.1580	5177840	Pipe, oil pump outlet (scavenging) (piece 30)		1	
-	-	5151370	Gasket, oil pump outlet (3/4" hole)	1	1	1
-	-	5153313	Gasket, oil pump outlet (1 1/16" sq. hole)	1	1	1
-	-	5153313	Gasket, oil pump outlet (1 1/16" sq. hole)		2	2
35	4.1660	5150433	Pipe, blower drive bearing oil (dev. L. 11 7/8")	1	1	1
35	4.1660	5150431	Pipe, blower drive bearing oil (dev. L. 8 5/8")	1	1	1
35	4.1660	5183427	Pipe Assy., blower drive bearing oil (dev. L. 8 3/8")		1	
-	-	137421	Elbow, 1/4" inv. fl. tube 90° (1/8" P.T.)	1	1	1

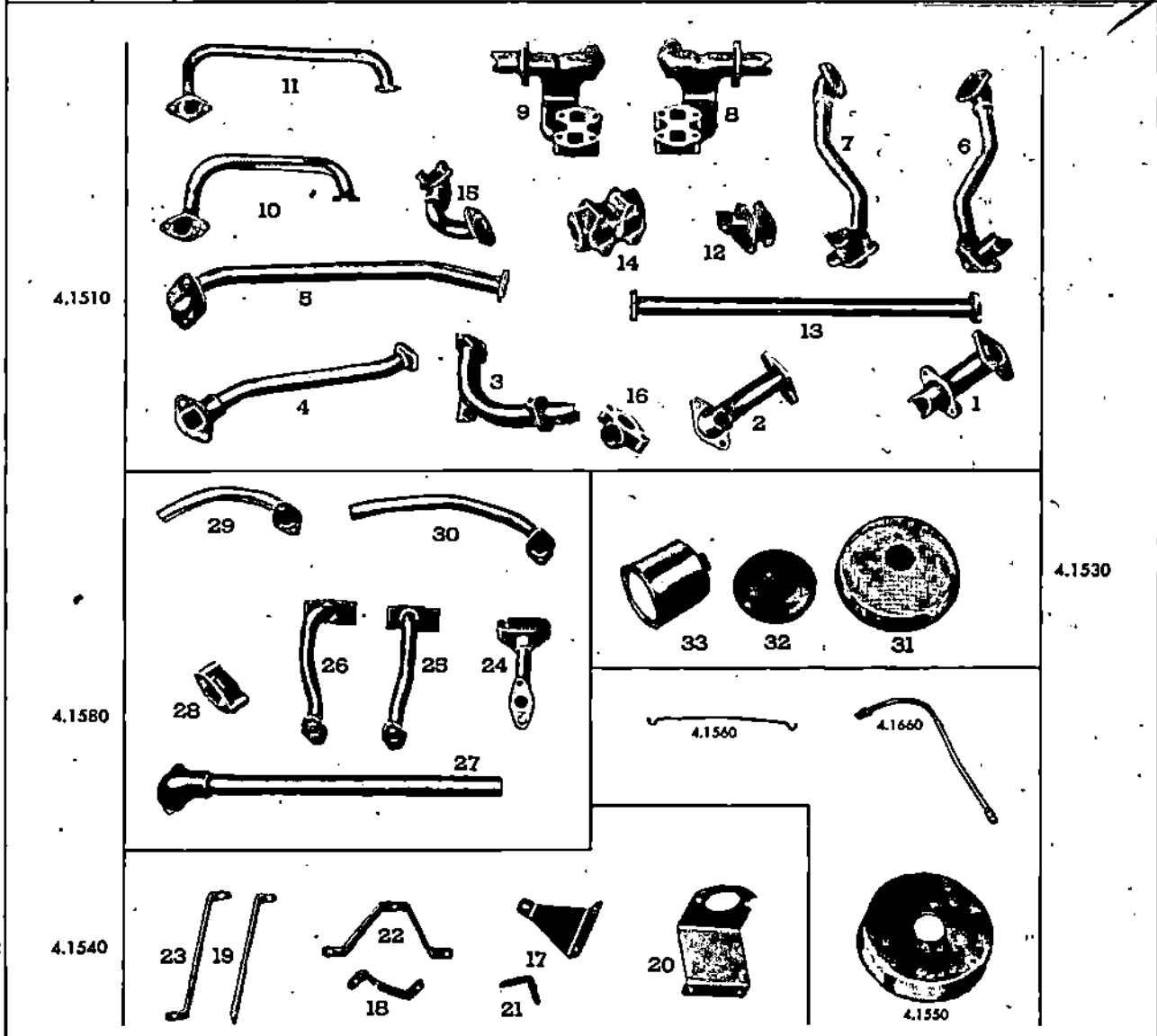


Fig. 35 - Oil Distribution System

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
-	-	143342	Elbow, 1/4" inv. fl. tube 90° (1/4" P.T.)	1	1	1
-	-	120401	Elbow, 1/8" street 90°	1	1	1
-	-	103877	Plug, 1/8" pipe	1	1	1
-	-	5151617	Tee (1/4") (at block)	1	1	1

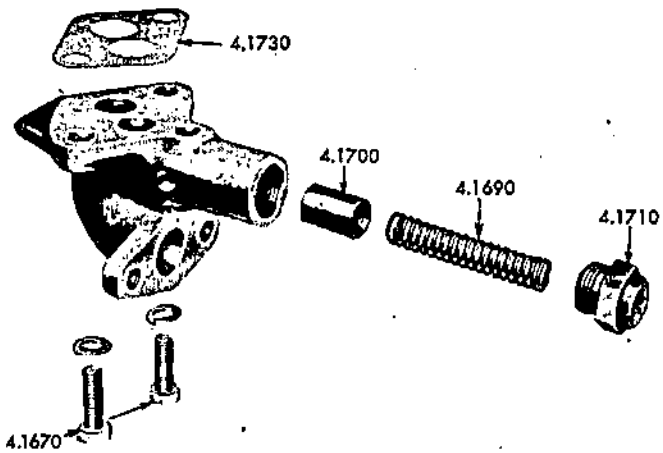


Fig. 36 - Oil Pressure Regulator

			OIL PRESSURE REGULATOR			
-	-	5159384	Regulator Assy., oil pressure (C & D eng.) } (includes indented items)	1	1	1
-	-	5159383	Regulator Assy., oil pressure (A & B eng.) }	1	1	1
36	4.1670	179819	Bolt, 5/16" - 18 x 1 1/8" hex. hd.	2	2	2
-	-	103320	Lockwasher, 5/16"	2	2	2
36	4.1690	5156815	Spring, oil pressure regulator	1	1	1
36	4.1700	5156819	Valve, oil pressure regulator	1	1	1
36	4.1710	5156816	Plug, oil pressure regulator	1	1	1
36	4.1730	5154199	Gasket, oil pressure regulator body	1	1	1
			OIL FILTER			
4	4.2240	5572941	Filter Assy., lube oil (single element by-pass, bracket mounted)	1	1	
3	4.2240	5572940	Filter Assy., lube oil (dual element by-pass, bracket mounted) (includes indented items)			1
-	-	5572942	Filter Assy., lube oil (by-pass strap mounted)	1	1	2

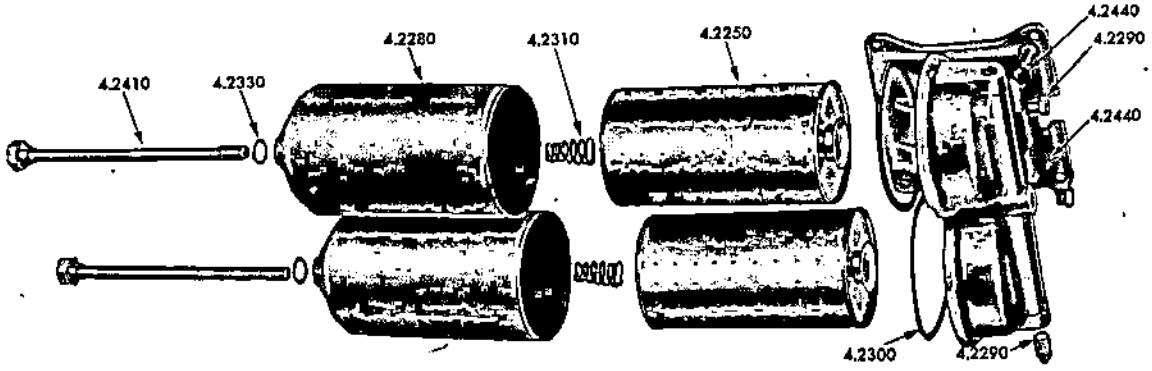


Fig. 37 - Oil Filter - By-pass

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-53	6-71
-	-	179838	Bolt, 3/8" - 16 x 7/8" hex. hd.	4	4	4
-	-	179839	Bolt, 3/8" - 16 x 1"	AR	AR	AR
-	-	103321	Lockwasher, 3/8"	AR	AR	AR
37	4.2250	5572425	Element, oil filter (by-pass, P-117) } (includes cover gaskets)	1	1	2
38	4.2250	5573014	Element, oil filter (full flow, PF-132) } (includes cover gaskets)	1	1	1
-	-	5570487	Spacer, oil filter	1	1	1
37	4.2280	5574008	Shell, oil filter (bracket mounted by-pass or full flow)	AR	AR	AR
-	-	5572408	Shell, oil filter (strap mounted)	1	1	AR
37	4.2290	103878	Plug, 1/4" pipe	1	1	2
37	4.2290	112578	Plug, 1/4" br. pipe	1	1	2
-	-	5571505	Cover, oil filter (by-pass)	1	1	1
-	-	5574128	Cover, oil filter (strap mounted)	1	1	1
-	-	5571540	Tube, oil filter cover	AR	AR	AR
-	-	5123928	Adaptor, oil filter (C & D eng.) (full flow)		1	1
-	-	5188923	Adaptor, oil filter (full flow)	1	1	1
-	-	5188028	Gasket, filter adaptor to cooler adaptor			1
37	4.2300	5571024	Gasket, oil filter cover (by-pass or full flow)			1
37	4.2310	1503518	Spring, oil filter (bracket mounted by-pass)	1	1	2
-	-	5574129	Spring, oil filter (strap mounted by-pass)	1	1	AR
38	4.2310	5187308	Spring, oil filter (full flow)	1	1	1
38	4.2315	5187309	Retainer, oil filter spring (full flow)	1	1	1
38	4.2315	5120602	Ring, oil filter spring retainer snap (full flow)	1	1	1
-	-	5574127	Bolt, oil filter cover lock (strap mounted)	1	1	AR
37	4.2330	5574130	Gasket, oil filter cover nut (by-pass or full flow)	AR	AR	AR
38	4.2330	5187310	Gasket, filter spring retainer (full flow)	1	1	1
38	4.2330	5154598	Washer, filter spring (full flow)	1	1	1
37	4.2410	1595893	Stud, oil filter center (bracket mounted by-pass)	1	1	2
38	4.2410	5120740	Stud, oil filter center (full flow)	1	1	1
37	4.2440	5186068	Bracket, oil filter mounting (to filter)	1	1	1
-	-	5127156	Bracket, oil filter mounting (by-pass)	2	2	2
-	-	5110091	Bracket, oil filter mounting	1	1	
37	4.2440	179856	Bolt, 7/16" - 14 x 3/4" hex. hd.	4	4	4
-	-	103922	Lockwasher, 7/16"	4	4	4
-	-	132430	Screw, 3/8" - 16 x 2 1/2" fil. hd.	2	2	2
-	-	103921	Lockwasher, 3/8"	2	2	2
-	-	117062	Nut, 3/8" - 16 hex.	2	2	2
-	-	179859	Bolt, 7/16" - 14 x 1 1/8"	2	2	2
38	4.2485	5133481	Valve, oil filter pressure regulator (full flow)	1	1	1
38	4.2486	5575087	Spring, oil filter pressure regulator (full flow)	1	1	1
38	4.2488	5126686	Plug, oil filter pressure regulator (full flow)	1	1	1
38	4.2489	5575086	Gasket, oil filter pressure regulator plug (full flow)	1	1	1

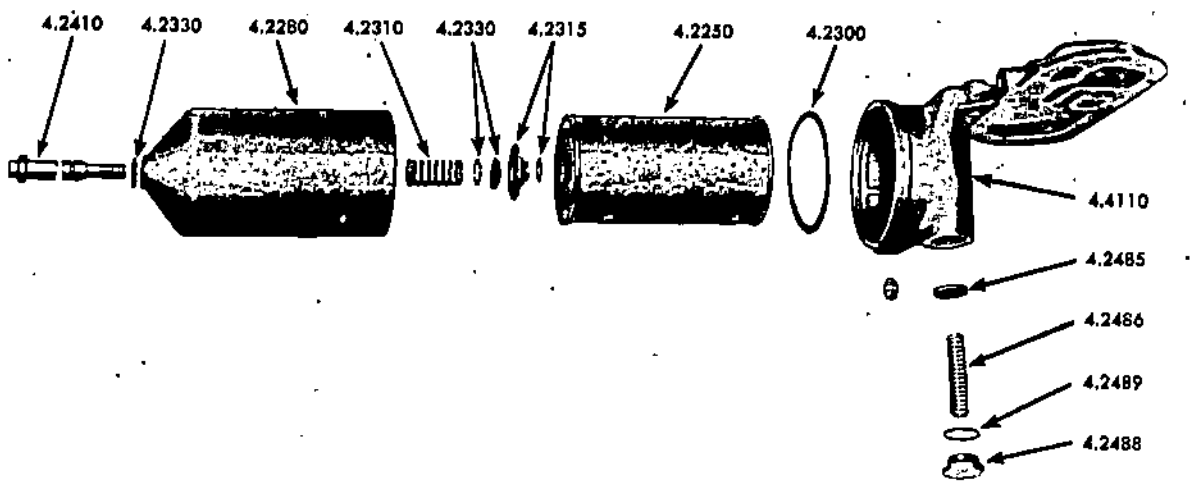


Fig. 38 - Oil Filter - Full Flow

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
			OIL FILTER LINES			
3	4.3001	5166569	Tube Assy., oil filter inlet (dev. L. 10")	1	1	1
-	-	143343	Elbow, 5/16" x 90° inv. fl. tube 1/4" P.T.	1	1	1
3	4.3020	5166550	Tube Assy., oil filter outlet (dev. L. 9 5/16")	1	1	1
-	-	144343	Elbow, 5/16" x 90° inv. fl. tube 1/4" P.T.	1	1	1
-	-	187343	Connector, 5/16" inv. fl. tube	1	1	1
			OIL COOLER			
			The proper oil cooler housing or adaptor for your engine can be interpreted by your Detroit Diesel dealer or distributor. It is necessary to furnish the model, unit and type number shown on the Option Plate on your engine.			
39	4.4001	8501328	Core Assy., oil cooler (6 plate)	AR	1	1
39	4.4001	8501329	Core Assy., oil cooler (8 plate)	1	1	1
39	4.4001	8514600	Core Assy., oil cooler (12 plate)			1
39	4.4030	5150155	Gasket, oil cooler core inner	1	1	AR
39	4.4040	5154215	Gasket, oil cooler core outer	1	1	AR
39	4.4050	-	Housing, oil cooler	1	1	1
40	4.4060	5167775#	Cover, oil cooler housing	1	1	1
49	4.4060	5176362†	Cover, oil cooler housing	1	1	
40	4.4060	179822#	Bolt, 5/16" - 18 x 1 1/2" hex. hd.	8	8	8
-	-	445601†	Bolt, 5/16" - 18 x 7 1/2" hex. hd.			6
-	-	446597†	Bolt, 5/16" - 18 x 6 1/2" hex. hd.	6	6	
-	-	103320	Lockwasher, 5/16"	AR	AR	AR
40	4.4085	5118457	Baffle, oil cooler	1	1	
-	-	5118219	Bolt, 5/16" - 18 x 7/8" (includes lockwasher)	4	4	
38	4.4110	-	Adaptor, oil cooler	1	1	1
39	4.4115	5150154	Gasket, oil cooler adaptor to block	2	2	2
39	4.4115	5152904	Gasket, oil cooler adaptor to block	1	1	1
2	4.4116	5177923	Cover, oil cooler adaptor (for remote mounted full flow filter)	1	1	1
-	-	186624	Bolt, 5/16" - 18 x 1 1/4" hex. hd.	2	2	2
-	-	103320	Lockwasher, 5/16"	2	2	2
-	-	5177924	Gasket, oil cooler adaptor cover	1	1	1
40	4.4120	5159505#	Valve Assy., oil cooler by-pass (A and B eng.) (includes indented items)	1	1	1
-	-	5159506#	Valve Assy., oil cooler by-pass (C and D eng.) (includes indented items)	1	1	1
40	4.4120	179822	Bolt, 5/16" - 18 x 1 1/2" hex. hd.	2	2	2
-	-	103320	Lockwasher, 5/16"	2	2	2
-	-	5123926	Housing, oil cooler by-pass valve		1	
39	4.4140	5177777	Valve, oil cooler by-pass	1	1	1
40	4.4140	5156769#	Valve, oil cooler by-pass	1	1	1
39	4.4150	5177778	Spring, oil cooler by-pass valve	1	1	1

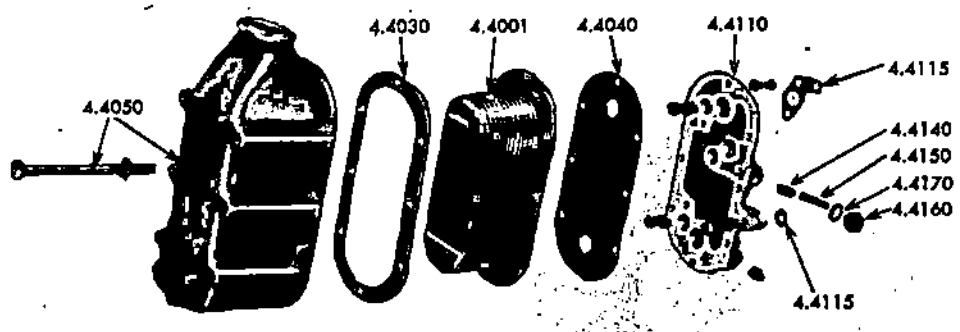


Fig. 39 – Oil Cooler

Heat exchanger units only. † Torque converter units only.

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
40	4.4150	5152381#	Spring, oil cooler by-pass valve	1	1	1
39	4.4160	5177772	Plug, oil cooler by-pass valve	1	1	1
40	4.4160	5156782#	Plug, oil cooler by-pass valve	1	1	1
39	4.4170	5177773	Gasket, oil cooler by-pass valve plug	1	1	1
40	4.4170	5156768#	Gasket, oil cooler by-pass valve plug	1	1	1
40	4.4180	5159430#	Gasket, oil cooler by-pass valve	1	1	1
40	4.4190	5167649#	Tube Assy., oil cooler inlet and outlet oil (A and B engine)	1	1	1
40	4.4190	5167650#	Tube Assy., oil cooler inlet and outlet oil (C and D engine)	1	1	1
40	4.4190	5157244#	Bolt, oil cooler inlet and outlet oil tube	4	4	4
-	-	179822#	Bolt, 5/16" - 18 x 1 1/2" hex. hd.	2	2	2
-	-	103320#	Lockwasher, 5/16"	2	2	2
-	-	103321#	Lockwasher, 3/8"	4	4	4
40	4.4200	5159447#	Gasket, oil cooler inlet and outlet tube (upper)	1	1	1
40	4.4200	5112401#	Gasket, oil cooler inlet and outlet tube (lower)	2	2	2
40	4.4220	5167770#	Elbow, oil cooler water outlet (at cooler housing)	1	1	1
40	4.4220	5167735#	Elbow, oil cooler water outlet	1	1	1
-	-	186619#	Bolt, 3/8" - 16 x 1 1/8" hex. hd.	4	4	4
-	-	103321#	Lockwasher, 3/8"	4	4	4
40	4.4230	5167762#	Gasket, oil cooler water outlet elbow	1	1	1
40	4.4240	5167747#	Hose, oil cooler water outlet (2 1/4" I.D. x 2 5/8")	2	1	1
40	4.4240	5167754#	Hose, oil cooler water outlet (2 1/4" I.D. x 4 1/4")		1	
39	4.4240	5167755#	Hose, oil cooler water outlet (2 1/4" I.D. x 7 1/2")			1
40	4.4250	5188036#	Clamp, oil cooler water outlet hose	4	4	4
40	4.4260	9139809#	Tube, oil cooler water outlet hose support			1
1	4.4320	5177241	Flange, oil cooler water hole	1	1	1
-	-	186629	Bolt, 5/16" - 18 x 1" hex. hd.	2	2	2
-	-	103320	Lockwasher, 5/16"	2	2	2
-	-	5153902	Gasket, oil cooler water hole flange	1	1	1

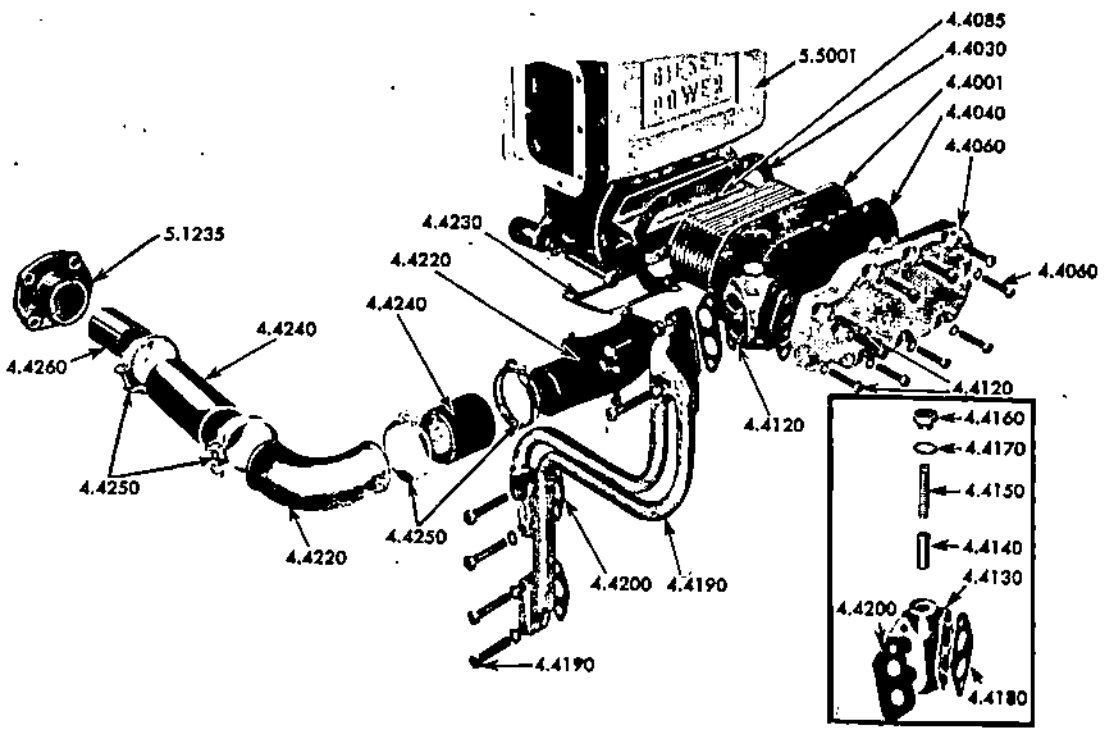


Fig. 40 - Oil Cooler

Heat exchanger units only.

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
			OIL FILLER TUBE			
41	4.5001	5178638	Tube, oil filler	1	1	1
61	4.5005	5171227‡	Adaptor Assy., oil filler tube (includes indented items)		1	1
-	-	5150042	Plug, oil filler tube adaptor		1	1
61	4.5005	179882	Bolt, 7/16" - 14 x 1 1/2" hex. hd.		4	4
-	-	103342	Washer, 7/16" flat		4	4
-	-	103322	Lockwasher, 7/16"		4	4
-	-	5173482	Gasket, oil filler tube adaptor		1	1
41	4.5010	1543853	Cap, oil filler tube	1	1	1
-	-	1543857	Gasket, oil filler tube	1	1	1
41	4.5020	5150147	Strainer, oil filler tube	1	1	1

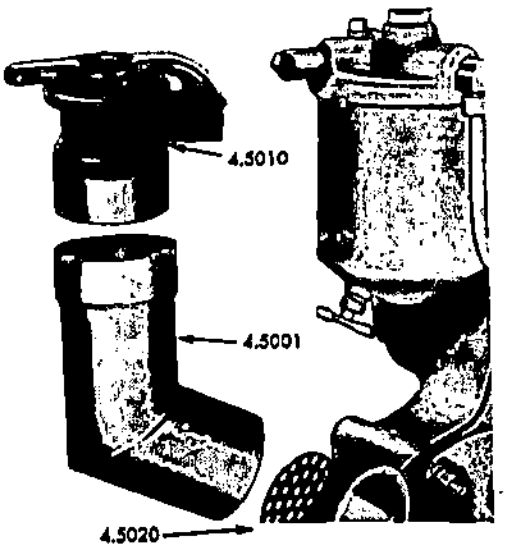


Fig. 41 - Oil Filler Tube

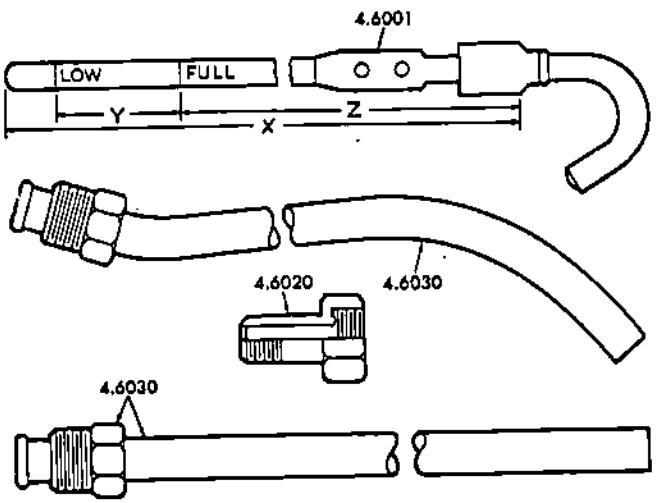


Fig. 42 - Dipstick

			DIPSTICK			
			Listed below are typical dipsticks, guides and adaptors. By furnishing your Detroit Diesel dealer or distributor with the model number and type number (if shown) on the Option Plate he can interpret your requirements.			
42	4.6001	5162926	Dipstick (X-15", Y-0.14", Z-12.47")	1	1	1
42	4.6001	5174984	Dipstick (X-8 1/8", Y-1.25", Z-4 27/32")	1	1	1
42	4.6001	5109261	Dipstick (X-6", Y-1.50", Z-3.62")			1
42	4.6001	5132589	Dipstick (X-27.50", Y-1.28", Z-24.62")	1	1	
42	4.6001	5109565	Dipstick (X-29", Y-0.75", Z-27")		1	
42	4.6001	5177339	Dipstick (X-8 1/8", Y-1.12", Z-6 1/8")	1		
42	4.6001	5109267	Dipstick (X-24", Y-1.25", Z-22.22")		1	
42	4.6001	5109258	Dipstick (X-18", Y-1.00", Z-15.88")			1
-	-	5150475	Gasket, dipstick	1	1	1
42	4.6020	5151430	Guide, dipstick (1 1/2" L.)	1	1	1
42	4.6020	5150473	Guide, dipstick (2 1/2" L.)	1	1	
42	4.6030	5132441	Adaptor, dipstick (9" dev. L.)	1	1	1
42	4.6030	5173855	Adaptor, dipstick (6.40" dev. L.)	1	1	
42	4.6030	5109715	Adaptor, dipstick (18.86" dev. L.)	1	1	
42	4.6030	5108890	Adaptor, dipstick (4.24" L.)			1
42	4.6030	5173856	Adaptor, dipstick (9" dev. L.)		1	
42	4.6030	5108913	Adaptor, dipstick (18.60" dev. L.)		1	

‡ Used in conjunction with blower drive support assy. 5129884.

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
			OIL PAN			
44	4.7001	5167807	Pan Assy., oil (stamped, no baffles) (includes plug and gasket)	1		
44	4.7001	5111283	Pan, oil (stamped, single baffle)	1		
-	-	5167809	Pan, oil (cast)	1		
44	4.7001	5112553	Pan, oil (stamped, single baffle)		1	
-	-	5167811	Pan, oil (stamped, dual baffles)		1	
44	4.7001	5167808	Pan Assy., oil (stamped dual baffles) (includes plug and gasket)		1	
44	4.7001	5111284	Pan, oil (stamped, single baffle)		1	
-	-	5167810	Pan, oil (cast)		1	
44	4.7001	5112556	Pan, oil (stamped, single baffle)		1	
-	-	5174150	Pan, oil (cast, deep sump)		1	
-	-	5114960	Pan, oil (stamped, dual baffle)		1	
44	4.7001	5174986	Pan, oil (stamped, shallow)			1
44	4.7001	189691	Bolt, 5/16" - 18 x 3/4" hex. hd. (with lockwasher) (stamped pan)	22	28	34
43	4.7001	189697	Bolt, 5/16" - 18 x 1" hex. hd. (with lockwasher) (cast pan)	22	28	34
43	4.7010	5153942	Pan, oil upper			1
43	4.7020	5153153	Pan, oil lower			1
43	4.7020	189697	Bolt, 5/16" - 18 x 1" hex. hd. (with lockwasher) (lower pan)			22
43,44	4.7030	5150115	Gasket, oil pan to block	1		
43,44	4.7030	5150116	Gasket, oil pan to block		1	
43,44	4.7030	5150117	Gasket, oil pan to block			1
-	-	5195625	Gasket Kit, oil pan (for use with cast iron pans only)			AR
43	4.7040	5153256	Gasket, lower oil pan			1
44	4.7080	5177772	Plug, oil pan drain (18 mm.)	1	1	
44	4.7080	53688	Plug, oil pan drain (18 mm. magnetic)	1	1	1
-	-	103880	Plug, 1/2" pipe	1	1	
44	4.7090	840277	Gasket, drain plug (18 mm.)	1	1	
44	4.7100	5175082	Tube Assy., oil pan drain	1	1	1
44	4.7100	122432	Nut, 7/8" - 14 hex.	1		1
-	-	5154506	Cover, oil pan rear	1	1	
43	4.7120	5171165	Cover, oil pan bottom (side drain)	1	1	1
-	-	5155608	Cover, oil pan bottom (flat, side drain)		1	
-	-	189700	Bolt, 5/16" - 18 x 1 1/4" hex. hd. (with lockwasher)	8		
43	4.7120	189697	Bolt, 5/16" - 18 x 1" hex. hd. (with lockwasher)	8	8	8
-	-	5172052	Bolt, 5/16" - 18 x 3/4" hex. hd. (with seal washer)			
41	4.7130	5153788	Gasket, oil pan cover (cover 5171165)	1	1	
-	-	5153986	Gasket, oil pan cover (cover 5155608)		1	
-	-	5154507	Gasket, oil pan cover (cover 5154506)	1	1	

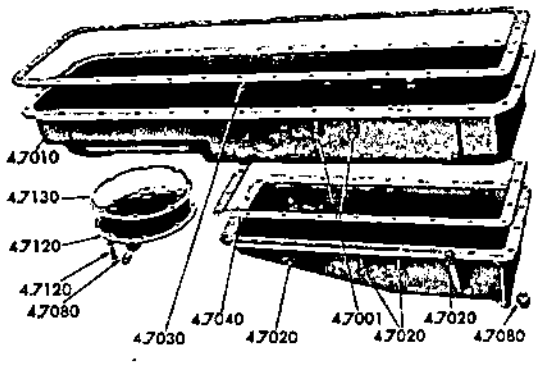


Fig. 43 - Oil Pan - Deep

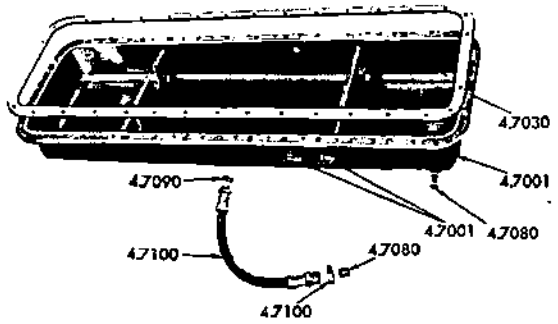


Fig. 44 - Oil Pan - Shallow

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
			VENTILATING SYSTEM			
			The proper breather pipe for your engine can be interpreted by your Detroit Diesel dealer or distributor. Furnish him with the model number, and type number shown on the Option Plate on your engine.			
1,4	4.8001	-	Pipe, breather	1	1	1
-	-	1528732	Cap, breather	1	1	1
45	4.8001	5167298	Breather, rocker cover	1	1	1
45	4.8001	5168435	Spacer, rocker cover breather	2	2	2
45	4.8020	5165228	Gasket, rocker cover breather	1	1	1
-	-	5150900	Gasket, breather pipe (at governor)	1	1	1
46	4.8020	5163299	Gasket, breather pipe (at separator)	1	1	1
-	-	5176066	Baffle, breather oil hole			1
45	4.8025	5168434	Baffle, rocker cover breather	1	1	1
-	-	5176694	Breather (crankcase)		1	1
-	-	5110384	Breather Assy., (crankcase)			1
46	4.8050	5113809	Separator Assy., breather oil (no provision for tachometer drive) (includes indented items)	1	1	1
46	4.8050	5111287	Separator Assy., breather oil (with provision for tachometer drive) (includes indented items)	1		
46	4.8050	5110397	Separator Body			1
-	-	5112067	Adaptor (with 5110397)			1
-	-	5111288	Seal, breather separator (3/8" I.D. for tachometer drive)	1		
-	-	5179282	Gasket, breather body cover (with 5110384)			1
-	-	5180214	Seal, breather body (with 5110384)			1
-	-	100146	Bolt, 7/16" - 14 x 1" hex. hd.	1	1	1
46	4.8050	179882	Bolt, 1/2" - 13 x 1 1/8" hex. hd.	4	4	4
46	4.8060	5190344	Filter Unit (pads) (with 5113809)	1	1	1
46	4.8060	5163918	Filter (pad) (with 5111287)	2	2	2
46	4.8070	5163910	Gasket, breather oil separator (with 5113809)	1	1	1
-	-	5130349	Gasket, breather body (with 5110384)			1
-	-	5117061	Gasket, breather oil separator (with 5111287)	1		
-	-	5173482	Gasket, breather oil separator (with 5176694)			1
46	4.8120	5164051	Tube Assy., cylinder head air inlet (C eng.)	1	1	1
46	4.8120	5172996	Tube Assy., cylinder head air inlet (A eng.)	1	1	1
48	4.8120	137420	Elbow, 3/16" inv. fl. tube 90°	1	1	1
46	4.8120	137404	Connector, 3/16" inv. fl. tube	1	1	1
-	-	5177214	Pipe, breather extension	1	1	1
-	-	5151906	Hose, breather (1 1/4" I.D. x 2 1/4" L.)			1
-	-	5177175	Hose, breather extension (7/8" I.D. x 2 1/4" L.)	1	1	1
-	-	111610	Clamp (with 1 1/4" dia. hose)	2	2	2
-	-	2337379	Clamp (with 7/8" dia. hose)			2

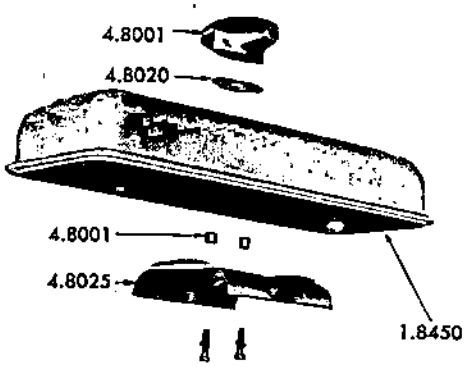
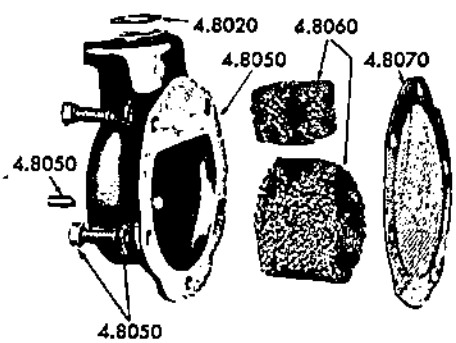


Fig. 45 – Breather – Rocker Cover



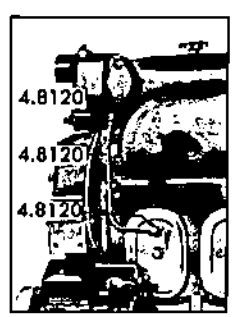


Fig. 46 – Breather – Flywheel Housing

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
			FRESH WATER PUMP			
49	5.1001	5186575	Pump Assy., fresh water (A & B eng.)	1	1	1
49	5.1001	5186576	Pump Assy., fresh water (C & D eng.)	1	1	1
49	5.1001	5113108§	Pump Assy., fresh water (A & B eng.)			1
49	5.1001	5113109§	Pump Assy., fresh water (C & D eng.) (includes indented items)			1
47	5.1001	5118219	Bolt (with seal-washer)	3	3	3
-	-	5198307#	Reconditioning Kit, water pump	AR	AR	AR
47	5.1010	5150193	Gasket, water pump	1	1	1
-	-	103647	Draincock, 1/4"	1	1	1
-	-	118536	Draincock, 3/8"	1	1	1
47	5.1035	5186572	Insert, water pump body	1	1	1
47	5.1040	5150182	Stud, water pump body	4	4	4
47	5.1050	5136671	Shaft Assy., water pump (includes slinger)	1	1	1
47	5.1090	5189041	Slinger, water pump shaft	1	1	1
47	5.1110	5126911†	Impeller, water pump	1	1	1
-	-	5134335‡	Impeller, water pump			1
-	-	5193605†	Replacement Kit, water pump seal (includes parts necessary to replace seal)	AR	AR	AR
47	5.1130	5186571†	Seal Assy., water pump	1	1	1
47	5.1210	5114011	Thrower, water pump	1	1	1
47	5.1220	5150191	Packing, water pump outlet	1	1	1
47	5.1230	5173730†	Flange, water pump outlet packing (1 5/8" bore)	1	1	1
47	5.1230	5178274‡	Flange, water pump outlet packing (1 3/4" bore)			1
47	5.1230	179819	Bolt, 5/16" - 18 x 1 1/8" hex. hd.	2	2	2

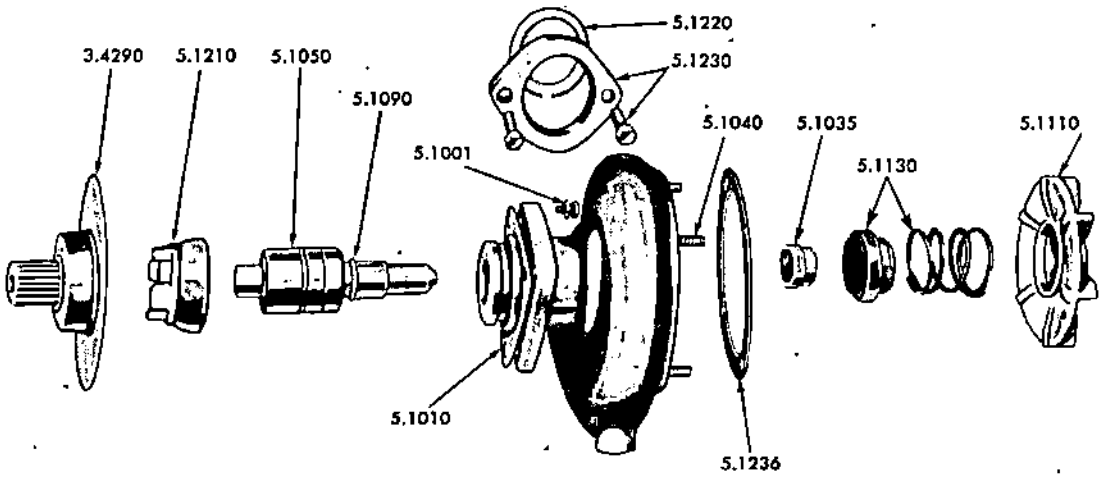


Fig. 47 – Fresh Water Pump

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION			
			FRESH WATER PUMP COVER			
48	5.1235	5179101†	Cover, water pump (2 tapped holes)	1	1	
-	-	5197005†	Cover, water pump (1 tapped hole)	1		
49	5.1235	5177244†	Cover, water pump (A eng.)			1
49	5.1235	5177220†	Cover, water pump (C eng.)			1
49	5.1235	5179386‡	Cover, water pump (C eng.)			1
-	-	5173727†	Cover		1	
48	5.1235	5113331‡	Cover			1

§ High capacity pump. † With pump 5186575 or 5186576 only. ‡ With pump 5113108 or 5113109 only.

Includes pump and cover gaskets, insert, shaft assy., impeller, seal assy., thrower, and packing; applicable to pump 5186575 or 5186576 only.

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
-	-	5113203‡	Cover			1
40	5.1235	5160466†	Cover, water pump (heat exchanger cooling)	1	1	1
-	-	5177218	Connector	1		
-	-	5175683	Connector		1	
-	-	121902	Nut, 1/4" - 28 hex.	4	4	4
-	-	9409961	Plug, 3/4" pipe	1	1	
47	5.1236	5150188†	Gasket, water pump cover	1	1	1
47	5.1236	5178273‡	Gasket, water pump cover			1
-	-	5156770	Seal, water pump inlet (2 3/4" O.D.)			1
-	-	5159457	Seal, water pump inlet (2 1/2" O.D.)	1	1	
49	5.1250	111628	Clamp, water pump inlet seal (2 3/4" dia.)			1
49	5.1250	111626	Clamp, water pump inlet seal (2 1/2" dia.)	1	1	
49	5.1270	5177217	Hose, water pump seal	1	1	1
-	-	111612	Clamp, water pump inlet seal (1 3/8" dia.)	2	2	2
			WATER OUTLET MANIFOLD			
4	5.2001	5169556	Manifold, water outlet (radiator cooling)	1		
4	5.2001	5181678	Manifold, water outlet (radiator cooling)		1	
40	5.2001	5196988	Manifold, water outlet (radiator cooling)			1
3	5.2001	5166351	Manifold, water outlet (heat exchanger cooling)	1		
3	5.2001	5167488	Manifold, water outlet (heat exchanger cooling)		1	
3	5.2001	5167294	Manifold, water outlet (heat exchanger cooling)			1
-	-	117049	Nut, 3/8" - 24 hex.	6	8	12
-	-	5150361	Gasket, water outlet manifold	3	4	6
6	5.2020	5150362	Stud, water outlet manifold	6	8	12
55	5.2043	5156770	Seal, water outlet manifold (heat exchanger cooling)	1	1	1
55	5.2043	111628	Clamp, 2 3/4" dia. (heat exchanger cooling)	1	1	1

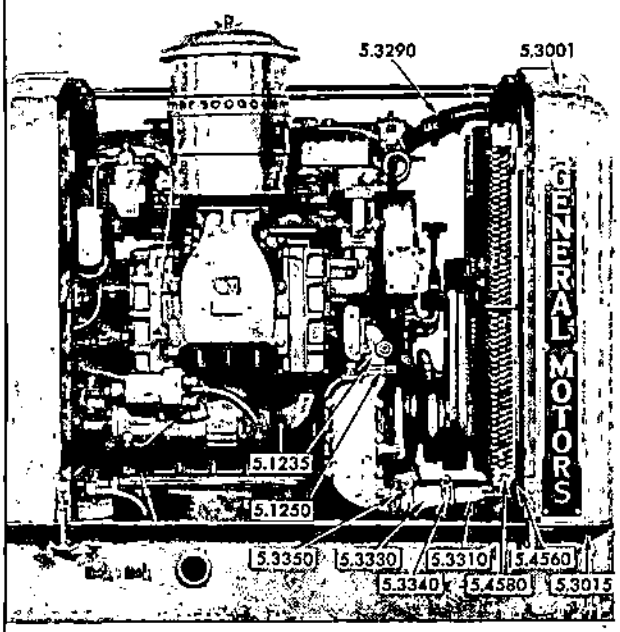


Fig. 48 – Cooling System – Power Take-Off Unit

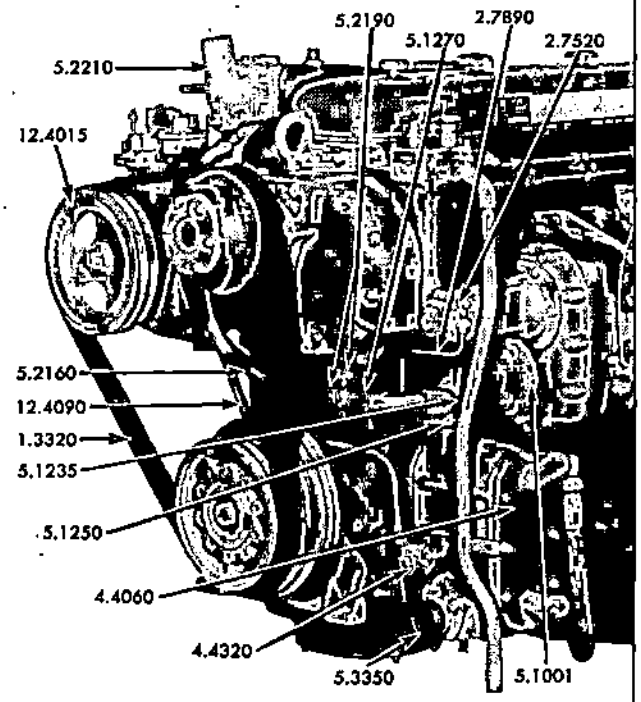


Fig. 49 – Cooling System – Fan to Flywheel Unit

†With pump 5186575 or 5186576 only. ‡With pump 5113108 or 5113109 only.

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
			THERMOSTAT			
54	5.2050	5172141	Thermostat Assy. (3 1/8" L.)	1	1	1
-	-	5186383	Thermostat Assy. (2 13/16" L., 1/16" bleed hole)		1	1
-	-	5178833	Thermostat Assy. (with water pump 5113109) (3 1/16" L., protected spring)			1
-	-	5172566	Deflector, thermostat		1	1
54	5.2110	5167761	Gasket, thermostat housing (at tank)	1	1	1
-	-	5169478	Gasket, thermostat housing	1	1	1
			WATER BY-PASS TUBE			
49,54	5.2160	5186203 Δ	Tube Assy., water by-pass (C eng.)	1	1	1
47	5.2160	5186204 +	Tube Assy., water by-pass (A eng.)	1	1	1
-	-	5186210 Δ	Tube Assy., water by-pass	1		1
-	-	5188130 Δ	Tube Assy., water by-pass (upper)		1	
-	-	5177279 Δ	Tube Assy., water by-pass		1	1
-	-	5188129	Tube Assy., water by-pass (lower)		1	1
-	-	5113371 Δ	Tube Assy., water by-pass (upper)		1	1
47	5.2160	5186211 Δ	Tube Assy., water by-pass (C eng.)			1
-	5.2160	5113332 Δ	Tube Assy., water by-pass (upper)			1
49	5.2160	103647	Draincock, 1/4"	1	1	1
-	-	5186840	Clamp, 13/16" - 1 1/2" dia. tube		2	2
-	-	5156170	Hose, water by-pass tube (1" I.D. x 2 1/2" L.)		1	1
-	-	5177217	Hose, water by-pass tube (1" I.D. x 3 1/2" L.)			1
49	5.2165	5178419	Hose, water by-pass tube (1" I.D. x 6 1/2")			1
54	5.2170	5169478	Gasket, water by-pass tube upper	2	2	2
-	-	5153902	Gasket, water by-pass tube lower		1	1
49	5.2190	5157702	Clip, water by-pass tube	1	1	1
49	5.2210	5186205	Elbow, water outlet manifold by-pass tube (vertical outlet, 2" O.D.) (with vent)	1	1	1
49	5.2210	5177200	Elbow, water outlet manifold by-pass tube (C eng.) (no vent)	1	1	1
49	5.2210	5186261	Elbow, water outlet manifold by-pass tube (horizontal outlet, A eng.) (with vent)	1	1	1
49	5.2210	5186206	Elbow, water outlet manifold by-pass tube (vertical outlet, 2 1/4" O.D.) (with vent)	1	1	1
49	5.2210	5186260	Elbow, water outlet manifold by-pass tube (horizontal outlet, C eng.)	1	1	1
49	5.2210	5189565	Elbow, water outlet manifold by-pass tube (horizontal outlet, 2" dia.)	1		
49	5.2210	5177193	Elbow, water outlet manifold by-pass tube (vertical outlet, 2" dia.)(no vent)		1	1
			RADIATOR			
4	5.3001	3118864	Radiator Assy., (3 3/8" core, 8-1/2" fins per inch, water outlet on right side)	1	1	1
4	5.3001	3135218	Radiator Assy., (3 3/8" core, 8-1/2" fins per inch, water outlet on left side)	1	1	1
4	5.3001	3125617	Radiator Assy., (3 3/8" core, 10-1/2" fins per inch, water outlet on right side)			1
-	-	3138196	Radiator Assy., (4" core, 8-1/2" fins per inch, two water outlets)			1
-	-	186629	Bolt, 5/16" - 18 x 1" hex. hd.	10	10	10
-	-	120393	Washer, 5/10" flat	10	10	10
-	-	103320	Lockwasher, 5/16"	10	10	10
-	-	5127310	Shell Assy., radiator (includes grille)	1	1	1
-	-	5112790 #	Shell Assy., radiator			1
-	-	181374	Bolt, 3/8" - 24 x 1 1/2" hex. hd.	4	4	4
-	-	103321	Lockwasher, 3/8"	4	4	4
-	-	117049	Nut, 3/8" - 24 hex.	4	4	4
-	-	5112795 #	Cover, radiator bottom tank			1
-	-	5177156 #	Gasket, radiator bottom tank cover			1
-	-	179839 #	Bolt, 3/8" - 16 x 1" hex. hd.			2
-	-	850802	Cap, radiator filler (with 5112790 shell assy.)			1
-	-	5197679	Cap, radiator filler (with 5127310 shell assy.)	1	1	1
-	-	5169383	Hose, radiator over flow pipe	1	1	1
4	5.3268	5174098	Plate, radiator name (GENERAL MOTORS) (use with 5112790 shell assy.)	2	2	2
-	-	162991	Screw, 1/4" - 14 x 1/2" tapping	12	12	12

ΔIncludes thermostat housing. +Use with water pump 5113109. # Used with rad. assy. 3138196.

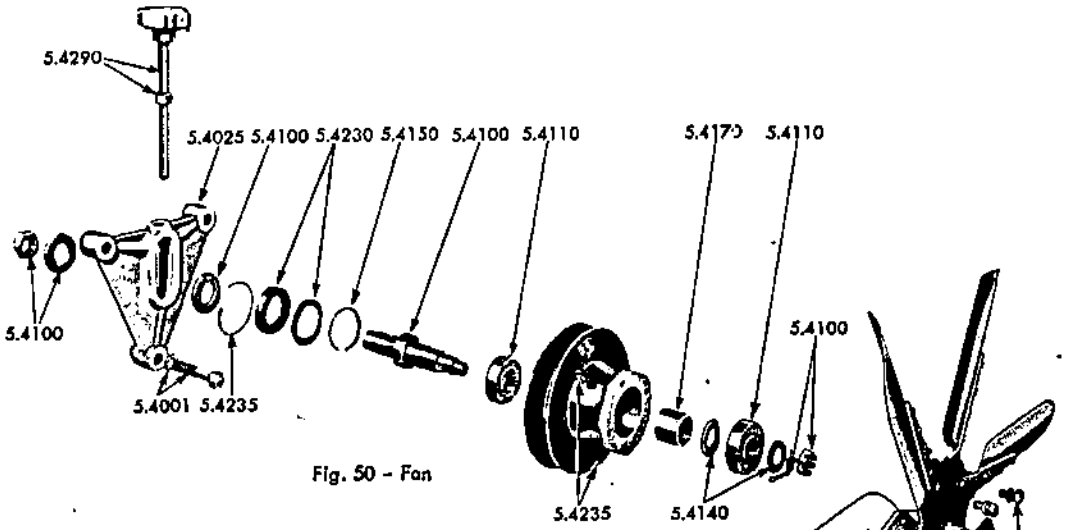


Fig. 50 - Fan

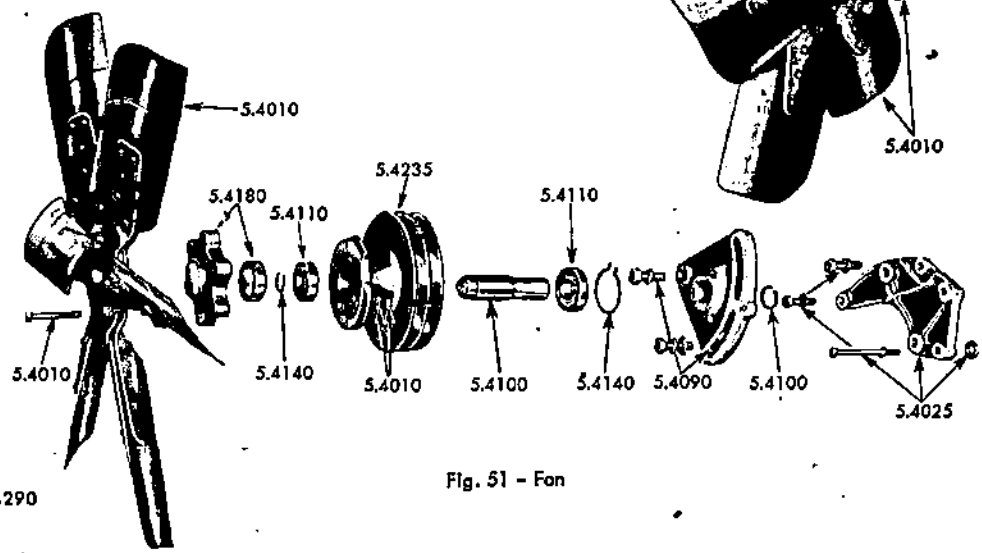


Fig. 51 - Fan

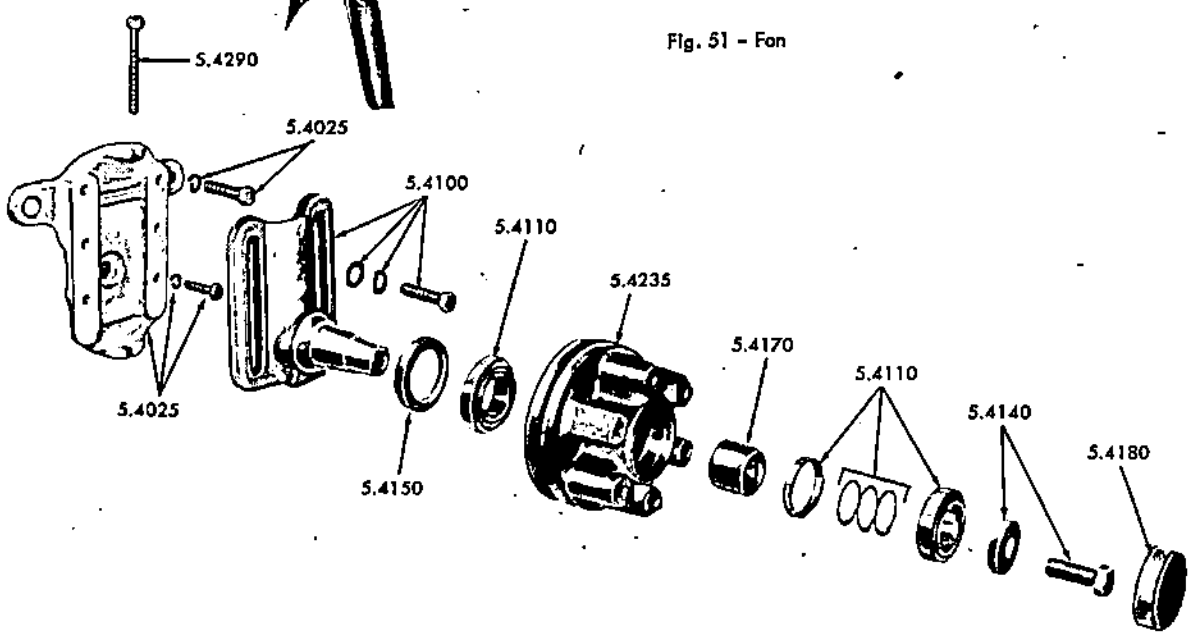


Fig. 52 - Fan

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
			WATER CONNECTIONS			
49	5.3290	5187231	Hose, radiator inlet (1 3/4" I.D. x 3 1/4")	1	1	1
-	-	5124623	Hose, radiator inlet (2 1/4" - 2 3/4" I.D. curved 9 1/2")	1	1	1
-	-	111622	Clamp, 2 1/4" dia., hose (radiator inlet hose)	2	2	2
-	-	111628	Clamp, 2 3/4" hose (radiator inlet hose)	1	1	1
-	-	5188036	Clamp, 2 3/4" dia. hose (radiator inlet hose)	1	1	1
49	5.3310	5170684	Tube, radiator outlet (straight, 7 5/16" L.)	1	1	1
-	-	5173449	Tube, radiator outlet (cross-over, dev. L. 28 5/8")	1	1	1
-	-	5112926	Elbow, radiator water outlet (2 5/16" O.D. - 3 1/2" B.C.)			1
-	-	5177156	Gasket, radiator outlet elbow (use with 5112926)			1
49§	5.3330	5173450	Hose, radiator outlet (2" I.D. x 2 1/2")	2	2	2
48	5.3340	111625	Clamp, 2 3/8" dia. hose (radiator outlet hose)	4	4	4
1,49	5.3350	5135549	Connection, oil cooler water inlet		1	
1,49	5.3350	5172508	Connection, oil cooler water inlet (2 5/16" O.D. - 3 3/8" B.C.)	1	1	1
1,49	5.3350	5188382	Connection, oil cooler radiator outlet (2 7/8" bolt center)	1	1	1
1,49	5.3350	5188383	Connection, oil cooler radiator outlet (3 3/8" bolt center)	1	1	1
-	-	186622	Bolt, 3/8" - 16 x 1 1/4" hex. hd.	2	2	2
-	-	179860	Bolt, 7/16" - 14 x 1 1/4" hex. hd.	2	2	2
-	-	103321	Lockwasher, 3/8"	2	2	2
-	-	103322	Lockwasher, 7/16"	2	2	2
-	-	2206783	Gasket, oil cooler radiator outlet connection (2 7/8" bolt center)	1	1	1
-	-	5163760	Gasket, oil cooler radiator outlet connection (3 3/8" bolt center)	1	1	1
-	-	118536	Draincock, 3/8" (radiator drain) (use with 5112926)			1
			FAN			
			The proper fan blade, mounting support, pulley, cap and spacer for your engine can be interpreted by your Detroit Diesel dealer or distributor. Furnish him with the model number and type number shown on the Option Plate on your engine.			
50,51	5.4010	-	Blade, fan	1	1	1
-	-	179829	Bolt, 5/16" - 18 x 2 3/4" hex. hd.	6	6	6
51	5.4010	103320	Lockwasher, 5/16"	6	6	6
51	5.4010	121917	Nut, 5/16" - 24 hex.	6	6	6
-	-	063565	Gasket, fan blade	1	1	1
50,51	5.4025	-	Support, fan mounting	1	1	1
-	-	5164789	Spacer, fan support	1	1	1
-	-	186288	Bolt, 3/8" - 16 x 4 1/2" hex. hd.	2	2	2
-	-	186725	Bolt, 1/2" - 13 x 1 1/2" hex. hd.	1	1	1
-	-	5150230	Washer (3/8" flat)	2	2	2
-	-	103323	Lockwasher, 1/2"	1	1	1
51	5.4090	5176202	Bracket, fan shaft (swivel adj. fan, with long shaft)	1	1	1
51	5.4090	5186334	Bracket, fan shaft (swivel adj. fan with short shaft)	1	1	1
51	5.4090	186646	Bolt, 1/2" - 13 x 1 3/4" hex. hd. (swivel adj. fan)	2	2	2
51	5.4090	426449	Bolt, 5/8" - 11 x 1 5/8" hex. hd. (swivel adj. fan)	1	1	1
-	-	103343	Washer, 1/2" flat (swivel adj. fan)	2	2	2
-	-	103323	Lockwasher, 1/2" (swivel adj. fan)	2	2	2
-	-	103325	Lockwasher, 5/8" (swivel adj. fan)	1	1	1
52	5.4100	5100201	Shaft, fan	1	1	1
52	-	427564	Bolt, 7/16" - 14 x 1 3/8" hex. hd.	4	4	4
52	-	5108436	Washer (7/16" flat)	4	4	4
52	-	103322	Lockwasher, 7/16"	4	4	4
50	5.4100	5158348	Shaft, fan	1	1	1
51	5.4100	5176208	Shaft, fan (swivel adj. fan, 5 7/16" L.)	1	1	1
51	5.4100	5186327	Shaft, fan (swivel adj. fan, 4 1/2" L.)	1	1	1
52	5.4110	7451369	Bearing, fan shaft (front)	1	1	1
52	5.4110	7450630	Bearing, fan shaft (rear)	1	1	1
52	-	5111124	Shim, (.015") fan shaft bearing	AR	AR	AR
52	-	5131205	Shim, (.020") fan shaft bearing	AR	AR	AR
52	-	5131206	Shim, (.025") fan shaft bearing	AR	AR	AR

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
51	5.4100	5176212	Snap Ring (swivel adj. fan)	1	1	1
50	5.4100	5158349	Washer, fan shaft	2	2	2
50	5.4100	2035201	Nut, fan shaft (front)	1	1	1
50	5.4100	272908	Nut, 7/8" - 14 hex.	1	1	1
50	5.4100	137171	Pin, 3/32" x 1" cotter	1	1	1
50	5.4110	954423	Bearing, fan shaft outer	1	1	1
50	5.4110	903205	Bearing, fan shaft inner	1	1	1
51	5.4110	7450079	Bearing, fan shaft outer (swivel adj. fan)	1	1	1
51	5.4110	954160	Bearing, fan shaft inner (swivel adj. fan)	1	1	1
52	5.4140	5131095	Retainer, fan shaft bearing	1	1	1
52	5.4140	9409060	Bolt, 1/2" - 20 x 1 1/2" hex. hd.	1	1	1
52	5.4140	5131123	Washer, fan shaft bearing retainer	1	1	1
50	5.4140	308993	Retainer, fan bearing outer	1	1	1
50	5.4140	5158359	Retainer, fan bearing inner	1	1	1
51	5.4140	5176905	Snap Ring, fan bearing outer (swivel adj. fan)	1	1	1
51	5.4140	5176211	Snap Ring, fan bearing inner (swivel adj. fan)	1	1	1
50	5.4150	714149	Seal, fan shaft	1	1	1
52	5.4150	5108219	Seal, fan shaft	1	1	1
50	5.4170	5158358	Spacer, fan shaft bearing	1	1	1
52	5.4170	5131122	Spacer, fan shaft bearing	1	1	1
51	5.4180	-	Cap and Spacer Assy., fan hub (swivel adj. fan)	1	1	1
51	5.4180	-	Cap, fan hub (swivel adj. fan)	1	1	1
-	-	714728	Gasket, fan shaft bearing	1	1	1
50	5.4230	714725	Retainer, fan shaft bearing seal (small)	1	1	1
50	5.4230	714726	Retainer, fan shaft bearing seal (large)	1	1	1
50	5.4235	-	Pulley, fan	1	1	1
50	5.4235	714727	Lockring, fan pulley	1	1	1
50	5.4235	271283	Fitting, 1/8" x 45° lube	1	1	1
50	5.4290	5158351	Screw, fan bracket adjusting	1	1	1
52	5.4290	5108434	Bolt, fan bracket adjusting (5/16" - 18 x 5")	1	1	1
-	-	120393	Washer, 5/16" flat	1	1	1
-	-	103323	Lockwasher, 1/2"	1	1	1
50	5.4290	117051	Nut, 1/2" - 20 hex.	1	1	1
			FAN SHROUD			
48	5.4560	5108922	Shroud, fan	1	1	1
48	5.4580	5173706	Guard, fan (R.H.)	1	1	1
4	5.4580	5173705	Guard, fan (L.H.)	1	1	1
-	-	149501	Screw, #14 - 10 x 5/8" self tapping	12	12	12
-	-	5170058	Nut	12	12	12

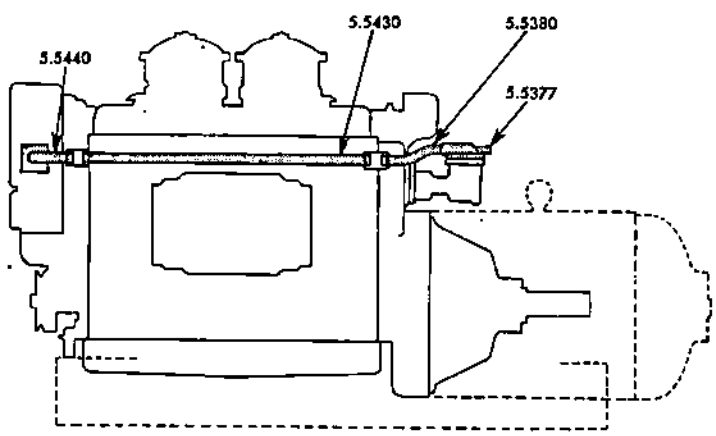


Fig. 53 - Heat Exchanger Cooling

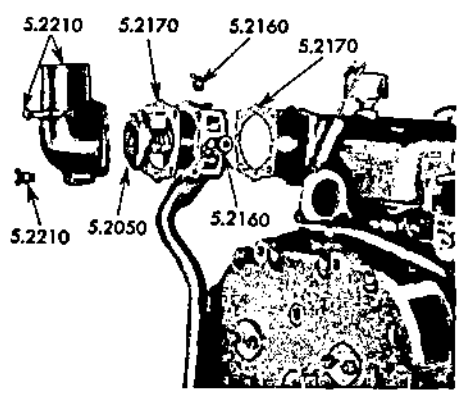


Fig. 54 - Thermostat and Water By-pass Tube

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
			HEAT EXCHANGER			
55	5.5001	5119718	Tank Assy., expansion (includes plugs 144015, 5111798)	1	1	1
55	5.5001	854012	Draincock, 1/8"	1	1	1
-	-	9409961	Plug, 3/4" pipe	2	2	2
-	-	5111798	Plug, 1" pipe	1	1	1
55	5.5001	179893	Bolt, 1/2" - 13 x 3" hex. hd.	2	2	2
-	-	103323	Lockwasher, 1/2"	2	2	2
55	5.5003	8509553	Core, heat exchanger	1	1	1
-	-	5192637	Gasket Kit, heat exchanger overhaul (includes necessary gaskets for one complete heat exchanger overhaul)	AR	AR	AR
55	5.5010	8515850	Electrode Assy. (includes 3 3/8" electrode)	1	1	1
-	-	8515841	Electrode Assy. (includes 2 1/8" electrode)	1	1	1
55	5.5025	5167766	Retainer, heat exchanger seal	1	1	1
55	5.5026	5167746	Seal, heat exchanger	2	2	2
55	5.5027	5167745	Gland, heat exchanger seal retainer	1	1	1
55	5.5030	5167768	Cover, heat exchanger (inlet)	1	1	1
55	5.5030	5167741	Cover, heat exchanger (outlet)	1	1	1
55	5.5030	103647	Draincock, 1/4"	1	1	1
-	-	113177	Plug, 3/4" brass pipe	1	1	1
55	5.5030	186624	Bolt, 5/16" - 18 x 1 1/4" hex. hd.	10	10	10
55	5.5030	186643	Bolt, 5/16" - 18 x 2 1/16" hex. hd.	10	10	10
55	5.5030	103320	Lockwasher, 5/16"	20	20	20
55	5.5050	5167764	Gasket, heat exchanger	3	3	3
55	5.5140	850802	Cap, expansion tank	1	1	1
55	5.5190	5168826	Tube Assy., expansion tank overflow	1	1	1
55	5.5190	143343	Elbow, 5/16" Inv. fl. tube 90°	1	1	1
-	-	137398	Nut, 5/16" inv. fl. tube	1	1	1
53	5.5377	5186345	Tube Assy., raw water pump inlet	1	1	1
-	-	113177	Plug, 3/4" brass pipe	1	1	1
-	-	179847	Bolt, 3/8" - 16 x 2" hex. hd.	2	2	2
-	-	103341	Washer, 3/8" flat	2	2	2
-	-	5158741	Gasket, water flange	1	1	1
53	5.5380	5185442	Tube Assy., raw water pump outlet	1	1	1
-	-	179839	Bolt, 3/8" - 16 x 1" hex. hd.	2	2	2
-	-	103341	Washer, 3/8" flat	2	2	2
-	-	5158741	Gasket, raw water flange	1	1	1
53	5.5430	5186526	Tube Assy., heat exchanger water inlet (intermediate) (PTO units)	1		
53	5.5430	5187458	Tube Assy., heat exchanger water inlet (intermediate) (generator sets)	1		
53	5.5430	5175818	Tube Assy., heat exchanger water inlet (intermediate) (PTO units)		1	
53	5.5430	5187459	Tube Assy., heat exchanger water inlet (intermediate) (generator sets)		1	
53	5.5430	5174535	Tube Assy., heat exchanger water inlet (intermediate) (PTO units)			1
53	5.5430	5187460	Tube Assy., heat exchanger water inlet (intermediate) (generator sets)			1

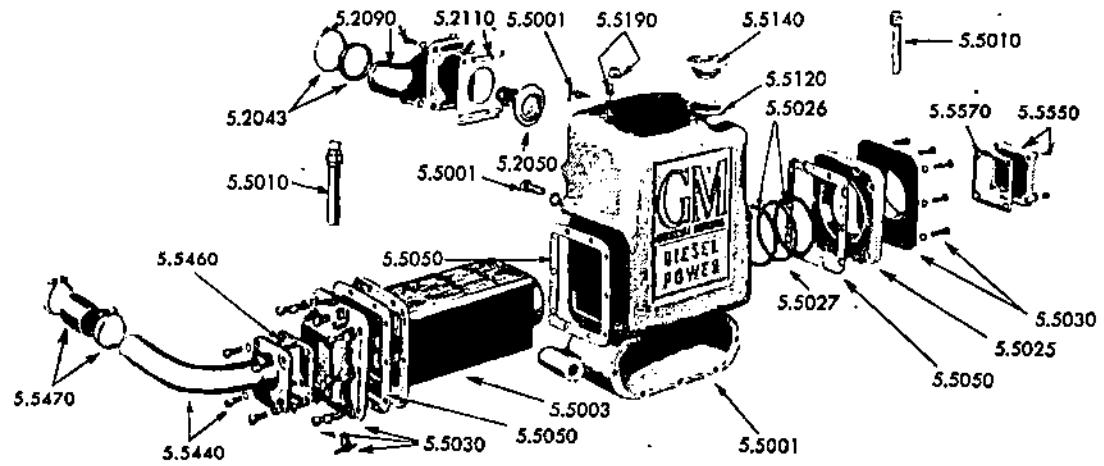


Fig. 55 - Heat Exchanger

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
55	5.5440	5175866	Tube Assy., heat exchanger water inlet	1	1	1
-	-	5159444¶	Elbow, heat exchanger water inlet	1	1	1
55	5.5440	186629	Bolt, 5/16" - 18 x 1" hex. hd.	4	4	4
-	-	103320	Lockwasher, 5/16"	4	4	4
55	5.5460	5158747	Gasket, heat exchanger water inlet tube	1	1	1
55	5.5470	5112181	Hose (1 1/2" x 2 3/4")	2	2	2
55	5.5470	111619	Clamp, 1 7/8" dia.	4	4	4
55	5.5550	5159444	Elbow, heat exchanger water outlet	1	1	1
55	5.5550	186629	Bolt, 5/16" - 18 x 1" hex. hd.	4	4	4
-	-	103320	Lockwasher, 5/16"	4	4	4
55	5.5570	5158747	Gasket, heat exchanger water outlet tube	1	1	1
			RAW WATER PUMP			
56	5.6001	5186250	Pump Assy., raw water (includes indented items)	1	1	1
-	-	179860	Bolt, 7/16" - 14 x 1 1/4" hex. hd. (to engine)	1	1	1
-	-	179884	Bolt, 1/2" - 13 x 1 3/8" hex. hd.	4	4	4
-	-	103322	Lockwasher, 7/16"	1	1	1
-	-	103323	Lockwasher, 1/2"	4	4	4
56	5.6010	5193551	Adaptor, raw water pump drive	1	1	1
56	5.6012	5194567	Gasket, raw water pump adaptor	1	1	1
56	5.6020	5193550	Body, raw water pump	1	1	1
56	5.6020	5193556	Plate, raw water pump body wear	1	1	1
-	-	141343	Pin, 3/16" x 5/16" dowel	1	1	1
56	5.6020	120233	Bolt, 3/8" - 16 x 1" hex. hd. (to adaptor)	6	6	6
-	-	120382	Lockwasher, 3/8"	6	6	6
-	-	5197224+	Reconditioning Kit, raw water pump	AR	AR	AR
56	5.6035	5193554	Cam, raw water pump body offset	1	1	1
56	5.6035	114366	Screw, 1/4" - 20 x 1/2" fil. hed. (cam)	1	1	1
56	5.6090	5193555	Cover, raw water pump	1	1	1
56	5.6090	114366	Screw, 1/4" - 20 x 1/2" fil. hd. (cover)	5	5	5
56	5.6100	5193562	Gasket, raw water pump cover	1	1	1
56	5.6120	5193552	Shaft, raw water pump	1	1	1

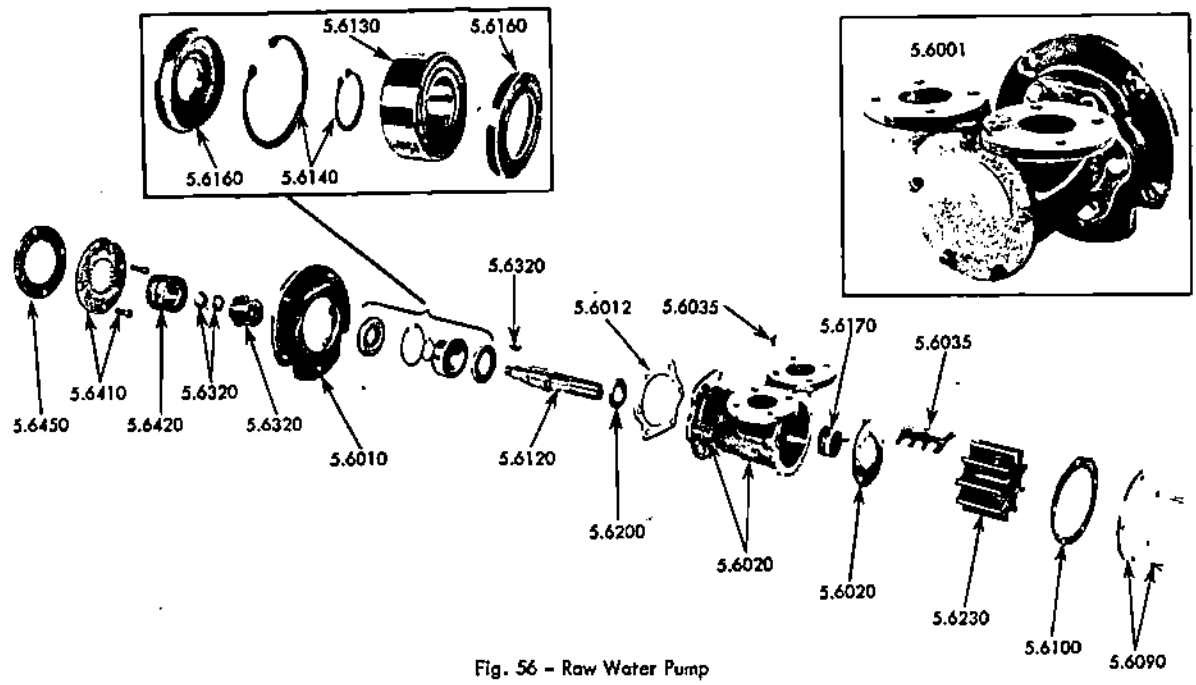


Fig. 56 - Raw Water Pump

¶ Used when raw water pump is not furnished.

+Included gasket, end cover, wear plate, cam, bearings, seal assy., slinger and impeller.

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
56	5.6130	954799	Bearing, raw water pump	1	1	1
56	5.6140	5193569	Ring, raw water pump bearing retainer (small)	1	1	1
56	5.6140	9415285	Ring, raw water pump bearing retainer (large)	1	1	1
56	5.6160	5195020	Seal, raw water pump bearing (1 1/16" I.D.)	1	1	1
56	5.6160	5195101	Seal, raw water pump bearing (1 11/32" I.D.)	1	1	1
56	5.6170	5193557	Seal Assy., raw water pump shaft	1	1	1
56	5.6200	5193676	Slinger, raw water pump shaft	1	1	1
56	5.6230	5193553	Impeller, raw water pump	1	1	1
56	5.6320	5161021	Gear, raw water pump drive	1	1	1
56	5.6320	5161024	Key, raw water pump drive gear	1	1	1
56	5.6320	103325	Lockwasher, 5/8"	1	1	1
56	5.6320	451078	Nut, 7/8" - 18 hex. lock (to shaft)	1	1	1
-	-	5117061	Gasket, raw water pump	1	1	1
56	5.6410	5131627	Plate, raw water pump drive	1	1	1
56	5.6410	5176474	Bolt, raw water pump drive	4	4	4
56	5.6420	5133710	Coupling, raw water pump drive	1	1	1
56	5.6450	5177026	Spacer, raw water pump drive	1	1	1
			WATER FILTER			
-	5.7001	2338846	Filter Assy., water (includes indented items)	1	1	1
-	-	1595836	Valve, water filter shut-off	1	1	1
-	-	179796	Bolt, 1/4" - 20 x 7/8" hex. hd.	2	2	2
-	-	106276	Bolt, 1/4" - 28 x 1 1/8" hex. hd.	2	2	2
-	-	5194597	Installation Kit, water filter (includes filter, hose and fittings)	AR	AR	AR
57	5.7020	5197804	Element, water filter (includes gasket) (use with anti-freeze)	1	1	1
57	5.7020	5194586	Element, water filter (includes gasket) (use with plain water)	AR	AR	AR
57	5.7035	5197437	Gasket, water filter cover	1	1	1
57	5.7045	2293822	Plate, water filter lower	1	1	1
-	-	5189267	Bracket, water filter (heat exchanger unit)	1	1	1
-	-	5186811	Bracket, water filter (radiator units)	1	1	1
-	-	5113396	Hose, water pump to filter (5/8" I.D. x 30 1/2")	1	1	1
-	-	5189471	Hose, water pump to filter (5/8" I.D. x 26")	1	1	1
-	-	5189470	Hose, water pump to filter (5/8" I.D. x 15")	1	1	1
-	-	9139801	Clamp, 9/16" x 1 1/16" dia. hose clamp	2	2	2
-	-	5189295	Valve, shut-off	1	1	1
-	-	3133153	Connector, hose	2	2	2
-	-	447181	Draincock, 3/8"	1	1	1
-	-	105405	Nipple, 1/4" x 7/8" pipe	1	1	1

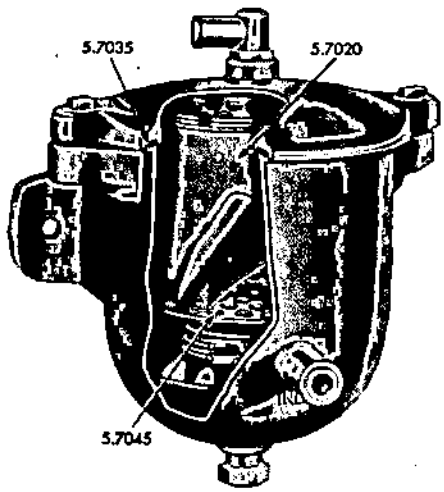


Fig. 57 - Water Filter

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
-	-	121207	Nipple, 3/8" x 1" pipe	1	1	1
-	-	111644	Coupling, 3/8" x 1/4" red. pipe	1	1	1
-	-	144128	Elbow, 3/8" x 90° pipe	2	2	2
-	-	5189303	Hose, water filter outlet (1/4" I.D. x 14")	1	1	1
-	-	5189468	Hose, water filter outlet (1/4" I.D. x 22")	1	1	1
-	-	5189294	Fitting, hose (to valve, 1/4" - 18)	1	1	1
-	-	5189292	Fitting, hose (to bushing, 1/2" - 20)	1	1	1
-	-	144033	Bushing, 3/4" x 1/4" red. pipe	1	1	1
-	-	116332	Bushing, 3/8" x 1/4" red. pipe	1	1	1
			EXHAUST MANIFOLD			
59	6.1001	5108988	Manifold, exhaust (dry)	1		
58	6.1001	5166485	Manifold, exhaust (water cooled)	1		
59	6.1001	5108427	Manifold, exhaust (dry)		1	
58	6.1001	5163809	Manifold, exhaust (water cooled)		1	
59	6.1001	5108950	Manifold, exhaust (dry)			1
3,58	6.1001	5168773	Manifold Assy., exhaust (water cooled) (includes plug 143969)			1
59	6.1001	5188273	Washer, exhaust manifold (dry manifold)	4	6	7
58	6.1001	5164360	Washer, exhaust manifold (water cooled manifold)	4	5	7
-	-	113175	Plug, 1/8" br. pipe	1	1	1
58	6.1001	5111798	Plug, 1" pipe			4
58	6.1001	9174746	Nut, 7/16" - 20 hex.	4		7
59	6.1010	5150194	Gasket, exhaust manifold	1		
58	6.1010	5150195	Gasket, exhaust manifold (end)		2	2
58	6.1010	5150196	Gasket, exhaust manifold (intermediate)			1
6	6.1020	5112899	Stud, exhaust manifold to head	4	6	7
58	6.1100	5119921	Plate, exhaust manifold cover (plain)	2	2	2
58	6.1100	5119923	Plate, exhaust manifold cover (tapped)	1	1	1
58	6.1100	5163834	Washer, exhaust manifold cover plate	6	6	6
58	6.1100	123197	Nut, 5/16" - 18 hex.	6	6	6
58	6.1110	5156319	Gasket, exhaust manifold cover plate	3	3	3
58	6.1120	5163867	Stud, exhaust manifold cover plate (1 7/32")	6	6	6
58	6.1130	103647	Draincock, 1/4"	1	1	1
58	6.1140	5119926	Flange, exhaust manifold water outlet	1	1	1
58	6.1140	5163834	Washer, exhaust manifold water outlet flange	2	2	2
58	6.1140	123197	Nut, 5/16" - 18 hex.	2	2	2
58	6.1150	5156319	Gasket, exhaust manifold water outlet flange	1	1	1
58	6.1160	5167325	Stud, exhaust manifold water outlet flange	2	2	2

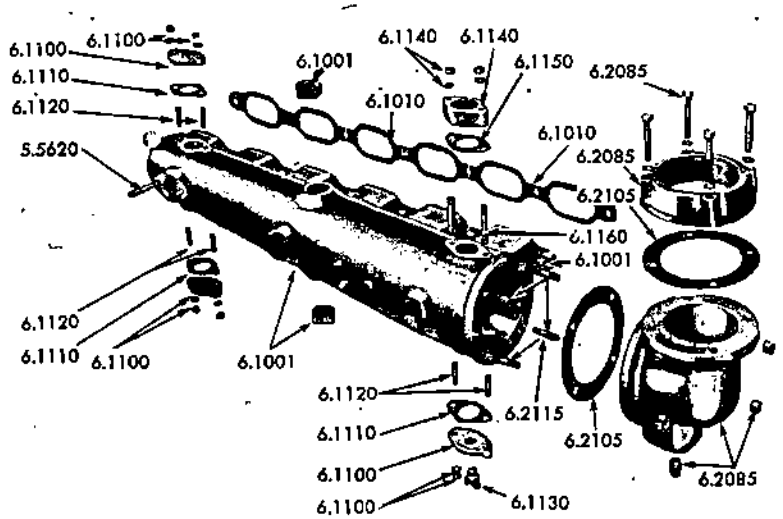


Fig. 58 – Exhaust Manifold – Water Cooled

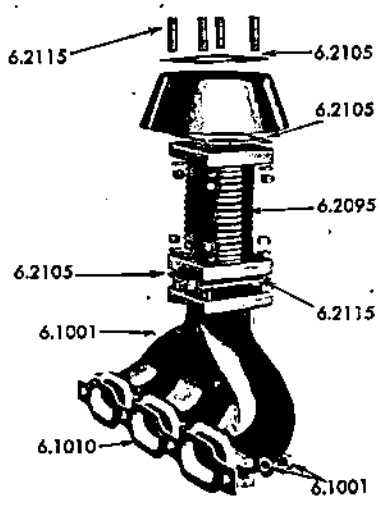


Fig. 59 – Exhaust Manifold – Dry

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
			EXHAUST MUFFLER			
-	-	5120946	Muffler (commercial silencing, 1200-1600 RPM)	1		
-	-	5120944	Muffler (1600-2000 RPM on 3-71, 1200-1600 RPM on 4-71)	1	1	
-	-	5179206	Muffler (moderate silencing)	1	1	
-	-	5162726	Muffler (commercial sil., 1600-2000 RPM on 4-71, 1200-1600 RPM on 6-71)		1	1
-	-	5167144	Muffler (high degree sil., 1600-2000 RPM on 4-71, 1200-1600 RPM on 6-71)		1	1
-	-	5176575	Muffler, exhaust (Maxim MSC2 #10)		1	
-	-	5162725	Muffler (high degree silencing, 1600-2000 RPM)			1
-	-	5179058	Muffler (moderate silencing)			1
-	-	5120948	Muffler (commercial silencing, 1600-2000 RPM)			1
-	-	5113259	Muffler, exhaust (Donaldson M90051)			1
60	6.2005	218873	Bushing, 3 1/2" x 3" red.	1	1	
60	6.2005	218885	Bushing, 4" x 3" red.	1	1	
60	6.2005	218895	Bushing, 5" x 4" red.			1
60	6.2085	3222532	Flange, exhaust (3" P.T.)	1	1	
60	6.2085	5168870	Flange, exhaust (3" P.T., 5 3/8" B.C.)		1	
60	6.2085	5167173	Flange, exhaust (4" P.T.)			1
-	-	5175943	Flange, exhaust (4", 4 1/4" B.C.)			1
59,60	6.2085	5164146	Flange, exhaust (4" P.T., 5 3/8" B.C.)			1
-	-	5113275	Flange, exhaust (5" P.T.)			1
60	6.2085	5166474	Elbow, exhaust (90° x 3")	1		
58,60	6.2085	5167288	Elbow, exhaust (90° x 4")		1	1
-	-	113175	Plug, 1/8" pipe	1	1	1
58	6.2085	444867	Plug, 3/8" pipe	1	1	1
58	6.2085	5164362	Nut, 3/8" - 16 hex. br.	4		
58	6.2085	125913	Nut, 3/8" - 24 hex.		4	4
-	-	114544	Nut, 7/16" - 20 hex. br.	4	4	4
-	-	103321	Lockwasher, 3/8"		4	4
-	-	103322	Lockwasher, 7/16"	4	4	4
58	6.2085	179848	Bolt, 3/8" - 16 x 2 1/4" hex. hd.		4	4
60	6.2093	5185786	Cap, exhaust pipe (3 1/2" pipe)	1	1	
60	6.2093	5185787	Cap, exhaust pipe (4 1/2" pipe)			1
60	6.2095	3290853	Connection, flex. exhaust (3" P.T., 18" L.)	1	1	
60	6.2095	3290854	Connection, flex. exhaust (3" P.T., 48" L.)	1	1	
60	6.2095	5167174	Connection, flex. exhaust (4" P.T., 18" L.)			1
60	6.2095	5167177	Connection, flex. exhaust (4" P.T., 48" L.)			1
59,60	6.2095	3291141	Connection, flex. exhaust (3", flange end)	1		
60	6.2095	5168608	Connection, flex. exhaust (4", flange end)		1	1
59,60	6.2105	3221863	Gasket, exhaust outlet (3 1/4" dia. opening)	1	1	
60	6.2105	5108989	Gasket, exhaust outlet (4 1/4" dia. opening)			1
60	6.2105	5166486	Gasket, exhaust outlet (3 1/8" dia. opening)	1		
59,60	6.2105	5163811	Gasket; exhaust outlet (4 3/8" dia. opening)		2	2
59	6.2115	3222533	Stud, 7/16" - 14 - 20 x 2 1/2"	4	4	4
58	6.2115	186622	Bolt, 3/8" - 16 x 1 1/4" hex. hd.	2		
58	6.2115	186289	Bolt, 3/8" - 16 x 4 1/2" hex. hd.	2		
58	6.2115	5150362	Stud, 3/8" - 16 - 24 x 1 11/16"		4	4
59	6.2115	5111227	Stud, 7/16" - 14 - 20 x 1 3/4"			4
			BATTERY CHARGING GENERATOR			
			Because of the variety of electrical equipment available, it is practical to list only the items, shown below, which are most commonly used. In all cases it is advisable to furnish your Detroit Diesel dealer or distributor the model, unit, and identifying type number shown on the Option Plate on your engine.			
4,61	7.1001	-	Generator	1	1	1
1,61	7.1500	5164285	Pulley, generator (3 1/4" dia., 21/32" groove)	1	1	1
1,61	7.1500	5133559	Pulley, generator (3 1/4" dia., 1/2" groove)	1	1	1
1,61	7.1500	5170771	Pulley, generator (4" dia., 51/64" groove)	1	1	1
1,61	7.1500	5170153	Pulley, generator (4 3/8" dia., 13/16" groove)	1	1	1
1	7.1500	5166785	Pulley, generator (5" dia., 13/16" groove)	1	1	1
61	7.1505	5164291	Pulley, generator drive (5 1/2" dia., 21/32" groove)	1	1	1

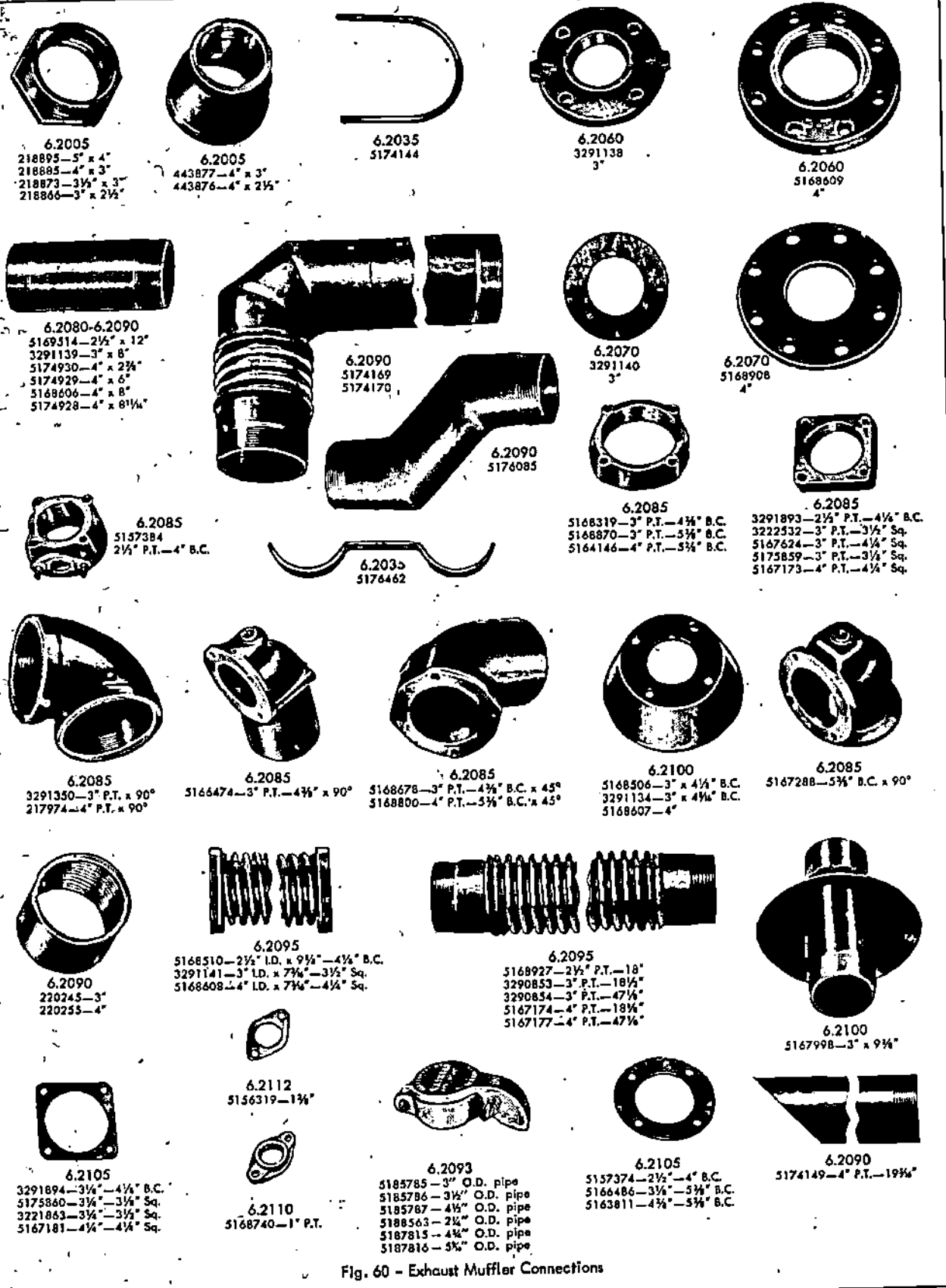


Fig. 60 – Exhaust Muffler Connections

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
14	1.7620	5155445	Seal, generator drive oil (1 1/2" I.D.)	1	1	1
61	7.1575	2068846	Belt, generator drive (34 5/8" L., .688" W.)	1	1	1
1	7.1575	3224367	Belt, generator drive (39 7/8" L., .860" W.)	1	1	1
61	7.1575	5164293	Belt, generator drive (32 5/8" L., .654" W.)	1	1	1
1	7.1575	5155911	Belt, generator drive (40 1/2" L., .774" W.)	1	1	1
1	7.1575	5133516	Belt, generator drive (38" L., .500" W.)	1	1	1
1	7.1575	5133079	Belt, generator drive (37" L., .500" W.)	1	1	1
1,61	7.1580	-	Strap, generator adjusting	1	1	1
3,4	7.1595	-	Bracket, generator mounting	1	1	1
3,4	7.1605	-	Regulator, generator voltage	1	1	1

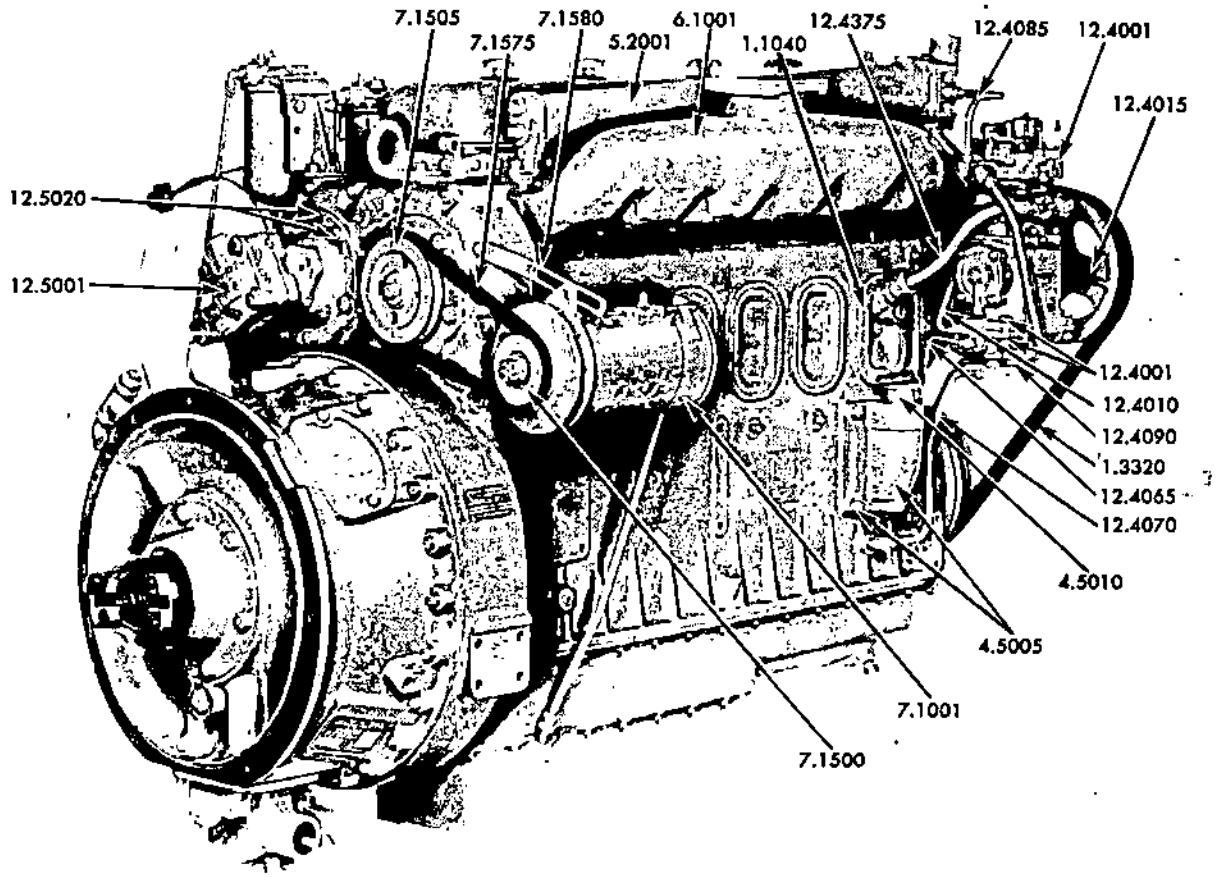


Fig. 61 - 6-71 Industrial Engine

			BATTERY CABLES			
-	-	5274839	Cable, battery (positive, 72" long)	1	1	1
-	-	5274840	Cable, battery (negative, 72" long)	1	1	1

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
			STARTING MOTOR			
			Owing to the variety of electrical equipment furnished, it is practical to list part numbers for the attaching parts only. By furnishing your Detroit Diesel dealer or distributor with the type number on the Option Plate on your engine he can properly interpret your requirements.			
1,74	7.3001	-	Starting Motor Assy.	1	1	1
-	-	271557	Bolt, 5/8" - 11 x 1 3/8" hex. hd.	3	3	3
-	-	103325	Lockwasher, 5/8"	3	3	3

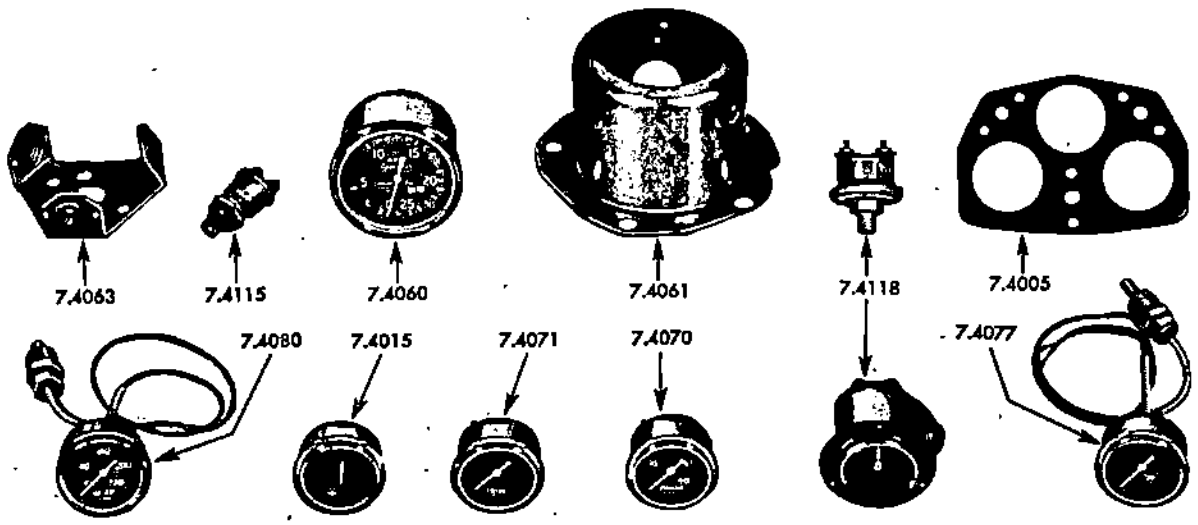


Fig. 62 - Instruments

			INSTRUMENT PANEL			
62	7.4005	1582507	Panel, instrument mounting (less instruments)	1	1	1
-	-	5193755	Mounting Assy., instrument panel (anti-vibration)	3	3	3
-	-	1501170	Ammeter, battery charging (50 amp.)	1		
-	-	857408	Clamp, ammeter	1	1	1
-	-	120217	Lockwasher, #10 instrument attaching	AR	AR	AR
-	-	120614	Nut, #10-32 hex. instrument attaching	AR	AR	AR
62	7.4060	1536865	Tachometer (C.W. rotation)	1	1	1
62	7.4060	1536866	Tachometer (C.C.W. rotation)	1	1	1
62	7.4061	5123740	Adaptor, tachometer mounting	1	1	1
-	-	122408	Bolt, 1/2" - 13 x 1" hex. hd.	4	4	4
-	-	179857	Bolt, 7/16" - 14 x 7/8" hex. hd.	1	1	1
-	-	103323	Lockwasher, 1/2"	4	4	4
-	-	103322	Lockwasher, 7/16"	1	1	1
62	7.4063	5186851	Retainer Assy., tachometer (includes mounting assy.)	1	1	1
-	-	5193754	Mounting Assy., tachometer (anti-vibration)	3	3	3
-	-	1535062	Clamp, tachometer	1	1	1
62	7.4070	1508352	Gage, oil pressure (engine)	1	1	1
-	-	118748	Connector, 1/4" fl. tube	1	1	1
62	7.4071	1508353	Gage, oil pressure (torque converter)	1		1
-	-	1505244	Clamp, pressure or temperature gage	2	2	2
62	7.4077	1513557	Gage, oil temperature (torque converter) (3 foot capillary)	1	1	1
62	7.4077	1513556	Gage, oil temperature (torque converter) (15 foot capillary)	1		
62	7.4080	1513549	Gage, water temperature (26" capillary)	1	1	1
62	7.4080	1513550	Gage, water temperature (73" capillary)	1	1	1
62	7.4080	1513551	Gage, water temperature (15 foot catillary)	1	1	1
4,62	7.4115	1996097	Switch, engine starting	1	1	1

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
62	7.4118	3736851	Hour Meter	1	1	1
62	7.4125	1507359	Switch, hour meter pressure	1	1	1

Fig. 63 - Tachometer Drive

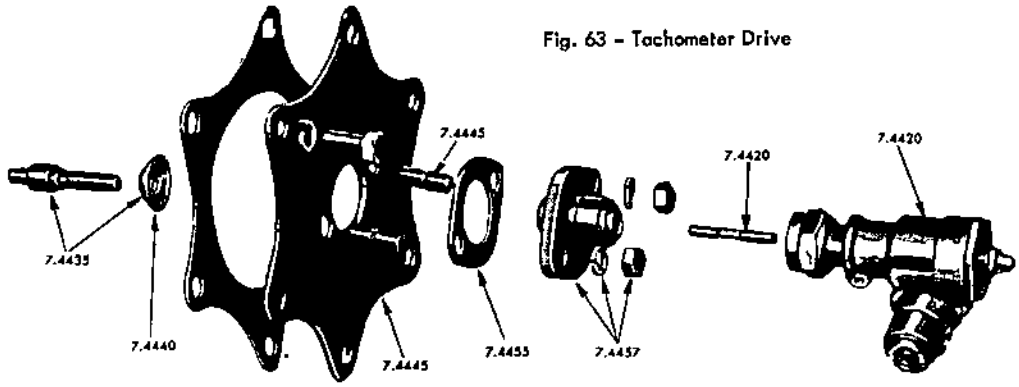


Fig. 64 - Tachometer Drive

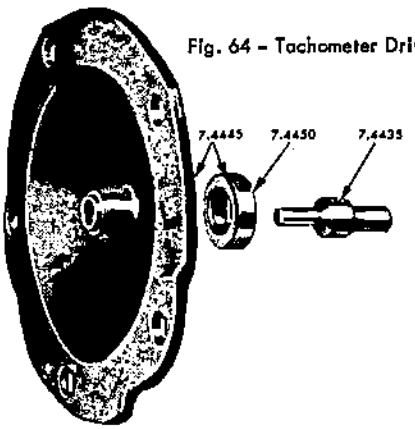
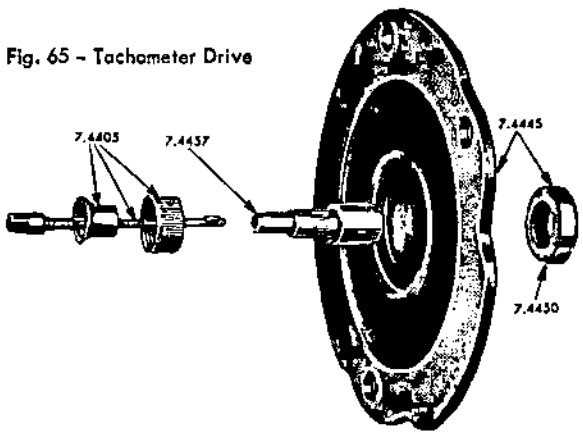


Fig. 65 - Tachometer Drive



TACHOMETER DRIVE

65	7.4405	1536033	Shaft Assy., tachometer drive flex. (3 3/4")	1	1	1
-	-	1568956	Shaft Assy., tachometer drive flex. (40")			1
-	-	845384	Shaft Assy., tachometer drive flex. (47 1/2")	1	1	1
63	7.4420	1566827	Adaptor, tachometer drive cable (90° L.H. 1:.500)	1	1	1
63	7.4420	1565192	Adaptor, tachometer drive cable (90° R.H. 1:.500)	1	1	1
63	7.4420	1536341	Adaptor, tachometer drive cable (90° L.H. 1:.250) (includes key)	1	1	1
63	7.4420	1565185	Adaptor, tachometer drive cable (90° R.H. 1:.250)	1	1	1
63	7.4420	1565170	Adaptor, tachometer drive cable (90° R.H. 1:1)	1	1	1
63	7.4420	1561509	Key (adaptor to tachometer)	1	1	1
63	7.4435	5188558	Shaft Assy., tachometer drive (off of blower gear) (includes slinger)	1	1	1
64	7.4435	3224992	Shaft, tachometer drive (off of cam or balancer shaft)	1	1	1
-	-	5176050	Shaft, tachometer drive (D.C. generator sets)	1	1	1
63	7.4440	5155818	Slinger, tachometer drive shaft oil	1	1	1
64	7.4445	5125153	Cover Assy., tach. drive (cam or balancer shaft-threaded hole) (includes seal)	1	1	1
65	7.4445	5124240	Cover Assy., tach. drive (cam or balancer shaft) (includes seal)	1	1	1
63	7.4445	5168555	Cover Assy., tach. drive (blower drive) (includes stud 5155854)	1	1	1
63	7.4445	5155854	Stud, tachometer drive cover	2	2	2
-	-	122408	Bolt, 1/2" - 13 x 1" hex. hd.	4	4	4
64,65	7.4450	3202615	Seal, tachometer drive cover oil	1	1	1
63	7.4455	5155816	Gasket, tachometer drive adaptor	1	1	1
65	7.4457	5158289	Adaptor, tachometer drive (with cover on cam or balancer shaft)	1	1	1
63	7.4457	5155819	Adaptor, tachometer drive (with cover on blower drive)	1	1	1
63	7.4457	103320	Lockwasher, 5/16"	2	2	2

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
63	7.4457	121917	Nut, 5/16" - 24 hex.	2	2	2

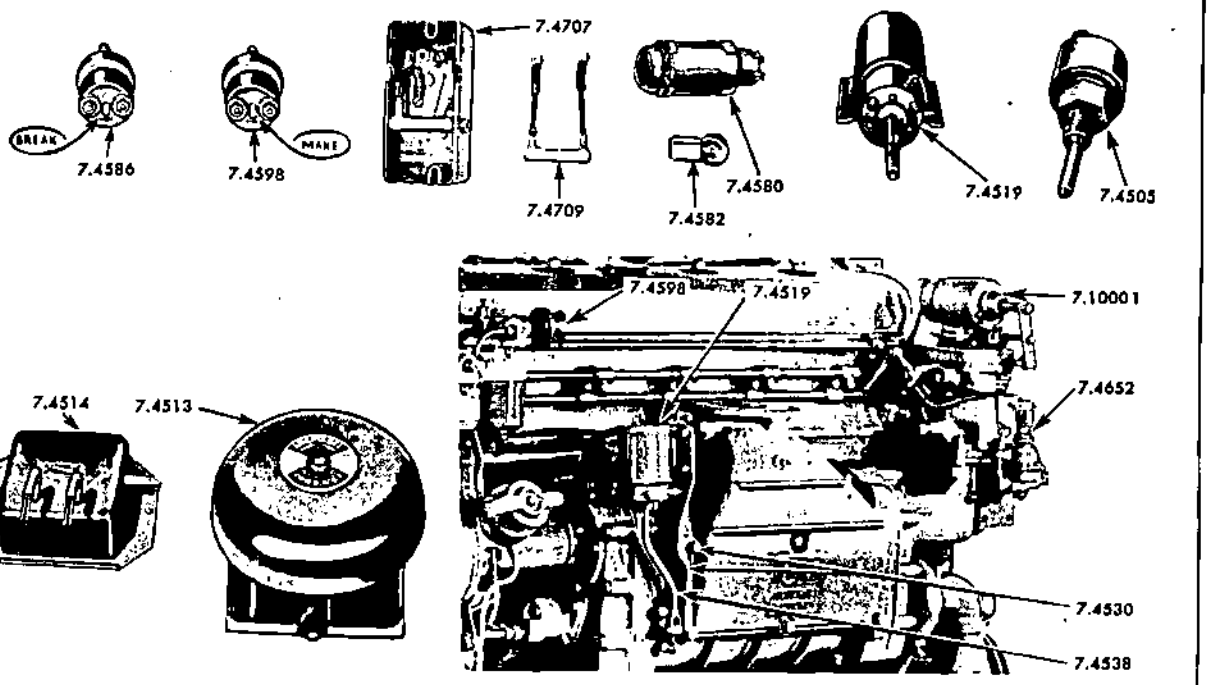


Fig. 66 - Shut-Off and Alarm System

SHUT-OFF OR ALARM SYSTEM

3,66	7.4505	5173018	Alarmstat (thermo switch)	1	1	1
66	7.4513	5131954	Bell, alarm system	1	1	1
66	7.4514	5177779	Relay, alarm bell	1	1	1
66	7.4519	1118128	Solenoid, air shut-off (12 volt)	1	1	1
66	7.4519	1118191	Solenoid, air shut-off (24-32 volt)	1	1	1
-	-	180016	Bolt, 1/4" - 20 x 1/2" hex. hd.	4	4	4
-	-	103319	Lockwasher, 1/4"	4	4	4
66	7.4530	5168929	Bracket, air shut-off solenoid	1	1	1
66	7.4530	179848	Bolt, 3/8" - 16 x 2 1/4" hex. hd.	2	2	2
-	-	103321	Lockwasher, 3/8"	2	2	2
66	7.4538	5168909	Rod, air shut-off solenoid control	1	1	1
-	-	114783	Pin, 1/4" clevis	1	1	1
-	-	103361	Pin, 1/16" x 1/2" cotter	1	1	1
-	-	122161	Nut, 1/4" - 28 hex.	1	1	1
66	7.4580	5177648	Lamp Assy., warning (12V., includes bulb)	1	1	1
66	7.4582	142450	Bulb, warning lamp	1	1	1
4,66	7.4586	1507289	Switch, oil pressure (10# BREAK)	1	1	1
-	-	9409931	Elbow, 1/8" street 90°	1	1	1
-	-	3231135	Tee, 1/4" inv. tube	1	1	1
3,66	7.4598	1507290	Switch, alarm shut-off (fuel pressure) (20# MAKE)	1	1	1
-	-	112877	Bushing, 1/4" x 1/8" red. pipe	1	1	1
-	-	5197675	Governor Assy., overspeed trip (incl. indented items) (1100-1450 RPM)..	1	1	1
-	-	5197676	Governor Assy., overspeed trip (incl. indented items) (1450-1850 RPM)..	1	1	1
-	-	5197677	Governor Assy., overspeed trip (incl. indented items) (1750-2300 RPM)..	1	1	1
-	-	5195822	Ring, overspeed trip governor oil seal	1	1	1
-	-	5197894	Switch, overspeed trip governor	1	1	1
-	-	421566	Screw, #3-48 x 3/4" rd. hd. sl.	2	2	2
-	-	5185834	Lockwasher, #3	2	2	2
-	-	9419442	Nut, 3/8" - 24 elastic stop hex.	2	2	2

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
-	-	5197891	Cap, overspeed trip governor switch housing	1	1	1
66	7.4652	5134104	Valve, automatic shutdown solenoid		1	1
4,66	7.4707	5182525	Relay Assy., time delay (12 volt)	1	1	1
4,66	7.4707	5182526	Relay Assy., time delay (24 volt) (includes indented items)	1	1	1
4,66	7.4707	5182527	Relay Assy., time delay (32 volt)	1	1	1
-	-	132788	Screw, #8 - 32 x 1 3/4" rd. hd.	2	2	2
-	-	446143	Washer, #8 flat	2	2	2
-	-	121841	Lockwasher, #8	2	2	2
66	7.4709	5182787	Resistor Assy., time delay relay (12 volt)	1	1	1
66	7.4709	5182788	Resistor Assy., time delay relay (24 volt)	1	1	1
66	7.4709	5182789	Resistor Assy., time delay relay (32 volt)	1	1	1
-	-	132796	Screw, #8 - 32 x 2 1/4" rd. hd.	1	1	1
-	-	446143	Washer, #8 flat	1	1	1
-	-	121841	Lockwasher, #8	1	1	1
-	-	120622	Nut, #8 - 32 hex.	1	1	1
-	-	5182531	Plate, time delay relay mounting	1	1	1
3,4	7.4711	5188436	Bracket Assy., time delay relay mounting (includes anti-vibration mounts)	1	1	
-	-	1580295	Mounting Assy., time delay relay (anti-vibration)	4	4	4
-	-	5182532	Insulator, time delay relay	1	1	1
			POWER GENERATOR			
			The variety of power generators available makes it impractical to list part numbers. By furnishing your Detroit Diesel dealer or distributor with the model, unit number and identifying type number shown on the Option Plate on your set he can properly interpret your requirements.			
4	7.5001	-	Generator Assy., power	1	1	1
-	-	5514417	Sight gage, oil level	1	1	1
-	-	5388489	Gasket, bearing cap	1	1	1
-	-	5388483	Collector Ring Assy.	1	1	1
-	-	5393929	Brush Holder Assy.	AR	AR	AR
-	-	5330666	Spring, brush tension - collector ring	1	1	1
-	-	901312	Bearing, generator shaft			
			The following items are used on Alternating Current Generators.			
-	-	5393668	Fan and Driving Disc Assy.	1	1	1
-	-	5521034	Brush, collector ring	4	4	4
-	-	5388541	Brush, commutator	4	4	4
-	-	5385510	Stud, brush holder mounting	4	4	4
-	-	5382040	Tube, brush holder stud insulating	4	4	4
-	-	5344540	Washer, brush holder stud insulating	2	2	2
-	-	5396176	Inter Pole Coil	2	2	2
-	-	5305919	Inter Pole Coil			
			The following items are used on Direct Current Generators.			
-	-	5310031	Brush Holder Assembly, armature	1		
-	-	5310032	Brush Holder Assembly, armature			6
-	-	5387142	Brush Holder Assembly, armature	4	4	
-	-	5308996	Brush, commutator	8	12	8
-	-	5378499	Brush, commutator	AR	AR	AR
-	-	5321999	Brush, commutator			12
-	-	5521034	Brush, collector ring	4	4	4
-	-	5310593	Spring, brush tension - armature	AR	AR	AR
-	-	5316870	Stud, brush holder - commutator	4		
-	-	5316871	Stud, brush holder - commutator		4	4
-	-	5360811	Stud, brush holder - commutator	4		
-	-	5314020	Stud, brush holder - collector ring	2	2	2
-	-	5382043	Tube, insulating - brush holder stud	2	2	2

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
-	-	5317124	Disc, insulating - stud end	AR	AR	AR
-	-	1070969	Plug, expansion - disc cover	AR	AR	AR
-	-	5357571	Washer, insulating - brush holder stud	AR	AR	AR
-	-	5386534	Washer, insulating - brush holder stud	AR	AR	AR
-	-	5312127	Washer, insulating - brush holder stud	AR	AR	AR
-	-	5327712	Washer, steel - brush holder stud	AR	AR	AR
-	-	5327711	Washer, spring - brush holder stud	AR	AR	AR
			CONTROL CABINET			
			The variety of control cabinets available for generator sets makes it impractical to list part numbers. By furnishing your Detroit Diesel dealer or distributor with the model, unit, and identifying type number shown on the Option Plate on your set he can properly interpret your requirements.			
4	7.8001	-	Cabinet Assy., control	1	1	1
			WIRING HARNESS			
			The proper wiring harness for your engine can be interpreted by your Detroit Diesel dealer or distributor. It is necessary to furnish the model number and type number (if shown) on the Option Plate on your engine.			
74	7.7001	-	Harness, engine wiring	1	1	1

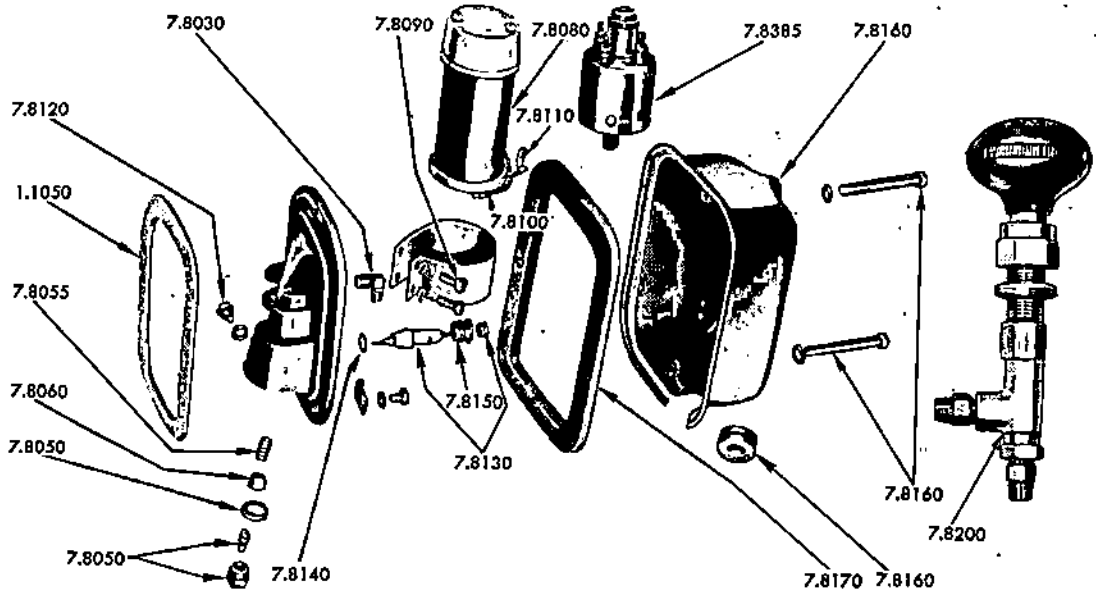


Fig. 67 – Air Heater

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER		
			AIR HEATER			
4	7.8001	5170792	Air Heater Assy. (includes indented items)	1	1	1
-	-	5158702	Tee (to body)	1	1	1
67	7.8030	137420	Elbow, 3/16" inv. fl. tube 90°	1	1	1
67	7.8050	5231329	Nozzle, air heater spray	1	1	1
67	7.8050	5151921	Washer, air heater spray nozzle	1	1	1
67	7.8080	1115485	Coil Assy., air heater	1	1	1
67	7.8090	114354	Bolt, 1/4" - 20 x 5/8" fil. hd.	2	2	2
-	-	103319	Lockwasher, 1/4"	2	2	2

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
67	7.8100	5152779	Lead, air heater coil ground	1	1	1
67	7.8110	5154125	Lead, air heater coil high tension	1	1	1
67	7.8120	5153390	Electrode, air heater	1	1	1
-	-	103319	Lockwasher, 1/4"	1	1	1
67	7.8130	1556410	Insulator, air heater (includes 1557767 nut)	1	1	1
67	7.8130	1557767	Nut, air heater insulator terminal	1	1	1
67	7.8140	5158594	Gasket, air heater insulator	1	1	1
67	7.8150	5153395	Nut, air heater insulator	1	1	1
67	7.8160	5175017	Cover, air heater	1	1	1
67	7.8160	117957	Grommet, air heater cover (5/8" O.D.)	1	1	1
67	7.8160	123956	Bolt, 5/16" - 18 x 2 7/8" hex. hd.	2	2	2
-	-	103320	Lockwasher, 5/16"	2	2	2
67	7.8170	5154066	Gasket, air heater cover	1	1	1
67	7.8200	5230535	Pump Assy., air heater (includes indented items)	1	1	1
-	-	5230543	Seal Ring, air heater pump plunger	2	2	2
-	-	5152674	Knob, air heater pump plunger	1	1	1
-	-	122366	Nut, 5/8" - 18 hex.	1	1	1
-	-	5230544	Valve, air heater pump inlet (1/2#)	1	1	1
-	-	5153358	Valve, air heater pump outlet (30#)	1	1	1
4	7.8295	5171387	Valve, air heater supply shut-off	1	1	1
-	-	5174659	Tube Assy., air heater to pressure switch	1	1	1
-	-	137404	Connector, 3/16" inv. fl. tube	1	1	1
67	7.8385	5175018	Switch, air heater pump pressure	1	1	1
-	-	5183574	Resistor, air heater (24V.)	1	1	1
-	-	5183575	Resistor, air heater (32V.)	1	1	1
			HYDRAULIC GOVERNOR SOLENOID			
-	-	1118088	Solenoid Assy., governor starting (24V. or 32V.)	1	1	1
-	-	1118040	Solenoid Assy., governor starting (12V.)	1	1	1
-	-	1507289	Switch, oil pressure	1	1	1
-	-	9409931	Elbow, 1/8" pipe 90°	1	1	1

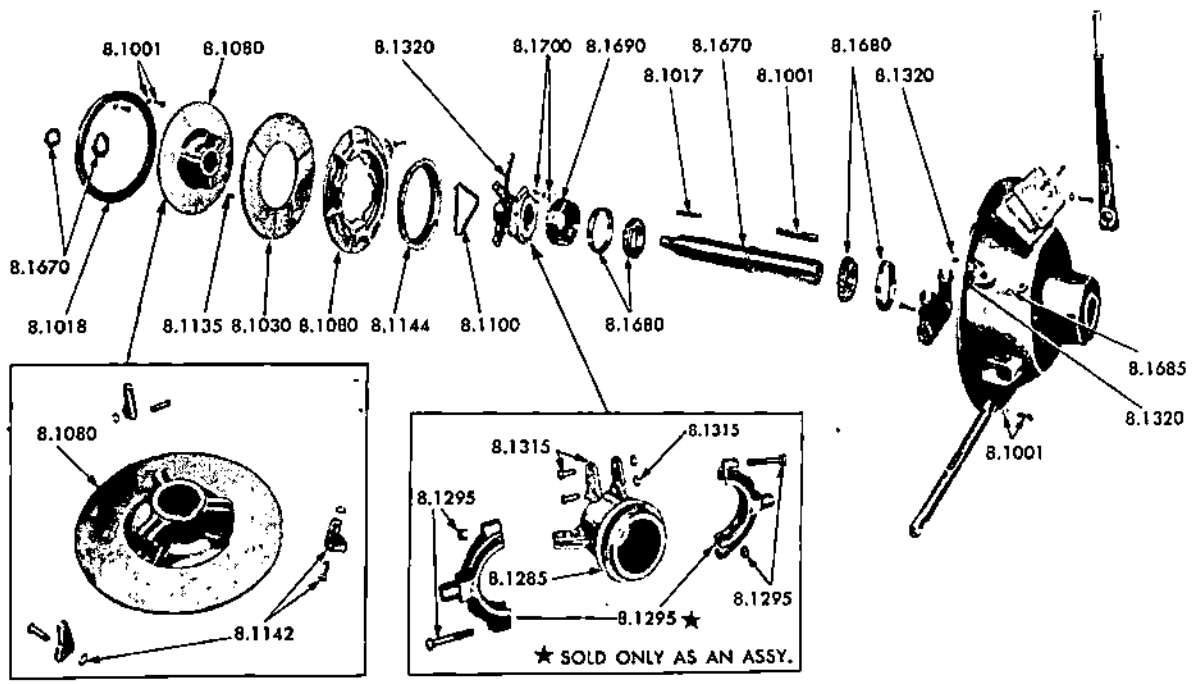


Fig. 68 - Power Take-Off

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
			CLUTCH AND/OR POWER TAKE-OFF			
3	8.1001	5171519#	Power Take-Off Assy. (direct drive, short shaft, PTA-1SD-50)	1	1	1
3	8.1001	5132201Δ	Power Take-Off Assy. (11 1/2" clutch, short shaft, PTA11162)	1	1	
3	8.1001	5132202Δ	Power Take-Off Assy. (11 1/2" clutch, long shaft, PTA11163)	1	1	
3	8.1001	5189516Δ	Power Take-Off Assy. (14" clutch, short shaft, PTA11485)	1	1	1
3	8.1001	5189515Δ	Power Take-Off Assy. (14" clutch, long shaft, PTA11486)			1
3	8.1001	5124173Δ	Power Take-Off Assy. (14" double plate clutch, short shaft, PTA114113)			1
3	8.1001	5189517Δ	Power Take-Off Assy. (14" clutch, 1.76:1 red., reverses rotation, GRA1148)	1	1	1
68	8.1001	5192156	Key, PTO pulley (5/8" x 5/8" x 5 1/4")	1	1	
68	8.1001	5192127	Key, PTO pulley (3/4" x 3/4" x 7 1/2")	1	1	1
68	8.1001	5192217	Key, PTO pulley (5/8" x 5/8" x 9 1/4")	1	1	
68	8.1001	5192216	Key, PTO pulley (3/4" x 3/4" x 13 1/2")			1
69	8.1001	5192341	Key, PTO pulley (3/4" x 3/4" x 5")	1	1	1
68	8.1001	179860	Bolt, 7/16" - 14 x 1 1/4" hex. hd. (to flywheel housing)	12	12	12
68	8.1001	186628	Bolt, 3/8" - 16 x 1 1/2" hex. hd. (to flywheel)	8	8	
68	8.1001	179884	Bolt, 1/2" - 13 x 1 3/8" hex. hd. (to flywheel)	8	8	8
68	8.1001	179837	Bolt, 3/8" - 16 x 3/4" hex. hd. (to flywheel)	8	8	8
68	8.1001	103321	Lockwasher, 3/8"	AR	AR	AR
68	8.1001	103322	Lockwasher, 7/16"	AR	AR	AR
68	8.1001	103323	Lockwasher, 1/2"	AR	AR	AR
-	-	5197881	Clutch Assy. (11 1/2")	1	1	

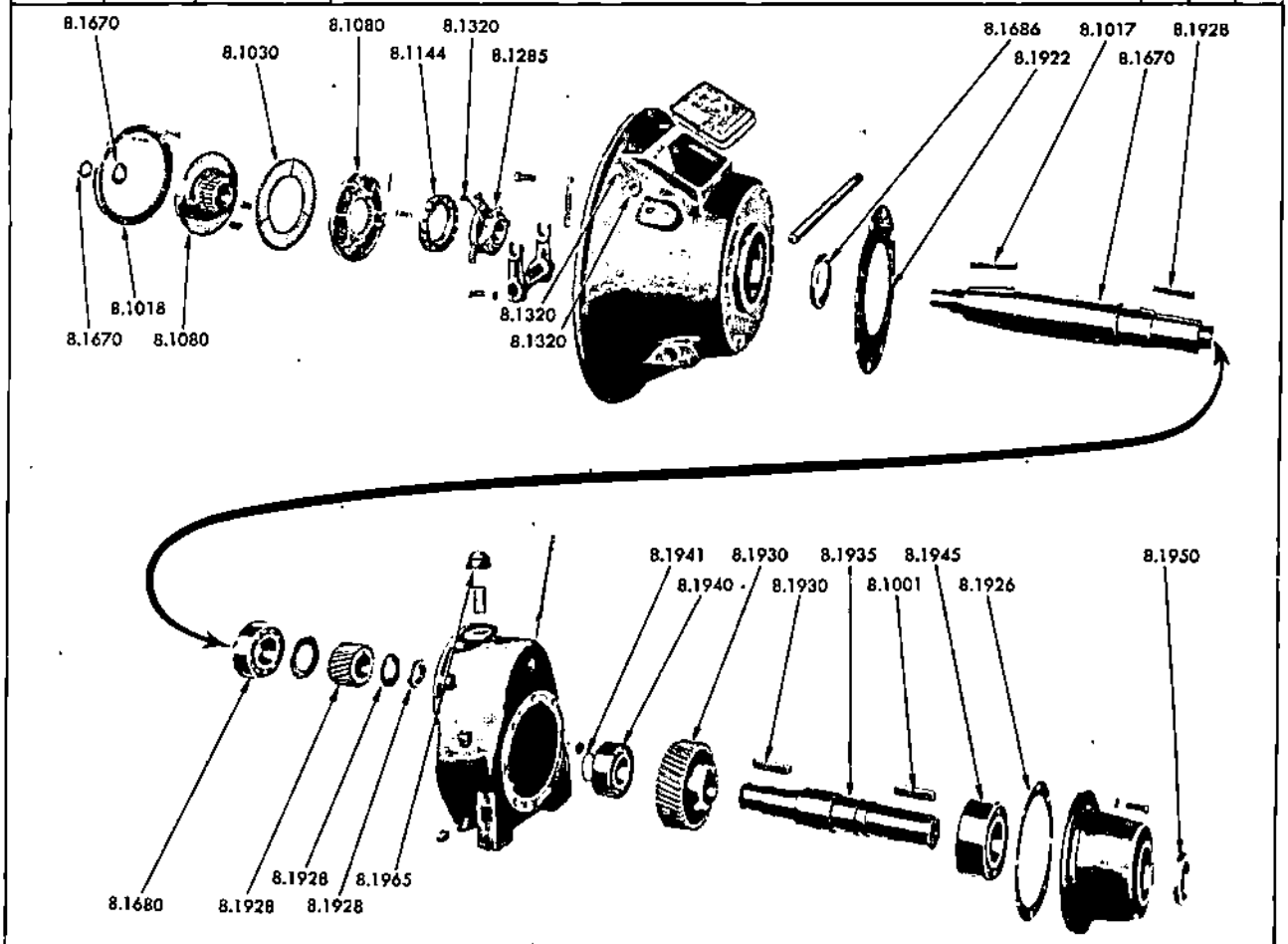


Fig. 69 – Power Take-Off

Uses "ball" type pilot bearing; includes indented items. Δ Uses "roller" type pilot bearing; includes indented items.

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
-	-	5196869	Clutch Assy. (14" single plate)	1	1	1
-	-	5196876	Clutch Assy. (14" double plate)			1
-	-	5194365	Clutch Assy. (10") (300 series T/C)	1	1	
-	-	761027	Clutch Assy. (500 series T/C)		1	1
68	8.1017	5193450	Key, clutch to shaft (3/8" x 1/2" x 2 1/4") (11 1/2" clutch)	1	1	
68	8.1017	5192126	Key, clutch to shaft (1/2" x 3/4" x 3 1/2") (14" clutch)	1	1	1
68	8.1017	5192841	Key, clutch to shaft (3/8" x 1/2" x 4 1/2") (14" double plate clutch)			1
68	8.1018	5192163	Ring, clutch driving (11 1/2" clutch)	1	1	
68,69	8.1018	5192128	Ring, clutch driving (14" clutch)	1	1	1
68	8.1018	5192180	Ring, clutch driving (10" clutch)	1	1	
70	8.1020	5175290§	Disc Assy., T/C clutch (500 series)		1	
70	8.1020	6754595†	Disc Assy., T/C clutch (500 series)			1
68	8.1030	5197884	Facing, clutch (1 piece, 11 1/2" clutch)	1	1	
67,68	8.1030	5192129	Facing, clutch (3 segments, 14" clutch)	1	1	AR
68	8.1030	5192182	Facing, clutch (3 segments, 10" clutch)	1	1	
-	-	2257211	Spring, disc (long) (500 series T/C clutch)		6	
-		5192725	Spring, disc (short) (500 series T/C clutch)		6	
-	-	2007110	Spring, disc (500 series T/C clutch)			12
68	8.1080	5194290	Plate, clutch pressure (inner) (11 1/2" clutch)	1	1	
68	8.1080	5194141	Plate, clutch pressure (outer) (11 1/2" clutch)	1	1	
68	8.1080	5192824	Plate, clutch pressure (inner) (14" clutch)	1	1	1
68	8.1080	5192825	Plate, clutch pressure (outer) (14" clutch)	1	1	1
-	8.1080	5172835	Plate, clutch pressure (center) (14" double plate clutch)			1
-	-	5192834	Plate, clutch pressure (outer) (14" double plate clutch)			1
68	8.1080	5194294	Plate, clutch pressure (inner) (10" clutch)	1	1	
68	8.1080	5193258	Plate, clutch pressure (outer) (10" clutch)	1	1	
70	8.1080	755079	Plate, clutch pressure (500 series T/C clutch)		1	1
68	8.1100	5194138	Spring, clutch toggle lever (10" or 11 1/2" clutch)	1	1	
-	-	755408	Hub and Spring Assy., clutch		1	1
68	8.1135	5193431	Spring, clutch pressure plate release (10" or 11 1/2" clutch)	3	3	
70	8.1135	755093	Spring, clutch pressure plate release (500 series T/C clutch)		3	3
70	8.1135	755415	Bolt, release spring (500 series T/C clutch)		3	3
70	8.1136	755405	Spacer, release spring (500 series T/C clutch)		3	3
68	8.1142	5194140	Lever, clutch release yoke (toggle) (10" or 11 1/2" clutch)	3	3	
68	8.1142	5122925	Lever, clutch release yoke (toggle) (14" clutch)	4	4	4
68	8.1142	5193422	Pin, clutch release yoke lever (10" or 11 1/2" clutch)	3	3	
68	8.1142	5192134	Pin, clutch release yoke lever (14" lever)	4	4	4
68	8.1142	5192142	Ring, retaining (pin) (10" or 11 1/2" clutch)	3	3	
68	8.1142	5192135	Ring, retaining (pin) (14" clutch)	4	4	4
68	8.1144	5197883	Nut, clutch adjusting (10" or 11 1/2" clutch)	1	1	
69	8.1144	5196872	Nut, clutch adjusting (14" clutch)	1	1	1
-	-	5196867	Lock, clutch adjusting nut (10" or 11 1/2" clutch)	1	1	
-	-	114351	Screw, 1/4" - 20 x 3/8" fil. hd. sl.	1	1	

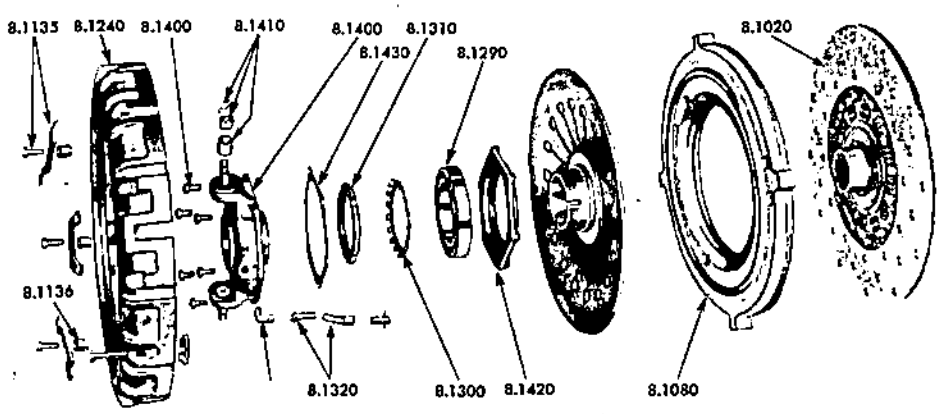


Fig. 70 - Disconnect Clutch - Torque Converter

§ Includes springs 2257211 and 5192725. † Includes spring 2007110.

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
-	-	114604	Lockwasher, 1/4" ext. tooth	1	1	
-	-	5196725	Lock, clutch adjusting nut	1	1	1
-	-	5196727	Spring, vlutch adjusting lock	1	1	1
-	-	5196726	Pin, clutch adjusting lock spring	1	1	1
-	-	5197834	Screw, drive (#10 x 1/2")	3	3	3
-	-	5197862	Plate, clutch adjusting nut lock wear	1	1	
-	-	5196724	Plate, clutch adjusting nut lock wear	1	1	1
68	8.1285	5193432	Sleeve, clutch release (11 1/2" clutch)	1	1	
69	8.1285	5192139	Sleeve, clutch release (14" clutch)	1	1	1
68	8.1285	5193259	Sleeve, clutch release (10" clutch)	1	1	
70	8.1290	903017	Bearing, clutch release (500 series T/C clutch)		1	1
68	8.1295	5196715	Collar Assy., clutch release (11 1/2" clutch)	1	1	
68	8.1295	5197139	Collar Assy., clutch release (14" clutch)	1	1	1
68	8.1295	5196719	Collar Assy., clutch release (10" clutch)	1	1	
70	8.1300	755126	Lockwasher, clutch release bearing (500 series T/C clutch)		1	1
70	8.1310	755090	Nut, clutch release bearing lock (500 series T/C clutch)		1	1
68	8.1315	5193421	Link, clutch release yoke (10" or 11 1/2" clutch)	6	6	
68	8.1315	5192140	Link, clutch release yoke (14" clutch)	8	8	8
68	8.1315	5193420	Pin, clutch release yoke link (10" or 11 1/2" clutch)	6	6	
68	8.1315	5192141	Pin, clutch release yoke link (14" clutch)	8	8	8
68	8.1315	5192176	Ring, retaining (10" or 11 1/2" clutch)	6	6	
68	8.1315	5192142	Ring, retaining (14" clutch)	8	8	8
68	8.1320	5192295	Hose, release bearing lube (9" L.)	1	1	
69	8.1320	5192296	Hose, release bearing lube (7 5/8" L.)	1	1	1
70	8.1320	5161543	Hose, release bearing lube (500 series T/C clutch)		1	1
68,69	8.1320	122366	Nut, 5/8" - 18 hex. thin	1	1	1
68,69	8.1320	191758	Fitting, 1/8" P.T. lubrication	1	1	1
-	-	6750656	Guide, clutch release bearing (500 series T/C clutch)		1	1
-	-	179838	Bolt, 3/8" - 16 x 7/8" hex. hd.		6	6
-	-	103321	Lockwasher, 3/8"		6	6
70	8.1400	755099	Sleeve Assy., clutch release bearing (500 series T/C clutch)		1	1
70	8.1400	186625	Bolt, 5/16" - 18 x 7/8" hex. hd.		6	6
-	-	103320	Lockwasher, 5/16"		6	6
70	8.1410	2078921	Bushing, release bearing sleeve (500 series T/C clutch)		2	2
70	8.1410	117051	Nut, 1/2" - 20 hex.		2	2
70	8.1410	108630	Pin, 1/8" x 7/8" cotter		2	2
70	8.1420	755085	Cover, release bearing sleeve (500 series T/C clutch)		1	1
70	8.1430	755088	Gasket, release bearing sleeve cover (500 series T/C clutch)		1	1
-	-	148418	Bearing, shifter shaft (500 series T/C clutch)		3	3
-	-	5178308	Seal, shifter shaft (500 series T/C clutch)		4	4
-	-	5157751	Washer, shifter shaft thrust (500 series T/C clutch)		1	1
68	8.1670	5194581	Shaft, clutch drive (19 31/16" L.) (11 1/2" clutch short shaft)	1	1	
68	8.1670	5194579	Shaft, clutch drive (24 11/16" L.) (14" clutch short shaft)	1	1	1
68	8.1670	5194582	Shaft, clutch drive (35" L.) (11 1/2" clutch long shaft)	1	1	
68	8.1670	5194572	Shaft, clutch drive (26 1/16" L.) (14" double plate clutch)			1
68	8.1670	5194580	Shaft, clutch drive (40 15/16" L.) (14" clutch short shaft)			1
68	8.1670	5192214	Shaft, clutch drive (18 7/8" L.) (PTO, direct drive)	1	1	1
69	8.1670	5194571	Shaft, clutch drive (21 7/64" L.) (14" clutch red. gear)	1	1	1
-	-	6750658	Shaft, clutch drive (500 series T/C clutch)		1	1
71A	8.1670	6772307	Shaft, clutch drive (300 series T/C clutch)	1	1	
68	8.1670	5192153	Nut, shaft (11 1/2" clutch)	1	1	
68,69	8.1670	5192124	Nut, shaft (14" clutch)	1	1	1
68	8.1670	5192154	Lockwasher, shaft (11 1/2" clutch)	1	1	
68	8.1670	5192125	Lockwasher, shaft (14" clutch)	1	1	1
69	8.1670	5192840	Washer, shaft	1	1	1
68	8.1680	142224	Cup, drive shaft bearing (11 1/2" clutch & direct drive PTO)	2	2	2
68	8.1680	441294	Cone, drive shaft bearing (11 1/2" clutch & direct drive PTO)	2	2	2
68	8.1680	457323	Cup, drive shaft bearing (14" clutch)			2
68	8.1680	457325	Cone, drive shaft bearing (14" clutch)			2
69	8.1680	954353	Bearing, drive shaft (5189517)	1	1	1
-	-	907516	Bearing, drive shaft (500 series T/C clutch)		1	1
68	8.1685	900454	Bearing, drive shaft (300 series T/C clutch)	1	1	1
69	8.1686	5194955	Seal, clutch drive shaft bearing grease	1	1	1
68	8.1690	5192149	Retainer, drive shaft bearing (11 1/2" clutch)	1	1	1

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
68	8.1690	5192115	Retainer, drive shaft bearing (14" clutch)			1
68	8.1690	5192838	Retainer, drive shaft bearing (14" double plate clutch)			1
68	8.1700	3223379	Lock, drive shaft bearing retainer	1	1	1
68	8.1700	106973	Bolt, 5/16" - 18 x 1/2" hex. hd.	1	1	1
-	-	5174184	Pillow Block Unit (bearing)	1	1	1
-	-	100080	Bolt, 5/8" - 18 x 3" hex. hd.	2	2	2
-	-	117053	Nut, 5/8" - 18 hex.	2	2	2
-	-	3222037	Shim, pillow block to support (.031")	AR	AR	AR
-	-	3222036	Shim, pillow block to support (.062")	AR	AR	AR
-	-	3222038	Shim, pillow block to support (.010")	AR	AR	AR
-	-	5158076	Shim, pillow block to support (.005")	AR	AR	AR
-	-	5186666	Shim, pillow block to support (.002")	AR	AR	AR
-	-	5168156	Support, pillow block	1	1	1
61	8.1830	186707	Bolt, 5/8" - 18 x 5 1/4" hex. hd.	2	2	2
-	-	5186504	Dowel, support, to pillow block	2	2	2
-	-	3222173	Dowel, support to base	1	1	1
69	8.1922	5192335	Gasket, reduction gear housing	1	1	1
69	8.1926	5192333	Gasket, reduction gear cover plate	1	1	1
69	8.1928	5193322	Gear, reduction drive (25 teeth)	1	1	1
69	8.1928	5195444	Key, reduction drive gear (1/2" x 1/2" x 3")	1	1	1
69	8.1928	5192124	Nut, reduction drive gear	1	1	1
69	8.1928	5192125	Lockwasher, reduction drive gear	1	1	1
69	8.1930	5193323	Gear, reduction driven (44 teeth)	1	1	1
69	8.1930	5192342	Key, reduction driven gear (3/4" x 3/4" x 4")	1	1	1
69	8.1935	5192328	Shaft, reduction gear	1	1	1
69	8.1940	905312	Bearing, reduction gear shaft pilot	1	1	1
69	8.1941	5192337	Ring, reduction gear shaft pilot	1	1	1
69	8.1945	905316	Bearing, reduction gear shaft outer	1	1	1
69	8.1950	5194526	Seal, reduction gear shaft oil	1	1	1
69	8.1965	1528732	Cap, reduction gear breather	1	1	1

TORQUE CONVERTER

The Torqmatic Converter is offered in a wide variety of models to fit its many applications. While part numbers for these converters are not shown they may be interpreted by your Detroit Diesel dealer or distributor. It is necessary to furnish model number and type number from the Option Plate on your engine.

- 500 SERIES -

2	8.3001	-	Converter Assy., Torqmatic (includes indented items)		1	1
-	-	179867	Bolt, 7/16" - 14 x 2 1/4" hex. hd. (to flywheel housing)		23	23
-	-	9412014	Bolt, torque converter to crankshaft		6	6
-	-	103322	Lockwasher, 7/16"		23	23
-	-	6759354	Gasket and Seal Kit, torque converter (includes gaskets, seals and snap rings for a torque converter overhaul)		AR	AR
72	8.3020	6768266	Sleeve, torque converter ground		1	1
72	8.3020	6751377	Key, torque converter ground sleeve		1	1
72	8.3020	141202	Pin, 1/4" x 1 1/8" dowel		1	1
72	8.3030	6768481	Seal, torque converter ground sleeve retainer oil		1	1
72	8.3045	6756761	Shaft, torque converter drive (TC, TCD - flange shaft)		1	1
72	8.3045	6758126	Shaft, torque converter drive (TC, TCD - industrial shaft)		1	1
72	8.3045	6768471	Shaft, torque converter drive (TCA, TCDA - industrial)		1	1
72	8.3045	6703152	Key, torque converter drive shaft (3/4" x 3/4" x 4")		1	1
72	8.3047	6703135	Ring, T/C drive shaft to converter housing piston (2 3/4" O.D.)		2	2
72	8.3050	903312	Bearing, torque converter drive shaft main		1	1
72	8.3050	457323	Cup, T/C drive shaft main bearing		2	2
72	8.3050	457325	Cone, T/C drive shaft main bearing		2	2
72	8.3055	6772040	Seal, torque converter drive shaft main bearing oil (3" I.D.)		1	1
72	8.3055	6771232	Seal, torque converter drive shaft main bearing oil (3 1/2" I.D.)		1	1
72	8.3055	6750434	Sleeve, torque converter oil seal		1	1
-	-	6753204	Spacer, T/C drive shaft main bearing (TCA, TCDA)		1	1
72	8.3065	6750507	Shim, torque converter main bearing retainer (.003")		AR	AR

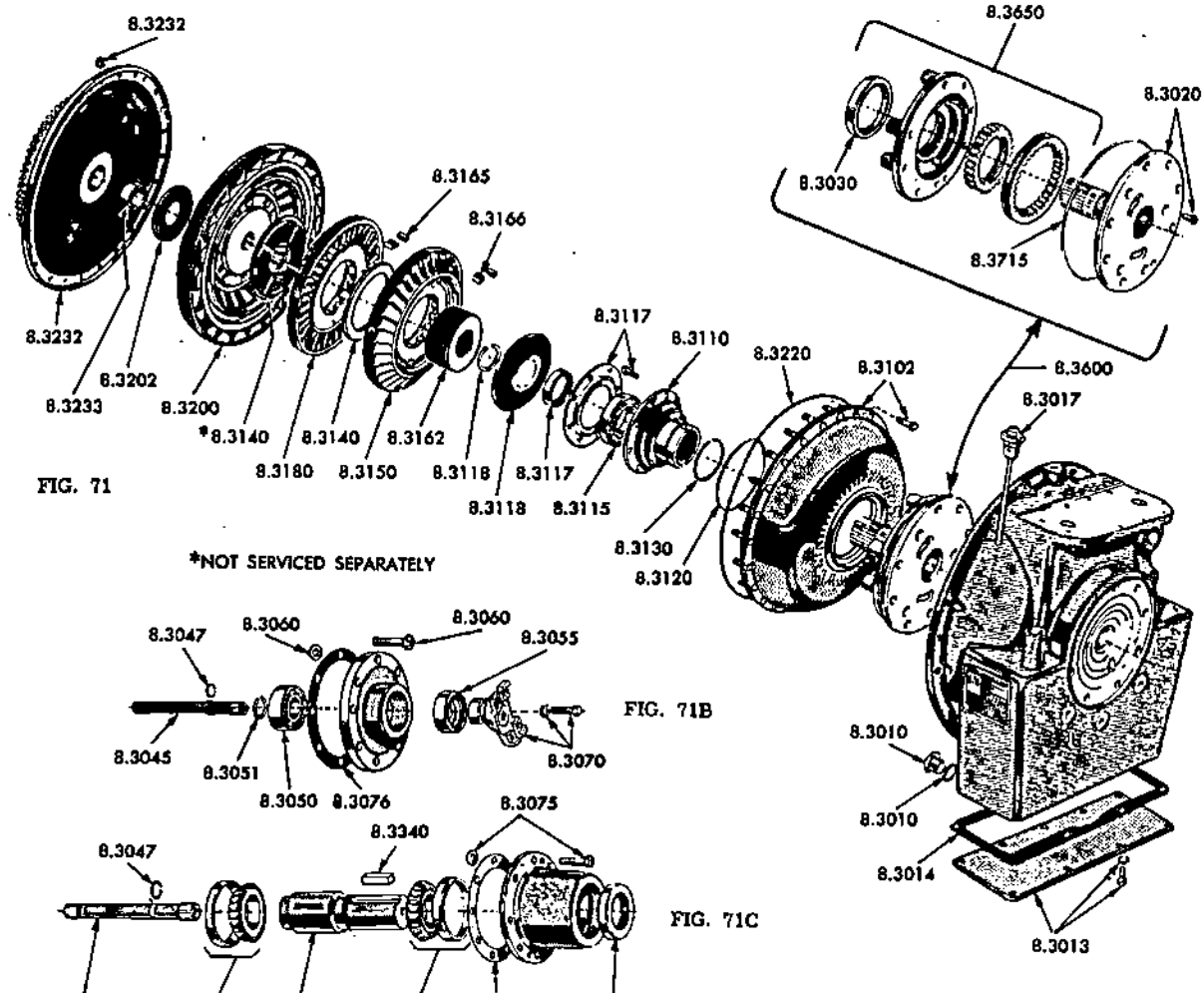


FIG. 71

*NOT SERVICED SEPARATELY

FIG. 71B

FIG. 71C

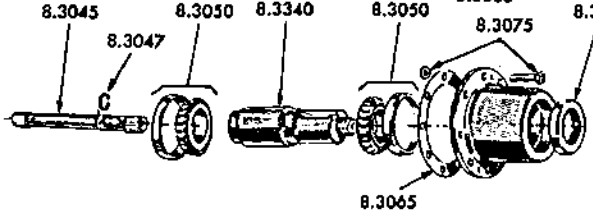


FIG. 71D

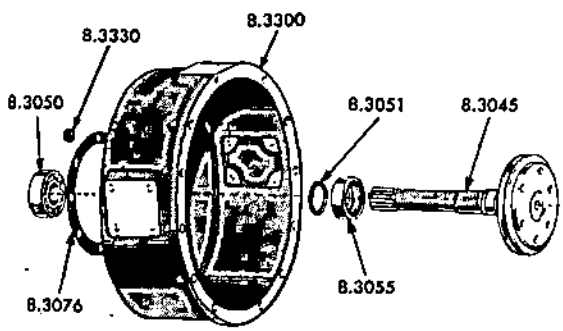


FIG. 71E

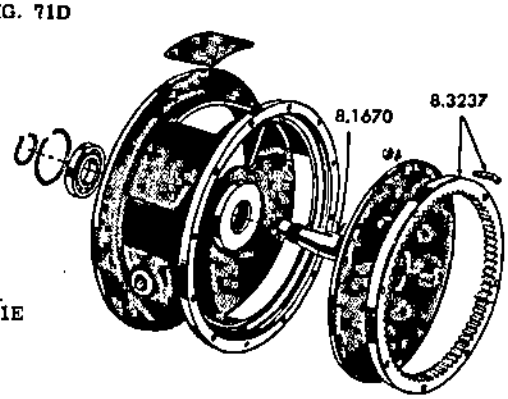


FIG. 71A

Fig. 71 – Typical 300 Series Converter

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	QUANTITY PER 4-71
72	8.3065	6750546	Shim, torque converter main bearing retainer (.010")		AR
72	8.3065	6750547	Shim, torque converter main bearing retainer (.031")		AR
72	8.3070	6750413	Yoke, torque converter drive shaft		1
72	8.3070	271632	Bolt, 3/4" - 16 x 1 3/4" hex. hd.		1
72	8.3070	103326	Lockwasher, 3/4"		1
72	8.3071	6750451	Retainer, torque converter drive shaft flange		1
72	8.3076	6753202	Gasket, torque converter bearing housing		1
-	-	6752617	Gear, torque converter governor drive		1
-	-	6752615	Shaft, torque converter governor drive		1
-	-	6752614	Bushing, torque converter governor drive shaft		1
-	-	3224773	Gasket, torque converter governor drive shaft adaptor		1
-	-	954498	Bearing, torque converter governor drive shaft		1
-	-	3224085	Sleeve, torque converter governor drive		1
-	-	6751524	Spacer, torque converter governor drive shaft bearing		1
72	8.3102	6756984	Pump, torque converter (540, 550 series)		1
72	8.3102	6756589	Pump, torque converter (560, 570 series)		1
72	8.3102	6757015	Pump, torque converter (520, 530 series)	1	
72	8.3102	9409037	Bolt, 3/8" - 24 x 1 1/4" hex. hd.	36	36
72	8.3110	6756764	Hub, torque converter pump		1
72	8.3115	907001	Bearing, torque converter pump hub		1
72	8.3118	6759855	Plate, torque converter freewheel roller		1
72	8.3120	6775643	Seal Ring, torque converter hub to pump (6 5/8" I.D.)		1
72	8.3130	6759413	Ring, torque converter ground sleeve to pump piston (4 3/16" O.D.)		2
72	8.3140	6758485	Washer, torque converter stator thrust		2
72	8.3150	6768833	Stator, torque converter second		1
72	8.3162	6756319	Race, torque converter freewheel roller		1
72	8.3162	6756322	Nut, torque converter freewheel roller race lock		1
72	8.3165	6769607	Roller, torque converter freewheel		16
72	8.3166	6769469	Spring, torque converter freewheel roller		16
72	8.3167	6754710	Pin, torque converter freewheel roller guide		16
72	8.3180	6768832	Stator Assy., torque converter first (520, 540, 560 series)		1
72	8.3180	6768832	Stator Assy., torque converter first (530, 550, 570 series)		1
72	8.3195	6703059	Ring, torque converter turbine hub to drive shaft retaining snap		1
72	8.3200	6756408	Turbine, torque converter		1
72	8.3205	127909	Bearing, torque converter drive shaft pilot		1
72	8.3206	6760289	Ring, pilot bearing snap (outer race)		1
72	8.3206	6751822	Ring, pilot bearing snap (inner race)		1
72	8.3220	6703141	Seal Ring, torque converter pump to flywheel (17 1/2" I.D.)		1
72	8.3230	6768925	Flywheel Assy., torque coverter (includes ring gear) (500 series)		1
72	8.3247	6750468	Disc, torque converter flexible coupling		4
72	8.3247	6751516	Disc Assy., torque converter flexible coupling		1
72	8.3247	9409056	Bolt, 1/2" - 20 x 3/4" hex. hd.	24	24
72	8.3250	6769418	Hub, torque converter flexible coupling		1
72	8.3252	6753364	Plate, torque converter flexible coupling		1
72	8.3260	6703138	Cover, torque converter housing		1
72	8.3260	179837	Bolt, 3/8" - 16 x 3/4" hex. hd.		2
-	-	103321	Lockwasher, 3/8"		2
72	8.3262	6750186	Gasket, torque converter housing cover		1
72	8.3600	6759444	Pump Assy., torque converter pressure (includes items marked ‡)		1
73	8.3600	186612	Bolt, 3/8" - 16 x 1 3/8" hex. hd.		6
-	-	103321	Lockwasher, 3/8"		6
72,73	8.3610	6751733	Gasket, torque converter pressure pump		1
73	8.3620	6756527	‡ Valve, torque converter pressure pump converter regulating		1
73	8.3620	6752682	‡ Valve, torque converter pressure pump clutch regulating		1
73	8.3625	6751410	‡ Cap, torque converter pump relief valve		2
73	8.3630	6756484	‡ Spring, torque converter pressure pump converter regulating valve		1
73	8.3630	6752719	‡ Spring, torque converter pressure pump clutch regulating valve		1
73	8.3635	142756	‡ Gasket, 1 1/4" copper		1
73	8.3635	6756237	‡ Shim, torque converter pressure pump valve cap		AR
73	8.3655	6770432	‡ Ring, torque converter pump shaft seal (1" O.D.)		1
-	-	6754379	‡ Ring, torque converter pump shaft seal (1 1/4" I.D.)		1
73	8.3658	6759437	‡ Sleeve, torque converter pressure pump bearing		1
73	8.3665	6751382	‡ Bearing, torque converter pressure pump inner		1
73	8.3670	6759436	‡ Shaft, torque converter pressure pump		1

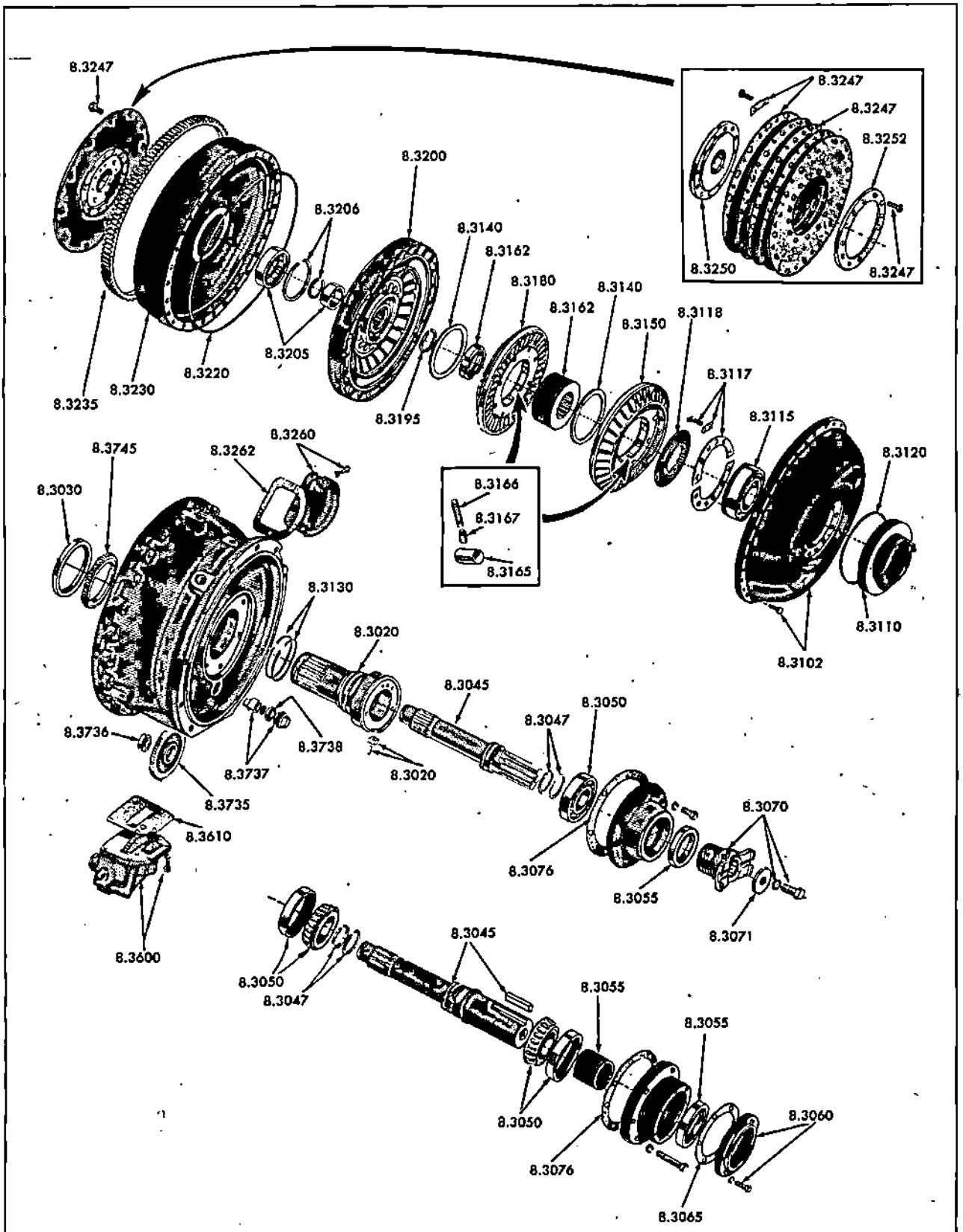


Fig. 72 – Typical 500 Series Converter

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
73	8.3678	6751383	‡ Gear, torque converter pressure pump driven		1	1
73	8.3678	148416	‡ Bearing, torque converter pressure pump driven gear		1	1
73	8.3685	6751379	‡ Shaft, torque converter pressure pump driven gear		1	1
73	8.3715	6759435	‡ Gasket, torque converter pressure pump		1	1
72	8.3735	6773523	Gear Assy., torque converter pressure pump idler (includes bearing).		1	1
72	8.3736	903304	Bearing, torque converter pressure pump idler gear		1	1
72	8.3737	6752423	Shaft, torque converter pressure pump idler gear		1	1
72	8.3737	6752414	Plug, torque converter pressure pump idler gear shaft		1	1
72	8.3738	6752415	Ring, torque converter pressure pump idler gear shaft seal (1.10" I.D.)		1	1
72	8.3745	6751502	Gear, torque converter pressure pump drive		1	1
73	8.3755	6751385	‡ Gear, torque converter pressure pump driving		1	1
			- 300 SERIES -			
74	8.3001	-	Converter Assy., Torqmatic (includes indented items)	1	1	1
-	-	179839	Bolt, 3/8" - 16 x 1" hex. hd.	12	12	12
-	-	103321	Lockwasher, 3/8"	12	12	12
71	8.3010	6701230	Plug, torque converter drain	1	1	1
71	8.3010	105456	Gasket, torque converter drain plug	1	1	1
71	8.3013	6754495	Plate, torque converter sump	1	1	1
71	8.3013	179817	Bolt, 5/16" - 18 x 7/8" hex. hd.	9	9	9
71	8.3013	103320	Lockwasher, 5/16"	9	9	9
71	8.3014	6754490	Gasket, torque converter sump plate	1	1	1
71	8.3017	6755786	Dipstick, torque converter	1	1	1
71	8.3020	6769530	Sleeve, torque converter ground	1	1	1
71	8.3020	113989	Screw, 1/4" - 20 x 11/16" fl. hd.	3	3	3
71	8.3030	6768644	Seal, torque converter ground sleeve oil (3" I.D.)	1	1	1
71B	8.3045	6759946	Shaft, torque converter drive	1	1	1
71E	8.3045	6772734	Shaft, torque converter drive	1	1	1
71D	8.3045	6759947	Shaft, torque converter drive	1	1	1
71B,D	8.3047	6751839	Ring, torque converter drive shaft piston (1 13/32" O.D.)	1	1	1
71B,E	8.3050	907050	Bearing, torque converter drive shaft main	1	1	1
71C,D	8.3050	457313	Cup, torque converter drive shaft main bearing	2	2	2
71C,D	8.3050	456634	Cone, torque converter drive shaft main bearing	2	2	2
71B,E	8.3051	6750046	Ring, torque converter drive shaft main bearing snap	1	1	1

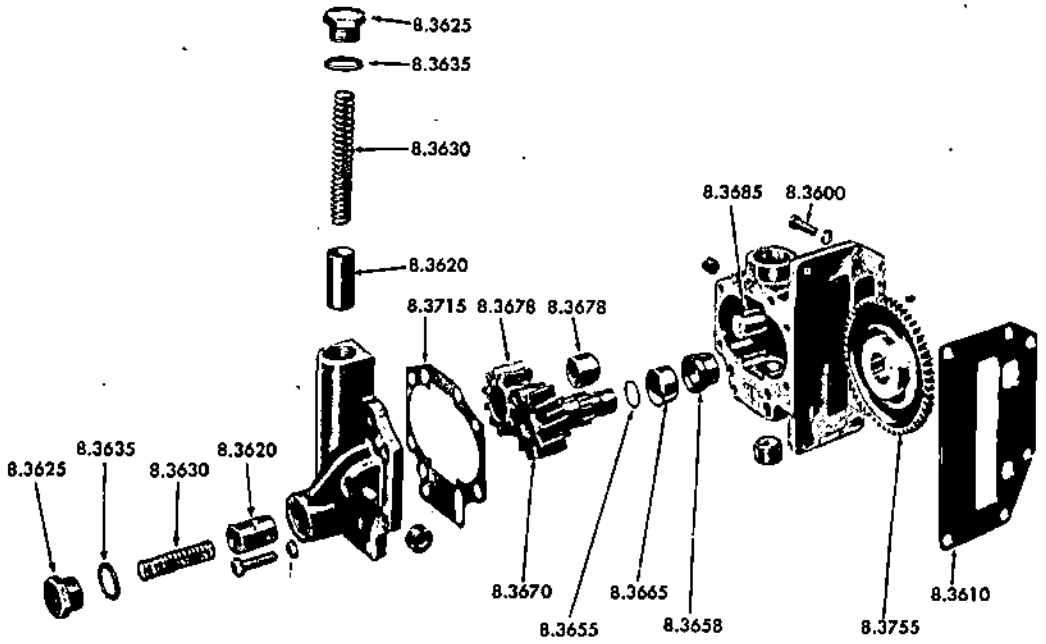


Fig. 73 – Torque Converter Pressure Pump

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
71B,E	8.3055	6773249	Seal, torque converter drive shaft main brg. retainer oil (1 3/4" I.D.)	1	1	
71C,D	8.3055	6754506	Seal, torque converter drive shaft main brg. retainer oil (2 11/32" I.D.)	1	1	
71B	8.3060	9409203	Bolt, 1/2" - 13 x 2 3/4" hex. hd.	8	8	
71C,D	8.3065	6753859	Shim, torque converter main bearing retainer (.003")	AR	AR	
71C,D	8.3065	6753860	Shim, torque converter main bearing retainer (.010")	AR	AR	
71B	8.3070	6755333	Flange, torque converter drive shaft	1	1	
71B	8.3070	181429	Bolt, 1/2" - 13 x 1 1/4" hex. hd.	1	1	
71B	8.3070	103323	Lockwasher, 1/2"	1	1	
71C,D	8.3075	9409240	Bolt, 1/2" - 13 x 3" hex. hd.	8	8	
71C,D	8.3075	6763013	Seal Ring (.487" I.D.)	8	8	
71B,E	8.3076	6753966	Gasket, torque converter main bearing housing	1	1	
71	8.3102	6756847	Pump Assy., torque converter (320 series) (include bolt)	1	1	
71	8.3102	6756001	Pump Assy., torque converter (370 series)	1	1	
71	8.3102	6755986	Bolt, torque converter pump to cover	24	24	
71	8.3110	6768714	Hub, torque converter pump	1	1	
71	8.3115	9417910	Bearing, torque converter pump hub	1	1	
71	8.3117	6757634	Retainer, torque converter pump hub bearing	1	1	
71	8.3117	9409088	Bolt, 1/4" - 20 x 3/4" hex. hd.	8	8	
72	8.3118	6769856	Spacer, torque converter freewheel (4 5/8" O.D.)	1	1	
72	8.3118	6755897	Ring, torque converter freewheel spacer snap	1	1	
72	8.3120	6758296	Seal Ring, torque converter hub to pump	1	1	
72	8.3130	6754488	Ring, torque converter ground sleeve to pump piston	1	1	
72	8.3140	6754994	Washer, torque converter stator thrust (steel)	1	1	
72	8.3150	6768902	Stator, torque converter second	1	1	
72	8.3162	6755892	Race, torque converter freewheel roller	1	1	
72	8.3165	7450737	Roller, torque converter freewheel	16	16	
72	8.3166	6771296	Spring, torque converter freewheel roller	16	16	
72	8.3180	6768903	Stator, torque converter first	1	1	
72	8.3200	6769453	Turbine, torque converter	1	1	
72	8.3220	6753866	Seal Ring, torque converter pump (13 3/4" I.D.)	1	1	
71	8.3232	6772408	Cover, torque converter pump	1	1	
71	8.3232	442812	Nut, 5/16" - 24 hex. lock	24	24	
71	8.3233	903208	Bearing, torque converter pump cover (1 5/8" I.D.)	1	1	
-	-	6769818	Seal Ring, torque converter pump cover	1	1	
71A	8.3237	6775414	Ring, torque converter drive (11 1/2")	1	1	
-	-	453675	Pin, 3/8" x 3/4" spring	12	12	
-	-	5192180	Ring, torque converter drive (clutch) (10")	1	1	
71A	8.3237	9409231	Bolt, 3/8" - 16 x 1 1/2" hex. hd.	8	8	
71C	8.3340	6756691	Shaft, torque converter output	1	1	
71D	8.3340	6756946	Shaft, torque converter output	1	1	
71D	8.3340	6756869	Shaft, torque converter output	1	1	
71C	8.3340	6751531	Key (5/8" x 5/8" x 3")	1	1	
72	8.3600	6768707	Pump, torque converter pressure	1	1	
72	8.3650	6768706	Body Assy., torque converter pressure pump (includes gears which are not sold separately plus seal in 8.3030.)	1	1	
72	8.3715	6702958	Seal Ring, torque converter pressure pump cover (8" I.D.)			

TORQUE CONVERTER LINES

The proper torque converter lines for your engine can be interpreted by your Detroit Diesel dealer or distributor. Furnish him the model number and type number (if shown) on the Option Plate on your engine.

2	8.3800	5182894	Tube, converter to oil cooler (flex. 39")	1		
2	8.3800	5182896	Tube, converter to oil cooler (flex. 47 5/16")	1		
2	8.3800	5177665	Tube, converter to oil cooler (flex. 56 1/4")	1	1	
2	8.3800	5182900	Tube, converter to oil cooler (flex. 53 5/16")		1	
2	8.3800	5182619	Tube, converter to oil cooler (flex. 64 13/16")		1	1
2	8.3800	5184110	Tube, converter to oil cooler (flex. 68")		1	1
3	8.3800	5184080	Tube, converter to oil cooler (flex. 76 1/2")		1	1
2	8.3800	5184112	Tube, converter to oil cooler (flex. 78 1/2")			1

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
2	8.3800	5179493	Tube, converter to oil cooler (flex. 85")			1
2	8.3800	5185297	Tube, converter to oil cooler (flex. 72")			1
-	-	144034	Bushing, 3/4" x 1/2" red. pipe	1	1	1
2	8.3800	5176705	Elbow, converter to oil cooler tube (3/4" tube, 3/4" pipe)	1	1	1
-	-	141621	Elbow, 3/4" street 90°	1		
2	8.3800	144066	Tee, 3/4" pipe	1	1	1
-	-	190717	Nipple, 3/4" x 2" pipe	1	1	1
-	-	140798	Elbow, 3/4" street 45°	1	1	1
-	-	5161874	Clip, converter to oil cooler tube	AR	AR	AR
74	8.3818	5182224	Tube, oil cooler to converter (flex. 50")	1		
74	8.3818	5182896	Tube, oil cooler to converter (flex. 58 1/4")	1		
74	8.3818	5182619	Tube, oil cooler to converter (flex. 64 13/16")		1	1
74	8.3818	5176705	Elbow,(3/4" tube, 3/4" pipe)	1	1	
-	-	5115748	Tube, converter tank to pump (flex. 44 5/8")	1		
-	-	5115753	Tube, converter tank to pump (flex. 48 3/4")		1	1
-	-	5115752	Tube, converter tank to pump (flex. 61 1/2")		1	1
-	-	5115754	Tube, converter tank to pump (flex. 68 3/4")			1
-	-	108687	Elbow, 1" street 90°	1	1	1
-	-	111001	Elbow, 1 1/4" street 90°	2	2	2
-	-	144116	Elbow, 1" street 45°	1	1	1
-	-	5183079	Adaptor, converter tank to pump tube	1	1	1
-	-	125915	Bushing, 1 1/4" x 1" red. pipe	1	1	1
-	-	5184291	Clip, converter tank to pump tube	1	2	2
-	-	5178633	Tube, oil cooler to converter tank (dev. L. 10 7/16")	1		
-	-	5177632	Tube, oil cooler to converter tank (dev. L. 12")		1	
-	-	5177211	Tube, oil cooler to converter tank (dev. L. 13 1/4")			1
-	-	5176526	Elbow, 3/4" tube sealastic	1	1	1
-	-	5176525	Connector, 3/4" tube sealastic	1	1	1
-	-	5176527	Nut, 3/4" tube sealastic	2	2	2
-	-	5176528	Seal Ring, 3/4" tube sealastic	2	2	2
-	-	5185392	Tube, converter to tank (flex. 46")	1	1	
-	-	5185389	Tube, converter to tank (flex. 57 1/2")		1	1

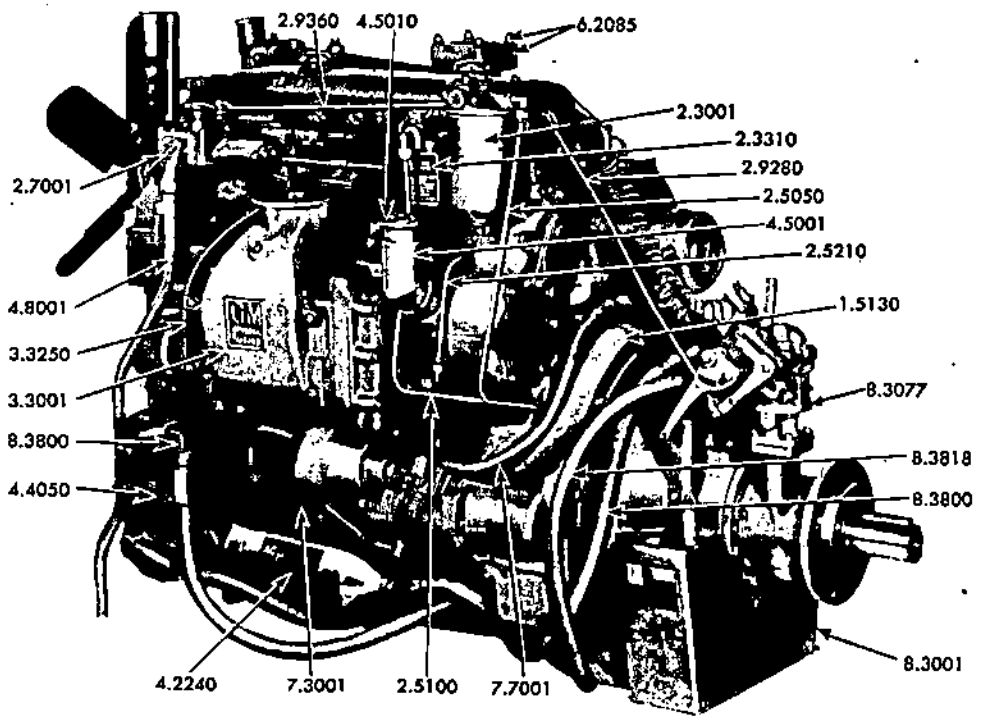


Fig. 74 – Torque Converter Lines

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
-	-	5185390	Tube, converter to tank (flex. 66")			1
-	-	120702	Elbow, 3/8" street 45°	1	1	1
-	-	118752	Adaptor, converter to tank tube	1	1	1
-	-	5151189	Clip, converter to tank tube	2	2	2
			ENGINE HOOD			
-	-	5170784	Hood Assy., engine (exhaust side)	1		
-	-	5171245	Hood Assy., engine (blower side) (heavy duty air cleaner)	1		
-	-	5170786	Hood Assy., engine (blower side) (light duty air cleaner)	1		
-	-	5170788	Hood Assy., engine (exhaust side)		1	
-	-	5171246	Hood Assy., engine (blower side) (heavy duty air cleaner)		1	
-	-	5170790	Hood Assy., engine (blower side) (light duty air cleaner)		1	
-	-	5170735	Hood Assy., engine (exhaust side)			1
-	-	5171247	Hood Assy., engine (blower side) (heavy duty air cleaner)			1
-	-	5170725	Hood Assy., engine (blower side) (light duty air cleaner)			1
			(includes clamps)			
4	10.1020	5170958	Hood Assy., radiator (short)	1	1	1
-	-	133094	Screw, 5/16" - 18 x 3/4" rd. hd.	11	11	11
-	-	181374	Bolt, 3/8" - 24 x 1 1/2" hex. hd.	4	4	4
-	-	123197	Nut, 5/16" - 18 hex.	11	11	11
-	-	117049	Nut, 3/8" - 24 hex.	4	4	4
-	-	3290602	Hood Assy., generator (includes clamps)	1	1	
-	-	5170965	Hood Assy., generator (includes clamps)			1
-	-	3222726	Clamp, engine and generator hood hold down generator sets	AR	AR	AR
-	-	3222748	Catch, engine hood hold down clamp (90°)	4	4	4
-	-	3291664	Catch, generator hood hold down clamp (105°)	4	4	4
-	-	5171531	Clamp, engine hood side panel	4	4	4
-	-	5156500	Anti-squeak, engine hood	AR	AR	AR
-	-	3222531	Rod, engine hood tie (right side front)	1		
-	-	5172035	Rod, engine hood tie (left side front)	1		
-	-	3222549	Rod, engine hood tie (right side front)		1	
-	-	5172036	Rod, engine hood tie (left side front)		1	
-	-	3222550	Rod, engine hood tie (right side front)			1
-	-	5172037	Rod, engine hood tie (left side front)			1
-	-	117064	Nut, 1/2" - 13 hex.	AR	AR	AR
-	-	3222531	Rod, generator hood tie	2	2	
-	-	3222549	Rod, generator hood tie			2
-	-	105608	Nut, 1/2" - 13 square	4	4	4
-	-	123550	Nut, 1/2" - 13 hex.	4	4	4
-	-	5170944	Panel, engine hood side	2		
-	-	5170926	Panel, engine hood side		2	
-	-	5170914	Panel, engine hood side			2
-	-	5170944	Panel, generator hood side	2	2	
-	-	5170926	Panel, generator hood side			2
			ENGINE MOUNTING AND BASE			
			The proper base for your engine can be interpreted by your nearest Detroit Diesel dealer or distributor. Furnish him the model number and the type number (if shown) on the Option Plate which is attached to the rocker cover.			
4	11.1001	-	Base	1	1	1
-	-	5170971	Washer, bevel (3/8" bolt hole)	AR	AR	AR
-	-	5167615	Washer, bevel (1/2" bolt hole)	AR	AR	AR
-	-	5167232	Cap, fuel tank	1	1	1
-	-	5192602	Gage, fuel	1	1	1
-	-	5192603	Screen, fuel tank filler	1	1	1
-	-	3291207	Cushion, generator set mounting	4	4	6
-	-	3291209	Cup, generator set mounting cushion	4	4	6
-	-	3291208	Cover, generator set mounting cushion	4	4	6
-	-	5166891	Bushing, starting motor cable insulating (thru base)	1	1	1
-	-	5169559	Nut, starting motor cable insulation bushing	1	1	1
-	-	5161734	Support, engine front (cross member)	1	1	1

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
-	-	5155374	Cushion, engine front support elastic	2	2	2
-	-	3290041	Washer, elastic cushion	2	2	2
-	-	436437	Bolt, 1/2" - 20 x 5 3/4" hex. hd.	2	2	2
-	-	122761	Nut, 1/2" - 20 hex. slotted	2	2	2
-	-	5167449	Spacer, engine front support (11/32" L.)	2	2	2
4	11.1073	5170127	Spacer, engine front support (2 7/32" L.)	2	2	2
4	11.1072	5163858	Spacer, engine front support (17/32" L.)	2	2	2
4	11.1072	5170680	Spacer, engine front support (1 23/32" L.)	2	2	2
-	-	5167615	Washer, bevel (1/2" bolt hole)	2	2	2
-	-	186340	Bolt, 1/2" - 20 x 5 1/2" hex. hd.	2	2	2
-	-	117051	Nut, 1/2" - 20 hex.	2	2	2
1	11.1090	5100262	Support Assy., front trunnion mounting	1	1	1
-	-	179867	Bolt, 7/16" - 14 x 2 1/2" hex. hd.	2	2	2
-	-	5166864	Ring, trunnion mounting support cushion	1	1	1
-	-	3222025	Support, engine rear (4 1/4" wide x 6 7/8" high)	2	2	2
3	11.1100	5170527	Support, engine rear (5" wide x 5 1/4" high)	2	2	2
-	-	5113611	Cushion, engine rear support elastic		2	2
-	-	3291378	Block, engine rear mounting (cushion)		1	
-	-	5112487	Bracket, engine rear frame (with engine rear support cushion)		2	2
-	-	5113584	Support, flywheel housing (with eng. rear support cushion and #1 housing)		2	2
-	-	5112434	Plate, flywheel housing mounting (with eng. rear support cushion #1 hsg.)		2	2
-	-	180175	Bolt, 1/2" - 13 x 1 1/4" hex. hd. (with flywheel housing support)		8	8
-	-	181429	Bolt, 1/2" - 20 x 1 1/4" hex. hd. (with eng. rear frame bracket)		8	8
-	-	181720	Bolt, 9/16" - 18 x 1 hex. hd. (with eng. rear support cushion #1 housing)		6	6
-	-	181725	Bolt, 9/16" - 18 x 1 1/4" hex. hd. (with eng. rear support cushion #2 hsg.)		2	2
-	-	181737	Bolt, 9/16" - 18 x 3 1/4" hex. hd. (with eng. rear support cushion #2 hsg.)		2	2
-	-	117050	Nut, 7/16" - 20 hex. (with 3291378)		4	
-	-	5171178	Insulator, generator rubber	2	2	2
-	-	5171180	Bushing, generator rubber insulator	4	4	4
-	-	106633	Bolt, 9/16" - 18 x 2 3/4" hex. hd.	4	4	4
-	-	5171177	Spacer, generator rubber insulator	4	4	4
-	-	5171179	Washer, generator rubber insulator	4	4	4

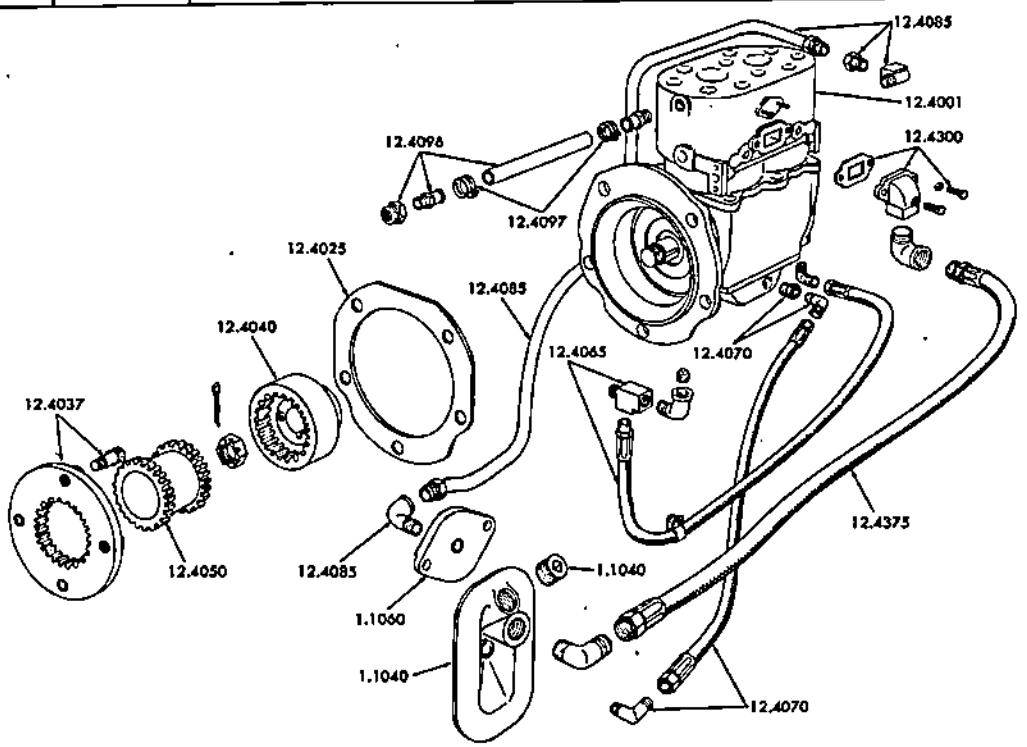


Fig. 75 – Air Compressor and Drive

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
			AIR COMPRESSOR			
			When ordering air compressor parts always provide your Detroit Diesel dealer or distributor with the identifying type number on the Option Plate on your engine.			
75	12.4001	-	Compressor Assy., (7 1/4" CFM) (flange mounted)	1	1	1
61	12.4001	-	Compressor Assy., (7 1/4" CFM) (belt driven)	1	1	1
61	12.4001	100040	Bolt, 7/16" - 20 x 1 1/2" hex. hd.	4	4	4
-	-	103322	Lockwasher, 7/16"	4	4	4
61	12.4001	117050	Nut, 7/16"-20 hex.	4	4	4
-	-	2067767	Gasket, air compressor	1	1	1
61	12.4010	3229254	Bracket, air compressor mounting	1	1	1
-	-	179837	Bolt, 3/8" - 16 x 3/4" hex. hd.	4	4	4
-	-	103321	Lockwasher, 3/8"	4	4	4
49	12.4015	5170754	Pulley, air compressor (7 1/2")	1	1	1
49	12.4015	5174767	Pulley, air compressor (9")	1	1	1
75	12.4025	5117061	Gasket, air compressor adaptor	1	1	1
75	12.4037	2136944	Plate, air compressor drive	1	1	1
75	12.4037	5119920	Bolt, air compressor drive	4	4	4
75	12.4040	2136945	Hub, air compressor drive	1	1	1
75	12.4050	2136946	Coupling, air compressor drive	1	1	1
61,75	12.4065	-	Tube Assy., air compressor lube oil supply	1	1	1
75	12.4065	143342	Elbow, 1/4" inv. fl. tube 90° (1/4" P.T.)	2	2	2
61,75	12.4070	-	Tube Assy., air compressor drain	1	1	1
75	12.4070	137425	Elbow, 1/2" inv. fl. tube 90° (3/8" P.T.)	1	1	1
75	12.4070	188947	Elbow, 1/2" inv. fl. tube 90° (1/4" P.T.)	1	1	1
75	12.4085	137409	Connector, 1/2" inv. fl. tube	1	1	1
61	12.4090	-	Tube Assy., air compressor water outlet	1	1	1
-	-	137425	Elbow, 1/2" inv. fl. tube 90°	1	1	1
-	-	137409	Connector, 1/2" inv. fl. tube	1	1	1
75	12.4097	111607	Clamp, air compressor water hose	2	2	2
75	12.4096	5181993	Hose, air compressor to water outlet manifold	1	1	1
75	12.4096	3133153	Connector, 5/8" dia. hose	2	2	2
75	12.4096	142269	Bushing, 1/2" x 3/8" red. pipe	1	1	1
75	12.4300	5110411	Strainer Assy., air compressor	1	1	1
75	12.4300	5110410	Gasket, air compressor strainer	1	1	1
75	12.4300	179827	Bolt, 5/16" - 18 x 2 1/4" hex. hd.	2	2	2
61,75	12.4375	-	Tube Assy., air compressor booster inlet	1	1	1

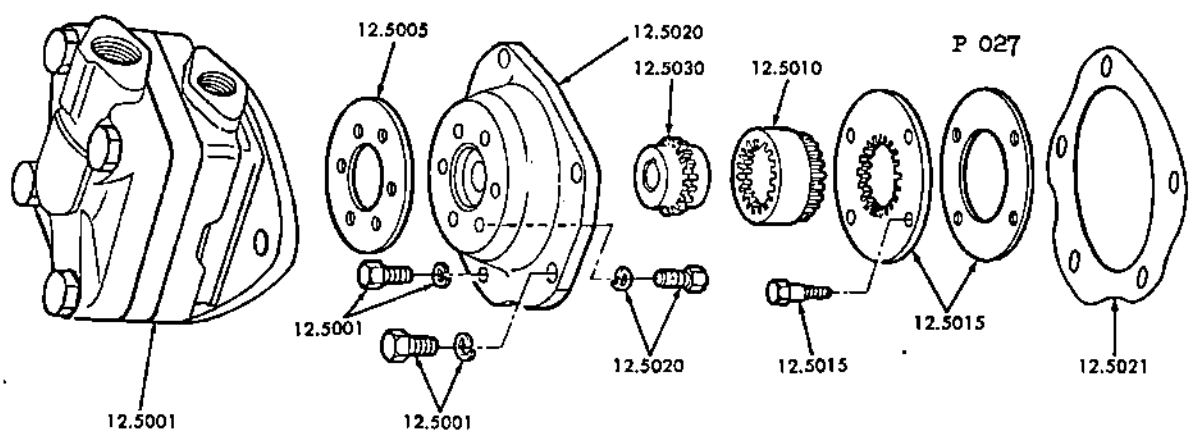


Fig. 76 - Hydraulic Pump and Drive

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
			HYDRAULIC PUMP			
2	12.5001	5184292	Pump Assy., hydraulic (drives off camshaft on A eng., balancer shaft on C eng.)	1	1	1
2	12.5001	5184293	Pump Assy., hydraulic (drives off camshaft on C eng., balancer shaft on A eng.)	1	1	1
76	12.5005	5168852	Gasket, hydraulic pump (between pump and adaptor)	1	1	1
76	12.5010	5133710	Coupling, hydraulic pump drive	1	1	1
76	12.5015	5131627	Plate, hydraulic pump drive	1	1	1
76	12.5015	5177026	Spacer, hydraulic pump drive	1	1	1
76	12.5015	5176474	Bolt, hydraulic pump drive	4	4	4
76	12.5020	5123814	Adaptor, hydraulic pump	1	1	1
76	12.5020	179839	Bolt, 3/8" - 16 x 1" hex. hd.	6	6	6
76	12.5021	5117061	Gasket, hydraulic pump adaptor	1	1	1
-	-	103321	Lockwasher, 3/8"	6	6	6
76	12.5030	5168688	Gear, hydraulic pump drive	1	1	1
-	-	103907	Key, 3/16" x 7/8" woodruff	1	1	1

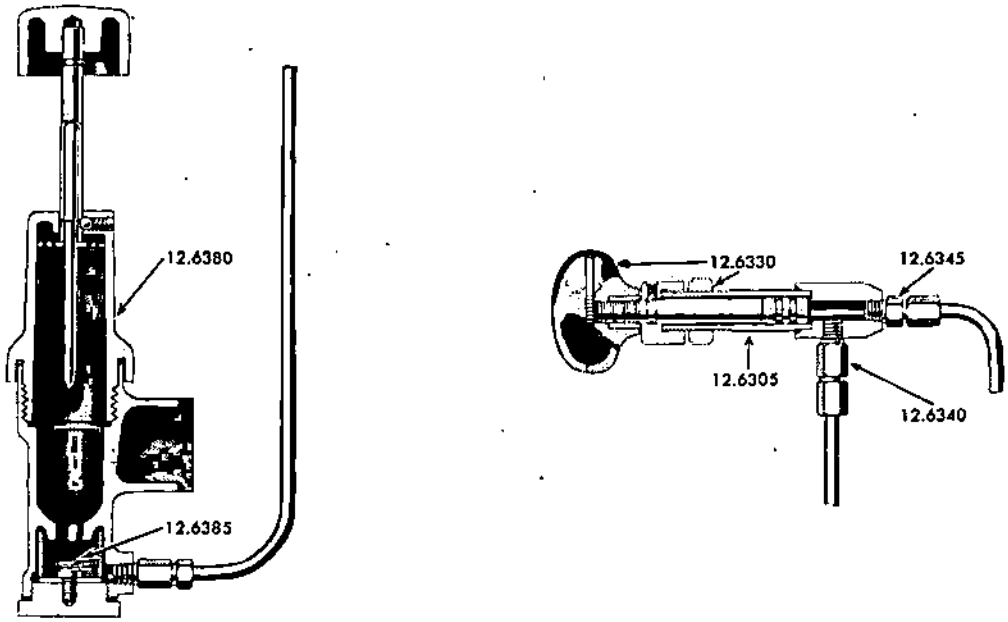


Fig. 77 - Cold Weather Starting

			COLD WEATHER AIDS			
-	-	5198056	Starting Kit, cold weather (start-pilot)	1	1	1
-	-	5193474	Starting Kit, cold weather (capsule type) (includes items below)	1	1	1
77	12.6305	5230535	Pump Assy., starting kit (includes indented items)	1	1	1
-	-	5230543	Seal Ring, starting kit pump plunger	2	2	2
77	12.6330	5152674	Knob, starting kit pump plunger	1	1	1
77	12.6330	122366	Nut, 5/8" - 18 hex.	1	1	1
77	12.6340	5230544	Valve, starting aid pump inlet (1/2 lb.)	1	1	1
77	12.6345	5153358	Valve, starting aid pump outlet (30 lb.)	1	1	1
-	-	5174649	Tube, starting pump to nozzle (1/8" dia. x 7')	1	1	1
-	-	140323	Elbow, 1/8" ball sleeve tube 90°	2	2	2
-	-	140303	Elbow, 1/8" ball sleeve tube 90°	1	1	1
-	-	121322	Sleeve, 1/8" ball tube	3	3	3
-	-	121220	Nut, 1/8" ball sleeve tube	3	3	3
-	-	2185536	Nozzle, starting aid pump tube	1	1	1
77	12.6380	5186071	Puncturing Tool Assy., starting fluid capsule (includes indented items)	1	1	1
77	12.6385	5192816	Strainer Assy., starting fluid (includes next 2 items)	1	1	1

FIG. NO.	ITEM NO.	PART NO.	NAME AND DESCRIPTION	QUANTITY PER 3-71	4-71	6-71
-	-	5192818	Strainer, starting fluid	1	1	1
-	-	142858	Screw, 1/4" - 20 x 1/4" rd. hd. sl.	1	1	1
-	-	5192819	Gasket, starting fluid strainer assy.	1	1	1
			HYDRAULIC STARTER			
-	-	6505065	Starter Assy., hydraulic (CW)	1	1	1
-	-	6505067	Starter Assy., hydraulic (CCW)	1	1	1
-	-	271557	Bolt, 5/8 - 11 x 1 3/8" hex. hd.	3	3	3
-	-	103325	Lockwasher, 5/8"	3	3	3
-	-	5130995	Gasket, hydraulic starter	1	1	1
-	-	6505001	Reservoir Assy., hydraulic starter (includes indented items)	1	1	1
-	-	1553180	Cap, hydraulic starter reservoir	1	1	1
-	-	6505020	Filter, hydraulic starter reservoir	1	1	1
-	-	5131274	Accumulator Assy., hydraulic starter (34 1/2" L.)	1	1	1
-	-	5131275	Accumulator Assy., hydraulic starter (24 5/8" L.)	1	1	1
-	-	6505012	Gage, hydraulic starter pressure	1	1	1
-	-	5125466	Pump Assy., hydraulic starter engine	1	1	1
-	-	6505002	Pump Assy., hydraulic starter hand	1	1	1
-	-	5110760	Primer, fuel	1	1	1
-	-	5196520	Remote Starting Kit, hydraulic starter (includes necessary items to install remote starting)	1	1	1
-	-	854453	Filter Assy., hydraulic starter (inclues element)	1	1	1
-	-	854454	Element, hydraulic starter filter	1	1	1
			SUPPLIES			
-	-	5191726	Paint, engine touch-up (1 gallon, gray)	AR	AR	AR
-	-	5194975	Paint, engine touch-up (1 gallon, Alpine green)	AR	AR	AR
-	-	5194973	Paint, engine touch-up (12 oz. spray can, gray)	AR	AR	AR
-	-	5194974	Paint, engine touch-up (12 oz. spray can, Alpine gray)	AR	AR	AR
-	-	5166164	Wire, injector spray tip cleaning (.006" x 5')	AR	AR	AR
-	-	5197621	Degreaser, engine (16 oz. spray can)	AR	AR	AR
-	-	5197623	Oil, penetrating (16 oz. spray can)	AR	AR	AR
-	-	5197622	Dressing, belt (16 oz. spray can)	AR	AR	AR
-	-	5193229	Wire, electric (#14 - 100' roll)	AR	AR	AR

ALPHABETICAL INDEX

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OPERATORS MANUAL

IN-LINE 71 ENGINES

DETROIT DIESEL ENGINE DIVISION
GENERAL MOTORS CORPORATION
DETROIT, MICHIGAN, 48228

Form 6SE225 (Rev. 7-65)
Printed in U.S.A.

(164)

FOREWORD

This manual contains instructions on the operation and preventive maintenance for the current In-line 71 Detroit Diesel Engines used in 3, 4, and 6 cylinder single and multiple Industrial and Marine engine units. It is not intended to cover engine repair or overhaul, as such work should be performed by an authorized Detroit Diesel Sales and Service Outlet.

Sufficient descriptive material, together with numerous illustrations, is included to enable the operator to understand the basic construction of the In-line 71 engines and the principles by which they function.

The operator should familiarize himself thoroughly with the contents of this manual before operating an engine or carrying out adjustment or maintenance procedures.

The information, specifications and illustrations in this publication are based on the information in effect at the time of approval for printing. The right is reserved to make changes at any time without obligation.

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DESCRIPTION

PRINCIPLES OF OPERATION

The Diesel Principle

The diesel engine is an internal combustion power unit in which the heat of fuel is converted into work within the cylinder of the engine.

In this type of engine, air alone is compressed in the cylinder. Then, after the air has been compressed, a charge of fuel is sprayed into the cylinder and ignition is accomplished by the heat of compression.

The Two-Cycle Principle

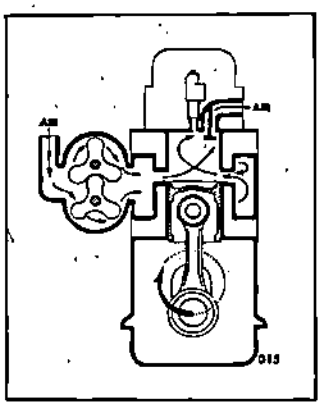


Fig. 1 - Scavenging

In the two-cycle engine, intake and exhaust take place during part of the compression and power strokes respectively, as shown in Figures 1 through 4. In contrast, a four-cycle engine requires four piston strokes to complete an operating cycle; thus during one half of its operation, the four-cycle engine functions merely as an air pump.

A blower forces air into the cylinders for expelling exhaust gases and to supply the cylinders with fresh air for combustion. The cylinder wall contains a row of ports which are above the piston when it is at the bottom of its stroke. These ports admit the air from the blower into the cylinder as soon as the rim of the piston uncovers the ports, as shown in Fig. 1.

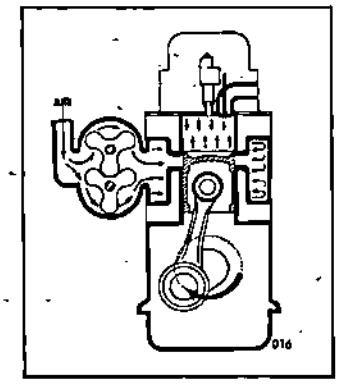


Fig. 2 - Compression

The unidirectional flow of air toward the exhaust valves produces a scavenging effect, leaving the cylinders full of clean air when the piston again covers the inlet ports.

As the piston continues on the upward stroke, the exhaust valves close and the charge of fresh air is subjected to compression, as shown in Fig. 2.

Shortly before the piston reaches its highest position, the required amount of fuel is sprayed into the combustion chamber by the unit fuel injector, as shown in Fig. 3. The intense heat generated during the high compression of the air ignites the fine fuel spray immediately and combustion continues until the injected fuel has been burned.

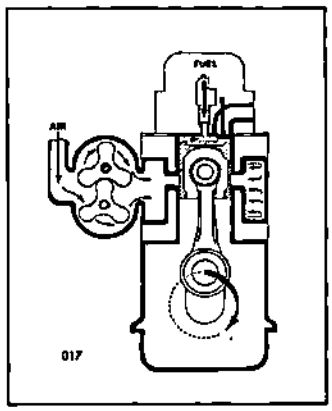


Fig. 3 - Power

The resulting pressure forces the piston downward on its power stroke. The exhaust valves are again opened when the piston is about halfway down, allowing the burned gases to escape into the exhaust manifold as shown in Fig. 4. Shortly thereafter, the downward moving piston uncovers the inlet ports, and the cylinder is again swept with clean scavenging air, as shown in Fig. 1. This entire combustion cycle is completed in each cylinder for each revolution of the crankshaft or, in other words, in two strokes; hence, it is a "two-stroke cycle".

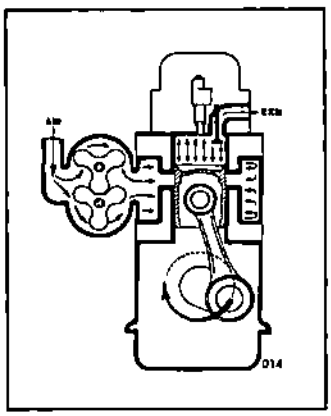


Fig. 4 - Exhaust

ENGINE MODELS

The two-cycle diesel engines covered in this manual are offered in three, four and six cylinder models having the same bore and stroke and using the same parts wherever possible. Thus, the major working parts, such as injectors, pistons, connecting rods, bearings, and other parts are interchangeable.

The blower, water pump, governor, and fuel pump form a group of standard accessories which on some models can be located on either the right or the left side of the engine, regardless of the direction of rotation. Further flexibility in meeting installation requirements is obtained by placing the exhaust manifold and the water outlet manifold on either side of the engine.

This variation in the arrangement of parts is accomplished by having both the cylinder block and cylinder head symmetrical at both ends with respect to each other. These various arrangements are designated by the letters A, B, C, or D in the model number, (Fig. 6). Letter R (right) or L (left) in the model number designates the direction of rotation.

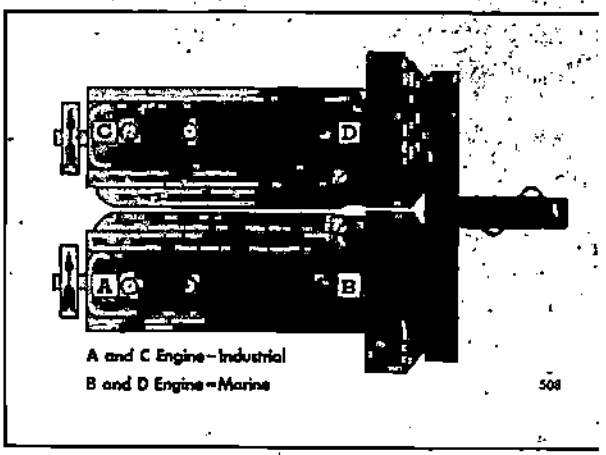


Fig. 5 – Typical Twin Engine Unit

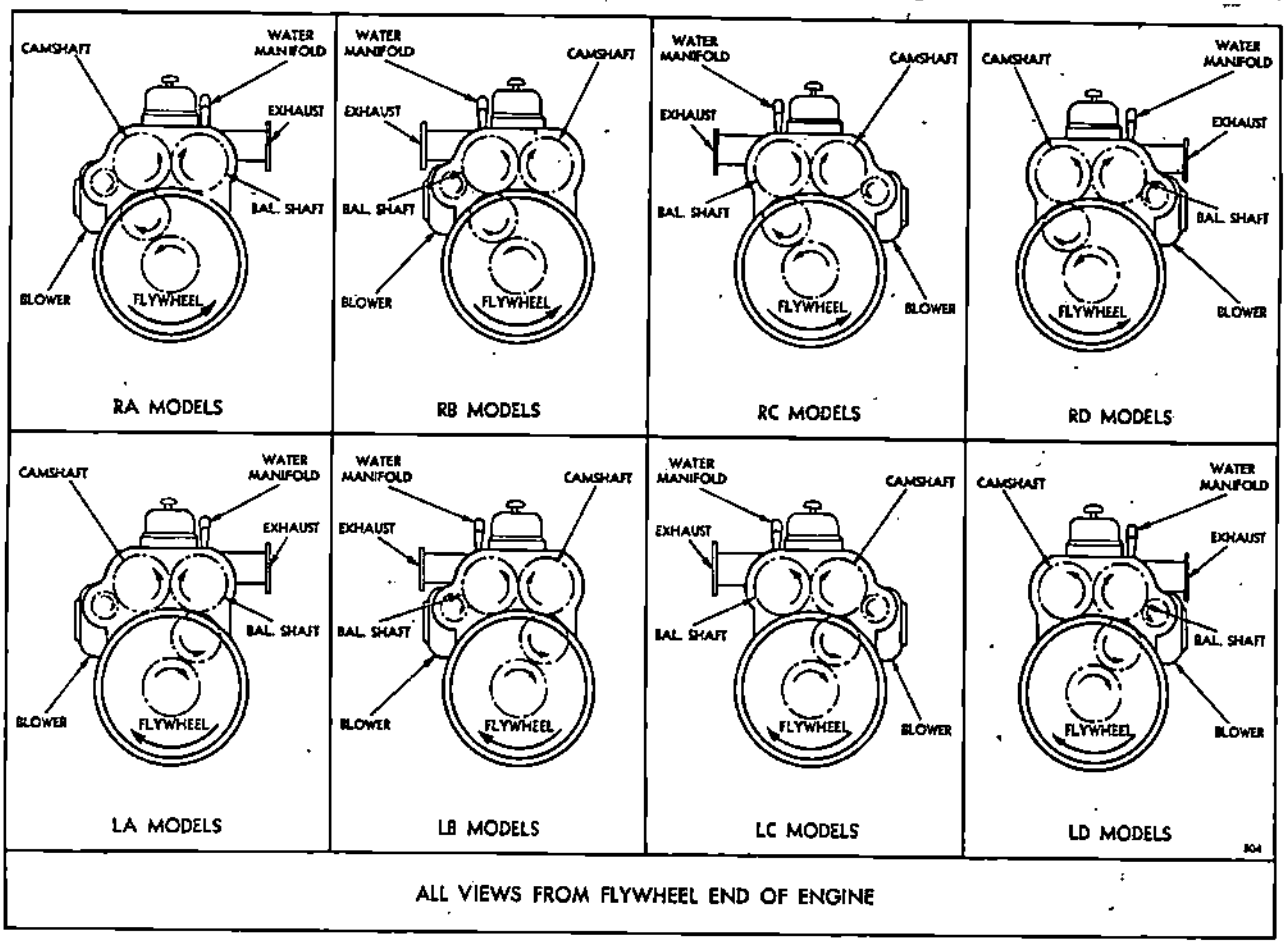


Fig. 6 – Rotation and Accessory Arrangements—3, 4 and 6 Cylinder Engines

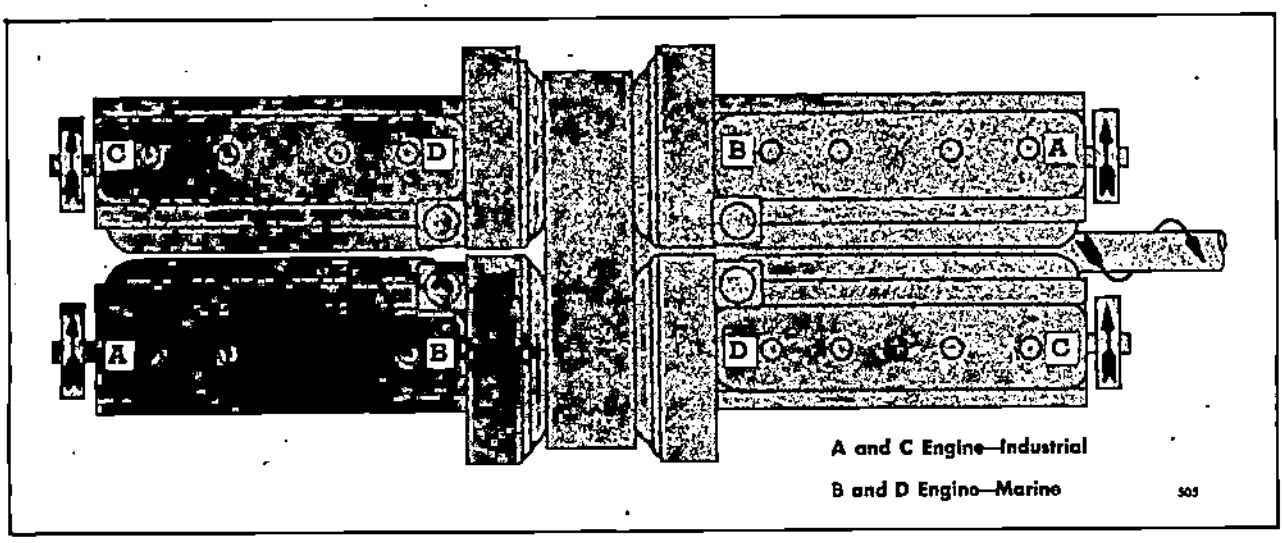


Fig. 7 - Typical Quad Engine Unit

In addition to single engine models, the side-by-side twin, tandem twin, and quad multiple engine power units are designed to deliver increased power to a single drive shaft with important savings in weight and space.

Each basic engine of a multiple engine unit has an individual clutch and throttle so that one or all engines may be used or cut out as desired. Thus, the power output may be varied from idling speed on one engine to full throttle on all engines as the load demands.

A and C engines are used in the twin and quad industrial models and in the tandem marine models. B and D engines are used in the twin and quad marine models.

Left-hand rotation of the power drive shaft on side-by-side twin engine units is obtained by using LA-LC or LB-LD engines as shown in Fig. 5. Right-hand rotation is obtained with RA-RC or RB-RD engines.

A quad unit comprised of LA-LC-RA-RC or LB-LD-RB-RD engines, arranged as shown in Fig. 7,

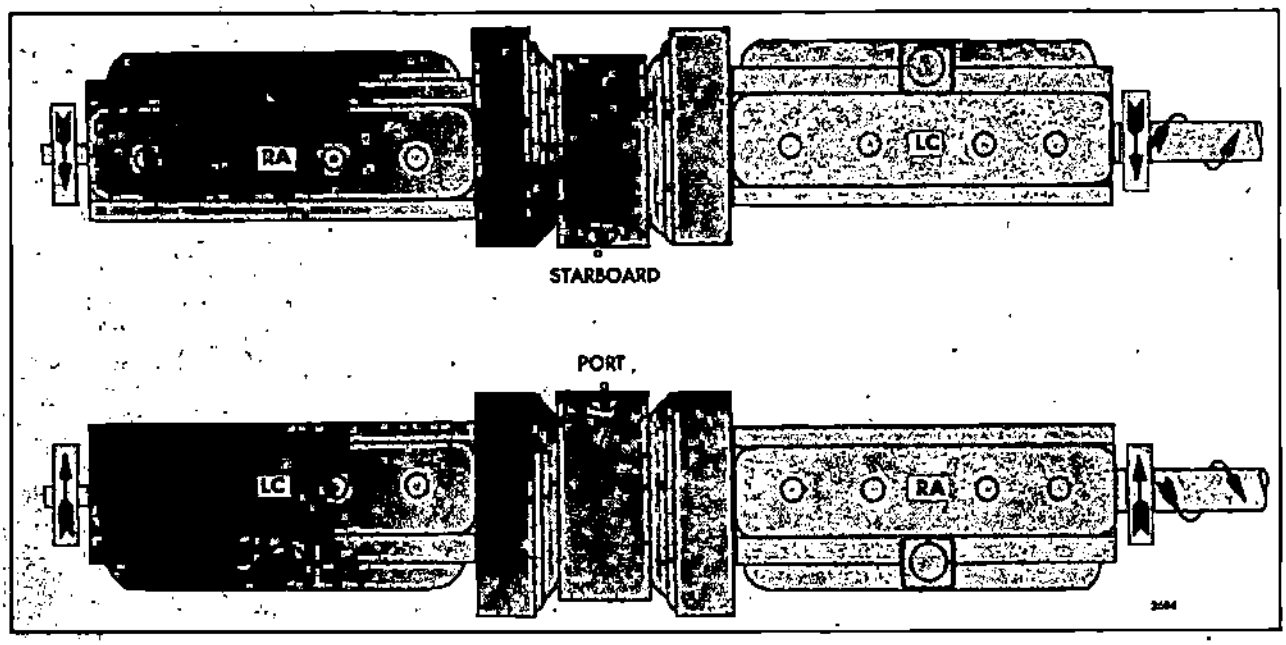


Fig. 8 - Typical Tandem Engine Unit

will produce left-hand rotation of the power drive shaft. However, right-hand rotation of the power drive shaft may be obtained by rearranging the engines so that the LA engine replaces the RA engine, etc.

Inclined engines are available in two models (RB and LD) for marine propulsion, each with its own reduction gear and drive shaft.

The tandem twin marine model uses an RA and an LC engine. On starboard models, the drive shaft turns clockwise and on port models the drive shaft turns counterclockwise, see Fig. 8.

It is very important that the correct model number and reduction gear ratio be given when contacting a Detroit Diesel Engine Sales and Service Outlet for service.

MODEL, SERIAL AND UNIT DESIGNATIONS

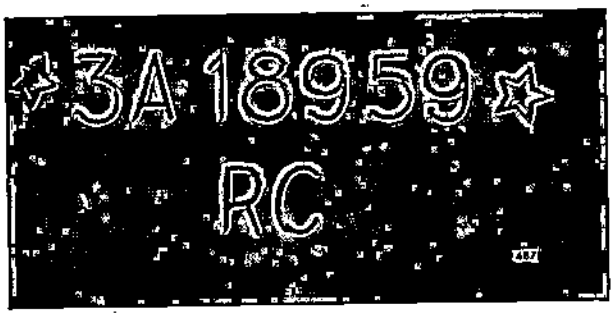


Fig. 9 - Typical Unit Number and Model Number As Stamped on Cylinder Block of Single Engine Units

Fig. 10 - Typical Unit Number and Model Number As Stamped on Cylinder Blocks of Multiple Engine Units

On the single engine units, the unit serial number, the rotation (R) or (L), and accessory arrangement (A, B, C or D), are stamped on the blower side of the cylinder block at the right hand corner as shown in Fig. 9. On certain single engine units such as model 6084, the model number is shown rather than rotation and accessory arrangement.

On multiple engine units, the basic unit serial number and model number cover the unit as a whole; however, each individual engine of the unit has a like number with suffix added to indicate rotation and accessory arrangement. For example; unit 12A3536, Fig. 10, would be comprised of two engines, one marked on the cylinder block as 12A3536 LA and the other as 12A3536LC. Also shown are the engine model numbers 671LA61 and 671LC61, respectively.

The unit serial number stamped on the cylinder

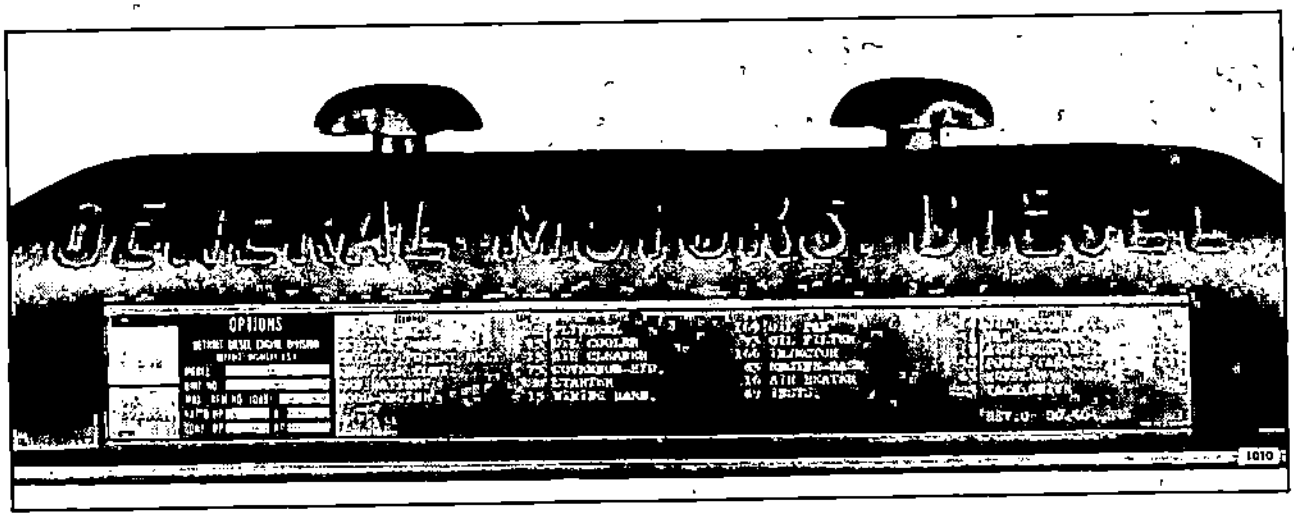


Fig. 11 - Option Plate

block of each engine is also stamped on the Option Plate along with the model number as shown in Fig. 11.

Always give the model and serial number of your engine. This is stamped on the Option Plate on the valve rocker cover on your engine; if a type number is shown covering the equipment required, be sure to include this number on your order. All parts orders should be placed with your nearest Detroit Diesel Sales and Service Outlet. Do not place orders directly with the factory.

Power take-off assemblies, torque converters, hydraulic marine gears, etc., may also carry name plates pertaining to the particular assembly to which they are attached.

GENERAL SPECIFICATIONS

	3-71	4-71	6-71
Number of Cylinders	3	4	6
Bore	4-1/4 in.	4-1/4 in.	4-1/4 in.
Stroke	5 in.	5 in.	5 in.
Compression Ratio (Nominal)	17 to 1	17 to 1	17 to 1
Compression Ratio (71N Engines) (Nominal)		18.71 to 1	18.71 to 1
Total Displacement-Cubic Inches	213	284	426
Firing Order-R.H. Rotation	1-3-2	1-3-4-2	1-5-3-6-2-4
Firing Order-L.H. Rotation	1-2-3	1-2-4-3	1-4-2-6-3-5
Number of Main Bearings	4	5	7

ENGINE SYSTEMS

The In-line 71 Detroit Diesel Engines incorporate four basic systems which direct the flow of fuel, air, lubricating oil, and engine coolant.

A brief description of each of these systems, and their components, maintenance and adjustment procedures are given in this manual.

FUEL SYSTEM

The fuel system (Fig. 1) consists of fuel injectors, fuel pipes, fuel manifolds (integral with the cylinder head), fuel pump, fuel strainer, fuel filter, and the necessary connecting fuel lines.

A restricted fitting, installed in the return fuel manifold, assists in maintaining a pressure in that part of the fuel system between the inlet and outlet manifolds.

Fuel is drawn from the supply tank through the fuel strainer and enters the fuel pump at the inlet side. Upon leaving the pump under pressure, the fuel is forced through the fuel filter and into the fuel inlet manifold where it passes through fuel pipes into the inlet side of each fuel injector. The fuel is filtered through elements in the injectors and atomized through small spray tip orifices into the combustion chamber. Surplus fuel, returning from the injectors, passes through the fuel return manifold and connecting fuel lines back to the fuel tank.

The continuous flow of fuel through the injectors helps to cool the injectors and remove air from the fuel system.

A check valve may be installed between the fuel strainer and the source of supply as optional equipment to prevent fuel drain back when the engine is not running.

Fuel Injector

The fuel injector combines in a single unit all of the parts necessary to provide complete and independent fuel injection at each cylinder. The injector creates the high pressure necessary for fuel injection, meters the proper amount of fuel, atomizes the fuel, and times the injection into the combustion chamber.

Since the injector is one of the most important and carefully constructed parts of the engine, it is recommended that if an injector is not operating properly, the engine operator should replace it as an assembly. Authorized Detroit Diesel Sales and Service Outlets are properly equipped to service injectors.

Remove Injector

An injector may be removed and replaced in the following manner:

1. Remove the valve rocker cover.
2. Remove the fuel pipes from both the injector and the fuel connectors.
3. Immediately after removing the fuel pipes, cover the injector inlet and outlet fittings with shipping caps to prevent dirt from entering.
4. Turn the crankshaft manually in the direction of engine rotation or crank the engine with the starting motor, if necessary, until the rocker arms for the particular cylinder are aligned in a horizontal plane.

CAUTION: On left-hand rotating engines, do not turn the crankshaft by

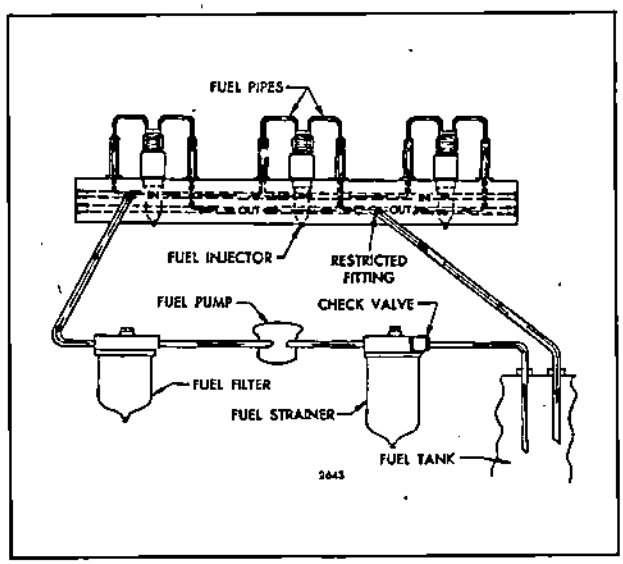


Fig. 1 - Schematic Diagram of Typical Fuel System

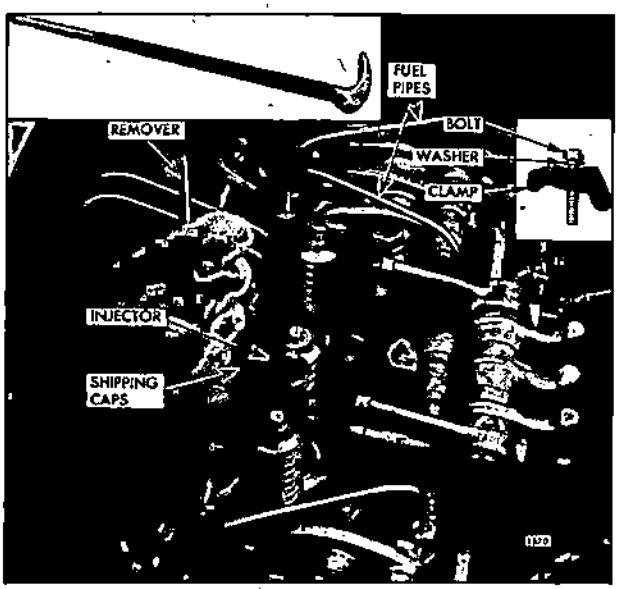


Fig. 2 – Removing Injector from Cylinder Head

using a wrench on the crankshaft end bolt or the bolt may be loosened. Either remove the starting motor or the pipe plug in the flywheel housing and use a pry bar against the teeth of the flywheel ring gear to turn the crankshaft.

5. Remove the two rocker shaft bracket bolts and swing the rocker arm assembly away from the injector and valves.

6. Remove the injector clamp bolt, washer and clamp.

7. Loosen the inner and outer adjusting screws on the injector rack control lever and slide the lever away from the injector.

8. Free the injector from its seat as shown in Fig. 2 and lift it from the cylinder head.

9. Cover the injector hole in the cylinder head to keep foreign particles out of the cylinder.

Install Injector

Before installing an injector, be sure the beveled seat of the injector tube is free from dirt particles and carbon deposits.

A new or reconditioned injector may be installed by reversing the sequence of operations given for removal.

Do not tighten the injector clamp bolt to more than 20-25 lb-ft torque, as this may cause the moving parts of the injector to bind. Tighten the rocker shaft bolts to 90-100 lb-ft torque.

Align the fuel pipes and connect them to the injector and the fuel connectors. Use socket J 8932-01 and a torque wrench to tighten the fuel pipe nuts to 12-15 lb-ft torque.

> **CAUTION:** Do not exceed the specified torque. Excessive torque will twist or fracture the flared ends of the fuel pipes and result in leaks. Lubricating oil diluted by fuel oil can cause serious damage to the engine bearings.

Time the injector, position the injector rack control lever and adjust the exhaust valve clearance (cold setting) as outlined in the engine tune-up procedure. If all of the injectors have been replaced, perform a complete tune-up on the engine.

Fuel Pump

A positive displacement gear type fuel pump (Fig. 3) is attached to the blower and driven off the rear end of the lower blower rotor.

A spring-loaded relief valve, incorporated in the pump body, normally remains in the closed position, operating only when the pressure on the outlet side (to the fuel filter) becomes excessive due to a

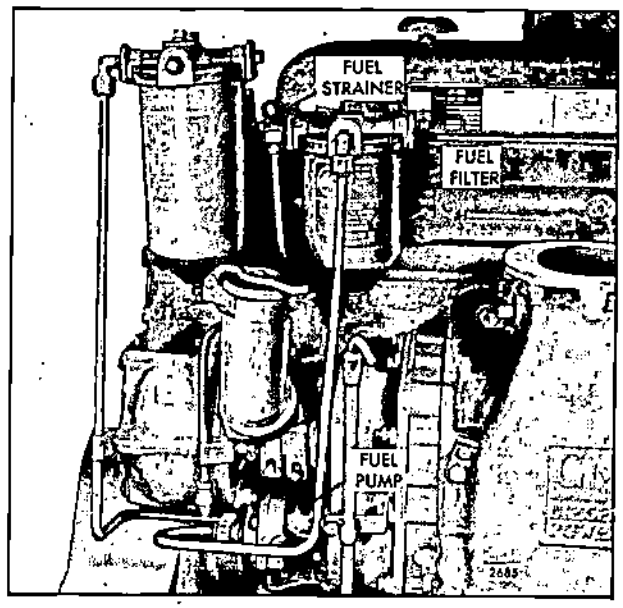


Fig. 3 – Fuel Pump, Fuel Strainer and Fuel Filter Mounting

plugged filter or fuel line. The valve will open at a pressure of approximately 65 to 70 lbs per sq. in. and allow the fuel to return, through a passage in the pump body, from the pressure side to the suction side of the pump.

The fuel pump incorporates two oil seals. Two tapped holes are provided in the underside of the pump body, between the oil seals, to permit a drain tube to be attached. If fuel leakage exceeds one drop per minute, the seals must be replaced. A Detroit Diesel Sales and Service Outlet is properly equipped to replace the seals.

The fuel pump should maintain a minimum fuel pressure at the fuel inlet manifold of 45 lbs per sq. in. between 1600-2100 rpm.

Fuel pumps are furnished in either left or right hand rotation according to the engine model, and are stamped RH and LH. These pumps are not interchangeable, and cannot be rebuilt to operate in an opposite rotation.

Fuel Strainer and Fuel Filter

A replaceable element type fuel strainer and fuel filter are used in the fuel system to remove impurities from the fuel. The strainer removes the larger particles and the filter removes the small foreign particles, Figs. 1 and 3.

The fuel strainer and fuel filter are basically identical in construction, both consisting of a cover, shell and replaceable element. Since the fuel strainer is placed between the fuel supply tank and fuel pump, it functions under suction; the fuel filter, which is installed between the fuel pump and fuel inlet manifold in the cylinder head, operates under pressure.

Drain approximately 1/4 pint of fuel to remove sediment and water from the strainer and filter daily. A drain cock is provided in the bottom of each shell.

Install new elements in the strainer and filter every 300 hours, 9,000 miles or as required due to excessive dust or other conditions. A method of determining when the elements are plugged to the extent that they should be changed is based on the fuel pressure at the cylinder head fuel manifold and the inlet restriction at the fuel pump. In a clean system, the maximum pump inlet restriction must not exceed 6 inches of mercury. At normal operating speeds (1600-2100 rpm), the fuel pressure is 45-70 psi. Change the fuel filter elements whenever the inlet restriction (suction) at the fuel pump reaches 12 inches of mercury at normal operating speeds and whenever the fuel pressure at the manifold falls to 45 psi.

Replace the elements as follows:

1. With the engine shut down, place a suitable container under the fuel strainer or filter and open the drain cock. The fuel will drain more freely if the cover nut is loosened slightly.
2. Support the shell, unscrew the cover nut and remove the shell and element.
3. Remove and discard the element and gasket. Clean the shell with fuel oil and dry it with a cloth or compressed air.
4. Place a new element, which has been thoroughly soaked in clean fuel oil, over the stud and push it down on the seat. Close the drain cock and fill the shell approximately two-thirds full with clean fuel oil.
5. Affix a new shell gasket, place the shell and element into position under the cover and start the cover nut on the shell stud.
6. Tighten the cover nut only enough to prevent fuel leakage.
7. Remove the plug in the strainer or filter cover and fill the shell with fuel. Fuel system primer J 5956 may be used to prime the fuel system.
8. Start and operate the engine and check the fuel system for leaks.

Fuel Tank

Refill the fuel tank at the end of each day's operation to prevent condensation from contaminating the fuel. Open the drain at the bottom of the fuel tank every 500 hours or 15,000 miles and drain the sediment and water.

> **CAUTION:** A galvanized steel tank should never be used for fuel storage because the fuel oil reacts chemically with the zinc coating to form powdery flakes which quickly clog the fuel strainer and filter and damage the fuel pump and injectors.

AIR SYSTEM

In the scavenging system used in two-cycle engines and illustrated in Fig. 4, a charge of air, forced into the cylinders by the blower, sweeps all of the burnt gases out through the exhaust valve ports, leaving the cylinder filled with fresh air for combustion at the end of each upward stroke of the piston. This air also assists in cooling the internal engine parts.

The blower supplies fresh air required for combustion and scavenging. Two hollow three-lobe rotors are closely fitted in a blower housing bolted to the cylinder block. The revolving motion of these rotors pulls fresh air through the air cleaner or silencer and provides a continuous and uniform displacement of air in each combustion chamber.

The continuous discharge of fresh air from the blower creates a pressure in the air box (air box pressure).

Air Cleaners

Several types of air cleaners are available for use with industrial engines. The oil bath air cleaner illustrated in Fig. 5 is furnished on most models and a heavy-duty oil bath, Fig. 6, or a heavy-duty dry type air cleaner may be installed where the engine is operating in heavy dust concentrations.

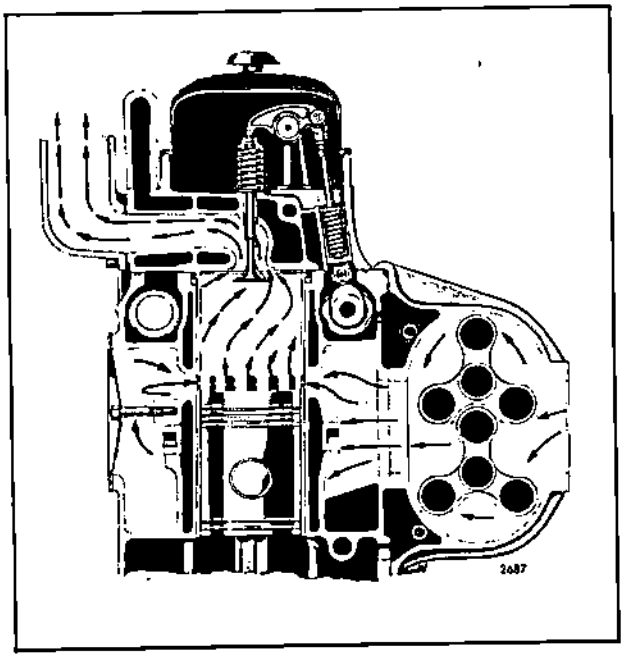


Fig. 4 - Air Intake System Through Blower and Engine

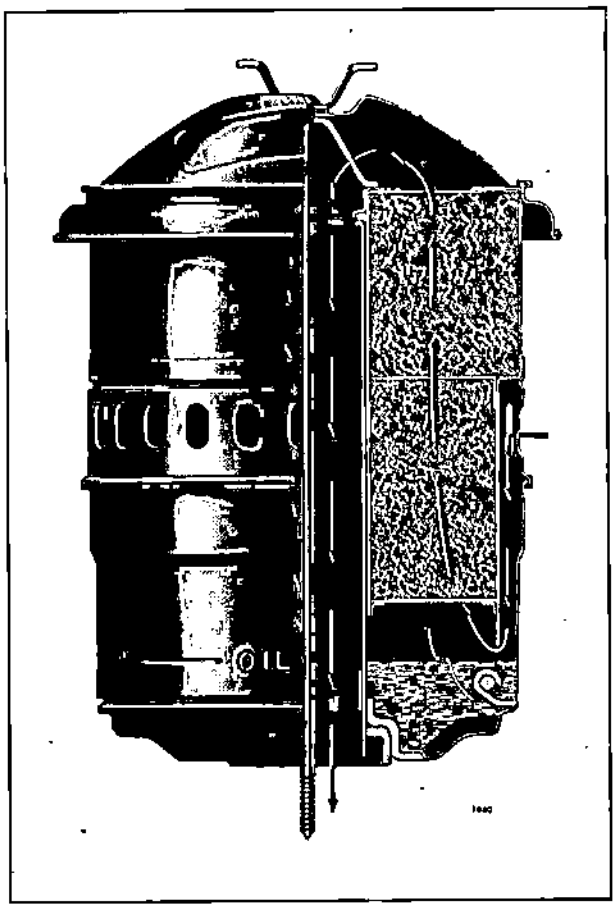


Fig. 5 - Light Duty Oil Bath Air Cleaner Assembly

The air cleaners are designed for fast, easy disassembly to facilitate efficient servicing.

The oil bath air cleaner consists of the body and fixed filter assembly which filters the air and condenses the oil from the air stream so that only dry air enters the engine. The condensed oil is returned to the cup where the dirt settles out of the oil and the oil is recirculated. A removable element assembly incorporated in the heavy duty oil bath air cleaners removes a major part of the dust from the air stream thereby decreasing the dust load to the fixed element. An inner cup, which can be removed from the outer or oil cup, acts as a baffle in directing the oil laden air to the element and also controls the amount of oil in circulation and meters the oil to the element. The oil cup supports the inner cup and is a reservoir for oil and a settling chamber for dirt.

The dry type air cleaner consists of a removable

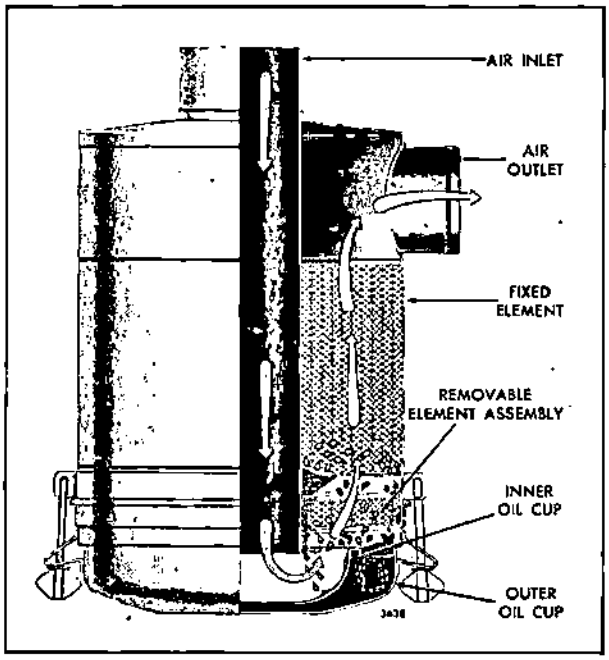


Fig. 6 - Heavy Duty Oil Bath Air Cleaner Assembly

cover attached to the air cleaner body which contains a replaceable paper filter cartridge and a dust cup. Air entering the dry type air cleaner is given a centrifugal precleaning by a turbine-type vane assembly. Air rotates at high speed around the filter element throwing the dust to the outside where it flows down the wall of the body and is ejected into a dust cup. The dust cup is baffled to prevent the re-entry of the dust. The pre-cleaned air passes through the paper filter and enters the engine.

Maximum protection of the engine against dust and other forms of air contamination is possible if the air cleaner is serviced at regular intervals. The light-duty oil bath air cleaner, Fig. 5, should be serviced as follows:

1. Loosen the wing bolt and remove the air cleaner assembly from the air inlet housing. The cleaner may then be separated into two sections; the upper section or body assembly contains the filter element, the lower section consists of the oil cup, removable inner cup or baffle, and the center tube.

2. Soak the body assembly and element in fuel oil to loosen the dirt; then flush the element with clean fuel oil and allow it to drain thoroughly.

3. Pour out the oil, separate the inner cup or baffle from the oil cup, remove the sludge and wipe the baffle and outer cup clean.

4. Push a lint-free cloth through the center tube to remove dirt or oil.

5. Clean and check all the gaskets and sealing surfaces to ensure air tight seals.

6. Refill the oil cup to the oil level mark only, install the baffle, and reassemble the air cleaner.

7. Check the air inlet housing before installing the air cleaner assembly on the engine. The inlet will be dirty if air cleaner servicing has been neglected or if dust laden air has been leaking past the air cleaner to air inlet housing seals.

8. Make sure that the air cleaner is seated properly on the inlet housing and the seal is installed correctly. Tighten the wing bolt until the air cleaner is securely mounted.

The heavy-duty oil bath air cleaner, Fig. 6, should be serviced as follows:

1. Loosen the wing nuts and detach the lower portion of the air cleaner assembly.

2. Lift out the removable element assembly and hold it up to a light. An even, bright pattern of light through the wire element indicates it is clean. Even a partially plugged element must be cleaned with a suitable solvent or fuel oil and blown out with compressed air to remove any dirt, lint or chaff.

3. Pour out the oil, separate the inner cup or baffle from the oil or outer cup, remove the sludge and wipe the baffle and outer cup clean.

4. Clean and inspect the gaskets and sealing surfaces to ensure an air tight seal.

5. Reinstall the baffle in the oil cup and refill to the proper oil level with the same grade of oil being used in the engine.

6. Inspect the lower portion of the air cleaner body and center tube each time the oil cup is serviced. If there are any indications of plugging, the body assembly should be removed and cleaned by soaking and then flushing with clean fuel oil. Allow the unit to drain thoroughly. It is recommended that the body and fixed element assembly be serviced every 500 hours, 15,000 miles, or as conditions warrant.

7. Place the removable element in the body assembly. Install the body if it was removed from the engine for servicing.

8. Install the outer cup and baffle assembly. Be sure the cup is tightly secured to the assembly body.

Some heavy duty dry-type air cleaners are equipped with an indicator which will aid in determining the servicing requirements. However, it is recommended that air cleaners without indicators be serviced every 8 hours, 240 miles, or as conditions warrant as follows:

1. Loosen the wing bolt and remove the air cleaner assembly from the air inlet housing.

2. Detach the cover and wing bolt and remove the element; empty and wipe the dust cup clean.

3. Clean the filter element as follows: If the element is dry and dusty, use compressed air (less than 100 psi). The air should be blown through the element opposite to the normal direction of air flow.

   If the element is oily or has soot deposits, use a water hose (less than 40 psi) wash with warm water and a non-sudsing detergent. Dry the element thoroughly.

4. Reassemble all the air cleaner parts, place the assembly on the air inlet housing and secure it with the wing bolt.

Air Silencer

The air silencer, Fig. 7, is bolted to the intake side of the blower housing. The silencer has a perforated steel partition welded in place parallel with the outside faces, enclosing flame proof, felted cotton waste which serves as a silencer for air entering the blower.

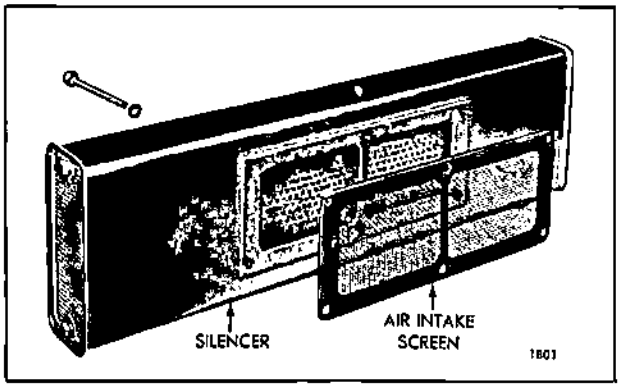


Fig. 7 - Blower Air Inlet Silencer Assembly

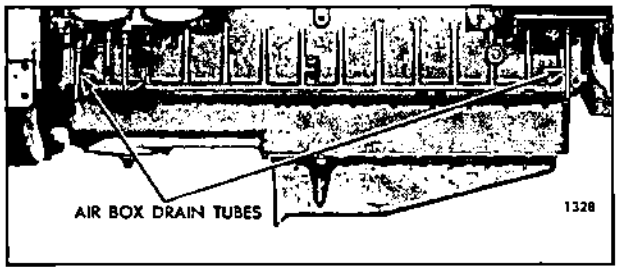


Fig. 8 - Air Box Drain Tubes

While no servicing is required on the air silencer proper, it may be removed, when necessary to replace the air intake screen. This screen is used to filter out any large foreign particles which might seriously damage the blower assembly.

Air Box Drains

In normal operation, a slight amount of vapor from the air condenses and settles at the bottom of the air box. This condensation is drained through drilled passages in the ends of the block into tubes, Fig. 8, which direct the expelled air and vapor away from the engine.

Air box drains must be open at all times; otherwise, water and oil may accumulate in the air box and be drawn into the cylinders with the incoming fresh air. Therefore, periodic checks should be made to ensure that they are open. Remove the air box covers and examine the air box floor for oil or an accumulation of water. If oil or water is found, wipe the air box dry with clean rags and, also, remove and clean the drain tubes.

Crankcase Ventilation

Harmful vapors which may form within the engine are removed from the crankcase and injector compartment by a continuous pressurized ventilation system.

A slight pressure is maintained within the engine crankcase and injector compartment by the seepage of a small amount of air past the piston rings.

Crankcase ventilation is accomplished by the air seepage past the piston rings sweeping up through the flywheel housing and balance weight cover into the valve and injector rocker arm compartment where it is expelled through a vent attached to the rocker cover, or through a vent pipe attached to the governor.

LUBRICATING SYSTEM

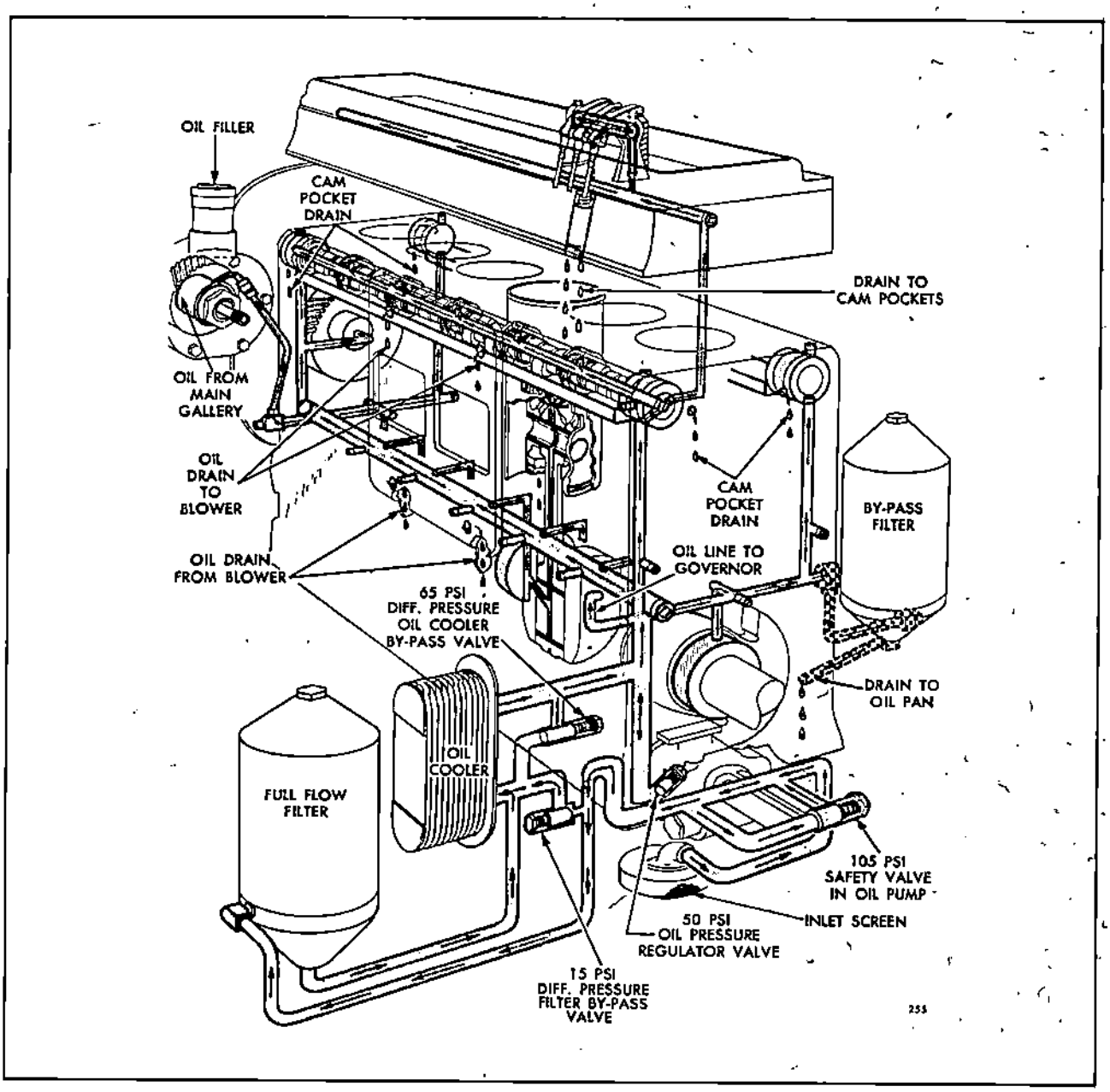


Fig. 9 – Schematic Diagram — Typical Lubricating System

The lubricating oil system is schematically illustrated in Fig. 9. This system consists of an oil pump, oil cooler, a full-flow oil filter, by-pass valves at the oil cooler and filter and pressure regulator valves at the pump and in the cylinder block main oil gallery. Positive lubrication is ensured at all times by this system. A by-pass oil filter may also be incorporated into the lubricating system at the owner's option.

Oil for lubricating the connecting rod bearings, piston pins, and for cooling the piston head, is provided through the drilled hole in the crankshaft from the adjacent forward main bearings. The gear train is lubricated by the overflow of oil from the camshaft pocket through a connecting passage into the flywheel housing. A certain amount of oil spills into the flywheel housing from the camshaft, balance shaft, and idler gear bearings. The blower

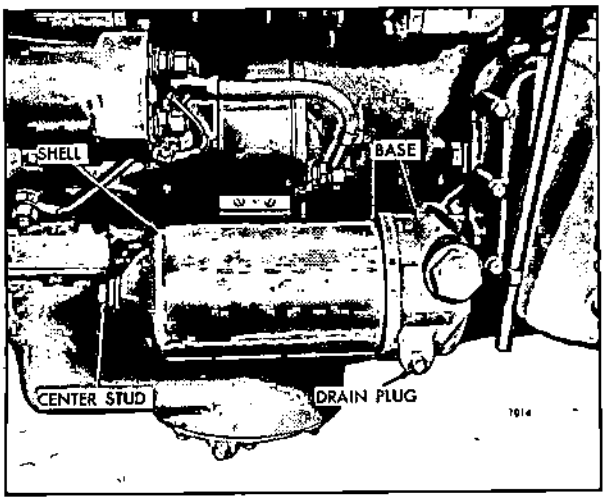


Fig. 10 - Typical Full Flow Filter Mounting

drive gear bearing is lubricated through an external pipe from the rear horizontal oil passage of the cylinder block.

Oil from the cam pocket enters the blower and overflows through two holes, one at each end of the blower housing, providing lubrication for the blower drive gears at the rear end and for the governor mechanism at the front.

Oil Filters

Engines are equipped with a full-flow type, lubricating oil filter. If additional filtering is required, a by-pass type oil filter may also be installed.

The full-flow filter assembly can be remotely mounted or mounted on the engine as shown in Fig. 10. A by-pass valve, which opens at 18 to 21 psi, is located in the filter base to ensure engine lubrication in the event the filter should become plugged.

All of the oil supplied to the engine passes through the full-flow filter that removes the larger foreign particles without restricting the normal flow of oil.

The by-pass filter assembly, when used, continually filters a portion of the lubricating oil that is being bled off the oil gallery when the engine is running. Eventually all the oil passes through the filter, filtering out minute foreign particles that may be present.

Some engines may be equipped with a by-pass filter assembly consisting of two filter elements each enclosed in a shell which is mounted on a single base. An oil passage in the filter base connects the two annular spaces surrounding both filter elements.

The full flow and by-pass filter elements should be replaced each time the engine oil is changed; as follows:

1. Remove the drain plug and drain the oil. (Figs. 10 and 11).
2. The filter shell, element and stud may be detached as an assembly, after removing the center stud from the base. Discard the gasket.
3. Clean the filter base.
4. Discard the used element, wipe out the filter shell and install a new element on the center stud.
5. Place a new gasket in the filter base, position the shell and element assembly on the gasket and tighten the center stud carefully to prevent damaging the gasket or center stud.
6. Install the drain plug and after the engine is started, check for oil leaks.

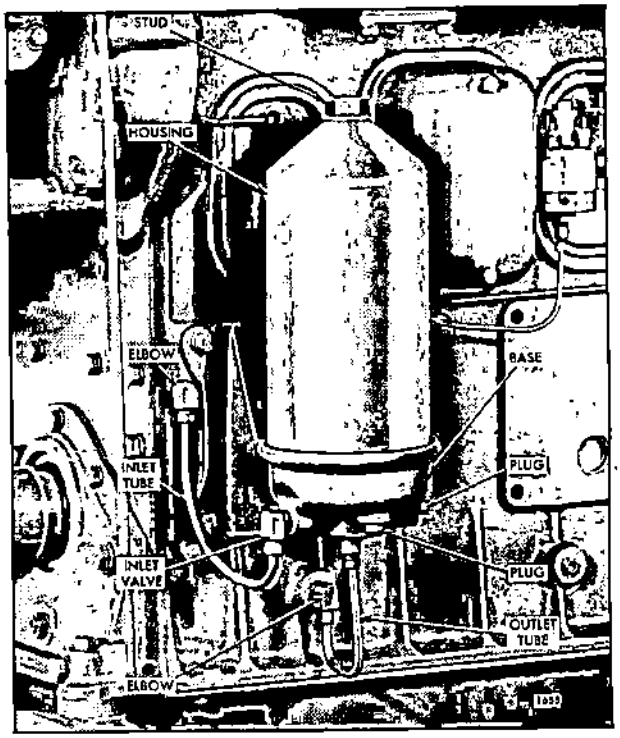


Fig. 11 - Typical Lubricating By-Pass Oil Filter Mounting

COOLING SYSTEM

The In-line 71 engines employ three different types of cooling systems: radiator and fan, heat exchanger and raw water pump, and keel cooling. A centrifugal type water pump is used to circulate the engine coolant in each system. Each system incorporates thermostats to maintain a normal operating temperature of 160°-185°F.

Radiator and Fan Cooling

A typical radiator and fan cooling system is illustrated in Fig. 12. The engine coolant is drawn from the bottom of the radiator core by the water pump and is forced through the oil cooler and into the cylinder block. The coolant circulates up through the cylinder block into the cylinder head, then to the water manifold and thermostat housing. From the thermostat housing, the coolant returns to the radiator where it passes down a series of tubes and is cooled by the air stream created by the fan.

When starting a cold engine or when the coolant is

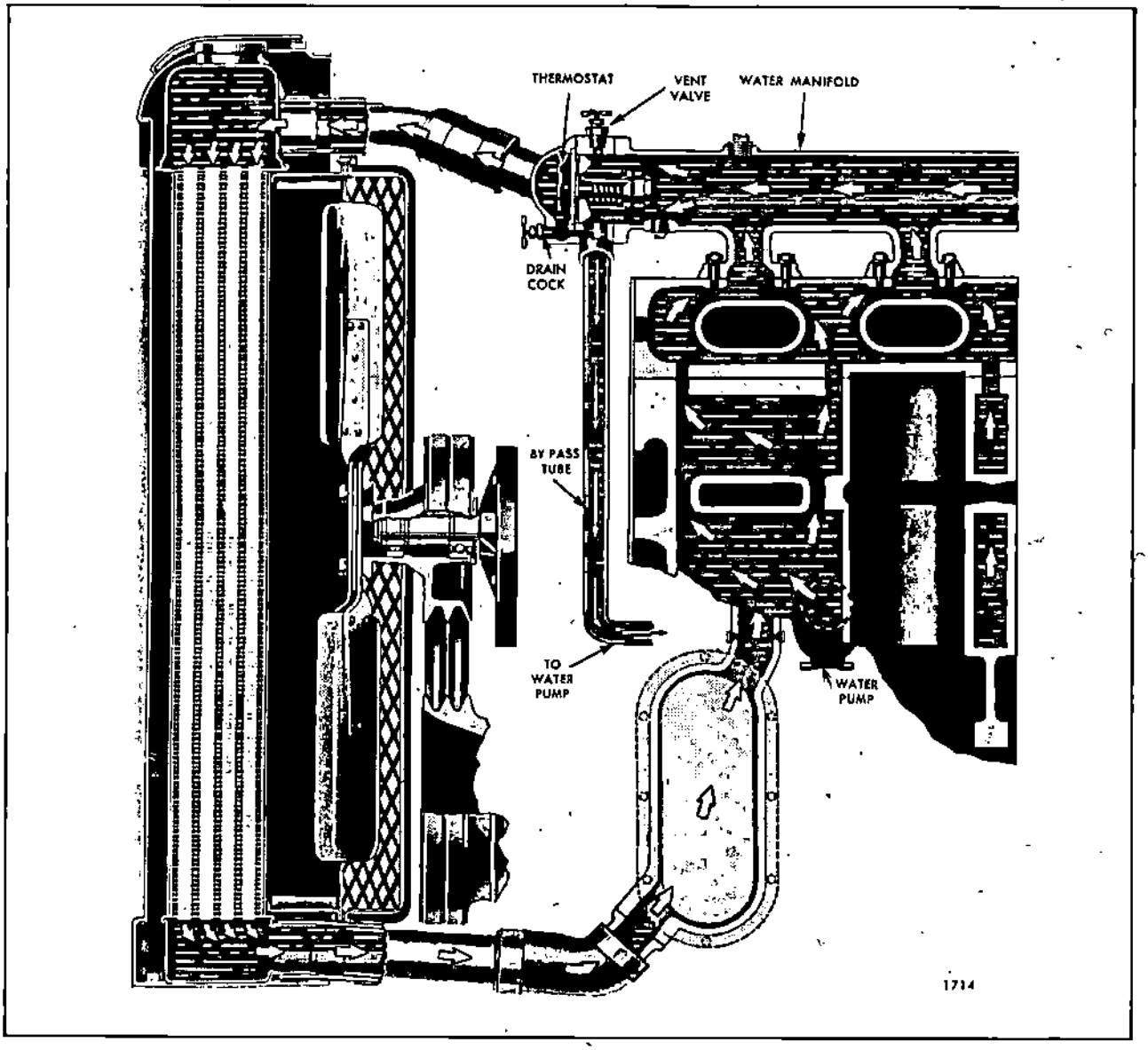


Fig. 12 - Typical Engine Cooling System with Radiator and Fan

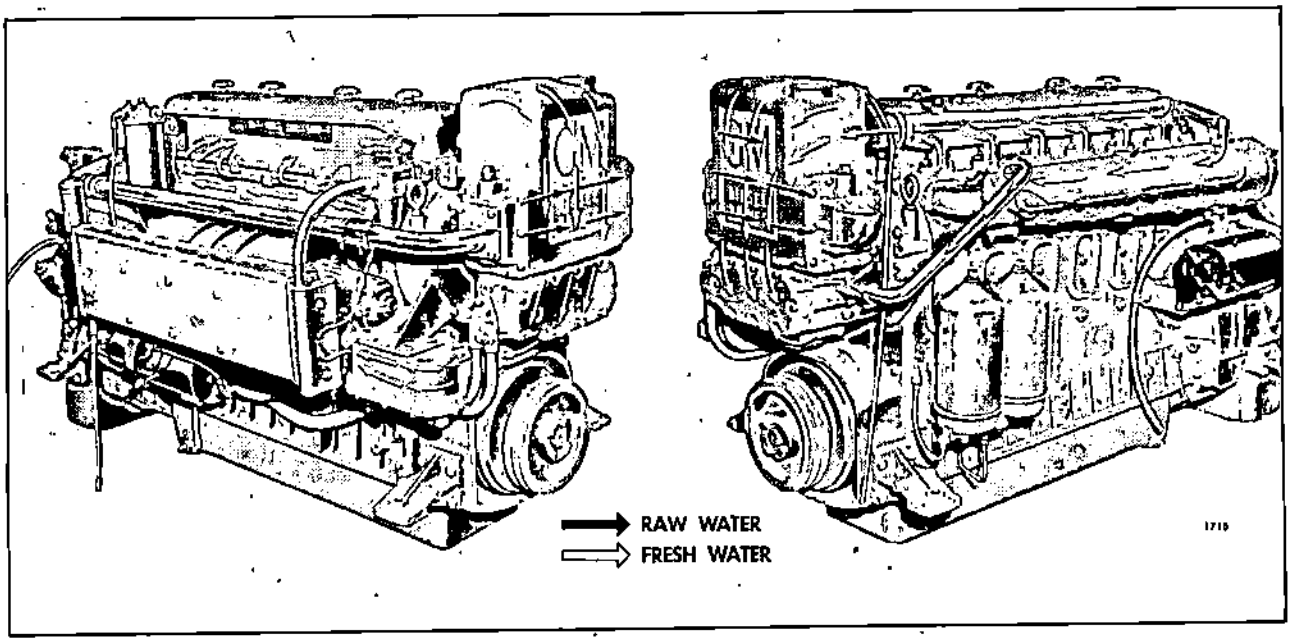


Fig. 13 - Water Circulation Through Heat Exchanger

below operating temperature, the coolant is restricted at the thermostat housing and a by-pass tube provides water circulation within the engine during the warm-up period.

Heat Exchanger Cooling

The heat exchanger cooling system is illustrated in Fig. 13. In this system, the coolant is drawn by the circulating pump from the bottom of the expansion tank through the reverse gear oil cooler and engine oil cooler (on six cylinder engine units, circulation is first through the engine oil cooler, then the reverse gear oil cooler), then through the engine the same as in the radiator and fan system. Upon leaving the thermostat housing, the coolant either passes through the heat exchanger core and oil coolers or by-passes the heat exchanger and oil coolers and flows directly to the water pump, depending on the coolant temperature.

While passing through the core of the heat exchanger, the coolant temperature is lowered by raw water, which is drawn by the raw water pump from an outside supply. The raw water enters the heat exchanger at one side and is discharged at the opposite side.

To protect the heat exchanger element from electrolytic action, a zinc electrode is located in both the heat exchanger inlet elbow and the raw water pump inlet elbow and extends into the raw water passage.

Zinc electrodes should be examined after thirty days or 200 hours of operation. Under normal operating conditions, the electrodes will last much longer and need only be examined at 500 hour intervals and replaced when necessary. If the electrodes are pitted, clean the surfaces with a stiff wire brush.

The length of time a heat exchanger will function satisfactorily before cleaning will be governed by the kind of coolant used in the engine and the kind of raw water used. Soft water plus rust inhibitor or high boiling point type antifreeze should be used as the engine coolant.

When foreign deposits accumulate in the heat exchanger, to the extent that cooling efficiency is impaired, such deposits can, in most instances, be removed by circulating a flushing compound through the fresh water circulating system without removing the heat exchanger. If this treatment does not restore the engine's normal cooling characteristics, contact your local Detroit Diesel Sales and Service Outlet.

Keel Cooling

The keel cooling system, illustrated in Fig. 14, is similar to the heat exchanger system, except that the coolant temperature is reduced in the keel cooler. In this system, the coolant is drawn by the circulating pump from the bottom of the expansion tank through the reverse gear oil cooler and engine

oil cooler (on six cylinder engine units circulation is first through the engine oil cooler, then the reverse gear oil cooler). From the coolers, the flow is the same as in the other systems. Upon leaving the thermostat housing, the coolant is by-passed directly to the bottom of the expansion tank until the engine operating temperature, controlled by the thermostat, is reached. As the engine temperature increases, the coolant is directed to the keel cooler, where the temperature of the coolant is reduced before flowing back to the expansion tank.

Fan Belt

Check the fan belt tension. Too tight a belt imposes undue load on the shaft bearings and shortens the life of the belt; too loose a belt allows slippage and lowers the fan speed, causes excessive belt wear and leads to overheating of the cooling system. To adjust the fan belt tension, loosen the bracket bolts and rotate the bracket up to tighten the belt or down to loosen the belt. Then, tighten the bracket bolts.

Corrosion Inhibitors

A corrosion inhibitor should be added to the water in the cooling system of the engine during the summer unless a Perry water filter and conditioner is used. Corrosion inhibitors coat the metal surfaces within the cooling system with a thin film which prevents the oxygen in the water or in the system from coming in contact with the surfaces and forming rust. Corrosion inhibitors are generally classified into two types; a chemical chromate type and a soluble oil type. The chromate type inhibitor provides a better protection against scale and erosion in engines with cast iron heads and blocks, with very little effect on heat transfer. The soluble oil type is designed primarily to combat the scale and erosion sometimes associated with aluminum block engines. When a soluble oil type corrosion inhibitor is used, its quantity should not exceed 1% of the total cooling system capacity.

When using the chromate type inhibitor, it is important that the strength of the cooling solution be maintained at the concentration recommended by the manufacturer. Should a loss of the coolant develop as a result of a leak, the concentration of the inhibitor will diminish and the corrosive tendencies of the coolant will increase. Therefore, a proper proportion of the inhibitor must be mixed with the water before adding the make-up solution to the coolant in the system to prevent any lowering of the concentration. However, if the water in the cooling system boils off, the concentration of the inhibitor will become too great and a possibility of thickening or congealing may occur. In this case, only the water must be added to the cooling system to reduce the concentration to normal.

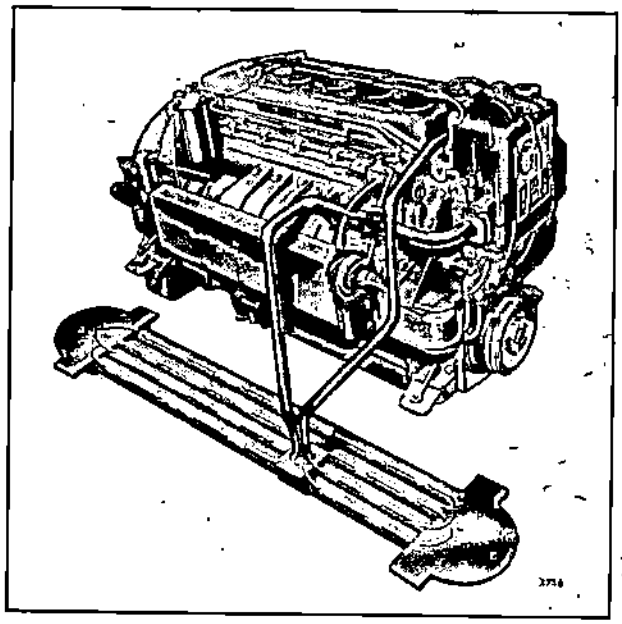


Fig. 14 - Water Flow in Keel Cooled Engine

CAUTION: Neither the soluble oil nor the chemical type inhibitor should be used in a cooling system containing a permanent type antifreeze.

Antifreeze Solutions

High boiling point type antifreeze solutions are used in diesel engines during the winter because of the high coolant temperature encountered in their operation. Alcohol base antifreeze has too low a boiling point. An alcohol base antifreeze solution protecting a unit to -21°F. would begin to boil at 180°F.; a high boiling point type ethylene glycol antifreeze solution protecting a unit to -20°F. would begin to boil at 223°F. Most high boiling point type antifreeze solutions include a corrosion inhibitor which will protect the cooling system through the winter season. No additives should be added to a system that is protected by this antifreeze solution. In the spring, the antifreeze solution should be drained and discarded.

NOTE: The corrosion inhibitor in a used antifreeze solution will not be of sufficient strength to protect the cooling system from corrosion the following winter. The addition of a corrosion inhibitor to an antifreeze solution, to permit reuse, could cause a reaction within the solution. A precipitation could result and clog the cooling passages, necessitating extensive engine and radiator cleaning.

Water Filter and Conditioner

A water filter and conditioner will remove foreign substances in the coolant, inhibit scale deposit and rust formation, and reduce the electrolytic action between dissimilar metals in the cooling system.

Corrosion inhibitors should never be used in conjunction with the water filter and conditioner. The cooling system filter and conditioner includes a chemically activated filter element, an electro-corrosion plate, a settling sump, and other component parts to assure protection of the engine cooling system. Engines equipped with a filter and conditioner which is properly maintained need not be flushed. However, when the cooling system is drained, the filter should be thoroughly cleaned and a new element installed. Prior to the initial installation of a filter and conditioner, the cooling system should be thoroughly cleaned and flushed to start out with a clean cooling system.

If the engine is protected by a Perry water filter and conditioner and if a permanent type antifreeze is used, a winter filter element identified by the letters PAF (permanent antifreeze) must be used. The winter element does not contain a corrosion inhibitor and when the cooling system is drained for summer months, it should be replaced by a summer element.

Flushing

The cooling system should be flushed each spring and fall. The flushing operation cleans the system of antifreeze solution in the spring and removes the summer rust inhibitor in the fall, preparing the cooling system for a new solution. The flushing operation should be performed as follows:

1. Drain the previous season's solution from the engine.
2. Refill the cooling system with soft clean water. If the engine is hot, fill slowly to prevent rapid cooling and distortion of the engine castings.
3. Start the engine and operate it for 15 minutes to circulate the water thoroughly.
4. Drain the cooling system completely.
5. Refill the system with the solution required for the coming season.

Cooling System Cleaners

If the engine overheats and the fan belt tension and water level are satisfactory, it will be necessary to clean and flush the entire cooling system. Scale formation should be removed by using a quality descaling solvent. Immediately after using the solvent, neutralize the system with the neutralizer. It is important that the directions printed on the container of the descaling solvent be thoroughly read and followed.

After the solvent and neutralizer have been used, completely drain the engine and radiator and flush with clean water. Then, fill the system with the coming season's cooling solution.

> **CAUTION:** Whenever water is added to a hot engine, it must be done slowly to avoid distortion and possible cracking of engine castings, resulting from too rapid cooling.

Water Softeners

The use of clean soft water in the cooling system will eliminate the need for using a descaling solution. Hard mineral laden water should be made soft by using water softener chemicals before it is poured into the cooling system. These water softeners modify the minerals in the water and greatly reduce or eliminate the formation of scale.

A clean cooling system will reduce engine wear and increase the satisfactory engine operating time between engine overhauls. Thus, when operating within the proper engine temperature range and not exceeding the recommended horsepower output of the engine, all engine parts will be within the normal operating temperature range and at the proper operating clearances.

Drain Cooling System

Drain the coolant by opening the drain cocks in the water outlet elbow, oil cooler housing, the fresh water pump, heat exchanger, radiator and, on certain engines, the water hole cover located on the blower side toward the rear of the cylinder block. Radiators, etc., that do not have a drain cock, are drained through the oil cooler housing drain cock.

The removal of the cooling system filler cap permits air to enter the cooling passages and the coolant to drain completely from the system.

The exhaust manifolds of marine engines are cooled by the same coolant used in the engine. Whenever the engine cooling system is drained, each exhaust

manifold drain cock, located on the bottom near the exhaust outlet, must be opened.

Raw water pumps are drained by loosening the cover attaching screws. It may be necessary to tap the raw water pump cover gently to loosen it. After the water has been removed, tighten the screws.

Before starting an engine, fill the cooling system completely. If the unit has a raw water pump, it should also be primed, since operation without water may cause an impeller failure.

Fresh Water Pump

The centrifugal type fresh water pump is mounted at the front of the engine and is driven by the blower.

A seal in the pump prevents the coolant from escaping and passing along the shaft. A worn seal will be evident by leakage of coolant through the drain hole provided in the pump housing. Should coolant leakage occur, contact a Detroit Diesel Sales and Service Outlet for service.

Raw Water Pump

A positive displacement raw water pump, driven by a coupling from the camshaft or balance shaft, circulates raw water through the heat exchanger to lower the temperature of the engine coolant.

The impeller (Fig. 15) is self-lubricated by the water pumped and should be primed before starting the engine.

Rubber spline plugs have been inserted between the end of the drive shaft and cover to reduce the possibility of foreign material working into the splines and causing wear.

Note that the end cover is marked to show the outlet port for RH rotation and the outlet port for LH rotation. Follow these markings when installing the raw water pump to assure proper direction of flow. Also, when installing the inlet elbow or outlet elbow, be sure to use two flat washers on the bolt being installed in the blind hole in the pump housing.

A rotary type seal assembly prevents any leakage along the shaft.

A raw water pump seal failure is readily noticeable by the leakage of water from the openings in the pump housing. These openings, which are located between the pump mounting flange and the inlet and outlet ports, must remain open at all times.

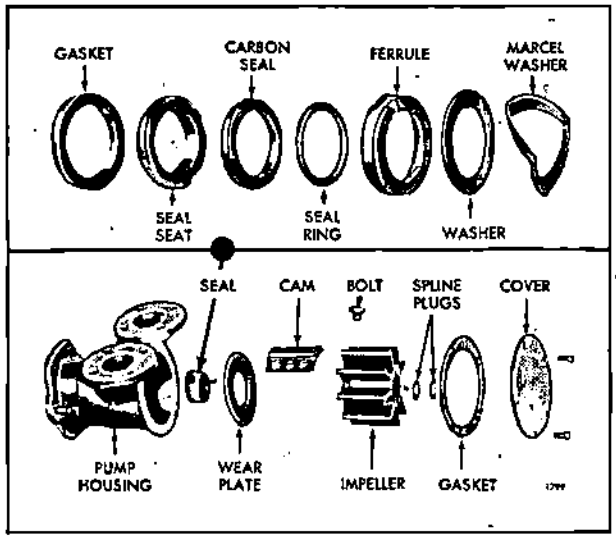


Fig. 15 - Raw Water Pump Details and Relative Location of Parts

It is possible to replace seal parts and the impeller without removing the pump from the engine.

Use care to prevent scratching the lapped surface of the seal seat or that portion of the shaft which the seal contacts.

The raw water pump seal parts and impeller may be removed and replaced as follows:

1. Remove the cover screws and lift the cover and gasket from the housing (Fig. 15). Note the position of the impeller blades to facilitate reassembly.

2. Grasp a blade at each side of the impeller with pliers and pull the impeller from the shaft. The spline plugs will come out with the impeller.

3. Remove the spline plugs by pushing a screw driver through the impeller from the opposite end.

CAUTION: If the impeller is reusable, care should be exercised to prevent damage to the splined surfaces.

Inspect the bond between the neoprene and the metal of the impeller. Check the impeller blades. If they have a permanent set, a new impeller should be used. If the impeller area which rides on the wear plate is damaged, the impeller should be replaced.

4. Insert two wires (each with a hook at one end) between the housing and seal, with the hooks over the edge of the carbon seal. Then, pull the seal assembly from the shaft.

5. The seal seat and gasket may be removed in the same manner.

6. Remove the cam bolt and cam.

7. Remove the wear plate and check it for wear and burrs. If the plate is worn or burred, it may be reversed.

8. Install the wear plate. There is a dowel in the pump body, and the wear plate is notched to ensure correct installation.

9. Hold the cam in position and install the cam bolt.

10. If the seal seat and gasket are removed, place the gasket and seal seat over the shaft and press them into position in the seal cavity.

11. Place the seal ring securely in the ferrule and, with the carbon seal and washer correctly positioned against the ferrule, slide the ferrule over the shaft and against the seal seat. Be sure the seal ring is correctly contained within the ferrule so that it grips the shaft.

12. Install the flat washer and then the marcel washer.

13. Compress the impeller blades to clear the offset cam and press the impeller on the splined shaft. The impeller blades must be correctly positioned to follow the direction of rotation.

14. Turn the engine over a few revolutions to position the impeller blades properly. Install the spline plugs.

15. Use a new gasket and install the cover on the housing.

ENGINE EQUIPMENT

INSTRUMENT PANEL, INSTRUMENTS AND CONTROLS

The instruments generally required in the operation of a diesel engine consist of a mechanical tachometer, ammeter, water temperature gage and an oil pressure gage. Also, closely related and usually installed in the general vicinity of these instruments are certain controls consisting of an engine starter switch, an engine stop knob, an emergency stop knob and on certain applications the engine hand throttle.

Marine propulsion units are provided with an instrument panel which usually includes an engine oil pressure gage, reverse gear oil pressure gage, water temperature gage, ammeter and a tachometer. The instrument panels are generally mounted some distance from the engine. Illuminated instrument panels are provided for marine applications which require night operations.

Oil Pressure Gage

The oil pressure gage registers the pressure of the lubricating oil in the engine. As soon as the engine is started, the oil pressure gage should start to register. If the oil pressure gage does not register at least the minimum pressure listed under "Running" in the "Engine Operating Instructions", the unit should be stopped and the cause of low oil pressure determined and corrected before the engine is started again.

Water Temperature Gage

The engine coolant temperature is registered on the water temperature gage.

Ammeter

An ammeter is incorporated into the electrical circuit to show the current flow to and from the battery. After starting the engine, the ammeter should register a high charge rate at rated engine speed. This is the rate of charge received by the battery to replenish the current used to start the engine. As the engine continues to operate, the ammeter should show a decline in charge rate to the battery. The ammeter will not show zero charge rate since the regulator voltage is set higher than the battery voltage. The small current registered prevents rapid brush wear in the battery-charging generator. If lights or other electrical equipment are connected into the circuit, then the ammeter will show discharge when these items are operating and the engine speed is reduced.

Tachometer

A mechanical tachometer is driven by the engine and registers the speed of the engine in revolutions per minute (rpm).

Throttle Control

The engine throttle is connected to the governor speed control shaft through linkage. Movement of the speed control shaft changes the speed setting of the governor and thus the engine speed.

Stop Knob

A stop knob is used on most applications to shut the engine down. When stopping an engine, the speed should be reduced to idle, and the engine allowed to operate at idle for a few minutes to permit the coolant to reduce the temperature of the engine's moving parts. Then, the stop knob should be pulled and held until the engine stops. Pulling on the stop knob manually places the injector racks in the "no-fuel" position. The stop knob should be returned to its original position after the engine stops.

Emergency Stop Knob

In an emergency, or if after pulling the engine stop knob the engine continues to operate, the emergency stop knob may be pulled to stop the engine. The emergency stop knob, when pulled, will trip the air shut-down valve located between the air inlet housing and the blower and shut off the air supply to the engine. Lack of air will prevent further combustion of the fuel and stop the engine.

The emergency stop knob must be pushed back in after the engine stops so the air shut-down valve can be opened for restarting after the malfunction has been corrected.

Engine Starting Motor Switch

The engine starting motor switch is used to energize the starting motor. As soon as the engine starts, release the switch.

The starting switch is mounted on the instrument panel with the contact button extending through the front face of the panel. A nut and flat washer at the front and a lock washer, plain washer and nut at the back of the panel secure the switch in place.

The starting switch is serviced as an assembly. When occasion requires, the switch should be removed and a new switch installed.

ENGINE SHUT-DOWN SYSTEMS

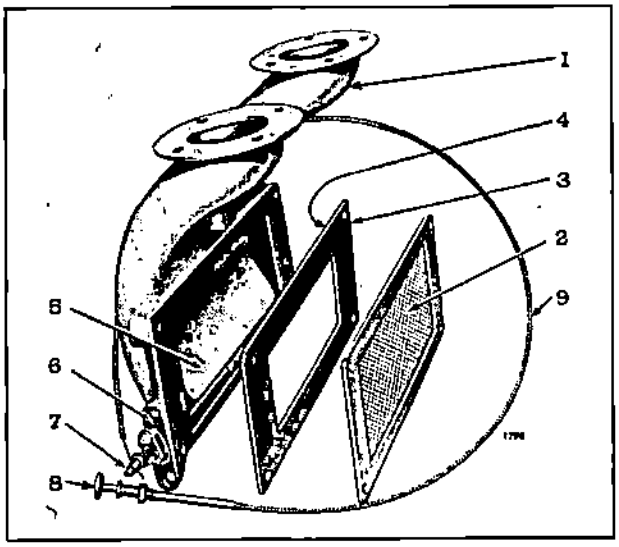


Fig. 1 – Manually Operated Engine Shut-Down Assembly

1. Housing--Air Inlet
2. Screen--Inlet Housing
3. Plate--Striker
4. Gasket
5. Valve--Shut-Down
6. Lock Plate
7. Lever--Valve Shaft
8. Knob--Control Wire
9. Wire--Air Shutdown Control

There are three shut-down devices, any one of which may be used on the engine.

1. Manual -- operation through a control wire.
2. Automatic -- controlled by a low oil pressure or a high coolant temperature.
3. Automatic -- controlled by an over-speed governor.

The manually operated shut-down device shown in Fig. 1, is operated by a knob located on the instrument panel which is connected to the valve shaft lever by a control wire. Pulling the knob all the way out will stop the engine and after the engine has been stopped, the valve may be reset by pushing the knob all the way in.

A typical installation of the automatic shut-down devices is illustrated in Fig. 2. These devices are available as optional equipment.

One device consists of a lubricating oil pressure switch extending into the oil gallery, a coolant temperature switch mounted on the water manifold, a fuel oil pressure switch which is connected to the fuel system, a solenoid coil attached to the air inlet housing and the necessary wiring.

Some engines are equipped with an overspeed shut-down device which is driven by the blower drive shaft. If the engine speed exceeds the speed which has been established by the governor, the over-speed governor actuates an overspeed switch, which is electrically connected to the shut-down solenoid.

If the engine has been stopped by an automatic device, the shut-down valve must be reset in the open position before the engine can be started.

The water temperature switch is normally an open type switch connected in the electrical circuit to the shut-down solenoid. When the engine coolant temperature exceeds 195°-205°F., the switch closes and the current energizes the shut-down solenoid.

The lubricating oil pressure switch is normally a closed type switch connected through a hot wire relay in the electrical circuit to the shut-down solenoid. When the lubricating oil pressure falls below 8-12 psi, the switch closes and current flows to the hot wire relay which must be heated by the current to complete the circuit to the solenoid. The few seconds required to heat the hot wire relay provides sufficient delay to avoid engine shut-down when low oil pressure is caused by a passing condition such as an air bubble, or temporary overlap in the operation of the lubricating oil pressure switch and fuel pressure switch during the starting and stopping of the engine.

The fuel pressure switch is normally a closed type switch connected in the electric circuit to the shut-down solenoid in series with the lubricating oil pressure switch and a hot wire relay. It is calibrated to close at fuel pressures which prevail at engine speeds of approximately 700 rpm. When the engine speed is above 700 rpm, the fuel pressure switch closes, completing the electrical circuit to the lubricating oil pressure switch.

When the engine speed is below 700 rpm, the fuel pressure switch is open and the electrical circuit to the lubricating pressure switch is broken. Thus the shut-down solenoid is not exposed to current when the engine is not running, and it will not be energized during normal starting and stopping of the engine.

For an installation of this nature contact your local Detroit Diesel Sales and Service Outlet.

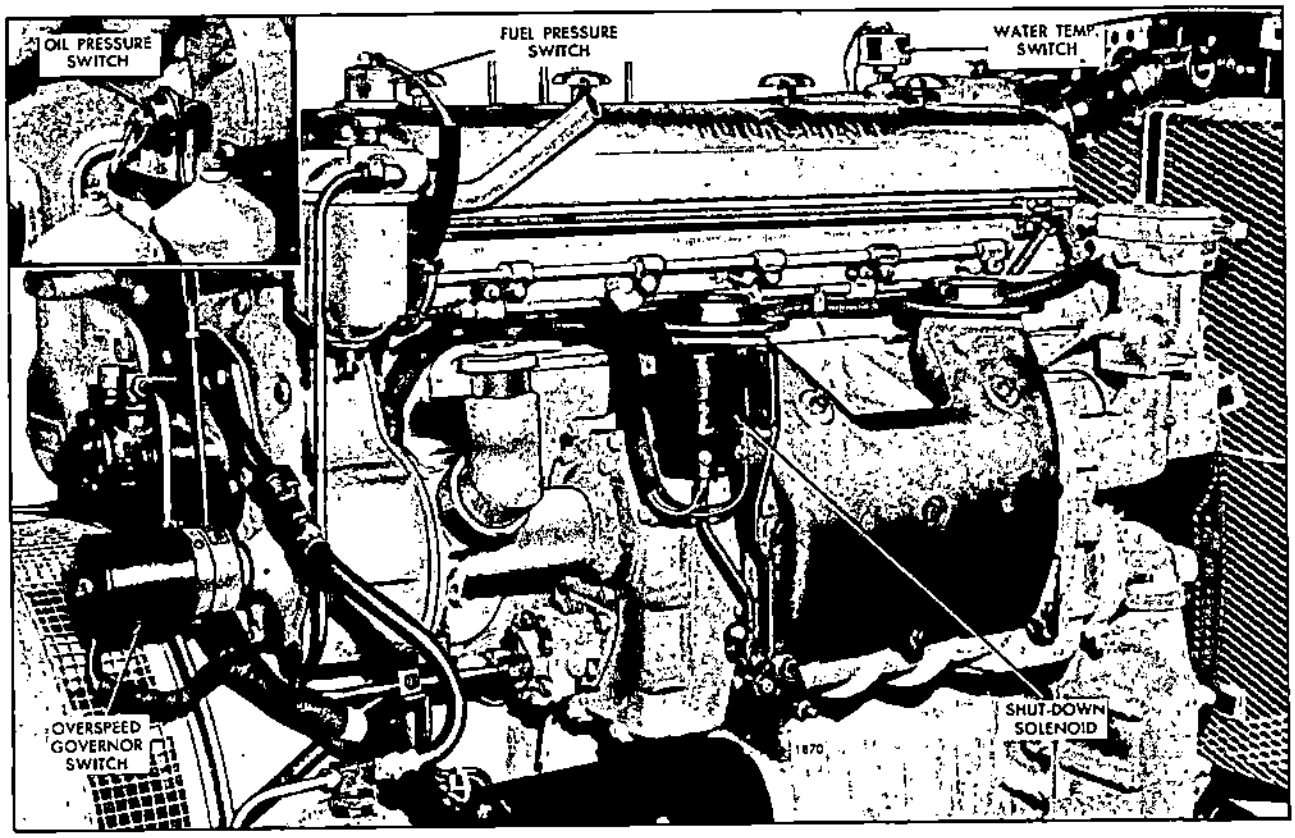


Fig. 2 – Typical Installation of Electrically Operated Shut-Down Device

ALARM SYSTEM

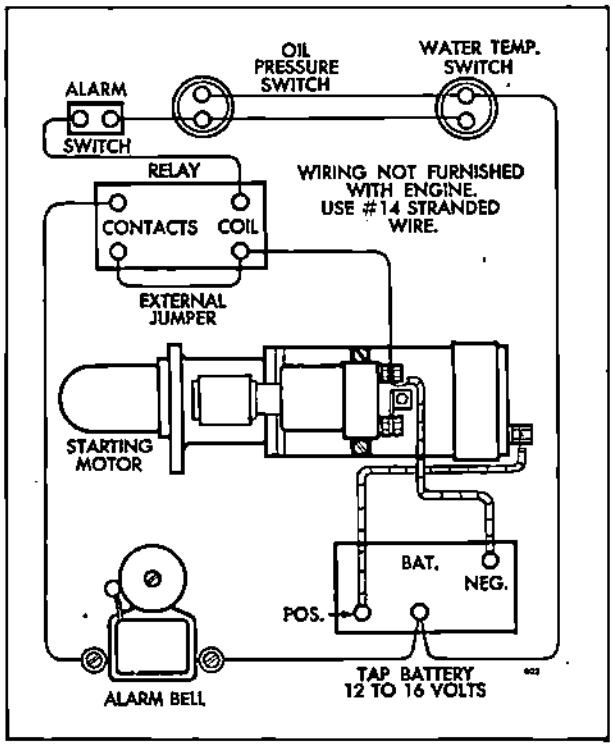


Fig. 3 – Alarm System Wiring Diagram

The alarm system (Fig. 3) is similar to the automatic shut-down system previously described, but does not include the automatic shut-down feature incorporating the electrical solenoid. A bell is used in place of the solenoid in the alarm system or the bell may be added to the automatic shut-down system. The alarm bell warns the engine operator if there is a drop in oil pressure, or if the engine coolant temperature is excessive.

A manually operated alarm switch is incorporated into the system and must be turned "OFF" before stopping the engine to prevent ringing the alarm bell. This switch must be turned "ON" after the engine is started so that the alarm system will operate in case of a malfunction.

The oil pressure and water temperature switches are similar to the switches used in the automatic shut-down device.

An overspeed governor may also be installed in the alarm system as optional equipment.

ELECTRICAL SYSTEM

The engine electrical system generally consists of a battery-charging generator, starting motor, voltage regulator, storage battery, starter switch and necessary wiring. Additional electrical equipment may be installed on the engine at the option of the owner.

Battery-Charging Generator

A DC or AC battery-charging generator is introduced into the electrical system to provide a source of electrical current for maintaining the storage battery in a charged condition and to supply sufficient current to carry any other electrical load requirements up to the rated capacity of the generator.

Regulator

A DC or AC regulator is incorporated in the electrical system to regulate the voltage and current output of the battery-charging generator and to help maintain a fully charged storage battery.

Storage Battery

The lead-acid storage battery is an electrochemical device for converting chemical energy into electrical energy.

The battery has three major functions:

1. It provides a source of electrical power for starting the engine.
2. It acts as a stabilizer to the voltage in the electrical system.
3. It can, for a limited time, furnish current when the electrical demands of the unit exceed the output of the generator.

The battery is a perishable item which requires periodic servicing. A properly cared for battery will give long and trouble-free service.

1. Check the level of the electrolyte regularly. Add water if necessary, but do not overfill. Overfilling can cause poor performance or early failure.

2. Keep the top of the battery clean. When necessary, wash with a baking soda solution and rinse with fresh water. Do not allow the soda solution to enter the cells.

3. Inspect the cables, clamps and hold-down bracket regularly. Clean and re-apply a light coating of grease when needed. Replace corroded, damaged parts.

4. Use the standard, quick in-the-unit battery test as the regular service test to check battery condition.

5. Check the electrical system if the battery becomes discharged repeatedly.

If the unit is to be stored for more than 30 days, remove the battery. The battery should be stored in a cool, dry place. Keep the battery fully charged and check the level of the electrolyte regularly.

The Lubrication and Preventive Maintenance section of this manual covers the servicing of the starting motor and generator.

Consult a Detroit Diesel Sales and Service Outlet for information regarding the electrical system.

STARTING SYSTEMS

ELECTRICAL STARTING SYSTEM

Starting Motor

The electric starting motor, installed on the engine, has an overrunning clutch drive or a Bendix drive assembly. Bendix drive starters are generally used on applications where automatic starting is required, such as standby generator sets. The overrunning clutch drive starters have the solenoid mounted on the starter and have a totally enclosed shifting mechanism.

Starter Switch

To start the engine, a switch is used to energize the starting motor. Release the switch immediately after the engine starts.

HYDRAULIC STARTING SYSTEM

The Hydrostarter System schematically illustrated in Fig. 4 is a complete hydraulic system for starting internal combustion engines. The system is automatically recharged after each start, and can be manually recharged. The starting potential remains during long periods of inactivity, and continuous exposure to hot or cold climates has no detrimental effect upon the Hydrostarter system. Also, the Hydrostarter torque for a given pressure remains substantially the same regardless of the ambient temperature.

The Hydrostarter System consists of a reservoir (95), an engine driven charging pump (120), a hand pump (55), a piston type accumulator (100), a starting motor (1) and connecting lines and fittings.

Operation

Hydraulic fluid flows by gravity, or a slight vacuum, from the reservoir to either the engine-driven pump or the hand pump inlet. Fluid discharging from either pump outlet at high pressure flows into the accumulator and is stored at 3250 psi under the pressure of compressed nitrogen gas. When the starter is engaged with the engine flywheel ring gear and the control valve is opened, fluid under pressure is forced out of the accumulator, by the expanding nitrogen gas, and flows into the starting motor which rapidly accelerates the engine to a high cranking speed. The used fluid returns directly to the reservoir from the starter.

The engine-driven charging pump runs continuously

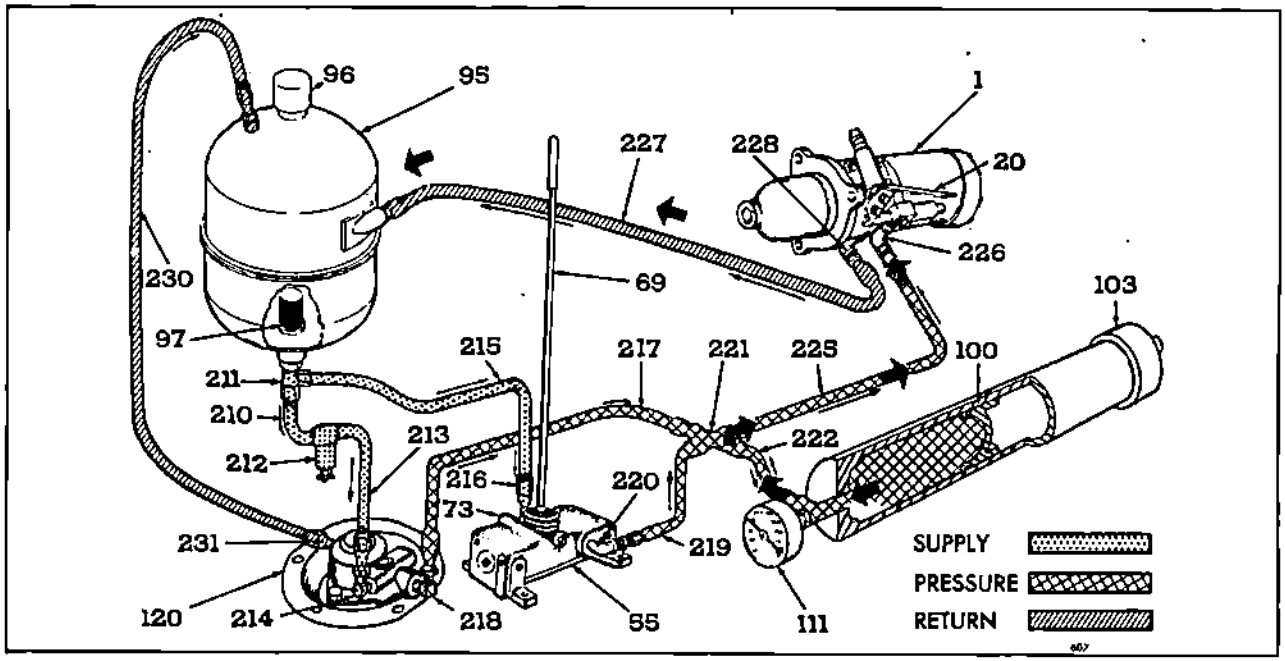


Fig. 4 - Schematic Diagram of Hydrostarter System Showing Oil Flow.

1. Motor--Starting
20. Lever--Control (Handle)
55. Pump--Hand
69. Handle--Pump
73. Valve--Relief
95. Reservoir
96. Cap--Filler
97. Filter
100. Accumulator
103. Cap
111. Gage
120. Pump--Direct Engine Driven Hydrostarter Charging
210. Line--Supply-Reservoir to Filter
211. Tee
212. Filter--Supply Line to Engine Pump
213. Line--Supply-Filter to Engine Pump
214. Elbow--Pump Inlet (Driven)
215. Line--Supply-Tee to Hand Pump
216. Elbow--Pump Inlet (Hand)
217. Line--Pressure-Engine Pump to Accumulator
218. Elbow--Pump Outlet (Driven)
219. Line--Pressure-Hand Pump to Accumulator
220. Elbow--Pump Outlet (Hand)
221. Cross
222. Line--Cross to Accumulator
225. Line--Pressure-Accumulator to Starting Motor
226. Elbow--Pressure-Inlet Starting Motor
227. Line--Return-Starter Motor to Reservoir
228. Elbow--Return-Starter Motor to Reservoir
230. Line--Return-Engine Pump to Reservoir
231. Elbow--Return-Engine Pump to Reservoir

during engine operation and automatically recharges the accumulator. When the required pressure is attained in the accumulator, a valve within the pump body opens and the fluid discharged by the pump is by-passed to the reservoir. The system can be shut down and the pressure in the accumulator will be maintained.

The precharge pressure of the accumulator is the pressure of the nitrogen gas with which the accumulator is initially charged. This pressure must be checked before the system pressure is raised for the initial engine start. To check the precharge pressure, open the relief valve (73), on the side of the hand pump, approximately 1/2 turn, allowing the pressure gage (111) to return to zero. Close the relief valve and pump several strokes on the hand pump. The gage should show a rapid pressure rise from zero to the nitrogen precharge pressure, where it will remain without change for several additional strokes of the pump.

Initial Engine Start

Use the hand pump (55), to raise the accumulator pressure. An accululator pressure of 1500 psi when the ambient temperature is above 40°F. will provide adequate cranking to start the engine. Between 40°F. and 0°F. 2500 psi should be sufficient. Below 0°F., the accumulator should be charged to the maximum recommended pressure. Although the Hydrostarter cranks the engine faster than other starting systems, starting aids should be used in cold weather.

> **NOTE:** Use the priming pump to make sure the filters, lines, manifolds, and injectors are full of fuel before attempting to start the engine.

For ambient temperatures below 40°F., use a fluid starting aid. Add the starting fluid just prior to moving the Hydrostarter lever and during the cranking cycle as required. Do not wait to add the

starting fluid after the engine is turning over, otherwise the accumulator charge may be used up before the engine can start. In this case, the accumulator charge must be replaced with the hand pump.

With the engine controls set for start (throttle at least half-open), push the Hydrostarter control lever (20), to simultaneously engage the starter pinion with the flywheel ring gear and to open the control valve. Close the valve quickly when the engine starts, to conserve the accumulator pressure and to prevent excessive overrunning of the starter drive clutch assembly.

Three different basic types of flywheel ring gear are used -- no chamfer, Bendix chamfer, and Dyer chamfer on the gear teeth. Some difficulty may be encountered in engaging the starter pinion with the Dyer chamfered ring gears. When this happens, it is necessary to disengage and re-engage until the starter pinion is cammed in the opposite direction enough to allow the teeth to mesh.

Remote Control System

The Hydrostarter remote control system, Fig. 5, consists of a master cylinder, a pedal, a lever arm, two springs, and a flexible hose. It is an independent hydraulic system using diesel fuel oil as a hydraulic fluid to actuate the Hydrostarter control valve by means of the pedal operated master cylinder.

The master cylinder is connected to the control valve on the Hydrostarter by a flexible hose. Pressing on the pedal forces the fluid through the line to the control valve which engages the starter pinion with the engine flywheel ring gear. Release the pedal as soon as the engine starts.

The master cylinder may be located at any desired location. However, for distances greater than 15 feet, 1/4" O.D. steel or copper tubing must be used between the flexible hose and the master cylinder. The flexible hose is always connected to the Hydrostarter control valve housing.

The Hydrostarter motor is equipped with a control valve that incorporates a threaded valve housing plug with a 1/8"-27 tapped hole in the center for installation of the flexible hose. A 1/8"-27 pipe plug is installed when the remote control system is not used.

Springs are used to return the master cylinder pedal and the Hydrostarter control lever to the off position.

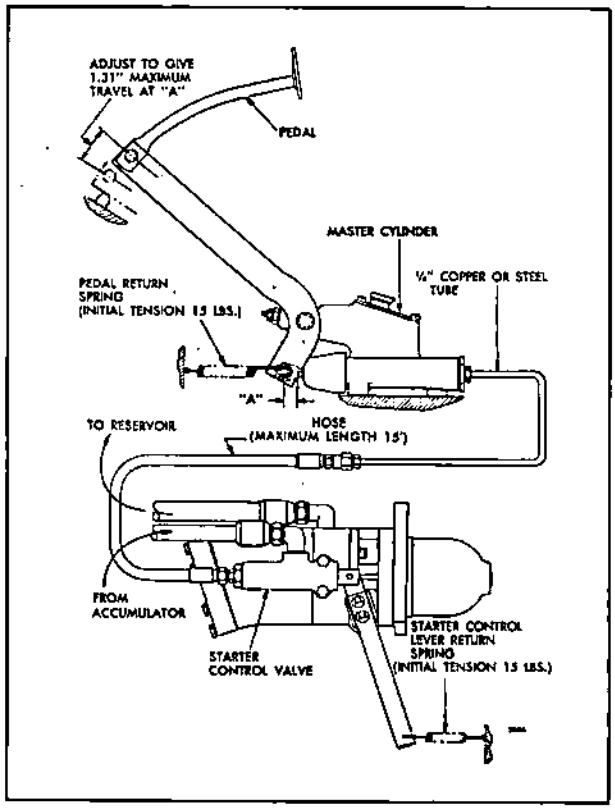


Fig. 5 - Hydrostarter Remote Control System

Filling

Remove the filler cap from the reservoir and add a sufficient quantity of hydraulic fluid (a mixture of 75% diesel fuel and 25% SAE 10 or 30 lubricating oil) to fill the system.

The required amount of hydraulic fluid will vary depending upon the size of the reservoir, length of hydraulic lines, size and number of accumulators. The reservoirs are available in 10, 12 and 16 quart capacities. In a 10 quart capacity reservoir, add approximately 8 quarts of hydraulic fluid, approximately 10 quarts in a 12 quart reservoir and approximately 14 quarts in a 16 quart reservoir.

> **NOTE:** When the accumulator is charged to 3000 psi and all lines are filled, there should be enough hydraulic fluid remaining in the reservoir to completely cover the screen in the bottom of the reservoir.

Purging

A by-pass valve is located on the inlet side of the hand pump. Loosen the lock nut and rotate this valve approximately one turn counterclockwise with

a screw driver. Operate the hand pump for 12 to 15 complete strokes. Do not pump too rapidly. Close the by-pass valve tightly and tighten lock nut.

1. Move the starter control lever to engage the pinion with the flywheel and open the control valve. While holding the lever in this position, operate the hand pump until the starter has turned several revolutions. Close the control valve. Loosen the swivel hose fitting at the discharge side of the engine-driven pump about two turns. Operate the hand pump to force air out until oil begins to appear at the loose fitting. Tighten the swivel hose fitting and pressurize the system with the hand pump sufficiently to start the engine.

2. Perform the initial starting instructions under "Preparation for Starting Engine First Time". Then, with the engine running at least 1500 rpm, purge the engine-driven pump of air. Break the hose connection at the discharge side of the engine-driven pump until a full stream of oil is discharged from the pump. Connect the hose to the pump and alternately loosen and tighten the swivel fitting on the discharge hose until the oil leaking out when the fitting is loose appears to be free of air bubbles. Tighten the fitting securely and observe the pressure gage. The pressure should rise rapidly to the accumulator precharge pressure (1250 p.s.i. at 70°F.), then increase slowly, reaching 2900 to 3300 psi.

3. After the pressure has stabilized near 3000 psi examine all the high pressure lines, connections and fittings for leaks.

4. The engine driven pump must by-pass oil to the reservoir when the accumulator pressure reaches 2900-3300 p.s.i. To determine whether the pump by-pass valve is operating properly, remove the reservoir filler cap, disconnect the pump by-pass line at the reservoir, and hold the hose over the open reservoir filler spout. An occasional spurt of oil may be emitted from the hose prior to by-passing. When the by-pass valve opens, a full and continuous stream of oil will flow from the hose. Reconnect the hose to the reservoir and install the filler cap.

5. Fill the reservoir to the proper level.

The Hydrostarter remote control system may be purged of air as follows:

1. Fill the master cylinder with fuel oil.

2. Loosen the hose fitting at the Hydrostarter control valve.

3. Actuate the master cylinder pedal until all the air is discharged from the system and a solid stream of fuel oil is being discharged with each stroke.

   NOTE: Replenish the fluid in the master cylinder as required during the purging operation.

4. Tighten the hose fitting and check for leaks.

Consult a Detroit Diesel Sales and Service Outlet for any information relating to the Hydrostarter System.

COLD WEATHER STARTING AIDS

When starting an internal combustion engine in cold weather, a large part of the energy of combustion is absorbed by the pistons, cylinder walls, and coolant, and in overcoming friction.

In the diesel engine, air alone is compressed in the cylinder; then, after the air has been compressed, a charge of fuel is sprayed into the cylinder and ignited by the heat of compression. This temperature becomes high enough under ordinary operating conditions, but may not be sufficiently high at extremely low outside temperatures to ignite the fuel charge.

To assist in starting an engine under low temperature conditions, different starting aids are available at the customer's option. One device is an Air Heater another is a Fluid Starting Aid.

Air Heater Starting Aid

The air heater is a small pressure oil burner with an electric igniter. It provides a means of preheating the in-going charge of air to the cylinders sufficiently to insure the engine will start in extremely low ambient temperatures, provided the lubricating oil in the engine is of the recommended viscosity.

The heater unit, Fig. 6, containing the nozzle, filter, ignition coil, and ignition points, is mounted on the cylinder block, replacing one of the air box covers.

A hand operated pressure pump and a fuel supply valve are usually mounted on the instrument panel. This pump draws fuel from the fuel strainer and delivers it under pressure to the burner unit where the charge is filtered before reaching the spray nozzle. The pump plunger, when not in use, is held in the IN position by a spring and ball mechanism and may be released merely by pulling the plunger out.

The contact points in a pressure switch in the fuel line between the pump and nozzle close automatically from pressure created by the pump. This completes the electrical circuit through the coil and causes a spark across the electrodes at the spray nozzle.

When starting an engine in cold weather, follow the Air Heater Instructions given on the plate attached to the instrument panel and listed below:

1. Open the air heater valve.
2. With the engine throttle wide open, engage the starter.
3. Operate the pump with smooth, even strokes, applying a firm pressure of 10 pounds or more on the pumping stroke.
4. With the engine running, regulate the throttle and push the plunger in all the way until the lock engages.
5. Close the air heater valve.

CAUTION: Use the air heater for cold weather starting only.

The engine usually starts firing during the first or second pumping stroke. At low temperatures, with heavy lubricating oil, the engine may fire for a time with the combined help of the starter and heater before developing sufficient power to run unassisted. Under these conditions, it is advisable to pause at the end of each pumping stroke to allow the engine time to absorb the heat generated. At a temperature of 10°F. or lower, it will be beneficial to use the heater for a short time after the engine has started.

Dependable starting of the engine by any means can be obtained only with an adequate cranking speed. The lubricating oil used in cold weather operations must meet the specifications given under "Lubricating Oil Specifications."

If electrical current is supplied from batteries, they must be kept in good condition. Air box drains must be open to prevent fuel accumulation in the air box.

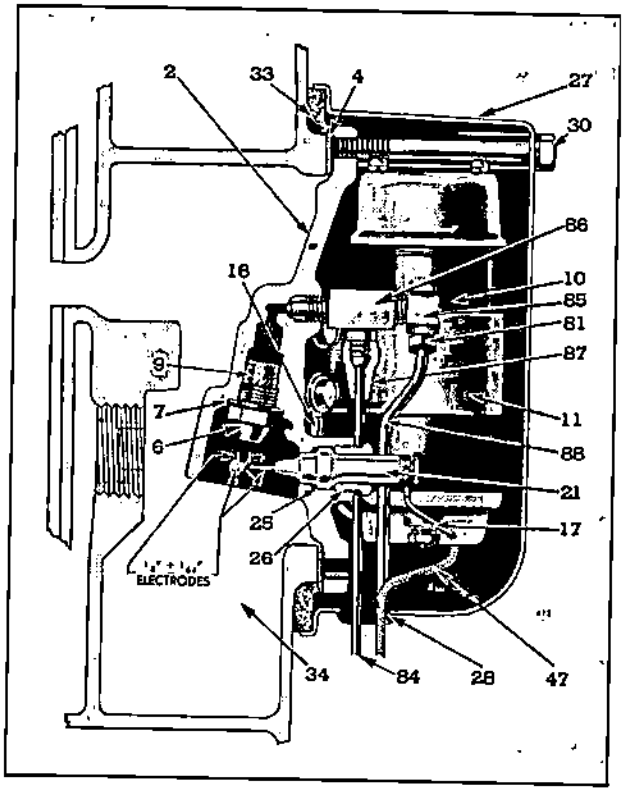


Fig. 6 - Air Heater Assembly

2. Body--Air Heater
4. Gasket (Cork)--Air Heater Body
6. Nozzle--Air Heater Spray
7. Washer--Spray Nozzle
9. Filter--Spray Nozzle
10. Coil--Air Heater
11. Bracket--Coil
16. Lead--Coil Ground
17. Lead-Air Heater High Tension
21. Electrode and Insulator--Air Heater
25. Gasket--Electrode Insulator
26. Nut--Electrode
27. Cover--Air Heater
28. Grommet
30. Bolt--Air Heater Cover
33. Gasket (Felt)--Air Heater Cover
34. Air Box--Cylinder Block
47. Wire--Air Heater Pressure
81. Connector--Fuel Tube
84. Tube--Air Heater Pump
85. Elbow--Fuel Tube (at Air Heater)
86. Fitting--Tee (at Air Heater)
87. Union--Fuel Tube
88. Tube--Air Heater to Pressure Switch

Fluid Starting Aid

The fluid starting aid, schematically illustrated in Fig. 7, is designed to inject a highly volatile fluid into the air intake system at low ambient temperatures to assist in the ignition of the fuel oil injected. This fluid is contained in a suitable capsule to facilitate handling.

This starting aid consists of a cylindrical capsule container with a screw cap. Inside this chamber is a sliding, plunger-like piercing shaft. A tube leads from the capsule container to the hand operated pump and another tube connects the pump to the atomizing nozzle which is threaded into the air intake housing.

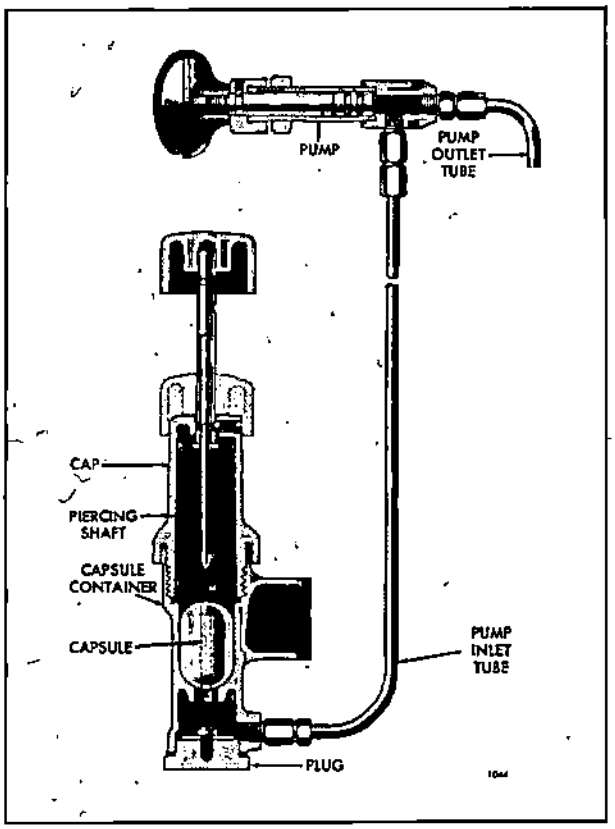


Fig. 7 - Typical Fluid Starting Aid

The capsule container should be mounted in a vertical position and away from any heat.

The fluid starting aid may be operated as follows:

1. Remove the threaded cap and insert a fluid capsule in an upright position within the container.

NOTE: The starting fluid is toxic and inflammable. Use caution when handling.

2. Pull the piercing shaft all the way out and install and tighten the cap on the container.

3. Push the piercing shaft all the way down. This will rupture the capsule and fill the container with the starting fluid.

4. Move the engine throttle to the maximum speed position.

5. Engage the starter and at the same time pull the pump plunger all the way out. Push the plunger in slowly forcing the starting fluid through the atomizing nozzle into the air intake. Continue to push the pump in until the engine starts. If the plunger is not all the way in when the engine starts, push it in slowly until it locks in the IN position.

6. Unscrew the cap and remove the capsule. Do not leave the empty capsule in the container.

7. Replace the cap on the capsule container and make sure the piercing shaft is all the way down.

The cold weather fluid starting aid will require very little service. Replace the piston seal packing if the pump leaks or if there is an excessive resistance to pumping the nozzle may be plugged. Remove the nozzle and clean it.

GOVERNORS

Engine Governors

The power requirements from an engine may vary continually due to the fluctuating loads; therefore, a means must be provided to control the amount of fuel required to hold the engine speed reasonably constant during such load fluctuations. To accomplish this control, one of three types of governors is used on the engine depending upon the application. Installations requiring maximum and minimum speed control, together with manually controlled intermediate speeds, ordinarily use a single or double weight type limiting speed mechanical governor. Applications requiring a near constant engine speed, under varying load conditions, that may be changed by the operator, are equipped with a variable speed mechanical governor. The hydraulic governor is used where a uniform engine speed is required, under varying load conditions, with a minimum speed droop.

The engine governor is mounted on the front of the blower and is driven by the upper blower rotor. The governor provides full fuel for starting when the control lever is in the IDLE or RUN position. Immediately after starting, the governor moves the injector racks to the position required for idling.

The mechanical engine governors are identified by a name plate attached to the governor housing.

The letters D.W.-L.S. stamped on the name plate denote a double weight limiting speed governor. A single weight variable speed governor name plate is stamped S.W.-V.S.

The maximum engine speed is stamped on the Option Plate attached to the engine rocker cover.

Surplus oil from the cylinder head provides lubrication for the parts in the mechanical governor control housing, oil picked up from a reservoir in the blower front end plate by a slinger attached to the lower rotor shaft, provides lubrication for the governor weights and weight carrier. Some engines have a line carrying oil under pressure, through a restricted fitting, to the weight housing, providing additional lubrication.

The hydraulic governor is lubricated by oil under pressure from the engine. A portion of this oil seeps past the power piston and pilot valve plunger providing lubrication for the moving parts in the governor housing. The oil which collects in the housing passes through a drilled passage into the governor drive housing thereby lubricating the governor drive and driven shafts and their bearings. The surplus oil returns to the crankcase through connecting drilled passages in the blower end plate and cylinder block.

Fluctuations of the engine speed usually indicates governor malfunction, however, these fluctuations can also be caused by an excessive load on the engine, misfiring, or binding linkage. Contact a Detroit Diesel Sales and Service Outlet for information regarding governors.

Output Shaft Governors

On certain applications equipped with a Torqmatic Converter, it is sometimes desirable to maintain a constant output shaft speed regardless of the engine speed or load fluctuations. To acquire the necessary results, a governor driven by the output shaft is installed in conjunction with an engine governor. This governor is called an output shaft governor and may be mechanical or hydraulic.

The output shaft governor controls the engine governor (usually a limiting speed type) in the engine speed range between idle and maximum speed. The engine speed is prevented from going below IDLE or exceeding the maximum speed setting by the engine governor. The following governor combination may be employed:

1. A mechanical output shaft governor and a mechanical engine governor with the necessary connecting linkage.
2. A hydraulic output shaft governor and a mechanical engine governor with the necessary connecting linkage.
3. A dual hydraulic output shaft engine governor.

Engine speed in the intermediate speed range, between idle and maximum engine speed, is controlled by the speed control lever on the output shaft governor.

On some applications where a very low output shaft speed is required, the governor may be equipped with an overrule lever that allows the operator to decrease the output shaft speed to zero or slightly above depending upon the load. If the governor is not equipped with an overrule lever the engine governor control lever would be moved toward the idle speed position. The engine governor would then maintain control until the output shaft increased to the speed setting of the output shaft governor.

The mechanical output shaft governor is mounted at the rear of the engine and may be gear driven by the Torqmatic Converter output shaft or belt driven by a pulley on the output shaft. An internal oil sump in the belt driven governor provides lubrication and the gear driven governor is lubricated through a line from the converter.

The hydraulic output shaft governor is mounted on the Torqmatic Converter and gear driven by the output shaft. An external oil line from the converter provides lubrication.

A minimum speed limit adjusting screw and a maximum speed limit adjusting screw incorporated in the output shaft hydraulic governor may be set to establish the minimum and maximum speed for any desired operating speed range.

The single or double lever dual hydraulic governor is a compound assembly which consists of two sections. One section is driven by the engine and the other by the Torqmatic Converter through a flexible cable. The sections are referred to as the engine governor and output shaft governor respectively.

The engine lubrication system supplies the oil under pressure for the hydraulic operation of the dual hydraulic governor. A larger auxiliary pump is incorporated into the governor to ensure sufficient pressure for both sections.

An anti-stall feature is incorporated into the output shaft governor section to prevent a complete fuel shutdown in case the output shaft rotates at a speed greater than the no-load engine speed setting.

Refer to the Engine Tune-Up Procedures for any adjustments to the output shaft governors.

TRANSMISSIONS

This manual includes information on the lubrication and preventive maintenance of the transmissions. It also includes adjustment procedures covering some of the more common power transmissions.

Problems relating to the repair and overhaul of these transmissions should be referred to an authorized Detroit Diesel Sales and Service Outlet.

POWER TAKE-OFF ASSEMBLIES

The power take-off units are basically similar in design, varying in clutch size to meet the requirements of a particular engine application.

The direct drive power take-off unit is attached to either an adaptor (front power take-off) or the engine flywheel housing (rear power take-off). Each power take-off unit has a single or double plate clutch. The drive shaft is driven by the clutch assembly and is supported by a pilot bearing in the flywheel or the adaptor and by two tapered roller bearings mounted in the clutch housing.

Clutch Adjustment

These instructions refer to field adjustment for clutch facing wear. Frequency of adjustment depends upon the amount and nature of the load.

To ensure a long clutch facing life and the best performance, the clutch should be adjusted before slippage occurs.

When the clutch is properly adjusted, a heavy pressure is required at the outer end of the hand lever to move the throwout linkage to the "over center" or locked position.

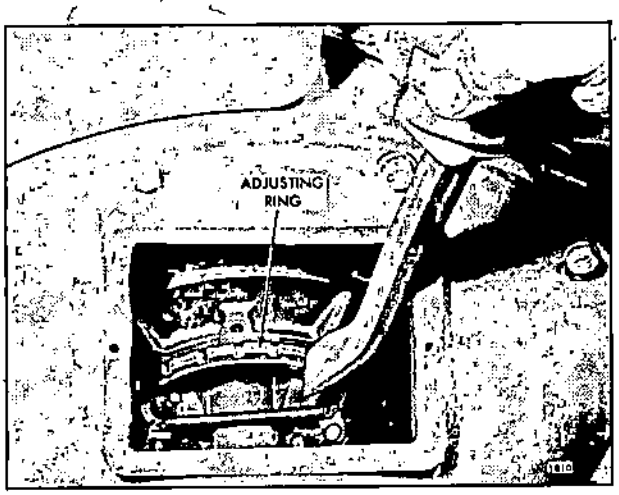


Fig. 8 - Power Take-Off Showing Typical 8" and 11-1/2" Diameter Clutch Adjustment Ring

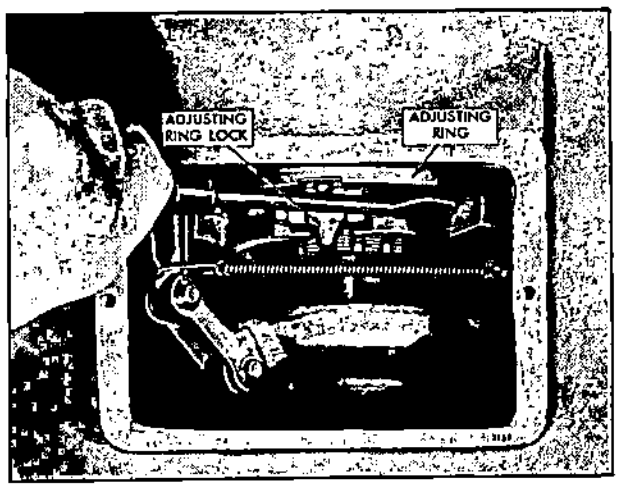


Fig. 9 - Power Take-Off Assembly Showing 14" Diameter Clutch Adjustment Ring

Adjust the 8", 11-1/2" and 14" diameter clutches as follows:

1. Disengage the clutch with the hand lever.
2. Remove the inspection hole cover to expose the clutch adjusting ring.
3. Rotate the clutch, if necessary, to bring the clutch adjusting ring lock within reach.
4. Remove the clutch adjusting ring spring lock on the 8" and 11-1/2" diameter clutches. Turn the adjusting ring counterclockwise to tighten the clutch as shown in Fig. 8. On the 14" diameter clutches, turn the adjusting ring lock up out of the splined groove. Turn the adjusting ring clockwise to tighten the clutch as shown in Fig. 9. When properly adjusted, the approximate pressure required at the outer end of the hand lever to engage the various clutches is

shown in the table below. These specifications apply only with the hand lever which is furnished with the power take-off.

Clutch dia.	Hand Lever Length	Pressure lbs.
8"	15-1/2"	55
8"	20"	40
11-1/2"	20"	65
11-1/2"	25"	50
14"	25"	75

A suitable spring scale may be used to check the pounds pressure required to engage the clutch. However, a more accurate method of checking the clutch adjustment is with a torque wrench as shown in Fig. 10.

To fabricate an adaptor, saw the serrated end off of a clutch hand lever and weld a 1-1/8" nut (across the hex) on it as shown in Fig. 10. Then, saw a slot through the nut.

When checking the clutch adjustment with a torque wrench, engage the clutch slowly and note the amount of torque immediately before the clutch engages (goes over center). The specified torque is shown in the table below.

Clutch Diameter	Torque Lb-Ft
8"	56-63
11-1/2"	94-100
14"	132-149

Install the clutch adjusting ring spring lock on the 8" and 11-1/2" diameter clutches. The ends of the lock must engage the notches in the adjusting ring. On the 14" diameter clutch, reinstall the end of the adjusting ring lock in one of the splined grooves in the hub of the outer pressure plate. Then, reinstall the inspection hole cover.

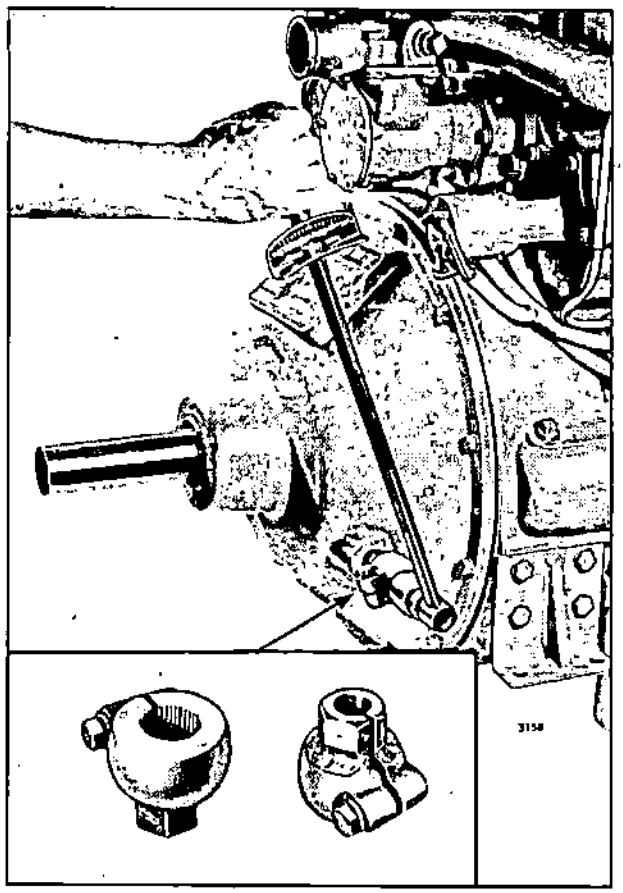


Fig. 10 - Power Take-Off Clutch Adjustment Check With Torque Wrench and Adaptor

POWER TRANSFER GEAR

The twin engine transfer gear is connected to the engines through mechanical clutches on industrial units or hydraulic marine gears on marine units.

The power of the two engines is transmitted through the clutches or hydraulic marine gears to the drive gears, then through a common driven gear to the power driven shaft.

In normal usage, the two clutches used on twin units are operated simultaneously and the engines perform as a single power plant. However, each engine has its own shifting mechanism permitting one or both engines to be cut out, thus providing a unit power output varying from idling speed on one engine to full throttle on both engines.

Each clutch is controlled by a hand lever mounted on a shaft common to the two levers. The shaft is supported in a bracket which in turn is bolted to the side of the gear box.

When a clutch is engaged, the lockout latch rests

on the lever quadrant, and when the clutch is disengaged this latch enters a notch in the quadrant. If one engine is stopped and the other engine is in operation, the clutch on the shut-down engine must be disengaged and the latch lever should be locked out by removing the pin in the lockout latch.

Clutch Adjustment

The clutches used in twin industrial units require no adjustment, however, when the facings on the clutch disc are worn so the over-all thickness of the disc and facings is less than 11/32", the disc assembly should be changed.

Clutch Control Adjustment

If the clutch control links are replaced or the adjustment changed, readjust the clutch control as follows:

1. With the clutches engaged, connect each control link at the clutch shift lever with the pin.
2. Set both hand levers in a vertical position.
3. Loosen the lock nut and adjust the clevis on each link so a clevis pin will slip into place through the clevis and lever.
4. Lock the clevis pins with cotter pins.

REDUCTION GEAR FOR MARINE SIDE-BY-SIDE TWIN UNITS

Two hydraulic marine gears are mounted on the forward side of the reduction gear used with side-by-side twin marine units. Each reverse gear drive shaft is splined to and drives a pinion gear. The two pinion gears mesh with a common power driven gear which is bolted to a driven shaft. A flange is provided at the rear end of the power driven shaft for installing a propeller shaft.

REDUCTION GEAR FOR MARINE TANDEM TWIN UNITS

A hydraulic marine gear is mounted on the front and rear of the reduction gear used with tandem twin marine units. Each reverse gear drive shaft is splined to and drives a pinion gear. The two pinion gears mesh with a common power driven gear which is bolted to a driven shaft. A flange is provided at the rear end of the power driven shaft for installing a propeller shaft.

QUAD REDUCTION GEAR

The individual clutch housings of the four engines in an industrial quad unit are attached to a reduction gear assembly. Two clutch housings pilot into and are secured to the front of the reduction gear housing and two housings are attached in the same way to the rear. The clutch housings also pilot into and are bolted to the flywheel housing of each engine.

The marine quad unit has a similar reduction gear, differing only in certain internal details. On these quad units, the engines are connected to the reduction gear assembly by hydraulic reverse gears.

TORQMATIC MARINE GEAR

The Torqmatic Marine Gear is used on the single and multiple engine marine units. When used on the single engine units, the marine gear consists of a reverse gear section and a reduction gear section. This gear is produced in "M" and "MH" models, each being available in several gear ratios. These two models are basically similar.

The oil for operating the hydraulic clutches and for lubricating the reverse gear is contained in the reverse gear sump and is circulated throughout the system by a hydraulic oil pump mounted on the flywheel housing and driven from the blower drive shaft through a flexible coupling.

The oil pressure ranges for the marine gear at forward operating speed are 90 to 150 psi and 60 to 125 psi in reverse. The average operating oil temperature is 200°F. in forward and a maximum of 250°F. in reverse.

A strainer is used between the oil sump and the pump to remove harmful solids. The oil passes from the pump through a cooler to the control valve. From the control valve, the oil operates the forward or reverse clutch pistons and sprays oil into the reduction gear housing to lubricate the gear.

The constant flow control valve, incorporated with a pressure relief valve, controls the amount of oil pumped through the hydraulic system and is sensitive only to engine speed and operates independently of the pressure relief valve section which controls the pressure within the complete hydraulic system.

When the engine is in operation, the moving parts of the marine reverse gear are pressure lubricated while the reduction gear assembly is splash lubricated.

Shifting from forward to reverse drive through neutral may be made at any speed; however, it is advisable to shift at low engine speeds. For longest clutch life, reduce the engine speed to idle, make the shift and then increase the engine speed.

It is recommended that all sailing vessels and boats utilizing Torqmatic marine gears (single or twin screw installations) have a locking (brake) devise to prevent the propeller shaft from rotating while the sailing vessel is operating under sail, or the boat is operating with one engine shut-down, or being towed.

When a marine gear installation of this type is operated with one engine shut-down, the propeller of the shut-down engine is forced through the water by the speed of the vessel or boat, causing it to rotate. Thus, with the engine shut-down, and the marine gear oil pump not operating, it cannot circulate lubricating oil through the reverse gear. Therefore, overheating and damage to the marine gear is possible unless the rotation of the propeller shaft is prevented.

If the clutches cannot be engaged hydraulically, in an emergency, the forward drive may be engaged with three bolts as follows:

1. Remove the large pipe plug from the forward face of the flywheel housing.
2. With the throttle in the STOP position, rotate the flywheel until one of the bolts aligns with the opening in the flywheel housing.
3. Remove the bolt from the flywheel.
4. Remove and save the jam nut, and replace the bolt finger-tight.
5. Remove and reinstall the remaining two bolts in the same manner.
6. Start at the first bolt and tighten all three bolts uniformly, thereby locking the clutch plate between the piston and the drive plate. Install the pipe plug in the flywheel housing.

NOTE 1: To prevent binding between the piston and the bore in the flywheel, the emergency engagement bolts must be tightened uniformly.

NOTE 2: To prevent damaging the gear, do not use the reverse drive when the engagement bolts are engaged.

NOTE 3: To reduce the possibility of overheating, add an additional gallon of oil if the forward clutch is engaged with the emergency engagement bolts and the hydraulic pump is inoperative.

MODEL HJ1 PARAGON MARINE REVERSE AND REDUCTION GEAR

The Paragon Hydraulic Marine Gear is a self-contained assembly consisting of a hydraulically operated multiple disc clutch which is combined with a hydraulically actuated reversing gear train, an oil pressure regulator, an independent oil sump and a coolant jacket integral with the marine gear housing.

The oil pressure necessary for the operation of the marine gear is provided by an oil pump which is incorporated in the gear housing and driven continuously while the engine is running. The oil is delivered under pressure from the pump to a pressure relief valve and control valve.

The relief valve maintains a constant pressure over a wide speed range and the control valve directs the oil under pressure to either the forward or reverse piston cylinder. The operating oil pressure range for the marine gear at operating speed is 90 to 150 psi and the mazimum oil temperature is 250°F.

Water is circulated through a cored passage in the reverse gear housing to cool the gear oil.

The shift from forward to reverse drive through neutral may be made at any engine speed, however, to avoid possible damage to the engine, reverse gear, or shaft, shift at speed below 1000 rpm.

The marine reverse and reduction gear uses the same oil that is used in the engine and is pressure and splash lubricated. The quantity of oil in the marine gear will vary with the inclination of the different engine installations.

TORQMATIC CONVERTERS

The Torqmatic Converter is a self contained unit which transfers and multiplies the torque of the prime mover. This unit transmits the power through the action of oil instead of through gears and in addition to multiplying the torque also acts as a fluid coupling between the engine and the equipment to be powered. The converter will automatically adjust the output torque to load requirements.

There are various combinations of Torqmatic Converters with features such as; an automotive or industrial flange on the shaft, a hydraulically operated lock-up clutch, a manual input disconnect clutch, and an accessory drive for either a governor or tachometer.

Check the oil level daily; and if the converter is equipped with an input disconnect clutch, additional checks and service will be necessary daily or at intervals determined by the type of operation.

Adjust the disconnect clutches as outlined under power take-off clutch adjustment.

Contact a Detroit Diesel Sales and Service Outlet for information on Torqmatic Converters.

OPERATING INSTRUCTIONS

ENGINE OPERATING INSTRUCTIONS

PREPARATION FOR STARTING ENGINE FIRST TIME

The operator should read and follow these instructions before attempting to start the engine.

> **NOTE:** When preparing to start a new or overhauled engine or an engine which has been in storage, perform all of the operations listed below. Before a routine start (at each shift), see "Daily Operations" in the Lubrication and Preventive Maintenance Chart.

Air Cleaner

If the engine is equipped with oil bath air cleaner(s) fill the air cleaner oil cup to the proper level with engine lubricating oil. DO NOT OVERFILL.

Cooling System

Install all the drain cocks in the cooling system. Drain cocks are removed for shipping.

Open cooling system vent, if unit is so equipped. Remove the filler cap and fill the cooling system with clean, soft water or a protective solution consisting of high boiling point anitfreeze if the engine will be exposed to freezing temperatures. Keep the liquid level about 2 inches below the filler neck to allow for fluid expansion.

Use a quality rust inhibitor if water only is used in the cooling system.

On a marine engine, prime the raw water pump by removing the priming cap on the outlet elbow and filling the pump with water to the level of the outlet elbow flange. Open the sea cocks in the raw water system.

Lubrication System

The lubricating oil on the upper parts of new or overhauled engines, and engines which have been in storage, may not be enough when the engine is started. It is recommended that the upper engine parts be prelubricated by removing the valve rocker cover and pouring approximately two quarts of the same oil used in the crankcase over the rocker arms and push rods.

Fill the engine crankcase to the proper level with the Heavy Duty Lubricating Oil specified under "LUBRICATING OIL SPECIFICATIONS".

Check the oil level in the crankcase with the dipstick on the side of the engine. Remove the dipstick, wipe the lower end with a clean cloth, insert and remove it again to check the oil level. Keep the oil at the proper level.

Transmission

Fill the hydraulic marine gear, Torqmatic Converter or reduction gear to the proper level with the lubricant specified under "LUBRICATION AND PREVENTIVE MAINTENANCE".

Fuel System

Fill the fuel tank with the fuel specified under "DIESEL FUEL OIL SPECIFICATIONS".

If the unit is equipped with a fuel valve, it must be opened.

To ensure prompt starting, the fuel system between the pump and the fuel return manifold should be filled with fuel. If the engine has been out of service for a considerable length of time, the filter between the fuel pump and the injectors should be primed. The filter may be primed by removing the plug in the top of the filter cover and slowly filling the filter with fuel.

> **NOTE:** The fuel system of a new engine is filled with fuel before leaving the factory. If the fuel is still in the system when preparing to start the engine, priming should be unnecessary.

Lubrication Fittings

Fill all the grease cups and lubricate all fittings with an all purpose grease such as Shell Alvania No. 2 or its equivlant. Apply lubricating oil to throttle linkage and other moving parts and fill the hinged cap oilers with a hand oiler.

Drive Belts

Adjust all of the drive belts as recommended under "LUBRICATION AND PREVENTIVE MAINTENANCE".

Storage Battery

Check the battery; the top should be clean and dry, the terminals tight and protected with a coat of petroleum jelly and the electrolyte must be at the proper level.

> **NOTE:** When necessary, check the battery with a hydrometer; the reading should be 1.265 or higher. However, hydrometer readings should always be corrected for the temperature of the electrolyte.

Clutch

Disengage the clutch or clutches if the unit is so equipped.

Generator Set

A generator set should be connected and grounded in accordance with the applicable local electrical codes.

The instructions for connecting the load terminals are contained in the generator connection diagram or control cabinet wiring diagram.

> **CAUTION:** The base of a generator set must be grounded.

STARTING

Shut-down System

If a manual or an automatic shut-down system is incorporated in the unit, the control must be set in the open position before starting the engine.

Starting Aid

The engine will require the use of a cold weather starting aid if the ambient temperature is below 40°F. Refer to "Cold Weather Starting Aids".

Initial Engine Start (Electric)

Start an engine equipped with an electric starting motor as follows: Set the throttle in the IDLE position. Press the starting motor switch firmly. If the engine fails to start within 30 seconds, release the starting switch and allow the starting motor to cool a few minutes before trying again. If the engine fails to start after four attempts, an inspection should be made to determine the cause.

> **CAUTION:** To prevent serious damage to the starter, if the engine does not start, do not press the starter switch again while the starter motor is running.

On twin or quad units, move the master throttle lever to "IDLE" and engage the starting motors, one at a time.

Initial Engine Start (Hydrostarter)

An engine equipped with a Hydrostarter may be started as follows:

Raise the Hydrostarter accumulator pressure with the hand pump until the gage reads as indicated in the chart.

Ambient Temperature	Pressure Gage Reading
Above 40°F.	1500 psi
40°F. to 0°F.	2500 psi
Below 0°F.	3300 psi

Use the priming pump to make sure the filter, lines, manifolds and injectors are full of fuel.

Set the engine controls for starting; throttle at least half open.

Push the Hydrostarter control lever to simultaneously engage the starter pinion with the flywheel ring gear and to open the control valve. Close the valve as soon as the engine starts to conserve the accumulator pressure and to avoid excessive over-running of the starter drive clutch assembly.

RUNNING

Oil Pressure

Observe the oil pressure gage immediately after starting the engine. If there is no oil pressure indicated within 10 to 15 seconds, stop the engine and check the lubricating system.

The normal and minimum oil pressures are shown in the following chart.

OIL PRESSURE (psi)								
	Engine Speed (rpm)							
	1200		1800		2100		2300	
ENGINE	Norm.	Min.	Norm.	Min.	Norm.	Min.	Norm.	Min.
3,4&6-71	30-60	18	38-60	27	40-60	30	40-60	30
71E & 71N	30-60	18	38-60	27	40-60	30	-	-
71M	-	-	38-60	27	40-60	30	40-60	30

Warm-Up

Run the engine at part throttle and no-load for approximately five minutes, allowing it to warm up before applying a load.

If the unit is in operation in a closed room, start the ventilating fan or open the doors and windows to supply ample air to the engine.

Inspection

While the engine is running at operating temperature, check for water, fuel or lubricating oil leaks. Tighten the line connections where necessary to stop the leaks.

Temperature

Normal engine coolant temperature is 160° to 185°F.

Clutch

Do not engage the clutch (with a sintered iron clutch plate) at engine speeds over 850 rpm. A clutch with an asbestos or vegetable fiber clutch plate must not be engaged at speeds over 1000 rpm.

Crankcase

If the engine crankcase was refilled, stop the engine after normal operating temperature has been reached; allow the oil to drain back into the crankcase and check the oil quantity. Add oil, if necessary to bring it to the proper level on the dipstick.

Use only the Heavy-Duty Lubricating Oils as specified under "LUBRICATING OIL SPECIFICATIONS".

Cooling System

Remove the radiator or heat exchanger tank cap SLOWLY after the engine has reached normal operating temperature and check the engine coolant level. The coolant level should be near the top of the opening. If necessary, add clean soft water or a high boiling point type antifreeze.

Marine Gear

Check the marine gear oil pressure. The minimum operating oil pressure of the Torqmatic and Paragon Marine Gear is 90 psi and the maximum is 150 psi.

Avoid Unnecessary Engine Idling

During long engine idling periods, the engine coolant temperature will fall below the normal operating range. The incomplete combustion of fuel in a cold engine will cause crankcase dilution, formation of lacquer or gummy deposits on the valves, pistons and rings and rapid accumulation of sludge in the engine.

> **NOTE:** When prolonged engine idling is necessary maintain at least 800 rpm.

STOPPING

Throttle

Release the load and decrease the engine speed. Allow the engine to run at half speed or lower with no-load for four or five minutes before closing the throttle and stopping the engine.

Fuel System

If the unit is equipped with a fuel valve, close it. Fill the fuel tank; a full tank reduces condensation.

Exhaust System

If a drain or valve is used in the exhaust line or silencer, open it to drain condensation.

Cooling System

Drain the cooling system if it is not protected with antifreeze and freezing temperatures are expected. Leave the drains open. Open the raw water drains of a heat exchanger cooling system.

Crankcase

Check the oil level in the crankcase with the dipstick. Add oil, if necessary, to bring it to the proper level.

Marine Gear

Check and, if necessary, replenish the oil supply in the marine gear.

Clean Engine

Clean and check engine thoroughly to make certain it will be ready for the next run.

Refer to "LUBRICATION AND PREVENTIVE MAINTENANCE" and perform all the daily maintenance operations. Also, perform the operations required for the number of hours or miles the unit has been in operation.

Make the necessary adjustments and minor repairs to correct difficulties which became apparent to the operator during the last run.

ALTERNATING CURRENT POWER GENERATOR UNIT OPERATING INSTRUCTIONS

These instructions cover the fundamental procedures for operating an alternating current power generator unit. The operator should read these instructions before attempting to operate the unit.

PREPARATION FOR STARTING

Before attempting to start a new or an overhauled engine or an engine which has been in storage, perform all of the operations listed under "Preparation for Starting Engine First Time". Before a routine start see "Daily Operations" in the "Lubrication and Preventive Maintenance Chart".

In addition to the "Engine Operating Instructions" the following instructions also apply when operating an alternating current power generator unit.

1. Before the first start, fill the generator main bearing oil reservoir to the proper level on the sight gage with the same grade of lubricating oil that is used in the engine crankcase. DO NOT OVERFILL.

2. Check the interior of the generator for dust or moisture. Blow out dust with low pressure air (25 psi maximum). If there is moisture on the interior of the generator, it must be dried before start-up.

3. The overspeed trip solenoid lever located at the air inlet housing must be in the open or reset position.

4. Refer to Fig. 1 and place the circuit breaker (162) in the OFF position.

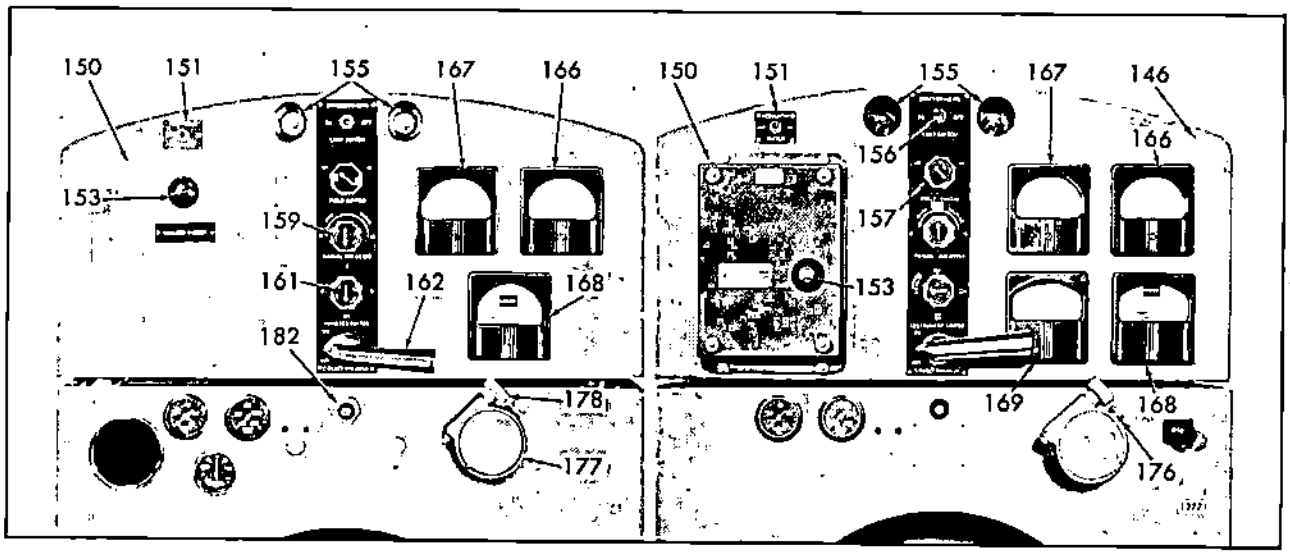


Fig. 1 - Typical Alternating Current Generator Control Cabinets

146. Cabinet--Control
150. Regulator--Voltage
151. Switch--Voltage Regulator
153. Control--Voltage Regulator Rheostat
155. Lamps--Synchronizing
156. Switch--Synchronizing Lamp
157. Switch--Field
159. Control--Manual Field Rheostat
161. Switch--Selector
162. Control--Circuit Breaker
166. Meter--Amperes
167. Meter--Volts
168. Frequency Meter
169. Meter--Kilowatt
176. Button--Throttle
177. Control--Throttle
178. Knob--Vernier Throttle
182. Button--Engine Starter

5. Place the field switch (157) in the OFF position.

6. Place the synchronizing lamp switch (156) in the OFF position.

7. Place the voltage regulator switch (151) in the OFF or MANUAL position.

8. Turn the field rheostat knob (159) clockwise to its lower limits.

9. Make sure the power generator unit has been cleared of all tools or other objects which might interfere with its operation.

STARTING

The engine will require the use of a cold weather starting aid if the ambient temperature is below 40°F. Refer to "Cold Weather Starting Aids".

Press the throttle button (176) and turn the throttle control (177), Fig. 1, counterclockwise to a position midway between RUN and STOP. Then, press the starter button (182) firmly.

If the engine fails to start within 30 seconds release the starter button and allow the starting motor to cool a few minutes before trying again. If the engine fails to start after four attempts an inspection should be made to determine the cause.

> **CAUTION:** To prevent serious damage to the starter if the engine does not start, do not press the starter switch again while the starter motor is rotating.

RUNNING

Oil Pressure

Observe the engine oil pressure gage immediately after starting the engine. If there is no oil pressure indicated within 10 to 15 seconds, stop the engine and check the engine lubricating system.

Warm-Up

Run the engine at part throttle and no-load for approximately five minutes, allowing it to warm up before applying a load.

The warm-up period may be omitted and a load applied to the unit, if circumstances require it, as soon as the engine oil pressure stabilizes.

If the unit is in operation in a closed room, start the ventilating fan or open the doors and windows to supply ample air to the engine.

Inspection

While the engine is running at operating temperature, check for water, fuel or lubricating oil leaks. Tighten the line connections where necessary to stop the leaks.

Temperature

Normal engine coolant temperature is 160° to 185°F.

Crankcase Oil Level

If the engine crankcase was refilled and the power supply from the unit is not immediately needed, stop the engine after it has reached normal operating temperature, allow the oil to drain back into the crankcase and check the oil quantity. Add oil if necessary to bring it to the proper level on the dipstick.

Use only the Heavy-Duty Lubricating Oils as specified under "Lubricating Oil Specifications".

Cooling System

Remove the radiator or heat exchanger tank cap SLOWLY after the engine has reached normal operating temperature and check the engine coolant level. The coolant level should be near the top of the opening. If necessary, add clean soft water or a high boiling point type antifreeze.

PREPARING UNIT FOR LOAD

1. Bring the engine up to rated speed. Then, place the field switch (157), Fig. 1, in the ON position.

2. Turn the voltage regualtor switch (151) ON.

3. Turn the instrument selector switch (161) to the desired position.

4. Turn the field rheostat (159) slowly in a counterclockwise direction to raise the voltage, while watching the voltmeter, until the desired voltage is reached. The voltage regulator will take control of the generator voltage as the field rheostat reaches the end of its travel.

5. If the power generator unit is equipped with a frequency meter, adjust the engine speed with the vernier throttle knob (178) until the desired frequency is indicated on the meter.

6. Adjust the voltage regulator rheostat (153) to obtain the desired voltage.

7. Make sure all power lines are clear of personnel, then place the circuit breaker control (162) in the ON position.

> **NOTE:** Perform Step 7 only if the unit is not being paralleled with an existing power source. If the unit is being paralleled with a power source already on the line, read and follow the instructions under PARALLELING before turning the circuit breaker control to the ON position.

PARALLELING

If the load conditions require an additional unit to be placed on the line, the following instructions will apply to power generator units of EQUAL CAPACITY, with one unit in operation on the line.

1. Prepare the unit to be paralleled as outlined under PREPARATION FOR STARTING, STARTING, RUNNING and Items 1 through 6 under PREPARING UNIT FOR LOAD.

2. Check the voltmeter (167), Fig. 1; the voltage must be the same as the line voltage. Adjust the voltage regulator rheostat control (153) if the voltages are not the same.

3. Place the synchronizing lamp switch (156), of the power unit to be paralleled, in the ON position.

4. Turn the vernier throttle knob (178) until both units are operating at approximately the same frequency indicated by the slow change in the brilliancy of the synchronizing lamps.

5. When the synchronizing lamps glow and then go out at a very slow rate, time the dark interval. Then, in the middle of this interval turn the circuit breaker control to the ON position. This places the incoming power unit on the line, with no load. The proper share of the existing load must now be placed on this unit.

6. The division of the kilowatt load between the alternating current generators operating in parallel depends on the power supplied by the engines to the generators as controlled by the engine governors and is practically independent of the generator excitation. Divide the kilowatt load between the units by turning the vernier throttle knob (178) counterclockwise on the incoming unit and clockwise on the unit that has been carrying the load, (to keep the frequency of the units constant) until both kilowatt meters (169) indicate that each unit is carrying its proper percentage of the total K.W. load. Refer to Item 8 if the units are not equipped with kilowatt meters.

7. The division of the reactive KVA load depends on the generator excitation as controlled by the voltage regulator. Divide the reactive load between the units by turning the voltage regulator rheostat control on the incoming unit (generally counterclockwise to raise the voltage) until the ammeters read the same on both units and the sum of the readings is minimum.

> **NOTE:** The units are equipped with a resistor and current transformer connected in series with the voltage coil of the regulator (cross-current compensation) which equalizes most but not all of the reactive KVA load between the generators.

8. When the load is unity power factor (lighting and a few small motors only) follow the instructions in Item 6 above until both ammeters read the same.

9. When the load is 80 per cent power factor lagging (motor and a few lights only), turn the vernier throttle knob (178) on the incoming unit until the ammeter on that unit reads approximately 40 per cent of the total current load.

10. Rotate the voltage regulator rheostat control (153) on the incoming unit (generally counterclockwise to raise the voltage) until the ammeters read the same on both units.

> **NOTE:** If a load was not added during paralleling, the total of the two ammeter readings should be the same as the reading before paralleling. Readjust the voltage regulator rheostat (153) on the incoming unit, if necessary.

11. To reset the load voltage, turn the voltage regulator rheostat controls slowly on each unit. It is necessary to turn the controls the same amount and in the same direction to keep the reactive current equally divided.

Power Generator Units with different capacities can also be paralleled by dividing the load proportionately to their capacity.

STOPPING

The procedure for stopping a power generator unit or taking a unit out of parallel is as follows:

1. Turn off all the load on the generator when stopping a single engine unit.

   Shift the load from the generator when taking a unit out of parallel operation by turning the vernier throttle knob (178), Fig. 1, until the ammeter (166) reads approximately zero.

2. Place the circuit breaker control (162) in the OFF position.

3. Turn the field rheostat (159) to the fully clockwise position.

4. Turn the voltage regulator switch (151) to the OFF position.

5. Place the field switch (157) in the OFF position.

6. Press the throttle button (176) and turn the throttle control (177) to STOP to shut-down the engine.

   NOTE: When performing a tune-up on a unit that will be operated in parallel with another unit, adjust the speed droop as specified in "ENGINE TUNE-UP".

DIRECT CURRENT POWER GENERATOR UNIT OPERATING INSTRUCTIONS

These instructions cover the fundamental procedures for operating a direct current power generator unit. The operator should read these instructions before attempting to operate the unit.

PREPARATION FOR STARTING

Before attempting to start a new or an overhauled engine or an engine which has been in storage perform all of the operations listed under "Preparation for Starting Engine First Time". Before a routine start see "Daily Operations" in the "Lubrication and Preventive Maintenance Chart".

In addition to the "Engine Operating Instructions" the following instructions also apply when operating a direct current power generator unit.

1. Before the first start, fill the generator main bearing oil reservoir to the proper level on the sight gage with the same grade of lubricating oil that is used in the engine crankcase. DO NOT OVERFILL.

2. Check the interior of the generator for dust or moisture. Blow out dust with low pressure air (25 psi maximum). If there is moisture on the interior of the generator, it must be dried before start-up.

3. The overspeed trip solenoid lever located at the air inlet housing must be in the open or reset position.

4. Refer to Fig. 2 and place the circuit breaker (162) in the OFF position.

5. Place field switch (157) in the OFF position.

6. Place the ground lamp switch (156) in the OFF position.

7. Turn the manual field rheostat control (153) counterclockwise to its lowest limit.

8. Make sure the power generator unit has been cleared of all tools or other objects which might interfere with its operation.

STARTING

The engine will require the use of a cold weather starting aid if the ambient temperature is below 40°F. Refer to "Cold Weather Starting Aids".

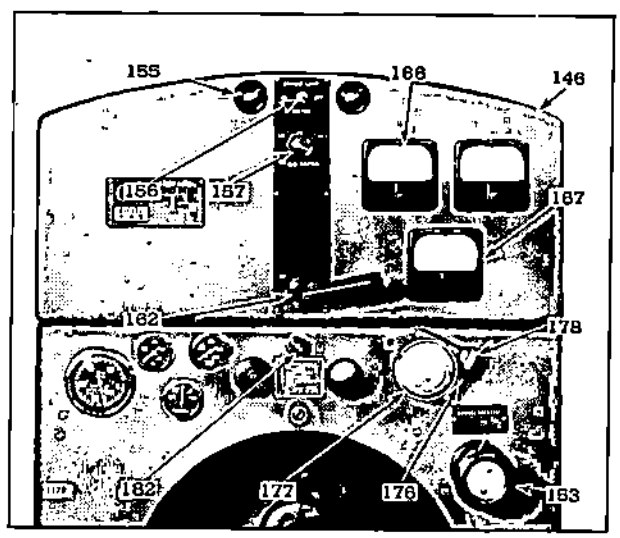


Fig. 2 - Typical Control Cabinet

146. Cabinet--Control
153. Control--Manual Field Rheostat
155. Lamp--Ground
156. Switch--Ground Lamp
157. Switch--Field
162. Control--Circuit Breaker
166. Meter--Amperes
167. Meter--Volts
176. Button--Throttle
177. Control--Throttle
178. Knob--Vernier Throttle
182. Switch--Engine Starter

Press the throttle button (176) and turn the throttle control (177), Fig. 2, counterclockwise to a position midway between RUN and STOP. Then, press the starter button (182) firmly.

If the engine fails to start within 30 seconds, release the starter button and allow the starting motor to cool a few minutes before trying again. If the engine fails to start after four attempts, an inspection should be made to determine the cause.

> **CAUTION:** To prevent serious damage to the starter, if the engine does not start, do not press the starter button again while the starter motor is rotating.

RUNNING

Oil Pressure

Observe the engine oil pressure gage immediately after starting the engine. If there is no oil pressure indicated within 10 to 15 seconds, stop the engine and check the engine lubricating system.

Warm-Up

Run the engine at part throttle and no-load for approximately five minutes, allowing it to warm up before applying a load.

The warm-up period may be omitted and a load applied to the unit, if circumstances require it, as soon as the engine oil pressure stabilizes.

If the unit is in operation in a closed room, start the ventilating fan or open the doors and windows, as weather permits, to supply ample air to the engine.

Inspection

While the engine is running at operating temperature, check for water, fuel or lubricating oil leaks. Tighten the line connections where necessary to stop the leaks.

Temperature

Normal engine coolant temperature is 160°to 185°F.

Engine Crankcase

If the engine crankcase was refilled, and the power supply from the unit is not immediately needed stop the engine after it has reached normal operating temperature, allow the oil to drain back into the crankcase and check the oil quantity. Add oil if necessary to bring it to the proper level on the dipstick.

Use only the Heavy-Duty Lubricating Oils as specified under "Lubricating Oil Specifications".

Cooling System

Remove the radiator or heat exchanger tank cap SLOWLY after the engine has reached normal operating temperature and check the engine coolant level. The coolant level should be near the top of the opening. If necessary, add clean soft water or a high boiling point type antifreeze.

PREPARING UNIT FOR LOAD

After the engine is warmed up, prepare the unit for load as follows:

1. Rotate the throttle control (177), Fig. 2, counterclockwise to the RUN position.
2. Turn the vernier throttle knob (178) and adjust the engine speed approximately 50 rpm above the rated full load speed.

   > **NOTE:** The speed droop is set at the factory and adjustment should be unnecessary. However, if required, reset the speed droop as outlined under "ENGINE TUNE-UP".

3. If the unit is equipped with a field switch (157) turn it to ON.
4. Observe the voltmeter (167) and turn the manual field rheostat control (153) to the desired voltage.
5. Make sure all power lines are clear of personnel, then place the circuit breaker control (162) in the ON position.

   > **NOTE:** Perform Step 5 only if the unit is not being paralleled with an existing power source. If the unit is being paralleled with a power source already on the line, read and follow the instructions under PARALLELING before turning the circuit breaker control to the ON position.

Check the electrical circuit occasionally with the ground lamps. While the unit is in operation, turn the ground lamp switch ON. If both lamps are dim and of equal brilliance, the circuit is satisfactory. If one lamp remains dark and the other is bright, a ground exists in one of the power leads.

PARALLELING

If the load conditions require an additional unit to be placed on the line, the following instructions will apply to power generator units equipped with equalizer connections only. Do not attempt to parallel units without equalizer connections.

On "flat compound wound" two-wire direct current generators, it is necessary to connect the equalizer leads together for stable operation. The equalizer cables should have a current carrying capacity equal to or larger than the cables necessary to carry the required load. On generators equipped with a three-wire system, a two-pole knife switch must be placed in the equalizer lines.

Do not use parallel operation if one unit is capable of carrying the required load, as both engine and generator operate more efficiently when operating alone at full load.

1. Prepare the unit to be paralleled as outlined under PREPARATION FOR STARTING, STARTING, RUNNING and Items 1 through 4 under PREPARING UNIT FOR LOAD.

2. Adjust the speed to NO-LOAD operating speed with the vernier throttle knob (178), Fig. 2.

3. Adjust the manual field rheostat control (153) of the incoming unit until the voltage is the same as the existing line voltage.

4. Close the switch in the equalizer lines and then place the circuit breaker control (162) in the ON position.

5. Adjust the manual field rheostat control to divide the line load equally.

STOPPING

The procedures for stopping a power generator unit or taking a unit out of parallel, is as follows:

1. Turn off all the load on the generator when stopping single engine unit. Shift the load from the generator when taking a unit out of parallel operation by turning the manual field rheostat control (153), Fig. 2, until the ammeter (166) reads approximately zero.

2. Place the circuit breaker control (162) in the OFF position.

3. Open the switch in the equalizer lines.

4. Turn the manual field rheostat control counterclockwise to the lowest position.

5. Press the throttle button (176) and turn the throttle control (177) to STOP to shut-down the engine.

   NOTE: When performing a tune-up on a unit that will be operated in parallel with another unit adjust the speed droop as specified in "ENGINE TUNE-UP".

LUBRICATION AND PREVENTIVE MAINTENANCE

To obtain the long life and best performance from a Detroit Diesel engine, the Operator must adhere to the following schedule and instructions on lubrication and preventive maintenance.

The daily instructions pertain to routine or daily starting of a unit and not to a new unit or one that has not been operated for a considerable period of time. For new or stored units, carry out instructions given under PREPARATION FOR STARTING ENGINE FIRST TIME under OPERATING INSTRUCTIONS.

The time intervals given in the chart on the following page are actual operating hours or miles of a unit. If oil is drained immediately after a unit has been run for some time, more of the sediment will be in suspension and therefore will drain readily.

All Detroit Diesel Sales and Service Outlets are prepared to service units with the viscosity and grade of lubricants recommended on the following pages.

LUBRICATION AND PREVENTIVE MAINTENANCE CHART

Item	Operation	Time Interval								
	Hours		8	50	100	200	300	500	1,000	2,000
	Miles	Daily	240	1,500	3,000	6,000	9,000	15,000	30,000	60,000
1.	Engine Oil	X								
2.	Oil Filter*									
3.	Coolant and Filter	X						X	X	
4.	Hoses							X		
5.	Radiator								X	
6.	Heat Exchanger Electrodes and Core							X	X	
7.	Raw Water Pump	X								
8.	Fuel Tank	X						X		
9.	Fuel Strainer and Filter	X					X			
10.	Air Cleaner(s)		X							
11.	Air Box Drains								X	
12.	Crankcase Ventilation								X	
13.	Blower Screen								X	
14.	Starting Motor*									
15.	Battery-Charging Generators				X	X.		X		X
16.	Battery				X					
17.	Tachometer Drive				X					
18.	Throttle and Clutch Controls					X				
19.	Tune-Up								X	
20.	Belts and Fan Bearings							X	X	X
21.	Power Generator				X		X			
22.	Power Take-Off		X	X				X		
23.	Reduction Gear (Single Engine Unit)		X	X				X	X	
24.	Torqmatic Marine Gear	X				X				
25.	Paragon Marine Gear	X				X				
26.	Torqmatic Converter**	X						X	X	
27.	Reduction Gear (Multiple Engine Industrial Units)	X							X	
28.	Reduction Gear (Multiple Engine Marine Units)	X				X				
29.	Overspeed Governor							X		
30.	Transmission (Railcar)	X							X	
31.	Oil Filter (Railcar)*									
32.	Hydrostarter									X

* See Item on Following Pages

** Single and Multiple Engine Units

Item 1

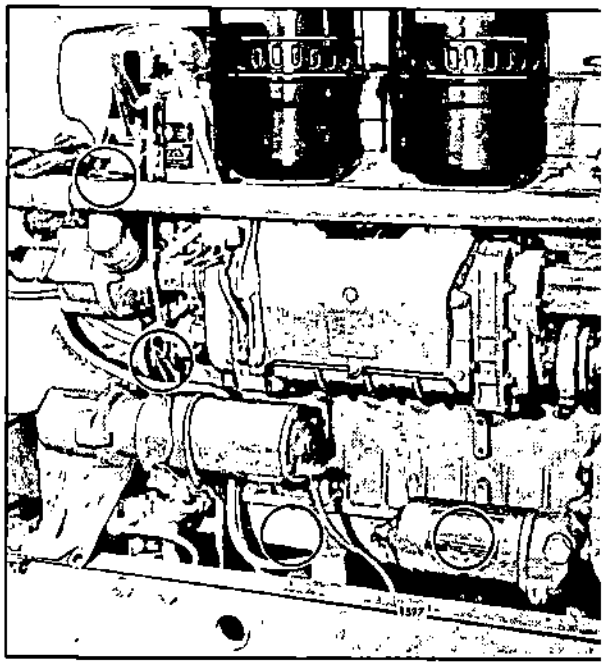
Check the oil level daily before starting the engine. Add oil, if necessary, to bring it to the proper level on the dipstick.

Select the proper grade of oil in accordance with the instructions in the "Lubricating Oil Specifications".

It is recommended that new engines be started with 100 hour oil change periods. For highway vehicles this corresponds to approximately 3,000 miles, and for city-service vehicles approximately 1,000-2,000 miles. The drain interval may then be gradually increased, or decreased following the recommendations of an independent oil analysis laboratory, or oil supplier (based upon the sample analysis) until the most practical oil change period for the particular service has been established.

Item 2

Install new oil filter elements and gaskets each time the engine oil is changed. Check for oil leaks after starting the engine.



Items 1 and 2

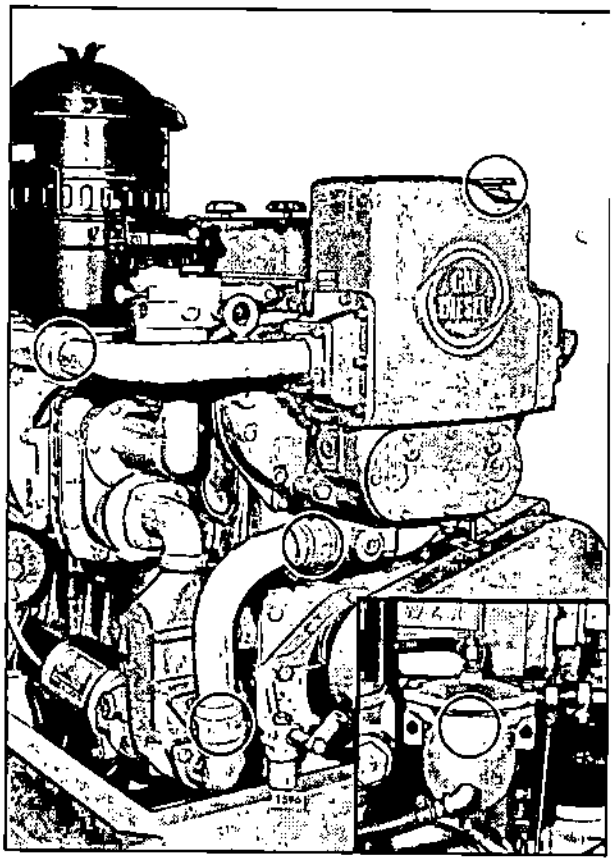
Item 3

Check the coolant level daily and maintain the level near the top of the heat exchanger tank or radiator upper tank.

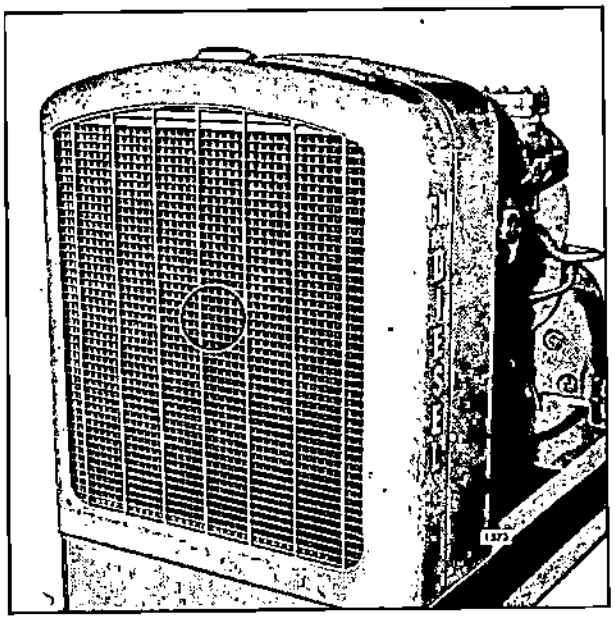
Clean the cooling system every 1,000 hours or 30,000 miles using a good cleaning compound in accordance with the instructions on the container. Following the cleaning operation, rinse the cooling system thoroughly with fresh water; then, fill the system with soft water, adding a good grade of rust inhibitor or a high boiling point type antifreeze. With the use of a proper antifreeze or rust inhibitor, this interval may be lengthened until, normally, this cleaning is done only in the Spring or Fall. The length of this interval will, however, depend upon an inspection for rust or other deposits on the internal walls of the cooling system.

When a thorough cleaning of the cooling system is required, it should be reverse flushed.

If the engine is protected by a Perry water filter and conditioner, a winter filter element identified with the letters PAF (permanent antifreeze) must be used if a permanent antifreeze solution is to be used in the cooling system. The winter filter element contains no corrosion inhibitor and must



Items 3 and 4



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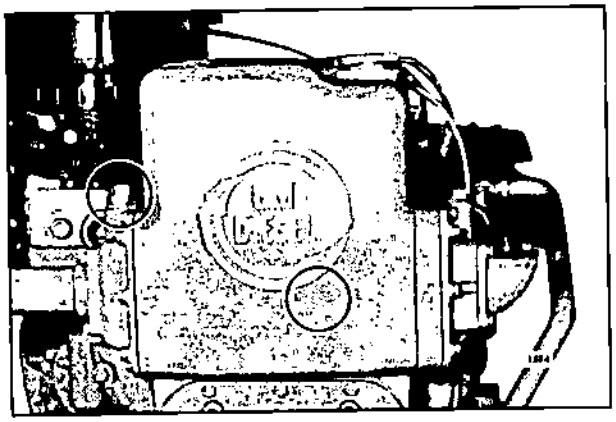
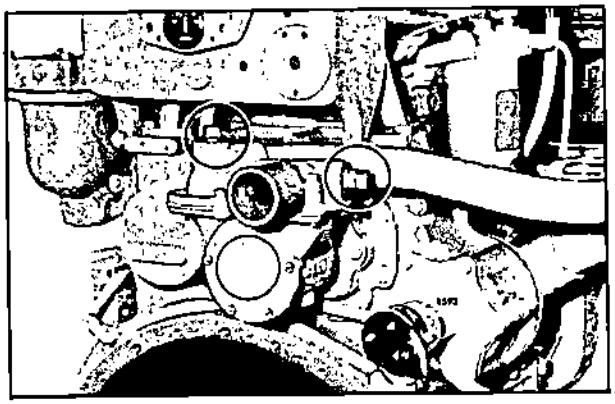


Item 6



Item 7

not be used in the summer. The water filter elements (summer and winter) should be changed every 500 hours or 15,000 miles.

Buff the lower corrosion resistor plate until it is bright each time the element is changed. This plate will periodically pit to the extent that it must be replaced.

Item 4

Inspect all of the cooling system hoses at least once every 500 hours or 15,000 miles for signs of deterioration. Replace the hoses if necessary.

Item 5

Inspect the exterior of the radiator core every 1,000 hours or 30,000 miles and, if necessary, clean it with a quality grease solvent such as Oleum and compressed air. It may be necessary to clean the radiator more frequently if the engine is being operated in dusty or dirty areas.

Item 6

Every 500 hours, drain the water from the heat exchanger raw water inlet and outlet tubes. Then, remove the zinc electrode from the inlet side of the raw water pump and the heat exchanger. Clean the electrodes with a wire brush or, if worn excessively, replace with new electrodes. To determine the condition of a used electrode, strike it sharply against a hard surface; a weakened electrode will break.

Drain the cooling system, disconnect the raw water pipes at the outlet side of the heat exchanger and remove the retaining cover every 1,000 hours and inspect the heat exchanger core. If a considerable amount of scale or deposits are present, contact a Detroit Diesel Sales and Service Outlet for removal and cleaning.

Item 7

Check the prime on the raw water pump; the engine should not be operated with a dry pump. Prime the raw water pump, if necessary, by removing the pipe plug provided in the pump inlet elbow and adding water.

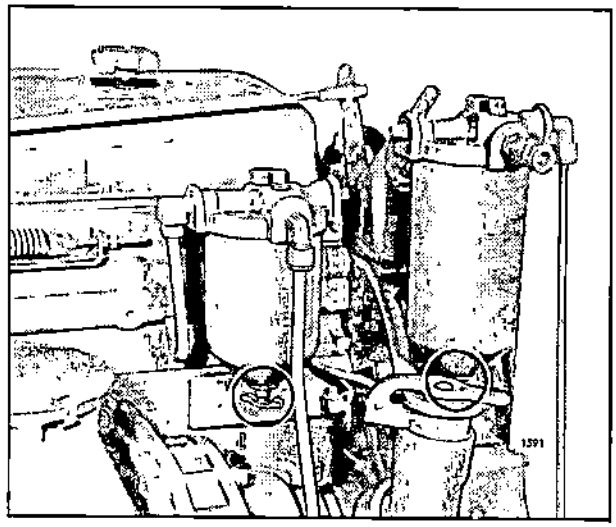
Item 8

Keep the fuel tank filled to reduce condensation to a minimum. Select the proper grade of fuel in accordance with the "Fuel Oil Specifications". Open the drain at the bottom of the fuel tank every 500 hours or 15,000 miles to drain off any water or sediment.

Item 9

Drain approximately one-fourth pint of fuel to remove sediment and water from the strainer and the filter daily by opening the drain cock in the bottom of each shell. Install new elements every 300 hours or 9,000 miles or when plugging is indicated.

A method of determining when elements are plugged to the extent that they should be changed is based on the fuel pressure at the cylinder head fuel manifold and the inlet restriction at the fuel pump. In a clean system, the maximum pump inlet restriction must not exceed 6 inches of mercury. At normal operating speeds (1600-2100 rpm), the fuel pressure is 45-70 psi. Change the fuel filter elements whenever the inlet restriction (suction) at the fuel pump reaches 12 inches of mercury at normal operating speeds (1600-2100 rpm) and whenever the fuel pressure at the manifold falls to 45 psi.

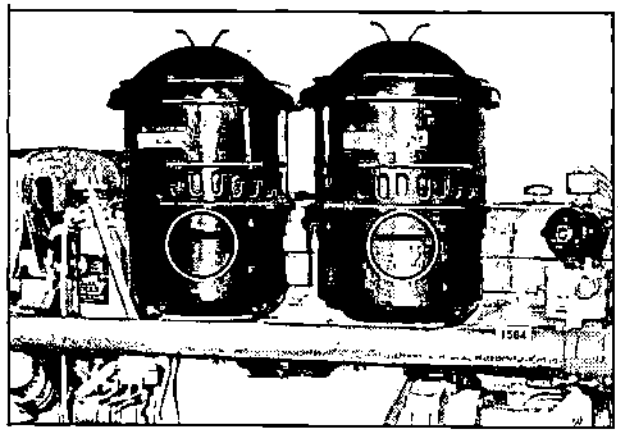


Item 9

Item 10

Remove the dirty oil and sludge from the air cleaner cups and center tubes every 8 hours (every 9,000 miles for highway vehicle engines), or less if operating conditions warrant. Wash the cups and elements in clean fuel oil and refill the cups to the level mark with the same grade of HEAVY-DUTY oil as used in the engine. The frequency of servicing may be varied to suit local dust conditons.

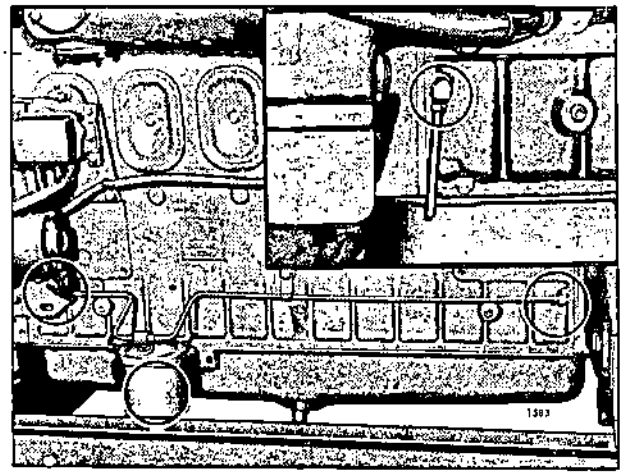
Replace the element in the dry-type air cleaner when the air intake restriction at the blower inlet reaches 28" of water or when indicated by the air cleaner restriction indicator.



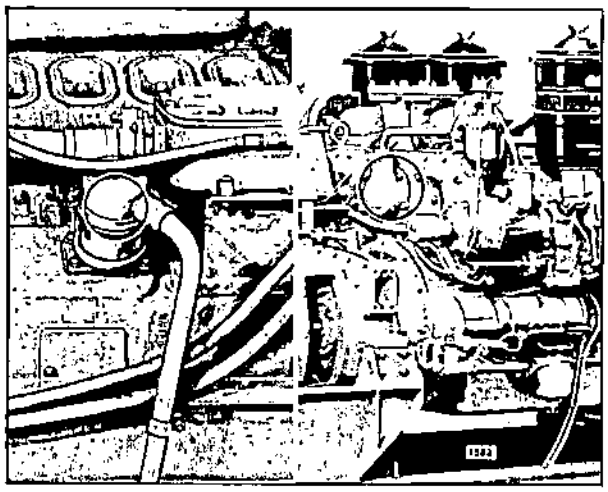
Item 10

Item 11

With the engine running, check for flow of air from the air box drain tubes every 1,000 hours or 30,000 miles. If the tubes are clogged, remove, clean, and reinstall the tubes. The air box drain tubes should be cleaned periodically even though a clogged condition is not apparent. If the engine is equipped with an air box drain tank, drain the sediment periodically.



Item 11



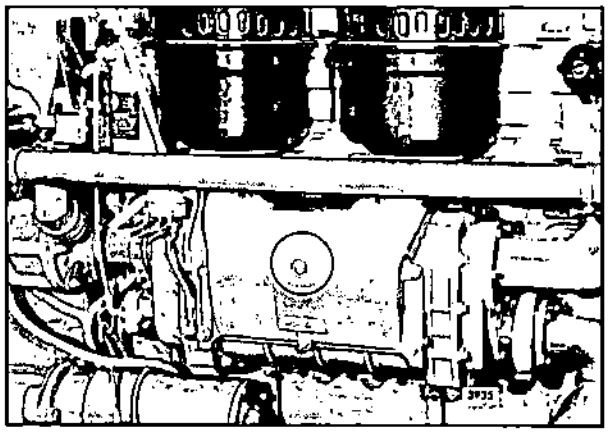
Item 12

Item 12

Clean the crankcase breather, if it is mounted on the flywheel housing or upper oil pan, every 1,000 hours or 30,000 miles. Remove crankcase breather from the engine and wash the steel mesh pad in fuel oil and dry it with compressed air. This cleaning period may be reduced or lengthened according to severity of service.

Item 13

Inspect the blower screen every 1,000 hours or 30,000 miles and, if necessary, clean the screen in fuel oil and dry it with compressed air.

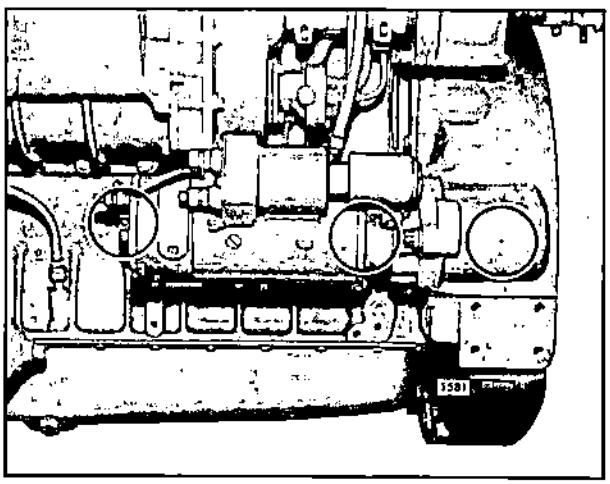


Item 13

Item 14

Some starting motors do not require lubrication except during overhaul. However, motors which are provided with lubrication fittings (grease cups, hinge cap oilers, or oil tubes sealed with pipe plugs) should be lubricated every 300 hours or 9,000 miles.

Add 8 or 10 drops of oil, of the same grade used in the engine, to hinge cap oilers; if sealed tubes are provided, remove the pipe plugs, add oil and re-seal the tubes. Grease cups should be turned down one turn. Refill the grease cups, if necessary.



Item 14

Item 15

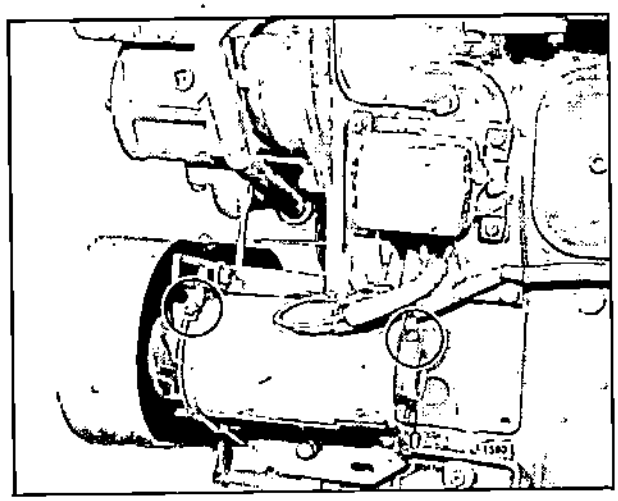
Lubricate the generator bearings or bushings with 5 or 6 drops of engine oil at the hinge cap oiler every 200 hours or 6,000 miles. Generators equipped with grease cups should have the caps turned down one full turn every 100 hours or 3,000 miles of operation. The grease cups should be kept filled with Delco-Remy Cam and Ball Bearing Lubricant or its equivalent. Care should be taken to avoid excessive lubrication since this may cause lubricant to be forced onto the commutator where it would gum and cause poor commutation. Such a condition results in reduced generator output and increased commutator and brush wear.

Some generators have a built-in supply of grease, while others use sealed bearings. In these latter two cases, additional lubrication is not necessary.

On D.C. generators, inspect the commutator and brushes every 500 hours or 15,000 miles. Examine the commutator and brushes every 2,000 hours

or 60,000 miles and clean the commutator, if necessary, with No. 00 sandpaper or a brush seating stone. After cleaning, reseat the brushes and blow out the dust.

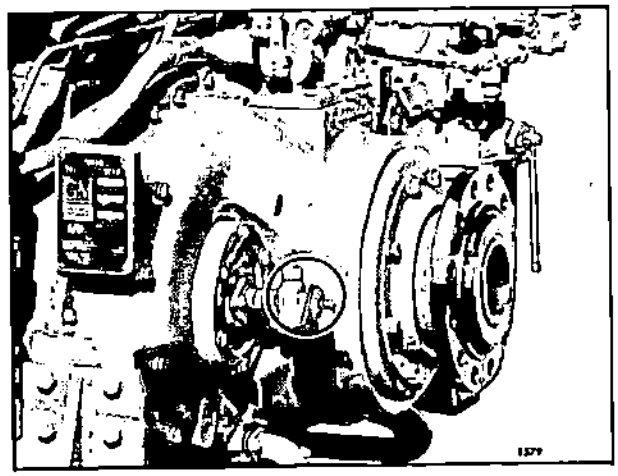
On A.C. generators, the slip rings and brushes can be inspected through the end frame assembly. If the slip rings are dirty, they should be cleaned with 400 grain or finer polishing cloth. Never use emery cloth to clean slip rings. Hold the polishing cloth against the slip rings with the generator in operation, and blow away all dust after the cleaning operation. If the slip rings are rough or out of round, replace them.



Item 15

Item 16

Check the specific gravity of the electrolyte in each cell of the battery every 100 hours or 3,000 miles. In warm weather, however, it should be checked more frequently due to a more rapid loss of water from the electrolyte. The electrolyte level should be maintained in accordance with the battery manufacturer's recommendations.



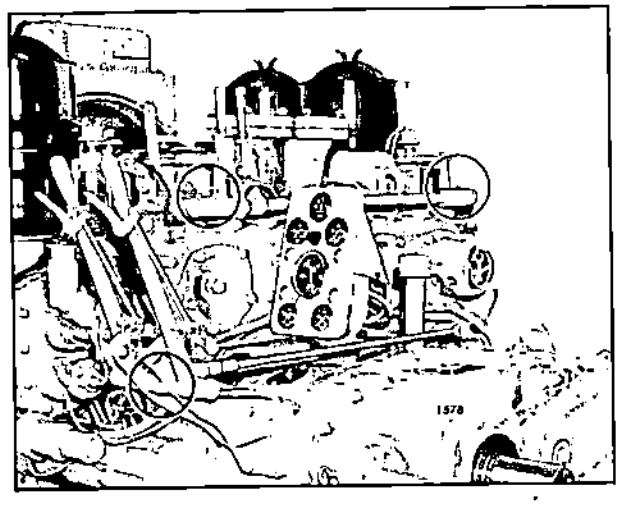
Item 17

Item 17

Lubricate the tachometer drive every 100 hours or 3,000 miles with an all purpose grease such as Shell Alvania No. 2 or its equivalent at the grease fitting. At temperatures above +30°F., use a No. 2 grade grease. Use a No. 1 grade grease below this temperature.

Item 18

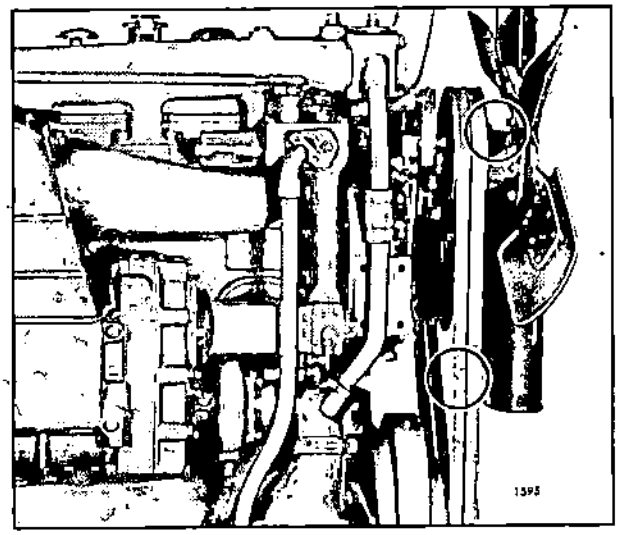
Lubricate the throttle control mechanism every 200 hours or 6,000 miles with an all purpose grease such as Shell Alvania No. 2 or its equivalent at the grease fittings. At temperatures above +30°F., use a No. 2 grade grease. Use a No. 1 grade grease below this temperature. Lubricate the clutch control levers and other control mechanism as required with engine oil.



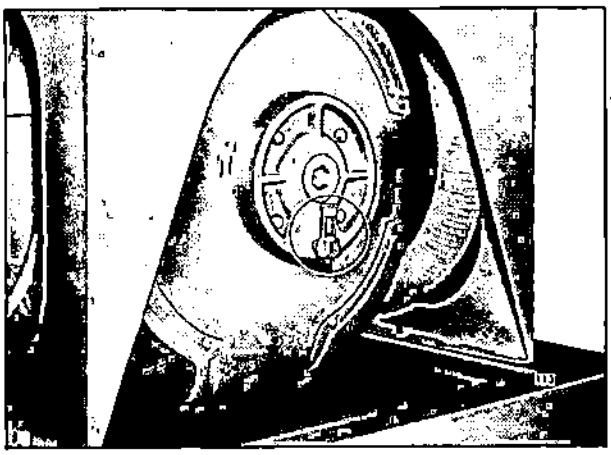
Item 18

Item 19

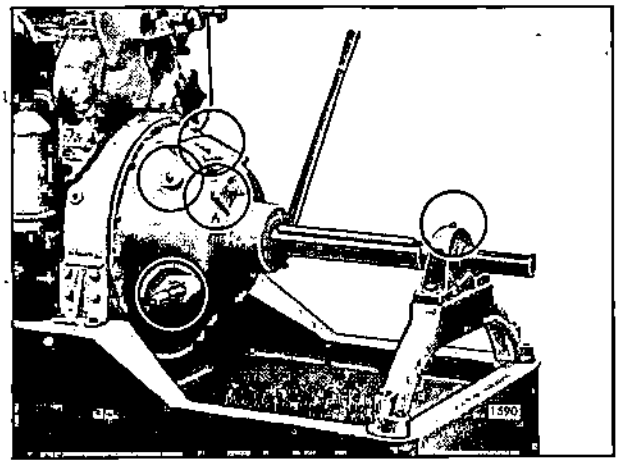
As long as the engine performance is satisfactory, no tune-up should be needed. Minor adjustment may be necessary after 75,000 to 100,000 miles (2500 to 3000 hours) of operation to compensate for some wear on the parts, which is normal.



Item 20



Item 21



Item 22

Item 20

New drive belts will stretch after the first few hours of operation. Therefore, retighten new fan drive, pump drive, and battery-charging generator drive belts after 4 hours and again after 40 hours of operation. Thereafter, check the tension of the drive belts every 500 hours or 15,000 miles and adjust, if necessary. Too tight a belt is destructive to the bearings of the driven part; a loose belt will slip. Adjust the belt for approximately 3/4" slack from a straight line over the outer diameter of the drive and driven pulleys, midway between the pulleys. Replace both belts in a set if either one is worn.

Lubricate the fan shaft bearings on units equipped with a grease fitting every 1,000 hours or 30,000 miles with an all purpose grease such as Shell Alvania No. 2 or its equivalent.

Lubricate the fan shaft bearings on units equipped with 1/8" pipe plugs by removing one of the pipe plugs and loosening the other to vent trapped air. Add the all purpose grease every 2,000 hours or 60,000 miles as required to pack the cavity between inner and outer shaft bearings. Install the plug that was removed and tighten both plugs.

Item 21

Check the oil level in the power generator sight gage every 300 hours; change the oil every six months. Use the same grade of oil as specified for the engine. Maintain the oil level to the line on the sight gage; do not overfill.

After 100 hours on new brushes, or brushes in generators that have not been in use over a long period, remove the end frame covers and inspect the brushes, commutator, and collector rings. If there is no appreciable wear on the brushes, the inspection interval may be extended until the most practicable period has been established (not to exceed six months). To prevent damage to the commutator or the collector rings, do not permit the brushes to become shorter than 3/4 inch.

Keep the generator clean inside and out. Before removing the end frame covers, wipe off the loose dirt. The loose dirt and dust may be blown out with low pressure air (25 psi maximum). Remove all greasy dirt with a cloth.

Item 22

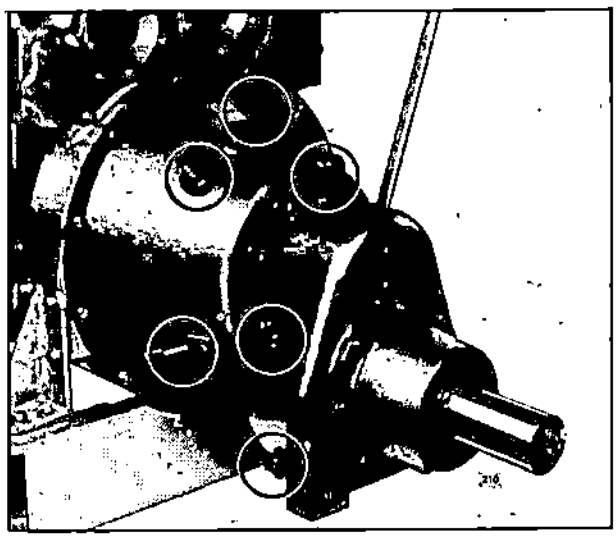
Lubricate all of the power take-off bearings with an all purpose grease such as Shell Alvania No. 2 or its equivalent. Lubricate sparingly to avoid getting grease on the clutch facings.

Lubricate the clutch throwout bearing sparingly every 8 hours through the grease fitting in the side of the clutch housing.

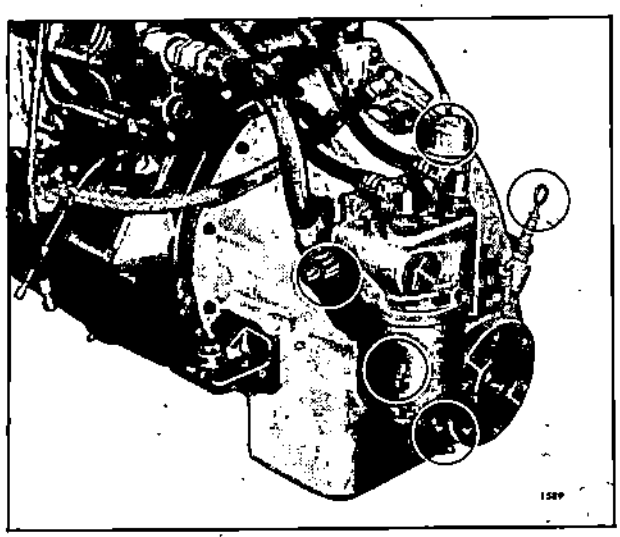
Lubricate the power take-off main bearing, also the outboard bearing if the unit is so equipped, every 50 hours. Frequency of lubrication will depend on the working conditions of the bearing, shaft speeds, and bearing loads. It may be necessary to lubricate this bearing more often than every 50 hours. Lubricate the front power take-off clutch pilot ball bearing through the fitting in the outer end of the drive shaft every 50 hours. One or two strokes with a grease gun should be sufficient.

Remove the inspection hole cover and lubricate the clutch release levers and link pins sparingly every 500 hours. Lubricate the clutch release shaft through the grease fittings on the front of the housing every 500 hours.

Check the clutch facing for wear every 500 hours. Adjust the clutch if necessary.



Item 23



Item 24

Item 23

Lubricate the clutch throwout bearing sparingly through the grease fitting in the side of the clutch housing every 8 hours with an all purpose grease such as Shell Alvania No. 2 or its equivalent.

Check the oil level in the reduction gear every 8 hours and add oil as required to bring the quantity to the proper level on the dipstick. Drain the oil every 1,000 hours, flush the housing with a light engine oil, and refill to the proper level with 5 quarts of the same HEAVY-DUTY oil that is used in the engine. This oil change period should be reduced under severe operating conditions.

Item 24

Check the oil level daily in the marine gear and add oil as required to bring it up to the proper level on the dipstick. Use the same Heavy-Duty Lubricating Oil in the marine gear that is used in the engine. Drain the oil every 200 hours and flush the gear with light engine oil.

NOTE: Series 3 oil should not be used in the marine gear.

When refilling after an oil drain, bring the oil up to the proper level on the dipstick (approximately 6 quarts in the M type and 8 quarts in the MH type gear), then run the engine at light load for three or four minutes, stop the engine and check the oil level again. Bring the oil level up to the proper level on the dipstick.

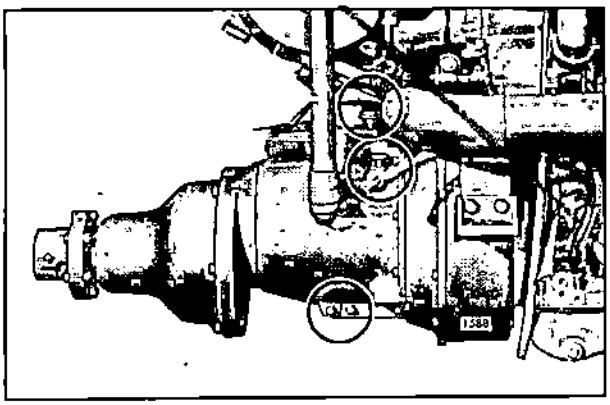
Every time the marine gear oil is changed, remove the oil strainer element, rinse it thoroughly in fuel oil, dry it with compressed air and reinstall it. Also, replace the full flow oil filter element every time the marine gear oil is changed.

Item 25

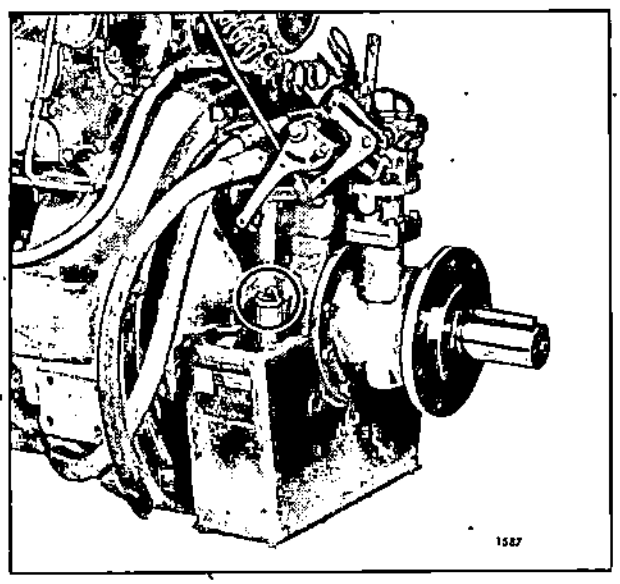
Check the Paragon Marine Gear oil level daily. To properly check the oil, operate the engine for 2 minutes at idle speed then stop it. Add oil as required to bring it to the proper level on the dipstick.

Change the oil every 200 hours. The oil may be drained by removing the drain plug in the bottom of the reverse gear housing and in the bottom of the reduction gear housing or with a hand operated sump pump.

Refill the marine gear to the proper level with the same oil that is used in the engine crankcase, operate the engine with a light load for 3 minutes, stop the engine and check the oil. Add oil as required.



Item 25



Item 26

Item 26

Check the oil level in all Torqmatic converters and supply tanks daily. The oil level must be checked while the converter is operating and the engine idling. If the converter is equipped with an input disconnect clutch, the clutch must be engaged.

Check the oil level after running it a few minutes. The oil level should be maintained at the proper level on the dipstick. If required, add hydraulic transmission fluid type "C-1" or automatic transmission fluid Type A, suffix A (see chart). (Use HEAVY-DUTY SAE 10 oil only if these fluids are not available.) Do not overfill the converter as too much oil will cause foaming and high oil temperature.

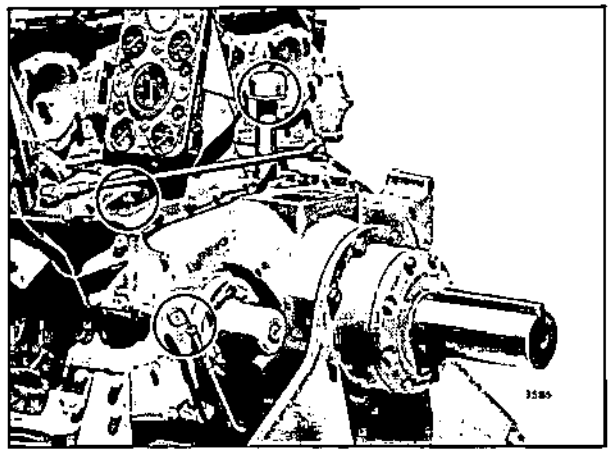
The oil should be changed every 500 hours for Series 300 converters, and every 1,000 hours for Series 500 through 900 converters. Also, the oil should be changed whenever it shows traces of dirt or effects of high operating temperature as evidenced by discoloration or strong odor. If the oil shows metal contamination, refer to the separate manual covering the specific converter as this usually requires disassembly. Under severe operating conditions, the oil should be changed more often.

Prevailing Ambient Temperature	Recommended Oil Specification
Above - 10°F.	Hydraulic Transmission Fluid, Type C-1
-10°F. to -25°F.	Automatic Transmission Fluid, Type A, Suffix A Identification*
Below -25°F.	Hydraulic Transmission Fluid, Type C-1 or Automatic Transmission Fluid, Type A, Suffix A Identification* Note: Auxiliary preheat required to raise temperature to sump and external circuit.

*The term "Suffix A Identification" refers to the Armour Qualification Number used to identify approved "Type A" Fluids that meet their latest specifications. Example "AQ-ATF-696A"—"Type C-1" fluids are not tested by the Armour Foundation, therefore they will not bear a Qualification Number.

Lubricate the input clutch release bearing and ball bearing every 50 hours with an all purpose grease. Operating conditions may vary this time interval. Two grease fittings are provided on the clutch housing. Over lubrication causes grease to be thrown on the clutch facing, and the clutch will slip.

The strainer in the Torqmatic transmission and the hydraulic system filters should be replaced or cleaned with every oil change.

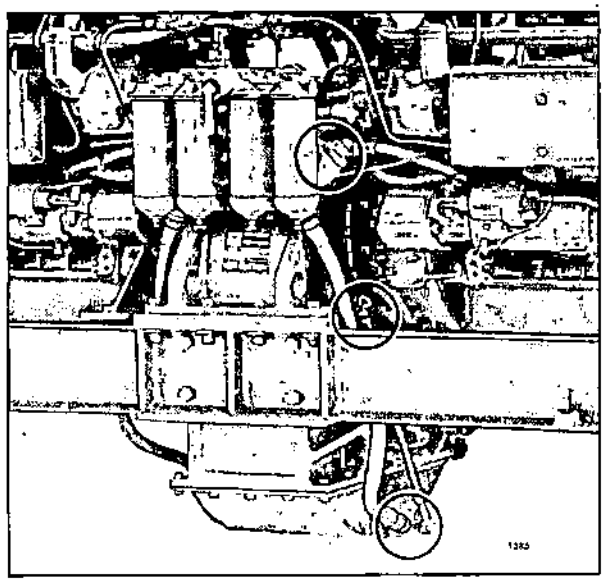


Item 27

Item 27

Check the oil level daily in the power transfer or reduction gear of "multiple engine industrial units". Add oil as required to bring it up to the proper level on the dipstick.

Drain the oil every 1,000 hours, flush with a light engine oil, and refill to the proper level on dipstick with the same Heavy-Duty Lubricating Oil that is used in the engine.



Item 28

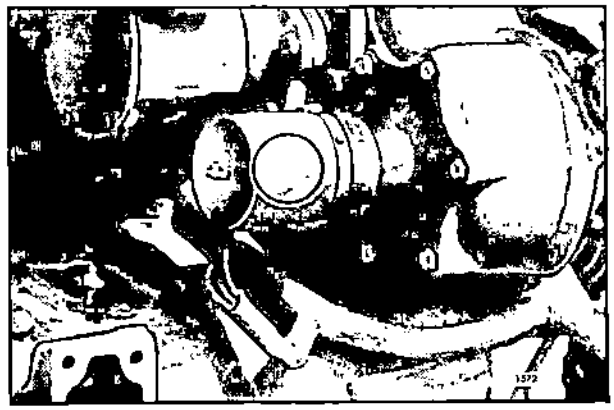
Item 28

Check the oil level daily in the power transfer gear or reduction gear of the "multiple engine marine units". Add oil as required to bring it up to the proper level on the dipstick.

Drain the oil every 200 hours, flush with a light engine oil, and refill to the proper level on the dipstick with the same Heavy-Duty Lubricating Oil that is used in the engine.

When refilling after an oil drain, bring the oil up to the proper level on the dipstick; then, run the engine at light load for three or four minutes, stop the engine and check the oil level again. Bring the oil level up to the proper level on the dipstick.

Every time the marine gear oil is changed, remove the oil strainer element, rinse it thoroughly in fuel oil, dry it with compressed air and reinstall it. Also, replace the full flow oil filter element every time the marine gear oil is changed.



Item 29

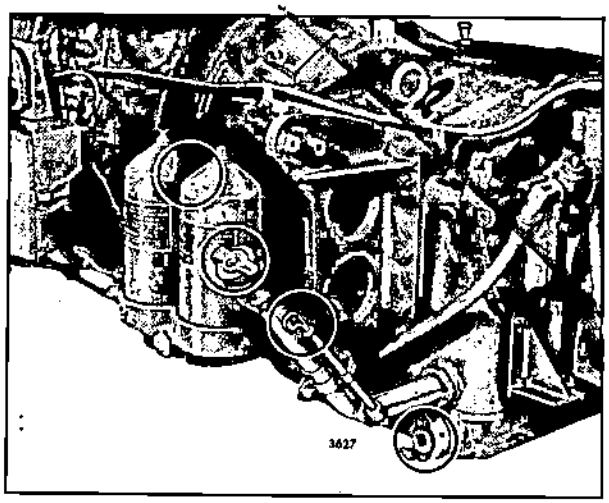
Item 29

Lubricate the overspeed governor, if it is equipped with a hinge cap oiler or oil cup, with 5 or 6 drops of engine oil every 500 hours. Avoid excessive lubrication and do not lubricate the governor while the engine is running.

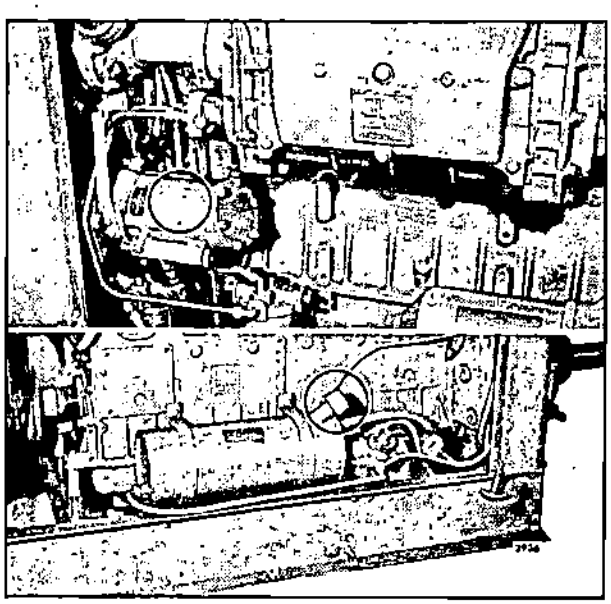
Item 30

Check the transmission oil level daily with the engine stopped, and if necessary, replenish to the proper level on the gage (dipstick).

Change the transmission oil every 30,000 car miles (1,000 hours) of operation. Drain the oil by removing the drain plug in the sump pan directly under the oil filler pipe. Use Hydraulic Transmission Fluid, Type "C-1". Use HEAVY-DUTY SAE 10 (MIL-L-2104A) oil only if the transmission fluid type "C-1" is not available. Run the unit a few minutes to fill the lubrication system; then check the oil level immediately after stopping the engine to avoid a false reading due to the oil drain back from the converter. Replenish to the proper level on the dipstick.



Items 30 and 31



Item 32

Item 31

Install new oil filter elements and gaskets every time the transmission oil is changed. Check for oil leaks after starting the engine.

Item 32

On units equipped with a Hydrostarter inspect the system periodically for leaks. Primarily examine the high pressure lines, connections, fittings and the control valve on the starter. Make certain the oil level in the reservoir is sufficient to completely cover the filter element at the bottom of the tank. Make this check after the accumulator is charged and the engine driven pump is by-passing oil to the reservoir.

Remove the Hydrostarter motor from the engine every 2,000 hours and apply a coating of Lubriplate, Type 130-AA or its equivalent on the drive clutch pinion to make sure the clutch slides freely while compressing the spring. Also apply Lubriplate or its equivalent on the fingers of the clutch and on the spool of the clutch yoke engaged by the fork. This lubrication period may be reduced or lengthened according to the severity of service.

Before removing the Hydrostarter, refer to "Hydraulic Starting System", release the pressure in the system with the relief valve in the hand pump then remove the three bolts that secure the starting motor to the flywheel housing. Remove the starter from flywheel housing without disconnecting the hydraulic lines. This will prevent dirt and air from entering the hydraulic system.

Remove the pipe plug from the starter drive housing, saturate the shaft oil wick with engine oil and reinstall the plug.

After lubricating, replace the starter and recharge the accumulator with the hand pump.

Every 2,000 hours, or as conditions warrant, drain the reservoir, and remove the filter from the bottom of the reservoir. Flush out the reservoir, clean the reservoir filter and reservoir filler cap.

Remove the bowl and element from the filter and wash both the element and the bowl in clean fuel oil and reassemble.

Drain the remaining hydraulic fluid from the system by disconnecting the lines from the hydraulic components. Reconnect all the hydraulic lines.

> **NOTE:** Make sure the lines and fittings are clean before any connections are made. With the exception of the thread nearest the open end, Permatex No. 2 or its equivalent should be applied in a small amount to the male threads ONLY. Never apply sealant to the female threads. Work the Permatex into the threads and wipe off the excess with a clean, lint-free cloth so that the sealant will not be washed into the system.

Refer to "Hydraulic Starting System", fill and purge the Hydrostarter system.

On units with a remote starting device, check the fluid level in the master cylinder every 2,000 hours or as necessary and refill with the same diesel fuel used by the engine. Lubricate the master cylinder pedal periodically with all purpose grease to prevent the shaft binding in the bushings.

DIESEL FUEL OIL SPECIFICATIONS

The quality of the fuel oil used for high-speed diesel engine operation is a major factor for satisfactory engine performance and life. The fuel oils selected must be clean, completely distilled, stable, and non-corrosive. Enlist the aid of your supplier in obtaining proper fuel oil. The responsibility for clean, efficient engine operation lies with the fuel supplier as well as the operator.

DISTILLATION RANGE, CETANE NUMBER, AND SULFUR CONTENT are three of the most important properties in the selection of diesel fuels for optimum combustion and minimum wear. Engine speed, load, and atmospheric temperature influence the selection of the fuels with respect to distillation range and cetane number. THE SULFUR CONTENT OF THE FUEL MUST BE AS LOW AS POSSIBLE, to avoid excessive deposit formation and premature wear.

Diesel fuels are generally marketed according to ASTM DESIGNATION D975-60T and only distillate fuels No. 1D and 2D are considered satisfactory for GM Diesel engines. These fuels should not be confused with the domestic type furnace oils ASTM D396-60T which have similar properties but are not always satisfactory for engine use due to their varying composition, cetane number, and distillation range.

As a guide to the selection of the proper fuel oil for various applications refer to the fuel oil selection chart and the ASTM Classification.

ASTM Classification of Diesel Fuel Oils

	No. 1-D	No. 2-D
Flash Pt.; °F Min.	100	125
Carbon Residue; %	0.15	0.35
Water and Sediment; (% by Volume) Max.	Trace	0.10
Ash; % by Wt.; Max.	0.01	0.02
Distillation, °F 90% Pt.; Max.	550	675
Min.	–	540
Viscosity at 100 °F; centistokes Min.	1.4	2.0
Max.	2.5	5.8
Sulfur; % Max.	0.5	1.0
Cetane No; Min.	40	40

Engine operation at altitudes above 5000 feet requires use of next lighter class of fuel oil than would normally be used.

During cold weather engine operation, the "cloud point" (the temperature at which wax crystals begin to form in the fuel oil) should be 10°F. below the lowest expected fuel temperature to prevent clogging of the fuel filters by wax crystals.

At temperatures below -20°F. consult your GM Diesel Sales and Service Outlet, since particular attention must be given the cooling system, lubricating system, fuel system, electrical system, and cold weather starting aids for efficient engine operation.

FUEL OIL SELECTION CHART

Type of Engine Service	Typical Application	General Fuel Classification	Distillation 90% Boiling Point (Max.)	Distillation Final Boiling Point (Max.)	Cetane Number (Min.)	Sulfur Content (Max.)
Light Load and speed with considerable idling.	City Buses	No. 1-D	500°F	550°F	45	0.30%
Light Load and speed.	Generator sets, industrial and automotive equipment in city and suburban operation.	Winter No. 1-D	500°F	550°F	45	0.30%
		Summer No. 1-D	550°F	600°F	40	0.50%
Medium Load and speed.	Marine Pleasure Craft, Tractors, Industrial equipment.	Winter No. 1-D	550°F	600°F	45	0.50%
		Summer No. 2-D*	625°F	675°F	40	0.50%
Heavy Load and high speed with idling.	Highway Trucks	Winter No. 2-D*	625°F	675°F	45	0.50%
		Summer No. 2-D*	625°F	675°F	40	0.50%
Heavy Load and high speed.	Heavy Duty Off-the-road Equipment, Trucks, Tractors.	No. 2-D*	675°F	–	40	0.50%

*NOTE: For most satisfactory engine life, use only those No. 2-D diesel fuel oils containing 0.50% or less sulfur; where minimum exhaust smoke is required or where long periods of idling or cold weather conditions below 32°F. are encountered, the more volatile or light distillate fuels are recommended.

BREAK-IN OILS AND ADDITIVES

The use of proprietary blends of supplementary additive or concentrates such as engine oil supplements, break-in oils, tune-up compounds and friction reducing compounds is not recommended in lubricating oils used in GM Diesel engines unless given official GM part numbers and made available for use in appropriate service applications.

DIESEL LUBRICATING OIL SPECIFICATIONS

OIL QUALITY

Satisfactory long-time operation of Heavy-Duty Engines requires the use of additive type "Heavy-Duty Lubricating Oils". These oils provide better lubrication, possess more heat resistance, and counteract sludge formation more effectively than the straight mineral type oils.

A list of these "Heavy-Duty Lubricating Oils" of MIL-L-2104A, S-1, and Series 3 types, grouped in accordance with their ability to meet common service requirements, has been compiled by and may be obtained from the INTERNAL COMBUSTION ENGINE INSTITUTE, 201 NORTH WELLS ST., CHICAGO 6, ILLINOIS.

The presence or omission of a brand name on the list is not necessarily a recommendation, disapproval, or guarantee of any petroleum product by GM Diesel. Responsibility for quality and performance lies with the oil supplier.

Selection of a reliable oil supplier, strict observance of his oil change period recommendations, and proper filter maintenance will assure good lubrication which contributes to longer engine life.

RECOMMENDATION

Supplement 1 (S-1) Lubricating Oils

Supplement 1 Lubricating Oils are recommended for all GM Diesel engines in every type of service. It is also recommended that this type of oil be used first, before deviating to other types.

SPECIAL OPERATING CONDITIONS

The following types of lubricating oils have been used in special circumstances. However, before using these oils consult your supplier and obtain his assurance of satisfactory performance for your operation.

MIL-L-2104A Lubricating Oils

MIL-L-2104A lubricating oils, if used, should be for light or intermediate engine operation, where the sulfur content of the fuel oil does not exceed 0.5%.

Series 3 (S-3) Lubricating Oils

Series 3 lubricating oils are not normally required or recommended for GM Diesel engines since they tend to deter proper run-in and, being more highly compounded with additives, tend to form excessive ash deposits resulting in valve burning and top ring sticking.

Multi-Graded Lubricating Oils

Multi-Graded lubricating oils are not normally recommended. They may be used to facilitate starting when prolonged exposure of the engine to temperatures below freezing is unavoidable. Consult your supplier regarding the performance characteristics of this type of oil and obtain his assurance of adequate lubrication before subjecting the engine to heavy-duty service.

COLD WEATHER OPERATION

The proper lubricating oil viscosity grade when operating at temperatures above +30°F. is SAE 30. It is permissible to use a lighter grade of oil in order to facilitate starting as shown in the following table:

Ambient Temperature	Viscosity Grade
+30° to 0°F.	SAE 20-20W
0° to -20°F.	SAE 10W

For complete cold weather starting instructions consult your nearest Authorized GM Diesel Sales and Service Outlet.

OIL CHANGES

It is recommended that new engines be started with 100 hour oil change periods. For highway vehicles this corresponds to approximately 3,000 miles, and for "city-service" vehicles approximately 1,000-2,000 miles. The drain interval may then be gradually increased, or decreased following the recommendations of the oil supplier (based on analysis of the drained oil) until the most practical oil change period for the particular service has been established.

Solvents should not be used as flushing oils in running engines. Dilution of the fresh refill oil supply can occur which may be detrimental.

OIL FILTRATION

Heavy sludge deposits found on the oil filter elements at the time of an oil change must be taken as an indication that the detergency of the oil has been exhausted. When this occurs, the oil drain interval should be shortened. The removal of abrasive dust, metal particles, and carbon must be ensured by replacement of the oil filter elements at the time of an oil change.

> **NOTE:** The manufacturer's warranty applicable to GM Diesel engines provides in part that the provisions of such warranty shall not apply to any engine unit which has been subject to misuse, negligence or accident. Accordingly, malfunctions attributable to neglect or failure to follow the manufacturer's lubricating recommendations indicated above may not be within the coverage of the warranty.

ENGINE TUNE-UP

The amount of time or mileage interval between engine tune-up procedures depends upon the performance of the engine. No tune-up is necessary if the engine is running satisfactory. Minor adjustments may be necessary after 75,000 to 100,000 miles (2500 to 3000 hours) of operation to compensate for some wear on the parts.

Three types of governors are used. Since each governor has different characteristics, the tune-up procedure varies accordingly. The three types are:

1. Limiting speed mechanical.
2. Variable speed mechanical.
3. Hydraulic.

The mechanical engine governors are identified by a name plate attached to the governor housing. The letters D.W.-L.S. stamped on the name plate denote a double weight limiting speed governor. A single weight variable speed governor name plate is stamped S.W.-V.S.

Normally, when performing a tune-up on an engine in service, it is only necessary to check the various adjustments for a possible change in the settings. However, if the cylinder head, governor, or injectors have been replaced or overhauled, then certain preliminary adjustments are required before the engine is started.

The preliminary adjustments consist of the first four items in the tune-up sequence. The procedures are the same except that the valve clearance is greater for a cold engine.

To tune-up an engine completely, all of the adjustments, except the valve bridge adjustment on four valve cylinder heads, are made by following the applicable tune-up sequence given below, after the engine has reached normal operating temperature. Since the adjustments are normally made while the engine is stopped, it may be necessary to run the engine between adjustments to maintain normal operating temperature.

> **NOTE:** The exhaust valve bridges on the four valve cylinder head are adjusted at the time the cylinder head is installed on the engine and, until wear occurs, no further adjustment is required. When wear is evident, perform a complete valve bridge adjustment as outlined on the following page.

The tune-up procedures apply to the individual engines of multiple engine units as well as to the single engine units. However, the throttle linkage of multiple engine units must be adjusted after the individual engines have been tuned-up.

Tune-Up Sequence for Mechanical Governor

1. Adjust the exhaust valve clearance.
2. Time the fuel injectors.
3. Adjust the governor gap.
4. Position the injector rack control levers.
5. Adjust the maximum no-load speed.
6. Adjust the idle speed.
7. Adjust the buffer screw.
8. Adjust the throttle booster spring (variable speed governor only).
9. Adjust the fuel modulator (if used).

Tune-Up Sequence for Hydraulic Governor

1. Adjust the exhaust valve clearance.
2. Time the fuel injectors.
3. Adjust the fuel rod.
4. Position the injector rack control levers.
5. Adjust the load limit screw.
6. Compensation adjustment (PSG governors only).
7. Adjust the speed droop.
8. Adjust the maximum no-load speed.

EXHAUST VALVE CLEARANCE ADJUSTMENT

The correct exhaust valve clearance at normal engine operating temperature is important for smooth, efficient operation of the engine.

Insufficient valve clearance can result in loss of compression, misfiring cylinders, and eventually, burned valve seats and valve seat inserts. Excessive valve clearance will result in noisy operation, especially in the low speed range.

Whenever the cylinder head is overhauled, the exhaust valves are reconditioned or replaced, or the valve operating mechanism is replaced or disturbed in any way, the valve clearance must first be adjusted to the cold setting to allow for normal expansion of the engine parts during the engine warm-up period. This will ensure a valve setting that is close enough to the specified clearance to prevent damage to the valves when the engine is started.

ENGINES WITH TWO VALVE CYLINDER HEADS

All of the exhaust valves may be adjusted, in firing order sequence, during one full revolution of the crankshaft. Refer to the general specifications at the front of the manual for the engine firing order.

Exhaust Valve Clearance Adjustment (Cold Engine)

1. Place the governor speed control lever in the NO-FUEL position.
2. Rotate the crankshaft until the injector follower is fully depressed on the cylinder to be adjusted.

   CAUTION: When using a wrench on the crankshaft bolt at the front of the engine, do not turn the crankshaft in a left-hand direction of rotation as the bolt will be loosened.

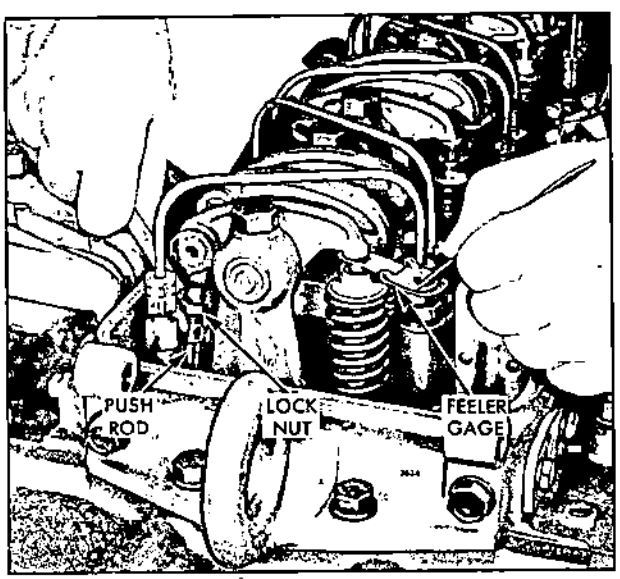


Fig. 1 - Adjusting Valve Clearance

3. Loosen the push rod lock nut.
4. Place a .013" feeler gage, tool J 9708, between the valve stem and the rocker arm (Fig. 1). Adjust the push rod to obtain a smooth "pull" on the feeler gage.
5. Remove the feeler gage. Hold the push rod with a 5/16" wrench and tighten the lock nut with a 1/2" wrench.
6. Recheck the clearance. At this time, if the adjustment is correct, the .011" feeler gage, J 9708, will pass freely between the valve stem and the rocker arm, but the .013" feeler gage will not pass through.
7. Check and adjust the remaining valves in the same manner as outlined above.

Exhaust Valve Clearance Adjustment (Hot Engine)

Maintaining normal engine operating temperature is particularly important when making the final valve clearance adjustment. If the engine is allowed to cool off before setting any of the valves, the clearance when running at full load may become insufficient.

With the engine at normal operating temperature (160°-185°F.), recheck the exhaust valve clearance with feeler gage J 9708. At this time, if the valve clearance is correct, the .008" feeler gage will pass freely between the valve stem and the rocker arm, but the .010" gage will not pass through.

ENGINES WITH FOUR VALVE CYLINDER HEADS

The exhaust valve bridges must be adjusted and the adjustment screws locked securely at the time the cylinder head is installed on the engine. Until wear occurs, no further adjustment is required on the exhaust valve bridges. When wear is evident, make the necessary adjustments as outlined.

Exhaust Valve Bridge Adjustment

1. Remove the injector fuel pipes and the rocker arm retaining bolts. Move the rocker arms away from the exhaust valve bridges.

2. Remove the exhaust valve bridge. See Fig. 2.

3. Place the bridge in a vise and loosen the lock nut on the bridge adjusting screw.

   CAUTION: Loosening or tightening the lock nut with the bridge in place may result in bending the bridge guide or the rear valve stem.

4. Install the bridge on the bridge guide.

5. While firmly pressing straight down on the pallet surface of the bridge, turn the adjusting screw clockwise until it just touches the valve stem; then, turn the screw an additional 1/8 to 1/4 turn clockwise and tighten the lock nut finger tight.

6. Remove the bridge and place it in a vise. Hold the screw from turning with a screw driver and tighten the lock nut on the adjustment screw. Complete the operation by tightening the lock nut with a torque wrench to 25 lb-ft being sure that the screw does nut turn.

7. Lubricate the bridge guide and bridge pilot with engine oil.

8. Reinstall the bridge in its original position.

9. Place a .0015" feeler gage under each end of the bridge. When pressing down on the pallet surface of the bridge, both feeler gages must be tight. If both feeler gages are not tight, readjust the screw, as outlined in Steps 5 and 6.

10. Adjust the remaining bridges as outlined above.

11. Swing the rocker arm assembly into position being sure the bridges are properly positioned on the rear valve stems. This precaution is necessary to prevent valve damage due to mislocated bridges.

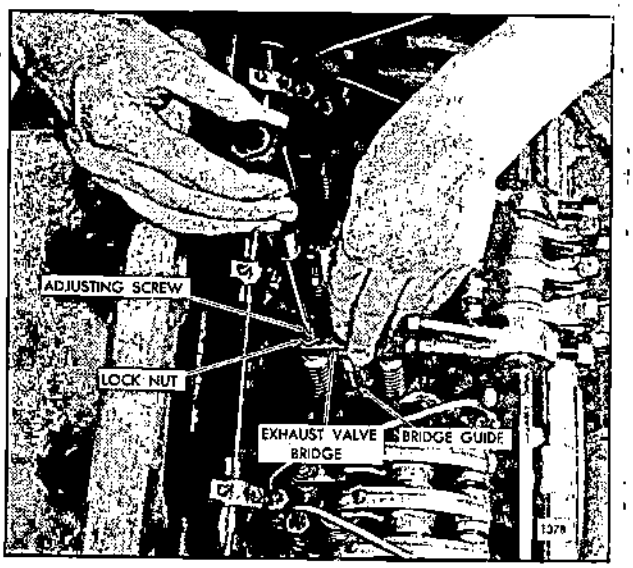


Fig. 2 - Valve Bridge Adjustment

12. Tighten the rocker bracket bolts to 90-100 lb-ft torque.

13. Align the fuel pipes and connect them to the injectors and the fuel connectors. Use socket J 8932 to tighten the connectors to 12-15 lb-ft torque.

    CAUTION: Do not exceed the specified torque. Excessive tightening will twist or fracture the flared ends of the fuel pipes and result in leaks. Lubricating oil diluted by fuel oil can cause serious damage to the engine bearings.

Exhaust Valve Clearance Adjustment (Cold Engine)

Adjust the exhaust valve clearance at the push rod. DO NOT DISTURB THE EXHAUST VALVE BRIDGE ADJUSTING SCREW.

All of the exhaust valves may be adjusted, in firing order sequence, during one full revolution of the crankshaft. Refer to the general specifications at the front of the manual for the engine firing order.

1. Place the governor speed control lever in the NO-FUEL position.

2. Rotate the crankshaft until the injector follower is fully depressed on the cylinder to be adjusted.

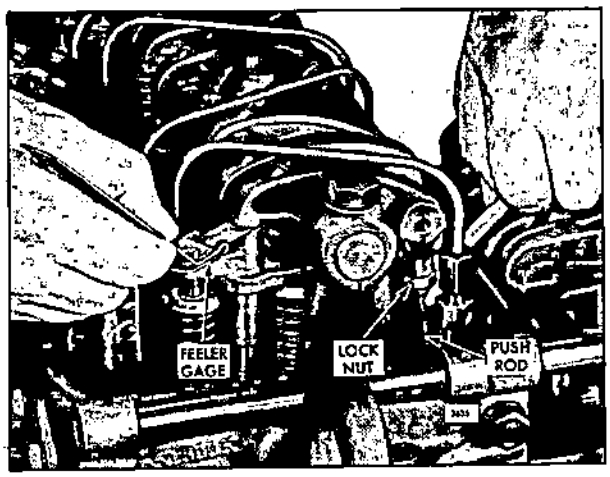


Fig. 3 - Adjusting Valve Clearance

CAUTION: When using a wrench on the crankshaft bolt at the front of the engine, do not turn the engine in a left-hand direction of rotation as the bolt will be loosened.

3. Loosen the push rod lock nut.

4. Place a .017" feeler gage, J 9708, between the valve bridge and the valve rocker arm pallet, Fig. 3. Adjust the push rod to obtain a smooth "pull" on the feeler gage.

5. Remove the feeler gage. Hold the push rod with a 5/16" wrench and tighten the lock nut with a 1/2" wrench.

6. Recheck the clearance. At this time, if the adjustment is correct, the .015" feeler gage, will pass freely between the valve bridge and the rocker arm pallet but the .017" feeler gage will not pass through.

7. Check and adjust the remaining valves in the same manner as outlined above.

Exhaust Valve Clearance Adjustment (Hot Engine)

Maintaining normal engine operating temperature is particularly important when making the final valve clearance adjustment. If the engine is allowed to cool off before setting any of the valves, the clearance when running at full load may become insufficient.

With the engine at normal operating temperature (160°-185°F.), recheck the exhaust valve clearance with feeler gage J 9708. At this time, if the valve clearance is correct, the .013" feeler gage will pass freely between the valve bridge and the rocker arm pallet, but the .015" gage will not pass through. Readjust the push rod, if necessary.

TIMING FUEL INJECTOR

To time an injector properly, the injector follower must be adjusted to a definite height in relation to the injector body.

All of the injectors can be timed, in firing order sequence, during one full revolution of the crankshaft. Refer to the general specifications at the front of the manual for the engine firing order.

Use the proper timing gage as indicated in the following chart.

TIMING GAGE CHART FOR INJECTORS

Injector	Timing Gage Tool Dimension	Tool Number
HV55	1.484"	J 1242
S55	1.460"	J 1853
N55	1.460"	J 1853
HV6	1.484"	J 1242
S60	1.460"	J 1853
N60	1.460"	J 1853
N65	1.460"	J 1853
HV7	1.460"	J 1853
S70	1.460"	J 1853
N70	1.460"	J 1853
HV8	1.460"	J 1853
S80	1.460"	J 1853
N80	1.460"	J 1853
HV9	1.460"	J 1853
S90	1.460"	J 1853

Time Fuel Injector

1. Place the governor speed control lever in the NO-FUEL position.

2. Rotate the crankshaft until the exhaust valves are fully depressed on the particular cylinder to be timed.

   CAUTION: When using a wrench on the crankshaft bolt at the front of the engine, do not turn the crankshaft in a left-hand direction of rotation as the bolt will be loosened.

3. Place the small end of the injector timing gage in the hole provided in the top of the injector body, with the flat of the gage toward the injector follower (Fig. 4).

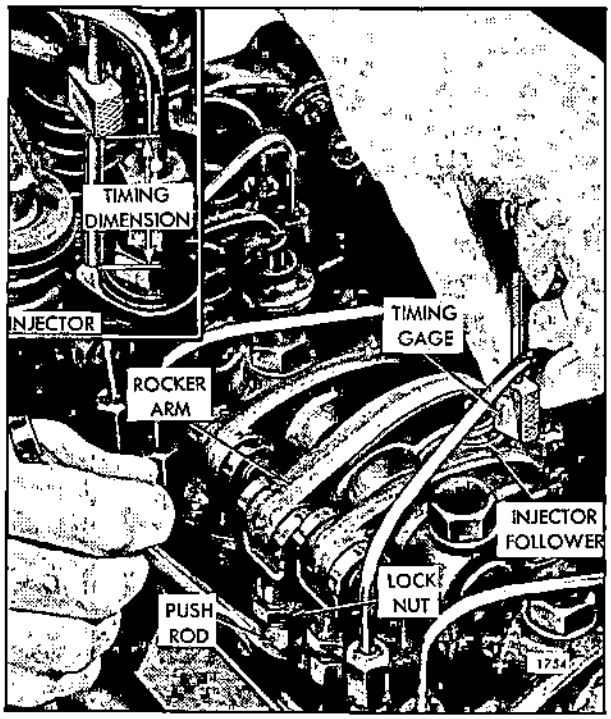


Fig. 4 - Timing Fuel Injector

4. Loosen the push rod lock nut.

5. Turn the push rod and adjust the injector rocker arm until the extended part of the gage will just pass over the top of the injector follower.

6. Hold the push rod and tighten the lock nut. Check the adjustment and, if necessary, readjust the push rod.

7. Time the remaining injectors in the same manner as outlined in Items 1 through 6.

LIMITING SPEED MECHANICAL GOVERNOR AND INJECTOR RACK CONTROL ADJUSTMENT

Adjust the limiting speed mechanical governor and injector rack control levers, after adjusting the exhaust valves and timing the fuel injectors.

Adjust Governor Gap—Single Weight Governor

With the engine at operating temperature, adjust the governor gap as follows:

1. With the engine stopped, remove the two attaching bolts and withdraw the governor high speed spring retainer cover.
2. Back out the buffer screw until it extends approximately 5/8" from the lock nut.
3. Start the engine and loosen the idle speed adjusting screw lock nut and adjust the idle screw to obtain the desired idle speed. Hold the screw and tighten the lock nut to retain the adjustment. The recommended idle speed is 550 rpm for single weight governors, but may vary with special engine applications.
4. Stop the engine and remove the governor cover and lever assembly.
5. Remove the valve rocker cover.

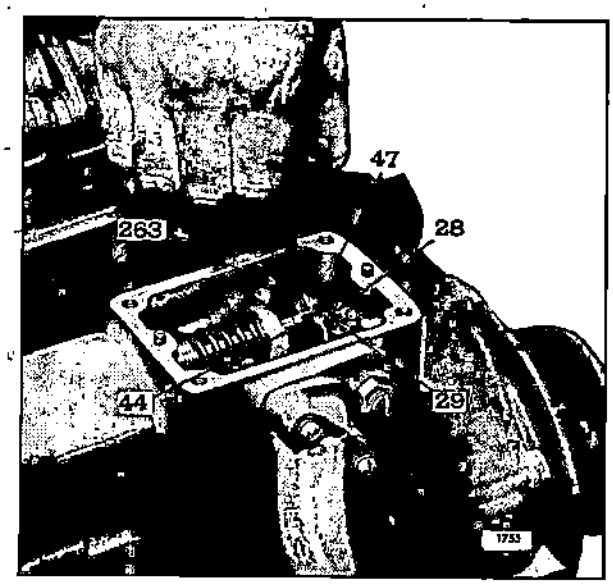


Fig. 5 - Adjusting Governor Gap

28. Screw--Gap Adjusting
29. Lock Nut
44. Plunger--High Speed Spring
47. Cap--Low Speed Spring
263. Gage--Governor Gap--Tool J 5407

6. Remove the fuel rod from the differential lever and the injector control tube lever.
7. Check the gap between the low speed spring cap (47) and the high speed spring plunger (44) with gage (.170") J 5407 as shown in Fig. 5.
8. If required, loosen the lock nut (29) and turn the gap adjusting screw (28) until a slight drag is felt on the gage.
9. Hold the adjusting screw and tighten the lock nut.
10. Recheck the gap and readjust if necessary.
11. Install the fuel rod between the governor and injector control tube lever.
12. Install the governor cover and lever assembly.

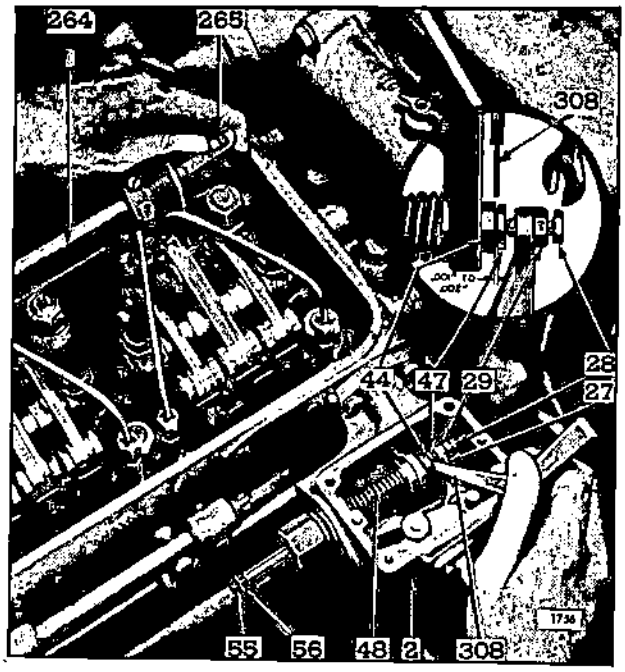


Fig. 6 - Adjusting Governor Gap

2. Housing--Governor Control
27. Lever--Operating Shaft
28. Screw--Gap Adjusting
29. Lock Nut
44. Plunger--High Speed Spring
47. Cap--Low Speed Spring
48. Spring--High Speed
55. Screw--Idle Speed Adjusting
56. Lock Nut
264. Tube--Injector Control
265. Lever--Injector Control Tube
308. Feeler Gage Set Tool J 3172

Adjust Governor Gap—Double Weight Governor

With the engine at operating temperature, adjust the governor gap as follows:

1. With the engine stopped, remove the two bolts and withdraw the governor high speed spring retainer cover.

2. Back out the buffer screw until it extends approximately 5/8" from the lock nut.

3. Start the engine and loosen the idle speed adjusting screw lock nut and adjust the idle screw to obtain the desired idle speed. Hold the screw and tighten the lock nut to retain the adjustment. The recommended idle speed is 450 rpm for double weight governors, but may vary with special engine applications.

4. Stop the engine and remove the governor cover and lever assembly.

5. Remove the valve rocker cover.

6. Remove the fuel rod from the differential lever and the injector control tube lever.

7. Start and run the engine between 800 and 1000 rpm by manual operation of the control tube lever.

   CAUTION: Do not overspeed the engine.

8. Check the gap between the low speed spring cap and the high speed plunger with a .0015" feeler gage as shown in Fig. 6. If the gap setting is incorrect, loosen the lock nut and adjust the gap adjusting screw.

9. Hold the gap adjusting screw and tighten the lock nut.

10. Recheck the governor gap, with the engine operating between 800 and 1000 rpm, by placing a screw driver between the gap adjusting screw and the governor housing and manually forcing the gap closed. If the setting is correct, the .0015" movement can be seen.

    NOTE: The gap closing can be easily seen if a drop of oil is placed into the gap just before it is closed.

11. Stop the engine and install the fuel rod between the differential lever and the control tube lever.

12. Install the governor cover and lever assembly.

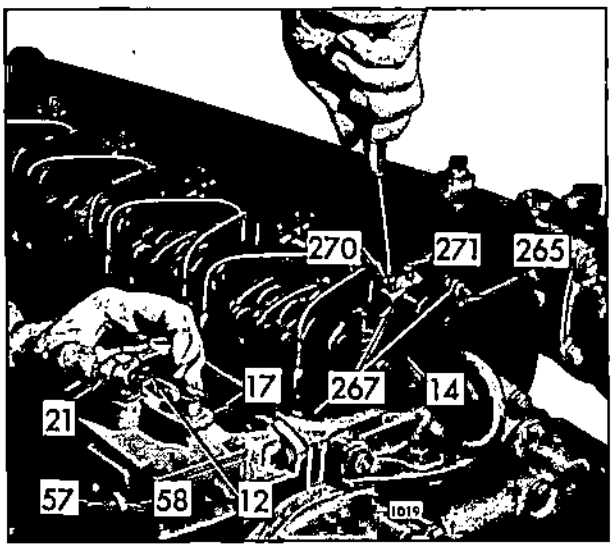


Fig. 7 – Positioning No. 1 Injector Rack Control Lever

12. Lever—Stop
14. Rod—Fuel
17. Cam—Cover
21. Lever—Speed Control
57. Screw—Buffer
58. Lock Nut
265. Lever—Injector Control Tube
267. Lever—Injector Rack Control
270. Screw—Control Lever Adjusting (Inner)
271. Screw—Control Lever Adjusting (Outer)

Position Injector Rack Control Levers

Properly positioned injector rack control levers will result in the following:

Speed control lever at a maximum speed position.

Governor low speed gap closed.

High speed spring plunger on the seat in the governor control housing.

Injector fuel control racks in the FULL FUEL position.

Adjust the No. 1 injector rack control lever first to establish a guide for the remaining injector rack control levers.

1. Disconnect any linkage attached to the speed control lever (21), Fig. 7.

2. Remove the valve rocker cover.

3. Loosen the idle speed adjusting screw lock nut and back out the idle speed adjusting screw until 1/2" of the threads project from the lock nut when the nut is against the high speed plunger.

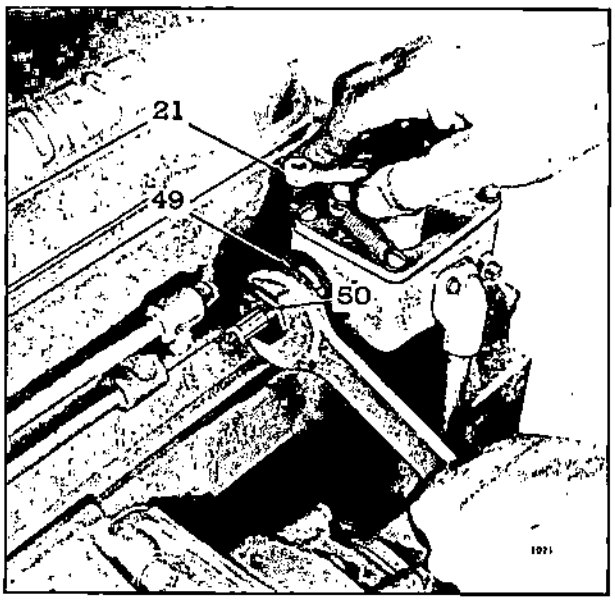


Fig. 8 - Adjusting Maximum No-Load Speed

21. Lever--Speed Control
49. Lock Nut--Spring Retainer
50. Retainer--High Speed Spring

4. Loosen the lock nut (58) and back out the buffer screw approximately 5/8".

5. Loosen all of the inner (270) and outer (271) injector rack control lever adjusting screws. Be sure all of the control levers are free on the injector control tube.

6. Move the governor speed control lever to the maximum speed position as shown in Fig. 7. Hold the lever in that position with light finger pressure. Turn the inner adjusting screw on the No. 1 injector rack control lever down until a slight movement of the control tube is observed or a step up in effort is noted. This will place the No. 1 injector rack in the full-fuel position. Turn the outer adjusting screw down until it bottoms lightly on the injector control tube. Then, alternately tighten both the inner and outer adjusting screws.

   NOTE: The above step should result in placing the governor linkage and control tube assembly in the same position that they will attain while the engine is running at full load.

7. To be sure the control lever is properly adjusted, hold the speed control lever in the maximum speed position and press down on the injector rack with a screw driver or finger tip, causing the rack to rotate. The setting is sufficiently tight if the injector rack returns to its original position.

   If the rack does not return to its original position, it is too loose. To correct this condition, back off the outer adjusting screw slightly and tighten the inner adjusting screw slightly.

   The setting is too tight if, when moving the speed control lever from the idle to the maximum speed position, the injector rack becomes tight before the speed control lever reaches the end of its travel (as determined by the stop under the governor cover). This will result in a step up in effort required to move the speed control lever to the end of its travel. To correct this condition, back off the inner adjusting screw slightly and tighten the outer adjusting screw slightly.

8. Disconnect the fuel rod from the injector control tube and manually hold the No. 1 injector in the full-fuel position and turn down the inner adjusting screw of the No. 2 injector until the injector rack has moved into the full-fuel position and the inner adjusting screw is bottomed on the injector control tube. Turn the outer adjusting screw down until it bottoms lightly on the injector control tube. Then, alternately tighten both the inner and outer adjusting screws.

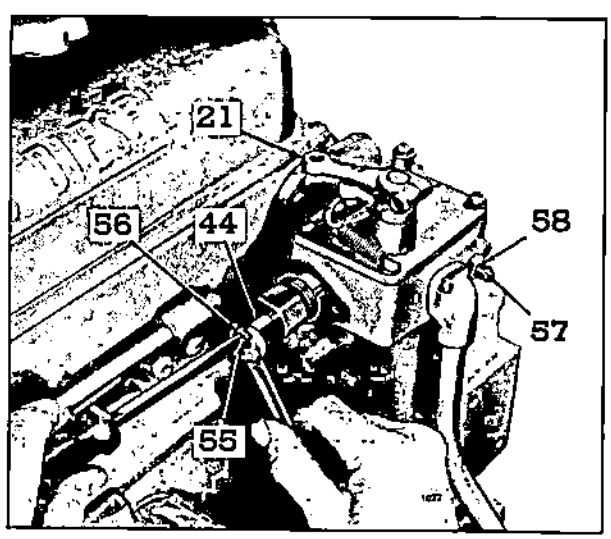


Fig. 9 - Adjusting Engine Idle Speed

21. Lever--Speed Control
44. Plunger--High Speed Spring
55. Screw--Idle Speed Adjusting
56. Lock Nut
57. Screw--Buffer
58. Lock Nut

9. Recheck the No. 1 injector rack to be sure that it has remained snug on the ball end of the injector rack control lever while adjusting the No. 2 injector. If the rack of the No. 1 injector has become loose, back off slightly on the inner adjusting screw on the No. 2 injector rack control lever and tighten the outer adjusting screw.

   When the settings are correct, the racks of both injectors must be snug on the ball end of their respective rack control levers.

10. Position the remaining injector rack control levers as outlined in Steps 8 and 9.

11. Connect the fuel rod to the injector control tube lever.

12. Reset the idle speed adjusting screw until it projects 3/8" beyond the lock nut. Tighten the lock nut.

Adjust Maximum No-Load Engine Speed

All governors are properly adjusted before leaving the factory. However, if the governor has been reconditioned or replaced, and to ensure the engine speed will not exceed the recommended no-load speed as given on the unit name plate, the maximum no-load speed may be set as follows:

1. Loosen the lock nut (49) Fig. 8, and back off the high speed spring retainer (50) approximately five turns.

2. With the engine at operating temperature and no-load on the engine, place the speed control lever in the full-fuel position. Turn the high speed spring retainer until the engine is operating at the recommended no-load speed.

   The best method of determining the engine rpm is with a hand tachometer.

3. Hold the spring retainer (50) and tighten the lock nut (49).

Adjust Idle Speed

With the maximum no-load speed properly adjusted, the idle speed may be adjusted as follows:

1. With the engine at normal operating temperature and with the buffer screw (57) backed out to avoid contact with the differential lever, turn the idle speed adjusting screw (55) until the engine is operating at approximately 15 rpm below the recommended idle speed.

   The recommended idle speed is 550 rpm for single weight governors and 450 rpm for double weight governors, but may vary with engine applications.

2. Hold the idle screw and tighten the lock nut (56).

3. Install the high speed spring retainer and retain with the two bolts.

Adjust Buffer Screw

With the idle speed set, the buffer screw may be adjusted as follows:

1. With the engine running at normal operating temperature, turn the buffer screw in so that it contacts the differential lever as lightly as possible and still eliminates the engine roll.

   NOTE: Do not increase the engine idle speed more than 15 rpm with the buffer screw.

2. Hold the buffer screw and tighten the lock nut.

3. Recheck the maximum no-load speed. If it has increased more than 25 rpm, back off the buffer screw until the increase is less than 25 rpm.

VARIABLE SPEED MECHANICAL GOVERNOR AND INJECTOR RACK CONTROL ADJUSTMENT

After adjusting the exhaust valves and timing the fuel injectors, adjust the variable speed mechanical governor and injector rack control levers.

Adjust Governor Gap

With the engine stopped, the governor gap may be set as follows:

1. Remove the governor cover.
2. Place the speed control lever (21), Fig. 10, in the maximum speed position.
3. Insert a .006" feeler gage between the spring plunger (45) and the plunger guide (37). If required, loosen the lock nut (29) and turn the gap adjusting screw (28) in or out until a slight drag is noted on the feeler gage.
4. Hold the adjusting screw and tighten the lock nut. Check the gap, and reset it, if necessary.
5. Install the governor cover.

Position Injector Rack Control Levers

The position of the injector rack control levers must be correctly set in relation to the governor.

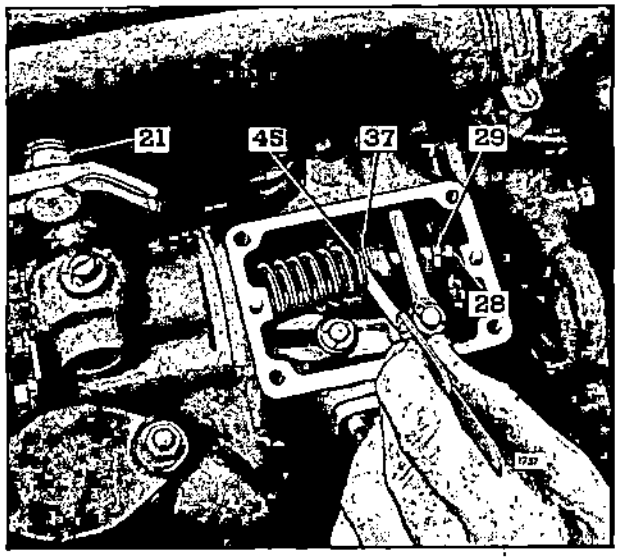


Fig. 10 - Adjusting Governor Gap

21. Lever--Speed Control
28. Screw--Gap Adjusting
29. Lock Nut
37. Guide--Plunger
45. Plunger--Variable Speed Spring

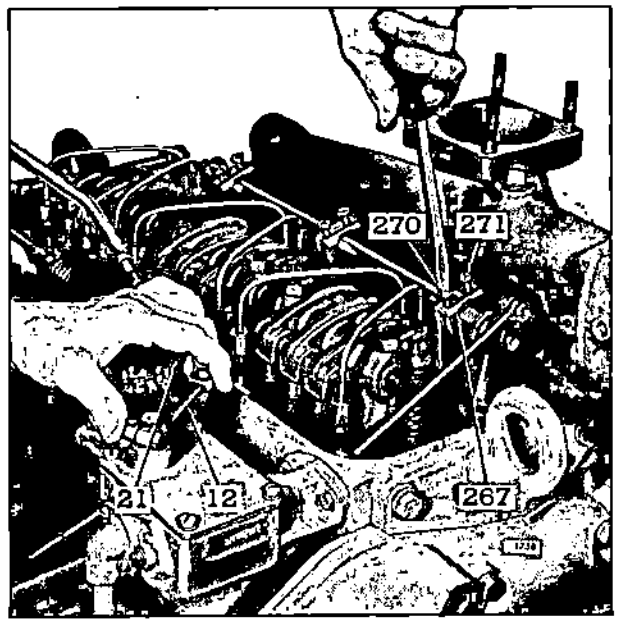


Fig. 11 - Positioning No. 1 Injector Rack Control Lever

12. Lever--Stop
21. Lever--Speed Control
267. Lever--Injector Rack Control
270. Screw--Control Lever Adjusting (Inner)
271. Screw--Control Lever Adjusting (Outer)

Their position determines the amount of fuel injected into each cylinder and ensures equal distribution of the load.

Properly positioned injector rack control levers with the engine at full load will result in the following:

Speed control lever at the maximum speed position.

Stop lever in the RUN position.

High speed spring plunger is within .005" to .007" of its seat in the governor control housing.

Injector rack control levers in the full fuel position.

NOTE: The cross link equalizer spring must be removed from multiple engine units before performing the individual engine tune-up. See "Throttle Adjustment for Load Equalization on Twin or Quad Units With Variable Speed Mechanical Governors" for the procedure for removing the cross link equalizer spring.

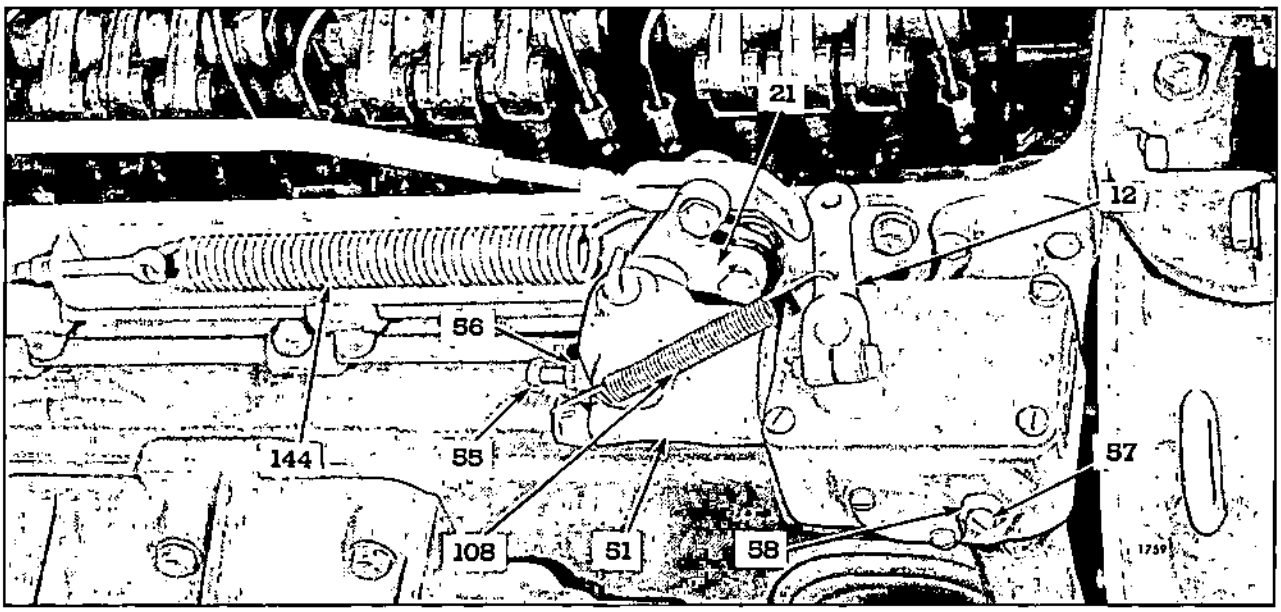


Fig. 12 - Buffer and Idle Speed Adjusting Screws

12. Lever--Stop
21. Lever--Speed Control
51. Housing--Variable Speed Spring
55. Screw--Idler Speed Adjusting
56. Lock Nut
57. Screw--Buffer
58. Lock Nut
108. Spring--Lever Retracting
144. Spring--Variable Speed Booster

Adjust the No. 1 injector rack control lever (267) Fig. 11 first, to establish a guide for adjusting the remaining injector rack control levers.

1. Disconnect any linkage attached to the stop lever.

2. Loosen the lock nut (58), Fig. 12, and back out the buffer screw (57) approximately 5/8".

3. Loosen all the inner and outer adjusting screws shown in Fig. 11. Be sure all the injector rack control levers are free on the injector control tube.

4. Move the speed control lever to the maximum speed position.

5. Move the stop lever to the RUN position. Hold it in that position with light finger pressure. Turn the inner adjusting screw into No. 1 injector rack control lever until a step up in effort is noted. This will place No. 1 injector rack in the FULL FUEL position. Turn the outer adjusting screw until it bottoms lightly on the injector control tube. Then alternately tighten both the inner and outer adjusting screws.

   NOTE: The above step should place the governor linkage and control tube assembly in the same position they will attain when the engine is running at full load.

6. To be sure the injector rack control lever is properly adjusted, the following check should be performed.

   Hold the stop lever in the RUN position and press down on the injector rack with a screw driver or finger tip, causing the rack to rotate. The setting is sufficiently tight if the injector rack returns to its original position.

   If the rack does not return to its original position, it is too loose. To correct, back off the outer adjusting screw slightly and tighten the inner adjusting screw slightly.

   The setting is too tight if when moving the stop lever from the STOP to the RUN position, the injector rack becomes tight before the stop lever reaches the end of its travel (as determined by the stop under the governor cover). This will result in a step-up in effort required to move the stop lever to the end of its travel. To correct this condition, back off the inner adjusting screw slightly and tighten the outer adjusting screw slightly.

7. Manually hold No. 1 injector rack control lever in the full fuel position and turn the inner ad-

justing screw (270), Fig. 11, into No. 2 injector rack control lever until the injector rack has moved into the full fuel position and the screw is bottomed on the injector control tube. Turn the outer adjusting screw (271) until it bottoms lightly on the injector control tube. Then alternately tighten both the inner and outer adjusting screws until they are tight.

8. Recheck No. 1 injector rack to be sure that it has remained snug on the ball end of the rack control lever while positioning No. 2 injector rack. If the rack in No. 1 injector has become loose, back off the inner adjusting screw slightly in No. 2 injector rack control lever. Tighten the outer adjusting screw.

   When the settings are correct, the rack of both injectors must be snug on the ball end of their respective rack control levers.

9. Position the remaining injector rack control levers as outlined in Steps 7 and 8.

Adjust Maximum No-Load Speed

The maximum no-load speed on engines equipped with variable speed governors is shown in Table 1 below.

TABLE 1--SPEED DROOP CHART

Engine	Injector	Full Load Speed	Max. Droop	Max. No. Load Speed
3-71	HV55,6,7	1200-2100	140	1340-2240
	HV8	1200-2100	175	1375-2275
	S55	1200-2100	140	1340-2240
4-71	HV6,7	1200-2300	140	1340-2440
	HV8	1200-2300	175	1375-2475
4-71E&N(4V)	S55,60,70	1200-2100	140	1340-2240
	N55,60,70	1200-2100	140	1340-2240
	N65	1200-2100	165	1365-2265
6-71	HV6,7	1200-2300	140	1340-2440
6-71&6-71M	HV8,9&N80	1200-2300	175	1375-2475
6-71E(2V)	HV6	1200-2100	140	1340-2240
6-71E&N(4V)	S55,60,70	1200-2100	140	1340-2240
	N55,60,70	1200-2100	140	1340-2240
	N65	1200-2100	165	1365-2265

Determine the maximum no-load speed of the engine with a hand tachometer, then, make the following adjustments, if required:

1. Refer to Fig. 12 and disconnect the booster spring.

2. Remove the two bolts and withdraw the variable speed spring housing (51), spring plunger and spring as an assembly.

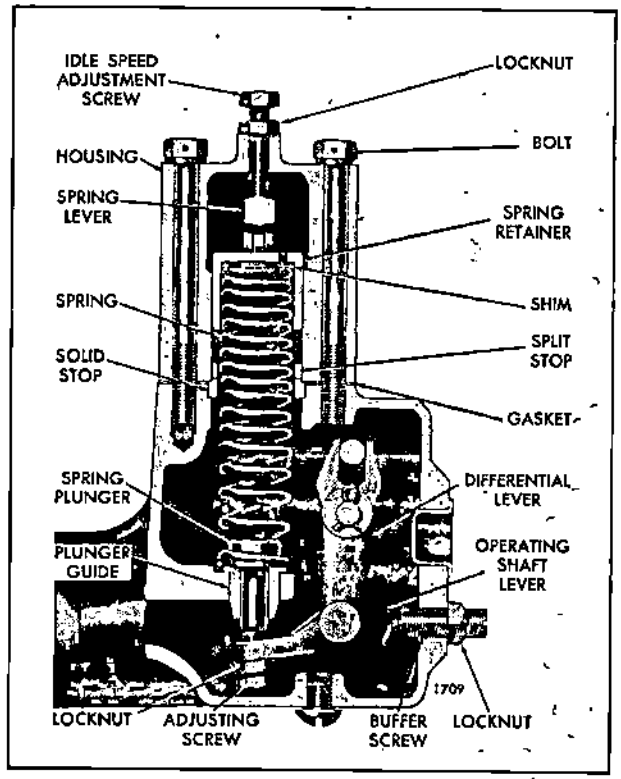


Fig. 13 - Location of Stops and Shims

3. Refer to Table 2 and determine the stop or shim required for the desired full load speed for an engine with a two valve cylinder head.

TABLE 2--TWO VALVE CYLINDER HEAD

Full Load Speed	Stops	Shims
1200 to 1425 rpm	2	Up to .325"
1426 to 1825 rpm	1	Up to .325"
1826 to 2100 rpm	0	Amount Required to get necessary speed.

Refer to Table 3 and determine the stops or shims required for the desired full-load speed for an engine with a four valve cylinder head.

TABLE 3--FOUR VALVE CYLINDER HEAD

Full Load Speed	Stops	Shims
1450 to 1800 rpm	2	Amount Required to get necessary speed.
1801 to 2250 rpm	1	
2251 to 2450 rpm	0	

4. Install the variable speed spring housing and recheck the maximum no-load speed.
5. If required, add shims in the spring plunger to obtain the necessary operating speed. For each .001" shim added, the operating speed will increase approximately 1 rpm.

   NOTE: If the maximum no-load speed is raised or lowered more than 50 rpm by the installation or removal of governor shims, the governor gap should be rechecked.

If re-adjustment of the governor gap is required, the position of the injector racks must be rechecked.

Adjust Idle Speed

With the maximum no-load speed properly adjusted, the idle speed may be adjusted as follows:

1. Place the speed control lever in the IDLE position and the stop lever in the RUN position as shown in Fig. 12.
2. With the engine running at normal operating temperature, back out the buffer screw to avoid contact with the differential lever.
3. Loosen the lock nut (56) and turn the idle speed adjusting screw (55) until the engine is operating at approximately 15 rpm below the recommended idle speed.

   The recommended idle speed is 500-600 rpm but may vary with the engine application.
4. Hold the idle speed adjusting screw and tighten the lock nut.

Adjust Buffer Screw

With the idle speed set at approximately 15 rpm below the recommended idle speed, the buffer screw may be set as follows:

1. Turn the buffer screw (57) in until the engine is operating at the recommended idle speed.

   Do not raise the engine speed more than 15 rpm with the buffer screw.
2. Recheck the maximum no-load speed. If it has increased more than 25 rpm, back off the buffer screw until the increase is less than 25 rpm.
3. Hold the buffer screw and tighten the lock nut.

Adjust Booster Spring

With the idle speed adjusted, the booster spring is adjusted as follows:

1. Refer to Fig. 12 and loosen the booster spring retaining nut on the speed control lever (21). Loosen the nut and lock nut on the eyebolt at the opposite end of the spring (144).
2. Move the bolt up or down in the slot in the speed control lever (21) until the center of the bolt is on or slightly below an imaginary line through the center of the bolt, lever shaft, and eyebolt. Hold the bolt and tighten the lock nut.
3. Start the engine and move the speed control lever (21) to the maximum speed position and release it. The speed control lever should return to the idle position. If it does not, reduce the booster spring tension. If it does, continue to increase the spring tension until it will not return to idle. Then, reduce the tension until it does return to idle and tighten the lock nut on the eyebolt. This setting will result in the minimum force to operate the speed control lever.

HYDRAULIC SG GOVERNOR AND INJECTOR RACK CONTROL ADJUSTMENT

After adjusting the exhaust valves and timing the fuel injectors, adjust the hydraulic governor and injector rack control levers.

Adjust Fuel Rod

1. Remove the governor cover, Fig. 15, and loosen all the inner adjusting screws (270) and outer adjusting screws (271). Make sure all control levers (267) are free on the injector control tube.
2. Loosen the fuel rod lock nut, Fig. 14, and remove the fuel rod knob.
3. Turn the lock nut until 3/16" of the fuel rod extends beyond the nut. Then, reinstall the fuel rod knob and tighten the lock nut.

Position Injector Rack Control Levers

After the fuel rod is properly adjusted, the rack control levers may be adjusted as follows:

1. Turn the outer adjusting screw (271), Fig. 15, in until a slight movement of the injector control tube lever (265) is observed. Then, tighten the inner adjusting screw (270).

Fig. 14 - Adjusting Fuel Rod

2. Pull the fuel rod out and check for 1/32" to 1/16" movement.

   If the movement exceeds the distance specified, back off the inner adjusting screw approximately 1/8 of a turn and tighten the outer adjusting screw.

   If the movement is less than the specified distance, back off the outer adjusting screw approximately 1/8 of a turn and tighten the inner adjusting screw.

3. Disconnect the fuel rod (14) from the injector rack control tube lever (265).

4. Manually hold No. 1 injector rack control lever in the full fuel position and turn the inner adjusting screw (270), Fig. 15, into No. 2 injector rack control lever until the injector rack has moved into the full fuel position and the inner adjusting screw is bottomed on the injector control tube. Turn the outer adjusting screw (271) down until it bottoms lightly on the injector control tube. Then, alternately tighten both the inner and outer adjusting screws until they are tight.

5. Recheck No. 1 injector fuel rack to make sure that it has remained snug on the ball end of the rack control lever while adjusting No. 2 injector rack. If the rack of No. 1 injector has become loose, back off slightly on the inner adjusting screw on No. 2 injector rack control lever. Tighten the outer adjusting screw.

   When the settings are correct, the racks of both injectors must be snug on the ball end of the respective rack control levers.

6. Position the remaining injector rack control levers as outlined in Steps 4 and 5.

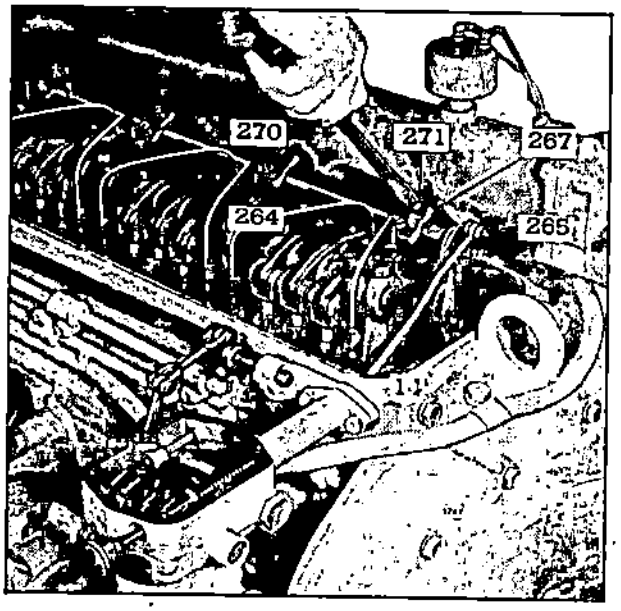


Fig. 15 - Positioning No. 1 Injector Rack Control Lever

14. Rod--Fuel
264. Tube--Injector Control
265. Lever--Injector Control Tube
267. Lever--Injector Rack Control
270. Screw--Control Lever Adjusting
271. Screw--Control Lever Adjusting

When the settings are correct, the racks of all the injectors must be snug on the ball end of the rack control levers when the control tube lever is held in the full fuel position.

7. Reconnect the fuel rod to the injector rack control tube lever.

Adjust Load Limit

The load limit is set at the factory and further adjustment should be unnecessary. However, if the governor has had major repairs or the injector rack control levers have been repositioned, the load limit screw should be re-adjusted.

With the injector rack control levers properly adjusted, the load limit may be set as follows:

1. Place the fuel rod (14) and terminal lever (132) in the FULL FUEL position as shown in Fig. 16.

2. Loosen the lock nut (25) and turn the adjusting screw (24) until a .020" space exists between the fuel rod collar (22) and the terminal lever (132). Hold the adjusting screw and tighten the lock nut.

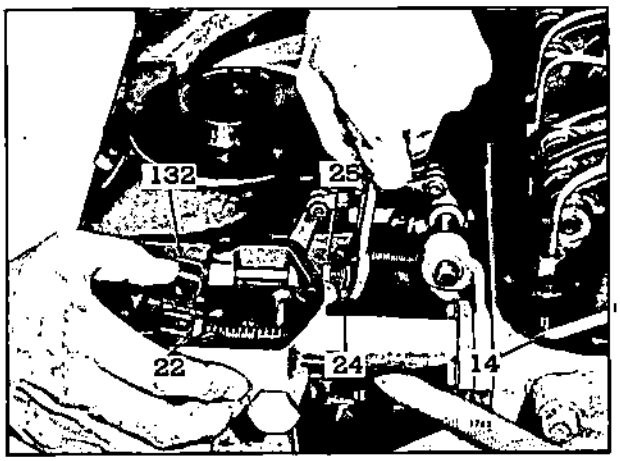


Fig. 16 - Load Limit Adjustment

14. Rod--Fuel
22. Collar--Fuel Rod
24. Screw--Load Limit Adjusting
25. Lock Nut
132. Lever--Terminal

Adjust Speed Droop

The purpose of adjusting the speed droop is to establish a definite engine speed at no-load with a given speed at rated full load.

The governor is set at the factory and further adjustment should be unnecessary. However, if the governor has had major repairs, the speed droop should be re-adjusted.

Use an accurate hand tachometer to determine the engine speed.

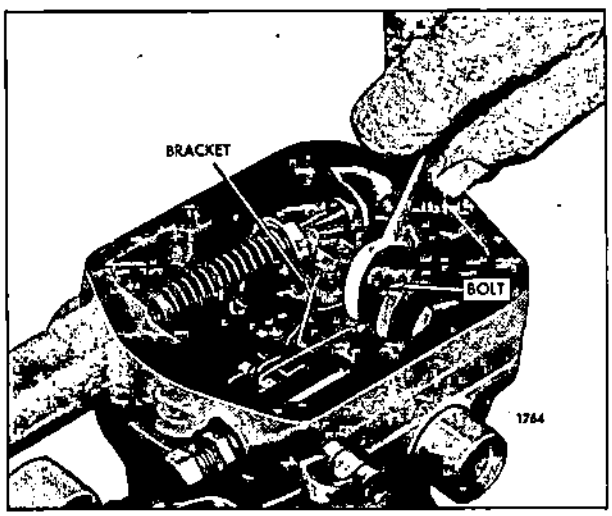


Fig. 17 - Speed Droop Adjustment

When a full rated load on the unit is established and the fuel rod, injector rack control levers, and load limit have been adjusted, the speed droop may be adjusted as follows:

1. Start the engine and operate at approximately one-half the rated no-load speed until the lubricating oil has had an opportunity to warm-up.

   NOTE: When the engine lubricating oil is cold, the governor regulation may be erratic. The regulation should become increasingly stable as the temperature of the lubricating oil increases.

2. Stop the engine and remove the governor cover.

3. Loosen the lock nut, Fig. 18, and back off the maximum speed adjusting screw approximately 5/8".

4. Refer to Fig. 17 and loosen the speed droop adjusting bolt. Move the speed droop adjusting bracket so the bolt is midway between the ends of the slot in the bracket. Tighten the bolt.

   Be sure the bracket remains on the shoulder of the terminal lever.

5. With the throttle in the RUN position, adjust the speed until the engine is operating at 5% above the recommended full load speed.

6. Apply the full rated load on the engine and re-adjust the engine speed to the correct full load speed.

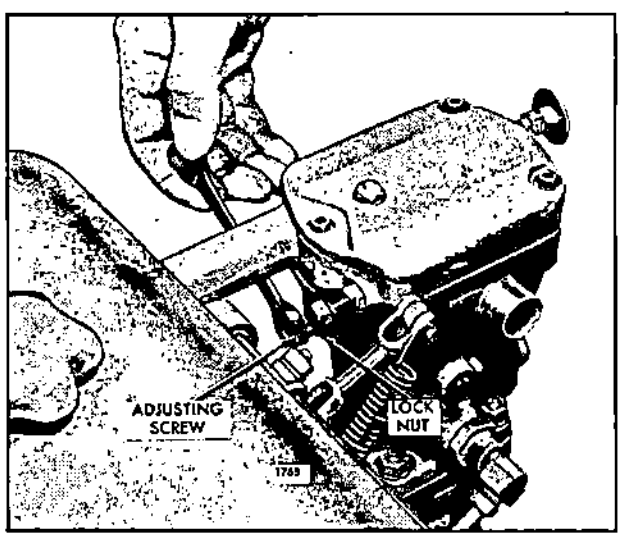


Fig. 18 - Adjusting Maximum No-Load Speed

7. Remove the rated load and note the engine speed after the speed has stabilized under no-load. If the speed droop is correct, the engine speed will be approximately 5% higher than the full load speed.

   If the speed droop is too high, stop the engine, loosen the bolt again and move the speed droop adjusting bracket IN (toward the engine). Tighten the bolt. To increase the speed droop, move droop adjusting bracket OUT, (away from the engine).

If the speed droop in the governors of power generator engines are not the same, the electrical load will not be equally divided when the generators are operated in parallel.

The speed droop bracket in the governor of each engine must be adjusted to obtain the desired variation between the engine no-load and full-load speeds shown in the table.

Full-Load	No-Load
50 cycles 1000 rpm	52.5 cycles 1050 rpm
60 cycles 1200 rpm	62.5 cycles 1250 rpm
50 cycles 1500 rpm	52.5 cycles 1575 rpm
60 cycles 1800 rpm	62.5 cycles 1875 rpm

The recommended speed droop at full-load for power generator units operating in parallel is 50 rpm (2-1/2 cycles) at 1000 and 1200 rpm. For units operating at 1500 and 1800 rpm the speed droop should be 75 rpm (2-1/2 cycles). The speed droop may be varied to suit the particular application.

Adjust Maximum No-Load Speed

After the speed droop is properly adjusted, the maximum no-load speed may be set as follows:

1. Operate the engine at no-load, approximately 8% above the rated full-load speed.

2. Turn the maximum speed adjusting screw, Fig. 18, in until the engine is operating approximately 6% above the rated full-load speed.

3. Hold the adjusting screw and tighten the lock nut. Then install the governor cover.

Governors with Synchronizing Motor

Some hydraulic governors are equipped with a reversible synchronizing motor which is mounted on the governor cover, Fig. 19. This motor makes a close adjustment of the engine speed possible by remote control and is especially valuable for synchronizing two generators from a central control panel.

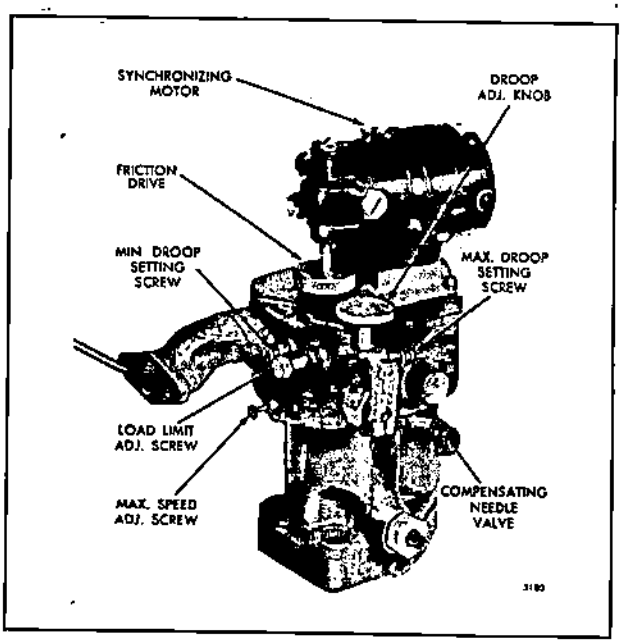


Fig. 19 - Typical Synchronizing Motor Mounting

The motor is connected to the source of electrical supply through a two-way switch located on the control panel. When this switch is held in the desired position, the motor shaft turns the governor speed adjusting shaft by means of a reduction gear and slip coupling. The position of the switch determines the direction of rotation of the speed adjusting shaft. When the desired engine speed is indicated on a tachometer or frequency meter mounted on the control panel, the switch is placed in the "OFF" position.

> **NOTE:** If the switch is held in the "Lower Speed" position too long, the synchronizing motor will continue to lower the engine speed and the engine will ultimately stop. If the switch is held in the "Raise Speed" position too long the synchronizing motor will turn the speed adjusting shaft until it strikes the maximum speed adjusting screw. The clutch or slip coupling will slip and the motor will continue to run at a slightly reduced speed without effecting the governor after the shaft strikes the adjusting screw.

The adjustments on a governor equipped with a synchronizing motor are the same as on a governor without the motor. If the governor does not have an external droop setting screw, Fig. 19, the governor cover and motor assembly must be removed when the engine speed droop is set. Reinstall the governor cover and motor to check the speed droop.

MECHANICAL OUTPUT SHAFT GOVERNOR AND LINKAGE ADJUSTMENT

A Pierce mechanical governor is used to maintain a near constant output shaft speed on engines equipped with a torque converter. The governor may be mounted at the front of the engine (Fig. 20) and driven by a flexible shaft from the converter output shaft, or may be mounted on the torque converter and gear driven from the output shaft (Fig. 21).

Lubrication for the direct driven governor is provided by an external oil line from the torque converter. The engine mounted governor is lubricated by engine oil contained within the governor housing. The governor sump is filled through the hinged cap oiler until the oil begins to drip out of the oil level hole. After filling, a plug is installed in the oil level hole to prevent leakage.

The output shaft governor is connected to the engine governor by control rods and levers as illustrated in Figs. 20 and 21. The control rod end ball joints are sealed assemblies and do not require lubrication. However, the throttle control shaft bearings should be lubricated periodically with all purpose grease through the grease fittings. Other moving parts of the control linkage should be lubricated with engine oil.

The centrifugal force of the revolving output shaft governor flyweights is converted into linear motion which is transmitted through a riser, thrust bearing, operating fork, and rocker shaft to an external speed adjusting spring. The speed of the torque converter output shaft is governed by the tension of the speed adjusting spring. This spring tension is established by the operator when he moves the output shaft governor speed adjusting lever to the desired speed setting.

The engine governor operating lever is positioned by the operator to limit the maximum fuel input to the engine. For most purposes, such as drag line and shovel operation, the lever is advanced to its maximum position to permit the output shaft governor to obtain full power from the engine. The lever may be used as an overrule lever when performing such jobs as laying of structural steel. A spring is used to return the lever to the idle position. Travel of the governor operating lever is limited by a stop (bolt).

The engine governor throttle control lever is pinned to the throttle shaft. The engine governor operating lever is mounted below the throttle control lever and rides on the throttle shaft boss on the governor cover. The output shaft governor lever is mounted above the throttle control lever and is retained on the shaft by a snap ring. A stop pin, pressed into the throttle control lever, transmits movement of the output shaft governor lever and/or engine governor operating lever through the throttle control lever to the injector racks. The torsion spring, used to retain the throttle control lever stop pin against the output shaft governor lever, yields to permit the governor operating lever to move the

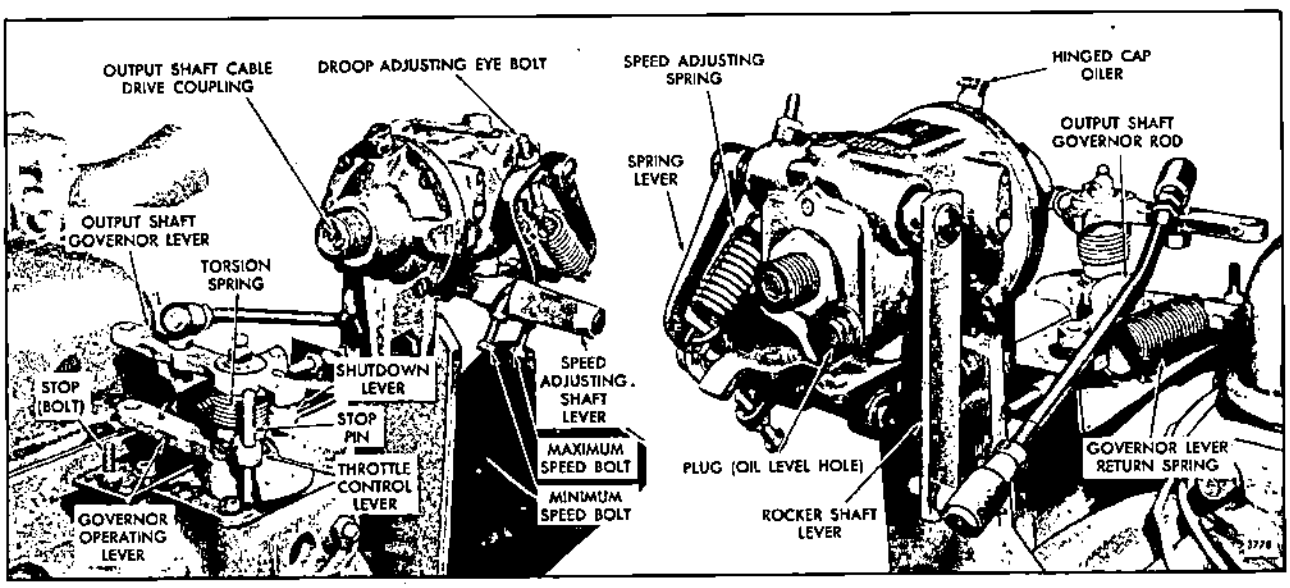


Fig. 20 – Flexible Shaft Driven Output Shaft Governor and Linkage

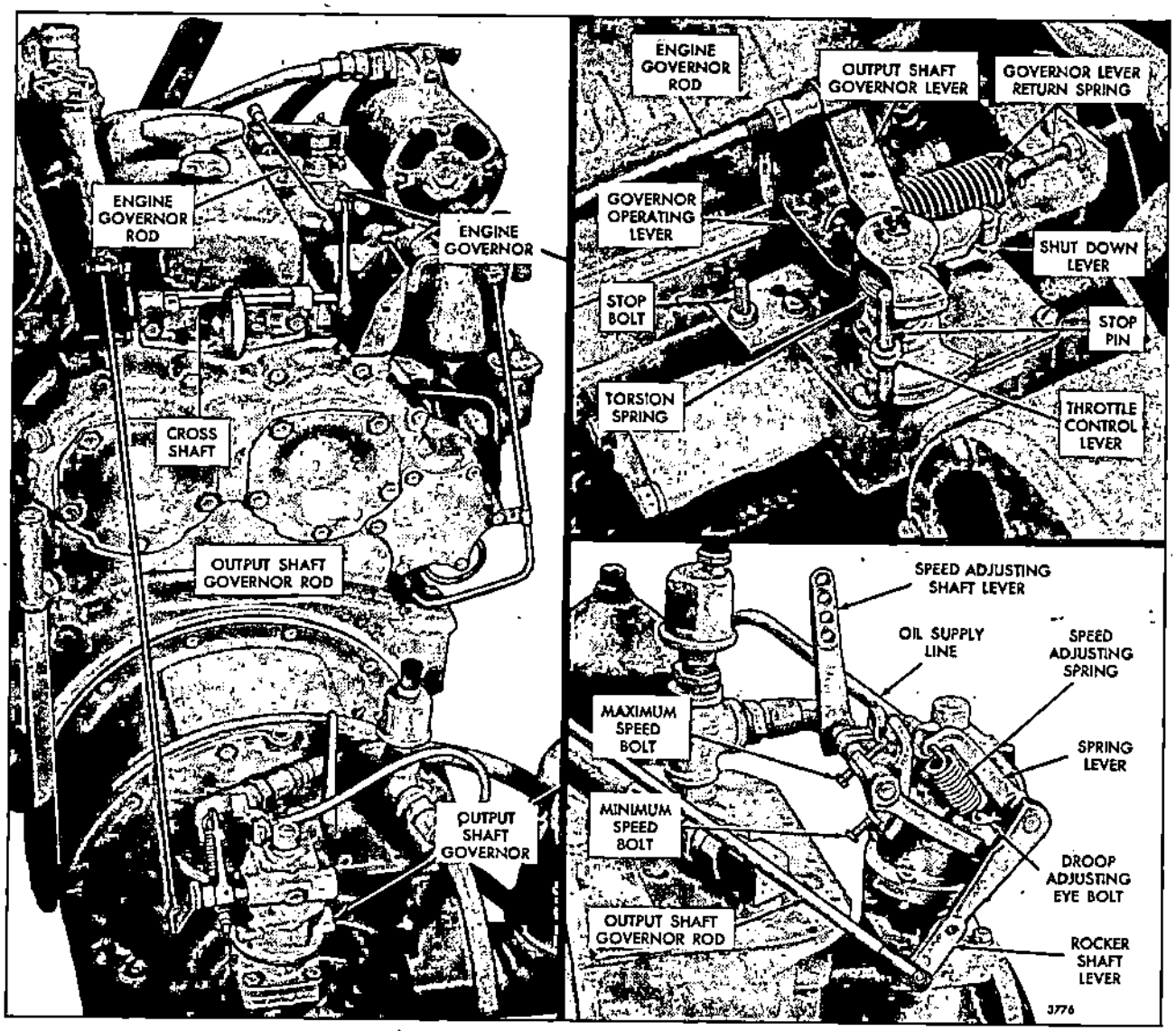


Fig. 21 - Gear Driven Output Shaft Governor and Linkage

throttle control lever toward the idle position, regardless of the position of the output shaft governor lever. A slot in the underside of the governor cover hub limits the travel of the throttle control lever in both its maximum and minimum speed positions.

Movement of the output shaft governor speed adjusting lever is limited by the maximum and minimum speed adjusting bolts.

The engine shut-down lever is connected through a shaft to another lever, under the governor cover, which bears against the pin in the differential lever. To stop the engine, the shut-down lever is used to move the differential lever to the no-fuel position.

Operation

When the output shaft governor speed adjusting lever is advanced, the tension on the speed adjusting spring is increased. The force resulting from the increased spring tension is transmitted through the rocker shaft lever and control linkage to the throttle control lever which advances the injector racks. Engine speed increases, as a result of the increased fuel, until the output shaft governor weight force is sufficient to balance the increased spring tension. The weights then move against the spring and reduce the injector rack fuel setting to an amount sufficient to maintain the higher engine speed setting.

Should the operator move the speed adjusting shaft lever to a decreased speed position, the tension on the speed adjusting spring will decrease and the governor weights will overcome the spring tension and move the rocker shaft lever to a decreased fuel position. The engine speed will be reduced until the force of the output shaft governor weights equals the tension of the speed adjusting spring. The engine will then operate at the desired reduced engine speed.

When a load is applied to the unit, the output shaft slows down and the force exerted by the governor flyweights is reduced, allowing the spring to move the rocker shaft lever to an increased fuel position to provide sufficient power to equal the new load.

When the load on the unit is removed, the output shaft speed will increase and the force exerted by the governor flyweights will increase, overcoming the spring tension and moving the rocker shaft lever to a decreased fuel position to reduce the power to match the reduced load.

Tune-Up

Adjust the exhaust valve clearance, time the injectors and adjust the engine and output shaft governors as follows:

1. Adjust the exhaust valve clearance and time the fuel injectors.

2. Disconnect the output shaft governor rod and the linkage to the engine governor operating lever. Then, adjust the engine governor as outlined under "Limiting Speed Mechanical Governor and Injector Rack Control Adjustment".

   NOTE: Set the No-Load engine speed to that specified on the engine option plate. The No-Load speed varies with the converter used and the maximum output shaft speed setting.

3. Reconnect the linkage to the governor operating lever and check the total travel of the operating lever. The lever should move to the stop (bolt) in one direction and the governor lever return spring should move the lever, in the other direction, until the throttle control lever reaches the end of its travel.

4. Move the governor operating lever to the maximum speed position (against the stop bolt).

5. Move the output shaft governor rocker shaft lever to the maximum fuel position and retain it by moving the speed adjusting lever to the full speed position. Then move the output shaft governor lever and the throttle control lever together to the maximum speed position and retain there.

   NOTE: This operation closes the low speed gap which may require more torque than is available from the torsion spring between the above two levers. Thus, it is important that they be held together, permitting no space between the throttle control lever pin and the arm of the output shaft governor lever.

6a. Adjust the flexible-shaft driven output shaft governor rod length until it will just slide into the inner hole of the output shaft governor lever (Fig. 20). Then, increase the length of the rod until there is approximately .020" clearance between the stop pin and the output shaft governor lever, and the bend in the rod is positioned as shown in Fig. 19. Tighten the adjustment.

6b. To adjust the linkage between the output shaft governor (mounted on the torque converter) and the engine governor, loosen the output shaft governor rod clamping bolt in the ball joint in the rear cross shaft lever (Fig. 21). Next, move the output shaft governor rod until there is approximately .020" clearance between the stop pin and the output shaft governor lever. Then, tighten the clamping bolt securely.

   NOTE: The engine governor control rod is connected to the outer bolt hole in the output shaft governor lever on units equipped with a rear mounted output shaft governor.

7. Adjust the governor operating lever return spring by retaining the rocker shaft lever in the full speed position and increasing the tension on the spring by adjusting the eyebolt and nuts, until the tension of the torsion spring is overcome and the throttle control lever is moved against its stop in the idle position.

8. Move the output shaft governor speed adjusting lever to the minimum speed position and start the engine.

9. Advance the output shaft governor speed adjusting lever to the desired maximum output shaft speed and adjust the maximum speed adjusting bolt to retain the lever.

10. Move the output shaft governor speed adjusting

shaft lever to the desired minimum speed position and adjust the minimum speed adjusting bolt to retain the lever.

11. Recheck the output shaft maximum and minimum speeds and readjust the position of the speed adjusting bolts, if necessary.

12. To check the unit for stability as affected by governor speed droop, move the speed adjusting shaft lever, with the engine operating at no load, to the maximum speed position. Then, move the output shaft governor rod to cause a speed decrease of several hundred rpm. Release the rod and check for hunting when the governor returns the engine to the maximum speed setting. If the engine stabilizes in less than three surges, the droop may be set too high; if the engine does not stabilize in five surges, the droop may be set too low. Set the speed droop as follows:

    a. If the engine hunts less than three surges, back off the outer speed adjusting spring eyebolt nut one full turn and tighten the inner nut one turn to retain the adjustment. If the engine hunts more than five surges, back off the inner speed adjusting spring eyebolt nut one full turn and tighten the outer nut one turn to retain the adjustment.

    NOTE: The eye of the bolt must be in a horizontal plane to avoid twisting the spring.

    b. Reset the maximum engine no-load speed, if necessary, as outlined in Steps 9 and 10.

    c. Recheck the speed droop. The engine speed should be stable when the governor droop is 7-1/2% to 10% of the full-load speed. For example, at an output shaft speed setting of 1800 rpm full load, the output shaft speed droop should be 150 to 200 rpm. Therefore, the no-load output shaft speed should be set at 1950 to 2000 rpm.

HYDRAULIC OUTPUT SHAFT GOVERNOR AND LINKAGE ADJUSTMENT

A hydraulic governor is used to maintain a near constant output shaft speed on engines equipped with a Series 500 or larger Torqmatic converter. The governor is mounted on the converter and gear driven from the output shaft.

The output shaft governor is connected to the engine governor by control rods and levers (Figs. 22 and 23). The control rod end ball joints are sealed assemblies and do not require lubrication. However, the throttle control shaft bearings should be lubricated periodically with all purpose grease through the grease fittings. Other moving parts of the control linkage should be lubricated with engine oil.

In most applications, such as drag line and shovel operation, it is desirable to have the output shaft governor control the fuel input to maintain a relatively constant output shaft speed. The output shaft speed will be constant up to full power of the engine, except for the amount of governor droop. The speed setting of the engine governor must be sufficiently higher than the speed setting of the output shaft governor so the engine governor will not reduce the fuel input to the engine before full power is required by the output shaft governor. As load is applied to the output shaft, the output shaft speed will decrease gradually up to the amount of the output shaft governor droop at full load. At the same time, the engine speed will gradually increase until full load is reached.

In some types of operation, such as laying of structural steel, it is desirable to operate the unit with a very low output shaft speed. This speed could be so low that the output shaft governor ball head assembly would not actuate the governor pilot valve and spring seat assembly. In such applications, the engine governor operating lever (6), Fig. 22, or the remote throttle control lever (1), Fig. 23, used as an overrule lever, can be moved toward the idle speed position sufficiently to provide the desired low output shaft speed. Output shaft speeds down to zero can be obtained through this type of engine governor control. The engine governor would maintain control unless the output shaft speed increased to the speed setting of the output shaft governor.

Two types of governor control linkages are in use. The adjustment procedure for each type is outlined in the following paragraphs.

Adjustments (Type A - Fig. 22)

The engine governor throttle control lever (Fig. 22) is pinned to the throttle shaft. The engine governor operating lever is mounted below the throttle control lever and rides on the throttle shaft boss on the governor cover. The output shaft governor lever is mounted above the throttle control lever and is retained on the shaft by a snap ring. A stop pin, pressed into the throttle control

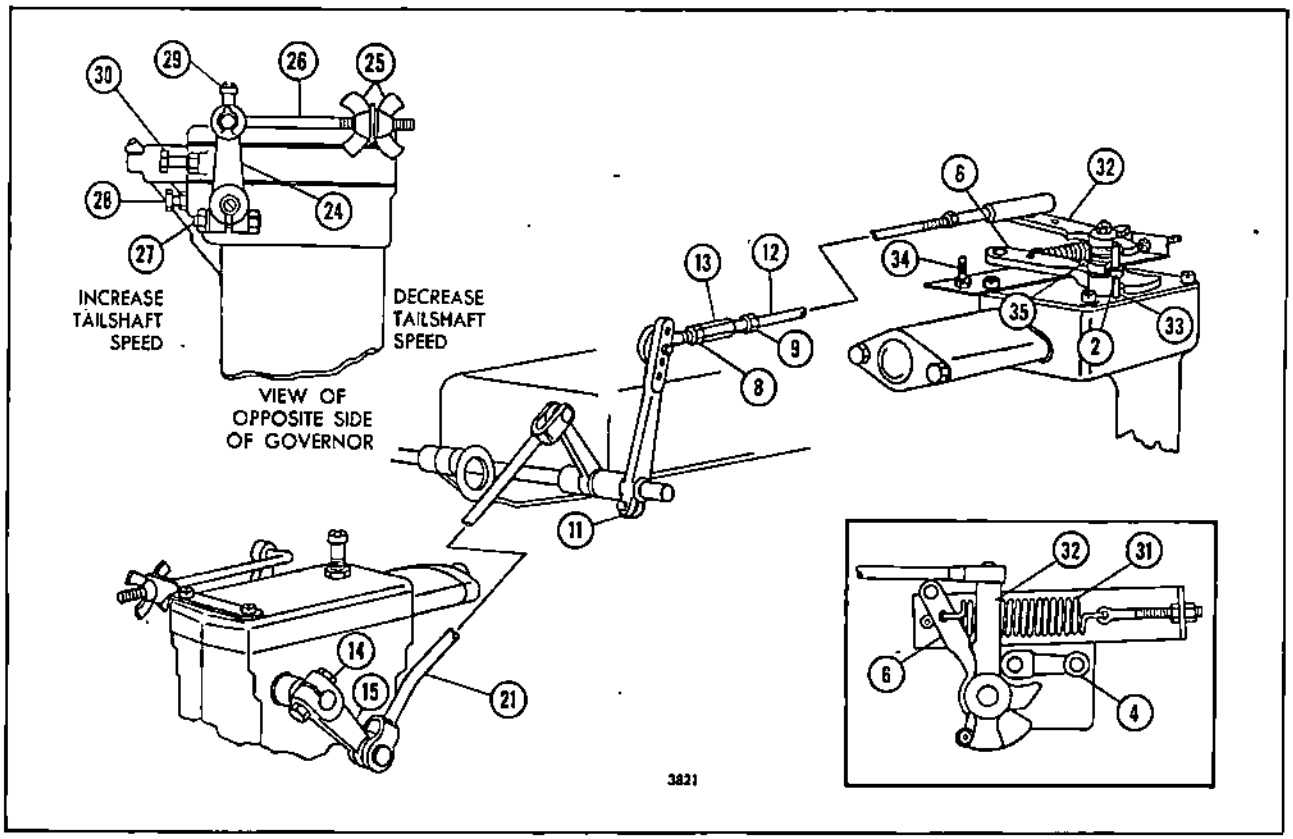


Fig. 22 - Hydraulic Output Shaft Governor and Linkage (Type A)

2. Lever--Throttle Control
4. Lever--Shut Down
6. Lever--Governor Operating
8. Lock Nut--Turnbuckle
9. Lock Nut--Turnbuckle
11. Lever--Throttle Control Rear Cross-Shaft
12. Rod--Engine Governor
13. Turnbuckle
14. Bolt
15. Lever--Output Shaft Governor Control
21. Rod--Output Shaft Governor
24. Lever--Speed Control
25. Wing Nuts--Speed Adjusting
26. Link--Sliding
27. Bolt
28. Screw--Maximum Speed Limit Adjusting
29. Screw--Minimum Speed Limit Adjusting
30. Screw--Maximum Fuel Adjusting
31. Spring--Governor Lever Return
32. Lever--Output Shaft Governor
33. Pin--Stop
34. Bolt--Stop
35. Spring--Torsion

lever, transmits movement of the output shaft governor lever and/or engine governor operating lever through the throttle control lever to the injector racks. The torsion spring, used to retain the throttle control lever stop pin against the output shaft governor lever; yields to permit the governor operating lever to move the throttle control lever toward the idle position, regardless of the position of the output shaft governor control lever. A slot in the underside of the governor cover hub limits the travel of the throttle control lever in both the maximum and minimum speed positions.

The engine shut-down lever is connected through a shaft to another lever, under the governor cover, which bears against the pin in the differential lever. To stop the engine, the shut-down lever is used to move the differential lever to the no-fuel position.

The following linkage and governor adjustments should be made with the engine stopped, after the limiting speed engine governor has been adjusted as outlined under Limiting Speed Mechanical Governor and Injector Rack Control Adjustment.

1. Connect the linkage to the governor operating lever (Fig. 22) and check the total travel of the lever. The lever should move to the stop bolt in one direction and the governor lever return spring should move the lever, in the other direction, until the throttle control lever reaches the end of its travel.

2. Move the governor operating lever to the maximum speed position (against the stop bolt).

3. Move the output shaft governor control lever to the full-fuel position and retain it by moving the speed control lever to the maximum speed position. Then, move the output shaft governor lever (on the engine governor cover) and the throttle control lever together to the maximum speed position and retain there.

   NOTE: This operation closes the low speed gap (in the engine governor) which may require more torque than is available from the torsion spring between the two levers. Thus, it is important that they be held together, permitting no space between the throttle control lever pin and the arm of the output shaft governor lever.

4. To adjust the linkage between the output shaft governor and the engine governor, loosen the output shaft governor rod clamping bolt in the ball joint in the rear cross-shaft lever. Next, move the output shaft governor rod until there is approximately .020" clearance between the stop pin and the output shaft governor lever. Then, tighten the clamping bolt securely.

   NOTE: The engine governor control rod is connected to the outer bolt hole in the output shaft governor lever.

5. To adjust the governor operating lever return spring, retain the output shaft governor control lever in the full-fuel position and increase the tension on the spring by adjusting the eyebolt and lock nuts until the tension of the torsion spring is overcome and the throttle control lever is moved against the stop in the idle position.

Final Adjustments

Move the output shaft governor lever in the idle speed position and start the engine.

After the engine reaches normal operating temperature, advance the output shaft governor speed control lever to the maximum speed position and check the Torqmatic converter output shaft speed. This speed will vary depending upon engine application.

If it is necessary to adjust the output shaft speed, loosen the wing nuts on the sliding link and move the speed control lever to increase or decrease the speed as needed.

The output shaft governor is driven through the converter and there is a high droop. Therefore, the no-load speed setting should be at least 150 rpm higher than the desired full-load speed setting. Tighten the wing nuts after completing the adjustment.

CAUTION: Do not set the Torqmatic converter output shaft speed in excess of the speed specified by the equipment manufacturer, to prevent damage to the driven machinery.

It will be noted during engine operation that the minimum droop will vary between 150 and 175 rpm. If the droop requires adjustment, move the droop bracket (inside the output shaft governor) to decrease or increase the amount of droop.

NOTE: To compensate for the output shaft speed droop, the engine no-load speed must be set approximately 175 rpm above the required engine full-load speed.

Move the output shaft governor speed control lever to the idle speed position and adjust the idle speed by means of the minimum speed limit adjusting screw.

The maximum fuel adjusting screw and the maximum speed limit adjusting screw are not used and should be backed out to prevent interference.

Adjustments (Type B - Fig. 23)

The following linkage and governor adjustments should be made with the engine stopped, and after the limiting speed engine governor has been adjusted as outlined under Limiting Speed Mechanical Governor and Injector Rack Control Adjustment.

1. Place the remote throttle control lever (1), Fig. 23, in the "MAXIMUM SPEED" position.

2. Move the governor speed control lever (6) and governor stop lever (4) into the "idle" notch in the governor cam (5). The repulsing spring (7) should be fully compressed when the stop lever reaches the "idle" notch of the governor cam.

   If the repulsing spring is not fully compressed, loosen the bolt (3) in the governor speed control lever and move the lever until the spring is compressed.

   If the repulsing spring becomes fully compressed before the governor stop lever reaches the "idle" notch in the governor cam loosen

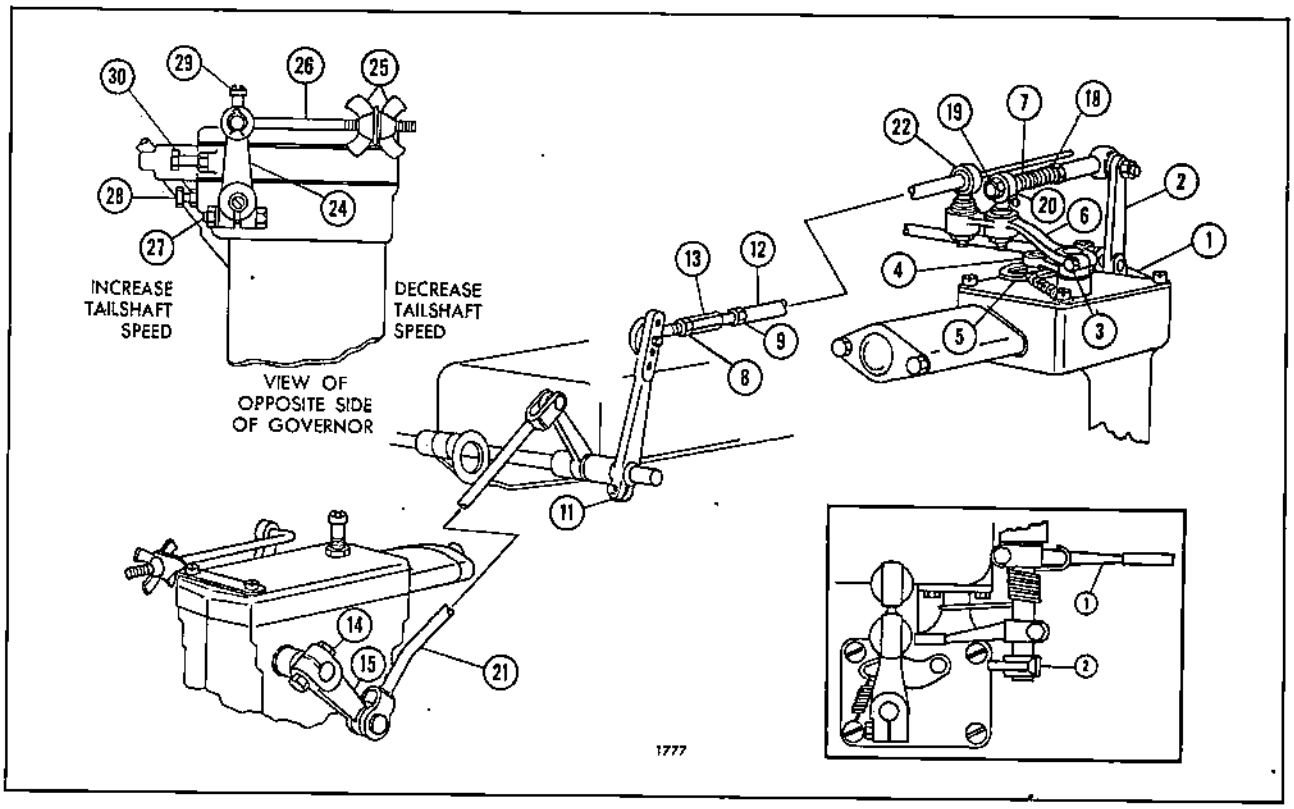


Fig. 23 - Hydraulic Output Shaft Governor and Linkage (Type B)

1. Lever--Remote Throttle Control
2. Lever--Governor Throttle Control
3. Bolt
4. Lever--Governor Stop
5. Cam--Governor
6. Lever--Governor Speed Control
7. Spring--Repulsing
8. Lock Nut--Turnbuckle
9. Lock Nut--Turnbuckle
11. Lever--Throttle Control Rear Cross-Shaft
12. Rod--Throttle
13. Turnbuckle
14. Bolt
15. Lever--Output Shaft Governor Control
18. Lock Nut
19. Bolt--Spring
20. Bearing--Rod End
21. Rod--Throttle
22. Bearing--Rod End
24. Lever--Speed Control
25. Wing Nuts--Speed Adjusting
26. Link--Sliding
27. Bolt
28. Screw--Maximum Speed Limit Adjusting
29. Screw--Minimum Speed Limit Adjusting
30. Screw--Maximum Fuel Adjusting

the bolt (3) in the governor speed control lever and manually move the stop lever into the "idle" notch.

3. Hold the governor stop lever (4) halfway between the IDLE and MAXIMUM SPEED positions, and loosen the lock nuts (8) and (9). Adjust the turnbuckle (13) so the rear cross-shaft lever (11) is vertical.

4. Loosen the bolt (14) and remove the output shaft governor control lever (15). Place the governor stop lever (4) into the IDLE position by moving the rear cross shaft lever (11) and reinstall the output shaft governor control lever.

   NOTE: Move the rear cross shaft lever (11) into the MAXIMUM SPEED position and check to see that there is no binding between the clevis on the end of the throttle rod (21) and the output shaft governor control lever (15).

5. Move the governor stop lever (4) into the MAXIMUM SPEED position in the governor cam (5) and check to see that there is 1/32" to 1/16" clearance between the rod end bearing (20) and the hex head of the spring bolt (19). If the clearance is not correct, loosen the lock nut and adjust the spring bolt.

6. Manually hold the governor stop lever (4) in the IDLE position. Loosen the lock nuts (8) and (9) and adjust the turnbuckle (13) until the shoulder on the throttle rod (12) just contacts the rod end bearing (22) and holds the stop lever in the IDLE position.

Final Adjustments

Place the remote throttle control lever (1) in the "mid-position", then start the engine. After the engine reaches normal operating temperature, place the remote throttle control lever in the MAXIMUM SPEED position and check the Torqmatic converter output shaft speed. This speed will vary depending upon engine application requirements.

If it is necessary to adjust the output shaft speed, loosen the wing nuts on the sliding link as needed and move the speed control lever to increase or decrease the speed.

The Torqmatic converter hydraulic output shaft governor is driven through the torque converter and there is a high droop. Therefore, the "no load" setting should be at least 150 rpm higher than the desired "full-load" setting. Tighten the wing nuts after completing the adjustment.

CAUTION: Do not set the Torqmatic converter output shaft speed in excess of the speed specified by the equipment manufacturer, to prevent damage to driven machinery.

During engine operation, it will be noted that the minimum droop will vary between 150 to 175 rpm. If the droop requires adjustment, move the droop bracket (inside the hydraulic output shaft governor) to decrease or increase the amount of droop.

NOTE: To compensate for the output shaft speed droop, the engine no-load speed must be set approximately 175 rpm above the required engine full load speed.

In the application of a hydraulic governor, the maximum fuel adjusting screw (30) and the maximum speed limit adjusting screw (28) are not used and therefore should be backed out to prevent any interference.

DUAL HYDRAULIC SGT GOVERNOR AND INJECTOR RACK CONTROL ADJUSTMENT

A dual hydraulic governor assembly is used with certain torque converter applications. This governor consists of 2 sets of flyweights and pilot valve assemblies that are interconnected to operate a single servo piston. One set of flyweights are driven by the engine. The other set is driven through a flexible shaft by the output shaft. The governor assembly used on a particular engine may have either single, Fig. 24, or dual, Fig. 26, speed control levers.

The control lever, on the single lever type governor, is attached to the output shaft governor speed adjustment shaft, Fig. 24. The engine governor and the output shaft governor speed adjusting shaft arms are linked together by a "slip-joint" link as shown in Fig. 25.

On the single lever type governor, the control lever has two distinct arcs of travel. In the first arc of travel (used to obtain the desired engine rpm) the control lever moves the engine governor speed adjusting shaft arm to a point between the engine IDLE and MAXIMUM SPEED positions. In the second arc of travel (used to set the desired output shaft rpm) the pin located at the lower end of the output shaft governor speed adjusting shaft arm "picks-up" the output shaft governor floating lever assembly. The movement of the governor control lever in the second arc of travel is opposed by the "slip-joint" linkage spring.

The two lever control of the dual lever type governor assembly has one of the control levers attached to the engine governor speed adjusting shaft and is used to control the engine governor. The other control lever is attached to the output shaft governor speed adjusting shaft and controls the output shaft governor.

In both the single lever and dual lever type governors, oil is pumped through the engine governor pilot valve to the output shaft governor pilot valve and then to a single common servo piston. The servo piston operates a terminal lever which in turn controls the position of the fuel rod connected to the injector control tube lever.

Pull out the fuel rod knob shown in Figs. 24 and 26, when it is necessary to stop the engine.

Adjustments

The following linkage and governor adjustments should be made after the engine has reached normal operating temperature and has been stopped.

Check the injector racks, injector control tube and remote throttle control linkage for freedom of

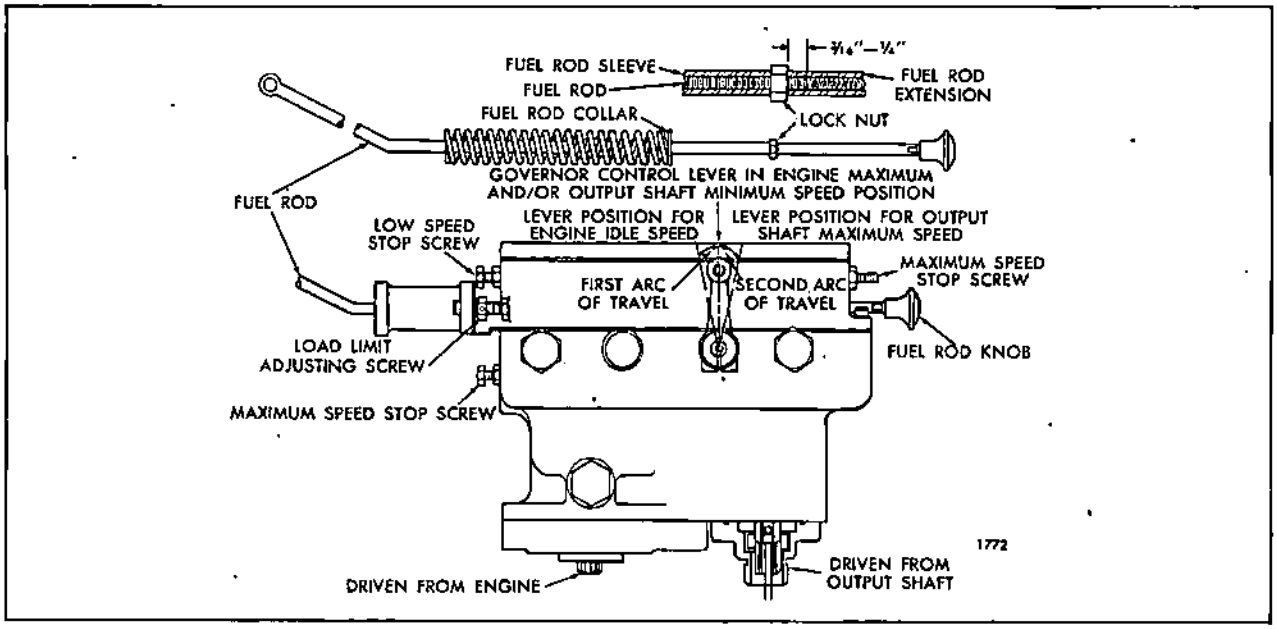


Fig. 24 - Single Lever Dual Hydraulic Governor

movement, before adjusting the governor to make sure the adjustments are necessary.

Adjust Fuel Rod (Engine Stopped)

1. Remove the governor cover. Refer to Fig. 15 and loosen all the inner adjusting screws (270) and the outer adjusting screws (271). Be sure all injector rack control levers (267) are free on the injector control tube.

2. Loosen the lock nut on the engine governor load limit adjusting screw (Fig. 24). Back the screw out until the end of the screw is flush with the face of the boss and tighten the lock nut.

3. Loosen the fuel rod lock nut and unscrew the shutdown knob and rod extension.

4. Turn the lock nut so 3/16" to 1/4" of the fuel rod extends beyond the nut.

5. Replace the fuel rod extension and knob, and tighten the extension against the lock nut.

Position Injector Rack Control Levers (Engine Stopped)

After the fuel rod is properly adjusted, adjust the injector rack control levers as follows:

1. Turn the outer adjusting screw of No. 1 injector rack control lever in until a slight movement of the injector control tube lever is observed. Then, tighten the inner adjusting screw.

2. Pull the fuel rod out and check for 1/32" to 1/16" movement.

   If the movement exceeds the specified amount back off the inner adjusting screw approximately 1/8 of a turn and tighten the outer adjusting screw.

   If the movement is less than the specified amount back off the outer adjusting screw approximately 1/8 of a turn and tighten the inner adjusting screw.

3. Remove the clevis pin and disconnect the fuel rod from the injector control tube lever.

4. Manually hold No. 1 injector rack control lever in the full fuel position and turn the inner adjusting screw (270) Fig. 15, into the No. 2 injector rack control lever until the injector rack has moved into the full fuel position and the inner adjusting screw is bottomed on the injector control tube. Turn the outer adjusting screw (271) down until it bottoms lightly on the injector control tube. Then, alternately tighten both the inner and outer adjusting screws until they are tight.

5. Recheck the No. 1 injector rack to make sure that it has remained snug on the ball end of the injector rack control lever while adjusting the No. 2 injector rack. If the rack of the No. 1 injector has become loose, back off slightly on the inner adjusting screw on No. 2 injector rack control lever. Tighten the outer adjusting screw.

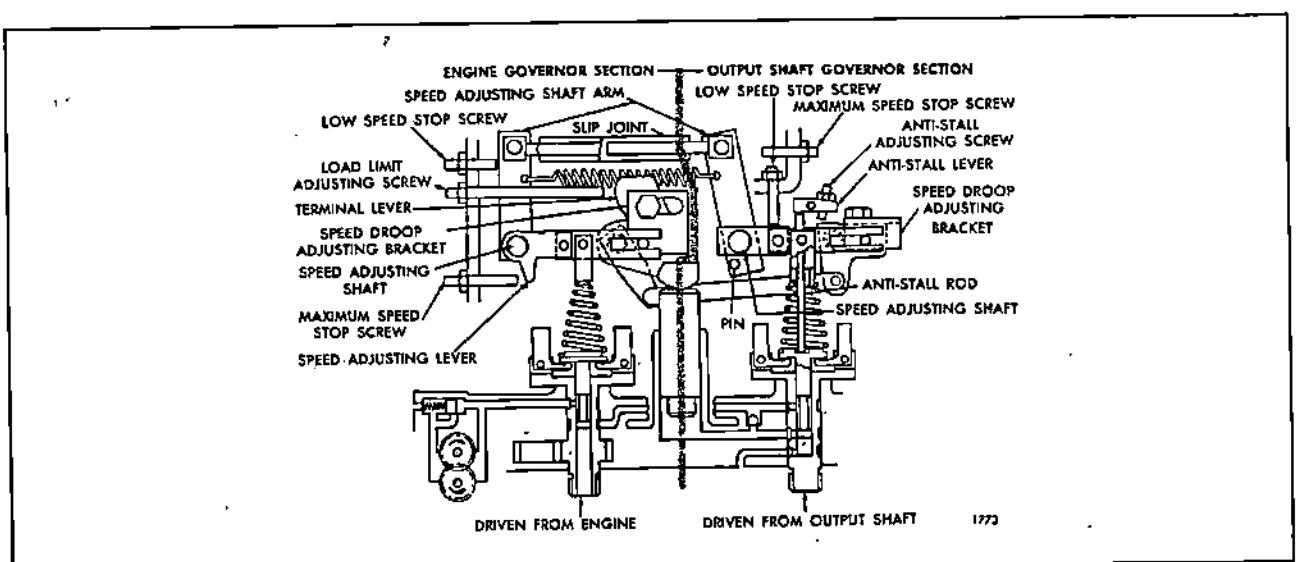


Fig. 25 – Schematic Diagram of Single Lever Dual Governor

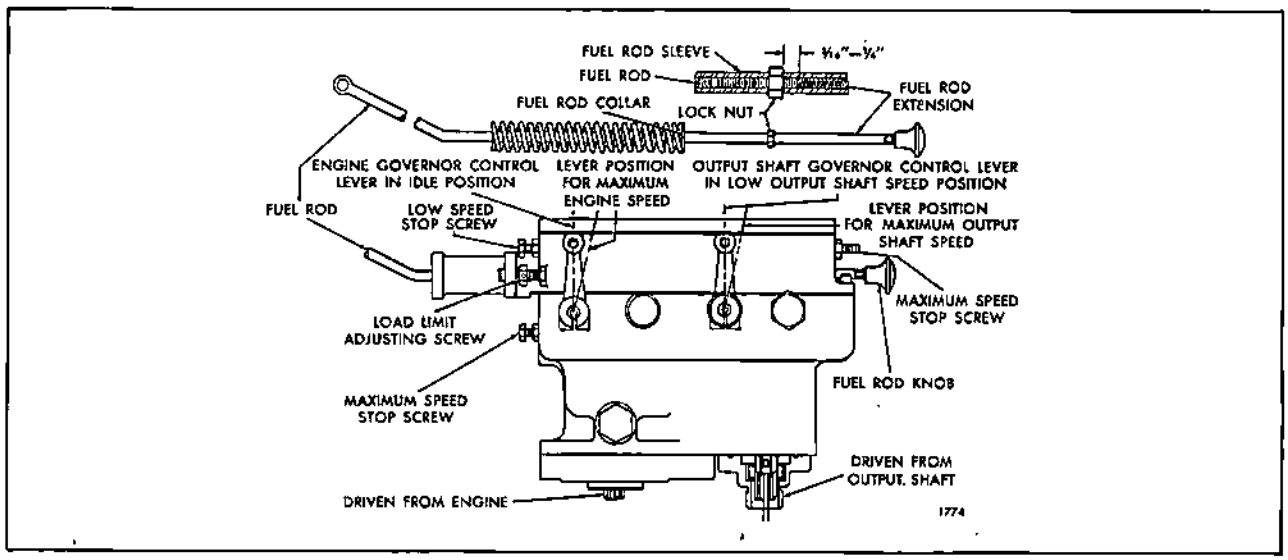


Fig. 26 – Two-Lever Dual Hydraulic Governor

When the settings are correct, the racks of both injectors must be snug on the ball end of their respective rack control levers.

Position the remaining injector rack control levers as outlined in Steps 4 and 5.

6. Connect the fuel rod to the injector control tube lever and replace the clevis pin; the clevis pin must rotate freely. Replace the valve rocker cover.

Adjust Load Limit (Engine Stopped)

The load limit is set at the factory and further adjustment should be unnecessary. However, if the governor has had major repairs or the injector rack control levers have been repositioned, the load limit screw should be re-adjusted.

With the injector rack control levers properly adjusted, the load limit may be set as follows:

1. Place the fuel rod and terminal lever in the FULL FUEL position (some improvised method may be employed to hold the fuel rod in the FULL FUEL position).

2. Loosen the lock nut on the load limit adjusting screw. Turn the adjusting screw until .020" gap exists between the terminal lever and the fuel rod collar. Hold the screw and tighten the lock nut.

Adjust Engine Governor (Engine Stopped)

1. Loosen the lock nut and back out the output shaft governor maximum speed stop screw, Fig. 25, until it extends approximately 1" from the face of the lock nut when the nut is tight against the housing.

2. Back out the output shaft governor anti-stall adjusting screw until it projects 1/2" above the anti-stall lever.

3. Loosen the output shaft governor low speed stop screw lock nut and turn the screw until it projects 5/16" above the upper face of the lock nut when the nut is tight against the governor body.

4. Disconnect the output shaft governor flexible drive shaft at governor.

5. Position the engine governor droop adjusting bracket so the adjusting screw is an equal distance from either end of the slot.

Adjust Engine Governor (Engine Running)

1. Start and warm up the engine.

2. Loosen the lock nut on the engine governor maximum speed stop screw, Figs. 24 and 25, and back out the screw until it projects 5/8" from the face of the lock nut when the nut is tight against the governor body.

3. Position the governor control lever, using the remote throttle control, so that the engine is running at the specified maximum no-load speed; shown on the unit name plate. Then turn the maximum speed stop screw in until it con-

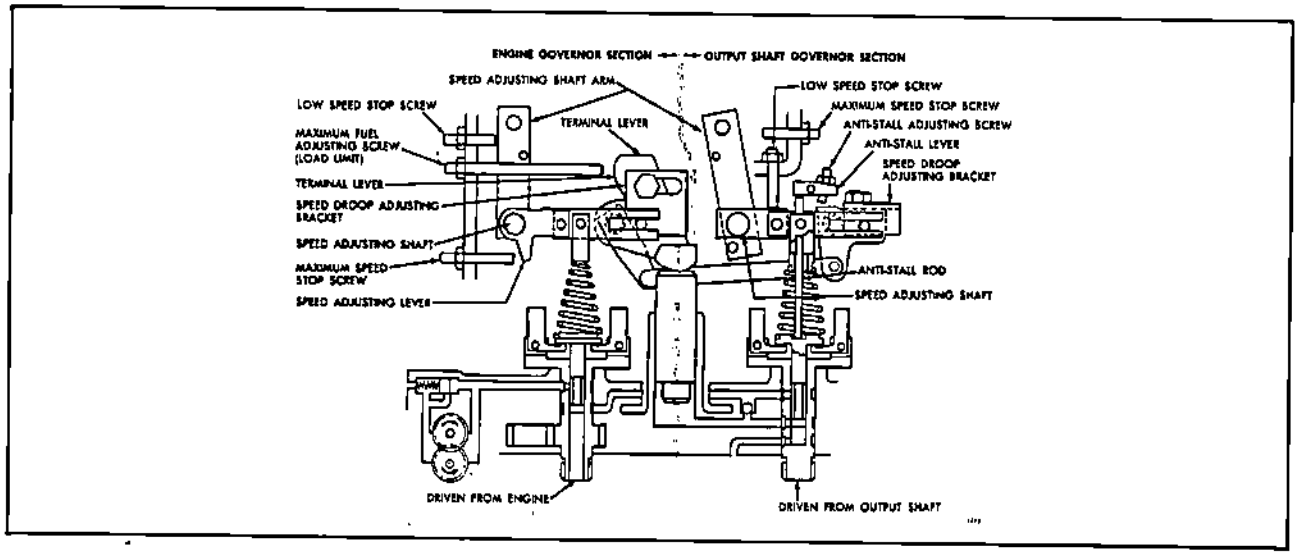


Fig. 27 – Schematic Diagram of Two Lever Dual Governor

tacts the speed adjusting lever. Tighten the lock nut.

4. Loosen the lock nut on the engine governor low speed stop screw and turn the screw until it projects 3/4" from the governor body when the nut is tight against the governor body.

5. Position the engine governor speed control lever, using the remote throttle control, so the engine is running at the specified no-load IDLE speed. Then, turn the low speed stop screw until it contacts the governor speed adjusting shaft arm. Then, tighten the lock nut.

   NOTE: Idle speed should be 500 rpm or more.

6. Adjust the governor speed droop bracket, if necessary, to obtain the minimum droop to stabilize the engine.

   NOTE: Droop is the difference or loss in rpm from maximum speed no-load to maximum speed full load. An insufficient speed droop will cause "hunting" or "surging" and the resultant unstable engine. A normally operating engine may surge three or four times before stabilizing.

Move the governor speed droop bracket toward the engine to decrease the speed droop and away from the engine to increase the speed droop. Stop the engine after making the necessary adjustments.

Adjust Output Shaft Governor (Engine Running)

1. Reconnect the flexible drive shaft to the output shaft governor. Start the engine and make sure the ball head assembly of the output shaft governor is turning.

2. Adjust the output shaft governor speed droop bracket, if necessary, to stabilize the engine. Moving bracket toward engine decreases and away from engine increases amount of droop.

3. On single lever type governor assemblies, position governor control lever, using remote throttle control, in the output shaft minimum speed position.

   On dual lever type governor assemblies, position output shaft governor control lever, using remote throttle control, in the low output shaft speed position (Fig. 26).

Dual governor assemblies with the "single" control lever incorporating the "slip-joint" linkage, may have the linkage adjusted to provide a "lag" or "dwell" between the throttle position at which the no-load maximum engine rpm is reached and the throttle position at which the output shaft speed begins to increase (as the governor control lever is moved toward the output shaft maximum speed position). This "lag" is usually governed by the type of application (or provided for the convenience of the operator), and permits movement of the control lever toward full output shaft position, for a short distance, without a corresponding change in output shaft speed. The "slip-joint" may be lengthened or shortened by loosening the lock nut

and turning the turnbuckle until the desired adjustment is made. Lengthening the linkage will decrease and shortening the linkage will increase the "lag".

4. On single lever type governor assemblies, position governor control lever, using remote throttle control, so that the output shaft is running at the maximum speed desired (usually shown on one of the unit name plates); then run in output shaft governor maximum speed stop screw until it contacts the output shaft governor speed adjusting shaft arm. Tighten lock nut.

   On dual lever type governor assemblies, position output shaft governor control lever, using remote throttle control, so that the output shaft is running at the maximum speed desired (usually shown on one of the unit name plates). Then, turn in output shaft governor maximum speed stop screw until it contacts the output shaft governor speed adjusting shaft arm. Tighten lock nut.

5. Loosen output shaft governor low speed stop screw lock nut and back out the screw until the desired minimum output shaft no-load speed is obtained. Tighten lock nut.

6. On single lever type governor assemblies, position governor control lever, using remote throttle control, in minimum speed position. Then, turn in anti-stall screw (Fig. 25) until anti-stall lever just contacts the anti-stall rod. This can be checked by lightly pressing the outer end of the anti-stall lever (side opposite screw) with a screw driver. The screw will be adjusted correctly when a slight increase in output shaft speed is noted when the lever is depressed slightly with screw driver.

   On dual lever type governor assemblies, position output shaft governor control lever, using remote throttle control, in minimum speed position. Then, turn in anti-stall screw until anti-stall lever just contacts the anti-stall rod. This can be checked by lightly pressing the outer end of the anti-stall lever (side opposite screw) with a screw driver. The screw will be adjusted correctly when a slight increase in output shaft speed is noted when the lever is depressed slightly with screw driver.

7. Replace the governor cover.

THROTTLE ADJUSTMENTS FOR LOAD EQUALIZATION—TWIN AND QUAD UNITS

Each twin unit consists of two engines and each quad unit has four engines connected through clutches to a common gear box. The throttle adjustment is made so that each engine of a twin or quad unit will carry its share of the load. Throttle adjustments are divided into two groups, depending on the type of governor used as follows:

1. Twin or quad units with limiting or variable speed mechanical governors.

2. Tandem twin marine units with variable speed mechanical governors.

THROTTLE ADJUSTMENT FOR LOAD EQUALIZATION ON TWIN OR QUAD UNITS WITH LIMITING SPEED MECHANICAL GOVERNORS

The tune-up of each engine is very important in the adjustment of twin and quad units because the engines must be synchronized to enable each to carry its full share of the load.

Disconnect the control rods (157), Fig. 29, from the governor speed control levers (12) and perform a tune-up on each engine before adjusting the throttle control linkage. Then, with the engines stopped proceed as follows:

1. Check the stop lever (12) and the governor speed control lever (21), Fig. 7, and make sure the levers are in alignment. The upper one must be exactly over the lower. Loosen the bolt in the upper lever and adjust the lever if necessary.

2. Make sure that each throttle control lever (195) is locked in place on the quadrant (218), by the latch pin (197), Fig. 28.

3. Move the master throttle control lever (161) to the MAXIMUM SPEED position.

4. Make sure the governor speed control lever (21) is in the MAXIMUM SPEED position. The pin in the stop lever (12) must be in contact with the end of the slot in the governor cam (17), Fig. 7.

5. If the governor speed control lever is not in the MAXIMUM SPEED position, loosen the two lock nuts (141) and adjust the turnbuckles (115), Figs. 29 and 30.

6. Tighten the turnbuckle lock nuts and recheck the position of the governor speed control levers.

   CAUTION: Use care when tightening the lock nuts to prevent misalignment of the rod end bearings (136), Figs. 29 and 30.

7. Disengage the clutches, place the master control lever (161) in the IDLE position and start the engines.

8. After the engines are warmed up, move the master control lever to the IDLE position and check the idle speed of each engine.

9. Move the master control lever to the MAXIMUM SPEED position and check the no-load speed of each engine.

10. Move the master control lever so the unit is operating at approximately 200 rpm below the normal no-load speed.

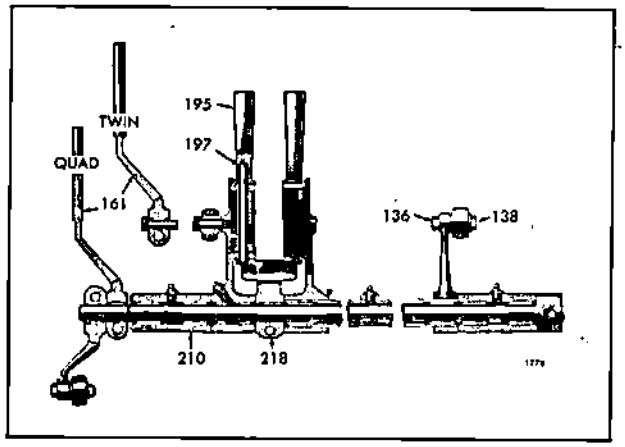


Fig. 28 - Throttle Control Cross Shaft Assembly-Twin and Quad Units

136. Bearing--Rod End
138. Bolt
161. Lever--Master Throttle Control
195. Lever--Throttle Control
197. Latch Pin--Throttle Control Lever
210. Bracket--Throttle Control Shaft
218. Quadrant--Throttle Control

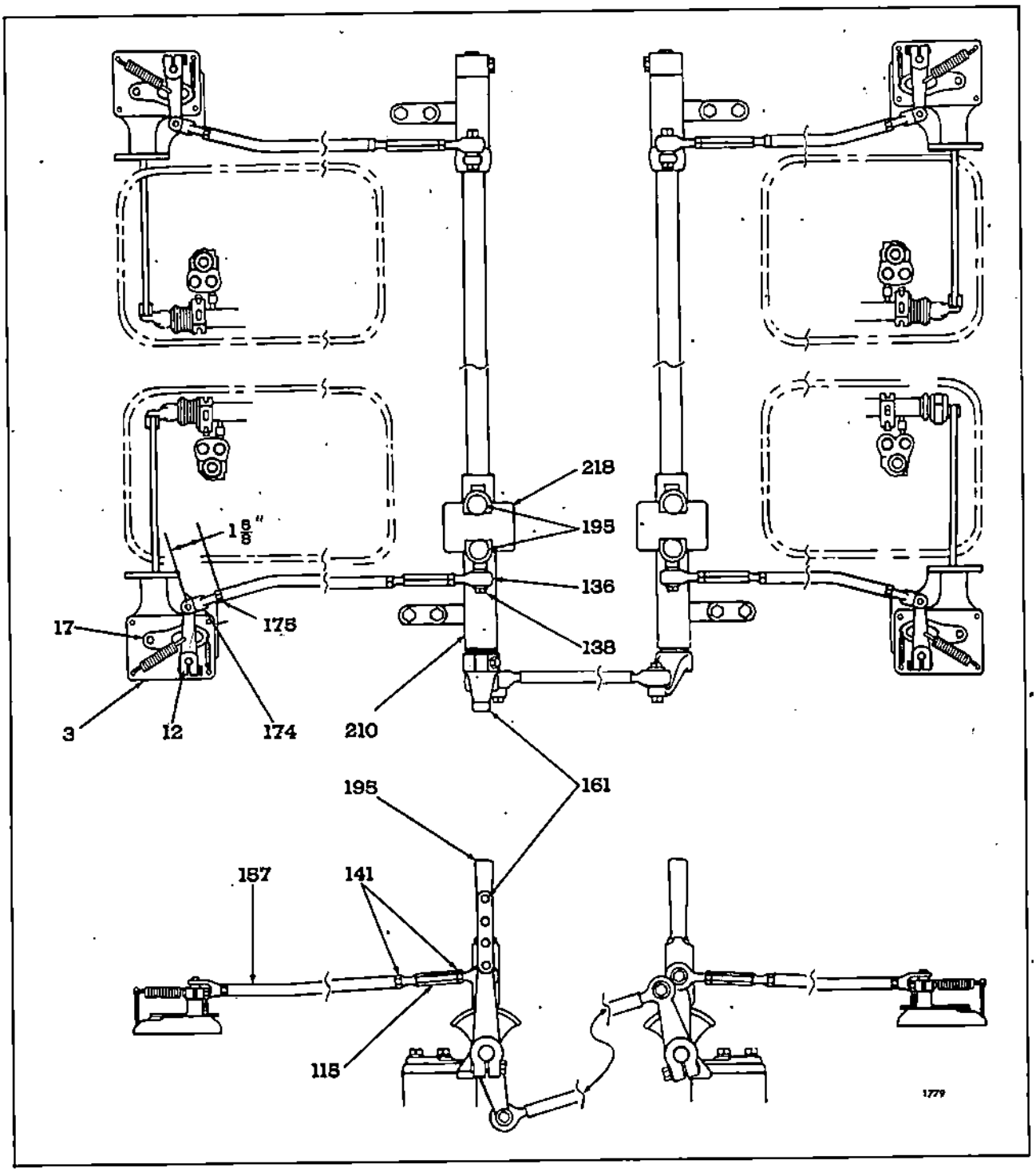


Fig. 29 - Diagram of Throttle Control Linkage for Quad Units With Limiting Speed Mechanical Governors

3. Cover--Governor
12. Lever--Governor Speed Control
17. Cam--Governor
115. Turnbuckle
136. Bearing--Rod End
138. Bolt
141. Lock Nut--Turnbuckle
157. Rod--Throttle Control
161. Lever--Master Throttle Control
174. Clevis--Control Rod
175. Lock Nut--Clevis
195. Lever--Throttle Control
210. Bracket--Throttle Control Shaft
218. Quadrant--Throttle Control

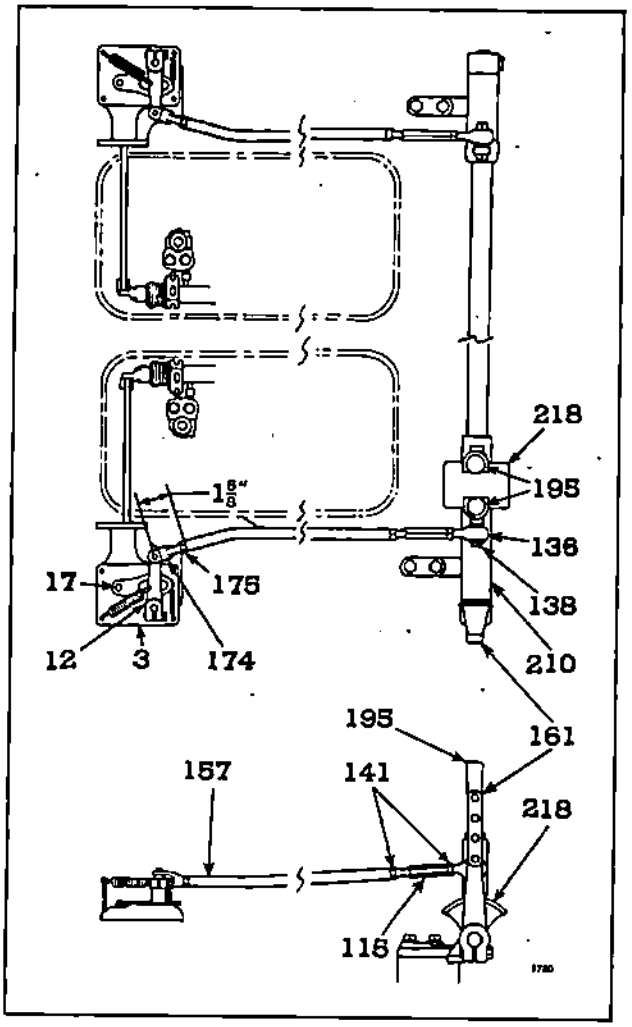


Fig. 30 - Diagram of Throttle Control Linkage for Twin Units With Limiting Speed Mechanical Governors

3. Cover--Governor
12. Lever--Governor Speed Control
17. Cam--Governor
115. Turnbuckle
136. Bearing Rod End
138. Bolt
141. Lock Nut--Turnbuckle
157. Rod--Control
161. Lever--Master Throttle Control
174. Clevis--Control Rod
175. Lock Nut--Clevis
195. Lever--Throttle Control
210. Bracket--Throttle Control Shaft
218. Quadrant--Throttle Control

The engines in the unit should be running within 50 rpm of each other. Then check the unit in the same way at 400 rpm and again at 600 rpm below the no-load speed.

If this procedure does not bring the engines within correct synchronization, recheck each engine for poor compression, faulty injectors, low fuel pressure, or other conditions which may cause unsatisfactory engine operation. See "Trouble Shooting".

11. Install the valve rocker covers.

THROTTLE ADJUSTMENT FOR LOAD EQUALIZATION ON SIDE BY SIDE TWIN OR QUAD UNITS USING VARIABLE SPEED GOVERNORS

The tune-up of each engine is very important in the adjustment of twin and quad units because the engines must be synchronized to enable each to carry its full share of the load.

Disconnect the control rods (157) from the governor speed control levers (12). On the side by side twin units remove the cross link equalizer spring (239) from the cross link (114), Fig. 31. Loosen the screw (147) and remove the master control equalizer spring (103), Fig. 32, on quad units. Perform a tune-up on each engine before adjusting the throttle control linkage.

Then, with the engines stopped proceed as follows:

1. Check the control rod end link (234), Figs. 31 and 32, on each engine. Make sure the bolt (111) is just touching the end of the link in the IDLE position.

2. Make sure that each throttle control lever (195) is locked in place on the quadrant (218), by the latch pin (197), Fig. 28.

3. Move the master throttle control lever (161), Figs. 31 and 32, to the MAXIMUM SPEED position.

4. Make sure the governor speed control lever (21) is in the MAXIMUM SPEED position. The pin in the stop lever (12) must be in contact with the end of the slot in the governor cam (17), Fig. 7.

5. If the governor speed control lever is not in the

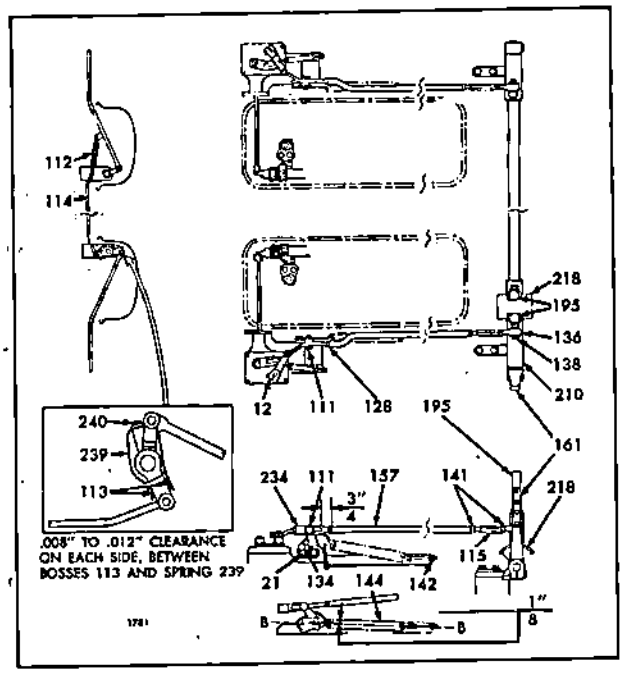


Fig. 31 - Diagram of Throttle Control Linkage for Twin Units With Variable Speed Mechanical Governors

12. Lever--Governor Speed Control
21. Lever--Speed Control
111. Bolt--Lever-to-Link
112. Turnbuckle--Cross Link Equalizer
113. Boss
114. Link--Equalizer
115. Turnbuckle
128. Lock Nut
134. Pin--Booster Spring
136. Bearing--Rod End
138. Bolt
141. Lock Nut--Turnbuckle
142. Lock Nut--Throttle Booster Spring Adjusting
144. Spring--Throttle Booster
157. Rod--Throttle Control
161. Lever--Master Throttle Control
195. Lever--Throttle Control
210. Bracket--Throttle Control Shaft
218. Quadrant--Throttle Control
234. Link--Control Rod End
239. Spring--Link Equalizer
240. Screw--Equalizer Spring

MAXIMUM SPEED position, loosen the two lock nuts (141) and adjust the turnbuckles (115).

6. Tighten the turnbuckle lock nuts and recheck the position of the governor speed control levers.

CAUTION: Use care when tightening the lock nuts to prevent misalignment of the rod end bearings (136), Figs. 31 and 32.

If it is necessary to adjust the booster spring (144) set the idle speed and proceed as follows:

a. Set the governor booster spring pin (134) 1/8" below the over-center line B-B, as shown in Figs. 31 and 32.

b. Disengage the clutches and start each engine.

c. Release each governor speed control lever (12) individually from its MAXIMUM SPEED position, and note its return to the IDLE position. The lever should return quickly.

d. Loosen the throttle booster spring retaining nut on the governor control lever (21). Then loosen the nut and lock nut on the throttle booster spring eyebolt.

e. Move the bolt as necessary in the slot of the lever to allow the speed control lever (21) to move from the MAXIMUM SPEED position to the IDLE position. Hold the bolt and tighten the spring retaining nut.

f. Turn the nut on the throttle booster spring eyebolt as necessary to allow the speed control lever to be moved to the MAXIMUM SPEED position with the least amount of effort.

7. Reconnect the governor control rods (157) to the levers.

8. Set the gap between the end of link (234) and governor control lever (21) at 1/16" to 1/8" by adjusting the lever on its shaft. While setting the gap, the governor lever must be in the IDLE position, and the forward end of the slot in link (234) must be in contact with the lever-to-link bolt (111).

9. Secure the master throttle control lever (161) in the MAXIMUM SPEED position, then replace the link equalizer spring (239) and secure it with the screw (240).

10. Loosen the turnbuckle lock nuts (141).

Adjust the turnbuckle until there is equal clearance between each leg of the link equalizer spring (239) and the lower boss (113), with approximately .010" clearance on each side.

11. Tighten the turnbuckle lock nuts (141) and recheck the clearance. Readjust them if necessary.

12. Lubricate the link joints of the equalizer linkage with a few drops of engine oil. Move the master throttle control lever (161) back and forth to check for binding in the equalizer. The equalizer link (114) must not rub inside the tube. Correct any binding that may exist.

13. Disengage the clutches then, move master throttle control lever (161) to the IDLE position

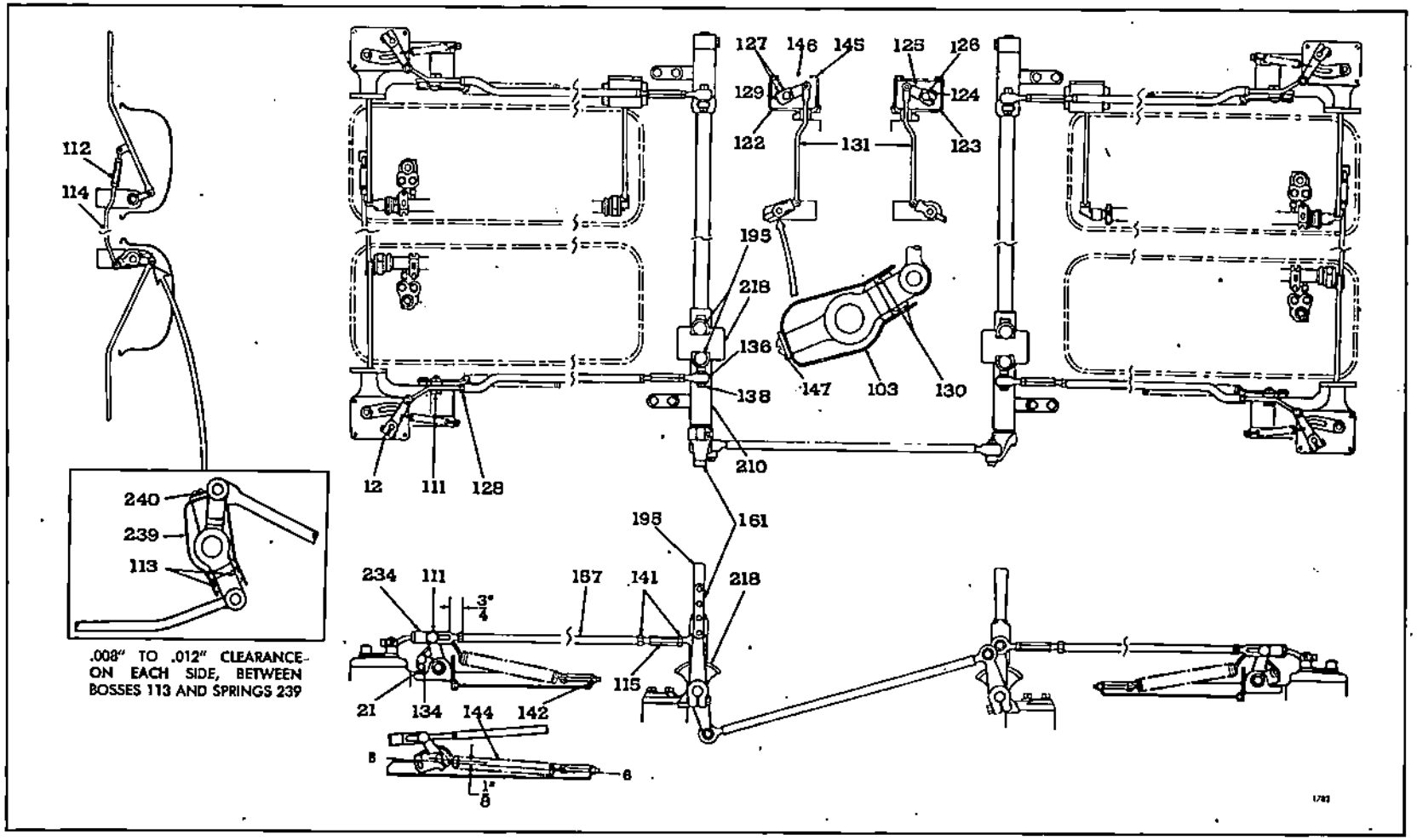


Fig. 32 - Diagram of Throttle Control Linkage for Quad Units with Variable Speed Mechanical Governors

12. Lever--Governor Speed Control
21. Lever--Speed Control
103. Spring--Master Control Equalizer
111. Bolt--Lever-to-Link
112. Turnbuckle--Cross Link Equalizer
113. Boss
114. Link--Equalizer
115. Turnbuckle
122. Housing--Master Control Equalizer
123. Housing--Master Equalizer
124. Bolt
125. Lever--Master Equalizer
126. Shaft--Equalizer
127. Screw--Adjusting
128. Lock Nut
129. Lever--Master Control Equalizer
130. Boss--Master Control Equalizer
131. Link--Master Control Equalizer
134. Pin--Booster Spring
136. Bearing--Rod End
138. Bolt
141. Lock Nut--Turnbuckle
142. Lock Nut--Booster Spring Adjusting
144. Spring--Throttle Booster
145. Bolt--Equalizer Housing
146. Cover--Equalizer Housing
147. Screw--Master Control Equalizer Spring
157. Rod--Throttle Control
161. Lever--Master Throttle Control
195. Lever--Throttle Control
210. Bracket--Throttle Control Shaft
218. Quadrant--Throttle Control
234. Link--Control Rod End
239. Spring--Link Equalizer
240. Screw--Equalizer Spring

and start the engine.

14. After the engines are warmed-up move the master throttle control lever (161) to IDLE position and check the idling speed.

    The idling speed of the engine, without the equalizer spring (239), will probably be less than the idling speed of an engine which has the spring due to the expansion of the equalizer link (114). In such cases, remove the valve rocker cover and proceed with Step 15.

15. Loosen the turnbuckle lock nuts (141), and adjust the cross link equalizer turnbuckle (112), until both engines are idling at the same speed. The clearance between each leg of the link equalizer spring (239) and lower bosses (113) should be equal.

16. Reinstall the valve rocker covers.

17. Start the engines, move the throttle control lever (161) to the MAXIMUM SPEED position and check the maximum no-load speed of each engine.

    The speed should be the same as previously set. If not, check for binding in the equalizer.

18. With the clutches still disengaged, move the master throttle control lever until the engines are running approximately 200 rpm lower than the maximum no-load speed.

19. With a hand tachometer, check the speed of the engines. They should be running within 25 rpm of each other.

20. If a difference of more than 25 rpm exists, check the tune-up of each engine.

    Then adjust the master control equalizer between the front and rear engine pairs in the quad unit (Fig. 32).

21. Remove the valve rocker covers.

22. Remove the bolts (145), covers (146) and gaskets from master equalizer housings (122) and (123).

23. Loosen the bolt (124) until the master equalizer lever (125) swings freely on the equalizer shaft (126).

24. Turn the adjusting screws (127) until they are threaded equally into the master control equalizer lever (129) and are contacting the flats in the equalizer shaft. The adjusting screws should be fairly tight.

25. With each throttle control lever (195) latched to its quadrant (218), move and secure the master throttle control lever (161) in the MAXIMUM SPEED position.

26. Move the master control equalizer link (131) and adjust each leg of the equalizer spring (103) and each master control equalizer boss (130).

    The clearance should be approximately .010" on each side.

27. Hold the master control equalizer link in this position and tighten the bolt (124) in the master equalizer lever (125).

28. Recheck the clearance between each leg of the equalizer spring and lower bosses (130). Readjust them if necessary.

29. Install the valve rocker covers.

30. Place the master throttle control lever (161) in the IDLE position and start the engines.

31. Move the master throttle control lever as necessary to warm up the engines.

32. Move the master throttle control lever to the MAXIMUM SPEED position and check the maximum no-load speed on each engine.

33. Place the master throttle control lever in the IDLE position and check the idle speed of each engine.

    The maximum no-load speed and the idle speed of each engine should be the same as previously set.

34. If the speeds are not as previously set, it will be necessary to readjust the master equalizer adjusting lever (129) with the adjusting screws (127).

35. After the adjustments have been satisfactorily completed, install the equalizer housing covers (146) and gaskets.

    If this procedure does not bring the engines within the correct synchronization, check each engine for poor compression, faulty injectors, low fuel pressure, or other conditions which may cause unsatisfactory engine operation. See "Trouble Shooting".

THROTTLE ADJUSTMENT FOR LOAD EQUALIZATION ON TANDEM TWIN UNITS USING VARIABLE SPEED MECHANICAL GOVERNORS

The tandem twin unit throttle and reverse gear control arrangement is shown in Figs. 33 and 35 and the master throttle control and individual throttle lever assemblies are illustrated in Figs. 34 and 36.

Master throttle levers and master reverse gear control levers are provided in both the engine room and pilot house, thus permitting operation of the propulsion unit at either location through this dual control arrangement.

The tune-up of each engine is very important in the adjustment of the twin units because the engines must be synchronized to enable each to carry its full share of the load.

Disconnect the control rods (157) from the speed control levers (21) Fig. 35 and perform a tune-up on each engine before adjusting the throttle control linkage. Then, with engines stopped proceed as follows:

1. Remove any binding or excessive play from the clevis pins.
2. Move the master throttle lever (129) toward the FULL OPEN position until the two clevis pins in the upper and lower arms of the throttle lever shank are in a vertical straight line, as observed through the two holes on the side of the lever housing (160). Secure the throttle lever in this position with the knurled lock nut (168), Fig. 34.

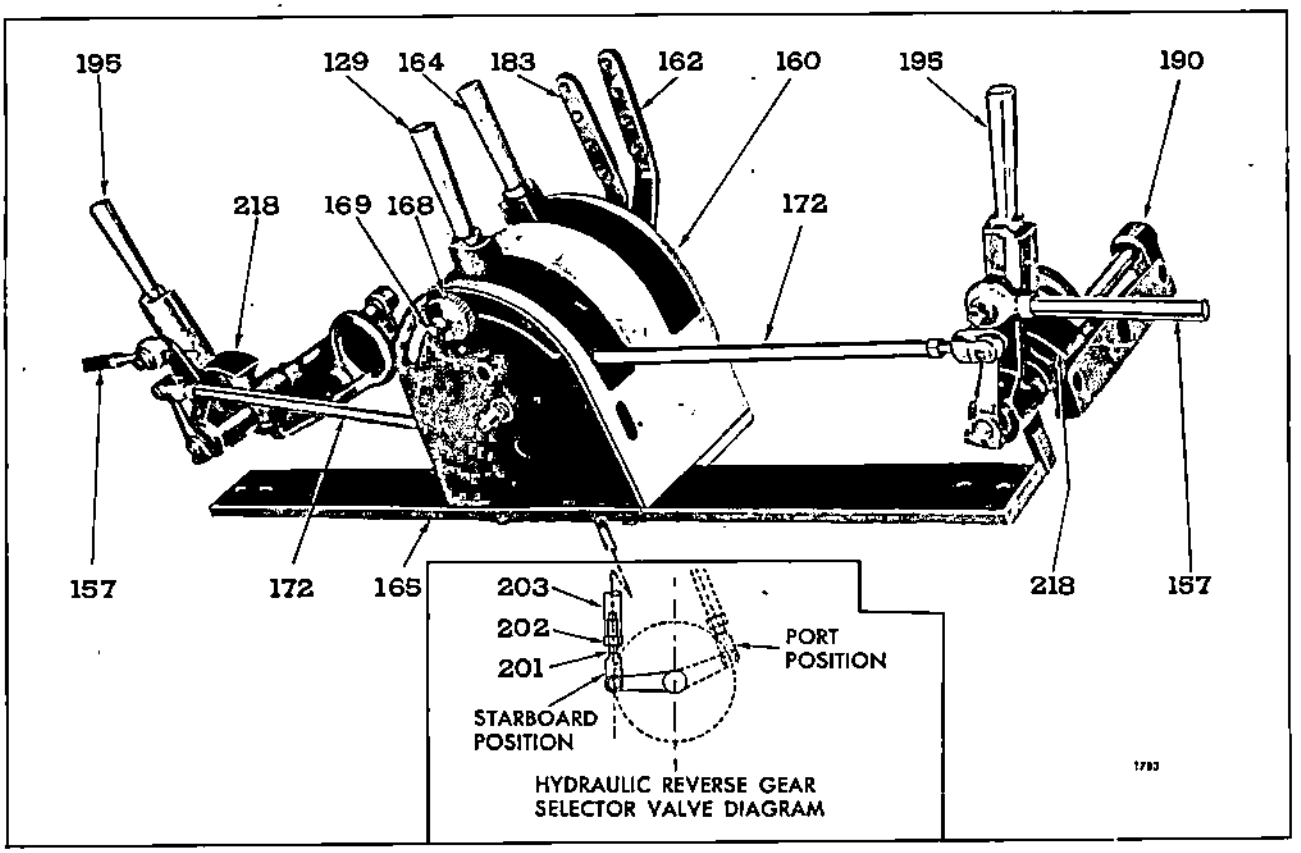


Fig. 33 – Arrangement of Throttle Levers on a Tandem Twin Marine Unit

129. Lever--Master Control Equalizer
157. Rod--Throttle Control
160. Housing--Master Throttle and Control Valve Lever
162. Lever--Master Throttle Remote Control
164. Lever--Master Remote Control Valve
165. Mounting Bracket--Control Housing
168. Nut--Master Hand Throttle Locking
169. Nut--Retaining
172. Rod--Master Throttle Control
183. Lever--Reverse Gear Control Valve (Remote Control)
190. Bracket--Engine Lifting
195. Lever--Throttle Control
201. Clevis--Valve Control Rod End
202. Lock Nut--Valve Control Rod
203. Rod--Valve Control
218. Quadrant--Throttle Control

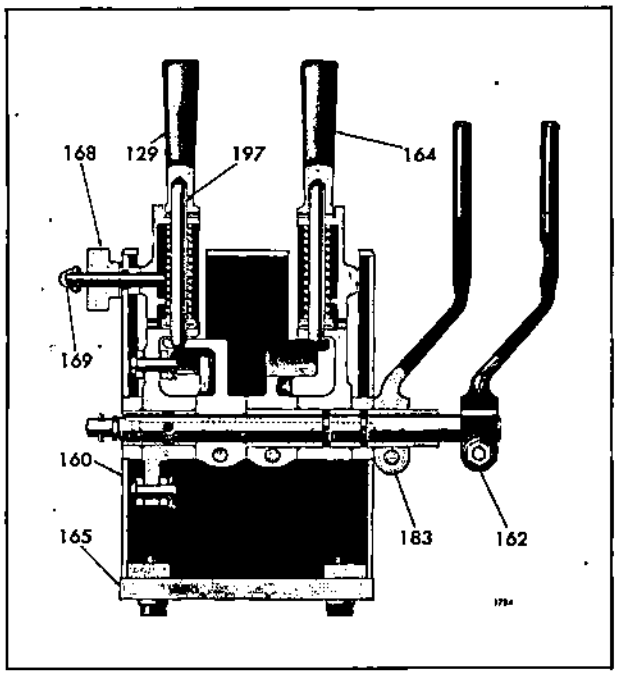


Fig. 34 - Master Throttle Assembly on a Tandem Twin Unit

129. Lever--Master Control Equalizer
160. Housing--Master Throttle and Control Valve Lever
162. Lever--Master Throttle Remote Control
164. Lever--Master Remote Control Valve
165. Support--Throttle and Control Valve
168. Nut--Master Throttle Control Lever Locking
169. Nut--Retaining
183. Lever--Reverse Gear Control Valve (Remote Control)
197. Latch Pin--Throttle Control Lever

3. Disconnect the master throttle control rods (172) from the cross shaft operating levers (199) of the "A" and "C" engines, Fig. 35.

4. Lock the throttle levers (195) to their quadrants (218) in a vertical position.

5. Loosen the clamp bolts on the throttle lever quadrants (218), if necessary, and set the cross shaft operating levers (199) vertically with the holes for the clevis pin on an imaginary line extending through the centers of the cross shafts and rod end bearings, and between these centers. Retighten the clamp bolts on the quadrants.

6. Hold the throttle control levers (195) in a vertical position and adjust the master throttle control rods (172) with the clevises, so the clevis pins will just slide into position through the holes in the clevises and levers (199). Install the cotter pins.

7. Loosen the knurled locking nut (168) and move the master throttle control lever (129) toward the FULL OPEN position until the threaded locking stud is within 3/8" to 1/2" from the end of the slot in the housing (160). Then retighten the locking nut.

8. Adjust the length of the throttle control rods (157), with the turnbuckles (115), until the speed control levers (21), are fully open. Tighten the turnbuckle lock nuts.

   CAUTION: Use care when tightening the turnbuckle lock nuts to prevent misalignment of the rod end bearings and to avoid damage to the bearing seal.

9. If all of the adjustments are correct, the speed of each engine will be the same when checked individually at maximum speed. Check the maximum speed of each engine as follows:

   a. Disconnect the equalizer link at the master equalizer lever (125) on the "A" engine.

   b. Warm up the engines, then run each engine at maximum speed and compare the speeds with the original maximum speed to check the proper length of the throttle control rod (157).

   c. If the engine speeds are satisfactory, connect the equalizer link and install the cotter pin; if the speeds are unsatisfactory, readjust the control rods (157) as necessary.

10. With the master remote control valve lever (164) set in a vertical position, check the position of the remote reverse gear control valve lever (183). On a port propulsion unit, the center of the clevis pin hole in the valve lever will lie on a horizontal center line drawn through the center of the valve lever shaft, as shown in Fig. 35, and point forward. On a starboard propulsion unit, the clevis pin hole in the selector valve lever will point aft and lie 7/8" above the horizontal center line drawn through the center line of the valve lever shaft.

11. Adjust the equalizer levers so each engine will carry its share of the load as follows:

    a. With the engines stopped, the master throttle control lever (129) in the FULL OPEN position, and the equalizer links connected at the

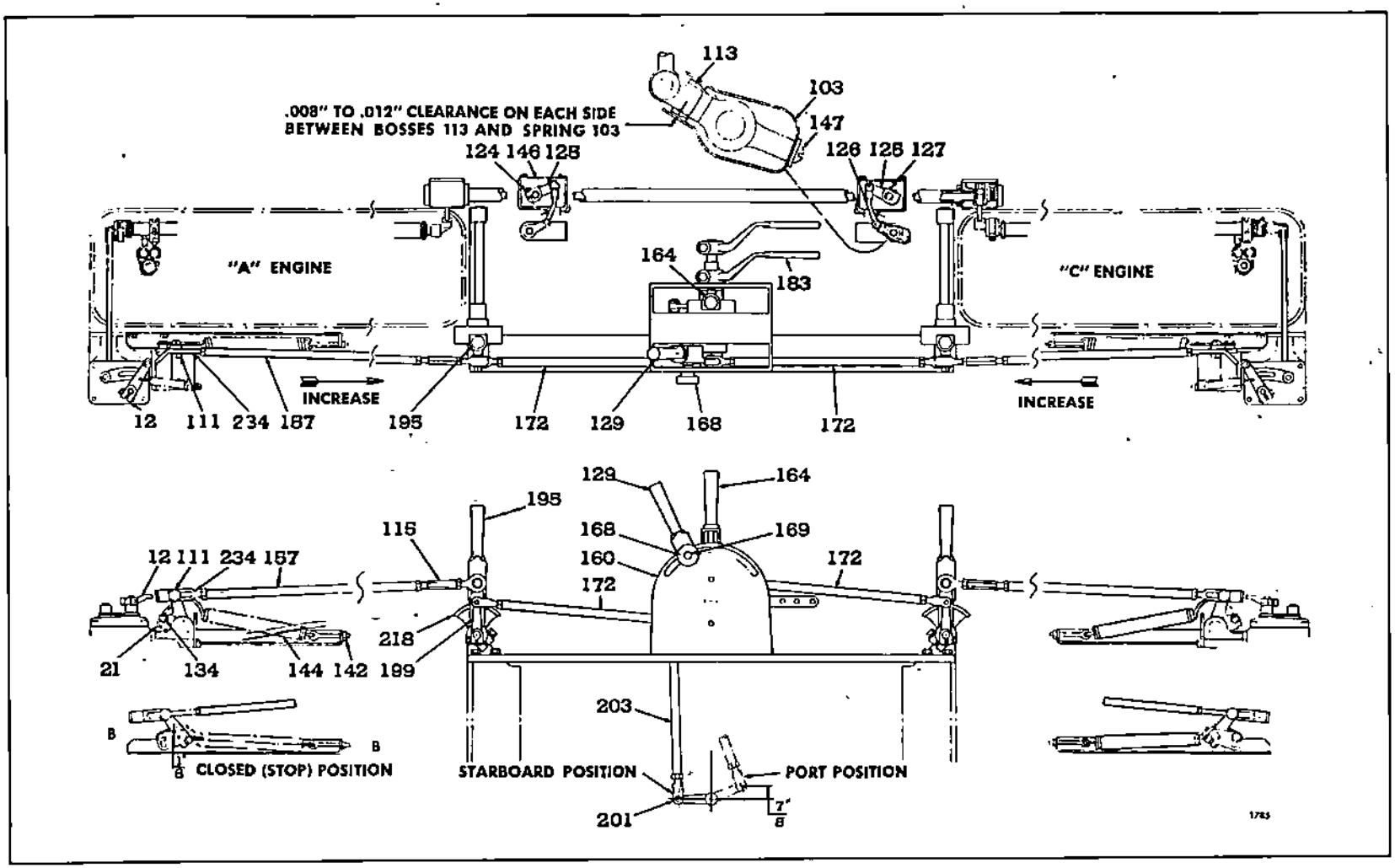


Fig. 35 - Diagram of Throttle Control Linkage for Tandem Twin Marine Unit with Variable Speed Governors

12. Lever--Governor Speed Control
21. Lever--Speed Control
103. Spring--Equalizer
111. Bolt--Link
113. Boss--Master Equalizer
115. Turnbuckle
124. Bolt
125. Lever--Master Equalizer
126. Shaft--Equalizer
127. Screw--Adjusting
129. Lever--Master Control Equalizer
134. Pin--Booster Spring
142. Lock Nut--Booster Spring Adjusting
144. Spring--Throttle Booster
146. Cover--Equalizer Housing
147. Screw--Master Control Equalizer Spring
157. Rod--Throttle Control
160. Housing--Master Throttle and Control Valve Lever
164. Lever--Master Remote Control Valve
168. Nut--Master Throttle Control Lever Locking
169. Nut--Retaining
172. Rod--Master Throttle Control
183. Lever--Reverse Gear Control Valve (Remote Control)
195. Lever--Throttle Control
199. Lever--Throttle Control Cross Shaft
201. Clevis--Valve Control Rod End
203. Rod--Valve Control
218. Quadrant--Throttle Control
234. Link--Control Rod End

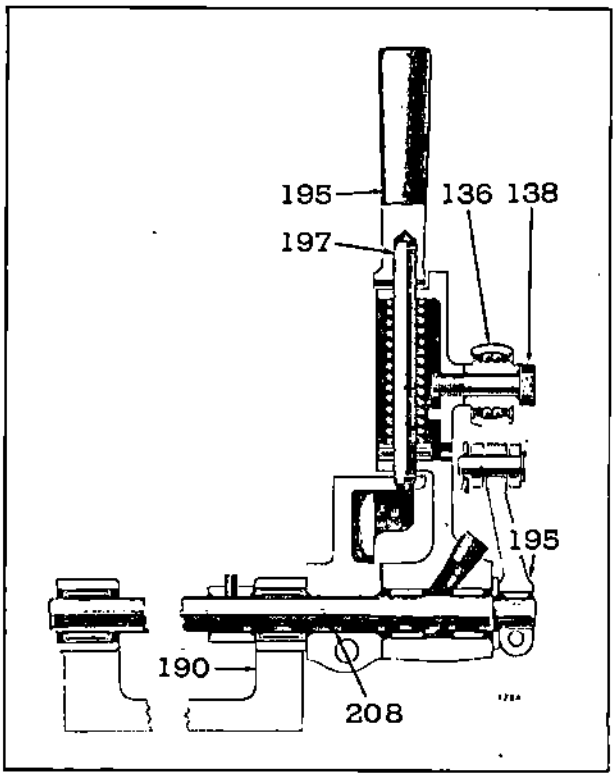


Fig. 36 - Individual Throttle Assembly on a Tandem Twin Unit

136. Bearing--Rod End
138. Bolt--Control Rod
190. Bracket--Engine Lifting
195. Lever--Throttle Control
197. Pin--Throttle Control Lever
208. Shaft--Throttle Lever

"A" and "C" engines, loosen the bolt (124) in the master equalizer lever (125) on the "A" engine so the lever can turn on the shaft.

b. Set the two adjusting screws (127) in the master equalizer lever on the "C" engine the same height in the lever so the lever can be readjusted, if necessary.

c. Turn the master equalizer lever on the shaft until the free ends of the equalizer spring (103) are contacting - without pressure - the two bosses on the injector control tube lever and are an equal distance from the master equalizer bosses (113) on each side of the equalizer link lever. Maintain the clearance between the lever bosses and spring and tighten the bolt (124) in the master equalizer lever (125).

d. Recheck the clearance between the bosses and spring and if the clearance was changed while tightening the bolt, readjust the screws (127) and change the position of the lever until the clearance between the bosses and spring is the same on both sides of the equalizer link lever.

e. With the clutches disengaged, place the throttle in the IDLE position and start the engines.

f. With the engines warmed up, the clutches still disengaged and the individual throttle levers (195) locked, move the master throttle lever (129) to FULL OPEN position and check the speed of each engine with a hand tachometer.

The speed of each engine should now be the same as the no load top speed previously set on the individual engines.

g. Place the master throttle control lever in the IDLE position and check the speed of each engine.

If either the idle or maximum speed is not the same as that previously established on the individual engines, readjust the clearance between the master equalizer bosses (113), and the spring (103) as outlined in Items "c" and "d".

TROUBLE SHOOTING

Certain abnormal conditions which sometimes interfere with satisfactory engine operation, together with methods of determining the cause of such conditions, are covered on the following pages.

Satisfactory engine operation depends primarily upon:

1. The presence of an adequate supply of air compressed to a sufficiently high compression pressure.

2. The injection of the proper amount of fuel at the right time.

Lack of power, uneven running, excessive vibration, stalling at idle speed, and hard starting may be caused by either low compression, faulty injection in one or more cylinders, or lack of sufficient air.

Since proper compression, fuel injection and the proper amount of air are important to good engine performance, detailed procedures for their investigation are given as follows:

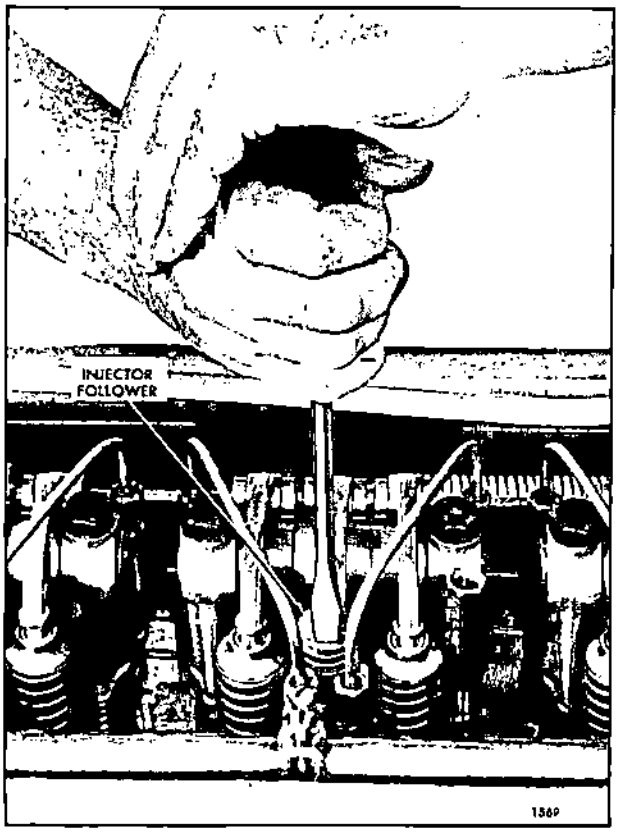


Fig. 1 - Locating a Misfiring Cylinder

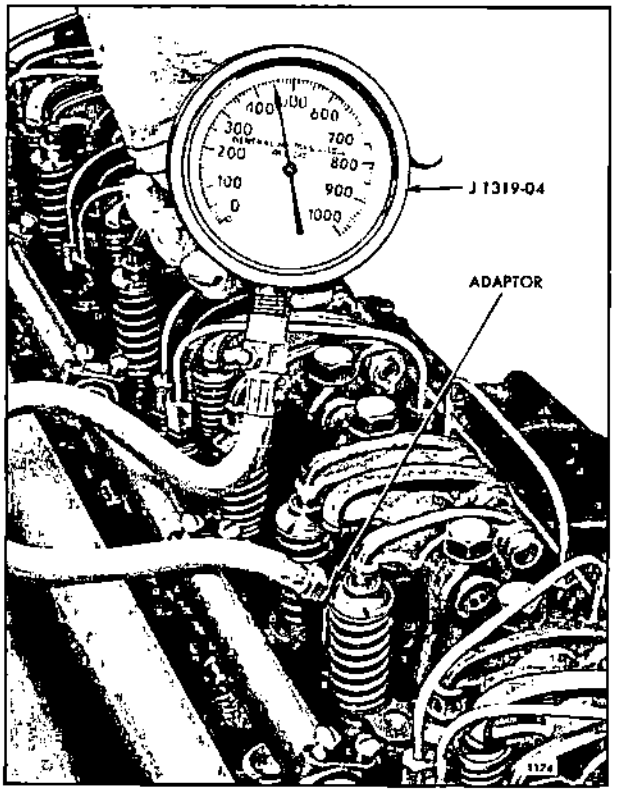


Fig. 2 - Checking Compression Pressure

Locating a Misfiring Cylinder

1. Start the engine and run it at part load until it reaches normal operating temperature.

2. Remove the valve rocker cover.

3. Run the engine at IDLE speed and check the valve clearance. The clearance should be .009" (two valve cylinder head) or .014" (four valve cylinder head).

4. Hold the No. 1 injector follower down with a screw driver, Fig. 1, to prevent operation of the injector.

   If the cylinder has been misfiring, there will be no noticeable difference in the sound and operation of the engine. If the cylinder has been firing properly, there will be a noticeable difference in the sound and operation when the

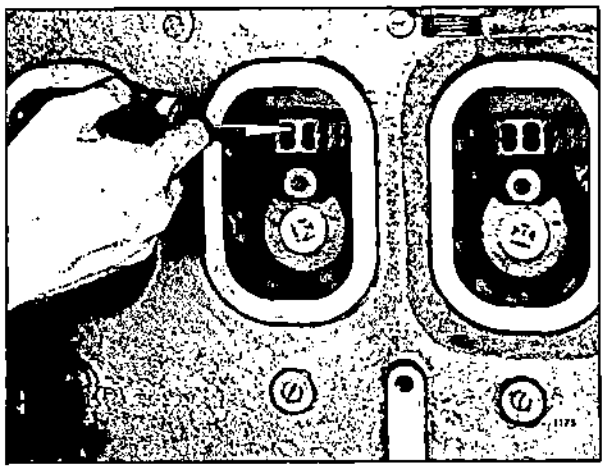


Fig. 3 – Inspecting for Broken Piston Rings Through Cylinder Liner Air Ports

follower is held down. This is similar to short-circuiting a spark plug in a gasoline engine.

5. If No. 1 cylinder is firing properly, repeat the procedure on the other cylinders until the faulty one has been located.

6. Provided that the injector operating mechanism of the faulty cylinder is functioning satisfactorily, remove the fuel injector and install a new one by performing the removal and installation procedure outlined in "Fuel System".

7. If installation of a new injector does not eliminate misfiring, check the compression pressures.

Checking Compression Prossure

1. Start the engine and run it at approximately one-half rated load until normal operating temperature is reached.

2. With the engine stopped, remove the fuel pipes from the No. 1 cylinder injector and fuel connectors.

3. Remove the injector from No. 1 cylinder and install the adaptor and pressure gage, J 1319-03, in place as shown in Fig. 2.

4. Use one of the two fuel pipes as a jumper connection between the fuel inlet and return manifold to permit fuel to flow directly to the return manifold. On four valve cylinder heads it is necessary to fabricate a jumper connection from a spare fuel pipe.

5. Start the engine and run it at 600 rpm. Observe and record the compression pressure indicated on the gage.

   NOTE: Do not crank the engine with the starting motor to obtain the compression pressure.

Compression pressure is affected by altitude as follows:

Minimum Compression Pressure psi (600 rpm)				Altitude, Feet Above Sea Level
Engine				
71	71E	71M	71N	
390	425	390	515	0
360	395	360	480	2,500
335	365	335	440	5,000
310	340	310	410	7,500
285	315	285	380	10,000

6. Perform the compression pressure check on each cylinder. The compression pressure in any one cylinder should not be less than the minimum prescribed for the particular engine at the given altitude above sea level. In addition, the variation in compression pressure between cylinders of the engine must not exceed 25 psi at 600 rpm.

   If the compression pressure readings for a 71 Engine, for example, were as shown in the following table, it would be evident that No. 3 cylinder should be examined and the cause of the low compression pressure determined and corrected even though the pressure is still above the low limit indicated for the satisfactory operation of the engine.

Cylinder	Gage Reading*
1	445 psi
2	440 psi
3	405 psi
4	435 psi
5	450 psi
6	445 psi

*These pressures are for a 71 Engine operating at an altitude near sea level.

Low compression pressures may result from any one of several causes:

A. Piston rings may be stuck or broken. To determine the condition of the rings, remove air box cover and press on the compression rings, Fig. 3, with a blunt tool. A broken or stuck ring will not have a spring-like action.

B. Compression may be leaking past the cylinder head gasket, the valve seats, the injector tube, or through a hole in the piston.

To correct any of these conditions, consult your authorized Detroit Diesel Sales and Service Outlet.

Fuel Flow Test

1. Disconnect the fuel return tube and hold the open end of the tube in a suitable container (Fig. 4).

2. Start and run the engine at approximately 1200 rpm and measure the fuel flow from the return tube for one minute. Refer to the chart for the gallons per minute flow that applies to the engine being tested.

FUEL FLOW (SPILL) (min. gallons per minute)			
No load — 1200 rpm			
Engine	Restriction		
	.055"	.080"	.1065"
71	.5	.8	.8
71E	.5	.8	-
71N	-	.8	-
71M	-	.9	-

3. Be sure all tube connections between the fuel supply and the pump are tight so that no air will be drawn into the fuel system; then immerse the end of the fuel tube in the fuel in the container. Air bubbles rising to the surface of the fuel will indicate a leak on the suction side of the pump.

Crankcase Pressure

The crankcase pressure indicates the amount of air passing between the oil control rings and the cylinder liner into the crankcase. Most of which is clean air from the air box. A slight pressure in the crankcase is needed to prevent the entrance of dust. A loss of engine lubricating oil through the governor breather tube, crankcase ventilator, or dipstick hole in the cylinder block is an indication of an excessive crankcase pressure. The maximum crankcase pressure is shown in the following chart.

The causes of high crankcase pressure may be traced to excessive blow-by due to worn piston rings, a hole or crack in a piston crown, loose piston pin retainers, defective blower, cylinder head or end plate gaskets, or excessive exhaust back pressure. Also, the breather tube or crankcase ventilator should be checked for obstructions.

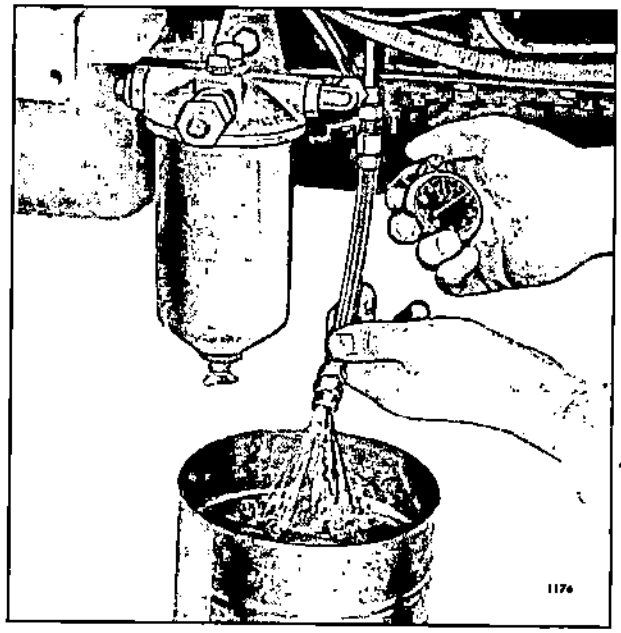


Fig. 4 - Measuring Fuel Flow from Fuel Return Manifold

CRANKCASE PRESSURE (max. in inches of water)				
Engine	Speed (rpm)			
	1200	1800	2100	2300
3-71	1.2	1.8	2.1	-
4-71	1.8	2.5	2.8	-
4-71E(2V)	1.8	2.5	2.7	-
4-71E(4V)	1.8	2.5	2.8	-
4-71N	1.8	2.5	2.8	-
6-71E(2V)	2.0	2.8	3.0	-
6-71E(4V)	2.0	2.8	3.1	-
6-71N	2.0	2.8	3.1	-
4-71M	-	2.5	2.8	2.8
6-71M	-	2.8	3.1	3.1

The crankcase pressure may be checked by means of a manometer. The manometer should be connected to the oil level dipstick opening in the cylinder block. Check the readings obtained at various engine speeds with the specifications in the chart.

Exhaust Back Pressure

A slight pressure in the exhaust system is normal. However, excessive exhaust back pressure seriously affects engine operation. It may cause an increase in the air box pressure with a resultant loss in the efficiency of the blower. This means less air for scavenging which results in poor combustion and higher temperatures. The maximum exhaust back pressure is shown in the following chart.

EXHAUST BACK PRESSURE - NO LOAD (max. in inches of Mercury)				
Engine	Speed (rpm)			
	1200	1800	2100	2300
71	1.2	2.8	3.5	-
71E(2V)	1.2	2.8	3.5	-
71E(4V)	1.0	2.8	3.5	-
71N	1.0	2.1	2.6	-
71M	-	2.8	4.0	4.0

Causes of high exhaust back pressure are usually a result of an inadequate or improper type of muffler, an exhaust pipe which is too long or too small in diameter, an excessive number of sharp bends in the exhaust system, or obstructions such as excessive carbon formation or foreign matter in the exhaust system.

The exhaust back pressure, measured in inches of mercury, may be checked with the manometer in the engine diagnosis test kit J 7333-06. The manometer or pressure gage is connected to the exhaust manifold by removing the 1/8" pipe plug which is provided for that purpose. If there is no opening provided, one can be made by drilling an 11/32" hole in the exhaust manifold companion flange and tapping a 1/8" pipe thread.

Check the readings obtained at various speeds (no load) with the specifications in the Exhaust Back Pressure Chart.

Air Box Pressure

Proper air box pressure is required to maintain sufficient air for combustion and scavenging of the burned gases. Low air box pressure is caused by a high air intake restriction, damaged blower rotors, an air leak from the air box (such as leaking end plate gaskets), or a clogged blower air inlet screen. Lack of power, or black or grey exhaust smoke are indications of low air box pressure.

To check the air box pressure, connect a manometer to an air box drain tube.

Check the readings obtained at various speeds with the specifications in the following chart.

AIR BOX PRESSURE (in inches of Mercury)				
Min. with Max. Exhaust Back Pressure (Full Load)				
Engine	Speed (rpm)			
	1200	1800	2100	2300
3,4-71	4.8	10.6	14.1	-
6-71	5.2	11.4	15.1	-
71E(2V)	3.5	8.4	10.6	-
71E(4V)	3.2	7.6	10.1	-
71N	3.2	7.6	10.1	-
4-71M	-	7.2	10.2	11.6
6-71M	-	8.0	11.2	12.8
Min. with Zero Exhaust Back Pressure				
3,4-71	3.3	7.3	10 0	-
6-71	3.7	8.1	11.0	-
71E(2V)	2.0	5.1	6.5	-
71E(4V)	1.7	4.3	6.0	-
71N	1.7	4.3	6.0	-
4-71M	-	4.0	5.8	7.2
6-71M	-	4.8	6.8	8.4

Air Intake Restriction

An excessive restriction of the air intake will affect the flow of air to the cylinders and result in poor combustion and lack of power. Consequently, the restriction must be kept to a minimum considering the size and capacity of the air cleaner. An obstruction in the air intake system or dirty or damaged air cleaners will result in a high blower intake restriction.

The air intake restriction may be checked with manometer connected to the blower air inlet assembly in the drilled and tapped hole provided for the cold weather starting aid connection.

Check the normal air intake vacuum at various speeds (at no load) and compare the results with the following chart.

AIR INTAKE RESTRICTIONS (in inches of water)				
Max. with Dirty Air Cleaner (Oil Bath or Dry)				
Engine	Speed (rpm)			
	1200	1800	2100	2300
71,71E,71N	12.4	25.0	30.0	-
71M	-	25.0	30.0	30.0
Max. with Clean Air Cleaner (Oil Bath or Dry Type with Pre-Cleaner Section)				
71,71E(4V),71N	9.0	15.0	18.0	-
71E(2V)	9.0	15.0	17.0	-
71M	-	15.0	20.0	20.0

PROPER USE OF MANOMETER

The U-tube manometer is a primary measuring device indicating pressure or vacuum by the difference in the height of two columns of fluid.

Connect the manometer to the source of pressure, vacuum, or differential pressure. When the pressure is imposed, add the number of inches one column of fluid travels up to the amount the other column travels down to obtain the pressure (or vacuum) reading.

The height of a column of mercury is read differently than that of a column of water. Mercury does not wet the inside surface; therefore, the top of the column has a convex meniscus (shape). Water wets the surface and therefore has a concave meniscus. A mercury column is read by sighting horizontally between the top of the convex mercury surface (Fig. 5) and the scale. A water manometer is read by sighting horizontally between the bottom of the concave water surface and the scale.

Should one column of fluid travel further than the other column, due to minor variations in the inside diameter of the tube or to the pressure imposed, the accuracy of the reading obtained is not impaired.

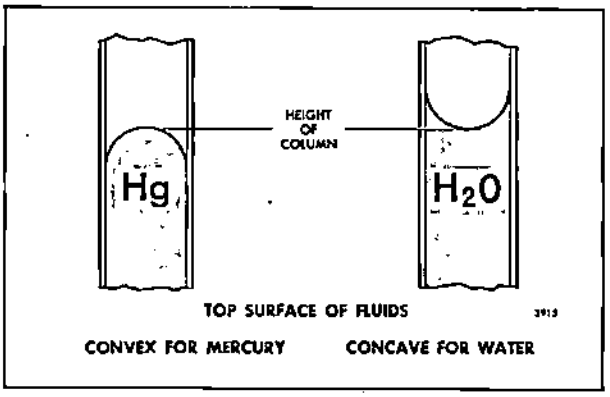


Fig. 5 – Comparison of Column Height for Mercury and Water Manometers

The manometer reading may be converted into other units of measurement by use of the pressure conversion chart.

PRESSURE CONVERSION CHART

1" water	=	.0735" mercury
1" water	=	.0361 psi
1" mercury	=	.491 psi
1" mercury	=	13.6" water
1 psi	=	27.7" water
1 psi	=	2.036" mercury

ENGINE ELECTRICAL GENERATING SYSTEM

Whenever trouble is indicated in the electrical generating system, the following quick checks can be made to assist in localizing the cause.

A fully charged battery and low charging rate indicates normal generator-regulator operation.

A low battery and high charging rate indicates normal generator-regulator operation.

A fully charged battery and high charging rate condition usually indicates the voltage regulator is set too high or is not limiting the generator output. A high charging rate to a fully charged battery will damage the battery and other electrical components.

A low battery and low or no charging rate condition could be caused by: Loose connections or damaged wiring, defective battery or generator, generator not or improperly polarized, and defective regulator or improper regulator setting.

Contact a Detroit Diesel Sales and Service Outlet if more information is needed.

STORAGE

PREPARING UNITS FOR STORAGE

When an engine unit is to be stored or removed from operation, special precautions should be taken to protect the interior and exterior of the engine, transmission and other parts from rust, corrosion, and gumming in the fuel system. The parts requiring attention and the recommended preparations are given below.

An engine unit should be processed for storage as soon as possible after removal from operation. If an engine unit is not processed at the earliest possible opportunity and corrosion starts on the exposed metal surfaces, it will then be necessary to carefully and thoroughly remove the corrosion before applying a rust inhibitor.

Engine units should be stored in a building which is dry and may be heated during the winter months. Moisture absorbing chemicals are available commercially for use when excessive dampness prevails in storage areas.

TEMPORARY STORAGE (30 Days or Less)

Protect engine unit for a temporary period of time as outlined below:

1. Drain the engine crankcase.
2. Fill the crankcase to the proper level with the recommended viscosity and grade of oil.
3. Fill the fuel tank with the recommended fuel oil. Operate the engine for two minutes at 1200 rpm and no load.

   NOTE: Do not drain the fuel system or the crankcase after this run.

4. Check the air cleaner and service it, if necessary, as outlined under "Air System".
5. If freezing weather is expected during the storage period, add a high boiling point type anti-freeze solution in accordance with the manufacturer's recommendations. Drain the raw water system and leave the drain cocks open.
6. Clean the entire exterior of the engine with fuel oil and dry it with air.
7. Seal all the engine openings. The material used for this purpose must be waterproof, vaporproof and possess sufficient physical strength to resist puncture and damage from the expansion of entrapped air.

Engines prepared in this manner can be put into service in a short time by simply removing the seals at the engine openings, checking the engine coolant, fuel oil, lubricating oil, gear box, and priming the raw water pump, if used.

EXTENDED STORAGE (30 Days or More)

When an engine unit is to be removed from operation for an extended period of time, prepare the unit as follows:

1. Drain and thoroughly flush the cooling system with clean, soft water.
2. Refill the cooling system with clean, soft water.
3. Add a rust inhibitor to the cooling system (refer to "Corrosion Inhibitor" under Cooling System).
4. Remove, check and recondition the injectors where necessary to make sure they will be ready to operate when the engine is again placed in service.
5. Reinstall the injectors in the engine, time the injectors, and adjust the valve clearance.
6. Circulate the coolant through the entire system by operating the engine until normal operating temperature is reached (160°F. to 185°F.)
7. Stop the engine.

8. Remove the plug and completely drain the engine crankcase. Install new lubricating oil filter elements and gaskets.

9. Fill the crankcase to the proper level with the recommended viscosity and grade of oil.

10. Drain the engine fuel tank.

11. Refill the fuel tank with enough Valvoline Oil Company "Tectyl 502-C" rust preventive compound, or its equivalent, to enable the engine to operate 15 minutes.

12. Drain the fuel filter and strainer. Remove the retaining bolts, shells and elements. Discard the used elements and gaskets. Wash the shells in clean fuel oil and insert new elements. Fill the cavity between the element and shell about two-thirds full of the same rust preventive compound as used in the fuel tank and reinstall the shell.

13. Refer to "Air System" and service the air cleaner.

14. MARINE GEARS

    Drain the oil completely and refill with clean oil of the proper viscosity and grade as is recommended. Remove, clean or replace all strainers or filters. When performing Step 15, engage the clutches alternately to circulate clean oil through all moving parts.

15. Start and run the engine at 600 rpm for 5 minutes so that the clean oil can coat all of the internal parts of the engine.

    NOTE: The performance of this step is not necessary on torque converter units.

16. TORQMATIC CONVERTER

    a. Start the engine and let it run at idle speed until the temperature of the converter oil reaches 150°F.

    b. Remove the plug and drain the converter.

    c. Remove the filter.

    d. Start the engine and stall the converter for twenty seconds at 1000 rpm to scavenge the oil from the converter.

    e. Reinstall the drain plug and the filter.

    f. Fill the unit to the proper operating level with a commercial preservative oil which meets Government specifications MIL-L-21260, Grade 1. Oil of this type is available from the major oil companies.

    g. Start the engine and operate the converter for at least 5 minutes at a minimum of 1000 rpm. Engage the clutch, then stall the converter to raise the oil temperature to 225°F.

    CAUTION: Do not allow the temperature to exceed 225°F. If the unit does not have a temperature gage, do not stall the converter for more than thirty seconds.

    h. Stop the engine and permit the converter to cool to a temperature suitable to touch.

    i. Seal all of the exposed openings and the breather with moisture proof tape.

    j. Coat all exposed, unpainted surfaces with preservative grease. Position all of the controls for minimum exposure and coat them with grease. The external shafts, flanges and seals should also be coated with grease.

17. POWER TAKE-OFF

    Lubricate the clutch throwout bearing, clutch pilot bearing, drive shaft main bearing, clutch release shaft, also the outboard bearing, if unit is so equipped, through the grease fittings with an all purpose grease such as Shell Alvania No. 2 or its equivalent.

    Remove the inspection hole cover on the clutch housing and lubricate the clutch release lever and pins with a hand oiler. To avoid getting oil on the clutch facing, do not over lubricate.

    If the unit is equipped with a reduction gear, drain and flush the gear box with light engine oil. Refill the gear box to the proper level with the oil grade indicated on the name plate.

18. HYDROSTARTER SYSTEM

    a. Release the pressure in the hydrostarter system by opening the relief valve on the side of the hand pump.

    b. Drain all of the fluid from the system.

    c. Remove the filler cap at the top and the filter in the bottom of the reservoir.

d. Flush the reservoir and clean the reservoir filler cap and filter.

e. Clean the filter element in the line between the reservoir and the engine pump.

f. To provide maximum protection, use Lubriplate type 130-AA, or its equivalent, as directed below:

Fill the hand pump cam cavity under the boot with Lubriplate. Also apply Lubriplate to both ends of the cam retaining pin and to the area where the boot fits around the cam.

Fill the cavity under the air valve cover on the accumulator with Lubriplate.

Coat the starter motor internal clutch splines, shaft splines, yoke, tangs of the fork, spool of the overrunning clutch and the control shaft with Lubriplate.

Remove the plug from the starter control valve housing and withdraw the control valve. Apply Lubriplate on the control valve surface ahead of the front seal ring and behind the rear seal ring.

If a hydraulic remote control is used, do not remove the control valve. Apply the Lubriplate on the control valve ahead of the front seal ring only.

g. Saturate the wick in the starter drive housing with SAE 20 lubricating oil.

h. Refill the Hydrostarter system with SAE 10 or 20 lubricating oil. See "Hydraulic Starting System" for the filling and purging procedure. Then start the engine at least 10 times to circulate oil through the system.

NOTE: Leave some pressure in the system (at least 100 psi above the nitrogen precharge pressure).

19. Remove the valve rocker cover from the engine and spray a thin film of Valvoline Oil Company "Tectyl 502-C" rust preventive compound, or its equivalent, on the injector operating mechanism, on the top of the cylinder head and on the underside of the valve rocker cover. This compound is soluble in the engine lubricating oil. Reinstall the valve rocker cover.

20. Apply a "non-friction" rust preventive compound, similar to Valvoline Oil Company "Tectyl No. 812", to the flywheel and all exposed parts.

CAUTION: Do not apply oil, grease or any wax base compound to the flywheel. The cast iron will absorb these substances which can "sweat" out during operation and cause the clutch to slip.

21. Drain the engine cooling system.

22. The oil may be drained from the engine crankcase if so desired.

23. If the oil is drained, reinstall and tighten the drain plug.

24. Remove and clean the battery and battery cables with a baking soda solution and rinse them with fresh water. Do not allow the soda solution to enter the battery. Add distilled water to the electrolyte, if necessary, and fully charge the battery.

Store the battery in a cool (never below 32°F.) dry place. Keep the battery fully charged and check the level and the specific gravity of the electrolyte regularly.

25. Insert heavy paper strips between the pulleys and belts to prevent sticking.

26. Seal all of the openings in the unit, including the exhaust outlet, with moisture resistant tape. Use cardboard, plywood or metal covers where practical.

27. Clean and dry the exterior painted surfaces of the engine. Spray the surfaces with a suitable liquid automobile body wax, a synthetic resin varnish or a rust preventive compound.

28. Cover the engine with a good weather-resistant tarpaulin or other cover if it must be stored outdoors. A clear plastic cover is recommended for indoor storage.

Stored engines should be inspected periodically. If there are any indications of rust or corrosion, corrective steps must be taken to prevent damage to the engine parts. Perform a complete inspection at the end of one year and apply additional treatment as required.

PROCEDURE FOR RESTORING TO SERVICE ENGINE UNITS WHICH HAVE BEEN IN EXTENDED STORAGE

1. Remove the valve rocker cover.

   Pour at least one-half gallon of the proper engine lubricating oil over the injector operating mechanism.

2. Reinstall the valve rocker cover.

3. Remove all covers and tape from the openings of the engine, fuel tank, and electrical equipment. Do Not Overlook The Exhaust Outlet!

4. Wash the exterior of the engine with fuel oil to remove the rust preventive. REMOVE THE RUST PREVENTIVE FROM THE FLYWHEEL.

5. Remove the paper strips from between the pulleys and belts.

6. Check the crankcase oil level. Fill the crankcase to the proper level with the HEAVY-DUTY lubricating oil recommended under "LUBRICATING OIL SPECIFICATIONS".

7. Fill the fuel tank with fuel specified under "DIESEL FUEL OIL SPECIFICATIONS".

8. Close all of the drain cocks and fill the engine cooling system with clean soft water and a rust inhibitor. If the engine is to be exposed to freezing temperatures, fill the cooling system with a high boiling point type antifreeze solution.

9. Install and connect the battery.

10. Service the air cleaner as outlined under "Air System".

11. POWER GENERATOR

    Prepare the generator for starting as outlined under "OPERATING INSTRUCTIONS".

12. MARINE GEAR

    Check the Marine gear; refill it to the proper level as necessary, with the correct grade of lubricating oil.

13. TORQMATIC CONVERTERS

    a. Remove the tape from the breathers and all of the openings.

    b. Remove all of the preservative grease with a suitable solvent.

    c. Start the engine and operate the unit until the temperature reaches 150°F. Drain the preservative oil and remove the filter. Start the engine and stall the converter for twenty seconds at 1000 rpm to scavenge the oil from the converter.

       CAUTION: A Torqmatic converter containing preservative oil should only be operated enough to bring the oil temperature up to 150°F.

    d. Install the drain plug and a new filter element.

    e. Refill the converter with the oil that is recommended under "LUBRICATION AND PREVENTIVE MAINTENANCE".

14. POWER TAKE-OFF

    Remove the inspection hole cover and inspect the clutch release lever and link pins and the bearing ends of the clutch release shaft. Apply engine oil sparingly, if necessary, to these areas.

15. HYDROSTARTER

    a. Open the relief valve on the side of the hand pump and release the pressure in the system.

    b. Refer to the filling and purging procedures outlined in "Hydraulic Starting Systems". Then, drain, refill and purge the Hydrostarter system.

16. After all of the preparations have been completed, start the engine. The small amount of rust preventive compound which remains in the fuel system will cause a smoky exhaust for a few minutes.

    NOTE: Before subjecting the engine to a load or high speed, it is advisable to check the engine tune-up.

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