SPECIFICATIONS

ENGINE:

	F-162 F-163	P3-144	P3-152
1. Number of Cylinders	4	3	3
2. Bore—Inches	3.4375	3.5	3.6
3. Stroke—Inches	4.375	5.0	5.0
4. Displacement—Cubic Inch	162	144	152
5. Bare Weight—Approx. Lbs.	490	550	550
6. Horsepower—Bare Engine	48.5	45.5	48.5
@ Engine RPM	2600	2400	2400
7. Idling RPM	550-600	500-550	500-550
8. Governed RPM:			
Standard Transmission	2500	2400	2400
Powershift Transmission	2600	2400	2400
9. Thermostat	155° F.	167-176° F.	167-176° F.
10. Valve Clearance—Hot:			
a. Intake—Inches	.014	.010	.10
b. Exhaust—Inches	.017	.010	.10
11. Timing:			
a. No. 1 Spark Plug Fires	2° BTDC		
@ Engine RPM	600		
b. Injection Into No. 1 Cyl. Starts		23° BTDC Pre-Set	23° BTDC Pre-Set
@ Engine RPM			
c. Firing Order	1-3-4-2	1-2-3	1-2-3
12. Spark Plugs:			
a. Make	Champion		
b. Heat Range	D 16		
c. Size	18 MM		
d. Gap—Inch	.025		
13. Distributor:			
a. Point Opening—Inch	.020		
b. Cam Angle—Degrees	32°		
14. Compression:			
a. Ratio	7.3:1	16.5:1	17.4:1
b. Normal PSI	160		
@ Engine RPM	150		
c. Max. PSI Variation Between Cyls.	10		
15. Oil Pressure:			
a. Normal PSI	20-30		
@ Engine RPM	2000		
b. Minimum PSI		30	30
@ Engine RPM		600	600
16. Minimum Cranking RPM	150	100	100

STEERING:

	Manual	Power
1. PSI at Governed RPM		1200
2. Approx. Lock to Lock Turns On Steering Wheel	4⅜	3½
3. Steering Time—Seconds @ Engine RPM		2.0 @ 600
4. Min. Turning Radius—No Load: NOTE: Plus or Minus 2 Inches Acceptable		

	S30B	S40B	S50B
a. Outside—Inches	70	73	75.5
b. Inside—Inches	5.0	4.5	3.5

HYDRAULIC OIL PRESSURE—PSI

1. Relief Setting at Main Valve @ Engine RPM	2000 @ 600
2. Relief Setting at Main Valve @ Engine RPM	2100 @ 2500

CARRIAGE SPEEDS:

NOTE: Plus or Minus 10% is Acceptable

	Manual Stg.	Power Stg.
1. Lifting—FPM		
a. No Load	93	84
b. Rated Load	84	75
2. Lowering—FPM		
a. No Load	75 Min.	75 Min.
b. Rated Load	120 Max.	120 Max.

UPRIGHT TILT ANGLES:

1. Forward	
a. Standard—Degrees	6
b. Optional—Degrees	10
c. Three-Stage—Degrees	6
2. Backward	
a. Standard—Degrees	12
b. Optional—Degrees	8
c. Three-Stage—Degrees	6

ELECTRICAL SYSTEM:

	6 Volt Positive	12 Volt Positive	12 Volt Negative
1. Voltage			
2. Polarity			
3. Generator Output—Hot:			
a. Amperes	11-13	7-10	10
@ Engine RPM	1400	1100	645
b. Voltage	7.5-7.7	14.3-14.9	14
@ Engine RPM	1400	1100	645
4. Generator Regulator:			
a. Cutout:			
(1) Normal Closing Voltage	6.6	13.3	12.7
(2) Closing Voltage Range	6.0-7.1	12.5-14.0	11.8-13.5
b. Voltage Regulator:			
(1) Normal Voltage Setting	7.7	14.7	14.3
(2) Voltage Range	7.38-8.1	14.0-15.0	13.8-14.8
c. Current Regulator:			
(1) Normal Ampere Setting			10
(2) Amperage Range			9-11

SERVICING INSTRUCTIONS

FAN BELT ADJUSTMENT

The tension of the fan belt should be examined periodically. The proper tension is obtained when the belt can be depressed approximately one-half inch on center of the section between the crankshaft pulley and the water pump pulley. To adjust the belt loosen the generator mounting capscrews and generator brace capscrew, then move generator in or out as required. After adjustment has been made, be sure to tighten the capscrew. When belt becomes oil-soaked or worn until it "bottoms" on the pulleys, it should be replaced to prevent slipping.

GOVERNOR—GASOLINE ENGINE

This governor operates on the principle of centrifugal weights or "flyballs." In operation the force developed by the revolving weights is opposed or balanced by a spring. The spring is adjusted to the proper tension to control the engine speed. Adjustment should not be attempted except by qualified mechanic.

BRAKE PEDAL ADJUSTMENT

When brake control system is in release position, foot brake pedal should have ¼" free travel before pressure stroke starts. This free travel is required to prevent blocking of by-pass port in master cylinder, and is obtained by altering the length of the master cylinder push rod. Make certain that foot brake lever return spring returns the lever to the limit of its travel when foot is removed from brake pedal.

FOOT BRAKE ADJUSTMENT

Adjust shoes for minimum drum clearance available without creating drag.

HAND BRAKE ADJUSTMENT

Standard Transmission: Hand brake adjustments are made by tightening or loosening the knob on the upper end of the hand brake lever. Any adjustment should be made with the brake lever in the full release position.

Monotrol Transmission: This model is not equipped with a hand brake. The parking brake is automatically applied and released.

BLEEDING THE BRAKE LINES

Any air inside of the hydraulic system must be removed. Whenever a line has been disconnected the system must be bled at both brakes.

Air in the system will cause a springy rubbery action of the brake pedal.

Be sure that master cylinder is kept at least half full of brake fluid during the entire bleeding operation.

1. Attach bleed hose to the bleeder connection. Pour a small amount of brake fluid into a clean container such as a pint jar and submerge the end of the bleeder tube in the fluid.
2. Unscrew the bleeder connection three-quarters of a turn and depress the brake pedal by hand, allowing the pedal to return slowly. Pumping the brake forces the fluid out into the glass jar and carries with it any air that is trapped in the system.
3. When air bubbles cease to appear, close the bleeder connection. Do not reuse the fluid that has been withdrawn.
4. Repeat operation for other brake.

CLUTCH PEDAL ADJUSTMENT

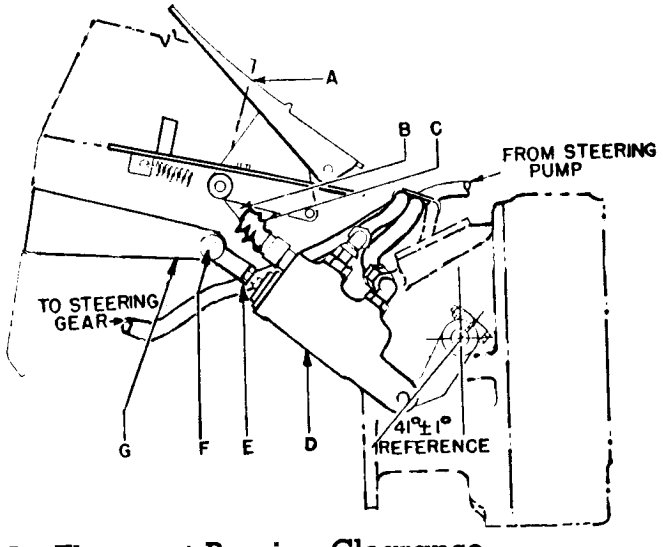
Standard Transmission with Dry Clutch: The correct clearance, or free travel, of the clutch pedal is 1¼" free movement before the clutch starts to disengage. The pedal should be checked occasionally and adjusted whenever free travel has been reduced to less than 1". This adjustment is made by means of the setscrew in the pedal hub.

Do not operate truck with no pedal clearance.

Standard Transmission with Oil Clutch: Refer to Clutch Booster Adjustment.

Monotrol Transmission: This model has no clutch pedal.

CLUTCH BOOSTER ADJUSTMENT



A. Throwout Bearing Clearance

1. Disconnect rod (B) from treadle (A).
2. Disconnect piston rod (E) from anchor (G). Hold the throwout crank back to the point where the throwout bearing is felt contacting the clutch fingers.

3. With the booster fully collapsed, adjust the piston rod (E) until pin (F) just slips in place.
4. Shorten the piston rod (E) four full revolutions for throwout bearing clearance. Connect the booster (D) to anchor (G) and treadle (A).
5. With the engine running, depress treadle (A). Check booster travel. Booster (D) should travel 1⅞ inches on piston rod (E). If it does not, adjust the pedal height.

B. Pedal Height

1. Measure the booster travel, with the engine running and treadle (A) fully depressed. Booster (D) should travel 1⅞ inches.
2. If the booster travel is not as specified, pull rubber boot (C) toward booster (D) to expose a jam nut on rod (B). Loosen the jam nut and turn the rod in the desired direction.
3. If the booster travel is not enough, lengthen rod (B), by turning it counterclockwise. Shorten the rod (B) if the booster travel is too much.

CARRIAGE AND UPRIGHTS

A. Carriage Removal

The carriage must be removed from the uprights to service the rollers. The carriage is removed by pulling it out of the bottom of the uprights. This is done by detaching the hoist chains from the carriage and raising inner upright until it is clear of carriage.

Carriage side thrust is taken by the rollers. Adjustment is made by shimming the bottom four rollers.

Always keep side play to a minimum, being sure that the carriage has freedom throughout entire length of inner upright.

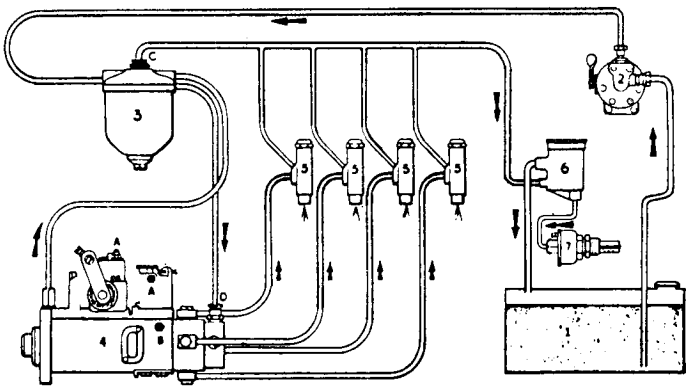
B. Uprights Removal

1. Be sure hoist cylinder is completely collapsed.
2. Disconnect the pressure hoses from the hoist cylinder.
3. Fasten an overhead hoist to the uprights to support and move them.
4. Disconnect the tilt cylinders from the uprights by removing pivot pins.
5. Match mark and remove the upright pivot bearing caps. Be careful not to damage the bushings.
6. Disconnect the hoist chain from the carriage.
7. Hoist the upright free of the truck and at the same time guide the carriage out of the bottom of the uprights.

C. To Replace Strip Bearings While Uprights Are Mounted

1. Raise front of truck about 6 inches and block securely.
2. Remove snap ring from top of hoist cylinder and inner upright.
3. Fasten overhead crane to inner upright and raise to free cylinder.
4. Holding cylinder out away from inner upright, lower upright until shoes are exposed on the inner and outer upright.
5. Replace or reshim shoes as necessary.

PRIMING (BLEEDING THE DIESEL FUEL SYSTEM



A Typical Fuel System

1. Fuel Tank.
2. Fuel Lift Pump.
3. Filter.
4. Fuel Injection Pump.
5. Injector.
6. Cold Start Fuel Reservoir.
7. Cold Start Aid.

In the case of a new engine or an engine which has been standing idle for any length of time, it is important that the fuel system be "bled." A typical fuel system is shown above.

To bleed the system proceed as follows:

1. Loosen the air vent screw (A) on top of the governor housing.
2. Loosen one of the two hydraulic head locking screws (B) on the side of the injection pump body (4).
3. Operate the priming lever of the fuel lift pump (2) and when fuel, free from air bubbles, issues from each venting point, tighten the screws in the following order:
   a. Filter cover vent screw (C).
   b. Head locking screw (B).
   c. Governor vent screw (A).
4. Loosen the pipe union unt (D) at the pump inlet, operate the priming device, and retighten when fuel, free from air bubbles, issues from around the threads.
5. Loosen the union at the injector (5) ends of two of the high pressure pipes.
6. Set the engine speed control in the fully open position and be sure that the "stop" control is in the "run" position.
7. Turn the engine until fuel oil, free from air bubbles, issues from both fuel pipes.
8. Tighten the unions on the fuel pipes, and the engine is ready for starting.

NOTE: If the cam on the camshaft driving the fuel lift pump is on maximum lift, then it will not be possible to operate the hand primer. If such a condition arises, then the engine should be turned until the hand primer can be operated.

L.P.G. MAINTENANCE

The following recommendations of Factory Mutual Engineering Division should be followed:

1. Avoid exposing L.P.G. powered trucks to high temperatures near ovens, furnaces, and other sources of high temperature. Do not allow trucks to remain standing near such equipment for other than extremely short intervals. Never leave them unattended near ovens and furnaces.
2. Establish a good preventative maintenance program with frequent inspections. This is essential to avoid creating hazardous conditions as a result of the escape of the L.P.G. fuel.

Storage and Repair

1. Provide an outdoor shelter or a detached or cut off (walls of 1-hour fire resistance rating), sprinklered, garage for storage of trucks during idle periods and for repair of trucks. The garage should have positive mechanical ventilation from floor level.
2. Trucks having replaceable fuel tanks may be stored during idle periods in indoor locations without the safeguards enumerated above provided the fuel tanks are removed and stored in an outside or other suitable location. Follow the operating procedure below for refueling.

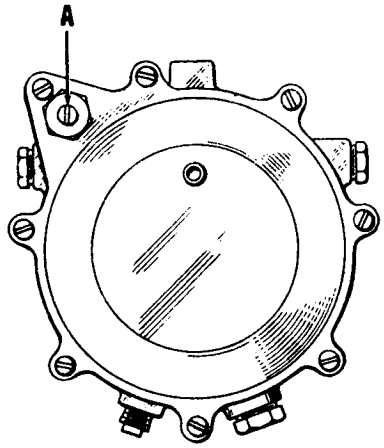
Refueling

1. Refuel trucks having permanently mounted fuel tanks out-of-doors at a location:
   a. At least 50 feet from important buildings.
   b. At least 15 feet from storage tanks at the end farthest from the relief valve.
2. Replaceable fuel containers may be exchanged indoors at least 25 feet away from open flames or other ignition sources if prior to disconnecting the empty tank, the fuel supply is shut off at the tank and the engine operated until all of the fuel in the fuel system is consumed.
3. a. Permanently mounted fuel tanks should not be filled beyond the maximum filling capacity according to the following temperatures at filling point:

   80 per cent of liquid capacity between 10° and 40° F.
   85 per cent of liquid capacity between 40° and 70° F.

   b. I.C.C. replaceable containers should be filled by weight in accordance with I.C.C. regulations.

L. P. G. REGULATOR AND CARBURETOR ADJUSTMENT



A. Connect vacuum gauge to intake manifold by means of a tee installed between the vacuum safety switch and the intake manifold.

B. Start and warm the engine to normal operating temperature.

C. Rotate idle adjusting screw "A" on the regulator clockwise for richer mixture and counter-clockwise for leaner mixture.

D. Adjust until highest, steady vacuum reading is obtained at the desired engine idle speed. To obtain minimum carbon monoxide content in exhaust gas, lean until a decrease of approximately ½" mercury is observed on the vacuum gauge. Adjust throttle stop screw on carburetor to correct idle speed.

E. Adjust the fuel adjusting screw on the carburetor until highest, steady vacuum reading is obtained with engine at governed R.P.M. The best setting for maximum economy and minimum carbon monoxide is obtained when the adjustment is sufficient to cause a drop of approximately ½" mercury on the vacuum gauge. The power adjustment can be made on road vehicles when the engine is under approximately ¾ load conditions.

F. Tighten locknut that secures the fuel adjusting needle with a wrench.

G. Recheck idle adjustment as outlined in step "D." Accelerate engine several times. If engine dies on deceleration or hesitates on acceleration, idle adjustment is set too lean.

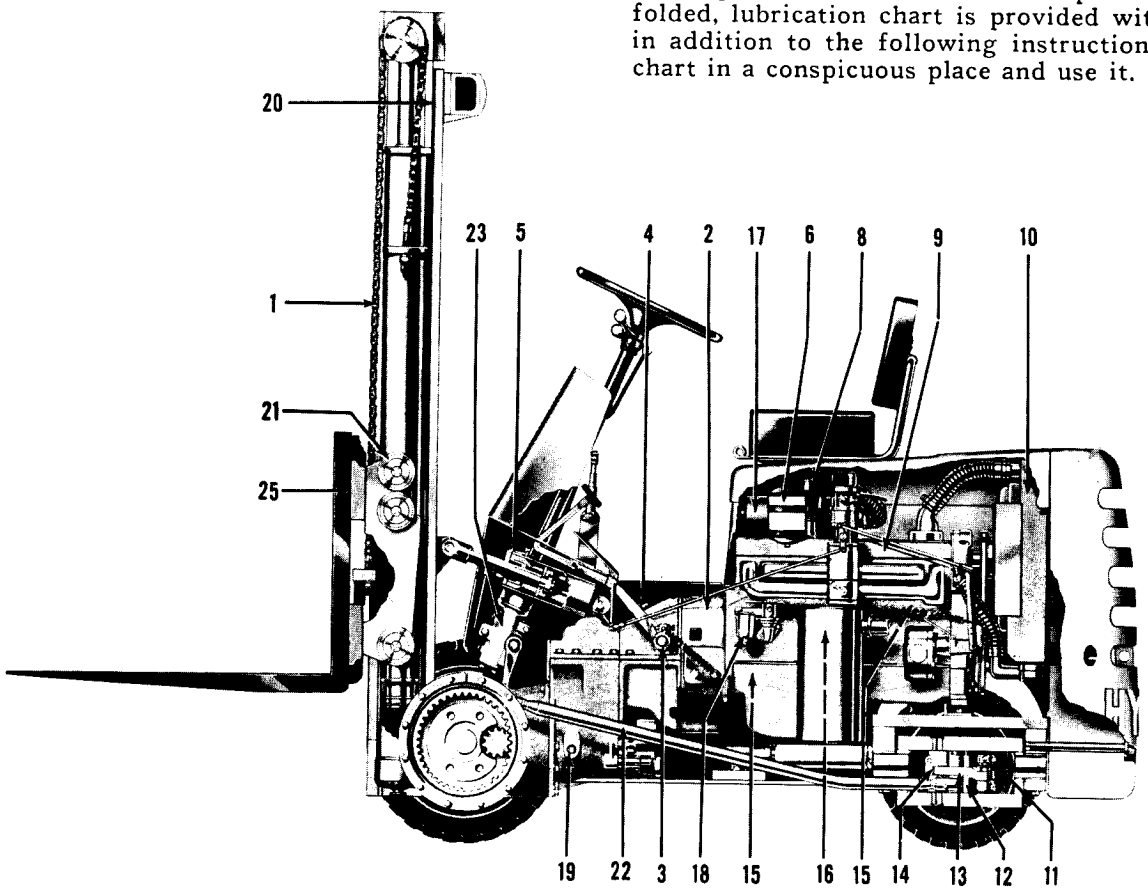
H. Tighten locknut that secures idle adjusting screw as tight as possible with fingers.

I. Remove vacuum gauge.

LUBRICATING INSTRUCTIONS

LUBRICATION CHART

Proper lubrication is most important. A large, folded, lubrication chart is provided with this book in addition to the following instructions. Post this chart in a conspicuous place and use it.



GREASE FITTINGS

Use a pressure grease gun and multi-purpose chassis grease. Force a small amount of new grease through fitting. Wipe off excess.

BEARINGS—HAND PACKING

Use short fiber wheel bearing grease. To repack, first wash with clean solvent to remove dirt and old grease. Pack with clean grease, forcing it completely around cage and balls or rollers.

GENERAL LUBRICATION

Use SAE 30 engine oil except where noted. General lubrication pertains to parts such as rod ends, small bushings, and hinges that do not have grease fittings. Wipe these points clean and add a few drops of oil. Wipe off excess.

FLUSHING

Drain old oil from the case and replace drain plug. Fill with flushing oil to level plug or level mark. Run gears or engine at half throttle with no load for five minutes. Drain the flushing oil immediately and fill the case with new oil as required.

CAUTION

Excessive lubrication is wasteful and is often as damaging as lack of lubrication. Analyze each lubrication point to determine the amount of lubrication necessary. Keep the machine clean. Wipe off all excess lubricant to prevent accumulation of dirt.

NOTE

The lubrication chart has been outlined in two systems. On an hourly basis for trucks operating more than 8 hours per day, and on a period basis for trucks operating eight hours or less per day, follow the system most applicable. Keep a lubrication record on each machine. Numbers preceding the maintenance items correspond to the location numbers on the lubrication chart above.

Every 8 Hours or Daily

9. *ENGINE:
Check level on bayonet gauge and add oil if necessary.

17. AIR CLEANER OIL BATH TYPE:
SAE 30W engine oil. Remove the bottom pan, clean and refill to the mark as indicated. Check oftener under extremely dusty conditions.

10. *RADIATOR:
Keep full with clean water. If machine is exposed to freezing weather, add a good grade of anti-freeze in amounts specified by anti-freeze manufacturer.

Every 50 Hours or Weekly

2. *HYDRAULIC SYSTEM:
Oil level bayonet gauge is attached to the breather. Add oil if necessary. Keep the breather cap clean.

19. *STANDARD TRANSMISSION—DIFFERENTIAL ASSEMBLY:
Add oil to filler plug level in front cover. Do not overfill.

19 *MONOTROL TRANSMISSION:
Bayonet gauge on right-hand side. Check level with transmission in "Park" and engine warm and running.

5. *BRAKE MASTER CYLINDER:
Check oil level and keep reservoir full.

7. FAN BELT:
Check adjustment and belt condition.

25. LOAD ARM PINS:
Brush with grease.

Every 100 Hours or Two Weeks

9. *GASOLINE ENGINE:
Drain and refill with new engine oil. Keep oil to proper level.

18. DIESEL ENGINE FUEL SYSTEM:
Clean fuel lift pump filter.

8. DISTRIBUTOR:
Remove cap and rotor. Add four drops of SAE 10 oil to felt wick in rotor shaft and place one drop of SAE 10 oil on breaker arm pivot. Place a very small amount of distributor cam grease on the breaker cam and wipe off excess. There should be no more than a light film of grease after wiping. Remove plug at base of distributor and fill reservoir with SAE 20 oil.

20. UPRIGHT:
Completely raise inner upright. Brush sliding surfaces on both the inner and outer uprights with "Lubriplate 130AA."

1. HOIST CHAIN:
SAE 30 engine oil. Brush with oil and wipe off the excess.

17. AIR CLEANER, DRY TYPE:
Remove the element, and tap it lightly on a smooth surface, alternating ends, until dust is removed. The end of the element should contact the surface squarely. Discard the element after no more than ten such servicings.

16. BATTERY:
Water level should be maintained ½-inch above the plates. Use distilled water only. If terminals are corroded, clean with a mild soda solution. Do not allow soda to get inside of battery. After cable terminals are securely tightened coat with heavy grease.

15. GENERATOR:
SAE 20 Engine Oil. Three drops in oiler. Do not over-lubricate.

4. CLUTCH THROW-OUT BEARING:
Turn the cap down one turn. Refill cup with high temperature grease.

GENERAL LUBRICATION:

A. All rod end pins.
B. Chain anchors.
C. Shift lever bushings.
D. Throttle linkage.
E. Brake linkage bushings.
F. Hand brake cable.
G. Hinges.
H. Clutch linkage bushings.
I. Hoist and tilt control linkage.

GREASE FITTINGS:

11. *Tie Rods.* Four fittings, one on each end of each tie rod.
14. *Center Arm Assembly Pivot.* Two fittings on the right side of the pivot.
12. *King Pins.* Four fittings, two on the back side of each spindle.
3. *Brake Pivot.* One fitting.
22. *Drag Link.* Two fittings, one each end.
21. *Load Carriage Rollers.* Six fittings, one on the inside of each roller.

First 200 Hours

2. HYDRAULIC SYSTEM:
Replace hydraulic oil filter element on new trucks.

Every 200 Hours or Four Weeks

9. *DIESEL ENGINE:
Drain and refill with new engine oil. Keep oil to proper level.

6. ENGINE OIL FILTER:
Replace old filter element with new cartridge.

Every 500 Hours or Three Months

See Capacity Chart Page A13.

9. *DIESEL ENGINE:
Clean strainer in crankcase.

23. *STEERING GEAR HOUSING:
Fill plug located on the right side of the steering case. Fill until oil level is at fill plug height.

2. *HYDRAULIC SYSTEM:
Clean and check tank breather filter. Add new oil as necessary.

1. HOIST CHAIN:
Remove the chain from the truck and wash with solvent. Wipe dry and soak in SAE 30 engine oil for fifteen minutes. Replace on truck and wipe off excess oil.

18. GASOLINE ENGINE FUEL SYSTEM:
Remove filter bowl from fuel pump and flush out sediment. Remove any accummulated dirt from the screen over the sediment bowl.

18. DIESEL ENGINE FUEL SYSTEM:
Clean and check atomisers.

Every 1000 Hours or Six Months

18. FUEL SYSTEM—DIESEL:
Install new element in the final fuel filter.

19. *MONOTROL TRANSMISSION:
Drain. Refill with new Type "A" automatic transmission fluid. Replace transmission oil filter element.

19. *STANDARD TRANSMISSION—DIFFERENTIAL ASSEMBLY:
Drain and flush. Add new oil to filler plug level in front cover.

13. REAR WHEEL BEARINGS:
Hand pack two wheels, four bearings.

Every 2000 Hours or Once a Year

2. *HYDRAULIC SYSTEM:
Replace hydraulic oil filter element. Add new oil as necessary.

Every 5000 Hours

2. *HYDRAULIC SYSTEM:
Drain and flush hydraulic tank. Refill with specified oil.

See Capacity Chart below.

CAPACITY CHART

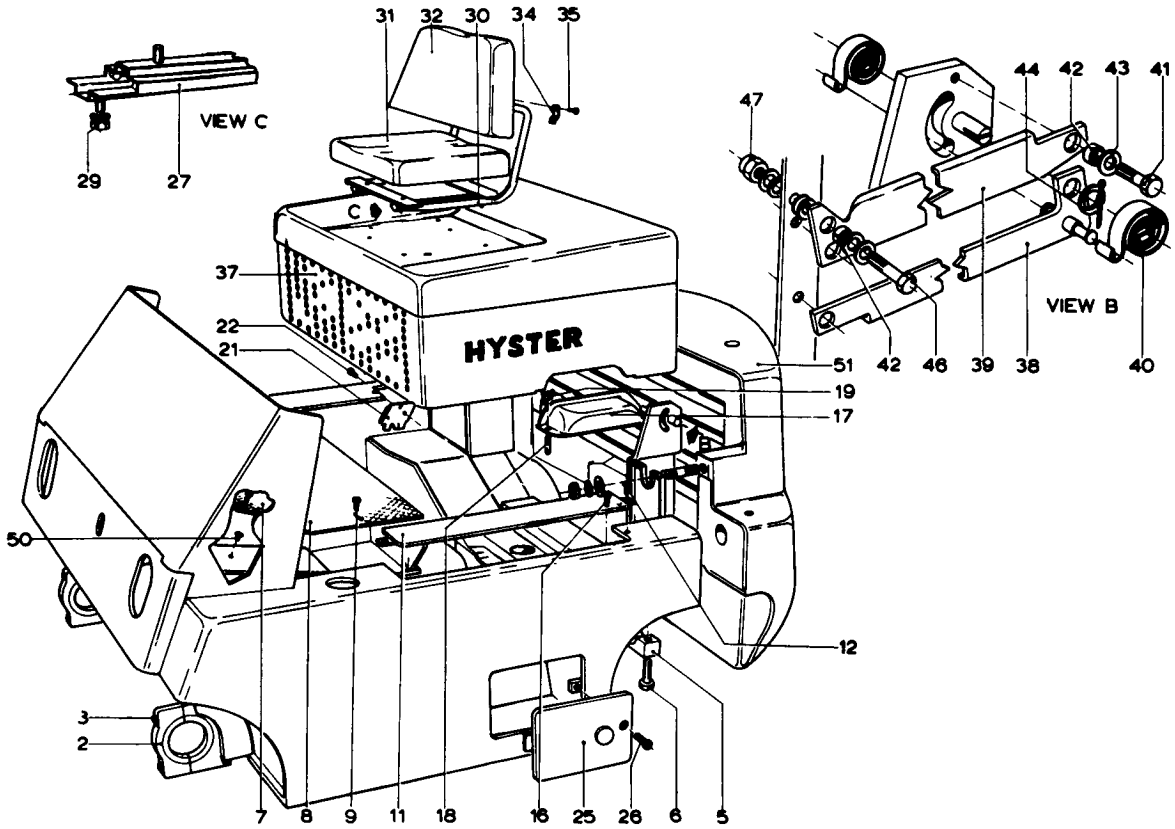
UNIT	CAPACITY	TYPE		
Cooling System—Gasoline	10 Quarts			
Cooling System—Diesel	9.5 Quarts			
		SAE No.	API Classification	TEMPERATURES
Gasoline Engine and Filter	4 Quarts	30	MS	60° F. and above
		20W	MS	32° F. to 60° F.
		10W	MS	32° F. and below
Diesel Engine and Filter	6 Quarts	30	DS	80° F. and above
		20/20W	DS	30° F. to 80° F.
		10W	DS	30° F. and below
Std. Transmission and Differential	17 Pounds	SAE 90 AP		
Powershift Transmission	15 Quarts	SAE 10 Type "A"		
Powershift Differential	12 Pounds	SAE 90 AP		
Steering Gear	1 Pound	No. 1 Lithium Soap or Calcium Soap Grease with an E.P. additive		
Fuel System	8 Gallons	Gasoline: Regular Diesel: No. 2, Dark Diesel Fuel		
Brake Master Cylinder	½ Pint	SAE 70R3		
Hydraulic System	6.5 Gallons	SAE 10W A.P.I. Classification "MS" U. S. Military Spec. MIL-L2104A Viscosity Index (Min.)—90		
Hydraulic System—Power Steering	6.5 Gallons	Obtain from Hyster dealers. 2 Gal. Containers—Part No. 131820 55 Gal. Containers—Part No. 131821		

Section B

FRAME AND BODY PARTS

INDEX

FRAME AND COWLING



120-86

KEY
A-FOR STANDARD TRANSMISSION.
B-FOR MONOTROL TRANSMISSION.

REF. NO.	HYSTER PART NO.		NAME OF PART 1 2 3 4	QTY. A	QTY. B
2	89086		CAP-BEARING	2	2
3	15661		CAPSCREW-1/2 UNF X 4	4	4
	15158		LOCKWASHER-1/2	4	4
5	117331	W	CAP-BEARING	2	2
6	15537		CAPSCREW-3/4 UNF X 3 1/2	4	4
7	113824		PLATE-FLOOR	••	1
	117529		PLATE-FLOOR	1	••
8	113825		PLATE-FLOOR	••	1
	*982986		PLATE-FLOOR	••	1
	¤ 77759		PLATE-FLOOR	••	1
	117530		PLATE-FLOOR	1	••
	*982985		PLATE-FLOOR	1	••
	¤ 77760		PLATE-FLOOR	1	••
	# 87046	W	PLATE-FLOOR	1	••
	# 87045		PLATE-FLOOR	••	1
	%134625		PLATE-FLOOR	1	••
	%141147		PLATE-FLOOR L.P.G.	1	••
	%134627		PLATE-FLOOR L.H.	1	••
	#134631		PLATE-FLOOR R.H.	1	••
9	15534		CAPSCREW-3/8 UNC X 5/8	6	6
	15134		WASHER-3/8	6	6
11	115456	W	COVER-FOR B2D SERIES TRUCKS	1	1
	*982981	W	COVER-GAS ENGINE	1	1
	¤ 78083		COVER-GAS ENGINE	1	1
	*982566	W	COVER-DIESEL ENGINE	1	1
	¤ 78085	W	COVER-DIESEL ENGINE	1	1

REF. NO.	HYSTER PART NO.		NAME OF PART 1 2 3 4	QTY. A	QTY. B
12	16351		CAPSCREW-3/8 UNF X 1 1/4	2	2
	15156		LOCKWASHER-3/8	2	2
	15006		NUT-3/8 UNF	2	2
16	16353		CAPSCREW-3/8 UNF X 1 DIESEL	2	2
17	982559	W	COVER-BATTERY } FOR	1	1
18	30757		STUD-3/8 } B2E AND	2	2
19	19148		NUT-WING,3/8 UNC } B2A	2	2
	15156		LOCKWASHER-3/8 } SERIES	2	2
21	982980		PLATE-SHIELD } TRUCKS	1	1
	113826		PLATE-SHIELD	1	1
22	15525		CAPSCREW-3/8 UNC X 3/4	1	1
	15134		WASHER-3/8	1	1
	15156		LOCKWASHER-3/8	1	1
25	* 69290	A	DOOR-AIR CLEANER } DIESEL	1	1
26	* 69289		CAPSCREW-SPECIAL } ENGINE	1	1
27	233126	A	RAIL SET-SEAT	1	1
	233164	A	ADJUSTER ASSY. R.H.	1	1
	233161	A	ADJUSTER ASSY.-L.H.	1	1
	233163		SPRING-LATCH	1	1
	233162		BOLT-MOUNTING	4	4

FRAME AND COWLING

REF. NO.	HYSTER PART NO. 1 2 3 4	NAME OF PART	QTY. A	QTY. B
29	15005	NUT-5/16 UNF	4	4
	16557	LOCKWASHER-5/16	4	4
30	109983 A	SEAT ASSEMBLY	1	1
	233155	FRAME-SEAT	1	1
	233159	SLEEVE-STUD, FRONT	2	2
	233160	NUT-ACORN, BACK	2	2
31	233156	CUSHION-SEAT	1	1
32	233157	CUSHION-BACK	1	1
34	233158	CLIP-SPECIAL	2	2
35	16709	SCREW-1/4 UNC X 3/4	4	4
37	#122786 A	HOOD-S30B W/ASME FUEL TANK	1	1
	#122787 A	HOOD-S40B & S50B W/ASME TANK	1	1
	#122784 A	HOOD-S30B W/ICC FUEL TANK	1	1
	#122785 A	HOOD-S40B & S50B W/ICC TANK	1	1
	*982554 W	HOOD-GAS ENGINE	1	1
	¤120658 W	HOOD	1	1
	*982563 W	HOOD-DIESEL ENGINE	1	1
	¤ 77462	HOOD-DIESEL ENGINE	1	1
38	113817 W	LINK-HOOD,R.H.	1	1
	113820 W	LINK-HOOD, L.H. B2E SER. TR.	1	1
	982978 W	LINK-HOOD, L.H.	1	1
39	115723	LINK-HOOD, R.H.	1	1
	115722	LINK-HOOD, L.H.	1	1
40	113823	SPRING-FLAT	4	4
41	12496	BOLT-PLACE, 1/2 UNF X1	2	2
42	113822	BUSHING	6	6
43	15135	WASHER-1/2	2	2
44	15136	WASHER-3/4	2	2
	15224	COTTER-1/8 X 1 1/4	2	2
46	15574	CAPSCREW-1/2 UNF X 1 3/4	4	4
47	58311	NUT-LOCK, 1/2 UNF	4	4
	15178	WASHER-1/2	12	12
	15910	LOCKWASHER-1/2	8	8
50	112431	BUMPER-RUBBER	2	2
51	•••••	COUNTERWEIGHT-SEE SEC. L	1	1
	@117711	LIFTING EYE KIT	1	1
	@118141	EYE-LIFTING	4	4
	@ 15164	LOCKWASHER 7/8	4	4
	@ 15014	NUT-7/8 UNF	4	4

*LAST USED ON SERIAL NO. B2E-1871 AND B2A-1787.

¤FIRST USED ON SERIAL NO. B2A-1788.

#FOR LPG TRUCKS. FIRST USED ON SERIAL NO. B2D-3247.

@FOR STEVEDORING TRUCK ONLY. NOT ILLUSTRATED.

%FOR OIL CLUTCH TRUCKS ONLY.

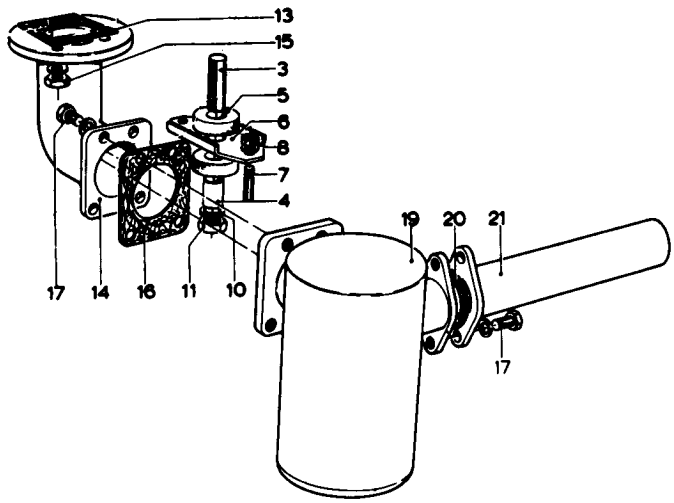
Section C

POWER UNIT

INDEX

ENGINE MOUNTS AND EXHAUST SYSTEM

FOR GAS ENGINE



120-87

KEY
A-FOR B2D SERIES TRUCKS ONLY.
B-FOR B2E AND B2A SERIES TRUCKS ONLY.

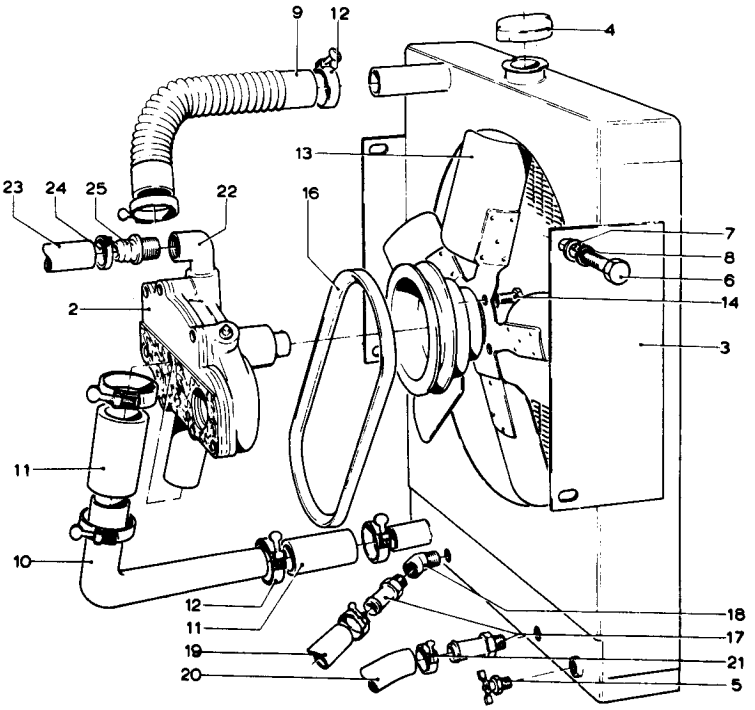
REF. NO.	HYSTER PART NO.	1 2 3 4 NAME OF PART	QTY. A	QTY. B
3	111116	STUD-5/8	1	1
4	111121	SPACER	1	••
	992413	SPACER	••	1
5	111120	PAD-ENGINE MOUNT	2	••
	992412	PAD-ENGINE MOUNT	••	2
6	114323	PLATE-ENGINE MOUNT	1	••
	982570	PLATE-ENGINE MOUNT	••	1
7	62436	STUD-3/8	2	2
8	15006	NUT-3/8 UNF	2	2
	15156	LOCKWASHER-3/8	2	2
10	15180	WASHER-5/8	1	1
11	17405	NUT-LOCK, 5/8 UNF	1	1
13	108961	GASKET-EXHAUST	1	1
14	114317	ELBOW-EXHAUST	1	1
15	17180	NUT-LOCK, 3/8 UNC	3	3
16	111114	GASKET-EXHAUST	1	1
17	15529	CAPSCREW-3/8 UNC X 1	6	6
	15156	LOCKWASHER-3/8	6	6
19	114318	MUFFLER	1	1
20	118654	GASKET-RING	1	1
	114319 W	PIPE-EXHAUST	1	1
	▫139989	PIPE-EXHAUST	1	1
	*117775 W	PIPE-EXHAUST	1	••
	* 15617	CAPSCREW-1/4 UNF X 5/8	2	••
	* 15154	LOCKWASHER-1/4	2	••
21	▫*137336	PIPE-EXHAUST	1	1
	▫* 68968	CLAMP	1	1
	▫*137337	EXHAUST ASSEMBLY	1	1
	▫* 15587	CAPSCREW-1/4 UNF X 1	2	2
	▫* 15127	WASHER-1/4	4	4
	▫* 15154	LOCKWASHER-1/4	2	2
	▫* 15004	NUT-1/4 UNF	2	2

*FOR GS TRUCKS ONLY.

▫FOR STEVEDORING TRUCK ONLY.

COOLING SYSTEM

FOR GAS ENGINE



KEY
A-FOR STANDARD TRANSMISSION TRUCKS ONLY.
B-FOR MONOTROL TRANSMISSION TRUCKS ONLY.
C-FOR STANDARD TRANSMISSION COTTON TRUCKS ONLY.
D-FOR MONOTROL TRANSMISSION COTTON TRUCKS ONLY.

120-88

REF. NO.	HYSTER PART NO. 1 2 3 4	NAME OF PART	QTY. A	B	C	D
2	•••••	WATER PUMP-SEE PAGE C3	1	1	1	1
3	131161	RADIATOR	1	••	1	••
	131162	RADIATOR	••	1	••	1
	*131180	RADIATOR	1	••	••	••
	*131181	RADIATOR	••	1	••	••
	*982580	SHROUD-RADIATOR	1	1	••	••
4	106483	CAP-RADIATOR, 7 PSI	1	1	1	1
	119055	CAP-RADIATOR, 13 PSI	1	1	1	1
5	12815	COCK-DRAIN	1	1	1	1
6	15513	CAPSCREW-3/8 UNF X 3/4	4	4	4	4
7	15176	WASHER-3/8	4	4	4	4
8	15156	LOCKWASHER-3/8	4	4	4	4
9	66746	HOSE-RADIATOR	1	1	1	1
	*980465	HOSE-RADIATOR	1	1	••	••
10	*982573 W	PIPE-RADIATOR	1	1	••	••
11	107706	HOSE-RADIATOR	1	1	1	1
	* 57130	HOSE-RADIATOR	2	2	••	••
12	18999	CLAMP-HOSE	4	4	4	4
	* 18999	CLAMP-HOSE	6	6	••	••

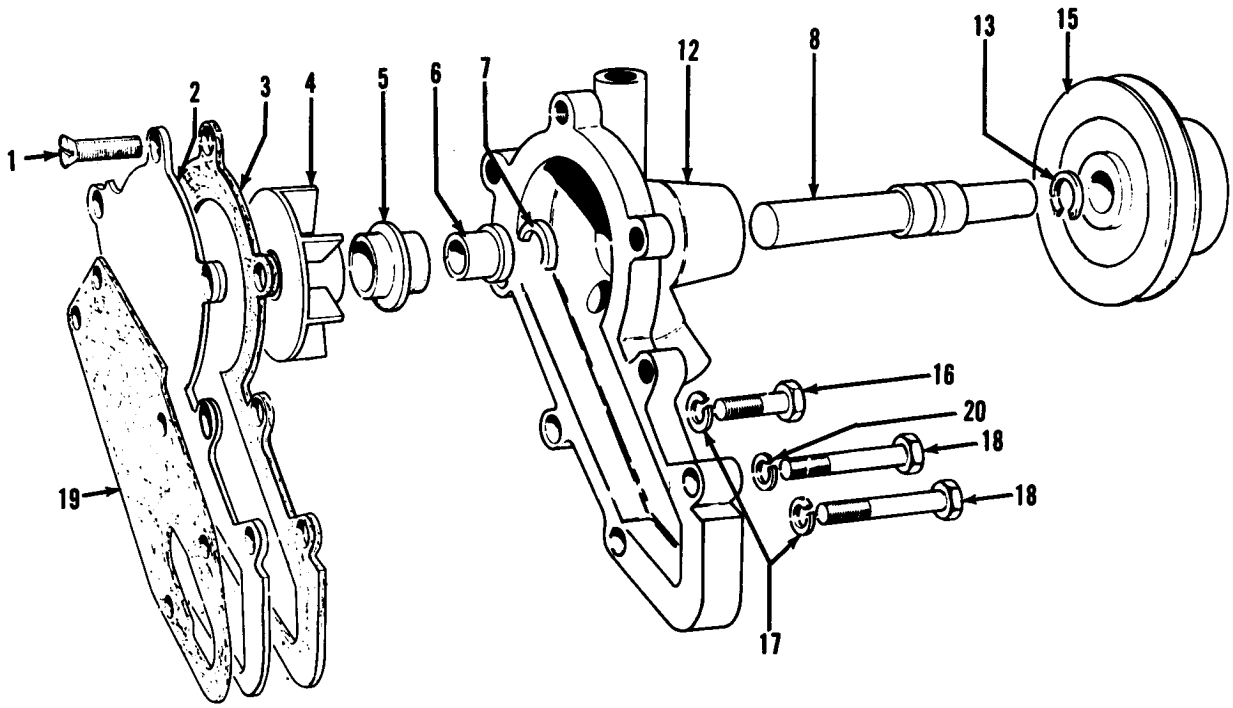
REF. NO.	HYSTER PART NO. 1 2 3 4	NAME OF PART	QTY. A	B	C	D
13	111096	BLADE-FAN	1	1	1	1
	202790	BLADE-FAN, OPT. PULLER	1	1	1	1
14	15556	CAPSCREW-5/16 UNC X 5/8	4	4	4	4
	15155	LOCKWASHER-5/16	4	4	4	4
16	108102	BELT-FAN	1	1	1	1
	¤ 85579	BELT-FAN	1	1	1	1
17	109417	NIPPLE-STREET	••	2	••	2
18	12822	ELBOW-STREET	••	1	••	1
19	114311	HOSE-FOR B2D SER. TR.	••	1	••	1
	983010	HOSE	••	1	••	••
20	114310	HOSE-FOR B2D SER. TR.	••	1	••	1
	983009	HOSE	••	1	••	••
21	18994	CLAMP-HOSE	••	4	••	4
22	15345	ELBOW-STREET	1	1	1	1
23	109311	HOSE-TO OUTLET ELBOW	1	1	1	1
24	109312	CLAMP-HOSE	1	1	1	1
25	108956	NIPPLE	2	2	2	2
	137877	PELLET-WATER CONDITIONER BOX OF 12				

*FOR B2E AND B2A SERIES TRUCKS ONLY.

¤FIRST USED ON SERIAL NO. B2D-2691 STD. TRANS. B2D-2764 MONOTROL TRANS., B2E-1771 AND B2A-1582.

WATER PUMP ASSEMBLY

GAS ENGINE



120-162

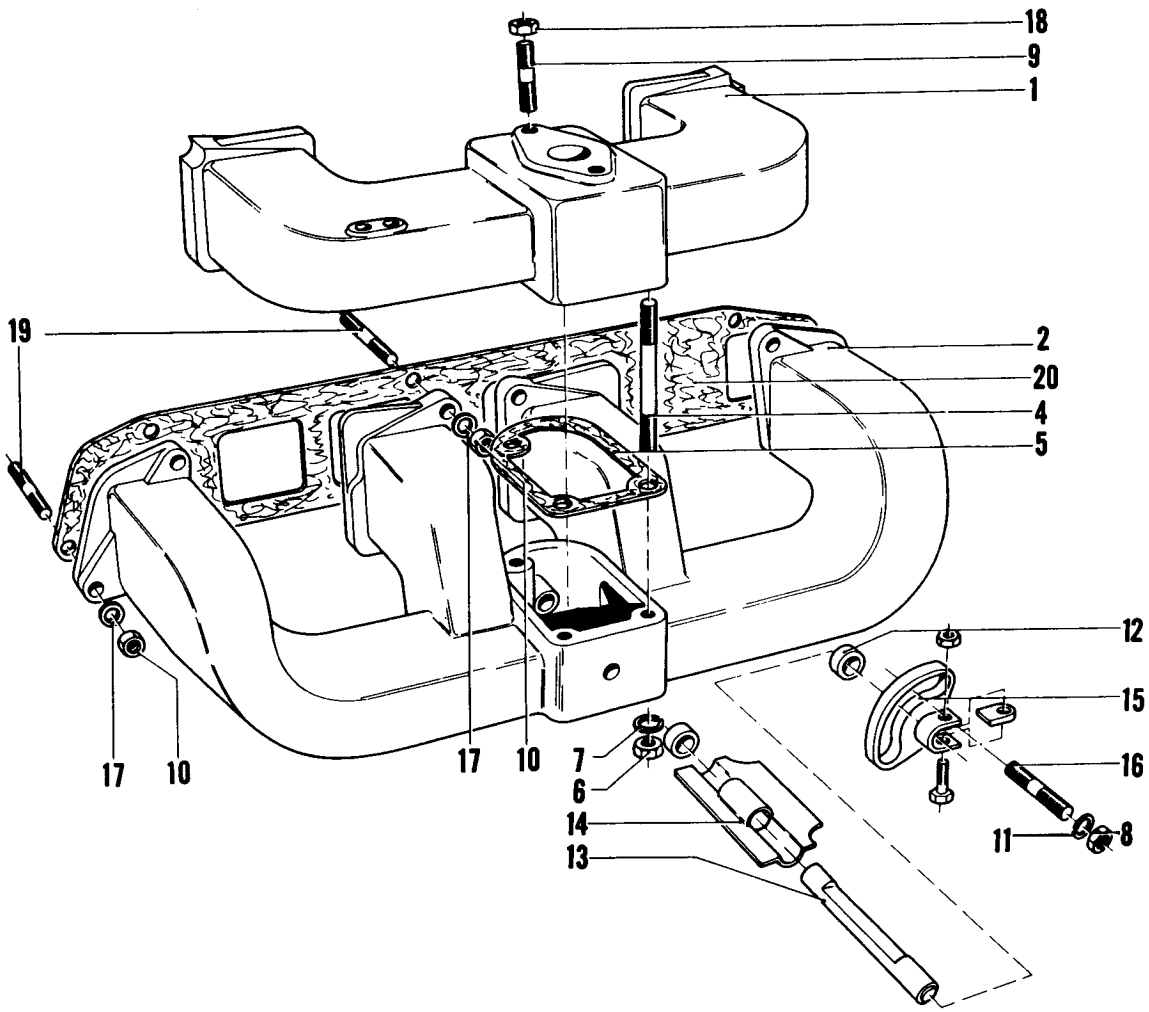
KEY
A-LAST USED ON SER. NO. B2D-2690, B2E-1770 AND B2A-1581.
B-FIRST USED ON SER. NO. B2D-2691, B2E-1771 AND B2A-1582.

REF. NO.	HYSTER PART NO. 1 2 3 4	NAME OF PART	QTY. A	QTY. B
	109310 A	WATER PUMP ASSY.	1	••
	121784 A	WATER PUMP ASSY.	••	1
1	16502	SCREW-COVER TO BODY	4	4
2	109334	COVER-WATER PUMP	1	1
3	*109335	GASKET-PUMP	1	1
4	* •••••	IMPELLER	1	1
5	*236188	SEAL	1	1
6	*109332	SHEDDER-WATER	1	1
7	*109336	RING-BEARING SEAT	1	1
8	* •••••	SHAFT	1	1
12	109327	BODY	1	1
	*142352	GASKET	1	1
13	*142355	RETAINER	1	1
15	109317	HUB-FAN	1	••
	235639	HUB-FAN	••	1
16	109315	CAPSCREW	2	2
17	15156	LOCKWASHER 3/8	3	3
18	16379	CAPSCREW-3/8 UNC X 2 1/4	2	2
19	*109313	GASKET-PUMP TO CYLINDER	1	1
20	109165	WASHER-COPPER, 3/8	1	1

*INCLUDED IN WATER PUMP REPAIR KIT 138613.

INTAKE AND EXHAUST MANIFOLD ASSEMBLY

GAS ENGINE



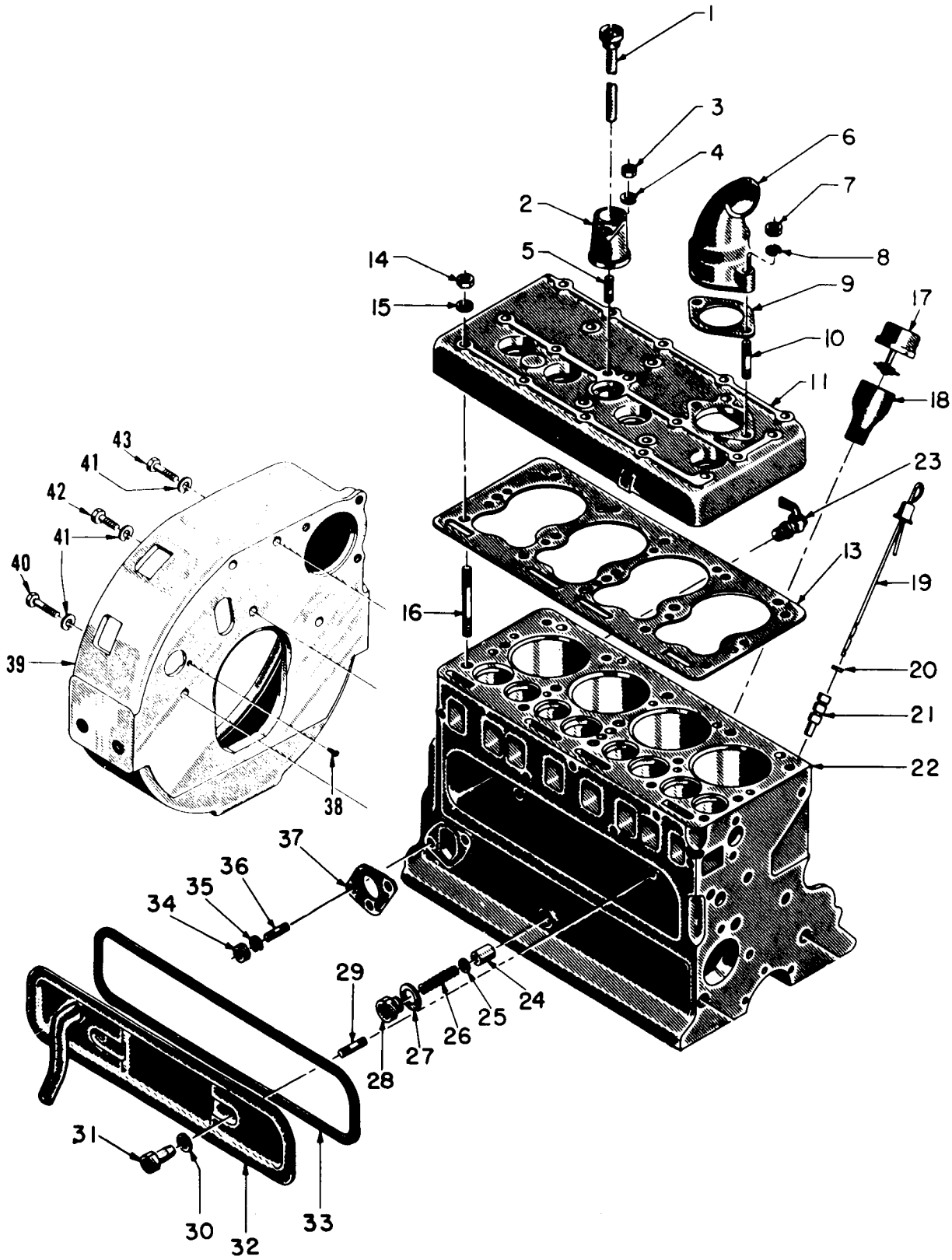
120-163

REF. NO.	HYSTER PART NO.	NAME OF PART 1 2 3 4	QTY.
	108957 A	INTAKE AND EXHAUST ASSY.	1
1	108958	MANIFOLD-INTAKE	1
	109282	SCREW-PLUGGING	2
	108970	GASKET-SCREW	2
	15306	PLUG-PIPE, 1/8	1
2	108959	MANIFOLD ASSY.-EXHAUST	1
4	108960	STUD-EXHAUST TO INTAKE MAN.	3
5	108961	GASKET	1
6	109276	NUT-3/8 UNC, BRASS	3
7	15920	LOCKWASHER 3/8	3
8	233318	NUT-1/4 UNC	1
9	108962	STUD-CARB. TO MAN.	2
10	109276	NUT-3/8 UNC	7
11	15142	WASHER-7/32	1

REF. NO.	HYSTER PART NO.	NAME OF PART 1 2 3 4	QTY.
12	108964	BUSHING-HEAT CONTROL VALVE	2
13	108966	SHAFT-HEATER VALVE	1
14	108965	VALVE-HEATER	1
15	108967	SECTOR-HEATER VALVE	1
16	109297	STUD	1
17	15920	LOCKWASHER	3
	127448	WASHER-3/8	3
	109277	WASHER-13/32	4
18	15056	NUT-3/8 UNC	2
	15156	LOCKWASHER-3/8	2
19	109222	STUD	7
20	109278	GASKET-MOUNTING	1

CYLINDER BLOCK, CYLINDER HEAD AND GASKET

GAS ENGINE



120-89

CYLINDER BLOCK, CYLINDER HEAD AND GASKET

GAS ENGINE

KEY
A-FOR F162 ENGINE.
B-FOR F163 ENGINE.

REF. NO.	HYSTER PART NO.		NAME OF PART 1 2 3 4	QTY. A	QTY. B
	123768		ENG. ASSY.-L.P.G. STD TRANS.	1	••
	114306	A	ENG. ASSY.-MONTROL TRANS.	1	••
	114303	A	ENGINE ASSY.-STD. TRANS.	1	••
	123769		ENG. ASSY.-L.P.G. MONOTROL	1	••
	134632		ENG. ASSY.-OIL CLUTCH	••	1
	134649		ENG. ASSY.-L.P.G. OIL CLUTCH	••	1
1	109326		SHAFT-DIST. DRIVE	1	••
	200822		SHAFT-DIST. DRIVE, L.P.G.	1	••
	142357		SHAFT-DIST. DRIVE	••	1
2	109324		ADAPTER-DIST.	1	••
	200829		ADAPTER-DIST., L.P.G	1	••
	142359		CLAMP-DIST. HOLDDOWN	••	1
3	15056		NUT-3/8 UNC	1	••
	142358		NUT	••	1
4	15156		LOCKWASHER-3/8	1	••
	127448		LOCKWASHER	1	1
5	109325		STUD	1	1
6	108976		ELBOW-WATER OUTLET	1	1
	113015	A	VAPORIZER ASSY.-L.P.G.	1	••
	* 99424	A	VAPORIZER ASSY.-L.P.G.	1	1
	109323		ADAPTER-THERMOSTAT	1	1
	109322		THERMOSTAT-160	1	1
	86027		THERMOSTAT-182	1	1
7	15055		NUT-5/16 UNC	2	2
8	15155		LOCKWASHER-5/16	2	2
9	109321		GASKET-WATER OUTLET	1	1
10	109320		STUD	2	2
11	200620		HEAD-CYLINDER	1	••
	142373		HEAD-CYLINDER	••	1
	116542		HEAD-CYLINDER, L.P.G.	1	••
	142538		HEAD-CYLINDER, L.P.G.	••	1
	15534		CAPSCREW-3/8 UNC X 5/8	1	••
	109165		WASHER-COPPER	1	••
	15962		PLUG-PIPE,1/2	••	3
13	109176		GASKET-CYL. HEAD	1	1
14	109175		NUT-CYL. HEAD	15	••
15	109162		WASHER	15	••
	235623		WASHER	••	15
16	109174		STUD	15	••
	142376		CAPSCREW	••	15
17	109256		CAP-OIL FILLER	1	1
18	109257		TUBE-OIL FILLER	1	••
	142365		TUBE-OIL FILLER	••	1
19	109258	A	GAUGE-OIL	1	••
	142366		ROD ASSY.-OIL GUAGE	••	1
20	109259		FELT	1	••
21	109260		SUPPORT-OIL GAUGE	1	1

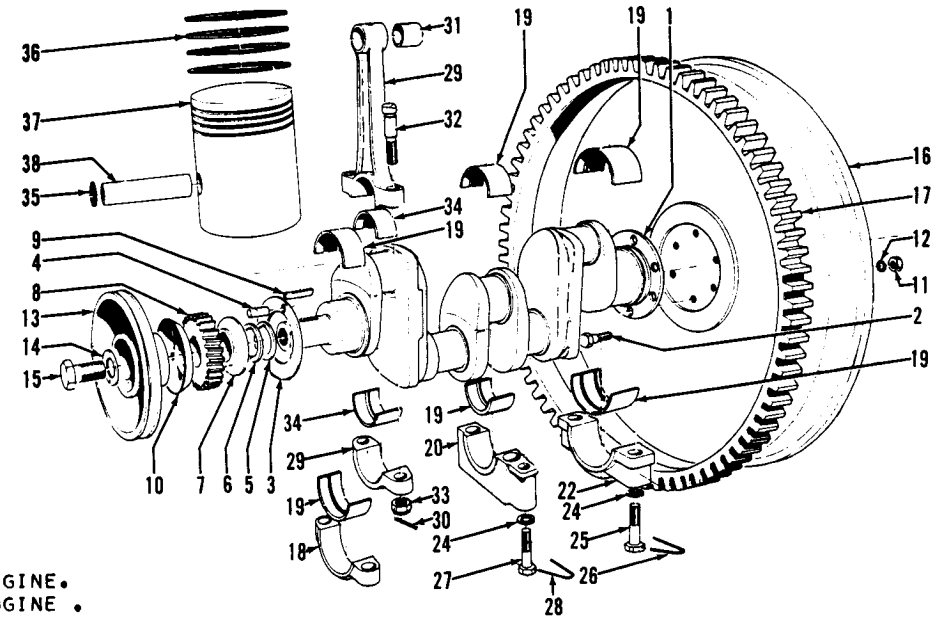
REF. NO.	HYSTER PART NO.		NAME OF PART 1 2 3 4	QTY. A	QTY. B
	134416		CRANKCASE ASSY. } INCL. PIST.	1	••
	142486		CRANKCASE ASSY. } AND RINGS	••	1
	16394		SCREW-PLUGGING	2	••
	109163		WASHER	2	••
	109165		WASHER-COPPER	1	••
	109166		STUD-GEN. BRACKET	4	••
	123823		STUD-OIL FILTER	••	4
22	233282		STUD-GEN. BRACKET	••	4
	109167		STUD-OIL FILTER	4	••
	109172		PLUG-1 1/2, CAM BUSHING	1	1
	109168		PLUG-1 1/8 CORE HOLE	1	1
	109169		PLUG-1 3/8 CORE HOLE	2	2
	108955		PLUG-1/4 OIL HEADER	3	3
	15306		PLUG-1/8	2	••
23	123868		COCK-DRAIN	1	••
24	109261		VALVE-OIL PRESS. RELIEF	1	1
25	109263		WASHER	1	••
	200614		WASHER	••	1
26	109262		SPRING	1	1
27	109265		GASKET	1	1
28	109264		PLUG	1	1
29	109238		STUD	2	••
	109320		STUD	••	2
30	109240		GASKET	2	2
31	108953		NUT-VALVE COVER	2	2
32	233297		BAFFLE	2	2
	109237	A	COVER-VALVE TAPPET CHAMBER	1	1
33	109241		GASKET	1	1
34	15055		NUT-5/16 UNC	2	2
35	15155		LOCKWASHER-5/16	2	2
36	236179		STUD	2	••
	109291		STUD	••	2
37	51814		GASKET-FUEL PUMP	1	1
38	233380		PIN-TIMING, STD. TRANS.	••	1
	200616		PIN-TIMING, MONOTROL TRANS.	1	••
39	233381		HOUSING-FLYWHEEL STD. TRANS.	1	••
	¤133986		HOUSING-FLYWHEEL	••	1
	111052		PLATE-REAR END, MONOTROL	1	••
	¤ 14385		PLUG	••	1
	¤ 17636		PLUG	••	1
	¤ 15769		CAPSCREW-3/4 UNC X 1	••	3
	¤118257		WASHER-SEAL, 3/4	••	3
	¤ 89880		GASKET-HOUSING TO CRANKCASE	••	1
40	109272		CAPSCREW-7/16 UNC X 1 1/2	2	2
41	15922		LOCKWASHER-7/16	5	5
42	109271		CAPSCREW-7/16 UNC X 1 1/8	1	1
43	126447		CAPSCREW-7/16 UNC X 1	2	••
	233383		CAPSCREW-7/16 UNC X 1 3/8	••	2
	200821	A	CRANKCASE GASKET SET	1	••
	142388		CRANKCASE GASKET SET	••	1
	109249	A	VALVE GRIND SET	1	1

*FIRST USED ON SERIAL NO B2D-4739 AND B2A-2039.

¤FOR OIL CLUTCH TRUCKS ONLY.

CRANKSHAFT, PISTONS AND FLYWHEEL

GAS ENGINE



120-164

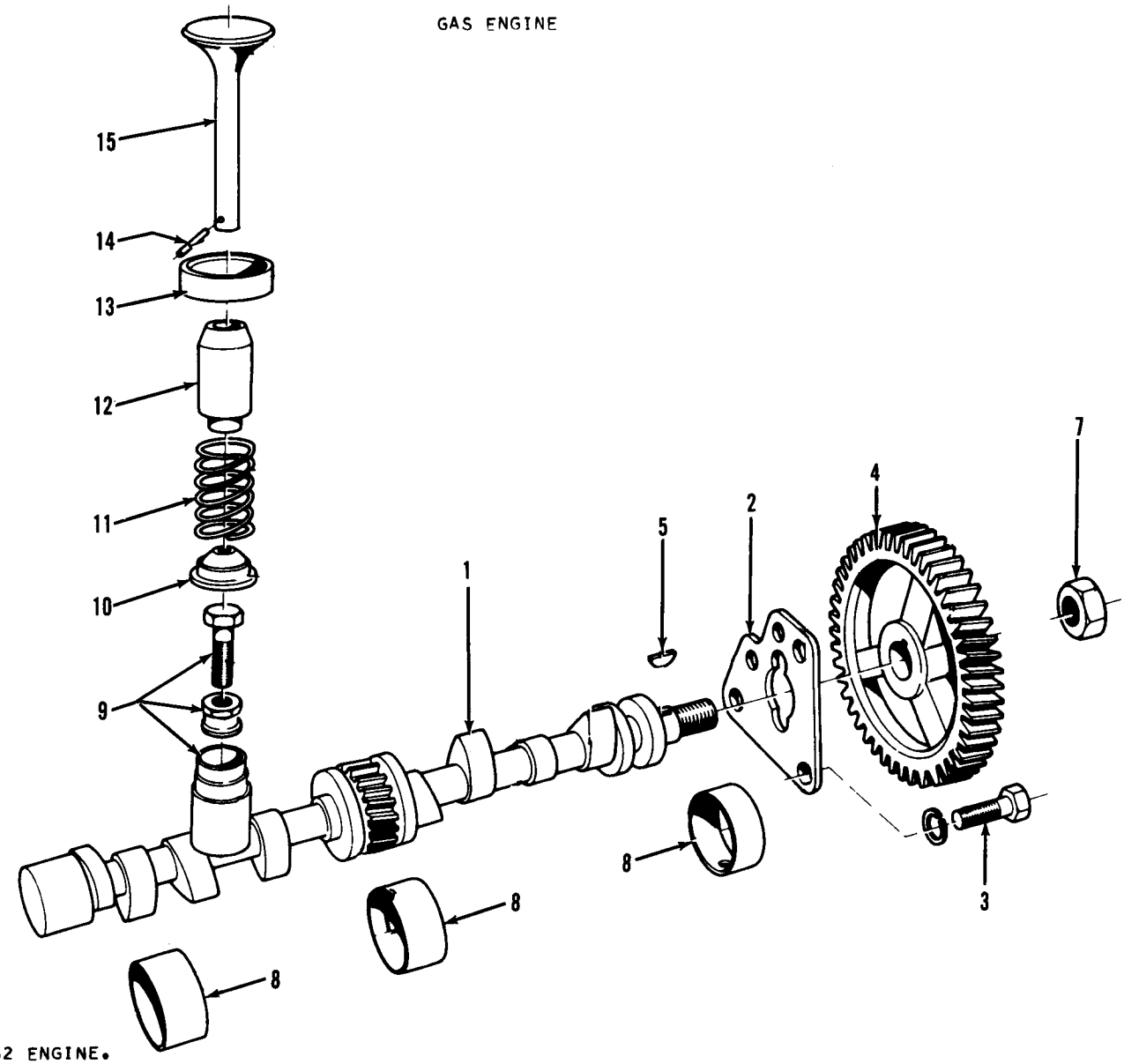
KEY
A-FOR F-162 ENGINE.
B-FOR F-163 ENGINE .

REF. NO.	HYSTER PART NO.	NAME OF PART 1 2 3 4	QTY. A	QTY. B
	109179	CRANKSHAFT	1	..
1	142360	CRANKSHAFT	..	1
	141113	OIL SEAL-REAR, OIL CLUTCH	..	1
2	109267	BOLT-FLYWHEEL TO CRANK	6	..
	79963	BOLT-FLYWHEEL TO CRANK	..	6
3	109181	WASHER-THRUST	2	..
4	109182	PIN-5/32 X 1/2	3	..
5	109183	SHIM-THRUST, .002	8	..
6	109184	SHIM-THRUST, .008	8	..
7	109180	PLATE-TIMING	1	..
	142361	PLATE-THRUST	..	1
	233363	GEAR-TIMING, STD.	1	1
8	128023	GEAR-TIMING, .002 O.S.	1	1
	128024	GEAR-TIMING, .002 U.S.	1	1
9	109192	KEY	1	..
10	109185	THROWER-OIL	1	1
11	17158	NUT-3/8 UNF	6	6
12	15920	LOCKWASHER-3/8	6	6
13	109191	PULLEY-CRANKSHAFT	1	..
	142356	PULLEY-CRANKSHAFT	..	1
14	78702	WASHER	1	1
15	109194	CAPSCREW	1	1
	200079 A	FLYWHEEL ASSY.-STD. TRANS.	1	..
16	113560 A	FLYWHEEL ASSY.-MONO. TRANS.	1	..
	133985	FLYWHEEL ASSY.-OIL CLUTCH	..	1
	233369	RING GEAR,112 TEETH STD.	1	..
17	111977	RING GEAR-146 TEETH MONO.	1	..
	109269	RING GEAR-OIL CLUTCH	..	1
18	.....	CAP-FRONT MAIN BEARING	1	1
	233370	DOWEL	..	2
	135721	MAIN BEARING SET-STD.	1	..
	135722	MAIN BEARING SET-.010 U.S.	1	..
19	135723	MAIN BEARING SET-.020 U.S.	1	..
	135724	MAIN BEARING SET-.030 U.S.	1	..
	142493	MAIN BEARING SET-STD.	..	1
	142494	MAIN BEARING SET-.002 O.S.	..	1
	142495	MAIN BEARING SET-.010 O.S.	..	1
	142496	MAIN BEARING SET-.020 O.S.	..	1
20	.....	CAP-MAIN BEARING, CENTER	1	1
	233370	DOWEL	2	2
22	.....	CAP-MAIN BEARING, REAR	1	1
	233376	DOWEL	2	2
24	79915	WASHER-1/2	6	..

REF. NO.	HYSTER PART NO.	NAME OF PART 1 2 3 4	QTY. A	QTY. B
25	109152	CAPSCREW-FRONT AND REAR CAPS	4	..
	142491	CAPSCREW-FRONT AND REAR CAPS	..	4
26	.....	LOCKWIRE	2	..
27	109153	CAPSCREW-CENTER CAP	2	..
	142492	CAPSCREW-CENTER CAP	..	2
28	.....	LOCKWIRE	2	..
	109195 A	CONN ROD ASSY.- 1 AND 3 CYL.	2	..
29	109296 A	CONN ROD ASSY.-2 AND 4 CYL.	2	..
	138289	CONN ROD ASSY.-1 AND 3 CYL.	..	2
	138290	CONN ROD ASSY.-2 AND 4 CYL.	..	2
30	15212	COTTER-3/32 X 3/4	2	..
31	109206	BUSHING-PISTON PIN	1	1
32	109197	BOLT-CONN ROD	2	2
33	79930	NUT-3/8 UNF, SLOTTED	2	2
	135725	BEARING SET-CONN ROD, STD.	1	..
	135726	BEARING SET-CONN.ROD, .010 US	1	..
	135727	BEARING SET-CONN ROD, .020 US	1	..
34	135728	BEARING SET-CONN ROD, .030 US	1	..
	142367	BEARING SET-CONN ROD, STD.	..	1
	142368	BEARING SET-CONN ROD, .005 OS	..	1
	142369	BEARING SET-CONN ROD, .010 OS	..	1
	142370	BEARING SET-CONN ROD, .020 OS	..	1
35	109205	RING-RETAINING	8	..
	142490	RING-RETAINING	..	2
	109253 A	RING SET-PISTON, STD.	1	1
	128621	RING SET-PISTON, .020 OS	1	1
36	128622	RING SET-PISTON, .030 OS	1	1
	128623	RING SET-PISTON, .040 OS	1	1
	128624	RING SET-PISTON, .060 OS	1	1
	109202 A	PISTON AND PIN ASSY.-STD.	4	..
	128616	PISTON AND PIN ASSY.-.020 OS	4	..
	128617	PISTON AND PIN ASSY.-.030 OS	4	..
37	128618	PISTON AND PIN ASSY.-.040 OS	4	..
	142487	PISTON AND PIN ASSY.-STD.	..	4
	142637	PISTON AND PIN ASSY.-.020 OS	..	4
	142638	PISTON AND PIN ASSY.-.030 OS	..	4
	142639	PISTON AND PIN ASSY.-.040 OS	..	4
	109204	PIN-PISTON, STD.	1	..
38	128625	PIN-PISTON, .005 OS	1	..
	142488	PIN-PISTON, STD.	..	1
	142489	PIN-PISTON, .005 OS	..	1

CAMSHAFT, TIMING GEAR AND VALVES

GAS ENGINE



KEY
A-FOR F-162 ENGINE.
B-FOR F-163 ENGINE.

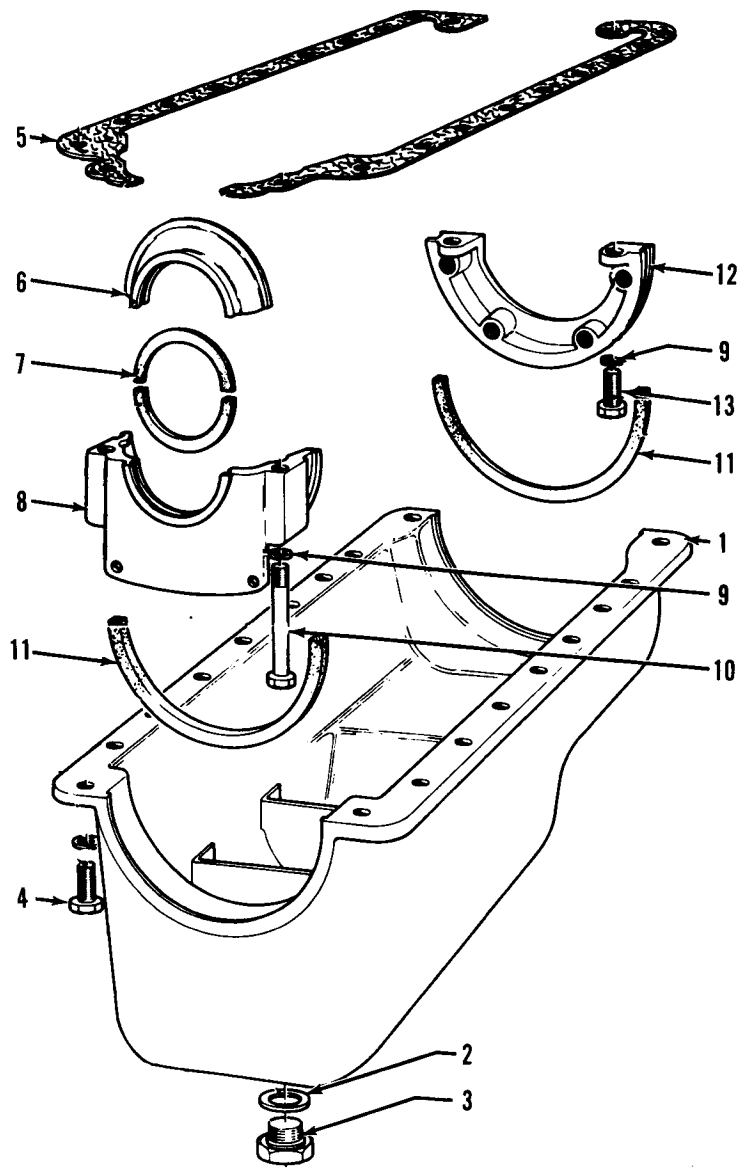
510-5

REF. NO.	HYSTER PART NO.	NAME OF PART 1 2 3 4	QTY. A	QTY. B
1	109207	CAMSHAFT	1	••
	142362	CAMSHAFT	••	1
2	109208	PLATE-THRUST	1	1
3	78688	CAPSCREW-5/16 UNC X 5/8	2	2
	15918	LOCKWASHER-5/16	2	2
4	110740	GEAR-TIMING, STD.	1	••
	128614	GEAR-TIMING, .002 OS	1	••
	128615	GEAR-TIMING, .002 US	1	••
	233346	GEAR-TIMING, STD.	••	1
	128021	GEAR-TIMING, .002 OS	••	1
	128022	GEAR-TIMING, .002 US	••	1
5	9033	KEY	1	1
7	127464	NUT	1	••
	108954	NUT	••	1
8	109210 A	BUSHING SET-CAMSHAFT	1	••
	128629	BUSHING SET-CAMSHAFT	••	1

REF. NO.	HYSTER PART NO.	NAME OF PART 1 2 3 4	QTY. A	QTY. B
9	78033	VALVE TAPPET ASSY.-STD.	8	8
	124192	VALVE TAPPET ASSY.-.001 OS	8	8
	124193	VALVE TAPPET ASSY.-.002 OS	8	8
	124194	VALVE TAPPET ASSY.-.003 OS	8	8
	124195	VALVE TAPPET ASSY.-.004 OS	8	8
	124196	VALVE TAPPET ASSY.-.005 OS	8	8
10	109234	RETAINER-VALVE SPRING	8	••
	142392	RETAINER-VALVE SPRING	••	8
11	109233	SPRING-VALVE	8	8
12	109232	GUIDE-VALVE STEM	8	8
13	109231	INSET-EXHAUST VALVE .010 OS	4	••
	142391	INSERT-EXHAUST VALVE .010 OS	••	4
14	109235	LOCK-RETAINER	8	••
	142393	LOCK-RETAINER	••	8
15	109229	VALVE-INTAKE	4	••
	109230	VALVE-EXHAUST	4	••
	142389	VALVE-INTAKE	••	4
	142390	VALVE-EXHAUST	••	4
	142394	CAP-ROTO	••	4

OIL PAN GASKET AND FILLER BLOCKS

GAS ENGINE



510-6

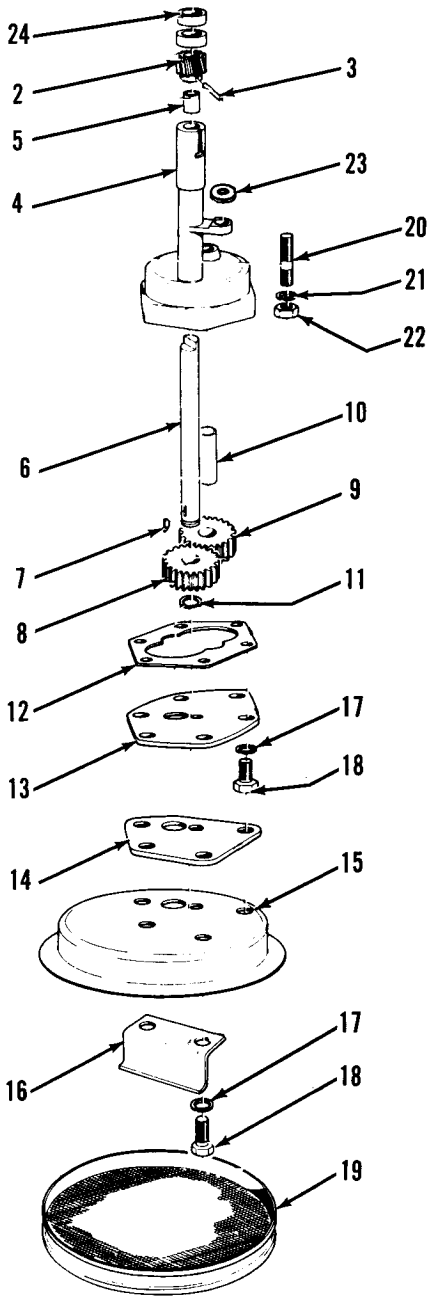
KEY
A-FOR F-162 ENGINE.
B-FOR F-163 ENGINE.

REF. NO.	HYSTER PART NO.	NAME OF PART 1 2 3 4	QTY. A	QTY. B
1	200832 A	OIL PAN ASSEMBLY	1	1
2	*109245	GASKET-DRAIN PLUG	1	1
3	109244	PLUG-DRAIN	1	1
4	16836	CAPSCREW-5/16 UNC X 3/4	14	14
	15155	LOCKWASHER-5/16	14	14
5	*109243	GASKET-OIL PAN	2	••
	*142364	GASKET-OIL PAN	••	2
6	109159	GUARD-OIL	1	••
	142497	GUARD-OIL	••	1
	109160	FELT-OIL GUARD	1	••
7	*109158	SEAL-FILLER BLOCK	2	1
8	234704	BLOCK-FILLER, REAR	1	••
	142372	BLOCK-FILLER, REAR	••	1
9	15918	LOCKWASHER-5/16	4	4
10	109161	CAPSCREW-5/16 UNC X 2 5/8	2	2
11	*109155	GASKET-FILLER BLOCK	2	1
12	109154	BLOCK-FILLER, FRONT	1	1
	142371	SEAL	1	1
13	14519	CAPSCREW-5/16 UNC X 7/8	2	2
	109868 A	OIL PAN GASKET SET	1	••
	142363	OIL PAN GASKET SET	••	1

*INCLUDED IN OIL PAN GASKET SETS 109868A AND 142363.

OIL PUMP ASSEMBLY

GAS ENGINE



KEY
A-FOR F-162 ENGINE.
B-FOR F-163 ENGINE.

120-165

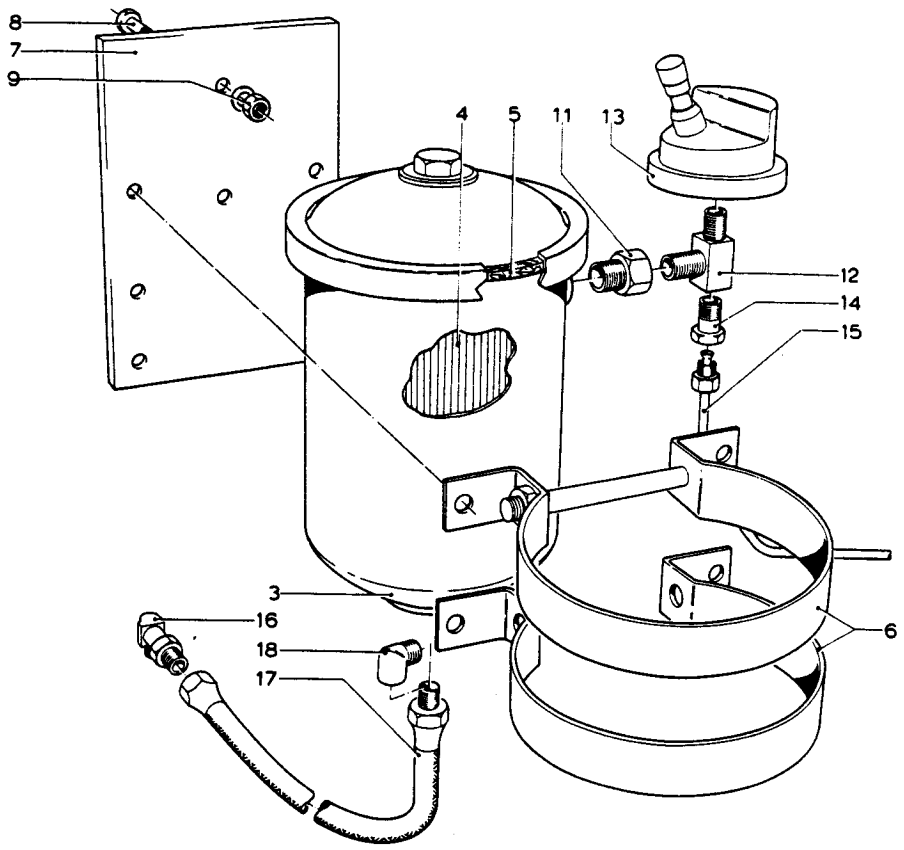
REF. NO.	HYSTER PART NO. 1 2 3 4	NAME OF PART	QTY. A	QTY. B
	109246 A	OIL PUMP ASSEMBLY.	1	1
2	*142379	GEAR	1	1
3	*142386	ROLL PIN-3/16 X 7/8	1	1
4	109247 A	BODY ASSEMBLY	1	1
5	109252	BUSHING	1	1
6	*142378	SHAFT-DRIVE	1	1
7	* 709	KEY	1	1
8	*142380	GEAR-DRIVE	1	1
9	*142381	GEAR-IDLER	1	1
10	*142382	STUD	1	1
11	*142383	RING-SNAP	1	1
12	*142384	GASKET	1	1

REF. NO.	HYSTER PART NO. 1 2 3 4	NAME OF PART	QTY. A	QTY. B
13	125588	COVER ASSEMBLY	1	1
14	*142385	GASKET	1	1
15	109177	FRAME-OIL STRAINER SCREEN	1	1
16	109226	SPACER	1	1
17	15154	WASHER	6	6
18	16378	CAPSCREW	6	6
19	109170	SCREEN ASSEMBLY	1	1
20	109248	STUD	1	1
21	15156	LOCKWASHER-3/8	1	1
22	15056	NUT-3/8 UNC	1	1
23	78696	SPACER-TO MAIN BRG. CAP	1	••
24	109251	BUSHING	1	1

*INCLUDED IN REPAIR KIT 138603.

OIL FILTER ASSEMBLY

FOR GAS ENGINE



120-90

KEY
A-FOR STANDARD TRANSMISSION TRUCKS.
B-FOR MONOTROL TRANSMISSION TRUCKS.

REF. NO.	HYSTER PART NO.	1 2 3 4	NAME OF PART	QTY. A	QTY. B
3	69623	A	FILTER ASSEMBLY	1	1
4	60518		CARTRIDGE	1	1
5	105625		GASKET-COVER	1	1
6	200547		STRAP-MOUNTING	2	2
7	121338		BRACKET	1	1
	* 88929		BRACKET	1	1
	□982571		BRACKET	1	1
8	123823		STUD-FILTER TO ENG.	4	4
	#123823		STUD-FILTER TO ENG.	4	••
	15556		CAPSCREW-5/16 UNC X 5/8	4	4
9	15055		NUT-5/16 UNC	6	6
	15155		LOCKWASHER-7/16	6	6
11	69607		RESTRICTOR	1	1

REF. NO.	HYSTER PART NO.	1 2 3 4	NAME OF PART	QTY. A	QTY. B
12	16199		TEE-MALE	1	1
13	114638		SENDER UNIT-OIL PRESSURE	1	1
14	16115		CONNECTOR-MALE	1	••
15	114304		TUBE ASSEMBLY	1	••
	103532		HOSE	••	1
16	16159		ELBOW	1	1
17	60432	A	HOSE	1	1
18	46944		ELBOW-MALE	1	1

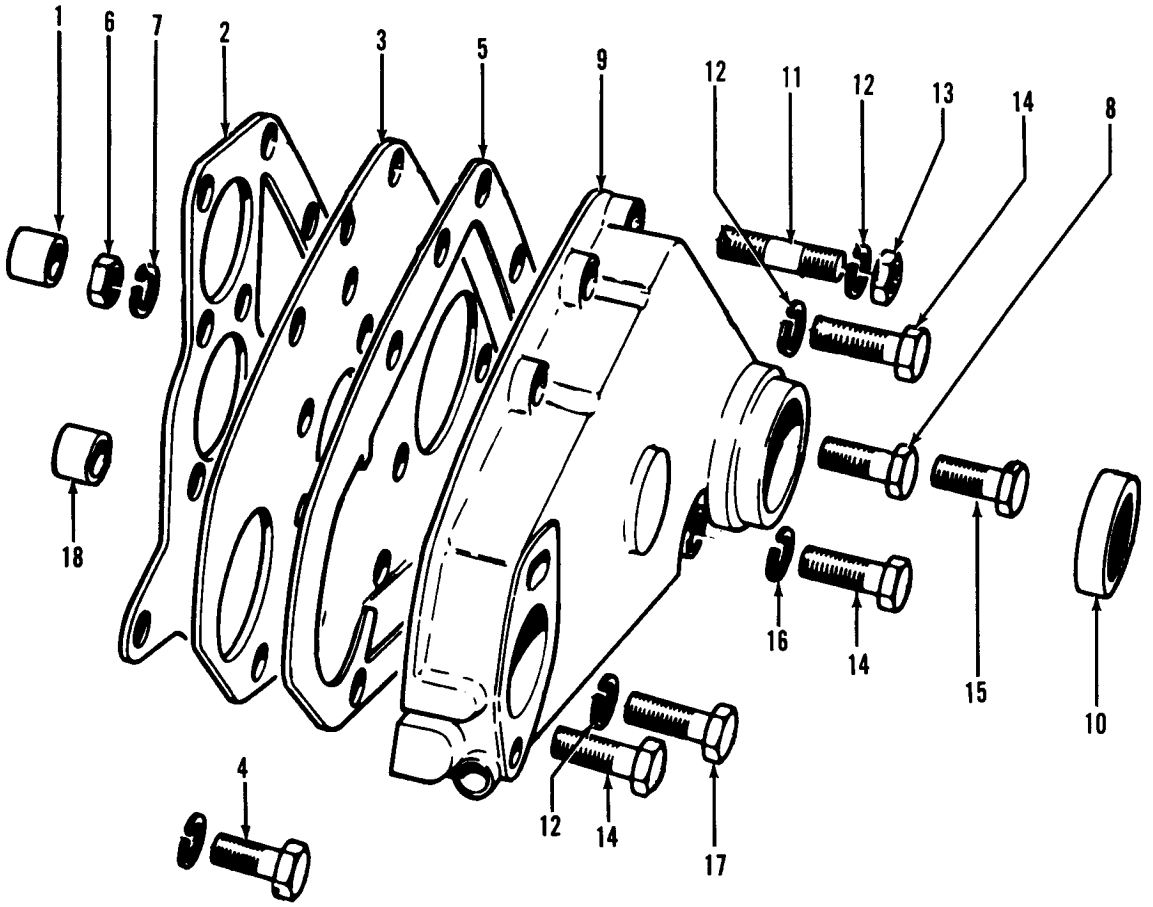
□FOR B2E AND B2A SERIES TRUCKS ONLY.

*FIRST USED ON SERIAL NO B2D-3507.

#FOR OIL CLUTCH TRUCKS ONLY.

GEAR COVER ASSEMBLY

GAS ENGINE



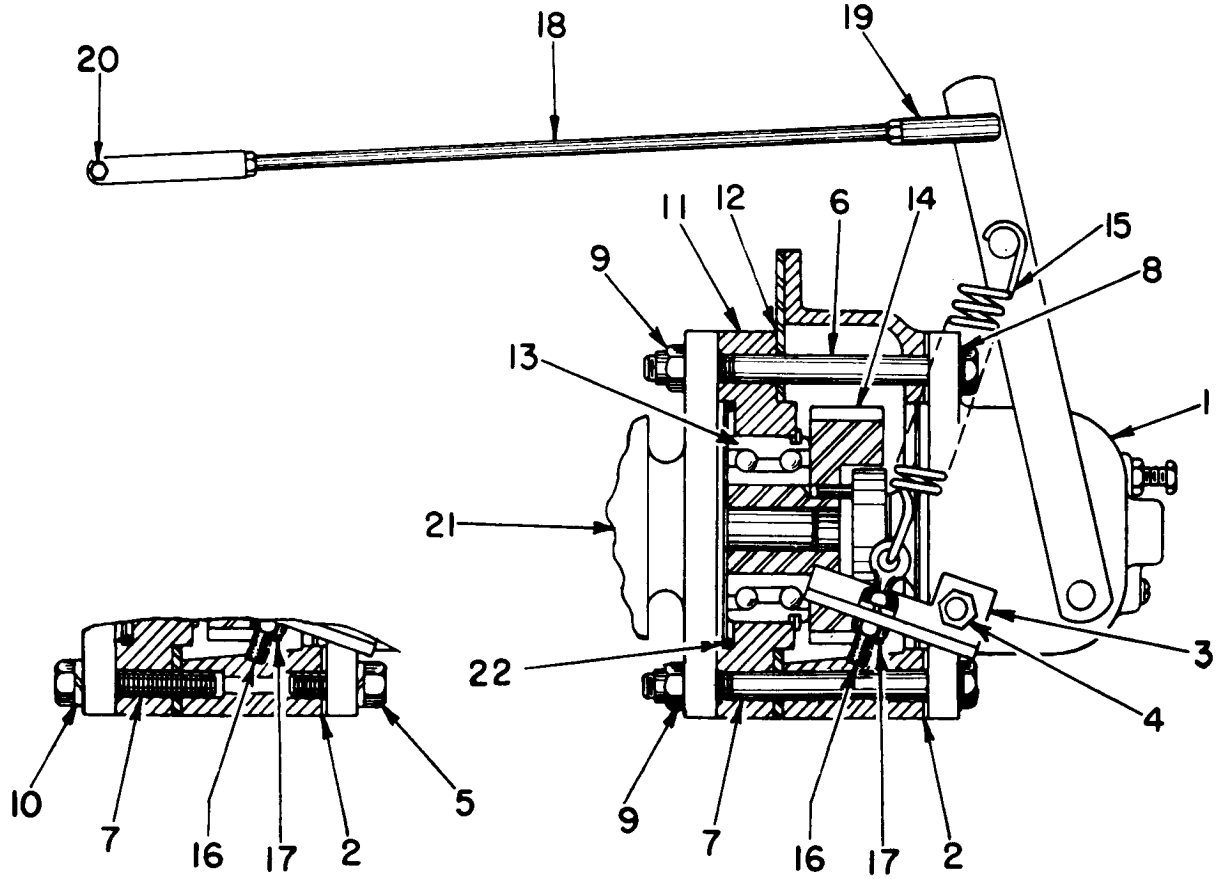
KEY
A-FOR F-162 ENGINE.
B-FOR F-163 ENGINE.

510-9

REF. NO.	HYSTER PART NO. 1 2 3 4	NAME OF PART	QTY. A	QTY. B
1	109217	DOWEL-RING	1	1
2	109228	GASKET-PLATE TO CRANKCASE	1	••
	122239	GASKET-PLATE TO CRANKCASE	••	1
3	109157	PLATE-END	1	••
	142375	PLATE-END	••	1
4	16836	CAPSCREW-5/16 UNC X 3/4	1	••
	200960	CAPSCREW-7/16 UNC X 1	1	1
	200962	CAPSCREW-3/8 UNC X 3/4	1	1
	16377	CAPSCREW-7/16 UNC X 1	1	1
	15155	LOCKWASHER-5/16	1	••
	15155	LOCKWASHER-5/16	1	1
	15920	LOCKWASHER-3/8	1	1
	15157	LOCKWASHER-7/16	1	1
5	109223	GASKET-COVER TO END PLATE	1	1
6	15057	NUT-7/16 UNC	1	1
7	15917	LOCKWASHER-7/16	1	1
8	109221	SCREW-DOWEL	1	••
9	122996	COVER-GEAR	1	1
10	109224	SEAL-OIL	1	1
11	109222	STUD	3	1
12	15905	LOCKWASHER-3/8	6	6
13	15056	NUT-3/8 UNC	5	5
14	109218	CAPSCREW-3/8 UNC X 1 1/8	3	3
15	18558	CAPSCREW-7/16 UNC X 1 1/2	1	1
16	109165	WASHER-COPPER, 3/8	2	2
	15905	LOCKWASHER-3/8	2	2
17	16376	CAPSCREW-3/8 UNC X 2	3	3
18	109225	DOWEL-RING	1	1

GOVERNOR DRIVE AND LINKAGE

GAS ENGINE



510-31

KEY
A-FOR F-162 ENGINE.
B-FOR F-163 ENGINE.

REF. NO.	HYSTER PART NO.	NAME OF PART 1 2 3 4	QTY. A	QTY. B
1	234936 A	GOVERNOR ASSEMBLY	1	1
2	57105	GASKET	1	1
3	109296	ANCHOR-SPRING	1	1
4	109297	STUD	1	1
	15154	LOCKWASHER-1/4	1	1
	15054	NUT-1/4 UNC	1	1
5	¤ 16828	CAPSCREW-3/8 UNC X 1 1/4	1	••
	¤ 15920	LOCKWASHER-3/8	1	••
6	109299	CAPSCREW-3/8 UNC X 4 5/8	1	1
7	¤109300	STUD	1	••
	109299	CAPSCREW-3/8 UNC X 4 5/8	1	1
8	109165	WASHER-COPPER	2	2
	109294	PLATE-GOVERNOR GASKET	1	1
	109295	GASKET	1	1
9	15115	NUT-LOCK	2	2
	109165	WASHER-COPPER	2	••
10	¤ 15920	LOCKWASHER-3/8	1	••
	¤ 15056	NUT-3/8 UNC	1	••
11	109301	ADAPTER-HYDRAULIC PUMP	1	1
12	57105	GASKET-ADAPTER	1	••

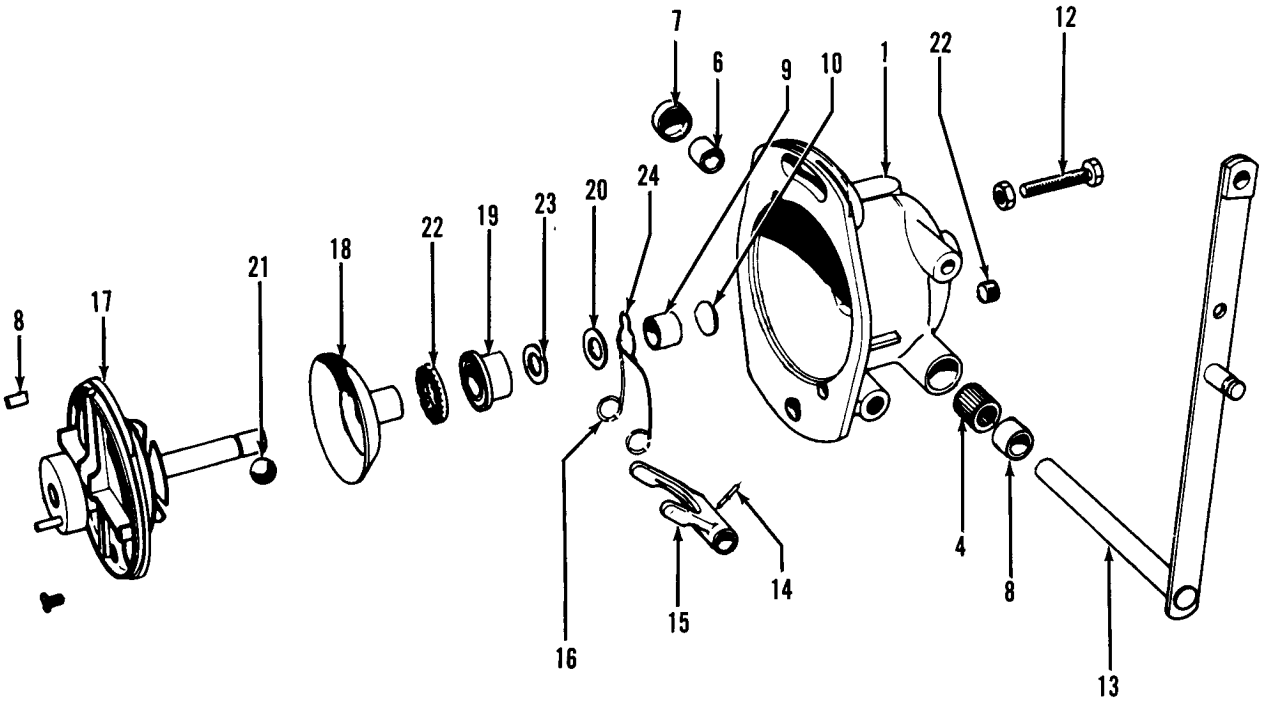
REF. NO.	HYSTER PART NO.	NAME OF PART 1 2 3 4	QTY. A	QTY. B
13	124691	BEARING-BALL	1	1
14	109304	GEAR-HYDRAULIC PUMP	1	••
	*1140921	GEAR-HYDRAULIC PUMP	1	1
15	78003	SPRING-GOVERNOR	1	1
16	108943	SCREW-ADJUSTING	1	1
17	108954	NUT-DRILLED	2	2
	56733	SEAL WIRE	2	••
18	108974	ROD-GOVE. TO CARB.	1	1
19	66707	BALL JOINT	1	1
	109309	SCREW-YOKE END	1	••
	130177	SCREW-YOKE END	••	1
20	15918	LOCKWASHER-5/16	1	1
	15154	LOCKWASHER-1/4	1	1
	15004	NUT-1/4 UNF	2	2
21	•••••	PUMP-HYDRAULIC,SEE SEC. J	1	1
22	15880	O RING	1	1

*FIRST USED ON ENGINE NO 265162.

¤LAST USED ON ENGINE NO. 265161.

GOVERNOR ASSEMBLY

GAS ENGINE



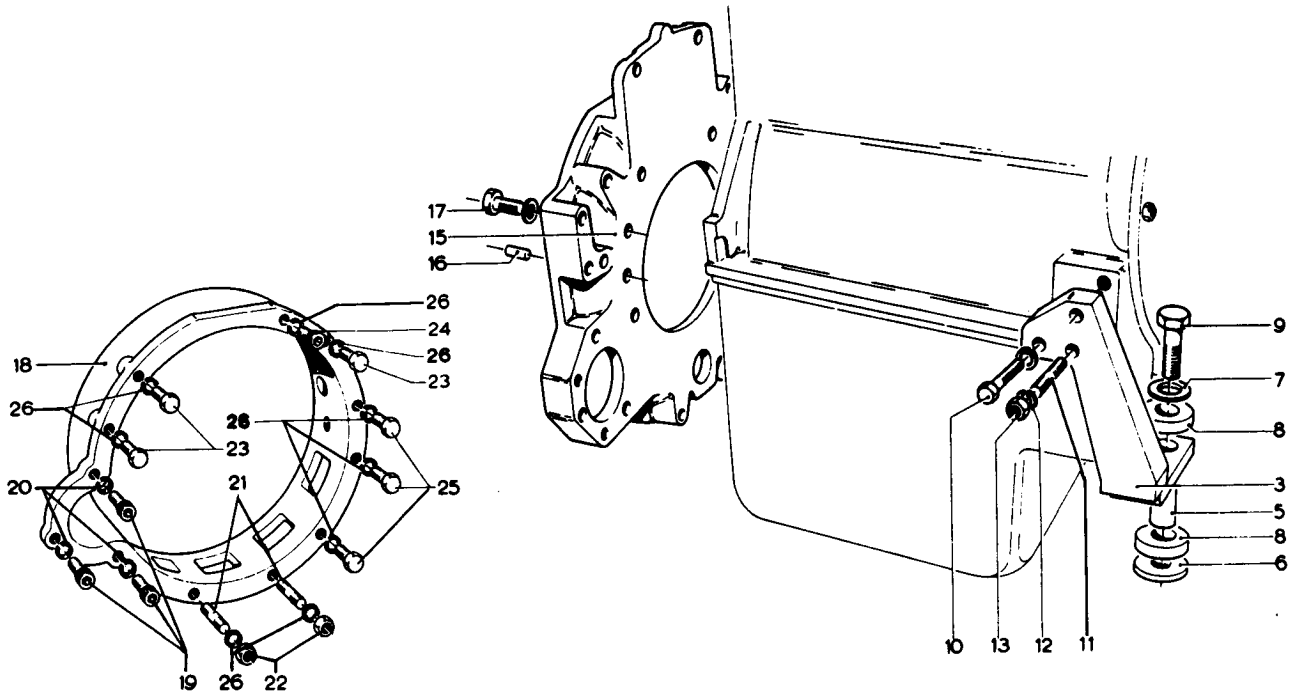
120-166

REF. NO.	HYSTER PART NO. 1 2 3 4	NAME OF PART	QTY.
	234936 A	GOVERNOR ASSEMBLY	1
1	108950 A	BODY AND LEVER ASSY.	1
	108935	BODY ASSEMBLY	1
3	108933	SEAL-OIL	1
4	108934	BEARING-NEEDLE	1
5	108936	PLUG-PIPE	1
6	108937	BUSHING-LEVER SHAFT	1
7	108938	PLUG	1
8	109306	SCREW	1
9	109302	BUSHING-DRIVE SHAFT	1
10	108927	PLATE-THRUST	1
12	108924	LOCKNUT-ADJUSTING SCREW	1
	108929	SCREW-ADJUSTING	1

REF. NO.	HYSTER PART NO. 1 2 3 4	NAME OF PART	QTY.
13	128819	LEVER ASSEMBLY	1
14	108930	PIN-FORK	1
15	108931	FORK	1
16	108932	SPRING-BUMPER	1
17	108951 A	SHAFT AND BASE ASSEMBLY	1
18	109250	RACE-UPPER	1
19	109268	BASE-FORK	1
20	109298	WASHER	AR
21	109314	BALL-5/8	1
22	108924	BEARING-THRUST	1
23	108925	WASHER	1
24	108926	CLIP	1

ENGINE MOUNTS, ADAPTER PLATE AND FLYWHEEL HOUSING

DIESEL ENGINE



120-91

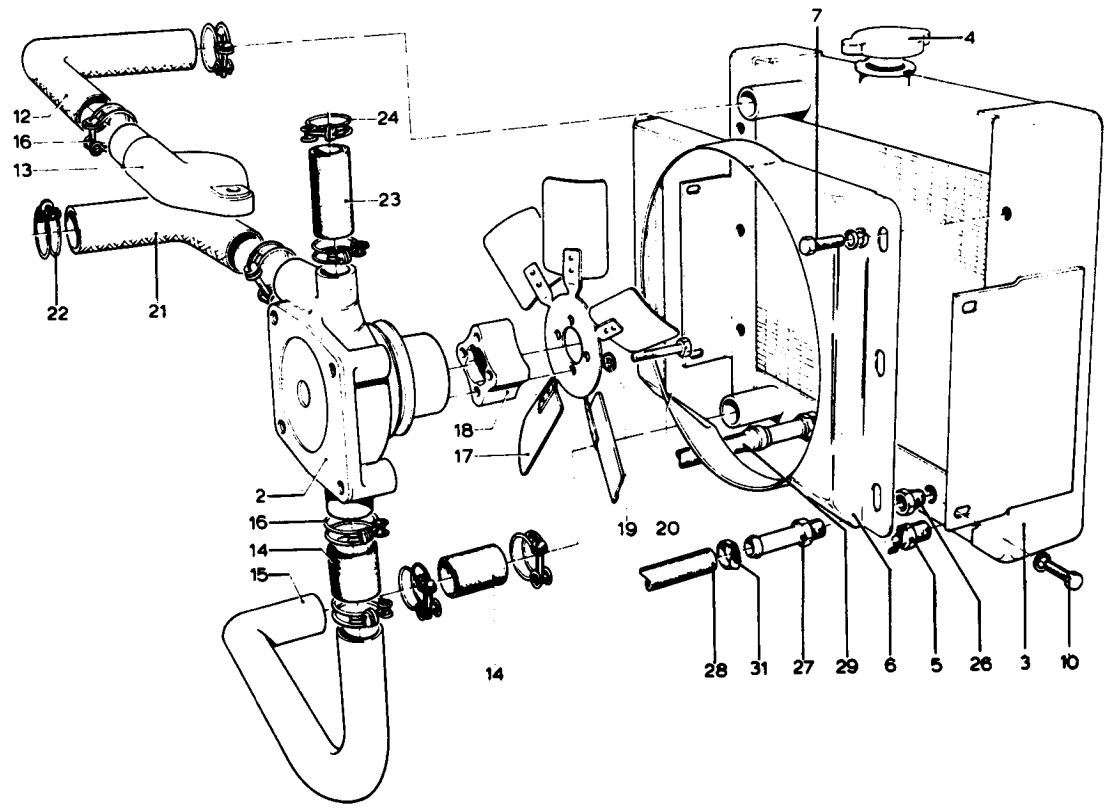
REF. NO.	HYSTER PART NO.	1 2 3 4 NAME OF PART	QTY.
3	982654 W	MOUNT-ENGINE, L.H.	1
	982653 W	MOUNT-ENGINE, R.H.	1
5	982671	SPACER	2
6	982655	PLATE-SPACER	2
7	15180	WASHER-5/8	2
8	992412	WASHER-RUBBER	4
9	15631	CAPSCREW-5/8 UNF X 3 3/4	2
10	16397	CAPSCREW-1/2 UNF X 1 3/4, L.H.	1
11	982670	STUD-1/2 UNF X 2 1/2	5
12	15158	LOCKWASHER-1/2	6
13	15008	NUT-1/2 UNF	5
15	983764	PLATE-ADAPTER	1
16	986082	DOWEL	2

REF. NO.	HYSTER PART NO.	1 2 3 4 NAME OF PART	QTY.
17	983282	CAPSCREW	8
	15156	LOCKWASHER-3/8	8
18	*982669	HOUSING-FLYWHEEL	1
19	16349	CAPSCREW-3/8 UNC X 2	3
20	15156 B	LOCKWASHER-3/8	3
21	982662	STUD-3/8 UNC X 3	2
22	15056	NUT-3/8 UNC	2
23	15747	CAPSCREW-3/8 UNC X 2 3/4	3
24	18761	CAPSCREW-3/8 UNC X 1 3/4	1
25	15686	CAPSCREW-3/8 UNC X 2 1/2	3
26	15156	LOCKWASHER-3/8	9

*FOR STANDARD TRANSMISSION TRUCKS ONLY.

COOLING SYSTEM

FOR DIESEL ENGINE



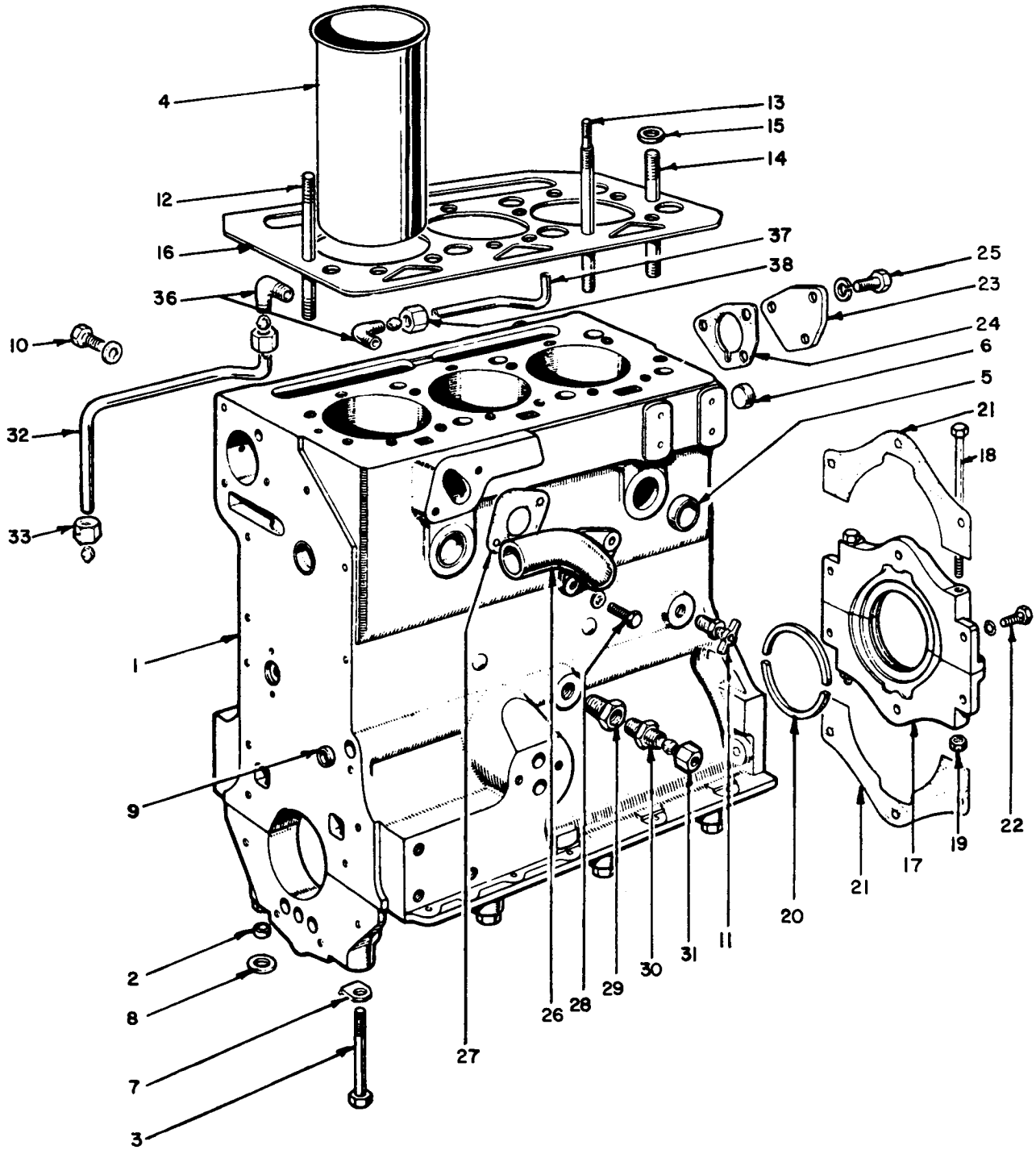
KEY
A-FOR STANDARD TRANSMISSION TRUCKS ONLY.
B-FOR MONOTROL TRANSMISSION TRUCKS ONLY.

120-92

REF. NO.	HYSTER PART NO.	NAME OF PART 1 2 3 4	QTY. A	QTY. B
2	984466 A	WATER PUMP ASSEMBLY	1	1
3	131180	RADIATOR	1	••
	131181	RADIATOR	••	1
4	106483	CAP-RADIATOR	1	1
5	12815	COCK-DRAIN	1	1
6	982581	SHROUD-RADIATOR	1	1
7	15585	CAPSCREW-1/4 UNF X 1/2	6	6
	15127	WASHER-1/4	6	6
	15154	LOCKWASHER-1/4	6	6
10	15513	CAPSCREW-3/8 UNF X 3/4	4	4
	15156	LOCKWASHER-3/8	4	4
12	982656	HOSE-WATER OUTLET TO RAD.	1	1
13	992399	CONNECTION-WATER OUTLET	1	1
14	57130	HOSE	2	2
15	982657 W	PIPE	1	1
16	18999	CLAMP-HOSE	6	6
17	980617	FAN-PUSHER	1	1
18	982725	EXTENSION-FAN	1	1
19	15154	LOCKWASHER	2	2
20	983814	CAPSCREW-FAN TO PULLEY	4	4
	992536	WASHER-TAP	2	2
21	983811	HOSE-PUMP TO BLOCK	1	1
22	992840	CLAMP	2	2
23	983812	HOSE-PUMP TO BYPASS	1	1
24	984030	CLAMP	2	2
26	12855	ADAPTER	••	2
27	109417	NIPPLE-STREET	••	2
28	983010	HOSE-RADIATOR TO TRANS.	••	1
29	983009	HOSE-FILTER TO RADIATOR	••	1
31	18994	CLAMP-HOSE	••	4
	982660	BELT-FAN, NOT ILLUS.	1	1
	137877	PELLET-WATER CONDITIONER BOX OF 12		

CYLINDER BLOCK ASSEMBLY

DIESEL ENGINE



120-144

CYLINDER BLOCK ASSEMBLY

DIESEL ENGINE

KEY
A-FOR 3-152 ENGINE.
B-FOR 3-144 ENGINE.

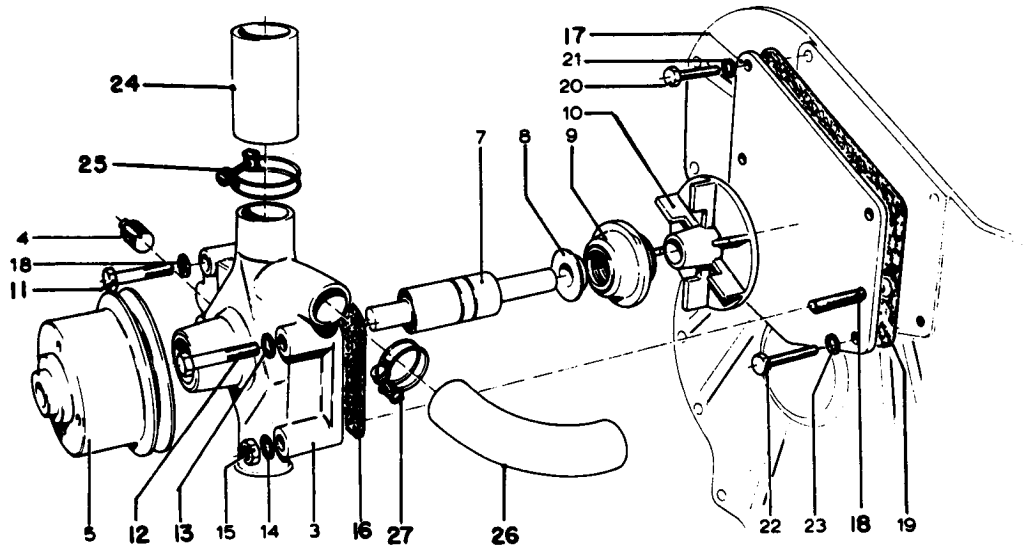
REF. NO.	HYSTER PART NO. 1 2 3 4	NAME OF PART	QTY. A	QTY. B
	805062	ENGINE ASSY.-STD. TRANS.	1	..
	88884 A	ENGINE ASSY.-STD. TRANS.	..	1
	805063	ENGINE ASSY.-MONOTROL TRANS.	1	..
	88887 A	ENGINE ASSY.-MONOTROL TRANS.	..	1
1	133540	BLOCK ASSY.-CYL.	1	..
	986448	BLOCK ASSY.-CYL.	..	1
2	990332	THIMBLE-BEARING CAP	8	8
3	983264	CAPSCREW	8	8
4	985564	LINER-CYL. BLOCK	3	..
	983752	LINER-CYL. BLOCK	..	3
5	980727	PLUG-WATER JACKET	5	5
6	*982207	PLUG-WATER RAIL	1	1
7	980736	WASHER-TAB	8	8
8	985646	WASHER-SHIM	8	8
9	990343	PLUG-PRESSURE RAIL	2	2
	133541	PLUG	2	..
	985299	WASHER	2	..
10	983754	PLUG-CAMSHAFT CHAMBER	2	..
	985299	WASHER	2	..
11	982211	COCK-WATER DRAIN	1	1
12	99589	STUD-CYL. HEAD	8	..
	985072	STUD-CYL. HEAD SHORT	..	8
13	986439	STUD-CYL. HEAD LONG	6	..
	984321	STUD-CYL. HEAD LONG	..	6
14	133543	STUD-CYL. HEAD, REAR	1	..
	985187	STUD-CYL. HEAD, REAR	..	1
15	985148	WASHER	2	..
	992632	WASHER-7/16	..	1
16	133544	GASKET-CYL. HEAD	1	..
	983900	GASKET-CYL. HEAD	..	1
17	983267 A	HOUSING ASSEMBLY-REAR SEAL	1	1
18	992999	CAPSCREW	2	2
19	980910	NUT	2	2
20	992374	SEAL-END	2	2
21	133545	GASKET-COVER TO BLOCK	2	..
	992947	GASKET-COVER TO BLOCK	..	2
	983268	CAPSCREW	6	6
22	992657	WASHER	6	6
	133546	SHIM	6	6
23	133547	COVER-CAMSHAFT	1	..
	983753	PLUG-CAMSHAFT REAR	..	1
24	133548	GASKET-COVER	1	..
25	983269	CAPSCREW	3	..
	15155	LOCKWASHER	3	..
26	983762	CONNECTION-WATER INLET	1	1
27	983763	GASKET	1	1
28	983310	CAPSCREW	2	2
	985299	WASHER	2	2
29	984008	ADAPTER	1	1
30	981608	CONNECTOR-OIL PRESSURE	1	..
	16148	NIPPLE-LONG	..	1
	16193	NUT	1	..
	51455	SLEEVE	1	..
31	12838	TEE-FEMALE	..	1
	114638	SENDER-OIL PRESSURE	..	1
	981878	SWITCH-HOUR METER	..	1
32	133549	PIPE-PRESSURE	1	..
	986411	PIPE-PRESSURE RAIL	..	1
33	16193	NUT	2	1
	51455	SLEEVE	2	1
36	983761	CONNECTION	2	2
37	986472	PIPE-CAM BRG. TO CYL. HEAD	1	1
38	16193	NUT	2	2
	51455	SLEEVE	2	2
	133611	GASKET SET-ENGINE	1	..
	983896 A	GASKET SET-ENGINE	..	1
	133612	GASKET SET-CYL. HEAD	1	..
	983897 A	GASKET SET-CYL HEAD	..	1
	133613	GASKET SET-OIL PAN	1	1

NOTE-3-152 ENGINE ILLUSTRATED.

*LAST USED ON ENGINE NO. 2604303.

WATER PUMP ASSEMBLY

DIESEL ENGINE



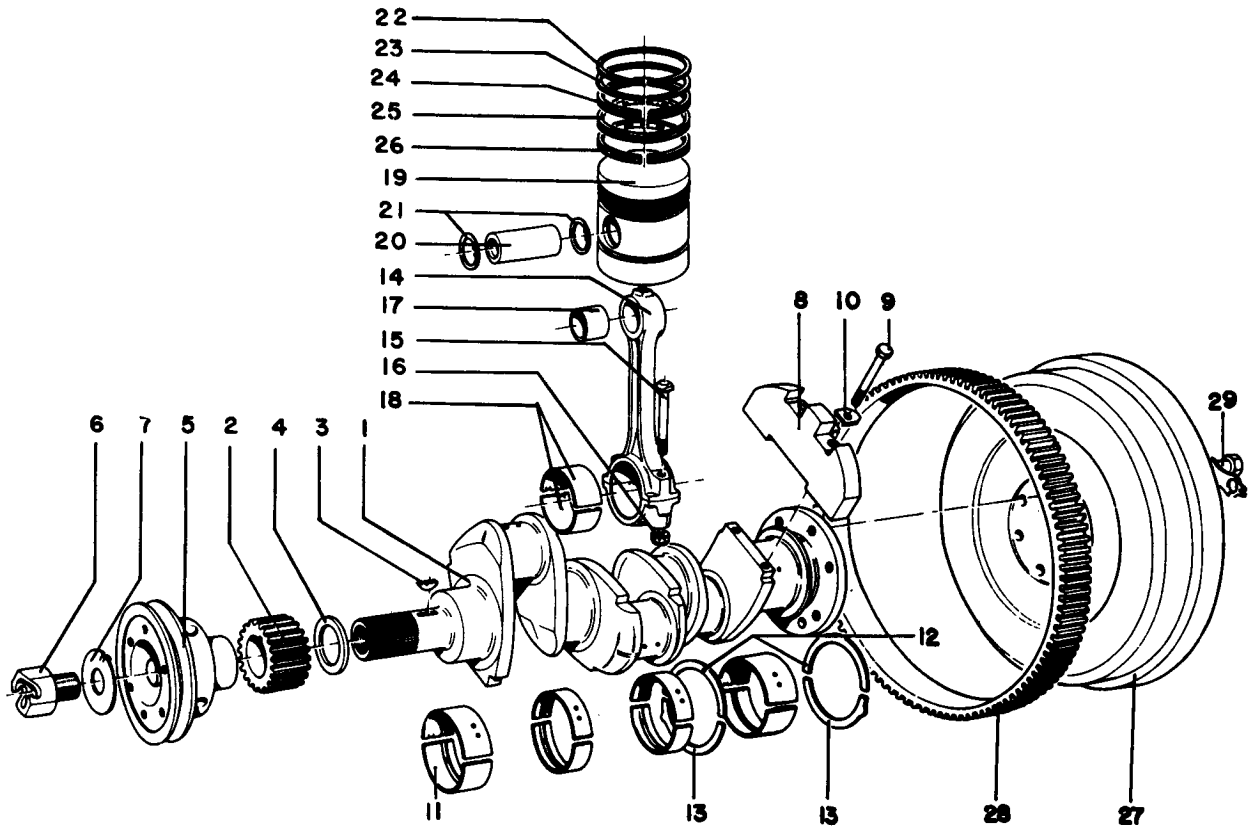
120-143

REF. NO.	HYSTER PART NO.	1 2 3 4 NAME OF PART	QTY.
3 {	984466	A WATER PUMP ASSEMBLY	1
	986093	BODY-WATER PUMP	1
4	15302	PLUG	1
5	983809	PULLEY	1
7	*983983	SHAFT	1
8	*984602	FLANGE	1
9	*985506	SEAL	1
10	*983984	IMPELLER	1
11	983953	CAPSCREW-5/16 X 2	1
12	986094	CAPSCREW-5/16 X 2 1/2	1
13	992641	WASHER-5/16	2
14	15155	LOCKWASHER-5/16	2
15	15005	NUT-5/16 UNF	2
16	983985	GASKET-PUMP TO PLATE	1
17	983810	PLATE-MOUNTING	1
18	983988	CAPSCREW-5/16 X 1 3/4	2
19	984016	GASKET-PLATE TO GEAR COVER	1
20	983952	CAPSCREW-5/16 X 1	1
21	15155	LOCKWASHER-5/16	1
22	984017	CAPSCREW-5/16 X 5/8	2
23	985299	WASHER	2
24	983812	HOSE-CYL. HEAD BY-PASS	1
25	984030	CLAMP-HOSE	2
26	983811	HOSE-TO WATER INLET	1
27	992840	CLAMP-HOSE	2

*INCLUDED IN WATER PUMP REPAIR KIT 986467.

CRANKSHAFT, PISTONS AND FLYWHEEL

DIESEL ENGINE



KEY
A-FOR 3-152 ENGINE.
B-FOR 3-144 ENGINE.

120-145

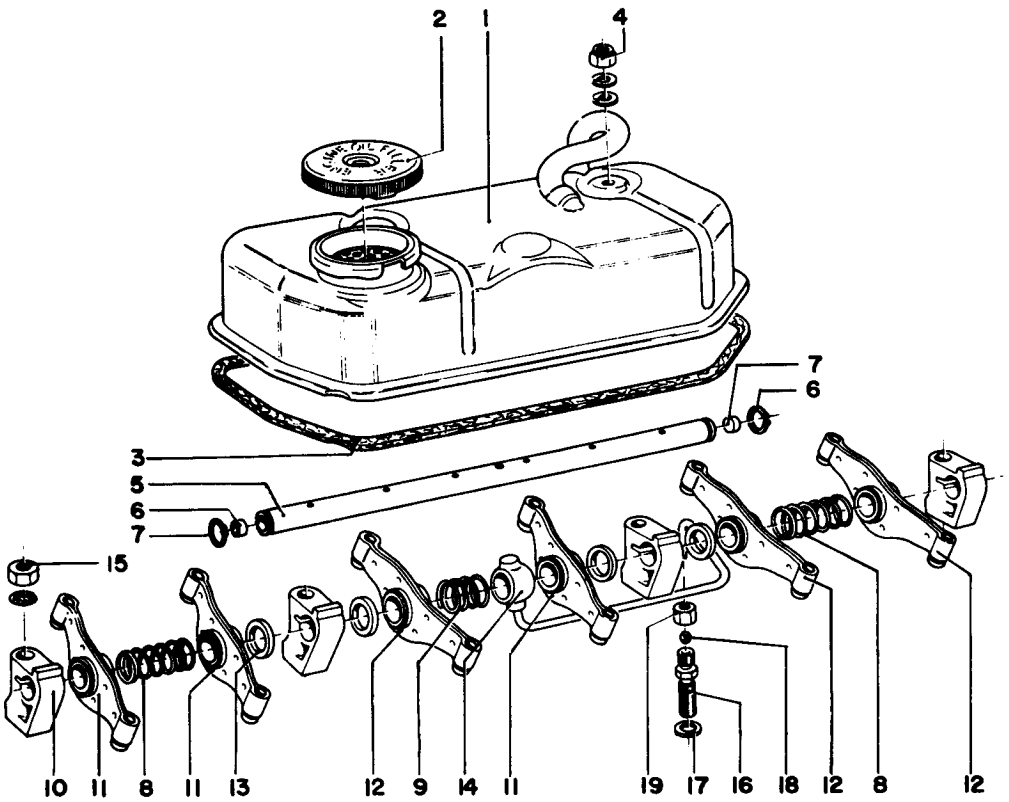
REF. NO.	HYSTER PART NO.	1 2 3 4 NAME OF PART	QTY. A	QTY. B
1	984384	CRANKSHAFT	1	1
2	984022	GEAR-TIMING	1	1
3	9477	KEY	1	1
4	984024	SPACER	1	1
5	983778	PULLEY	••	1
	133556	PULLEY	1	••
	985210	FLANGE-OIL THROWER	1	••
6	986087	DOG-STARTER	1	1
7	985213	WASHER-TAB	1	1
8	983904	WEIGHT-BALANCE	2	2
9	983905	CAPSCREW	4	4
10	986085	WASHER-TAB, R.H.	2	2
	986086	WASHER-TAB, L.H.	2	2
11	984195	A MAIN BEARING SET-STANDARD	1	1
	984196	A MAIN BEARING SET-.010 U.S.	1	1
	984197	A MAIN BEARING SET-.020 U.S.	1	1
	984198	A MAIN BEARING SET-.030 U.S.	1	1
12	130291	WASHER-THRUST, STD.	2	2
	130843	WASHER-THRUST,.007 O.S.	2	2
13	130292	WASHER-THRUST, STD.	2	2
	130844	WASHER-THRUST,.007 O.S.	2	2
14	992988	A ROD ASSEMBLY- CONNECTING	3	3
15	980701	BOLT	2	2
16	985597	NUT	2	2

REF. NO.	HYSTER PART NO.	1 2 3 4 NAME OF PART	QTY. A	QTY. B
17	990409	BUSHING	1	1
18	133464	CONN. ROD BEARING SET-STD.	1	1
	133465	CONN ROD BRG. SET-.010 U.S.	1	1
	133466	CONN. ROD BRG. SET-.020 U.S.	1	1
	133467	CONN. ROD BRG. SET-.030 U.S.	1	1
19	983779	A PISTON ASSEMBLY-STD.	••	3
	986224	PISTON ASSY.-STD.	3	••
20	990416	PIN-PISTON	1	1
21	990417	SNAP RING	2	2
22	982273	RING-COMP. NO. 1 STD.	••	1
	133468	RING SET	1	••
23	990418	RING-COMP. NO. 2 STD.	••	1
24	990419	RING-COMP. NO. 3 STD.	••	4
25	991453	RING-TOP SCRAPER, STD.	••	1
26	991453	RING-BOTTOM SCRAPER STD.	••	1
27	983780	A FLYWHEEL ASSY.-STD. TRANS.	1	1
	983781	A FLYWHEEL ASSY.-MONO. TRANS.	1	1
28	982188	RING GEAR	1	1
29	983294	CAPSCREW-STD. TRANS.	6	6
	983293	CAPSCREW-MONOTROL TRANS.	6	6
	980935	WASHER-TAB	6	6

NOTE-3-144 ENGINE ILLUSTRATED.

CYLINDER HEAD COVER AND ROCKER SHAFT ASSEMBLY

DIESEL ENGINE



KEY
A-FOR 3-152 ENGINE.
B-FOR 3-144 ENGINE.

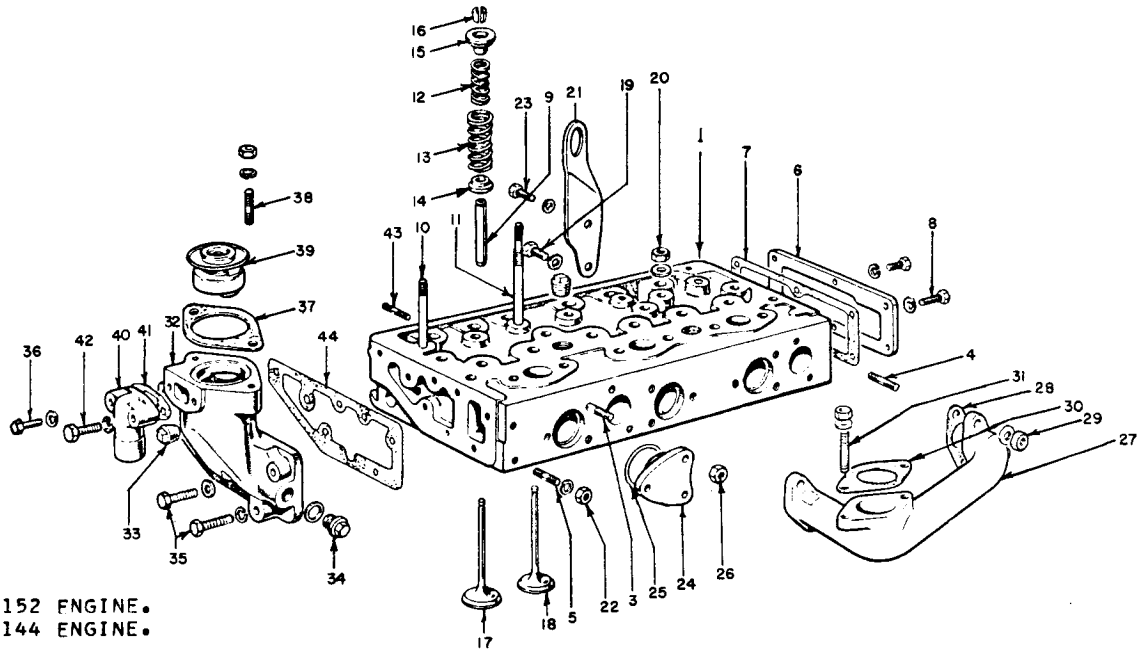
120-146

REF. NO.	HYSTER PART NO. 1 2 3 4	NAME OF PART	QTY. A	QTY. B
1	985159	COVER-CYL HEAD	1	1
2	982341	CAP	1	1
3	984035	GASKET	1	1
4	983344	NUT	2	2
4	983923	WASHER-LEATHER	2	2
4	992629	WASHER	2	2
5	983924 A	SHAFT ASSY.-ROCKER	1	1
5	983925 A	SHAFT-ROCKER	1	1
6	990429	PLUG	2	2
7	990438	SNAP RING	2	2
8	990431	SPRING	2	2
9	983928	SPRING-CENTER	1	1
10	992368	BRACKET-ROCKER SHAFT	4	4
11	980744	LEVER-R.H. ROCKER	3	3
12	980743	LEVER-L.H. ROCKER	3	3
13	990437	SPACER	4	4
14	983929	PIPE-OIL FEED	1	1
15	983623	NUT	4	4
15	992630	WASHER	4	4
16	983776	UNION-FEED PIPE	1	1
17	992642	WASHER	••	1
17	101985	WASHER	1	••
18	51455	SLEEVE	1	1
19	16193	NUT	1	1
	980751	TAPPET (NOT ILLUS.)	6	6
	980748	CAPSCREW-ADJ. (NOT ILLUS.)	6	6
	992829	NUT-LOCK (NOT ILLUS.)	6	6

NOTE-3-144 ENGINE ILLUSTRATED.

CYLINDER HEAD ASSEMBLY

DIESEL ENGINE



KEY
A-FOR 3-152 ENGINE.
B-FOR 3-144 ENGINE.

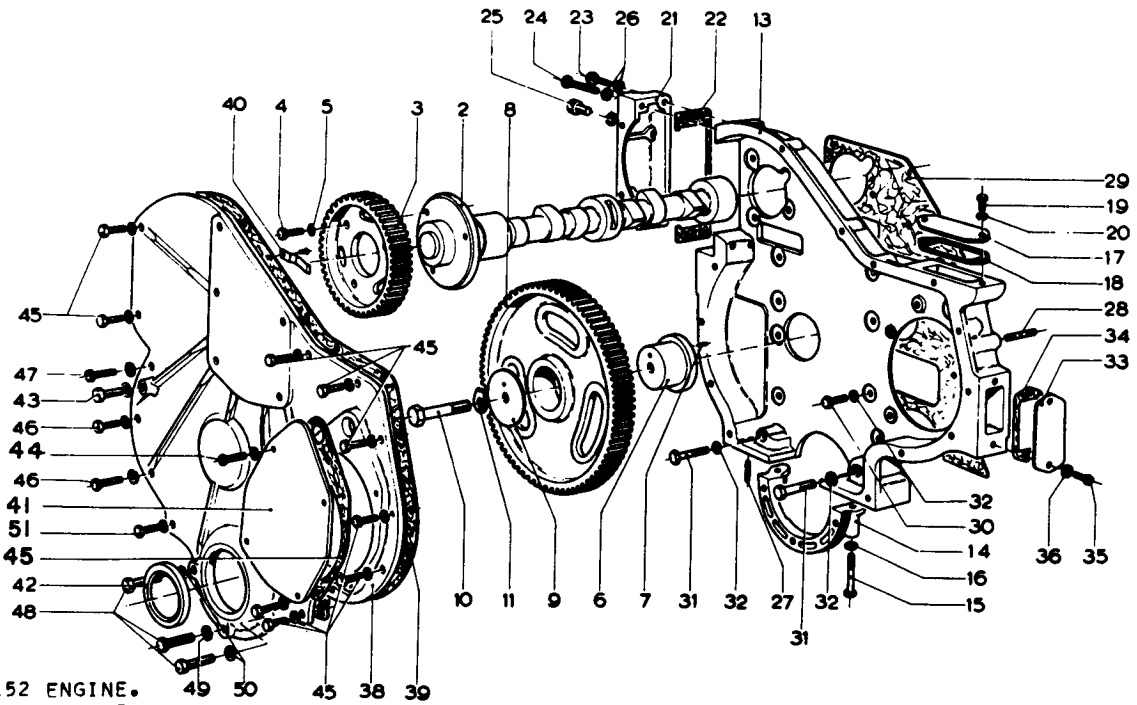
120-147

REF. NO.	HYSTER PART NO. 1 2 3 4	NAME OF PART	QTY. A	QTY. B
1	133553	CYLINDER HEAD ASSY.	1	••
	985246 A	CYLINDER HEAD ASSY.	••	1
2	15303	PLUG	2	••
3	983273	STUD-HEAD TO COVER	9	9
4	983770	STUD-HEAD TO MANIFOLD	4	4
5	983771	STUD-LIFTING PLATE	2	2
6	983772	COVER	1	1
7	983248	GASKET	1	1
8	983310	CAPSCREW	3	••
	982300	CAPSCREW	3	••
	15155	LOCKWASHER-5/16	6	6
	983774	STUD-COVER, LONG	••	1
	983271	STUD-COVER	••	2
	983773	STUD-COVER, SHORT	••	3
	983775	SPACER	••	1
	15005	NUT-5/16 UNF	••	6
9	990355	GUIDE-VALVE	••	6
	*985145	GUIDE-VALVE	6	6
10	983768	STUD-ROCKER SHAFT, SHORT	2	2
11	984612	STUD-ROCKER SHAFT, LONG	2	2
12	990357	SPRING-INNER	6	6
13	990356	SPRING-OUTER	6	6
14	985146	WASHER-LOCATING	6	6
15	992358	CAP-SPRING LOCATING	6	6
16	990359	COTTER	12	12
17	981623	VALVE-INTAKE	3	3
18	990354	VALVE-EXHAUST	3	3
19	982154	PLUG	2	••
	101985	WASHER	2	••
	981640	PLUG	••	2
	992642	WASHER	••	2
20	99590	NUT-CYLINDER HEAD	15	15
	992632	WASHER-HEAD, REAR	1	••
21	983777	PLATE-ENGINE LIFT	1	1
	984069	PLATE-ENGINE LIFT	1	1
22	17158	NUT-3/8 UNF	2	2
	15156	LOCKWASHER-3/8	2	2
23	984010	CAPSCREW	2	2
	15156	LOCKWASHER-3/8	2	2
24	984067 A	CAP-COMBUSTION CHAMBER	3	3
25	986083	GASKET	3	3
26	17158	NUT	9	••
	982157	NUT	••	9
27	984031	MANIFOLD-EXHAUST	1	1
	990671	PLATE-OUTLET COVER	1	••
	133555	STUD-OUTLET COVER	2	••
	983286	NUT	2	••
	992629	LOCKWASHER	2	••
	985294	FLANGE-MANIFOLD	••	1
	984009	SCREW	••	2
28	984032	GASKET	2	2
29	983286	NUT	4	4
	992629	LOCKWASHER	4	4
30	990370	GASKET	2	2
31	984467	STUD-OUTLET FLANGE	2	2
	992629	WASHER	2	2
	983286	NUT	2	2
	983901	BODY-WATER OUTLET	1	1
33	15303	PLUG	1	••
	114637	SENDER-WATER TEMP.	••	1
	992025	PLUG	1	1
34	986475	WASHER	1	••
	992647	WASHER	••	1
	982154	CAPSCREW	2	••
	983281	CAPSCREW	••	2
35	101985	WASHER-TOP	1	••
	992642	WASHER-TOP	••	1
	15156	LOCKWASHER-3/8	1	1
36	983310	CAPSCREW	3	3
	992641	LOCKWASHER-5/16	3	3
	15005	NUT-5/16UNF	••	3
37	991441	GASKET	1	1
38	991440	STUD	2	2
	15156	LOCKWASHER-3/8	2	2
	17158	NUT-3/8 UNF	2	2
39	981635	THERMOSTAT	1	1
40	984029	CONNECTION-WATER OUTLET	1	1
41	991442	GASKET	1	1
42	986084	CAPSCREW	2	2
	992641	LOCKWASHER	2	2
43	983271	STUD-VENTURI	••	2
	15155	LOCKWASHER-5/16	••	2
	15005	NUT-5/16 UNF	••	2
44	984027	GASKET	1	1

*FIRST USED ON ENGINE NO. 111638.
NOTE-3-152 ENGINE ILLUSTRATED.

TIMING GEAR ASSEMBLY

DIESEL ENGINE



120-148

KEY
A-FOR 3-152 ENGINE.
B-FOR 3-144 ENGINE.

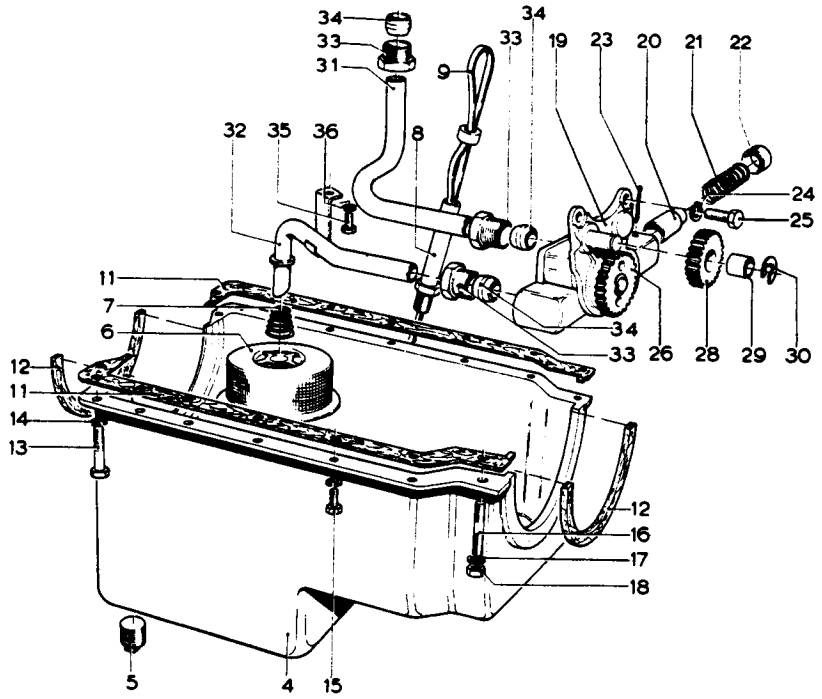
REF. NO.	HYSTER PART NO. 1 2 3 4	NAME OF PART	QTY. A	QTY. B
2	983939	CAMSHAFT	••	1
	133560	CAMSHAFT	1	••
3	983940	GEAR-CAMSHAFT	1	1
4	985238	CAPSCREW	3	3
5	15155	LOCKWASHER-5/16	3	3
6	983941	HUB-IDLER GEAR	1	1
7	983942	DOWEL	1	1
8	983943	GEAR-IDLER	••	1
	133561	GEAR-IDLER	1	••
9	983944	PLATE	1	1
10	983945	CAPSCREW	1	1
11	983946	WASHER	1	1
13	985290 A	HOUSING ASSY.-TIMING GEAR	••	1
	133562	HOUSING ASSY.-TIMING GEAR	1	••
	133565	BRACKET ASSY.	1	••
	983947	HOUSING-TIMING GEAR	••	1
	133564	HOUSING-TIMING GEAR	1	••
14	983798	COVER-BOTTOM	1	1
15	984011	CAPSCREW	2	2
16	15156	LOCKWASHER-5/16	2	2
17	983948	COVER	1	1
18	983949	GASKET	1	1
19	982259	CAPSCREW	2	2
20	15154	LOCKWASHER-1/4	2	2
21	985291	COVER-P.T.O.	••	1
	983950	COVER-P.T.O.	1	••
22	983951	GASKET	1	1
23	983952	CAPSCREW	3	3
24	983954	CAPSCREW	1	1
25	983799	PLUG	••	1
26	15155	LOCKWASHER-5/16	4	5
27	983954	STUD-PAN	2	2
28	983303	STUD-FUEL INJ. PUMP	••	5
	133563	STUD-FUEL INJECTION PUMP	3	••
29	983955	GASKET-HOUSING TO BLOCK	••	1
	133566	GASKET-HOUSING TO BLOCK	1	••
30	983956	CAPSCREW-SHORT	12	12
31	983814	CAPSCREW	2	2
32	992657	WASHER	14	14

REF. NO.	HYSTER PART NO. 1 2 3 4	NAME OF PART	QTY. A	QTY. B
33	983948	COVER-INSPECITON	1	1
34	983949	GASKET	1	1
35	982259	CAPSCREW	2	2
36	15154	LOCKWASHER-1/4	2	2
38	985292	COVER ASSEMBLY-HOUSING	••	1
	133567	COVER ASSEMBLY-HOUSING	1	••
	985293	COVER-FRONT	••	1
	133568	COVER-FRONT	1	••
39	983958	GASKET	1	1
40	990519	SPRING-THRUST	1	1
	79742	RIVET	••	1
	990520	RIVET	1	••
41	984013	COVER-INSPECTION	••	1
	133570	COVER-INSPECTION	1	••
42	982266	OIL SEAL	••	1
	985117	OIL SEAL	1	••
43	983799	PLUG	••	1
	133569	PLUG	1	••
	15155	LOCKWASHER-5/16	••	1
	983966	CAPSCREW AND WASHER	••	4
44	133572	CAPSCREW	6	••
	133573	LOCKWASHER	6	••
45	984012	GASKET	••	1
	133572	GASKET	1	••
	983961	CAPSCREW AND WASHER	••	2
46	983555	CAPSCREW	2	••
	15155	LOCKWASHER	2	••
	983962	CAPSCREW AND WASHER	••	1
47	983555	CAPSCREW	1	••
	15155	LOCKWASHER	1	••
48	986092	CAPSCREW	3	3
49	992641	WASHER	••	1
	985299	WASHER	1	••
50	15155	LOCKWASHER-5/16	2	2
51	983960	CAPSCREW AND WASHER	••	10
	133574	CAPSCREW	10	••
	15154	LOCKWASHER	10	••

NOTE-3-144 ENGINE ILLUSTRATED.

OIL PAN AND OIL PUMP ASSEMBLY

DIESEL ENGINE



KEY
A-FOR 3-152 ENGINE.
B-FOR 3-144 ENGINE.

120-99

REF. NO.	HYSTER PART NO. 1 2 3 4	NAME OF PART	QTY. A	QTY. B
4	983802	PAN-OIL	1	1
5	991984	PLUG-DRAIN	••	1
	15303	PLUG-DRAIN	1	••
6	983803 A	STRAINER	1	1
	984500	GASKET-STRAINER	1	1
7	983804	SPRING-STRAINER	1	1
8	983806	TUBE-DIPSTICK	••	1
	133607	TUBE-DIPSTICK	1	••
	133606	ADAPTER-DIPSTICK	1	••
	992696	WASHER	1	••
9	983807	DIPSTICK	••	1
	133615	DIPSTICK	1	••
11	* •••••	GASKET SET-SIDE	1	1
12	* •••••	GASKET-FRONT AND REAR	2	2
13	982300	CAPSCREW-LONG	2	2
14	983329	LOCKWASHER	••	2
	985299	LOCKWASHER	2	••
15	983805	CAPSCREW AND WASHER	••	12
	983310	CAPSCREW	12	••
	15155	LOCKWASHER-5/16	12	12
16	983954	STUD-PAN TO GEAR HOUSING	2	2
17	15155	LOCKWASHER-5/16	2	2
18	15005	NUT-5/16 UNF	2	2
19	986081 A	OIL PUMP ASSEMBLY	••	1
	984659 A	OIL PUMP ASSEMBLY	1	••

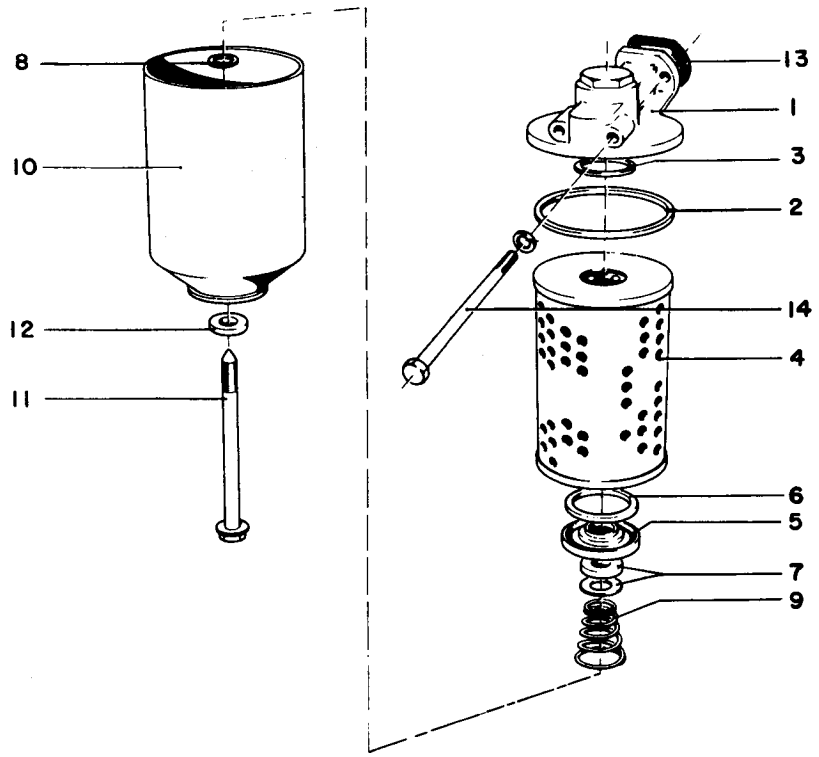
REF. NO.	HYSTER PART NO. 1 2 3 4	NAME OF PART	QTY. A	QTY. B
20	982284	PLUNGER	1	1
21	982285	SPRING	1	1
22	982286	CAP	1	1
23	982287	COVER	1	1
24	992657	LOCKWASHER	3	3
25	983956	CAPSCREW-PUMP TO BRG. CAP	3	3
26	983970	GEAR-DRIVE	1	1
	28269	KEY-GEAR	1	1
28	986474	GEAR-IDLER	1	••
	983976	GEAR-IDLER	••	1
29	983977	BUSHING-GEAR	1	1
30	982292	CLIP-GEAR	1	1
31	984317	PIPE-DELIVERY	1	1
32	985663	PIPE-SUCTION	1	1
33	984336	UNION	2	3
34	982302	SLEEVE	2	3
35	983299	CAPSCREW	••	1
	983804	CAPSCREW	1	••
36	980611	WASHER	1	1

*INCLUDED IN PAN GASKET SET 133613.

NOTE-3-144 ENGINE ILLUSTRATED.

LUBE OIL FILTER ASSEMBLY

DIESEL ENGINE



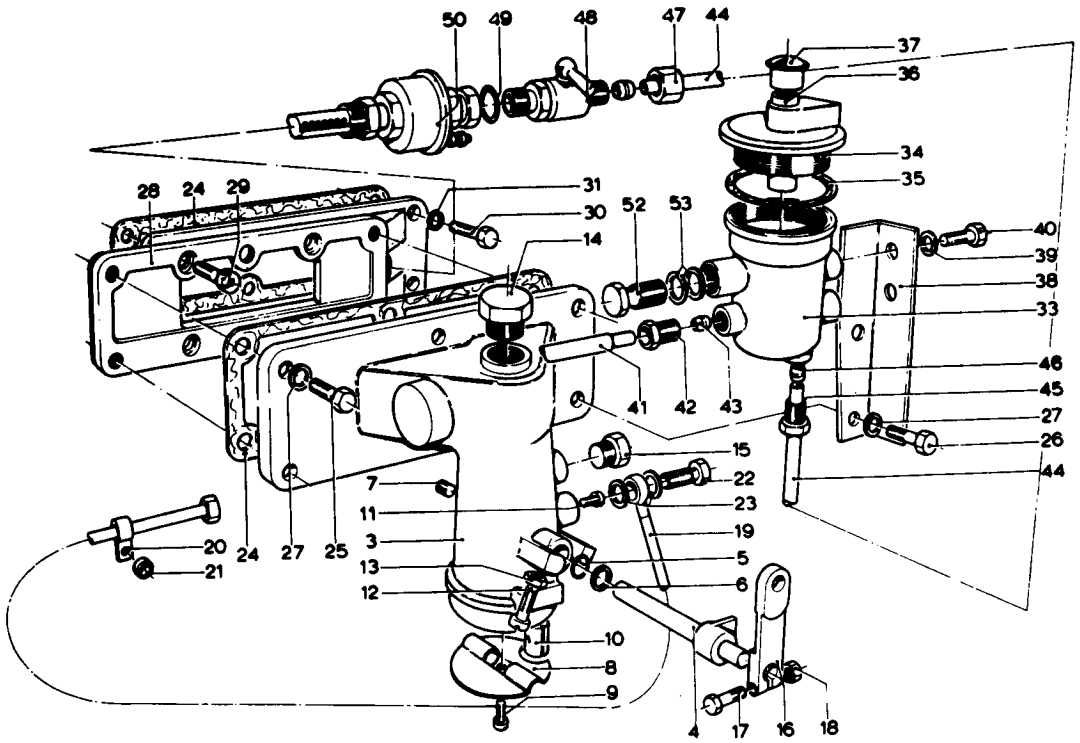
120-149

REF. NO.	HYSTER PART NO. 1 2 3 4	NAME OF PART	QTY.
	983089 A	FILTER ASSY.-LUBE OIL	1
1	983090	COVER-FILTER	1
2	983091	GASKET-COVER, OUTER	1
3	983879	GASKET-COVER, INNER	1
4	133575	ELEMENT-FILTER	1
5	985171	PLATE ASSY.-PRESSURE	1
6	983879	GASKET	1
7	983885	WASHER-STEEL	1
	983886	WASHER-FELT	1

REF. NO.	HYSTER PART NO. 1 2 3 4	NAME OF PART	QTY.
8	983882	SNAP RING	1
9	983887	SPRING-ELEMENT	1
10	983092	CONTAINER-FILTER	1
11	985173	BOLT-CONTAINER TO COVER	1
12	983094	WASHER-BOLT	1
13	982182	GASKET-FILTER TO BLOCK	1
14	985174	CAPSCREW	2
	15156	LOCKWASHER-3/8	2

INTAKE VENTURI AND COLD STARTING EQUIPMENT

DIESEL ENGINE



KEY
A-FOR 3-152 ENGINE.
B-FOR 3-144 ENGINE.

120-101

REF. NO.	HYSTER PART NO.	1 2 3 4 NAME OF PART	QTY. A	QTY. B
3	984084	VENTURI	••	1
	133559	VENTURI	1	••
4	983932	SPINDLE ASSEMBLY	••	1
5	983933	SEAL-SPINDLE	••	1
6	992629	WASHER-SEAL	••	1
7	992393	PLUG	••	1
8	983934	BUTTERFLY-VENTURI	••	1
9	992789	SCREW	••	1
10	981797	VENTURI-AUXILIARY	••	1
11	981798	TUBE-PILOT	••	1
12	983935	SCREW-LEVER ADJUSTING	••	2
13	983936	NUT-LOCKING		2
14	991705	PLUG-1/2	••	1
15	983784	PLUG-3/8	••	1
16	991738	LEVER-CONTROL	••	1
17	983992	BOLT-CLAMPING	••	1
18	983993	NUT	••	1
19	983788 A	PIPE-VENTURI TO GOVERNOR	••	1
20	983796	CLIP-PIPE	••	1
21	983775	SPACER	••	1
22	983789	BOLT-FITTING	••	1
23	79803	WASHER-SEAL	••	2
24	983786	GASKET	2	2
25	983310	CAPSCREW-5/16 UNF X 7/8	4	3
	986091	CAPSCREW-5/16 UNF X 1	••	2
26	983338	CAPSCREW	2	••
	992629	WASHER	2	••
27	15155	LOCKWASHER-5/16	6	6
	¤984086	ADAPTER-VENTURI	••	1
28	986089	ADAPTER-VENTURI	1	1
	133558	PLUG	1	••
29	983787	CAPSCREW-5/16 UNF X 1 1/4	4	4
30	982300	CAPSCREW-5/16 UNF X 3/4	2	2
31	15155	LOCKWASHER-5/16	2	2

REF. NO.	HYSTER PART NO.	1 2 3 4 NAME OF PART	QTY. A	QTY. B
33	983298 A	CONTAINER ASSY. COLD START	1	1
	982195	CONTAINER	1	1
34	983790	CAP-CONTAINER	1	1
35	982197	GASKET	1	1
36	982198	VALVE-CHECK	1	1
37	983791	COVER-DUST	1	1
38	984087	BRACKET	1	1
39	15154	LOCKWASHER-1/4	2	2
40	983299	CAPSCREW	2	2
	984090 A	PIPE-FROM LEAK-OFF TEE	••	1
	*985297 A	PIPE-FROM LEAK-OFF TEE	••	1
41	133617	PIPE-LEAK-OFF TO CONTAINER	1	••
	16193	NUT	2	••
	51455	SLEEVE	2	••
42	982201	NUT	••	1
43	51455	SLEEVE	••	1
44	¤984088	PIPE-CONTAINER TO HEATER	••	1
	986090 A	PIPE-CONTAINER TO HEATER	1	1
45	982201	NUT	1	1
46	51455	SLEEVE	2	2
47	16193	NUT	1	1
48	¤982336	COCK	••	1
49	¤980685	WASHER	••	1
50	¤982335	HEATER-INDUCTION	••	1
51	986104	HEATER-INDUCTION	1	1
52	982063	BOLT-FITTING	••	2
53	982160	WASHER	••	2

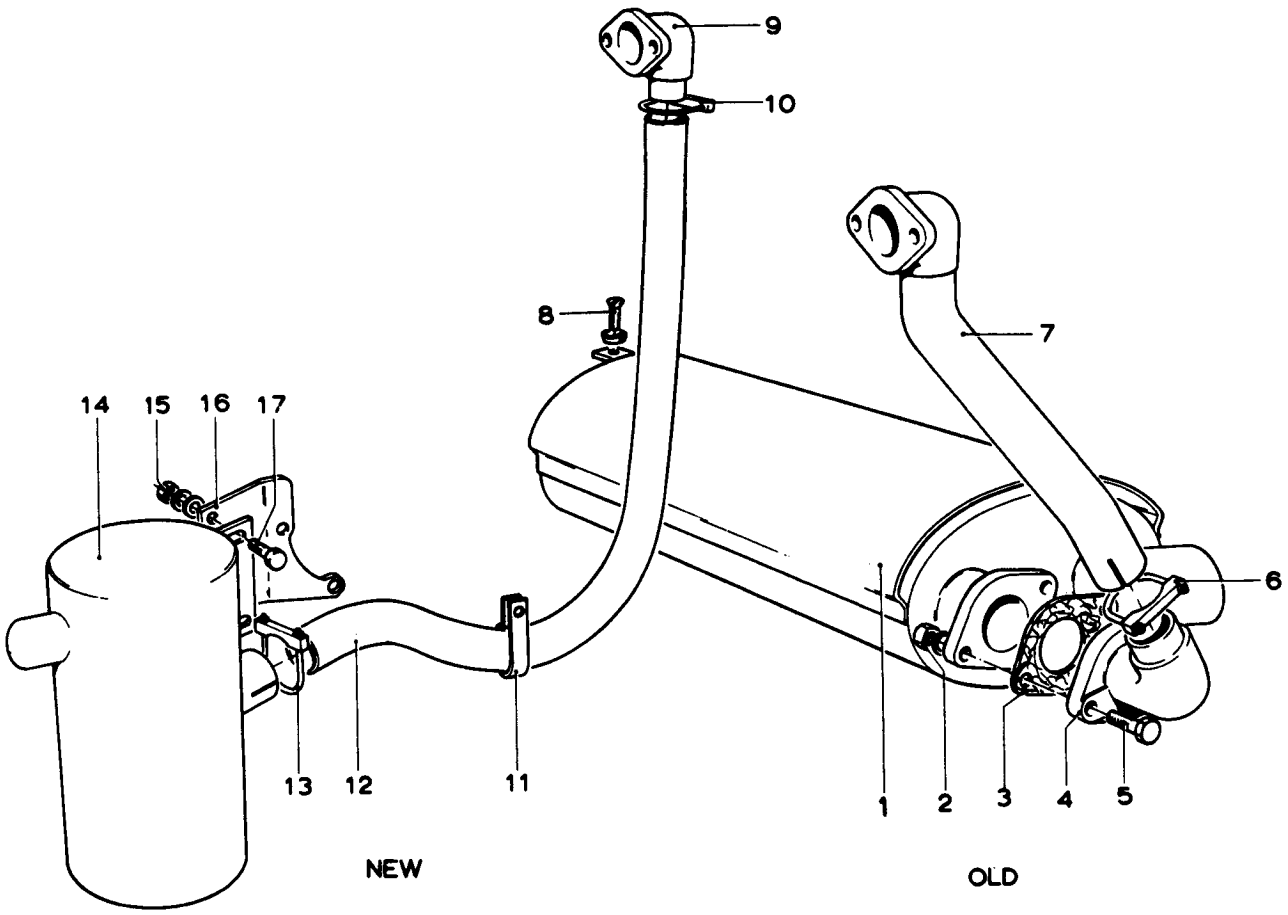
¤LAST USED ON ENGINE NO. 1121658.

*FIRST USED ON ENGINE NO. 1116878.

NOTE-3-144 ENGINE ILLUSTRATED.

EXHAUST SYSTEM

FOR DIESEL ENGINE



120-102

REF. NO.	HYSTER PART NO.	NAME OF PART 1 2 3 4	QTY.
1	982673	MUFFLER-EXHAUST	1
2	14465	NUT-BRASS, 5/16 UNF	2
	15155	LOCKWASHER-5/16	2
3	983018	GASKET	1
4	982647 B	ELBOW-EXHAUST	1
5	15621	CAPSCREW-5/16 UNF X 1 1/4	2
6	38738	CLAMP	1
7	982650 W	PIPE-EXHAUST	1
8	16353	CAPSCREW-3/8 UNF X 1	1
	15933	LOCKWASHER-3/8	1
9	*982647 B	ELBOW-EXHAUST	1
10	* 38738	CLAMP	1

REF. NO.	HYSTER PART NO.	NAME OF PART 1 2 3 4	QTY.
11	* 78078	CLAMP	1
12	* 78080	PIPE-EXHAUST	1
13	* 30368	CLAMP	1
14	* 78077	MUFFLER-EXHAUST	1
15	* 15005	NUT-5/16 UNF	2
	* 18515	WASHER-5/16	2
	* 15155	LOCKWASHER-5/16	2
16	* 78079	BRACKET-MUFFLER	1
17	* 15554	CAPSCREW-5/16 UNF X 1	2

*FIRST USED ON SERIAL NO. B2A-1788.

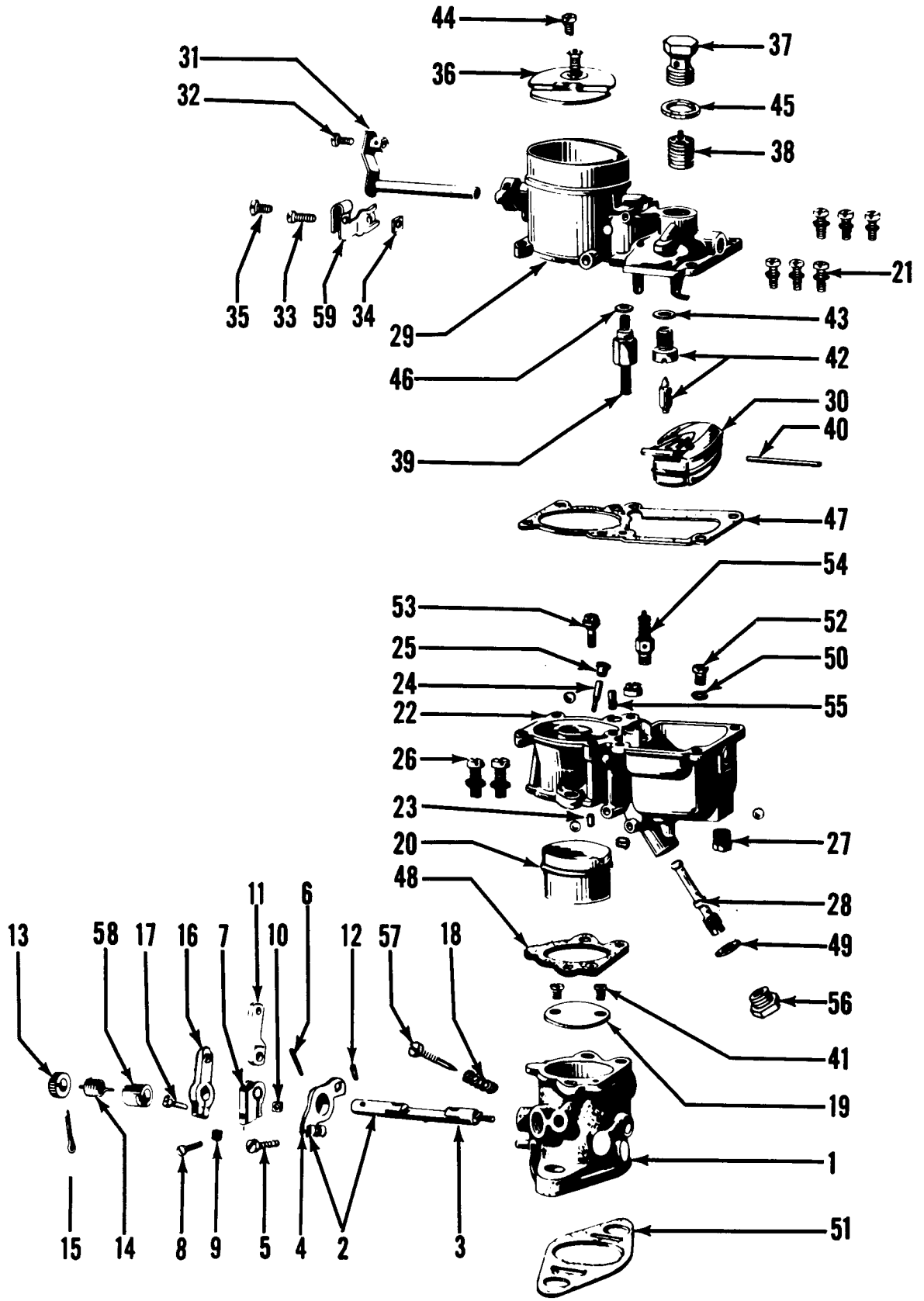
Section D

CARBURETOR AND THROTTLE LINKAGE

INDEX

CARBURETOR ASSEMBLY

FOR GAS ENGINE



120-167

CARBURETOR ASSEMBLY

FOR GAS ENGINE

REF. NO.	HYSTER PART NO.	1 2 3 4	NAME OF PART	QTY.
	56749	A	CARBURETOR ASSEMBLY	1
1	•••••		BODY ASSEMBLY-THROTTLE	1
2	56777		SHAFT AND STOP ASSY.	1
3	•••••		SHAFT-THROTTLE	1
4	138561		LEVER ASSY.-STOP	1
5	50562		SCREW	1
6	132618		PIN-TAPER, STOP LEVER	1
7	56774		STOP ASSY.-FLOATING LEVER	1
8	97451		SCREW-CLAMP	1
9	56781		WASHER	1
10	56772		NUT-CLAMP	1
11	56773		LEVER-FLOATING	1
12	141001		PIN-THROTTLE SHAFT	1
13	56238		RETAINER-SPRING	1
14	56242		SPRING	1
15	56239		COTTER	1
16	97446		LEVER ASSY.-THROTTLE	1
17	56036		SCREW	1
18	56756		SPRING	1
19	138651		PLATE-THROTTLE	1
20	127775		VENTURI	1
21	56754		SCREW	6
22	56765	A	BOWL ASSEMBLY	1
	140963		PLUG-LEAD	4
23	56766		BUSHING	1
24	56763		JET-ACCELERATOR	1
25	56028		PLUG-ACCELERATOR JET	1
26	56767		SCREW	2
27	56014		PLUG-DRAIN	1
28	56769		JET-MAIN DISCHARGE	1
29	140964		INTAKE ASSEMBLY-AIR	1
	140965		PLUG-CHANNEL	2

REF. NO.		HYSTER PART NO.	1 2 3 4	NAME OF PART	QTY.
30		56013		FLOAT ASSEMBLY	1
31		56082		LEVER AND SHAFT-CHOKE	1
32		97450		SCREW-SWIVEL	1
33		56092		SCREW-TUBE CLAMP	1
34		56750		NUT-CLAMP SCREW	1
35		56759		SCREW-BRACKET ASSY.	1
36		56075		PLATE-CHOKE	1
37		56010		HEAD-FILTER	1
38		56753		ELEMENT-FUEL FILTER	1
39	*	56002		CYLINDER ASSY.-VACUUM	1
40	*	56168		AXLE-FLOAT	1
41	*	50552		SCREW-THROTTLE PLATE	2
42	*	56757		VALVE ASSY.-FUEL	1
43	*	56758		WASHER-FIBRE	1
44	*	56076		SCREW	1
45	▫*	56752		WASHER-FILTER HEAD	1
46	▫*	56185		WASHER-VACUUM CYLINDER	1
47	▫*	56012		GASKET-BOWL TO INTAKE	1
48	▫*	56031		GASKET-BOWL TO INTAKE	1
49	▫*	56182		WASHER-LOWER PLUG	1
50	▫*	56182		WASHER-MAIN JET	1
51	*	56057		GASKET-FLANGE	1
52		56819		JET-MAIN	1
53		56761		JET-IDLING	1
54		56762		VALVE-POWER JET	1
55		56754		VENT-WELL	1
56		50553		PLUG-LOWER	1
57		56755		SCREW-IDLE ADJ.	1
58		56779		BUSHING-DRIVER SHAFT	1
59		138650		BRACKET-CHOKE	1

*INCLUDED IN REPAIR KIT 124140.

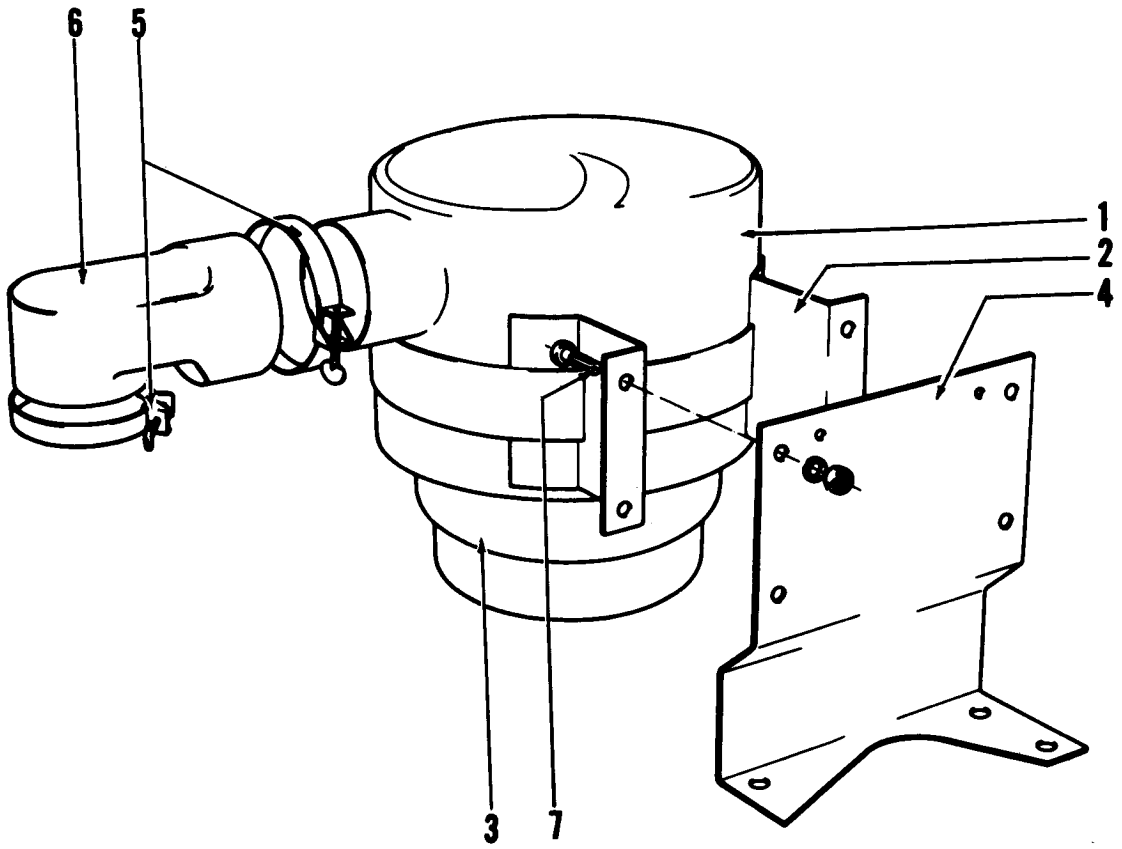
▫INCLUDED IN GASKET KIT 56425A.

NOTE-REPAIR KIT INCLUDES GASKET KIT.

AIR CLEANER ASSEMBLY

FOR GAS ENGINE

LAST USED ON SERIAL NO. B2D-2885, B2E-1870 AND B2A-1787



120-168

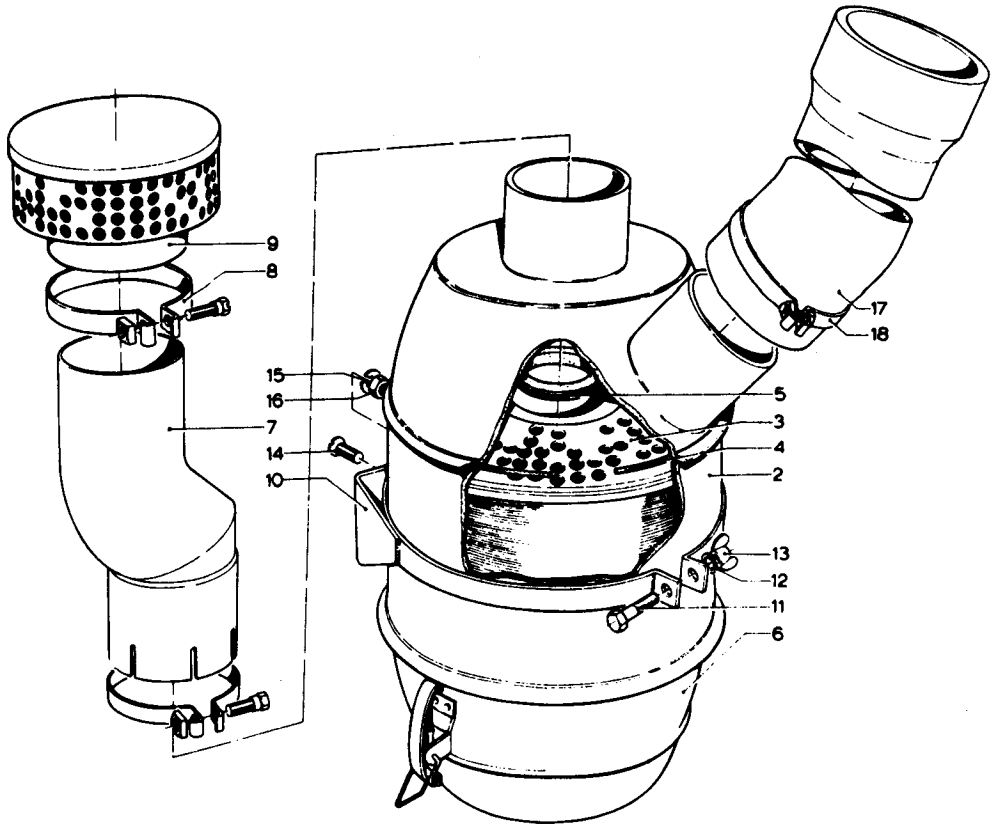
REF. NO.	HYSTER PART NO. 1 2 3 4	NAME OF PART	QTY.
1	114314 A	AIR CLEANER ASSEMBLY	1
2	114315	BRACKET-SADDLE	1
3	200878	CUP ASSEMBLY	1
4	114313	PLATE-BRACKET	1
5	112989	CLAMP-HOSE	2

REF. NO.	HYSTER PART NO. 1 2 3 4	NAME OF PART	QTY.
6	111105	BOOT-INLET	1
7	15553	CAPSCREW-5/16 UNC X 3/4	4
	15155	LOCKWASHER-5/16	4
	15055	NUT-5/16 UNC	4

AIR CLEANER ASSEMBLY

FOR DIESEL ENGINE

LAST USED ON SERIAL NO. B2E-1870 AND B2A-1787

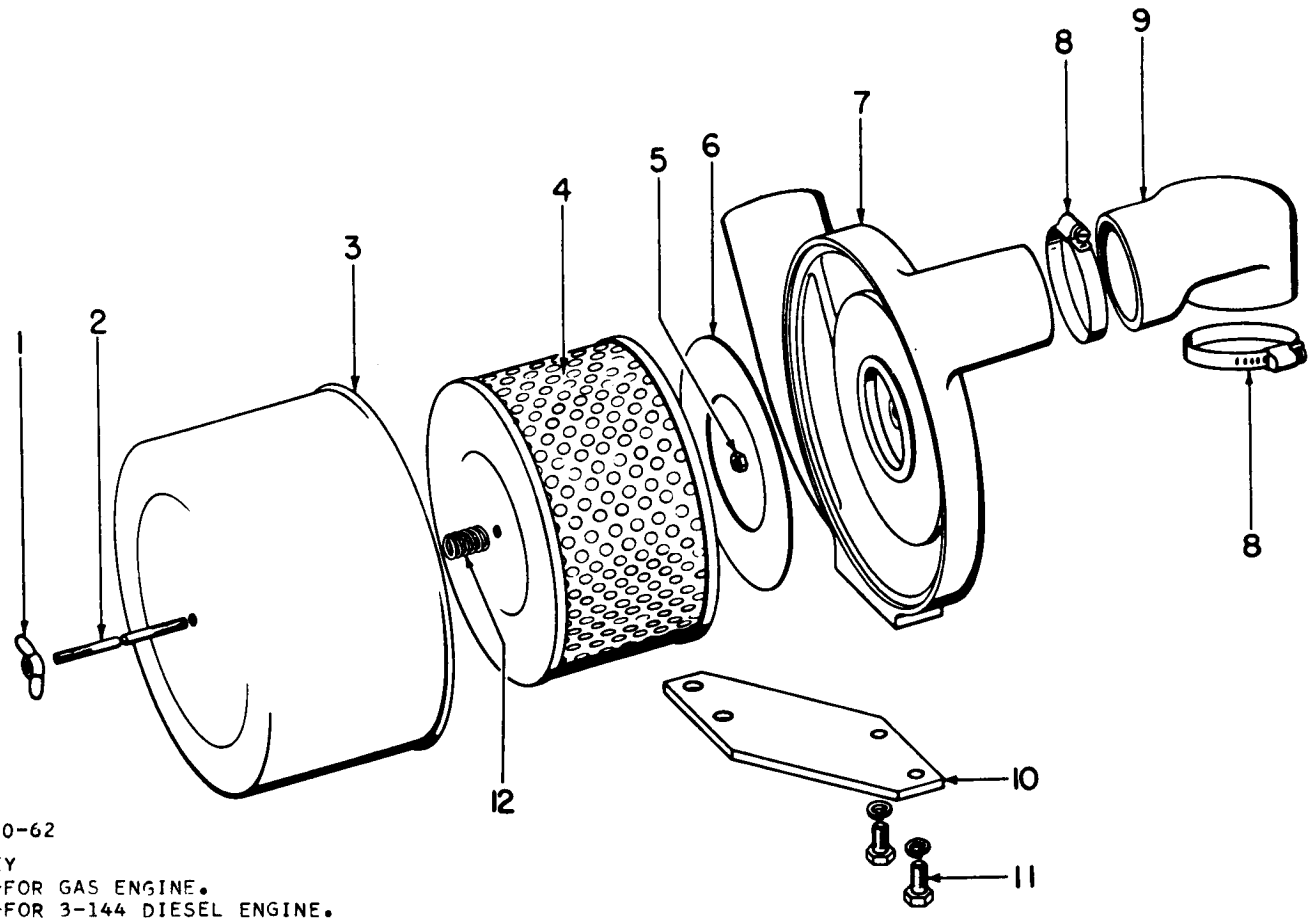


120-103

REF. NO.	HYSTER PART NO. 1 2 3 4	NAME OF PART	QTY.
2	982897 A	AIR CLEANER ASSEMBLY	1
3	984524	ELEMENT-FILTER	1
4	984526	RING-OUTER	1
5	984525	RING-INNER	1
6	984523	CONTAINER	1
7	982988	PIPE ASSEMBLY	1
8	18999	CLAMP	2
9	992113 W	CAP-RAIN	1
10	980261AB	BRACKET-AIR CLEANER	1
11	15588	CAPSCREW-1/4 UNF X 1 1/2	1
12	15923	LOCKWASHER-1/4	1
13	15067	NUT-WING, 1/4 UNF	1
14	16367	CAPSCREW-1/4 UNF X 1	2
15	15154	LOCKWASHER-1/4	2
16	15004	NUT-1/4 UNF	2
17	982661	HOSE-TO VENTURI	1
18	18998	CLAMP-HOSE	1

DRY TYPE AIR FILTER

FIRST USED ON SERIAL NO. B2D-2886 AND B2A-1788



120-62

KEY
A-FOR GAS ENGINE.
B-FOR 3-144 DIESEL ENGINE.
C-FOR 3-152 DIESEL ENGINE.

REF. NO.	HYSTER PART NO. 1 2 3 4	NAME OF PART	QTY. A	B	C
1	119234	WING NUT-SPECIAL	1	1	1
	15174	WASHER-1/4	1	1	1
2	120737	LINK	1	1	1
3	131128	COVER ASSEMBLY	1	1	1
4	118643	ELEMENT	1	1	1
5	15000	NUT-JAM,1/4 UNC	1	1	1
6	118896	GASKET	1	1	1
7	120736	ADAPTER-AIR FILTER	1	1	1
8	112989	CLAMP-HOSE	2	2	2
9	77501	HOSE-TO VENTURI	••	1	••
	111105	BOOT-AIR INLET	1	••	••
	805072	HOSE-TO VENTURI	••	••	1

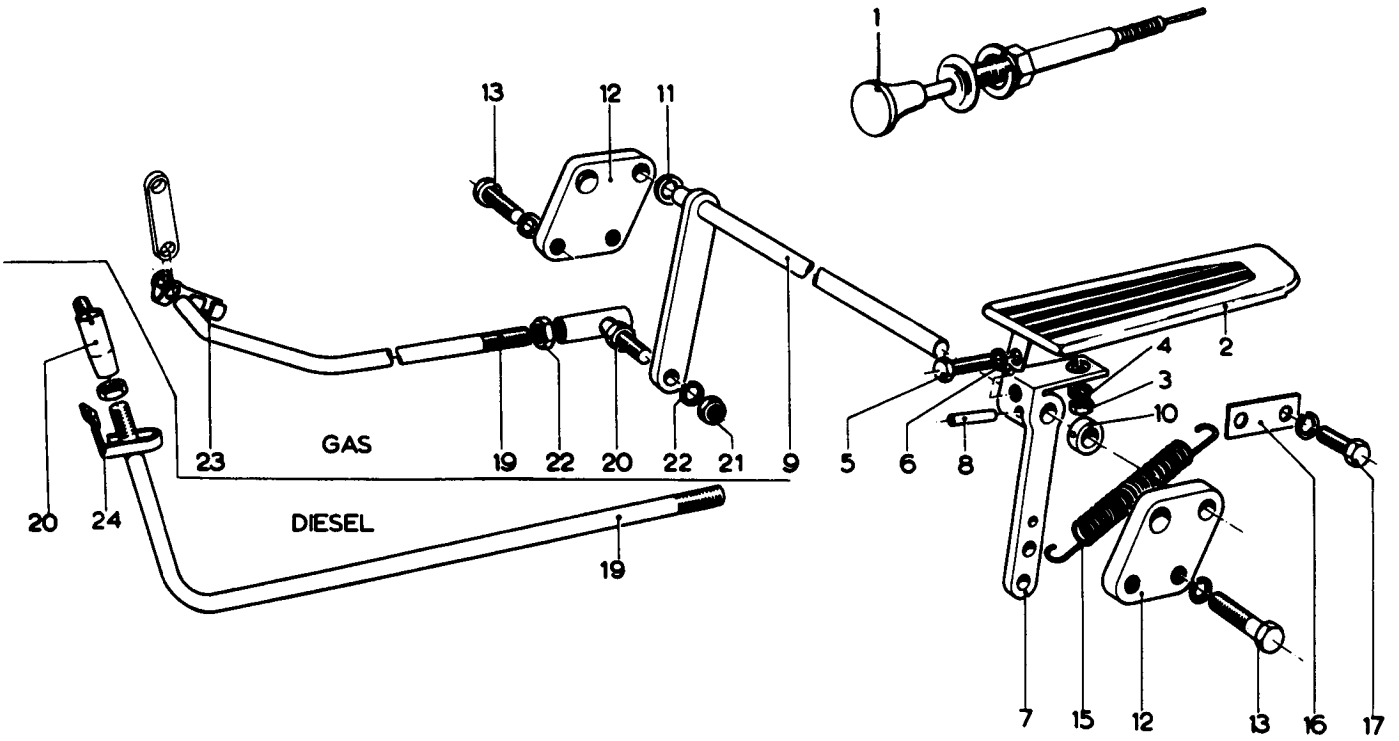
REF. NO.	HYSTER PART NO. 1 2 3 4	NAME OF PART	QTY. A	B	C
10	120735	PLATE-BRACKET	1	••	••
	77502	PLATE-BRACKET	••	1	••
	805070	PLATE-BRACKET	••	••	1
	805071	SPACER	••	••	1
	15600	CAPSCREW-5/16 UNF X 5/8	••	2	••
	15155	LOCKWASHER-5/16	••	2	••
	16757	WASHER-COPPER,5/16	••	2	••
11	15529	CAPSCREW-3/8 UNC X 1	2	2	••
	15680	CAPSCREW-3/8 UNC X 1 1/2	••	••	2
	15156	LOCKWASHER-3/8	2	2	2
	15134	WASHER-3/8	2	2	2
12	*120657	SPRING	1	1	1

*LAST USED ON SERIAL NO. B2D-5155.

NOTE-GAS ENGINE FILTER ILLUSTRATED.

THROTTLE LINKAGE

FOR STANDARD TRANSMISSION



KEY
A-FOR GAS ENGINE.
B-FOR 3-144 DIESEL ENGINE.
C-FOR 3-152 DIESEL ENGINE.

120-104

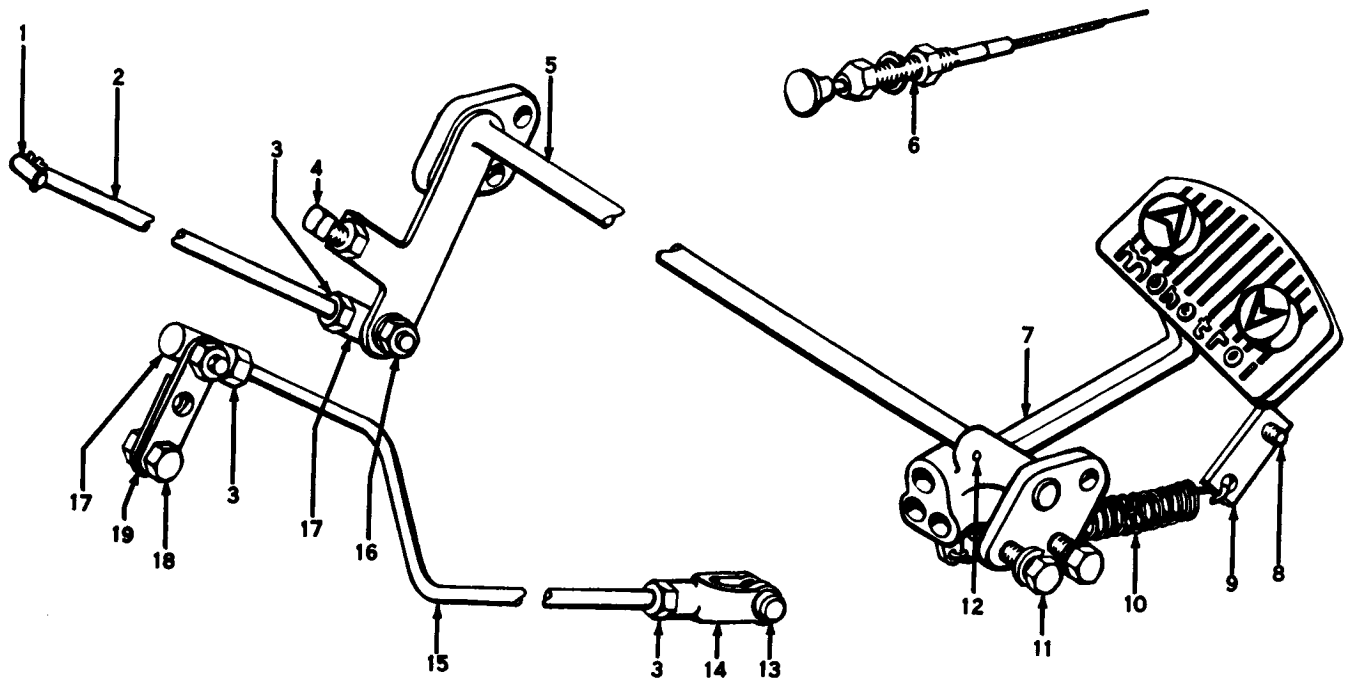
REF. NO.	HYSTER PART NO. 1 2 3 4	NAME OF PART	QTY. A	B	C
1	108147	CONTROL-CHOKE	1	••	••
	982992	CONTROL-STOP	••	1	1
2	66958	PEDAL-THROTTLE	1	1	1
3	15004	NUT-1/4 UNF	1	1	1
4	15154	LOCKWASHER-1/4	1	1	1
5	15551	CAPSCREW-1/4 UNC X 1/2	1	1	1
6	15154	LOCKWASHER-1/4	1	1	1
7	114502	LEVER-THROTTLE PEDAL	1	1	1
8	19975	ROLL PIN-1/8 X 3/4	1	1	1
9	114505 W	CRANK-THROTTLE	1	1	••
	805076	SHAFT-THROTTLE	••	••	1
10	17250	COLLAR-SET	1	1	1
11	15134	WASHER-3/8	1	1	1
12	114508	BRACKET	2	2	2
13	15532	CAPSCREW-3/8 UNF X 1 1/4	4	4	4
	15156	LOCKWASHER-3/8	4	4	4
15	114504	SPRING	1	1	1
16	61499	KEEPER	1	1	1
17	15513	CAPSCREW-3/8 UNF X 3/4	1	1	1
	15156	LOCKWASHER-3/8	1	1	1

REF. NO.	HYSTER PART NO. 1 2 3 4	NAME OF PART		QTY. A	B	C
19	114503	ROD-THROTTLE		1	••	••
	982591	ROD-THROTTLE		••	1	••
	* 77218	ROD-THROTTLE		••	1	••
	805076	ROD-THROTTLE		••	••	1
20	66707	BALL JOINT-1/4		1	2	1
	125	ROD END		••	••	1
	126	PIN-ROD END		••	••	1
	15200	COTTER-1/16 X 1/2		••	••	1
21	15004	NUT-1/4 UNF		2	4	4
22	15154	LOCKWASHER-1/4		1	2	2
23	100267	CLIP-CLEVIS		1	••	••
24	77219	GUIDE-THROTTLE ROD		••	1	••
	805083	PLATE		••	••	1
	15585	CAPSCREW-1/4 UNF X 1/2		••	••	1
	15154	LOCKWASHER-1/4		••	••	1
	15004	NUT-1/4 UNF		••	••	1
	132808	BRACKET	ON	1	••	••
	132809	BRACKET-L.P.G.	CARB.	1	••	••
	132806	BRACKET	NOT	1	••	••
	132807	SPRING	ILLUS.	1	••	••

*FIRST USED ON SERIAL NO. B2E-1871 AND B2A-1788.

THROTTLE LINKAGE

FOR MONOTROL TRANSMISSION



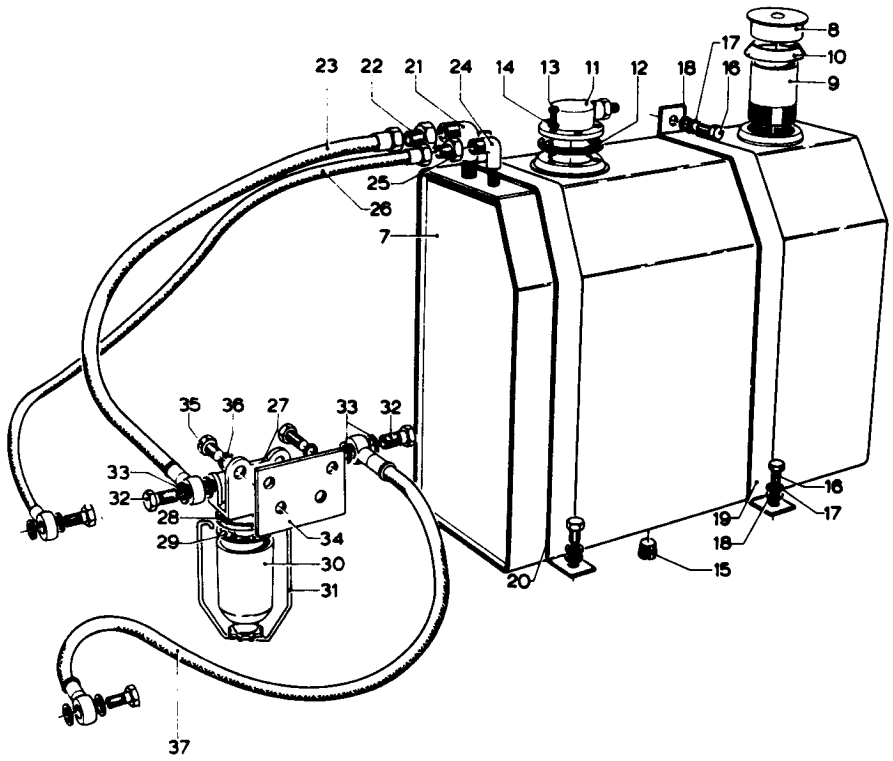
120-150

KEY
A-FOR GAS ENGINE.
B-FOR 3-144 DIESEL ENGINE.
C-FOR 3-152 DIESEL ENGINE, FIRST ON SER. NO. B2A-2172.

REF. NO.	HYSTER PART NO.	NAME OF PART 1 2 3 4	QTY. A	B	C
1	100267	CLIP-CLEVIS	1	••	••
2	114557	ROD-THROTTLE	1	••	••
3	15004	NUT-1/4 UNF	1	3	3
4	17242	SETSCREW-1/4 UNC X 1 1/4	1	1	1
	15054	NUT-1/4 UNC	1	1	1
5	114553 W	SHAFT-THROTTLE	1	••	••
	* 76582 W	SHAFT-THROTTLE	1	1	••
	805082	SHAFT-THROTTLE	••	••	1
	41696	WASHER	1	1	1
6	108147	CHOKE CONTROL	1	••	••
	982992	STOP CONTROL	••	1	1
7	126430	PEDAL ASSEMBLY	1	1	1
8	15513	CAPSCREW-3/8 UNF X 3/4	1	1	1
	15156	LOCKWASHER-3/8	1	1	1
9	100780	KEEPER	1	1	1
10	15532	CAPSCREW-3/8 UNF X 1 1/4	4	4	4
	15156	LOCKWASHER-3/8	4	4	4
11	114508	BRACKET	2	2	2
12	19980	ROLL PIN-1/8 X 7/8	1	1	••
	* 19872	ROLL PIN-3/16 X 1 1/8	1	1	1
13	126	PIN-ROD END	••	1	1
	15200	COTTER-1/16 X 1/2	••	1	1
14	125	ROD END	••	1	1
15	77231	ROD-THROTTLE	••	1	••
	805084	ROD-THROTTLE	••	••	1
16	15024	NUT-JAM, 1/4 UNF	1	••	••
	15915	LOCKWASHER-1/4	1	••	••
	15127	WASHER-1/4	2	••	••
17	66707	BALL JOINT-1/4	1	1	1
18	15004	NUT-1/4 UNF	••	••	1
	15154	LOCKWASHER-1/4	••	••	1
	15585	CAPSCREW-1/4 UNF X 1/2	••	••	1
19	77219	GUIDE-ROD	••	1	••
	805083	PLATE	••	••	1
	132808	BRACKET (ON CARB.)	1	••	••
	132809	BRACKET-L.P.G. (ON CARB.)	1	••	••
	132806	BRACKET (NOT ILLUS.)	1	••	••
	132807	SPRING (NOT ILLUS.)	1	••	••

*FIRST USED ON SERIAL NO. B2D-2995, B2E-1797 AND B2A-1501.

FUEL TANK ASSEMBLY



KEY
A-FOR B2D SERIES GAS TRUCKS.
B-B2F AND B2A SERIES GAS TRUCKS.
C-FOR 3-144 DIESEL ENGINE.
D-FOR 3-152 DIESEL ENGINE, FIRST ON SER. NO. B2A-2172.

120-106

REF. NO.	HYSTER PART NO. 1 2 3 4	NAME OF PART	QTY. A	B	C	D
7	113868	TANK-FUEL	1	••	••	••
	*982593 W	TANK-FUEL	••	1	1	••
	¤985871 W	TANK-FUEL	••	1	1	1
8	60503 A	CAP ASSEMBLY	1	1	1	1
	63899 A	CAP-PROTECTO SEAL, OPT.	1	1	1	1
	#137328	FILLER-PROTECTO-SEAL	1	1	••	••
9	19619	NIPPLE-LONG	1	1	1	1
	#137329	NIPPLE-SPECIAL	1	1	••	••
10	61843	WASHER-RUBBER	1	1	1	1
11	110488	SENDER-FUEL LEVEL	1	1	1	1
	*981959	SENDER-FUEL LEVEL	••	1	1	••
12	111561	GASKET	1	1	1	1
	*981964	GASKET	••	1	1	••
13	16708	SCREW-10-32 X 1/2	5	5	5	5
14	77610	WASHER	5	5	5	5
15	15314	PLUG	1	1	1	1
16	15513	CAPSCREW-3/8 UNF X 3/4	4	4	4	4
17	15156	LOCKWASHER-3/8	4	4	4	4
18	15134	WASHER-3/8	4	4	4	4
19	140452	CLAMP	2	••	••	••
20	112444	PAD-FELT	5	5	5	5
21	19558	CAP-PIPE	••	1	••	••
	14369	ELBOW	••	••	1	••
	805074	ADAPTER	••	••	••	1
22	*980277	CONNECTOR	••	••	1	••
23	985934 A	LINE-FUEL, TK. TO FLT.	••	••	1	••
	805096	LINE-FUEL, TK. TO FLT.	••	••	••	1
24	14288	ELBOW-FEMALE	1	1	••	••
	* 16151	ELBOW	••	••	1	••
	¤ 14368	ELBOW	••	••	1	••
	805073	ADAPTER	••	••	••	1
	986097	BOLT	••	••	••	1
	981260	WASHER	••	••	••	2
25	*992465	CONNECTOR	••	••	1	••
26	113869	TUBE-TANK TO FILTER	1	1	••	••
	985892 A	FUEL LINE-FROM CONT.	••	••	1	••
	805096	FUEL LINE-FROM CONT.	••	••	••	1
27	982674 A	PRE-FILTER ASSY.	••	••	1	1
28	983582	GASKET			1	1
29	983895	STRAINER-BRASS	••	••	1	1
30	990319	BOWL-GLASS	••	••	1	1
31	983583	STIRRUP	••	••	1	1
32	982996	BOLT	••	••	2	2
33	981260	WASHER	••	••	4	4
34	*982950	BRACKET	••	••	2	••
	¤ 77502	BRACKET	••	••	1	••
35	15600	CAPSCR.-5/16 UNF X 5/8	••	••	2	••
	15583	CAPSCR.-5/16 UNF X 1/2	••	••	••	2
36	15155	LOCKWASHER-5/16	••	••	2	2
37	982605 A	FUEL LINE-FLT. TO PUMP	••	••	1	••
	805095	FUEL LINE-FLT. TO PUMP	••	••	••	1
	986097	BOLT	••	••	••	1
	981260	WASHER	••	••	••	2

*LAST USED ON SERIAL NO. B2E-1870 AND B2A-1787.

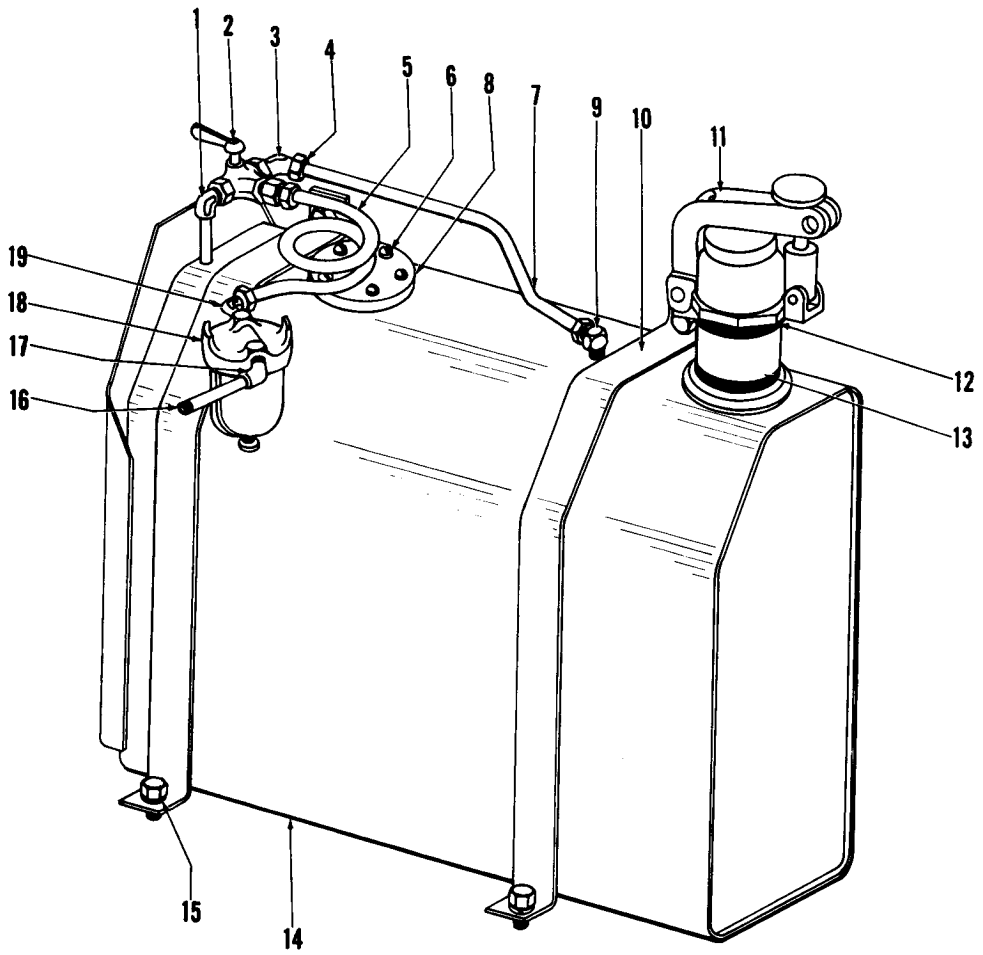
¤FIRST USED ON SERIAL NO B2A-1788.

#FOR PORTABLE REFUELING-STEVEDORING TRUCK ONLY.

NOTE-DIESEL FUEL SYSTEM LAST ON SERIAL NO. B2A-2172 ILLUSTRATED.

FUEL TANK ASSEMBLY

FOR GS TRUCKS ONLY



120-56

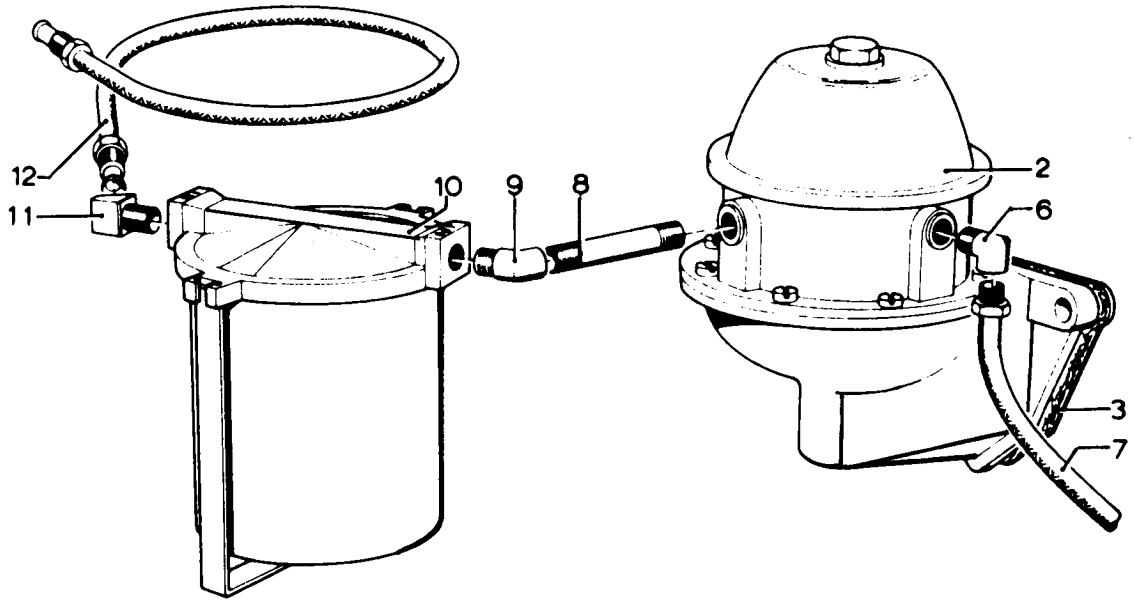
REF. NO.	HYSTER PART NO.	NAME OF PART 1 2 3 4	QTY.
1	16151	ELBOW-STREET	1
	28584	ADAPTER-PIPE	1
2	117767	VALVE-SHUT-OFF	1
3	16185	ELBOW-MALE	1
4	16138	CONNECTOR-MALE	1
5	117776	TUBE ASSEMBLY	1
6	16708	SCREW-10-32 X 1/2	5
	15152	LOCKWASHER-3/16	1
	77610	WASHER	4
7	117772	TUBE ASSEMBLY	1
8	110488	SENDER-FUEL LEVEL	1
	111561	GASKET	1
9	14288	ELBOW-FEMALE	1
10	140452	CLAMP	2
	112444	PAD-FELT	3
11	63899 A	CAP-PROTECTO SEAL	1
	*137328	FILLER-PROTECTO-SEAL	1
12	61843	WASHER-RUBBER	1
13	19619	NIPPLE-LONG	1
	*137329	NIPPLE-SPECIAL	1

REF. NO.	HYSTER PART NO.	NAME OF PART 1 2 3 4	QTY.
14	117766	TANK-FUEL	1
	15314	PLUG-PIPE	2
15	15513	CAPSCREW-3/8 UNF X 3/4	4
	15156	LOCKWASHER-3/8	4
16	15831	NIPPLE-LONG	1
17	12821	ELBOW-STREET	1
18	61974AC	FUEL FILTER ASSEMBLY	1
	56459	GASKET-BOWL	1
	56460	ELEMENT	1
	56461	SPRING	1
	201572	RETAINER-BOWL	1
	56591	BOWL	1
	202466	MAGNET	1
19	12821	ELBOW-45	1
	117768 W	COVER-NOT ILLUS.	1

*FOR PORTABLE REFUELING STEVEDORING TRUCKS ONLY.

FUEL PUMP AND FILTER ASSEMBLY

FOR GAS ENGINE



120-105

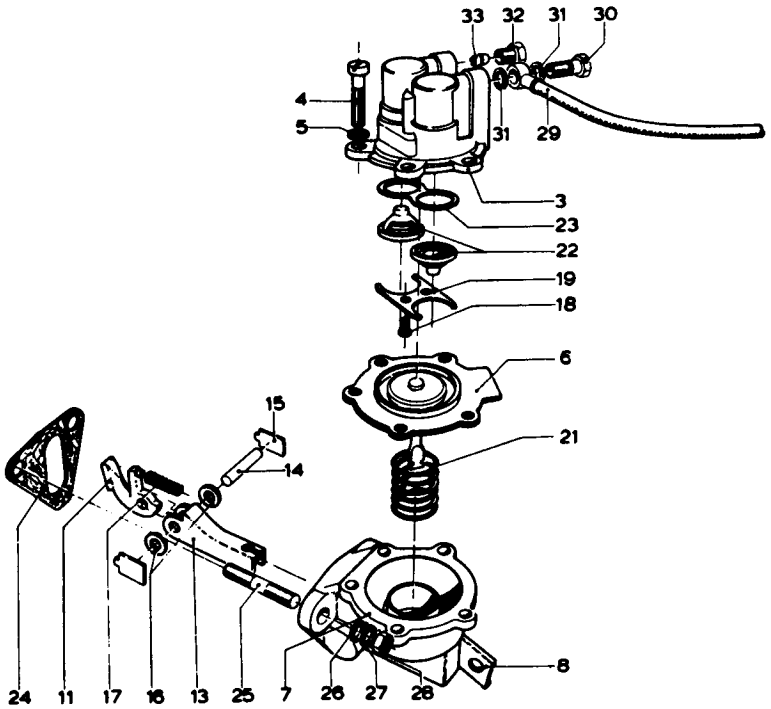
REF. NO.	HYSTER PART NO.	1 2 3 4 NAME OF PART	QTY.
2	108920 A	FUEL PUMP ASSEMBLY	1
3	51814	GASKET	1
6	16185	ELBOW-MALE	1
7	108099 A	LINE-PUMP TO CARB.	1
8	19831	NIPPLE-FILTER TO PUMP	1
9	12821	ELBOW-STREET, 45	1
10	61974AC	FUEL FILTER ASSEMBLY	1
	56459	GASKET-BOWL	1
	56460	ELEMENT-FILTER	1
	56461	SPRING	1
	201572	RETAINER-BOWL	1
	56591	BOWL	1
	202466	MAGNET	1

REF. NO.	HYSTER PART NO.	1 2 3 4 NAME OF PART	QTY.
11	16164	ELBOW-MALE	1
12	113869	TUBE ASSY.-FROM TANK	1
	□982602 A	TUBE ASSY.-FROM TANK	1
	108923 A	DIAPHRAGM KIT	1
	108922 A	REPAIR KIT-FUEL PUMP	1

□FOR B2E AND B2A SERIES TRUCKS ONLY.

LIFT PUMP ASSEMBLY

FOR 3-144 DIESEL ENGINE



120-107

REF. NO.	HYSTER PART NO.	NAME OF PART 1 2 3 4	QTY.
3	984319 A	LIFT PUMP ASSEMBLY	1
	139985	COVER AND VALVE ASSY.	1
	143749	COVER	1
4	¤	VALVE	2
5	¤	GASKET-VALVE	1
6	¤	DIAPHRAGM	1
7	.....	BODY AND LEVER ASSY.	1
8	138785	PRIMING LEVER SET	1
	983863	SPRING-PRIMING LEVER	1
11	*	ARM-ROCKER	1
13	¤983825	LINK	1
14	¤	PIN	1
15	¤	RETAINER	2
16	¤	WASHER	2
17	¤	SPRING	1
18	¤	SCREW	2
19	¤	PLATE-VALVE	1
21	983820	SPRING-DIAPHRAGM	1
22	983818	SCREW	5
23	983586	WASHER	5
24	¤	GASKET-MOUNTING	1

REF. NO.	HYSTER PART NO.	NAME OF PART 1 2 3 4	QTY.
25	984364	STUD	2
26	984371	WASHER	2
27	992744	LOCKWASHER	2
28	984365	NUT	2
29	982605 A	LINE-FROM PRE-FILTER	1
30	982996	BOLT-FITTING	1
31	981260	WASHER-SEALING	2
32	985222	NUT	1
33	16114	SLEEVE	1
	143750	DIAPHRAGM REPAIR KIT	1

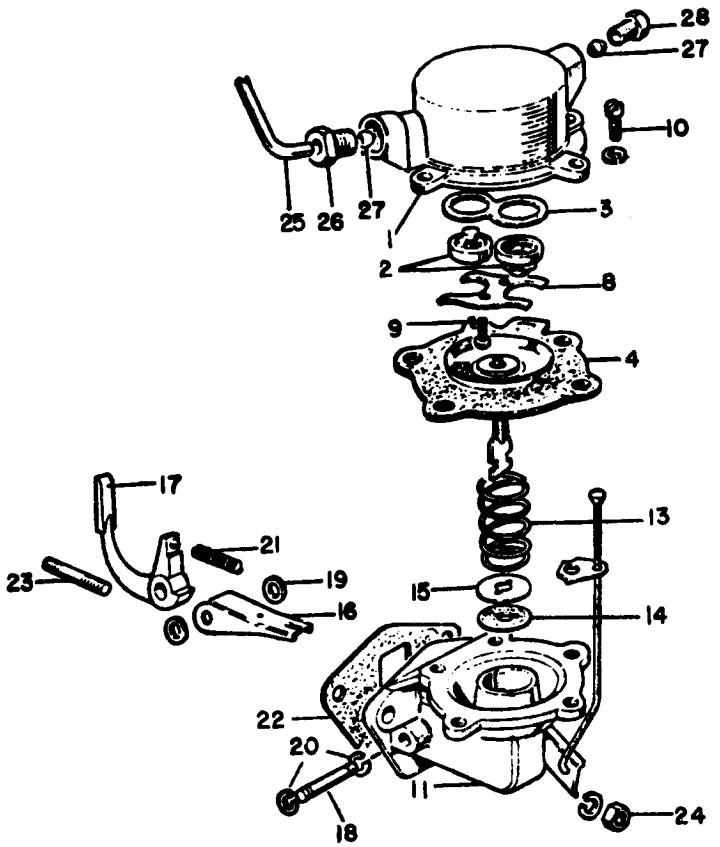
*INCLUDED IN MAJOR REPAIR KIT 986071A.

¤INCLUDED IN MINOR REPAIR KIT 986072A.

NOTE-MAJOR KIT INCLUDES MINOR KIT.

LIFT PUMP ASSEMBLY

FOR 3-152 DIESEL ENGINE



120-168

REF. NO.	HYSTER PART NO.	NAME OF PART 1 2 3 4	QTY.
	138568	LIFT PUMP ASSEMBLY	1
1	139985	COVER-PUMP	1
	143749	COVER	1
2	*	VALVE-INLET AND OUTLET	2
3	*	GASKET	1
4	*	DIAPHRAGM	1
8	*983580	PLATE-RETAINING	1
9	*	SCREW	2
10	983818	SCREW	5
	983586	WASHER	5
	.....	BODY-LIFT PUMP	1
11	138785	PRIMER PARTS SET	1
	983863	SPRING	1
13	983820	SPRING-RETURN	1
14	*	SEAL	1

REF. NO.	HYSTER PART NO.	NAME OF PART 1 2 3 4	QTY.
15	*	RETAINER	1
16	*	LINK	1
17	¤	ARM-ROCKER	1
18	*	PIN	1
19	*	WASHER	2
20	*	SNAP RING	2
21	*	SPRING	1
22	*	GASKET-PUMP TO BLOCK	1
23	983343	STUD-PUMP TO BLOCK	2
24	984383	NUT	2
	15155	LOCKWASHER	2
	133588	PIPE-PUMP TO FILTER	1
25	16118	NUT	1
	133589	CLIP	1
26	985222	NUT	1
27	16114	SLEEVE	3
28	985222	NUT	1
	139986	DIAPHRAGM KIT	1

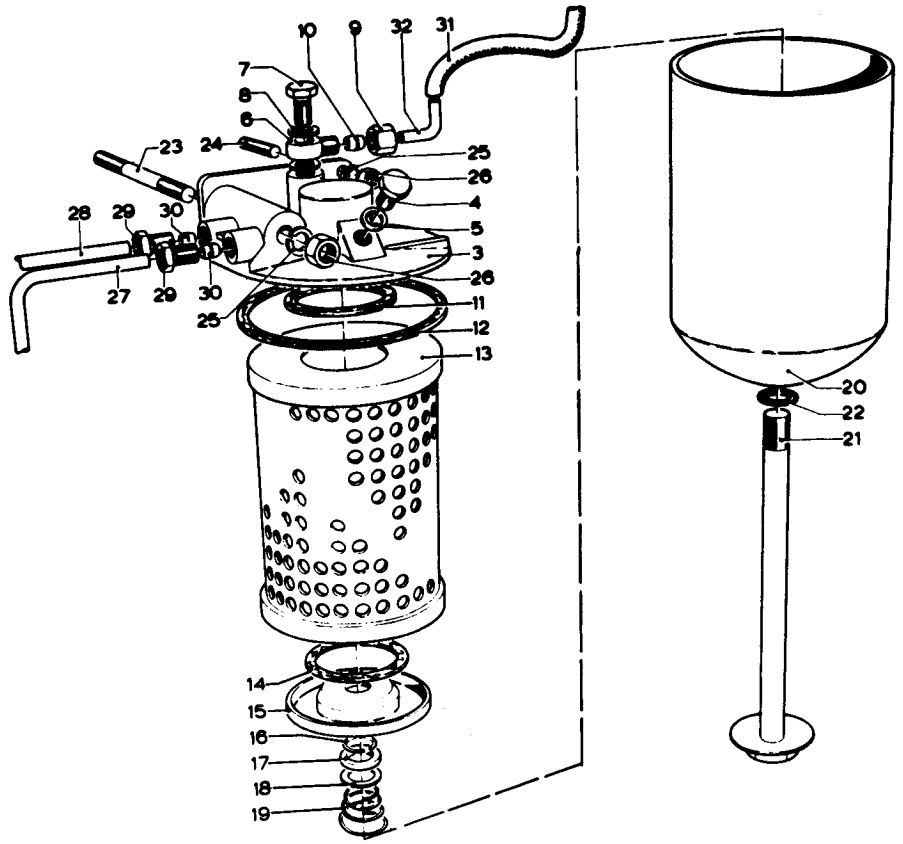
¤INCLUDED IN MAJOR REPAIR KIT 986071A.

*INCLUDED IN MINOR REPAIR KIT 986072A.

NOTE-MAJOR REPAIR KIT INCLUDES MINOR KIT.

FUEL OIL FILTER AND LINES

FOR 3-144 DIESEL ENGINE



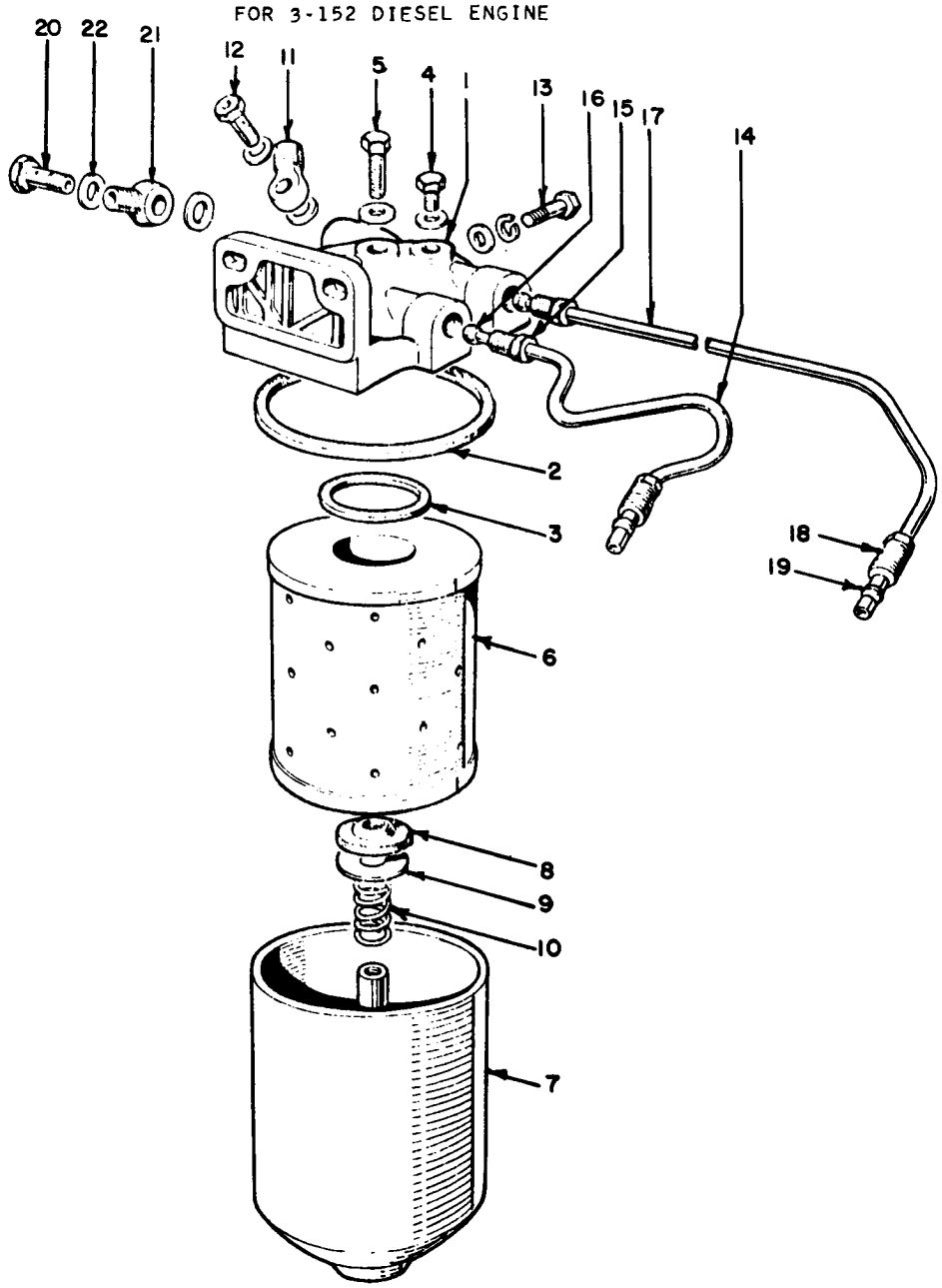
120-112

REF. NO.	HYSTER PART NO. 1 2 3 4	NAME OF PART	QTY.
	983870 A	FILTER ASSEMBLY-FUEL	1
3	984609	HEAD	1
4	983872	PLUG-AIR VENT	1
5	983873	WASHER-PLUG	1
6	983874	CONNECTION	1
7	983875	BOLT-BANJO	1
8	983876	WASHER-SEALING	2
9	983877	NUT	1
10	983878	SLEEVE	1
11	983879	GASKET-INNER	1
12	983091	GASKET-OUTER	1
13	985220	ELEMENT	1
14	983879	GASKET-PRESSURE PLATE	1
15	983884	PLATE-PRESSURE	1
16	983882	SNAP RING	1
17	983886	WASHER-FELT	1
18	983885	WASHER-PLAIN	1
19	983887	SPRING	1

REF. NO.	HYSTER PART NO. 1 2 3 4	NAME OF PART	QTY.
20	983880	CONTAINER	1
21	983881	BOLT-CENTER	1
22	983094	WASHER-RUBBER	1
23	983758	STUD-LONG	1
24	983759	STUD	1
25	15155	LOCKWASHER	2
26	15005	NUT	2
27	983890	PIPE-LIFT PUMP TO FILTER	1
28	983891	PIPE-FILTER TO INJEC. PUMP	1
29	985222	NUT	2
30	982232	SLEEVE	2
31	983892	PIPE-FILTER TO LEAK-OFF PIPE	1
32 {	986099	ADAPTER-PIPE, FILTER END	1
{	983867	ADAPTER-PIPE, TEE END	1

FUEL OIL FILTER AND LINES

FOR 3-152 DIESEL ENGINE



120-152

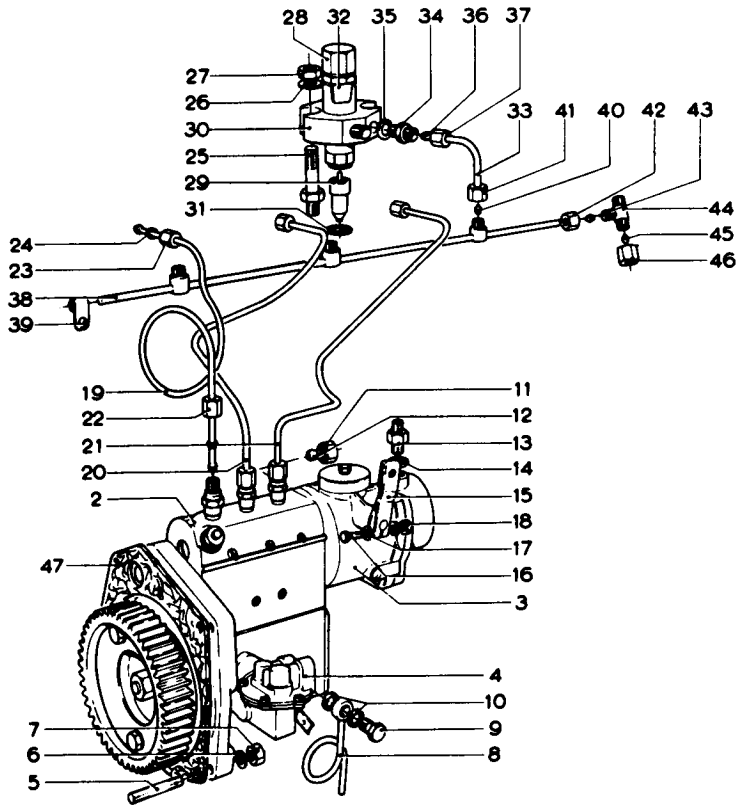
REF. NO.	HYSTER PART NO. 1 2 3 4	NAME OF PART	QTY.
	985224 A	FILTER ASSEMBLY-FUEL	1
1	985267 A	COVER ASSEMBLY	1
2	983561	GASKET	1
3	985276	SEAL-TOP	1
4	985270	PLUG	1
	985269	WASHER-SEAL	1
5	985273	BOLT	1
	985265	WASHER	1
	985220	ELEMENT-FILTER	1
7	985271	CONTAINER ASSEMBLY	1
8	985266	SEAL-LOWER	1
9	985275	PLATE-PRESSURE	1
10	985274	SPRING	1
11	980763	FITTING	1

REF. NO.	HYSTER PART NO. 1 2 3 4	NAME OF PART	QTY.
12	133591	BOLT	1
	101985	WASHER	2
	983310	CAPSCREW	2
13	992629	WASHER	2
	15155	LOCKWASHER	2
14	133592	PIPE-FILTER TO INJEC. PUMP	1
15	985222	NUT	2
16	16114	SLEEVE	2
17	133593	PIPE-PUMP TO FILTER RETURN	1
18	985222	NUT	2
19	51455	SLEEVE	2
20	982951	BOLT	1
21	133590	FITTING	1
22	992649	WASHER	2

FUEL INJECTION SYSTEM

FOR 3-144 DIESEL ENGINE

LAST USED ON ENGINE NO. 1116878



120-108

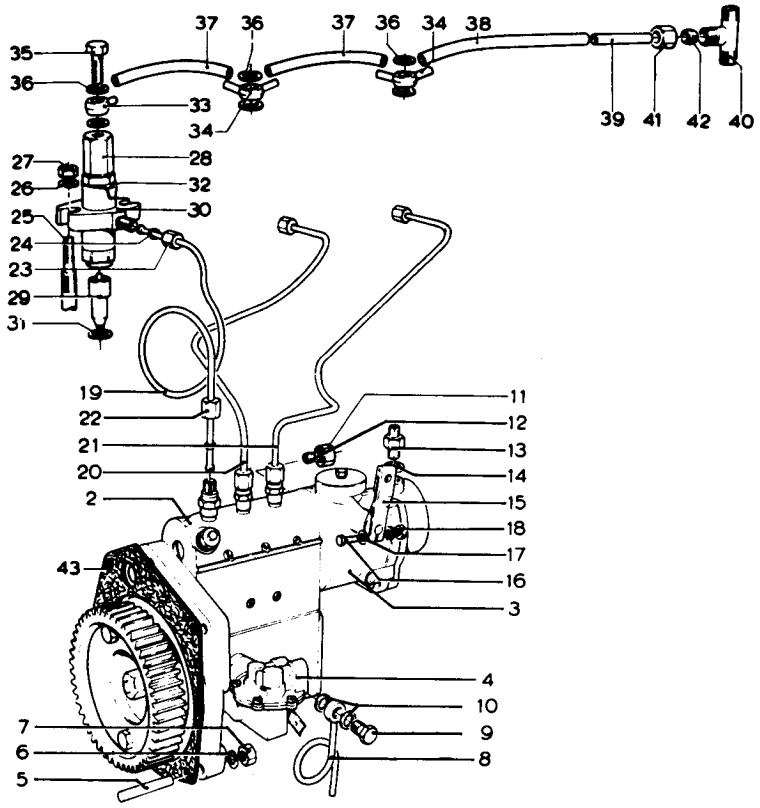
REF. NO.	HYSTER PART NO. 1 2 3 4	NAME OF PART	QTY.
2	983815 A	FUEL INJECTION PUMP	1
3	985219 A	GOVERNOR ASSEMBLY	1
4	984319 A	LIFT PUMP ASSEMBLY	1
5	983303	STUD	5
6	15155	WASHER	5
7	15005	NUT	5
8	983995	PIPE-DRAIN	1
9	986097	BOLT	1
10	980685	WASHER	2
11	983320	NUT-PUMP INLET	1
12	16114	SLEEVE	1
13	992784	UNION-GOVERNOR	1
14	984018	WASHER-UNION	1
15	980677	LEVER-STOP CONTROL	1
16	983992	BOLT	1
17	980680	WASHER	1
18	983993	NUT	1
19	985580 A	PIPE-INJECTION, NO.1 ATOMIZER	1
20	985581 A	PIPE-INJECTION, NO.2 ATOMISER	1
21	985582 A	PIPE-INJECTION, NO.3 ATOMISER	1
22	982970	NUT-PUMP END	3
23	982971	NUT-ATOMISER END	3
24	962969	NIPPLE	6
25	984321	STUD-HOLDER TO CYL. HEAD	6
26	992630	WASHER	6

REF. NO.	HYSTER PART NO. 1 2 3 4	NAME OF PART	QTY.
27	984314	NUT	6
28	983866 A	ATOMISER AND HOLDER ASSY.	3
29	991513	NOZZLE	3
30	983867	HOLDER ASSEMBLY	3
31	990615	WASHER	3
32	983470	WASHER-TAB	3
33	983867	PIPE	3
34	983868	UNION	3
35	992669	WASHER	3
36	51455	SLEEVE	3
37	16193	NUT	3
38	984089	PIPE-MAIN LEAK-OFF	1
39	984091	CLIP	2
40	51455	SLEEVE	3
41	16193	NUT	3
42	983320	NUT	1
43	16114	SLEEVE	1
44	984092	TEE	1
45	51455	SLEEVE	2
46	16193	NUT	2
47	983394	GASKET	1

FUEL INJECTION SYSTEM

FOR 3-144 DIESEL ENGINE

FIRST USED ON ENGINE NO. 1116879

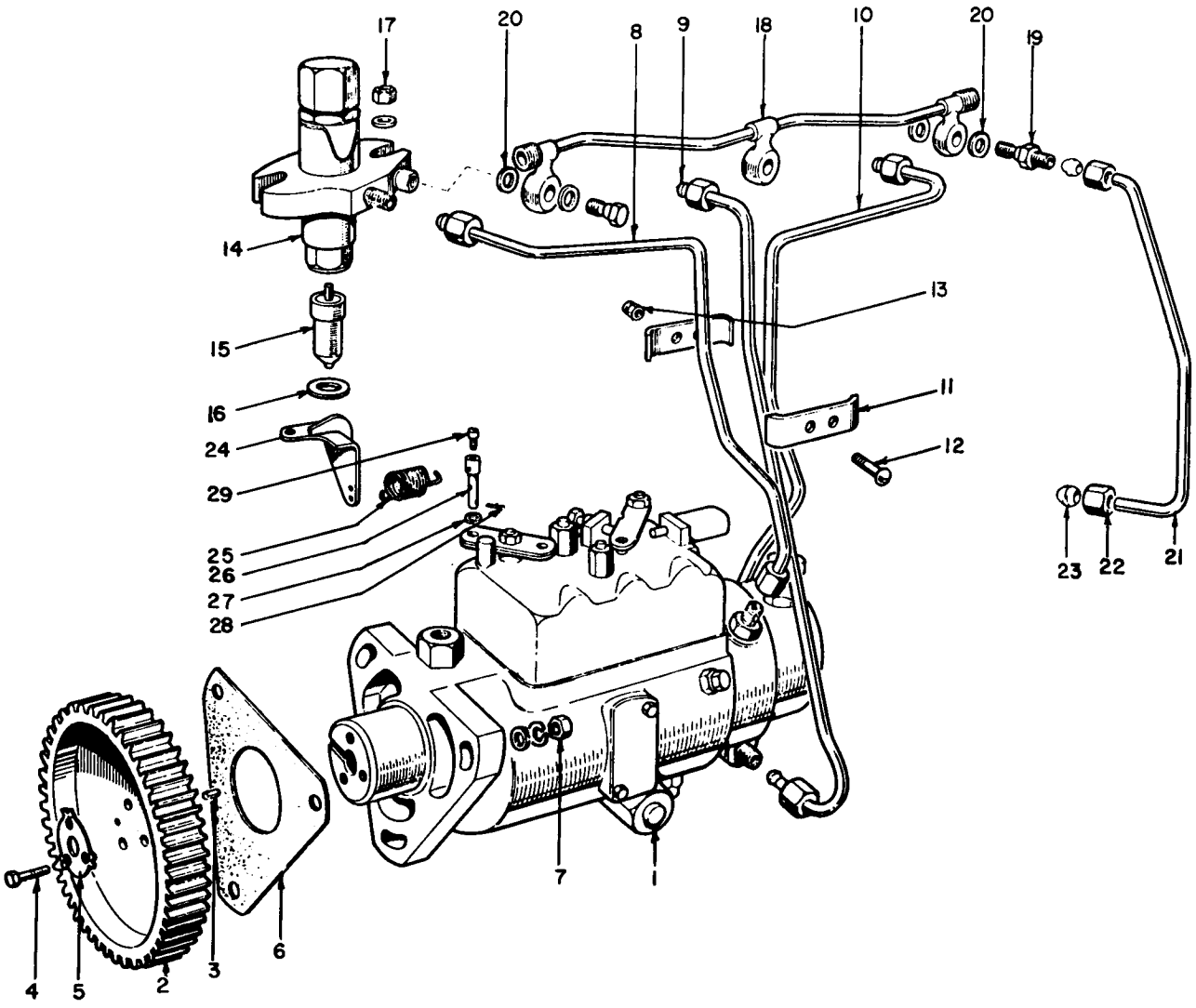


120-109

REF. NO.	HYSTER PART NO. 1 2 3 4	NAME OF PART	QTY.
2	983815 A	FUEL INJECTION PUMP	1
3	985219 A	GOVERNOR ASSEMBLY	1
4	984319 A	LIFT PUMP ASSEMBLY	1
5	983303	STUD	5
6	15155	WASHER	5
7	15005	NUT	5
8	983995	PIPE-DRAIN	1
9	986097	BOLT	1
10	980685	WASHER	2
11	983320	NUT-PUMP INLET	1
12	16114	SLEEVE	1
13	992784	UNION-GOVERNOR	1
14	984018	WASHER-UNION	1
15	980677	LEVER-STOP CONTROL	1
16	983992	BOLT	1
17	980680	WASHER	1
18	983993	NUT	1
19	985580 A	PIPE-INJECTION, NO.1 ATOMISER	1
20	985581 A	PIPE-INJECTION, NO.2 ATOMISER	1
21	985582 A	PIPE-INJECTION, NO.3 ATOMISER	1
22	982970	NUT-PUMP END	3
23	982971	NUT-ATOMISER END	3
24	982969	NIPPLE	6
25	984321	STUD-HOLDER TO CYL. HEAD	6
26	992630	WASHER	6
27	984314	NUT	6
28	985298 A	ATOMISER AND HOLDER ASSEMBLY	3
29	991513	NOZZLE	3
30	983479	HOLDER-ATOMISER	3
31	990615	WASHER	3
32	982431	WASHER-TAB	3
33	982373	CONNECTION	1
34	982372	CONNECTION	2
35	983340	BOLT	3
36	985567	WASHER	6
37	982374	PIPE-LEAK-OFF, SHORT	2
38	985296	PIPE-LEAK-OFF, LONG	1
39	985240	ADAPTER-PIPE	1
40	985244	TEE	1
41	16193	NUT	3
42	51455	SLEEVE	3
43	983394	GASKET	1

FUEL INJECTION SYSTEM

FOR 3-152 DIESEL ENGINE



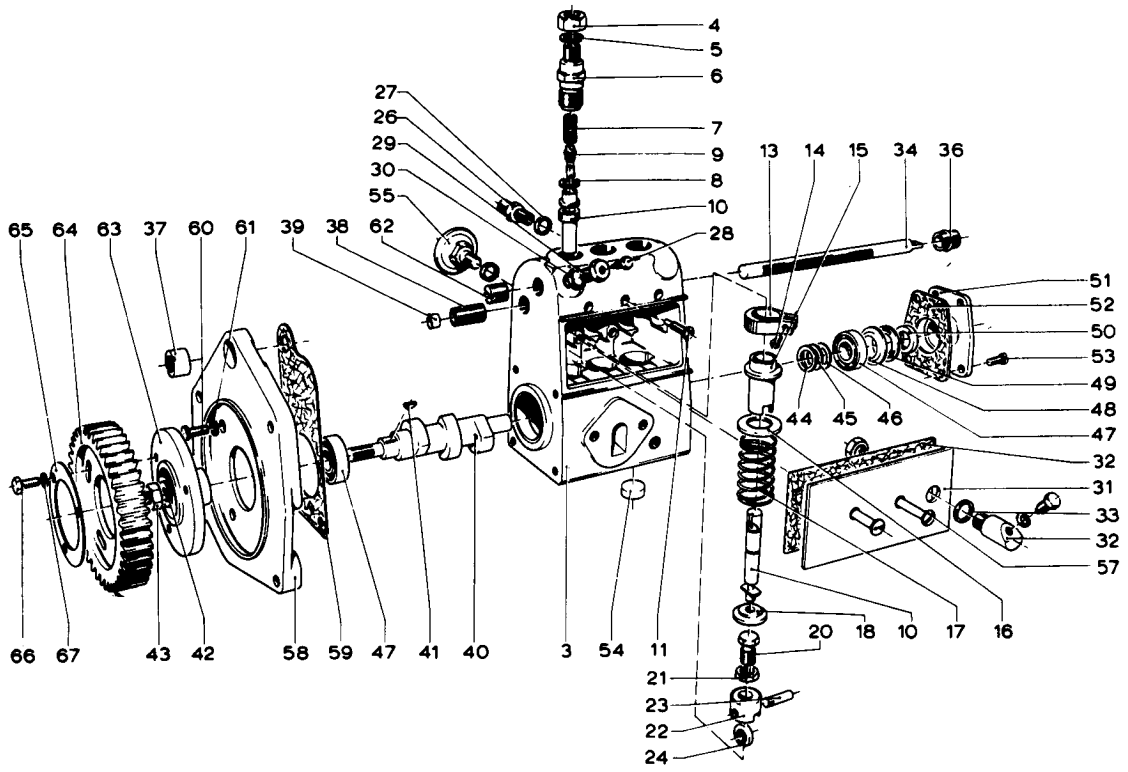
120-153

REF. NO.	HYSTER PART NO.	NAME OF PART 1 2 3 4	QTY.
1	133594	PUMP ASSEMBLY-INJECTION	1
2	133595	GEAR-DRIVE	1
3	133596	DOWEL	1
4	982300	CAPSCREW	3
5	133597	WASHER-TAB	1
6	982352	GASKET-HOUSING	1
7	15005	NUT	3
	992629	WASHER	3
	15155	LOCKWASHER	3
8	133598	PIPE SET-INJECTION	1
	133599	PIPE-INJECTION, NO.1 CYL.	1
9	133600	PIPE-INJECTION, NO.2 CYL.	1
10	133601	PIPE-INJECTION, NO.3 CYL.	
11	991838	CLIP-CLAMPING	2
12	984335	BOLT	2
13	983993	NUT	2
14	133602	ATOMISER ASSEMBLY	3
	133603	HOLDER	1

REF. NO.	HYSTER PART NO.	NAME OF PART 1 2 3 4	QTY.
15	983480	NOZZLE	1
16	990615	WASHER	1
17	17158	NUT	6
	992630	WASHER	6
18	133604	PIPE-LEAK-OFF	1
	133605	BALL-SEALING	1
	16193	NUT-RETAINING	1
19	983575	CONNECTION	1
20	985567	WASHER	6
21	133616	PIPE-LEAK-OFF	1
22	16193	NUT	2
23	51455	SLEEVE	2
24	133565	BRACKET-STOP CONTROL	1
25	133608	SPRING	1
26	133609	PIN-STOP LEVER	1
27	15156	WASHER	1
28	133610	COTTER	1
29	99631	SCREW	1

FUEL INJECTION PUMP ASSEMBLY

FOR 3-144 DIESEL ENGINE



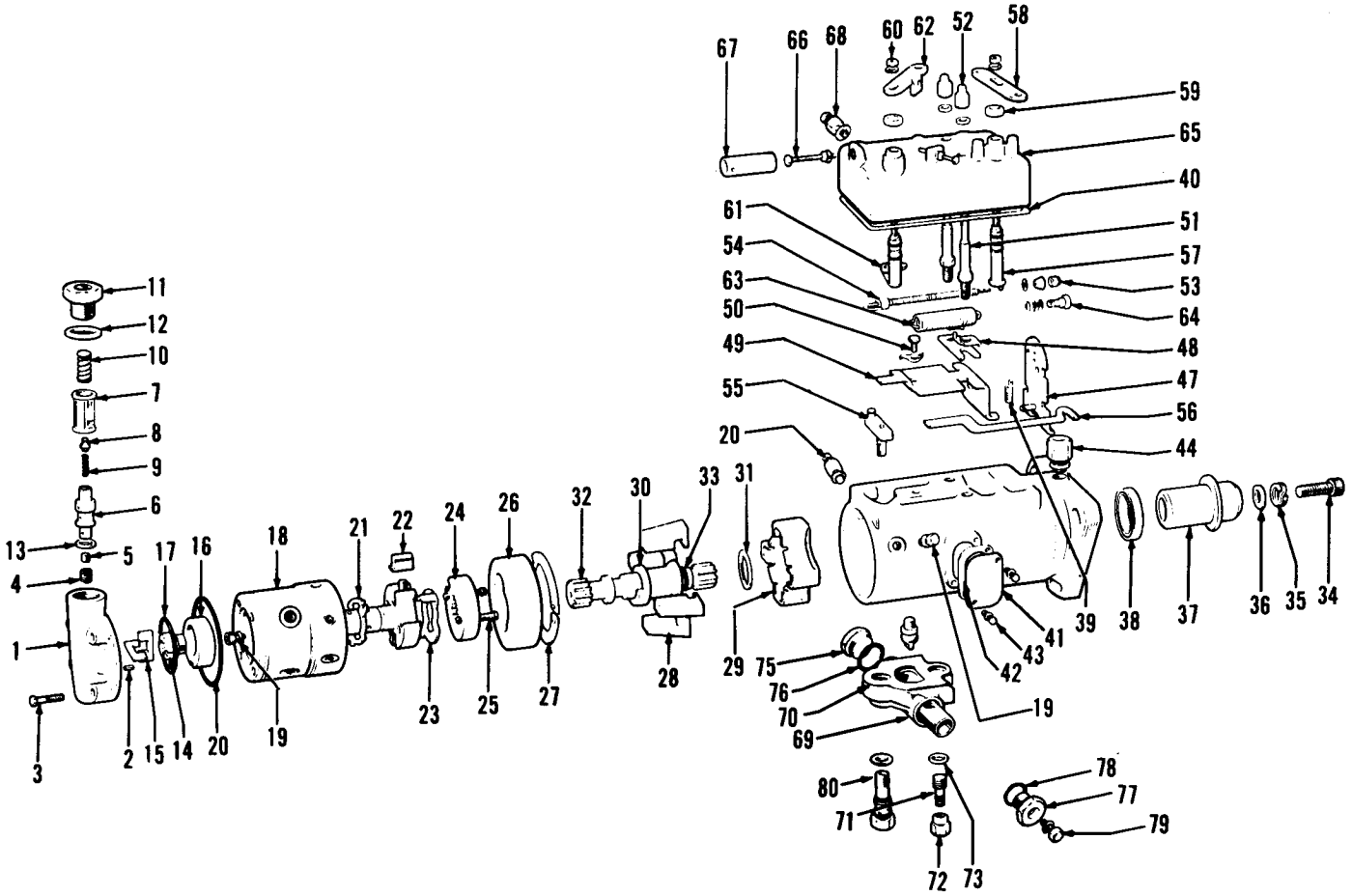
120-154

REF. NO.	HYSTER PART NO. 1 2 3 4	NAME OF PART	QTY.
	983815 A	FUEL INJECTION PUMP ASSEMBLY	1
3	•••••	HOUSING-PUMP	1
4	992610	NUT	1
5	992668	WASHER	1
6	983536	HOLDER	1
7	980130	SPRING-VALVE	1
8	983537	GASKET	1
9	984342	VALVE-DELIVERY	1
10	984343	ELEMENT	1
11	983539	PIN-LOCKING	3
	986188	CUP	3
13	984369	QUADRANT	3
14	980119	SCREW-ADJUSTING	3
15	984370	SLEEVE-CONTROL	3
16	980168	PLATE-UPPER	3
17	980133	SPRING	3
18	980132	PLATE-LOWER	3
20	983545	TAPPET ASSEMBLY	1
	980139	SCREW	1
21	992795	NUT-LOCK	1
22	983600	GUIDE	1
23	980156	PIN-ROLLER	1
25	980138	ROLLER	1
	980140	BUSHING	1
26	984344	ADAPTER-UNION	1
27	984346	GASKET-UNION	1
28	984251	SCREW-AIR VENT	1
29	984347	BODY-AIR VENT	1
30	992801	GASKET-AIR VENT	1
31	986102 A	COVER ASSEMBLY	1
	984355 A	COVER-TYPE	1
32	980155	PLUG	1
33	986017	WASHER	1
34	984351	ROD-CONTROL	1
	980146	SCREW-LOCATING	1

REF. NO.	HYSTER PART NO. 1 2 3 4	NAME OF PART	QTY.
36	980142	BUSHING-CONTROL ROD	1
37	984353	RING-LOCKING	1
38	984352	SLEEVE	1
39	986103	PLUG-SLEEVE	1
40	984358	CAMSHAFT	1
41	986075	KEY	1
42	992794	WASHER	1
43	992796	NUT	1
44	980121	SHIM-.015	AR
45	980122	SHIM-.030	AR
46	980123	SHIM-.010	AR
47	980171	BEARING-BALL	2
48	980153	SHIM-OIL SEAL	1
49	980147	THROWER-OIL	1
50	980152	SEAL-OIL	1
51	984359	PLATE-END	1
52	984360	GASKET	1
53	984361	SCREW	4
54	983669	CAP-BASE	3
55	984350	DAMPER-INLET	1
56	984356	GASKET	1
57	984357	SCREW	1
58	984366	FLANGE-MOUNTING	1
59	984368	GASKET-MOUNTING	1
60	984367	SCREW	4
61	992672	LOCKWASHER	4
62	984345	PLUG-FUEL GALLERY	1
63	983989	ADAPTER	1
64	983990	GEAR-PUMP DRIVE	1
65	983991	PLATE-GEAR RETAINING	1
66	983310	CAPSCREW	3
67	992657	LOCKWASHER	3
	985219 A	GOVERNOR ASSEMBLY } NOT	1
	984319 A	LIFT PUMP ASSY. } ILLUS.	1

FUEL INJECTION PUMP ASSEMBLY

FOR 3-152 DIESEL ENGINE



120-155

REF. NO.	HYSTER PART NO.	NAME OF PART 1 2 3 4	QTY.
	133594	INJECTION PUMP ASSY.-FUEL	1
1	985699	PLATE-END	1
2	984204	PIN-LOCATING	1
3	985280	CAPSCREW	4
4	984206	SPRING-RETAINING	1
5	984209	PISTON-REGULATING	1
6	134911	SLEEVE	1
7	984477	FILTER	1
8	134912	PLUG	1
9	134913	SPRING	1
10	984474	SPRING	1
11	985702	CONNECTOR	1
12	*	WASHER-INLET	1
13	*	WASHER-SLEEVE	1
14	985704	ROTOR-PUMP	1
15	984300	BLADE-PUMP	2
16	984223	LINER-PUMP	1
17	*	SEAL	1

REF. NO.	HYSTER PART NO.	NAME OF PART 1 2 3 4	QTY.
	134914	HEAD AND ROTOR ASSY.	1
	984248	SCREW-PLUGGING	1
	984212	WASHER	1
	984253	FITTING	1
18	984236	STUD	2
	986000	CONNECTION	1
	*	WASHER	6
	984265	NUT-DELIVERY UNION	3
	992668	WASHER	3
19	984224	CAPSCREW	1
	*	WASHER	1
20	134915	VENT ASSEMBLY	1
	*	WASHER	1
21	984255	PLATE-BOTTOM	1
22	984256	SHOE-ROLLER	1
	984231	ROLLER	1
23	984233	PLATE-TOP	1
24	985553	PLATE-DRIVE	1

FUEL INJECTION SYSTEM PUMP ASSEMBLY

FOR 3-152 DIESEL ENGINE

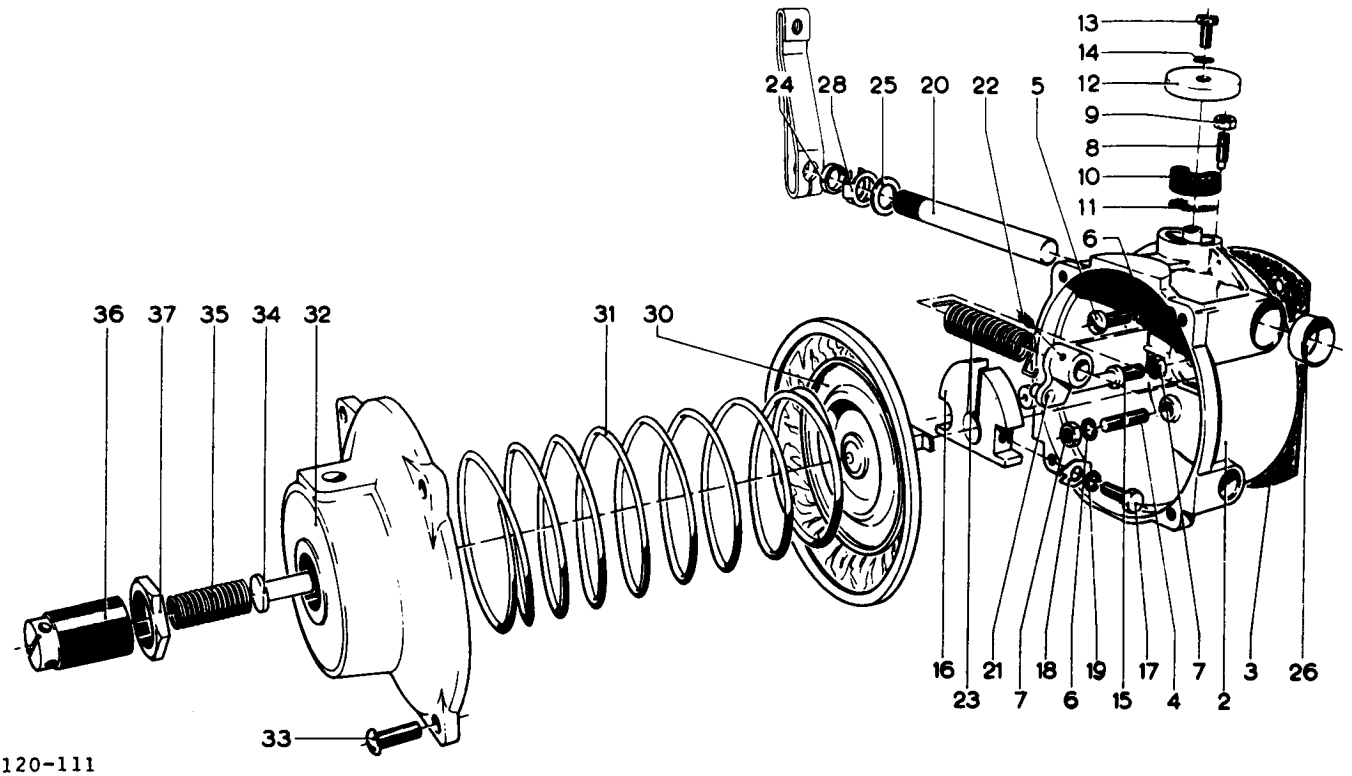
REF. NO.	HYSTER PART NO.	NAME OF PART 1 2 3 4	QTY.
25	984257	SCREW	2
26	134916	RING-CAM	1
27	134917	RING-TIMING	1
28	134918	WEIGHT-GOVERNOR	6
29	134919	RETAINER-WEIGHT	1
30	134920	SLEEVE-THRUST	1
31	134921	WASHER-THRUST	1
32	134922	SHAFT-DRIVE	1
33	*	SEAL	1
34	134923	SCREW-DRIVE SHAFT	1
35	134924	WASHER-SPRING	1
36	134925	WASHER-SUPPORT	1
37	134926	HUB-DRIVE	1
38	*	SEAL	1
39	134927	HOUSING-PUMP	1
40	*	GASKET-HOUSING	1
41	134928	PLATE-COVER	1
42	*	GASKET	1
43	984262	CAPSCREW	2
	984217	LOCKWASHER	2
44	134929	CONNECTOR-DRAIN	1
	*	WASHER	1
45	134930	ARM-GOVERNOR	1
46	134931	SPRING-GOVERNOR	1
47	134932	PLATE-KEEPER	1
48	134933	WASHER-TAB	2
49	134934	BRACKET-CONTROL	1
50	134935	CAPSCREW	1
	134936	WASHER-TAB	1
51	134937	STUD-COVER	2
52	134938	NUT	2
	*	WASHER	2
53	134939	NUT-LINKAGE	1
	134940	WASHER	1
	134941	WASHER	1
54	134942	HOOK-LINKAGE	1
	134943	SPRING-LINKAGE	1
	134944	RETAINER	1
55	134945	VALVE-METERING	1
56	134946	BAR-SHUT-OFF	1

REF. NO.	HYSTER PART NO.	NAME OF PART 1 2 3 4		QTY.
57	134947	SHAFT		1
	*	SEAL		1
58	134948	LEVER		1
59	134949	CAP		1
60	984243	NUT		2
	984217	LOCKWASHER		2
61	134950	SHAFT-THROTTLE		1
62	134951	ARM-THROTTLE		1
63	134952	SPRING-GOVERNOR		1
64	134954	GUIDE-SPRING		1
	134953	SPRING		1
	134955	CONTROL COVER		1
	134960	SHAFT-ADJUSTMENT	AUTO.	1
65	134961	NUT-LOCKING	ADVANCE	1
	134962	WASHER		1
	134963	CAP-SEALING		1
	134956	SCREW-ADJUSTING		2
66	984243	NUT-ADJUSTING		3
	134957	WASHER		1
67	134958	SLEEVE-LOCKING		1
68	134959	SCREW ASSY.-VENT		1
	*	WASHER		1
69	134964	HOUSING AND PISTON		1
70	*	GASKET-HOUSING		1
71	985627	STUD-HOUSING		1
72	985628	NUT-CAP		1
73	*	WASHER		1
74	134965	SCREW-SPECIAL		1
75	134966	PLUG-PISTON		1
76	134967	SEAL		1
77	134968	CAP-PISTON		1
78	*	SEAL		1
79	134969	CAPSCREW		1
	*	WASHER		1
	134970	STUD		1
	134971	WASHER-SLIDE		1
80	134972	STOP-MAXIMUM ADVANCE		1
	134973	SPRING-STOP		1
	134974	WASHER		1
	134975	WASHER-LOCATING		1

*INCLUDED IN GASKET KIT 135140.

GOVERNOR ASSEMBLY

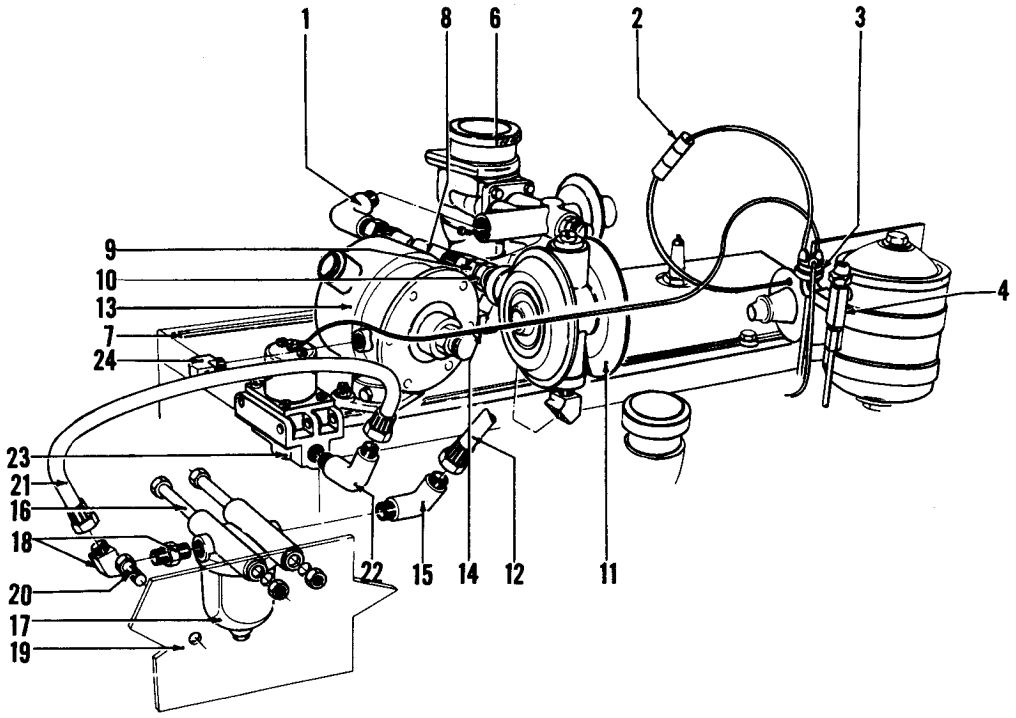
FOR 3-144 DIESEL ENGINE



120-111

REF. NO.	HYSTER PART NO.	NAME OF PART 1 2 3 4	QTY.
	985219 A	GOVERNOR ASSEMBLY	1
2	985524	HOUSING	1
3	985525	GASKET	1
4	984598	STUD	2
5	985529	SCREW	1
6	992672	WASHER	3
7	992804	NUT	2
8	985542	SCREW-FUEL	1
9	992748	NUT-LOCKING	1
10	983534	PAD-BREATHER	1
11	983535	STRAINER-BRASS	1
12	983532	CAP-BREATHER	1
13	985541	BOLT	1
14	992672	LOCKWASHER	1
15	985544	BOLT-GUIDE	1
16	985543	BLOCK-GUIDE	1
17	985545	SCREW-GUIDE BLOCK	1
18	985546	WASHER-TAB	1
19	984216	WASHER-PLANE	1
20	985533	SPINDLE	1
21	985531	PAWL	1
22	983531	PIN-GROOVED	1
23	985532	SPRING	1
24	985534	WASHER	1
25	985535	WASHER-SEALING	1
26	985536	CAP-SPINDLE	1
28	983527	CLIP-SPRING	1
30	985526	DIAPHRAGM	1
31	985527	SPRING-MAIN	1
32	985528	COVER-GOVERNOR	1
	986098	SHIM-COVER	AR
33	983523	SCREW	4
34	985550	PIN-CONTROL	1
35	985538	SPRING-IDLING STOP	1
36	985539	BODY-IDLING STOP	1
37	985540	NUT-LOCKING	1

L. P. G. EQUIPMENT



120-169

REF. NO.	HYSTER PART NO.	NAME OF PART 1 2 3 4	QTY.
1	14350	ELBOW-UNION, 45	1
2	121344 A	WIRE AND FUSE ASSY.	1
	#121450 A	WIRE AND FUSE ASSY.	1
	21778	FUSE	1
3	101810	VACUUM SWITCH	1
	% 98383	VACUUM SWITCH	1
	% 16199	FITTING-MALE	1
	% 16151	ELBOW-STREET	1
	52641	BOOT } FOR	2
	15174	WASHER-1/4 } L.P.G.	2
4	15324	COUPLING-NIPPLE	1
	% 16199	FITTING-PIPE	1
	19520	ELBOW-STREET, 45	1
	% 16151	ELBOW-STREET	1
6	200183 A	CARBURETOR ASSEMBLY	1
	113009	HOSE-AIR CLEANER	1
	104105	SLEEVE	1
	112989	CLAMP-HOSE	2
7	116542	HEAD-CYLINDER	1
	109176	GASKET-CYLINDER HEAD	1
	101793	PLATE-COVER, FUEL PUMP	1
	51814	GASKET-FUEL PUMP	1
8	115966	TUBE ASSEMBLY	1
9	14312	UNION-45	1
10	56944	LOCKNUT	2
11	56933 A	REGULATOR ASSEMBLY	1
	17314	ELBOW-STREET, 45	1
	16271	NIPPLE-45	1
12	111596	HOSE	1
13	113015 A	VAPORIZER ASSEMBLY	1
	% 99424 A	VAPORIZER ASSEMBLY	1
	38942	STUD-5/16 UNF	2
	15005	NUT-5/16 UNF	2
	15155	LOCKWASHER-5/16	2
	15453	NIPPLE-LONG	1
	15451	ELBOW-STREET	1
14	115979	WIRE ASSEMBLY	1
	%111181	WIRE ASSEMBLY	1
15	16863	ELBOW-45	1
16	15619	CAPSCREW-1/4 UNF X 2 1/2	2
	15004	NUT-1/4 UNF	2
	15154	LOCKWASHER-1/4	2

REF. NO.	HYSTER PART NO.	NAME OF PART 1 2 3 4	QTY.
17	113017 A	FILTER ASSEMBLY	1
18	17314	ELBOW-STREET, 45	1
	16134	CONNECTOR-MALE	1
19	115965	PLATE-MOUNTING	1
	@983634	PLATE-MOUNTING	1
20	15508	CAPSCREW-3/8 UNF X 1	2
	15576	WASHER-PLAIN, 3/8	2
21	113134	HOSE	1
22	14358	ELBOW-MALE, 45	1
23	101808AB	MAGNETIC LOCKOFF	1
	#121037 A	MAGNETIC LOCKOFF	1
	52641	BOOT (FOR L.P.S. TRUCKS ONLY)	1
	15174	WASHER-1/4	1
24	17314	ELBOW-STREET	1
	12869	NIPPLE-LONG	1
	16708	SCREW-10-28 X 1/2	1
	*116314	HANDLE-HOOD	1
	* 16515	SCREW-1/4 UNF X 7/8	4
	* 15174	WASHER-PLAIN, 1/4	4
	* 15154	LOCKWASHER-1/4 NOT	4
	* 15004	NUT-1/4 UNF ILLUS.	4
	233136	LATCH-HOOD	2
	@ 2009	CATCH-HEAD	2
	16708	SCREW-10-28 UNF X 1/2	4
	15142	WASHER-PLAIN, 7/32	4
	15152	LOCKWASHER-3/16	4
	15002	NUT-28 UNF	4
	67658	PLUG-BUTTON	1

NOTE-TRUCKS AFTER SERIAL NO. B2D-4739 AND B2A-2039 ILLUSTRATED.

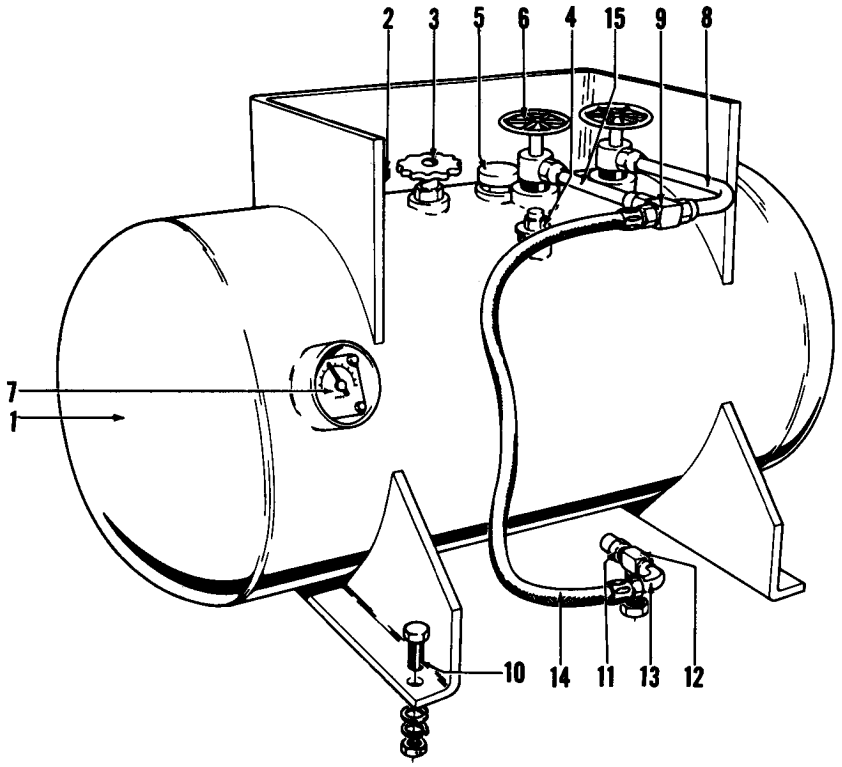
*FOR A.S.M.E. TANK APPLICATION ONLY.

#FIRST USED ON SERIAL NO. B2D-3247.

@FOR B2E B2A SERIES TRUCKS ONLY.

%FIRST USED ON SERIAL NO. B2D-4739 AND B2A-2039.

L. P. G. TANK ASSEMBLY - A. S. M. E.

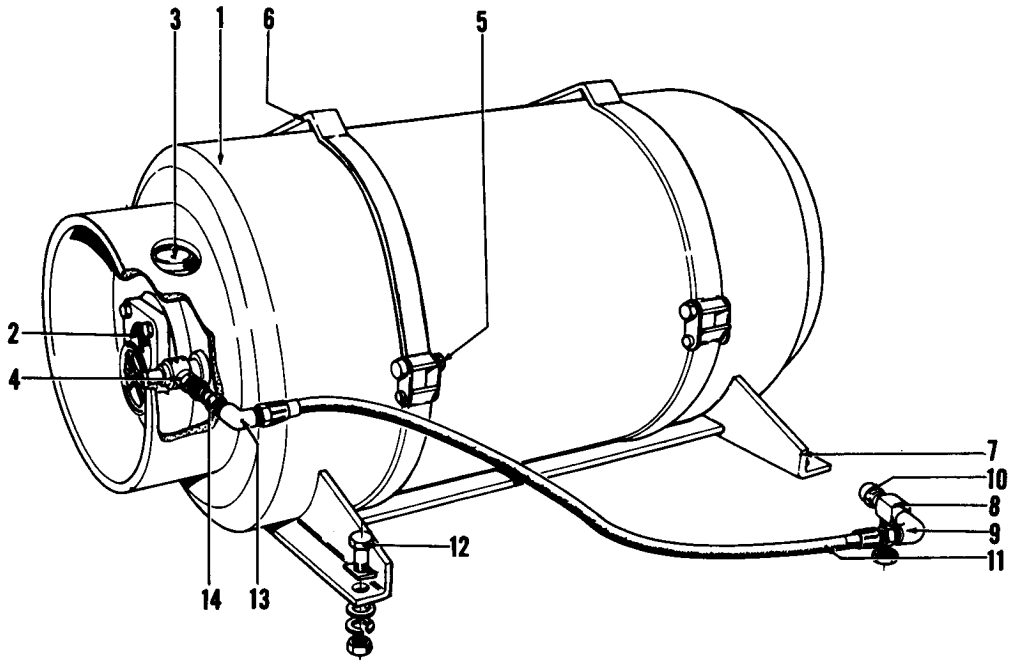


120-170

REF. NO.	HYSTER PART NO.	NAME OF PART 1 2 3 4	QTY.
1	116371 A	TANK ASSEMBLY-44 LBS.	1
2	200806	VALVE-VAPOR RETURN	1
3	200807	VALVE-FILLER	1
4	200809	GAUGE-LIQUID LEVEL	1
5	200808 A	RELIEF VALVE-INTURNAL	1
6	200805	VALVE-VAPOR AND LIQUID	2
7	200917	GAUGE-FUEL	1
8	114013	TUBE ASSEMBLY	1
9	14382	TEE-45	1

REF. NO.	HYSTER PART NO.	NAME OF PART 1 2 3 4	QTY.
10	15532	CAPSCREW-3/8 UNF X 1 1/4	4
	15156	LOCKWASHER-3/8	4
	15176	WASHER-PLAIN, 3/8	4
	15176	WASHER-PLAIN,3/8	4
	15194	WASHER-BEVEL	4
11	101809	HYDROSTATIC RELIEF VALVE	1
12	115967	TEE-PIPE	1
13	14358	ELBOW-MALE, 45	1
14	107612	HOSE	1

L. P. G. TANK ASSEMBLY - I. C. C.

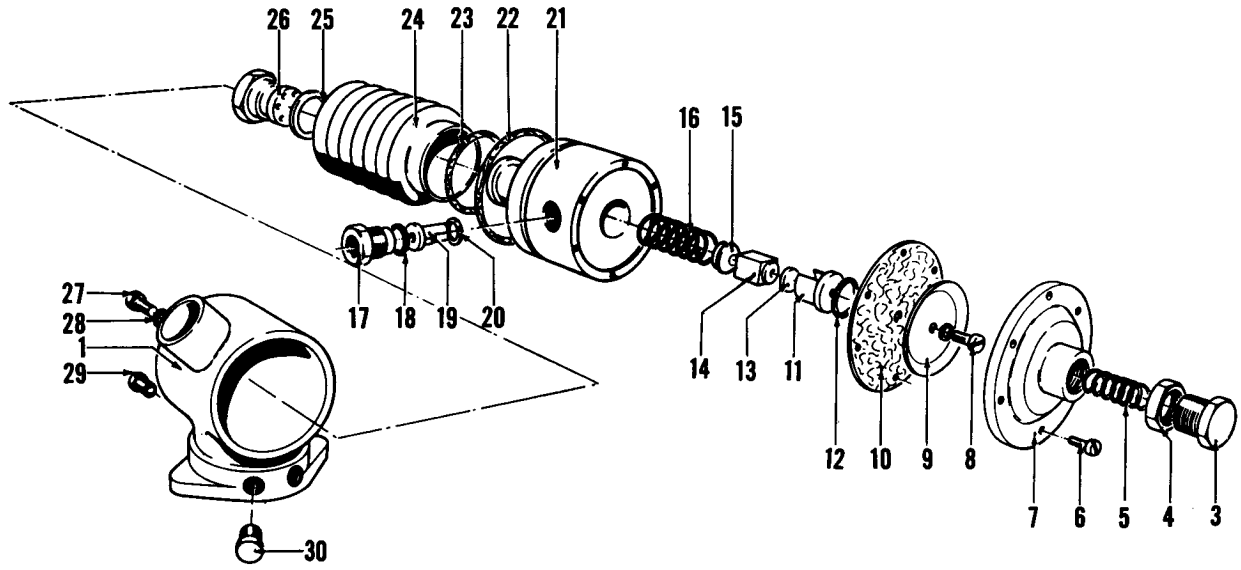


120-171

REF. NO.	HYSTER PART NO.	1 2 3 4 NAME OF PART	QTY.
1	101812AB	TANK ASSEMBLY-33 1/2 LBS.	1
2	56942 A	GAUGE-FUEL	1
3	200170	RELIEF VALVE	1
	200171	ADAPTER	1
	200172	RAIN CAP	1
4	233908	VALVE-SHUT-OFF	1
5	117107 A	BRACKET ASSEMBLY	1
	108293	LINK	8
	15746	CAPSCREW-1/4 UNF X 3/4	4
	15024	NUT-JAM, 1/4 UNF	4
	108290 W	LEVER ARM	2
	108294 W	BOLT-TEE	2
	15056	NUT-3/8 UNC	4
6	108536 W	STRAP-UPPER	2

REF. NO.	HYSTER PART NO.	1 2 3 4 NAME OF PART	QTY.
7	117111 W	SUPPORT-TANK	1
8	115967	TEE-FITTING	1
9	14358	ELBOW-MALE, 45	1
10	101809	HYDROSTATIC RELIEF VALVE	1
11	115757	HOSE	1
12	15532	CAPSCREW-3/8 UNC X 1 1/4	4
	15156	LOCKWASHER-3/8	4
	15176	WASHER-PLAIN, 3/8	4
	15194	BEVEL-WASHER	4
	15006	NUT-3/8 UNC	4
13	16863	ELBOW-MALE, 45	2
14	56879 A	DISCONNECT ASSEMBLY	1
	101811	FEMALE END	1
	56878	MALE END-ON TANK	1

L. P. G. VAPORIZER ASSEMBLY



207-44

KEY
A-LAST USED ON SERIAL NO. B2D-4738 AND B2A-2038.
B-FIRST USED ON SERIAL NO. B2D-4739 AND B2A-2039.

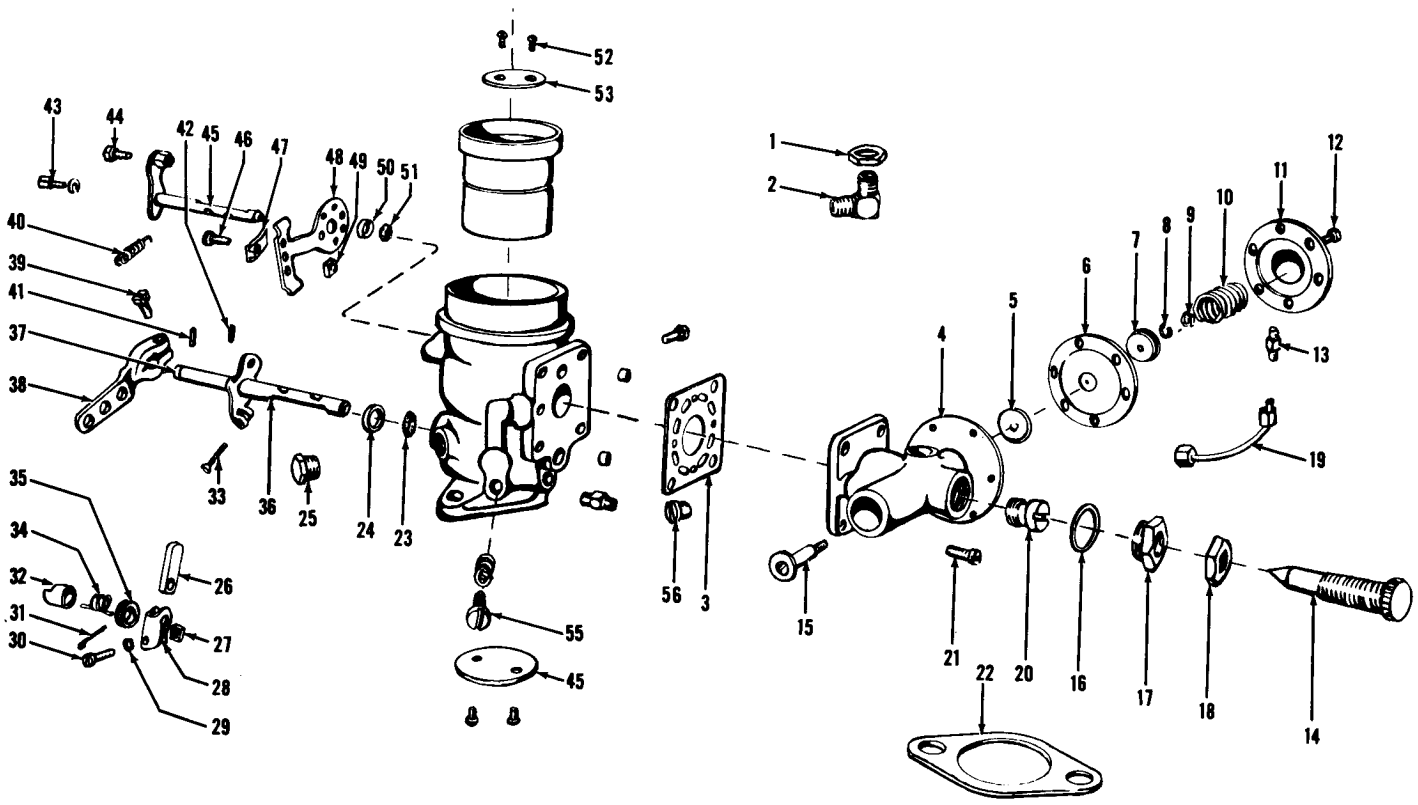
REF. NO.	HYSTER PART NO. 1 2 3 4	NAME OF PART	QTY. A	QTY. B
	113015 A	VAPORIZER ASSEMBLY	1	••
	99424 A	VAPORIZER ASSEMBLY	••	1
1	56915	WATER JACKET ASSY.	1	1
	126984	VAPORIZER ASSY.	1	1
3	56926	ADJUSTMENT-PRESSURE	1	••
4	56927	NUT-ADJUSTMENT	1	••
	79267	DAMPENER-VIBRATION	••	1
	56925	SPRING-REGULATOR	1	••
5	¤	SPRING-INNER	••	1
	¤	SPRING-OUTER	••	1
6	56909	SCREW-COVER	6	••
	130803	SCREW-COVER	••	8
7	56910	COVER-DIAPHRAGM	1	••
	79266	COVER-DIAPHRAGM	••	1
	56928	SCREW-DIAPHRAGM	1	••
8	79269	CAP-FUEL	••	1
	79269	CAP-FUEL	••	1
	56924	PLATE-DIAPHRAGM	1	••
9	79268	PLATE-BAFFLE	••	1
	¤	GASKET-BAFFLE	••	1
10	*¤	DIAPHRAGM	1	1
11	56911	PISTON	1	••
	79270	SEAT ASSEMBLY	••	1
12	*¤	O-RING	1	1
13	*	SEAT-VALVE	1	••
14	*	RETAINER	1	••
	¤	VALVE-FUEL	••	1
15	56921	BUTTON-SPRING SEAT	1	••
16	56919	SPRING-VALVE	1	••
	¤	SPRING-FUEL VALVE	••	1
17	56922	RETAINER-INLET ORIFICE	1	••
18	*	WASHER-INLET	1	••
19	56923	ORIFICE-INLET	1	••
20	*	WASHER-ORIFICE	1	••
21	79271	BODY-VAPORIZER	1	1
22	*¤	O-RING	1	1
23	*¤	O-RING	1	2
24	56913	EXCHANGER-HEAT	1	••
	130802	COIL AND PLATE ASSY.	••	1
25	*	WASHER	1	••
26	56916	SCREW-RETAINER	1	••
	130803	SCREW-MOUNTING	••	1
27	56917	SCREW-RETAINER	1	••
	126985	BOLT-VAPORIZER	••	1
28	56918	WASHER	1	1
29	56014	PLUG-PIPE, 1/8	2	1
30	56932	PLUG-PIPE, 1/4	1	1
	109321	GASKET-MOUNTING } NOT	1	••
	133621	GASKET-MOUNTING } ILLUS.	••	1
	56929 A	VAPORIZER REPAIR KIT	1	••
	79274 A	VAPORIZER REPAIR KIT	••	1

NOTE-VAPORIZER ASSY. 113015A ILLUSTRATED.

*INCLUDED IN VAPORIZER REPAIR KIT 56929A.

¤INCLUDED IN VAPORIZER REPAIR KIT 79274A.

L. P. G. CARBURETOR ASSEMBLY

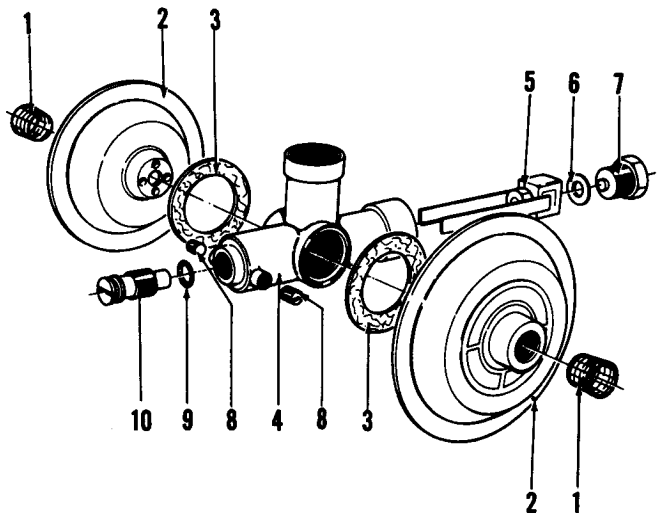


120-173

REF. NO.	HYSTER PART NO.	NAME OF PART 1 2 3 4	QTY.
	200183 A	CARBURETOR ASSEMBLY	1
1	56944	LOCKNUT-OUTLET ELBOW	2
2	56945	ELBOW-OUTLET	1
3	56946	GASKET	1
4 {	56950 A	METERING CONTROL ASSY.	1
{	141027	HOUSING-CONTROL UNIT	1
5	141061	STOP-VALVE	1
6	56947	DIAPHRAGM	1
7	141062	GUIDE-SPRING	1
8	56166	LOCKWASHER-VALVE NUT	1
9	141063	NUT-VALVE	1
10	141064	SPRING-DIAPHRAGM	1
11	141065	COVER-DIAPHRAGM	1
12	141066	SCREW-COVER	6
13	141137	UNION-TUBE	1
14	141140	NEEDLE-ADJUSTING	1
15	141040	VALVE-POWER JET	1
16	56752	WASHER-CHANNEL SCREW	1
17	141149	SCREW-CHANNEL	1
18	141141	LOCKNUT	1
19	56948	LINE-VACUUM CONTROL	1
20	56949	JET-MAIN	1
21	56754	SCREW	4
22	56057	GASKET-FLANGE	1
23	50559	WASHER	1
24	56046	RETAINER	1
25	56014	PLUG	1
26	56773	LEVER	1
27	76772	NUT	1

REF. NO.	HYSTER PART NO.	NAME OF PART 1 2 3 4	QTY.
28	56774	LEVER	1
29	56781	WASHER	1
30	97451	SCREW	1
31	56239	COTTER	1
32	56779	DRIVER	1
33	50562	SCREW	1
34	56242	SPRING	1
35	56238	RETAINER	1
36 {	97444	SHAFT AND STOP LEVER	1
{	138561	LEVER-STOP	1
37	97445	SHAFT	1
38	97446	LEVER	1
39	56036	SCREW	1
40	50550	SPRING	1
41	141001	PIN	1
42	132618	PIN-TAPER	1
43 {	97448	SCREW	1
{	56056	LOCKWASHER	1
44	97450	SCREW	1
45	97449	SHAFT & LEVER	1
46	97448	SCREW	1
47	56857	CLAMP	1
48	56856	BRACKET	1
49	56055	NUT	1
50	56154	RETAINER	1
51	56153	WASHER	1
52	97441	SCREW-PLATE	4
53	97434	SHUTTER-AIR	1
54	97440	PLATE-THROTTLE	1
55 {	97442	SCREW-IDLE ADJ.	1
{	97443	SPRING-ADJUSTMENT	1
56	97438	JET-POWER	1

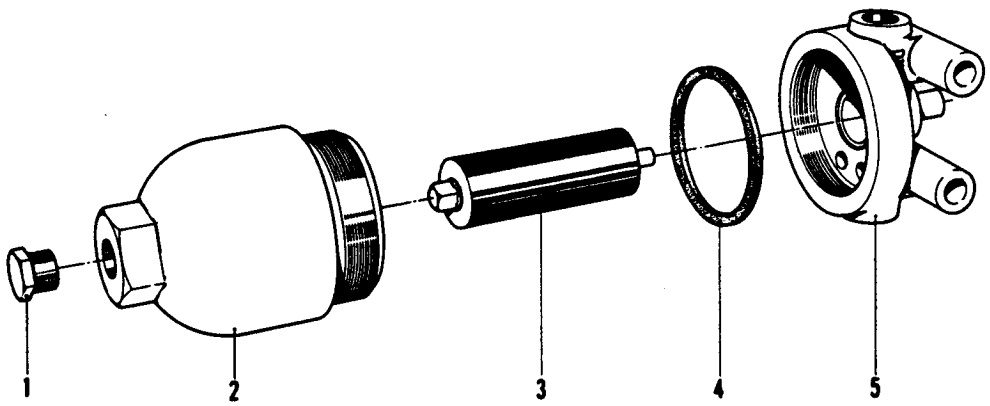
L. P. G. REGULATOR ASSEMBLY



REF. NO.	HYSTER PART NO. 1 2 3 4	NAME OF PART	QTY.
	56933 A	REGULATOR ASSEMBLY	1
1	*	SCREEN-DIAPHRAGM VENT	2
2	202496	DIAPHRAGM-REGULATING	2
3	*	GASKET	2
4	56937	BODY-REGULATOR	1
5	56938	VALVE-CONTROL	1
6	*	SEAT-VALVE	1
7	56940	INLET-CONN. AND SEAT	1
8	.....	SCREW-SPRING LOCK	2
9	*	O-RING	1
10	56943	SCREW-ADJUSTING	1

*INCLUDED IN REGULATOR REPAIR KIT 56934.

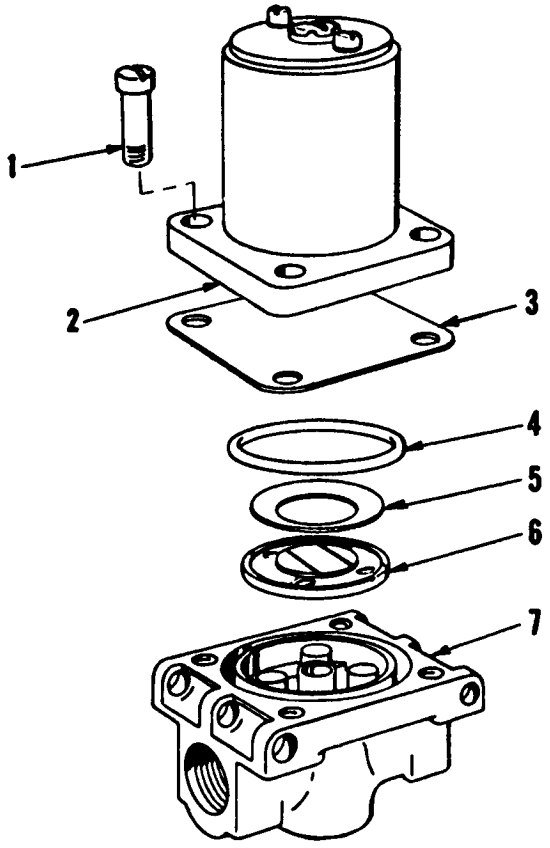
L. P. G. FILTER ASSEMBLY



14-74

REF. NO.	HYSTER PART NO. 1 2 3 4	NAME OF PART	QTY.
	113017 A	FILTER ASSEMBLY	1
1	56014	PLUG-PIPE, 1/8	1
2	56951	FILTER-BOWL	1
3	56952	ELEMENT-FILTER	1
4	56953	GASKET	1
5	56954	FILTER HEAD	1

MAGNETIC LOCK-OFF VALVE ASSEMBLY



KEY
A-LAST USED ON SERIAL NO B2D-3246.
B-FIRST USED ON SERIAL NO. B2D-3247.

110-108

REF. NO.	HYSTER PART NO. 1 2 3 4	NAME OF PART	QTY. A	QTY. B
	101808AB	LOCK-OFF ASSY. - MAGNETIC	1	••
	121037 A	LOCK-OFF ASSY. - MAGNETIC	••	1
1	200819	SCREW AND LOCKWASHER	4	4
2	202404	MAGNET	1	••
2	134401	MAGNET	••	1

REF. NO.	HYSTER PART NO. 1 2 3 4	NAME OF PART	QTY. A	QTY. B
3	202405	SEAL-DIAPHRAGM	1	1
4	202406	O-RING	1	1
5	233151	SPRING-ARMATURE	1	1
6	233152	ARMATURE	1	1
7	•••••	BODY	1	1

Section E

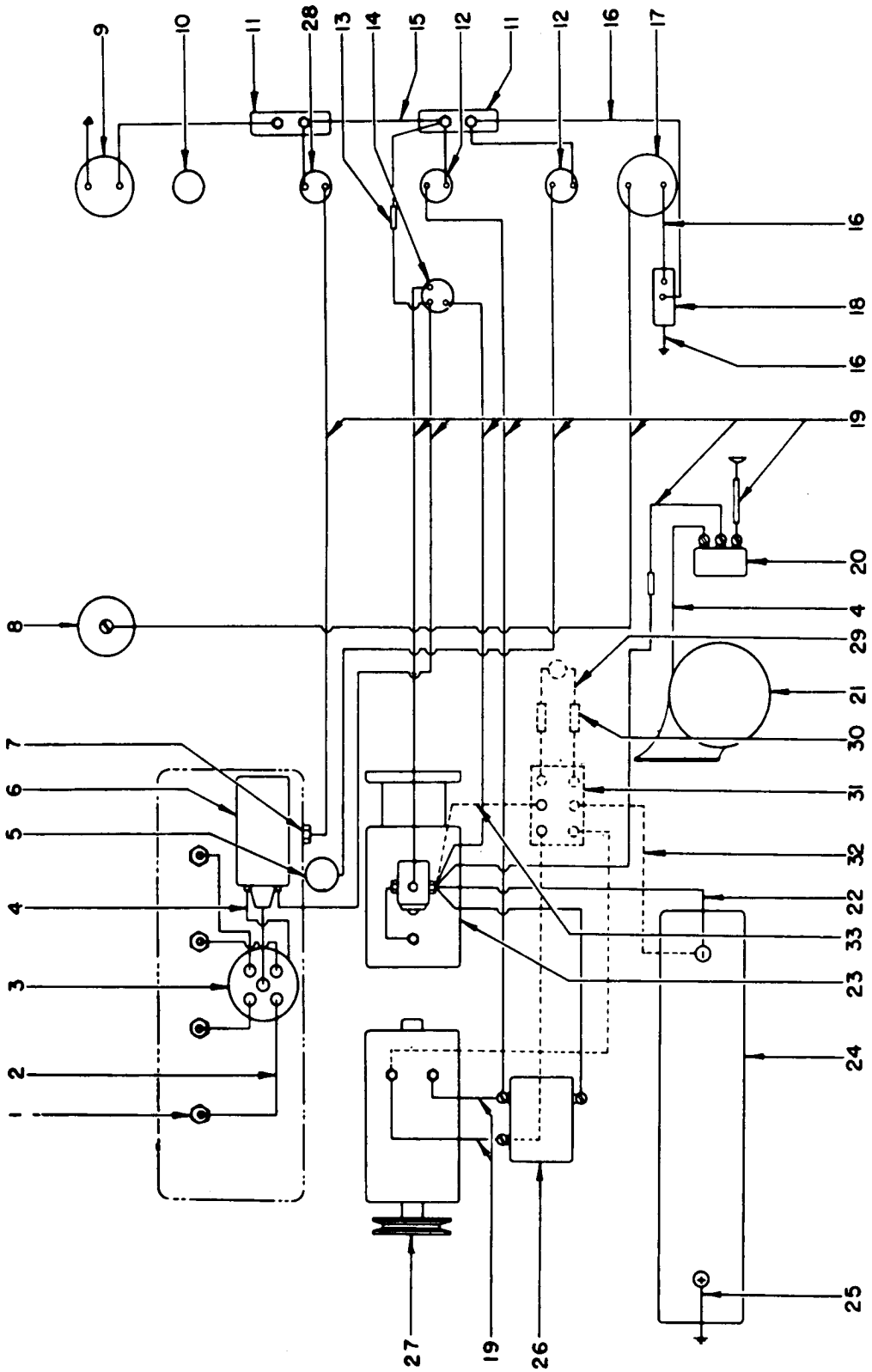
ELECTRICAL EQUIPMENT

INDEX

GAS ENGINE ELECTRICAL SYSTEM - 6 Volt

FOR STANDARD TRANSMISSION

LAST USED ON SERIAL NO. B2D-3246, B2E-1870 AND B2A-1787



120-15

GAS ENGINE ELECTRICAL SYSTEM-6 Volt

FOR STANDARD TRANSMISSION

LAST USED ON SERIAL NO. B2D-3246, B2E-1870 AND B2A-178,

KEY
A-FOR TRUCKS WITHOUT GS OR LPS.
B-TRUCKS WITH GS OR LPS.

REF. NO.	HYSTER PART NO.		NAME OF PART 1 2 3 4	QTY. A	QTY. B
1	28758		SPARK PLUG	4	4
	55924		BOOT	••	4
2	106039	A	IGNITION WIRE SET	1	1
	112027	A	WIRE-COIL TO DISTRIBUTOR	1	1
	202068	A	DISTRIBUTOR ASSEMBLY	1	1
3	202067	A	CLAMP-DISTRIBUTOR	1	1
	52641		BOOT	••	1
4	69309	A	WIRE ASSEMBLY	2	2
5	114638		SWITCH-PRESSURE WARNING	1	1
	52641		BOOT	••	1
6	22060		COIL	1	1
	110709		BOOT	••	2
7	114637		SWITCH-TEMP. WARNING	1	1
	52641		BOOT	••	1
	110488		SENDER-FUEL LEVEL	1	1
8	*981959		SENDER-FUEL LEVEL	1	••
	52641		BOOT	••	1
9	119379		HOUR METER ASSY.	1	1
10	114641		BUTTON-PLUG	1	1
	73513	A	WIRE AND FUSE ASSY.	1	1
11	21778		FUSE	1	1
	110709		BOOT	••	3
	52641		BOOT	••	1
12	114629	A	LAMP ASSEMBLY	2	2
	73513	A	WIRE AND FUSE ASSY.	1	1
13	21778		FUSE	1	1
	117800		WIRE AND FUSE HOLDER ASSY.	••	1
	131116		SWITCH-IGNITION	1	1
14	123754		KEY	1	1
	110709		BOOT	••	3
15	100594	A	WIRE ASSEMBLY	1	1
16	28285	A	WIRE ASSEMBLY	3	3
	111559		GAUGE-FUEL LEVEL	1	1
	*981979		GAUGE-FUEL LEVEL	1	••
17	*981979		GAUGE-FUEL LEVEL	1	••
	52641		BOOT	••	1
	110709		BOOT	••	1
	111562		VOLTAGE REGULATOR	1	1
18	114633		BLOCK-MOUNTING	1	1
	110709		BOOT	••	2
	114642		HARNESS-WIRING	1	••
19	*982959		HARNESS-WIRING	1	••
	117793		HARNESS-WIRING	••	1
	□117795		HARNESS-WIRING	••	1
20	10531		RELAY-HORN	1	1
	110709		BOOT	••	3
	2033	B	HORN	1	1
21	*981411		HORN	1	••
	110709		BOOT	••	1
22	112453		CABLE-BATTERY	1	1
	*982955		CABLE-BATTERY	1	••

REF. NO.	HYSTER PART NO.		NAME OF PART 1 2 3 4	QTY. A	QTY. B
23	•••••		STARTING MOTOR-SEE P. E12	1	1
	117766		BOOT	••	2
	24201		BATTERY	1	1
	*982645		BATTERY	1	••
	117785		BATTERY	••	1
	*982542		PLATE-BATTERY	1	••
24	110508		TRAY-BATTERY	1	••
	32697		MACHINE SCREW-3/8 UNF X 3/4	2	2
	71550		HOLD DOWN-BATTERY	1	1
	11095		LINK	2	2
	18515		WASHER-5/16	2	2
	16690		WING NUT-5/16 UNF	2	2
	115333		STRAP-BATTERY GROUND	1	1
25	*982954		CABLE-BATTERY GROUND	1	••
	55638		VOLTAGE REGULATOR-17 AMP	1	1
	62814	A	VOLTAGE REGULATOR-40AMP	1	1
	114316		PLATE-BRACKET	1	1
	119169		PAD	1	1
26	119168		PAD	2	2
	113714		SPACER	2	2
	15174		WASHER	2	2
	119246		WIRE	1	1
	55924		BOOT	••	1
	110709		BOOT	••	1
	55640	AB	GENERATOR ASSY.-17 AMP.	1	1
27	62895	A	GENERATOR-ASSY.-40 AMP.	1	1
	52641		BOOT	••	2
28	114629		LAMP ASSY.-TEMP. WARNING	1	1
29	117789		WIRE ASSY.	••	1
30	42958		CONNECTOR	••	2
	117797	A	SWITCH-DISCONNECT	••	1
	117765	W	BRACKET	••	1
	15617		CAPSCREW-1/4 UNF X 5/8	••	3
31	15004		NUT-1/4 UNF	••	3
	15154		LOCKWASHER-1/4	••	3
	111763		SCREW-SELF TAP	••	1
	110709		BOOT	••	2
32	117786		CABLE-BATTERY	••	1
	111770		PROTECTOR	••	1
33	111529		CABLE-BATTERY	••	1
	111529		CABLE-BATTERY	••	1
	114640		PLATE-PANEL	1	1
	114623		PANEL-INSTRUMENT	1	1
	114624		MOLDING-PANEL NOT ILLUS	1	1
	114627	W	NUT-CAM	4	4
	117801		PLATE-INSTRUMENT	••	1
	□ 69296		PLUG-FUEL GAUGE	••	1

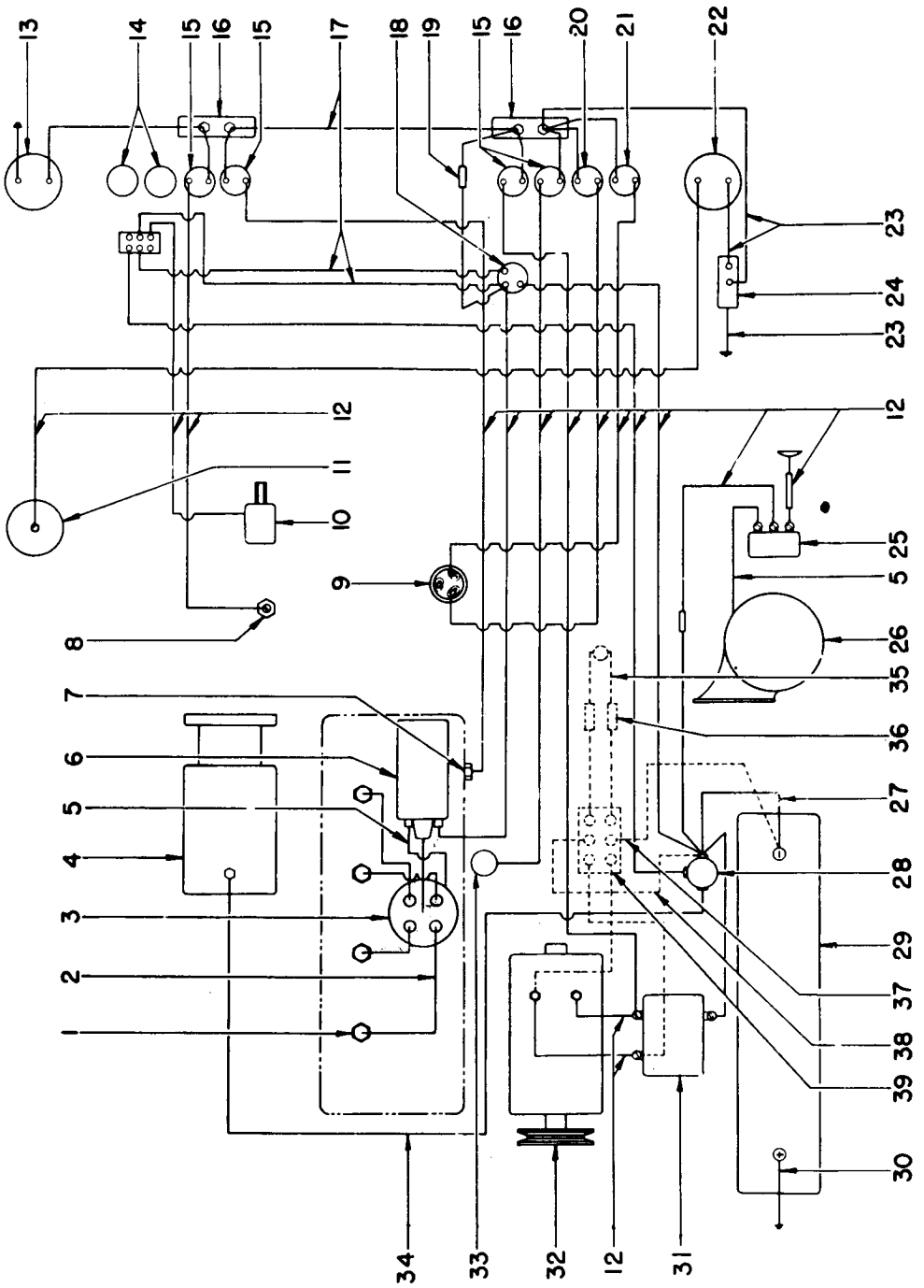
□FOR LPS TRUCKS.

*FOR B2E AND B2A SERIES TRUCKS ONLY.

GAS ENGINE ELECTRICAL SYSTEM-6 Volt

FOR MONOTROL TRANSMISSION ONLY

LAST USED ON SERIAL NO. B2D-3246, B2E-1870 AND B2A-1787



KEY
A-FOR TRUCKS WITHOUT GS OR LPS.
B-FOR TRUCKS WITH GS OR LPS.

REF. NO.	HYSTER PART NO.	NAME OF PART 1 2 3 4	QTY. A	QTY. B
1	28758	SPARK PLUG	4	4
	55924	BOOT	••	4
2	106039 A	IGNITION WIRE SET	1	1
	112027 A	WIRE-COIL TO DISTRIBUTOR	1	1
	202068 A	DISTRIBUTOR ASSEMBLY	1	1
3	202067 A	CLAMP-DISTRIBUTOR	1	1
	52641	BOOT	••	1

REF. NO.	HYSTER PART NO.	NAME OF PART 1 2 3 4	QTY. A	QTY. B
26	2033 B	HORN	1	1
	114634 W	BRACKET-HORN	1	1
	55924	BOOT	••	1
27	112453	CABLE-BATTERY	1	1
	*982952	CABLE-BATTERY	1	••

GAS ENGINE ELECTRICAL SYSTEM-6 Volt

FOR MONOTROL TRANSMISSION ONLY

LAST USED ON SERIAL NO. B2D-3246, B2E-1870 AND B2A-1787

REF. NO.	HYSTER PART NO.	1	2	3	4	NAME OF PART	QTY. A	QTY. B
4	202325	A				STARTING MOTOR ASSEMBLY	1	1
	111766					BOOT	••	1
5	69309	A				WIRE ASSEMBLY	2	2
6	22060					COIL	1	1
	110709					BOOT	••	2
	114637					SWITCH-TEMP.WARNING	1	1
7	52641					BOOT	••	1
	15174					WASHER-1/4	1	1
	114662					SWITCH-TEMP WARNING	1	1
8	52641					BOOT	1	1
	15174					WASHER-1/4	1	1
9	114289					SWITCH-PRESSURE	1	1
	110709					BOOT	••	2
10	114288					SOLENOID-VALVE	1	1
	110709					BOOT	••	1
	110488					SENDER-FUEL	1	1
11	52641					BOOT	••	1
	15174					WASHER-1/4	1	1
	114660					HARNESS-WIRING	1	••
12	*982960					HARNESS-WIRING	1	••
	117794					HARNESS-WIRING, GS ONLY	••	1
	117796					HARNESS-WIRING, LPS ONLY	••	1
13	119379					HOUR METER ASSY.	1	1
14	114649	A				SWITCH ASSEMBLY	1	1
	55870					BOOT	••	1
15	114629	A				LAMP ASSEMBLY	4	4
	42958					CONNECTOR-TERMINAL	4	4
	114630	W				BLOCK-TERMINAL	2	2
16	110709					BOOT	••	3
	52641					BOOT	••	1
17	114659					HARNESS-PANEL WIRING	1	1
	202017					SWITCH-IGNITION	1	1
18	123754					KEY	1	1
	110709					BOOT	••	3
	73513	A				WIRE ASSEMBLY	1	1
19	21778					FUSE	1	1
	117800					WIRE AND FUSE HOLDER ASSY.	••	1
20	114647	A				LAMP ASSEMBLY	1	1
	42598					CONNECTOR-TERMINAL	1	1
21	114648	A				LAMP ASSEMBLY	1	1
	42598					CONNECTOR-TERMINAL	1	1
	111559					GAUGE-FUEL	1	1
	*981979					GAUGE-FUEL	1	••
22	110709					BOOT	••	1
	52641					BOOT	••	1
	15174					WASHER-1/4	••	1
23	28285	A				WIRE ASSEMBLY	3	3
	117799					WIRE ASSEMBLY	••	1
	111562					VOLTAGE REGULATOR	1	1
24	114633					BLOCK-INSULATED MOUNT	1	1
	52641					BOOT	••	2
	15174					WASHER-1/4	••	2
	10531					RELAY-HORN	1	1
25	55924					BOOT	••	2
	110709					BOOT	••	1

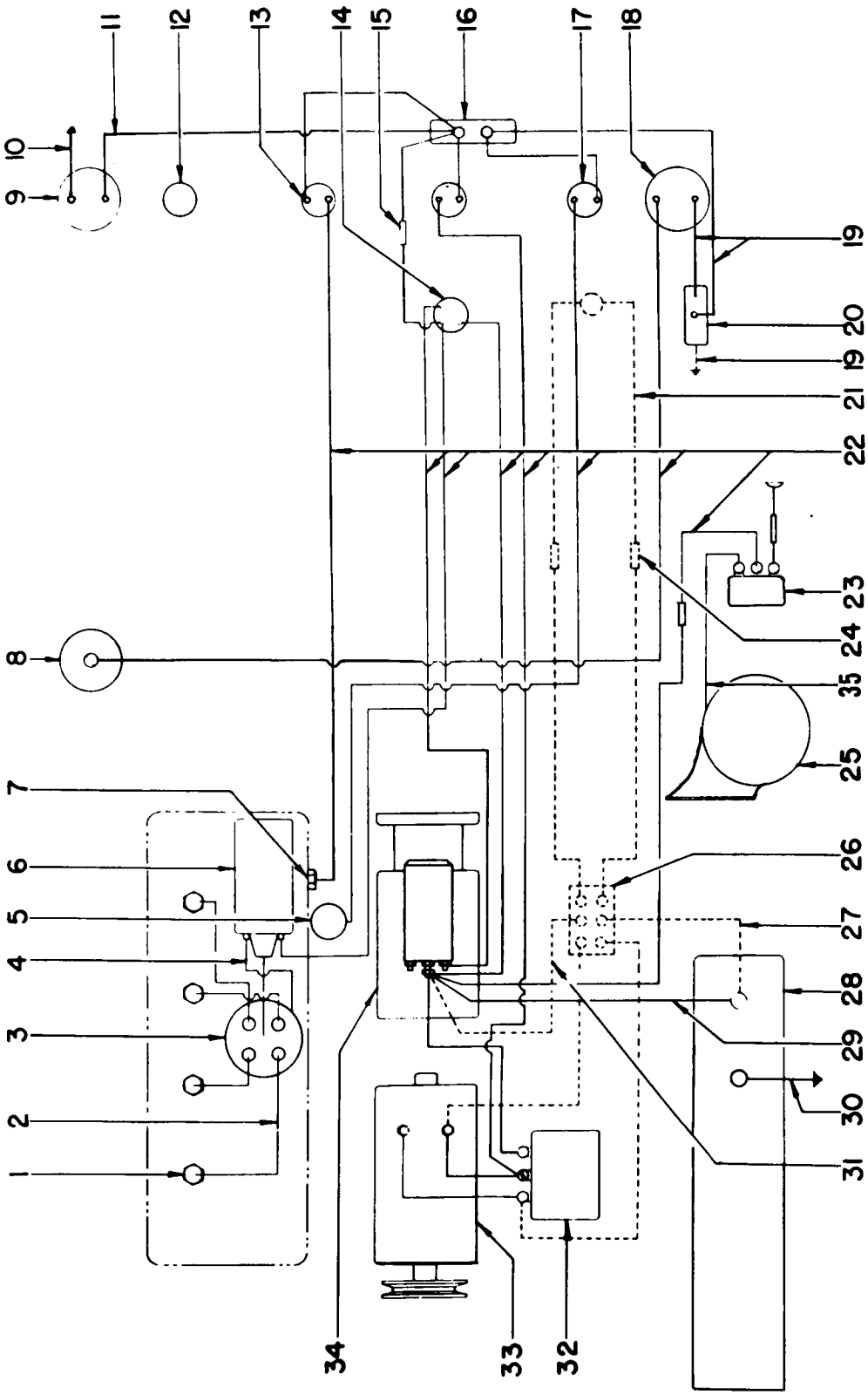
REF. NO.	HYSTER PART NO.	1	2	3	4	NAME OF PART	QTY. A	QTY. B
	55842					SOLENOID-STARTER	1	1
28	111766					BOOT	••	2
	110709					BOOT	••	1
	24201					BATTERY	1	1
	*117785					BATTERY	••	1
	110508					TRAY-BATTERY	1	1
	32687					MACHINE SCREW-3/8 UNF X 3/4	2	2
29	71550					HOLD DOWN-BATTERY	1	1
	11095					LINK	2	2
	18515					WASHER-5/16	2	2
	16690					WING NUT-5/16 UNF	2	2
	*111770					PROTECTOR	••	2
30	115333					STRAP-BATTERY GROUND	1	1
	*982954					CABLE	1	••
	55638					VOLTAGE REGULATOR-17 AMP.	1	1
	62814					VOLTAGE REGULATOR-40 AMP.	1	1
	114316					PLATE-BRACKET	1	1
	119169					PAD	1	1
31	119168					PAD	2	2
	113714					SPACER	2	2
	15174					WASHER	2	2
	119246					WIRE	1	1
	* 55924					BOOT	••	1
	*110709					BOOT	1	1
	55640	AB				GENERATOR ASSY.-17 AMP.	1	1
32	62895	A				GENERATOR ASSY.-40 AMP.	1	1
	* 52641					BOOT	••	2
	* 15174					WASHER-1/4	••	2
	114638					SWITCH-PRESSURE WARNING	1	1
33	* 52641					BOOT	••	1
	* 15174					WASHER-1/4	••	1
34	69304	A				CABLE-STARTER	1	1
	*982953					CABLE-STARTER	1	••
35	*117798					WIRE ASSY.	••	1
36	* 42958					CONNECTOR	••	2
37	*117786					CABLE-BATTERY	••	1
38	*111529					CABLE-BATTERY	••	1
	*117797	A				SWITCH-DISCONNECT	••	1
	*117765	W				BRACKET	••	1
	* 15671					CAPSCREW-1/4 UNF X 5/8	••	3
	* 15004					NUT-1/4 UNF	••	3
39	* 15154					LOCKWASHER	••	3
	111763					CLAMP	••	1
	* 16650					SCREW-SELF TAP	••	1
	*111766					BOOT	••	2
	*110709					BOOT	••	2
	114623					PANEL-INSTRUMENT (NOT ILLUS.)	1	1
	114646					PLATE-PANEL (NOT ILLUS.)	1	1
	114624					MOLDING-PANEL (NOT ILLUS.)	1	1
	114627	W				NUT-CAM (NOT ILLUS.)	4	4
	*117801					PANEL-INSTRUMENT (NOT ILLUS.)	••	1
	69296					PLUG-FUEL GA. LPS (NOT ILLUS.)	••	1

*FOR B2E AND B2A SERIES TRUCKS ONLY.

GAS ENGINE ELECTRICAL SYSTEM–12 Volt

FOR STANDARD TRANSMISSION

FIRST USED ON SERIAL NO B2D-3247 AND B2A-1788



120-113

GAS ENGINE ELECTRICAL SYSTEM-12 Volt

FOR STANDARD TRANSMISSION

FIRST USED ON SERIAL NO B2D-3247 AND B2A-1788

KEY
A-FOR TRUCKS WITHOUT GS OR LPS.
B-FOR TRUCKS WITH GS OR LPS.

REF. NO.	HYSTER PART NO.		NAME OF PART 1 2 3 4	QTY. A	QTY. B
1	138366		SPARK PLUG	4	4
	55924		BOOT	••	4
2	106039	A	IGNITION WIRE SET	1	1
	112027	A	WIRE-COIL TO DIST.	1	1
	* 88928		WIRE-COIL TO DIST.	1	1
	202068	A	DIST. ASSY.- FOR F-162 ENG.	1	1
	137705		DIST. ASSY.- FOR F-163 ENG.	1	1
3	202067	A	CLAMP-DISTRIBUTOR	1	1
	52641		BOOT	••	1
	15174		WASHER-1/4	••	1
4	69309	A	WIRE ASSEMBLY	1	1
	*100594	A	WIRE-DISTRIBUTOR	1	1
	114638		SWITCH-PRESSURE WARNING	1	1
5	52641		BOOT	••	1
	15174		WASHER-1/4	••	1
6	72785		COIL	1	1
	110709		BOOT	••	2
	87048		SWITCH-TEMP. WARNING	1	1
7	52641		BOOT	••	1
	15174		WASHER-1/4	••	1
	110488		SENDER-FUEL LEVEL	1	1
8	52641		BOOT	••	1
	15174		WASHER-1/4	••	1
9	119379		HOUR METER ASSEMBLY	1	1
	*121797		INSULATOR	••	1
10	122088	A	WIRE ASSEMBLY	1	1
11	122089	A	WIRE ASSEMBLY	1	1
12	114641		BUTTON-PLUG	1	1
13	119989	A	LAMP ASSEMBLY	1	1
	131116		SWITCH-IGNITION	1	1
14	123754		KEY	1	1
	110709		BOOT	••	3
15	119382	A	WIRE ASSEMBLY	1	1
	53123		FUSE-5 AMP.	1	1
	114630	W	BLOCK-TERMINAL	1	1
16	52641		BOOT	••	1
	110709		BOOT	••	1
17	119378	A	LAMP ASSEMBLY	2	2
	42958		CONNECTOR	2	2
	111559		GAUGE-FUEL LEVEL	1	1
18	52641		BOOT	••	1
	110709		BOOT	••	1
	15174		WASHER-1/4	••	1
19	28285	A	WASHER ASSEMBLY	3	3
	111562		VOLTAGE REGULATOR	1	1
20	114633		BLOCK-MOUNTING	1	1
	110709		BOOT	••	2
21	121334		WIRE ASSEMBLY	••	1
	121328		HARNESS-WIRING	1	••
22	▫985873		HARNESS-WIRING	1	••
	121332		HARNESS-WIRING, GS	••	1
	121330		HARNESS-WIRING, LPS	••	1
	103739		RELAY-HORN	1	1
23	42958		CONNECTOR	1	1
	110709		BOOT	••	3
24	42958		CONNECTOR	••	2
	103738		HORN	1	1
25	▫ 88626		HORN	1	••
	110709		BOOT	••	1
	121339	A	SWITCH-DISCONNECT	••	1
	121336		BRACKET	••	1
	15617		CAPSCREW-1/4 UNF X 5/8	••	3
	15004		NUT-1/4 UNF	••	3
26	15154		LOCKWASHER-1/4	••	3
	111763		SCREW-SELF TAP	••	1
	111770		PROTECTOR	••	2
	110709		BOOT	••	2
	111766		BOOT	••	2
27	121342		CABLE-BATTERY	••	1
	72786		BATTERY	1	1
	120132		TRAY-BATTERY	1	1
	121337		TRAY-BATTERY	••	1
28	32687		MACHINE SCREW-3/8 UNF X 3/4	2	2
	11095		LINK	2	2
	18515		WASHER-5/16	2	2
	16690		WING NUT-5/16 UNF	2	2
	111770		PROTECTOR	••	1
29	120133		CABLE-BATTERY	1	1
30	121340		CABLE-BATTERY	1	••
31	121341		CABLE-BATTERY	••	1
	118614		VOLTAGE REGULATOR-10 AMP	1	1
	120980		VOLTAGE REGULATOR-20 AMP	1	1
	▫ 79439		SHOCK MOUNT ASSY.	1	1
	* 79438		SHOCK MOUNT ASSY.	1	1
32	79440		WIRE-LEAD	1	1
	* 15588		CAPSCREW-3/8 UNF X 1 1/2	7	7
	* 15154		LOCKWASHER-1/4	7	7
	* 15004		NUT-1/4 UNF	7	7
	110709		BOOT	••	2
	55924		BOOT	••	1
	118609	A	GENERATOR-10 AMP	1	1
33	120117	A	GENERATOR-20 AMP	1	1
	52641		BOOT	••	2
	15174		WASHER-1/4	••	2
34	120979	A	STARTING MOTOR ASSEMBLY	1	1
	110709		BOOT	••	2
35	100848		WIRE ASSEMBLY	1	1
	69296		PLUG-FUEL GA., LPS (NOT ILLUS.)	1	1
	114623		PANEL-INSTRUMENT (NOT ILLUS.)	1	1
	114640		PLATE-PANEL (NOT ILLUS.)	1	1
	114624		MOULDING-PANEL (NOT ILLUS.)	1	1
	114627	W	NUT-CAM (NOT ILLUS.)	1	1

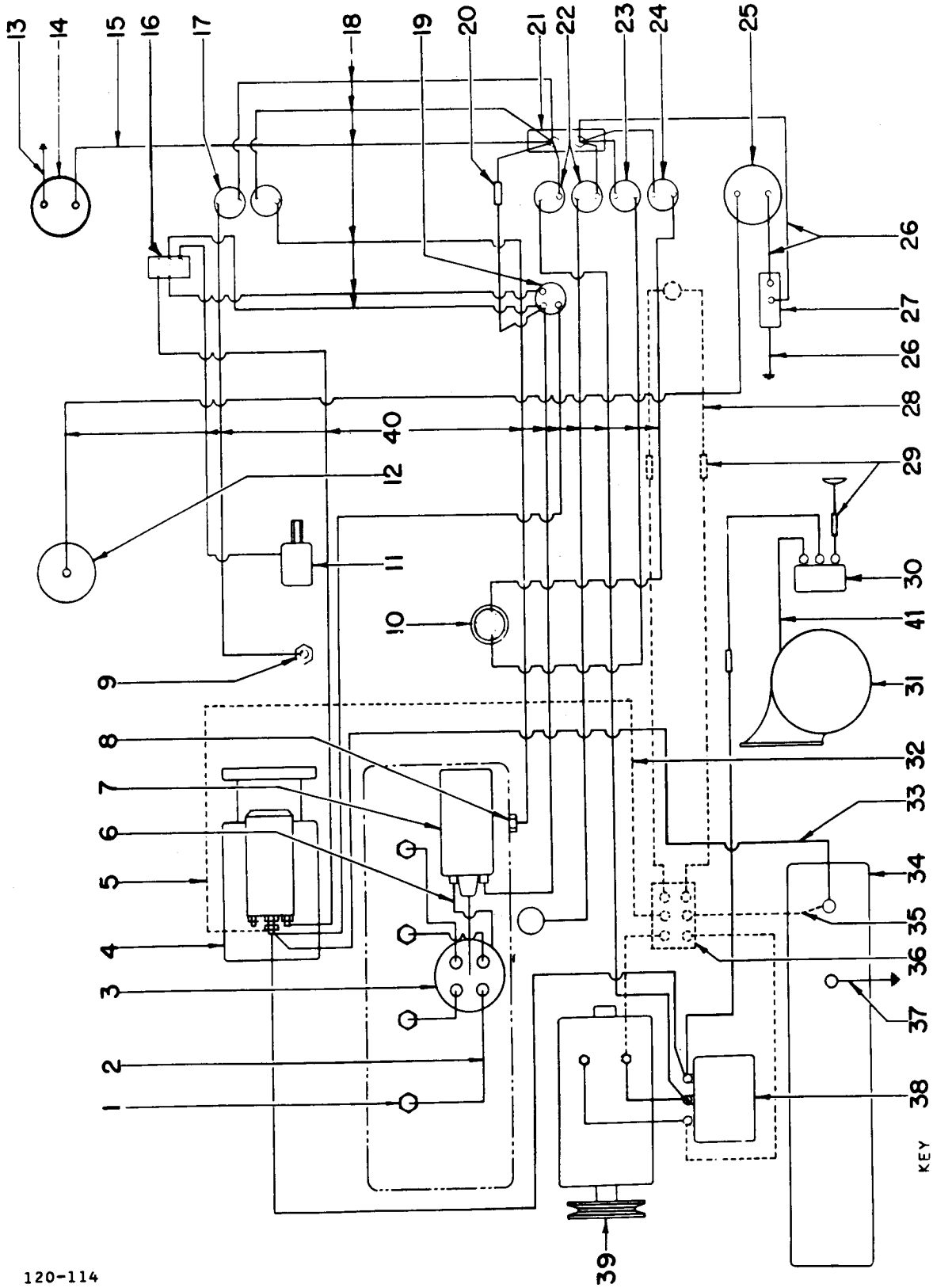
*FIRST USED ON SERIAL NO. B2D-3507.

▫FOR B2E AND B2A SERIES TRUCKS ONLY.

GAS ENGINE ELECTRICAL SYSTEM–12 Volt

FOR MONOTROL TRANSMISSION

FIRST USED ON SERIAL NO. B2D-3247 AND B2A-1788



REF. NO.	HYSTER PART NO.	NAME OF PART 1 2 3 4	QTY. A	QTY. B
30	103739	RELAY–HORN	1	1
	55924	BOOT	••	2
	110709	BOOT	••	1

KEY
A–FOR TRUCKS WITHOUT GS OR LPS.
B–FOR TRUCKS WITH GS OR LPS.

REF. NO.	HYSTER PART NO.	NAME OF PART 1 2 3 4	QTY. A	QTY. B
1	138366	SPARK PLUG	4	4
	55924	BOOT	••	4
2	106039 A	IGNITION WIRE SET	1	1
	112027 A	WIRE–COIL TO DISTRIBUTOR	1	1

120-114

GAS ENGINE ELECTRICAL SYSTEM-12 Volt

FOR MONOTROL TRANSMISSION

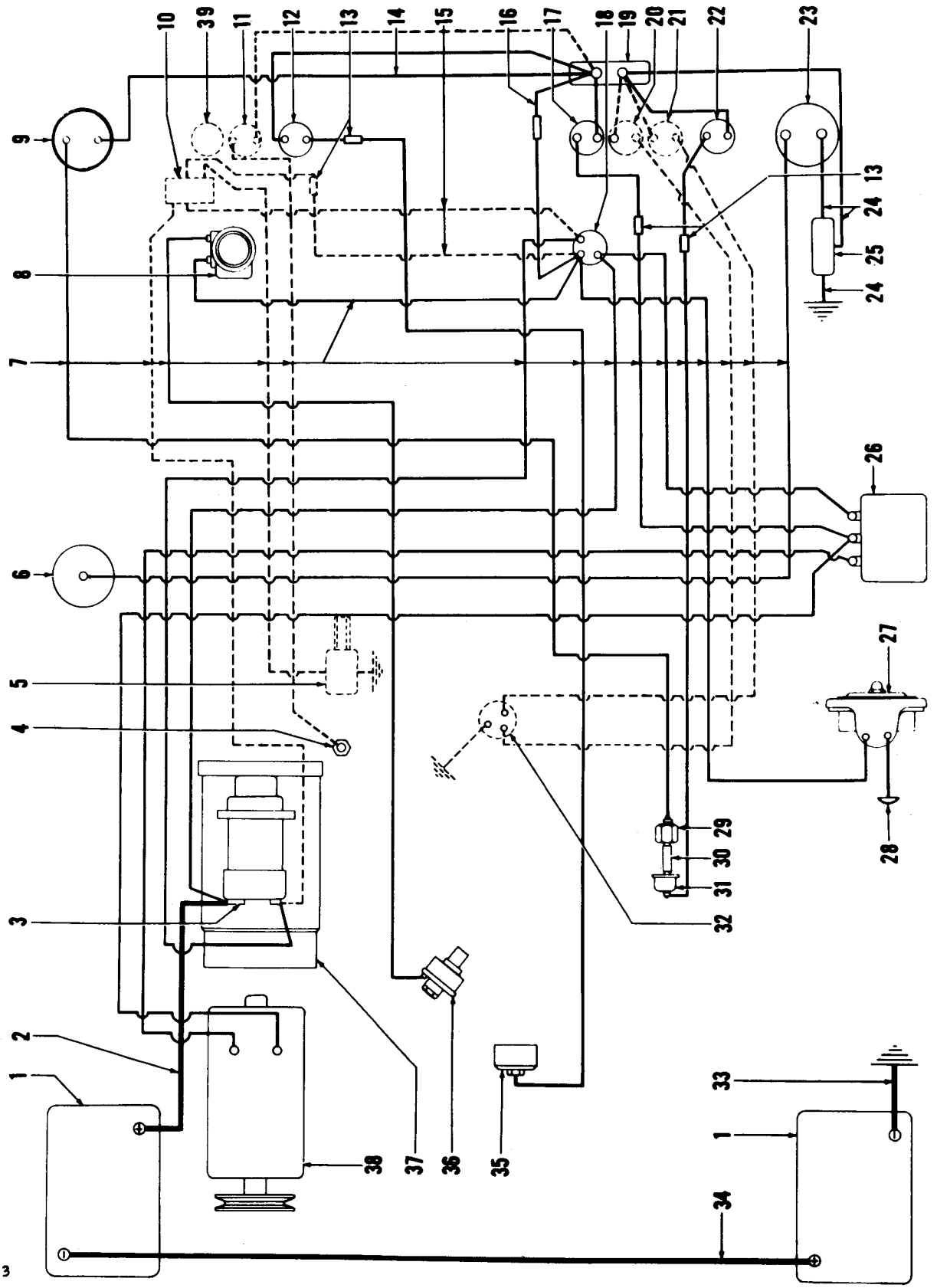
FIRST USED ON SERIAL NO. B2D-3247 AND B2A-1788

REF. NO.	HYSTER PART NO. 1 2 3 4		NAME OF PART	QTY. A	QTY. B
	202068	A	DIST.ASSY.-FOR F-162 ENG	1	1
	137705		DIST.ASSY.- FOR F-163 ENG.	1	1
3	202067	A	CLAMP-DISTRIBUTOR	1	1
	52641		BOOT	••	1
	15174		WASHER-1/4	••	1
	118616	A	STARTING MOTOR ASSY.	1	1
4	111766		BOOT	••	1
	110709		BOOT	••	1
5	121335		CABLE-BATTERY	••	1
6	69309	A	WIRE ASSEMBLY	1	1
	*100594	A	WIRE-DISTRIBUTOR	1	1
7	72785		COIL	1	1
	110709		BOOT	••	2
	87048		SWITCH-TEMP. WARNING	1	1
8	52641		BOOT	••	1
	15174		WASHER-1/4	••	1
	114662		SWITCH-TEMP. WARNING	1	1
9	52641		BOOT	••	1
	15174		WASHER-1/4	••	1
	114289		SWITCH-PRESSURE	1	1
10	100848		WIRE ASSEMBLY	1	1
	110709		BOOT	••	2
11	982751		SOLENOID-VALVE	1	1
	110709		BOOT	••	1
	110488		SENDER-FUEL	1	1
12	52641		BOOT	••	1
	15174		WASHER-1/4	••	1
13	122088	A	WIRE ASSEMBLY	1	1
14	119379		HOUR METER	1	1
	121797		INSULATOR	••	1
15	122089	A	WIRE ASSEMBLY	1	1
16	114649	A	SWITCH ASSEMBLY	1	1
	55870		SLEEVE	••	4
17	119989	A	LAMP ASSEMBLY	••	2
	42958		CONNECTOR-TERMINAL	••	2
18	#120138		HARNESS-PANEL WIRING	1	1
	131116		SWITCH-IGNITION	1	1
19	123754		KEY	1	1
	110709		BOOT	••	3
	119382	A	WIRE AND FUSE ASSY.	1	1
20	121344		WIRE AND FUSE ASSY.	••	1
	53123		FUSE-5 AMP	1	1
	114630	W	BLOCK-TERMINAL	1	1
21	110709		BOOT	••	1
	52641		BOOT	••	1
22	119378	A	LAMP ASSEMBLY	2	2
23	119397	A	LAMP ASSEMBLY	2	2
24	119398	A	LAMP ASSEMBLY	1	1
	42598		CONNECTOR-TERMINAL	1	1
	111559		GAUGE-FUEL	1	1
25	52641		BOOT	••	1
	15174		WASHER-1/4	••	1
	110709		BOOT	••	1
26	28285	A	WIRE ASSEMBLY	3	3
	111562		VOLTAGE REGULATOR	1	1
27	114633		BLOCK-MOUNTING	1	1
	52641		BOOT	••	2
	15174		WASHER-1/4	••	2
	103738		HORN	1	1
31	# 88626		HORN	1	••
	55924		BOOT	••	1
32	121335		CABLE-BATTERY	••	1
33	121343		CABLE-BATTERY	1	1
	111770		PROTECTOR	••	2
	72786		BATTERY	1	1
	120132		TRAY-BATTERY	1	1
34	32687		MACHINE SCREW-3/8 UNF X 3/4	2	2
	74751		HOLD DOWN-BATTERY	1	1
	11095		LINK	2	2
	18515		WASHER-5/16	2	2
	16690		WING NUT-5/16 UNF	2	2
35	121342		CABLE-BATTERY	••	1
	121339	A	SWITCH-DISCONNECT	••	1
	121336		BRACKET	••	1
	15671		CAPSCREW-1/4 UNF X 5/8	••	3
	15004		NUT-1/4 UNF	••	3
36	15154		LOCKWASHER-1/4	••	3
	111763		CLAMP	••	1
	16650		SCREW-SELF TAP	••	1
	111766		BOOT	••	2
	110709		BOOT	••	2
37	115333		STRAP-BATTERY	1	1
	118614		VOLTAGE REGULATOR-10 AMP	1	1
	120980		VOLTAGE REGULATOR-20 AMP	1	1
	121338		BRACKET	1	1
	113714		SPACER	2	2
	15174		WASHER	2	2
38	119246		WIRE	1	1
	* 79439		SHOCK MOUNT ASSEMBLY	1	1
	* 79438		SHOCK MOUNT ASSEMBLY	1	1
	* 79440		WIRE-LEAD	1	1
	* 15588		CAPSCREW-1/4 UNF X 1 1/2	7	7
	* 15154		LOCKWASHER-1/4	7	7
	* 15004		NUT-1/4 UNF	7	7
	55924		BOOT	••	1
	110709		BOOT	••	2
	118609	A	GENERATOR ASSEMBLY-10 AMP	1	1
39	120117	A	GENERATOR ASSEMBLY-20 AMP	1	1
	111766		BOOT	••	1
	110709		BOOT	••	1
	121329		HARNESS-WIRING	1	••
40	#985874		HARNESS-WIRING	1	••
	121333		HARNESS-WIRING, FOR GS	••	1
	121331		HARNESS-WIRING, FOR LPS	••	1
	100848		WIRE ASSEMBLY	1	1
	114623		PANEL-INSTRUMENT	1	1
	114646		PLATE-PANEL	1	1
	114624		MOULDING-PANEL NOT	1	1
	114627	W	NUT-CAM ILLUS	4	4
	69296		PLUG-FUEL HOLE, FOR LPS	••	1

*FIRST USED ON SERIAL NO. B2D-3507.

#FOR B2E AND B2A SERIES TRUCKS ONLY.

DIESEL ENGINE ELECTRICAL SYSTEM – 12 Volt



120-173

KEY
A-FOR STANDARD TRANSMISSION TRUCKS ONLY.
B-FOR MONOTROL TRANSMISSION TRUCKS ONLY.

REF. NO.	HYSTER PART NO. 1 2 3 4		NAME OF PART	QTY. A	QTY. B
1	982645		BATTERY-6 VOLT	2	2
	111769		BOOT-R.H.	2	2
	111770		BOOT-L.H.	2	2
	982542		PLATE-BATTERY	2	2
	983234		CAPSCR.-BRASS, 5/16 UNF X 3/4	4	4
2	*982957		CABLE-BATTERY, NEG.	1	1
	▫982955		CABLE-BATTERY, NEG.	1	1
	# 88881		CABLE-BATTERY, POS.	1	1
3	▫111766		BOOT-RUBBER	1	1
4	87048		SWITCH-TEMP. WARNING	••	1
5	982751		VALVE-SOLENOID	••	1
	110709		BOOT	••	1
6	*981959		SENDER-FUEL LEVEL	1	1
	▫110488		SENDER-FUEL LEVEL	1	1
7	*982961		HARNESS-WIRING	1	••
	▫ 97505		HARNESS-WIRING	1	••
	*982962		HARNESS-WIRING	••	1
	▫ 97506		HARNESS-WIRING	••	1
8	982991		SWITCH-HEATER	1	1
9	119379		HOUR METER	1	1
10	114649		SWITCH ASSEMBLY	••	1
11	119989	A	LAMP ASSY.-TRANS TEMP.	••	1
12	119989	A	LAMP ASSY.-ENG. TEMP.	1	1
13	42958		CONNECTOR	3	6
14	122089		WIRE	1	1
15	▫120138		HARNESS-WIRING, PANEL	••	1
16	▫119382	A	WIRE AND FUSE ASSY.	1	1
	53123		FUSE-5 AMP	1	1
17	119378	A	LAMP ASSY.-GENERATOR	1	1
18	131116		SWITCH-IGNITION	1	1
	123754		KEY	1	1
19	114530	W	BLOCK-TERMINAL	1	1
20	119378	A	LAMP ASSY.-OIL PRESS.	••	1
21	119397	A	LAMP ASSY.-TRANS. FWD.	••	1
22	119398	A	LAMP ASSY.-TRANS. REV.	••	1
	119989	A	LAMP ASSY.-OIL PRESSURE	1	••

REF. NO.	HYSTER PART NO. 1 2 3 4		NAME OF PART	QTY. A	QTY. B
23	*981948		GAUGE-FUEL	1	1
	▫111559		GAUGE-FUEL	1	1
24	▫282285	A	WIRE	3	3
25	▫111562		VOLTAGE REGULATOR	1	1
	▫114633		BLOCK-MOUNTING	1	1
26	118614		VOLTAGE REGULATOR-10 AMP	1	1
	120980		VOLTAGE REGULATOR-20 AMP.	1	1
27	*980305		HORN-12 VOLT	1	1
	▫ 88626		HORN-12VOLT	1	1
28	•••••		BUTTON-HORN	1	1
29	981878		SWITCH-HOUR METER	1	1
30	12838		TEE	1	1
	16148		NIPPLE	1	1
31	114638		SENDER-OIL PRESSURE	1	1
32	114289		SWITCH-PRESSURE	••	1
33	*982956		CABLE-BATTERY, POS.	1	1
	▫984696		CABLE-BATTERY, POS.	1	1
	# 88866		CABLE-BATTERY, NEG.	1	1
34	982958		CABLE-BATTERY	1	1
35	114637		SENDER-WATER TEMP.	1	1
36	•••••		HEATER-COLD STARTING	1	1
37	981833	A	STARTING MOTOR	1	1
	# 88890	A	STARTING MOTOR	1	1
	16779		CAPSCREW-3/8 UNF X 2 1/4	2	2
	#805055		CAPSCREW-SPECIAL, 3/8 X 9	1	1
	981999		SPACER-STARTER TO HOUSING	1	1
	@133552		SPACER-STARTER TO HOUSING	1	1
38	*103879	A	GENERATOR ASSEMBLY	1	1
	▫118609	A	GENERATOR ASSEMBLY	1	1
39	114641		PLUG	1	••

*LAST USED ON SERIAL NO. B2E-1870 AND B2A-1787.

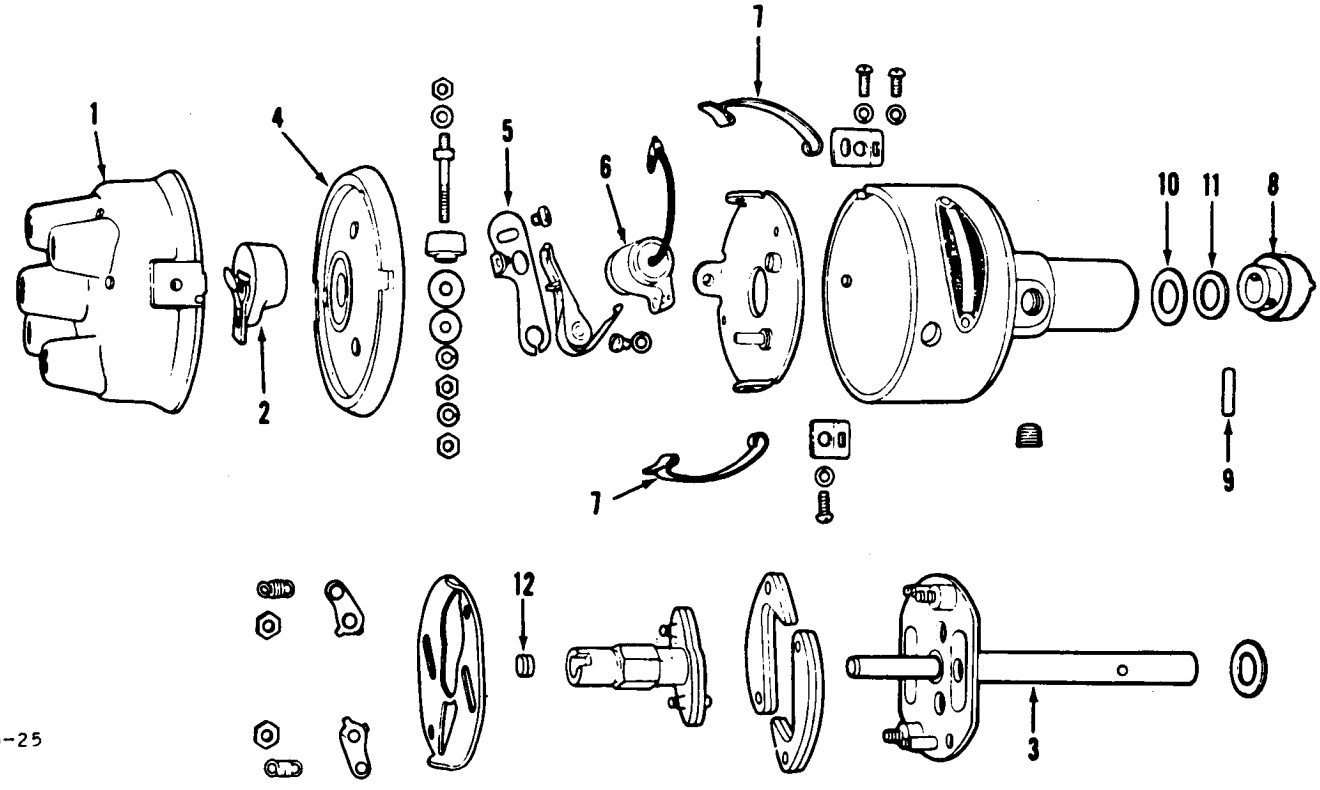
▫FIRST USED ON SERIAL NO. B2A-1788.

@FOR 3-152 DIESEL ENGINE ONLY.

#FIRST USED ON SERIAL NO. B2A-1899.

DISTRIBUTOR ASSEMBLY

FOR GAS ENGINE



510-25

KEY
A-FOR F-162 ENGINE.
B-FOR F-163 ENGINE.

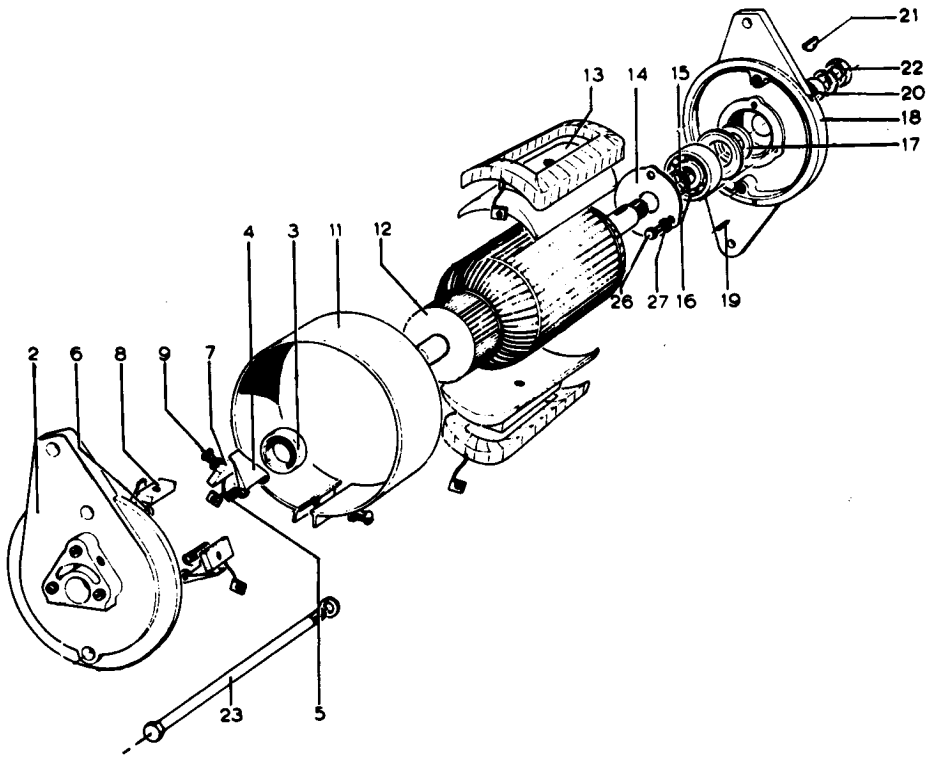
REF. NO.	HYSTER PART NO.	1 2 3 4	NAME OF PART	QTY. A	QTY. B
	202068	A	DISTRIBUTOR ASSEMBLY	1	•
	137705		DISTRIBUTOR ASSEMBLY	••	1
1	202098		CAP	1	••
	141085		CAP	••	1
2	55944		ROTOR	1	••
	141084		ROTOR	••	1
3	108940		SHAFT	1	••
	141079		SHAFT	••	1
4	55907		COVER-HOUSING	1	••
	141082		COVER-HOUSING	••	1
5	108942	A	BRAKER POINT	1	••
	132818		BRAKER POINT	••	1
6	55528	A	CONDENSER	1	1
7	55886		SPRING-CAP	2	••

REF. NO.	HYSTER PART NO.	1 2 3 4	NAME OF PART	QTY. A	QTY. B
8	108941		COUPLING	1	••
	141077		COUPLING	••	1
9	51859		PIN	1	••
	141073		PIN	••	1
10	55727		WASHER-SPACER	1	••
	141076		WASHER-SPACER	••	2
11	55884		WASHER-SHIM, .005	AR	AR
	55885		WASHER-SHIM, .010	AR	AR
12	55930		WICK-FELT	1	••
	15625		CAPSCR.-1/4 UNC X 5/8	1	••
	141083		GREASE FITTING	••	1
	141074		WASHER-WEIGHT PLATE	••	1
	202067	A	CLAMP ARM-DISTRIBUTOR (NOT ILLU.)	1	••
	137870		CLAMP ARM-DISTRIBUTOR (NOT ILLU.)	••	1
	15154		LOCKWASHER-1/4 (NOT ILLU.)	1	••
	15056		NUT-3/8 UNC (NOT ILLU.)	••	1
	15156		LOCKWASHER-3/8 (NOT ILLU.)	••	1

NOTE-DISTRIBUTOR FOR F-162 ENGINE ILLUSTRATED.

GENERATOR ASSEMBLY

LAST USED ON SERIAL NO. B2D-3246, B2E-1870 AND B2A-1787



KEY
A-FOR 6 VOLT 17 AMP GENERATOR, GAS ENGINE.
B-FOR 6 VOLT 40 AMP GENERATOR, GAS ENGINE.
C-FOR 12 VOLT GENERATOR, DIESEL ENGINE

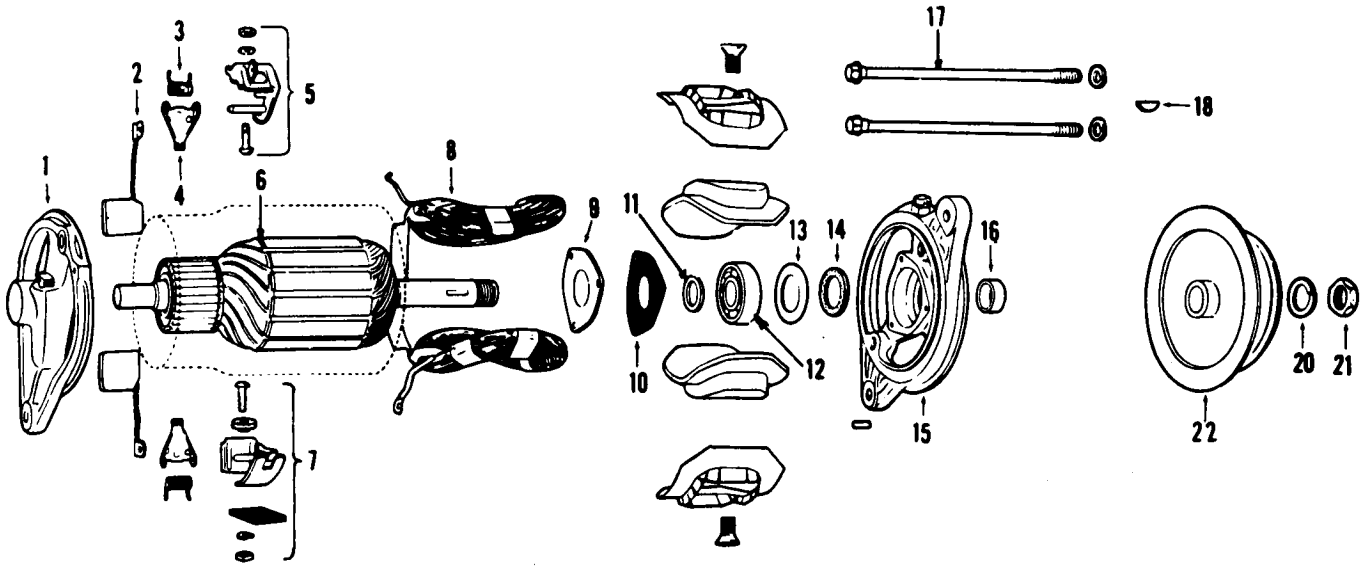
55-87

REF. NO.	HYSTER PART NO. 1 2 3 4	NAME OF PART	QTY. A	B	C
	55640AB	GENERATOR ASSEMBLY	1	••	••
	62895 A	GENERATOR ASSEMBLY	••	1	••
	103879 A	GENERATOR ASSEMBLY	••	••	1
2	55851	FRAME-C.E.	1	••	1
	55519	FRAME-C.E.	••	1	••
3	55518	BUSHING-C.E.	1	1	1
4	55668	ARM-BRUSH	3	3	3
5	55669	SPRING	1	1	1
6	55853	SPRING-THIRD BRUSH	1	1	1
7	55667	BRUSH-MAIN	2	2	2
8	55849	BRUSH-THIRD	1	1	1
9	202013	SCREW-BRUSH	3	3	3
	202014	WASHER-SCREW	3	3	3
11	202000	BAND-COVER	1	1	1
12	55665	ARMATURE	1	••	••
	55800	ARMATURE	••	1	••
	202001	ARMATURE	••	••	1

REF. NO.	HYSTER PART NO. 1 2 3 4	NAME OF PART	QTY. A	B	C
13	55854	FIELD COIL SET	1	••	••
	55809	FIELD COIL SET	••	1	••
	202002	FIELD COIL SET	••	••	1
14	202003	RETAINER-BEARING	1	1	1
	202004	GASKET-RETAINER	1	1	1
15	202005	SPACER-INSIDE	1	1	1
16	43203	BEARING-D.E.	1	1	1
17	55517	WASHER-FELT	1	1	1
18	55852	FRAME-D.E.	1	••	1
	202323	FRAME-D.E.	••	1	••
19	55894	PIN-DOWEL	1	1	1
20	202009	COLLAR	1	••	1
21	59184	KEY	1	1	1
22	55580	NUT-SHAFT	1	1	1
23	202011	BOLT-THRU	2	2	2
	202012	LOCKWASHER	2	2	2
26	986038	CAPSCREW-RETAINER	3	3	3
27	55972	LOCKWASHER	3	3	3

GENERATOR ASSEMBLY - 12 Volt

FIRST USED ON SERIAL NO B2D-3247 AND B2A-1788



120-156

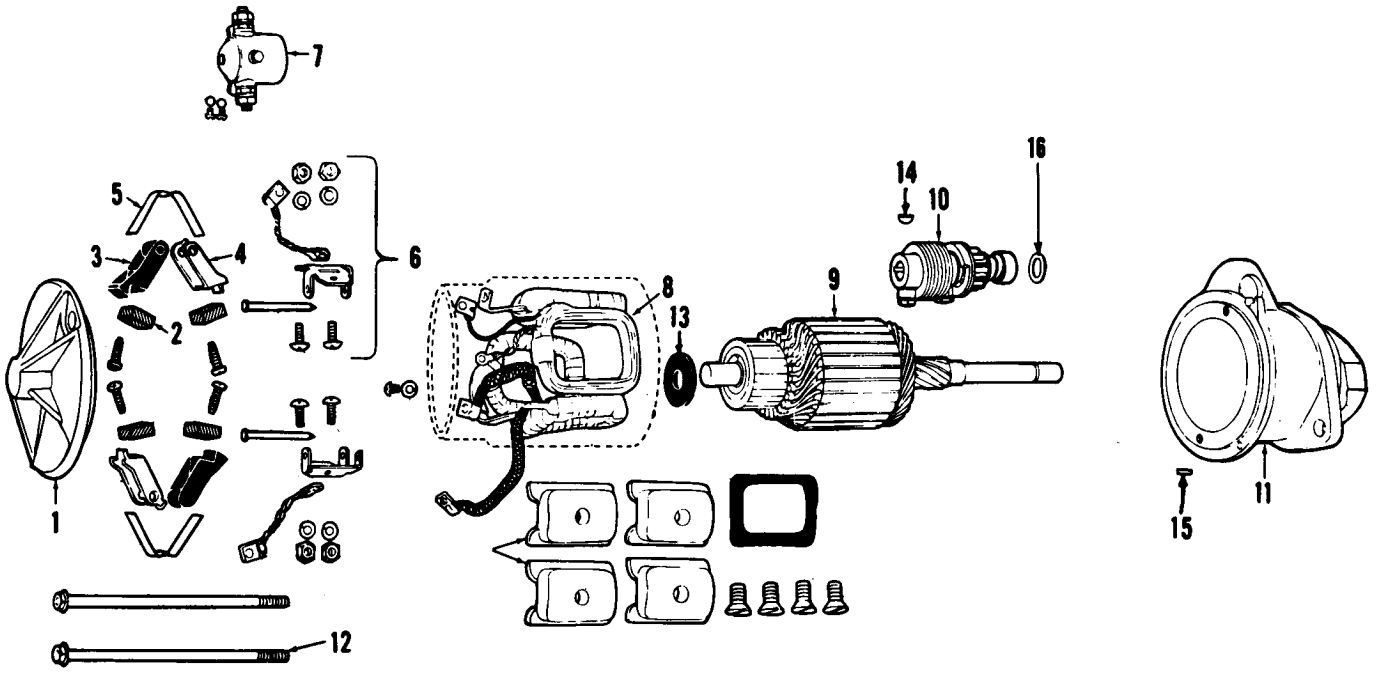
KEY
A-10 AMP GENERATOR ASSY.
B-OPTIONAL 20 AMP GENERATOR.

REF. NO.	HYSTER PART NO. 1 2 3 4	NAME OF PART	QTY. A	QTY. B
	118609 A	GENERATOR ASSEMBLY	1	••
	120117 A	GENERATOR ASSEMBLY	••	1
1	236063	FRAME-C.E.	1	••
1	235945	FRAME-C.E.	••	1
1	235304	BEARING-C.E.	1	1
2	235947	BRUSH	2	2
3	202322	SPRING-BRUSH	2	2
4	55521	ARM-BRUSH	2	2
5	200175	GROUND BRUSH HOLDER SET	1	1
6	200176	INSUL. BRUSH HOLDER SET	1	1
7	236062	ARMATURE	1	••
7	235948	ARMATURE	••	1
8	235949	FIELD COIL SET	1	1
9	202003	PLATE-BEARING RETAINER	1	1
10	202004	GASKET	1	1
11	202005	WASHER-SPACER	1	1
12	235950	BEARING-D.E.	1	1
13	55670	PLATE-RETAINER	1	1
14	55517	WASHER-FELT	1	1
15	55852	FRAME-D.E.	1	••
15	55810	FRAME-D.E.	••	1
16	202009	COLLAR-SPACER	1	••
16	202371	COLLAR-SPACER	••	1
17	202011	BOLT-THRU	2	2
17	202012	LOCKWASHER	2	2
18	59184	KEY	1	1
20	55579	LOCKWASHER	1	1
21	236064	NUT-SHAFT	1	••
21	55580	NUT-SHAFT	••	1
22	69417	SHEAVE-GENERATOR	1	1
22	45512	FAN-GENERATOR	••	1
	111106	BRACKET-GENERATOR (NOT ILLUS.)	1	1
	114321	BRACKET-GEN. ADJ. (NOT ILLUS.)	1	1
	*984058 W	BRACKET-GENERATOR (NOT ILLUS.)	1	••
	¤984060	LINK-GENERATOR (NOT ILLUS.)	1	••

*FOR 3-152 DIESEL ENGINE.

STARTING MOTOR ASSEMBLY - 6 Volt

FOR STANDARD TRANSMISSION



KEY
A-DELCO REMY-1107170.
B-DELCO REMY-1108085.
C-DELCO REMY-1107494.

531-198

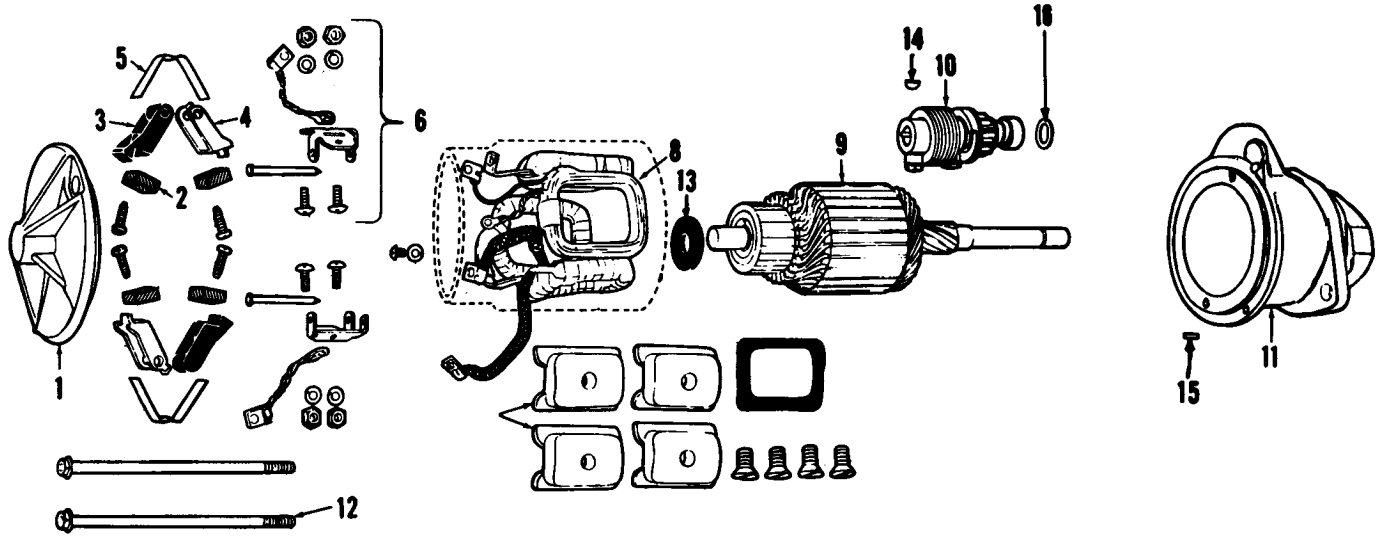
REF. NO.	HYSTER PART NO. 1 2 3 4	NAME OF PART	QTY. A	B	C
	114094 A	STARTING MOTOR ASSY.	1	••	••
	111094AB	STARTING MOTOR ASSY.	••	1	••
	96921 A	STARTING MOTOR ASSY.	••	••	1
1	55586	FRAME-C.E.	1	••	••
	200564	FRAME-C.E.	••	1	••
	55965	BUSHING	1	1	••
	236065	FRAME-C.E.	••	••	1
	55964	BAND-COVER	1	1	1
2	55799	BRUSH	4	4	••
	97316	BRUSH	••	••	4
3	236068	BRUSH HOLDER-INSULATED	••	••	2
4	55542	HOLDER-BRUSH	4	4	••
	236067	BRUSH HOLDER-GROUNDED	••	••	2
5	236069	SPRING-BRUSH	••	••	2
	55541	SPRING-BRUSH	4	4	••
6	236070	SUPPORT KIT-BRUSH HOLDER	••	••	2
7	55914	SOLENOID-STARTER	1	1	1
	55919	CABLE-START. TO SOLENOID	1	1	••
8	55910	FIELD COIL-R.H.	1	••	••
	202334	FIELD COIL-R.H.	••	1	••
	55909	FIELD COIL-L.H.	1	••	••
	202335	FIELD COIL-L.H.	••	1	••
	86883	FIELD COIL ASSY.	••	••	1
9	202050	ARMATURE	1	1	1

REF. NO.	HYSTER PART NO. 1 2 3 4	NAME OF PART	QTY. A	B	C
10	108944 A	DRIVE-MOTOR	1	1	1
	202052	SPRING-MESHING	1	1	1
	202053	SPRING-DRIVE	1	1	1
	202054	PLATE-DRIVE SPRING	2	2	2
11	202361	HOUSING-DRIVE	1	••	••
	87066	HOUSING-DRIVE	••	1	••
	86882 A	HOUSING-DRIVE	••	••	1
	55544	BUSHING-D.E.	1	1	1
12	55917	BOLT-THRU	2	2	••
	88567	BOLT-THRU	••	••	2
13	55901	WASHER-SPACER	1	1	1
14	55893	KEY	1	1	1
15	55894	PIN-DOWEL	1	1	1
16	202333	WASHER-SPACER, D.E.	1	1	1
	* 55892	PLATE-CENTER BEARING	1	1	••
	* 89541	BUSHING	1	1	••
	*202387 A	PLATE-CENTER BEARING	••	••	1
	*202388	BUSHING	••	••	1
	*202389	SEAL-OIL, CENTER BRG.	••	••	1

*NOT ILLUSTRATED.
NOTE-STARTING MOTOR 96921A ILLUSTRATED.

STARTING MOTOR ASSEMBLY - 6 Volt

FOR MONOTROL TRANSMISSION



120-116

KEY
A-DELCO REMY-1108068.
B-DELCO REMY-1107198.

REF. NO.	HYSTER PART NO. 1 2 3 4	NAME OF PART	QTY. A	QTY. B
	202325 A	STARTING MOTOR ASSY.	1	••
	202325AB	STARTING MOTOR ASSY.	••	1
1	202330	FRAME-C.E.	1	••
	55965	BUSHING	1	••
	236065	FRAME-C.E.	••	1
	55964	BAND-COVER	1	••
2	55799	BRUSH	4	••
	236066	BRUSH	••	4
3	236068	BRUSH HOLDER-INSULATED	••	2
4	88572	BRUSH HOLDER-GROUNDED	••	2
	55542	HOLDER-BRUSH	4	••
5	236069	SPRING-BRUSH	••	2
	55541	SPRING-BRUSH	4	••
6	236070	SUPPORT KIT-BRUSH HOLDER	••	2
	986154	LEAD-GROUND	••	2
	202334	FIELD COIL	1	••
8	202335	FIELD COIL-L.H.	1	••
	97318	FIELD COIL ASSEMBLY	••	1
9	202050	ARMATURE	1	1
10	202331	DRIVE-MOTOR	1	1

REF. NO.	HYSTER PART NO. 1 2 3 4	NAME OF PART	QTY. A	QTY. B
	202332 A	HOUSING-DRIVE	1	••
11	97319 A	HOUSING-DRIVE	••	1
	¤ 55544	BUSHING-.625 O.D.	••	1
	55965	BUSHING-.685 O.D.	••	1
	55917	BOLT-THRU	2	••
12	88567	BOLT-THRU	••	2
	55918	LOCKWASHER	2	••
13	55901	WASHER-THRUST, C.E.	1	1
14	9033	KEY	1	1
15	55894	DOWEL PIN	1	1
16	202333	WASHER-SPACER, D.E.	1	1
	* 55892	PLATE-CENTER BEARING	1	1
	* 89541	BUSHING	1	1
	*111050 W GUARD-GAS	FOR B2E AND B2A	1	••
	*118623 W GUARD-GAS	SERIES TRUCKS	••	1

*NOT ILLUSTRATED.

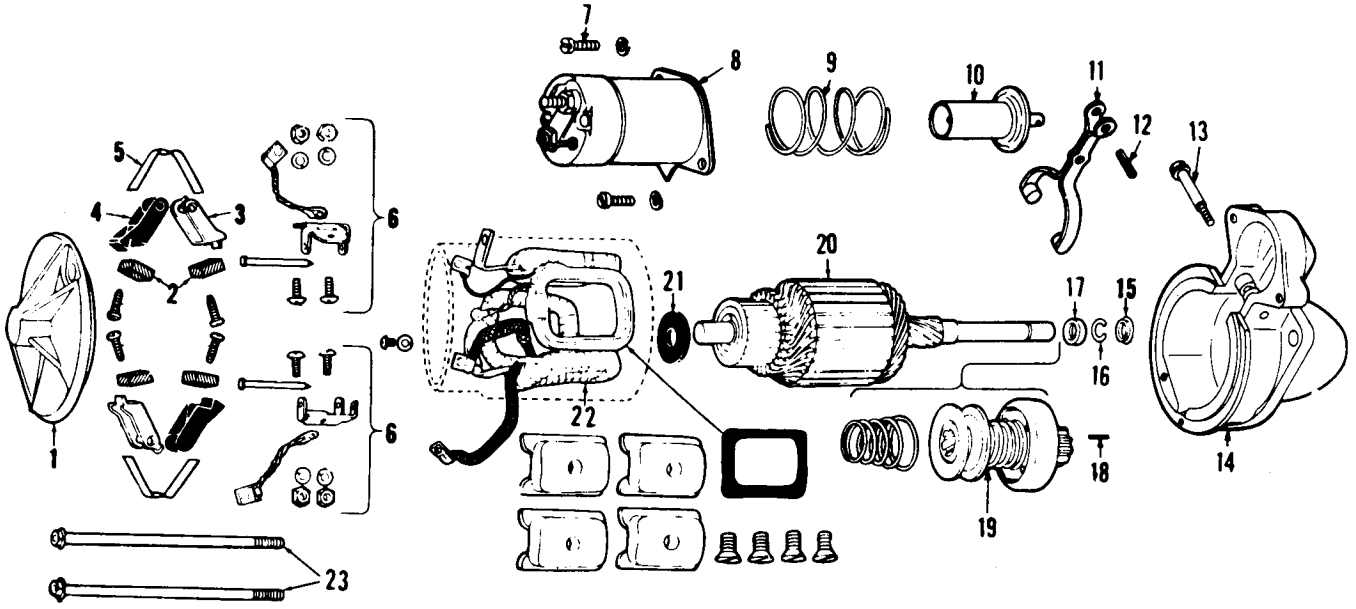
¤CHECK BORE IN HOUSING BEFORE ORDERING BUSHING.

NOTE-STARTING MOTOR ASSEMBLY 202325AB ILLUSTRATED.

STARTING MOTOR ASSEMBLY - 12 Volt

FOR GAS ENGINE

FIRST USED ON SERIAL NO. B2D-3247 AND B2A-1788



KEY
B-FOR STANDARD TRANSMISSION ONLY.
A-FOR MONOTROL TRANSMISSION ONLY.

163-22

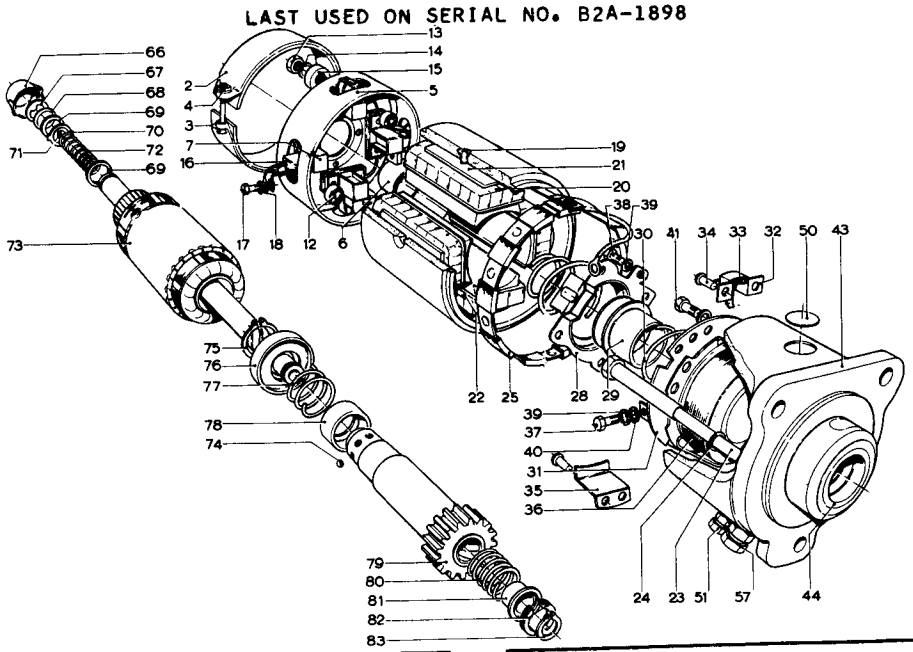
REF. NO.	HYSTER PART NO. 1 2 3 4	NAME OF PART	QTY. A	QTY. B
	120979 A	STARTING MOTOR ASSY.	••	1
	118616 A	STARTING MOTOR ASSY.	1	••
1	236065	FRAME-C.E.	1	1
	89541	BUSHING	1	1
2	236066	BRUSH	4	4
3	236067	HOLDER-BRUSH, GROUND	2	2
4	236068	HOLDER-BRUSH, INSULATED	2	2
5	236069	SPRING-BRUSH	2	2
6	236070	SUPPORT KIT-BRUSH HOLDER	2	2
7	236071	SCREW	2	2
	236072	LOCKWASHER	2	2
8	236073	SOLENOID-STARTER	1	1
9	236074	SPRING-RETURN	1	1
10	236075	PLUNGER	1	1
11	236076	LEVER-SHAFT	1	1
12	236077	PIN	1	1
13	236078	STUD-LEVER	1	1

REF. NO.	HYSTER PART NO. 1 2 3 4	NAME OF PART	QTY. A	QTY. B
14	98342	HOUSING-DRIVE	1	••
	77116	HOUSING-DRIVE	••	1
	55585	BUSHING	1	1
15	236080	COLLAR-THRUST	1	1
16	236081	RING-RETAINER	1	1
17	236082	COLLAR-STOP	1	1
18	55894	PIN	1	1
19	236083	MOTOR-DRIVE	1	••
	77117	MOTOR-DRIVE	••	1
20	236084	ARMATURE	1	1
21	55901	WASHER-BRAKE, C.E.	1	1
22	236085	FIELD COIL ASSEMBLY	1	1
23	88567	BOLT-THRU	2	2
	55969	PLATE-CENTER BRG.	1	1
	111403	SPACER (NOT ILLUS.)	••	1
	55970	BUSHING (NOT ILLUS.)	1	1
	104708	ADAPTER (NOT ILLUS.)	1	••

STARTING MOTOR ASSEMBLY

FOR DIESEL ENGINE

LAST USED ON SERIAL NO. B2A-1898



189-74

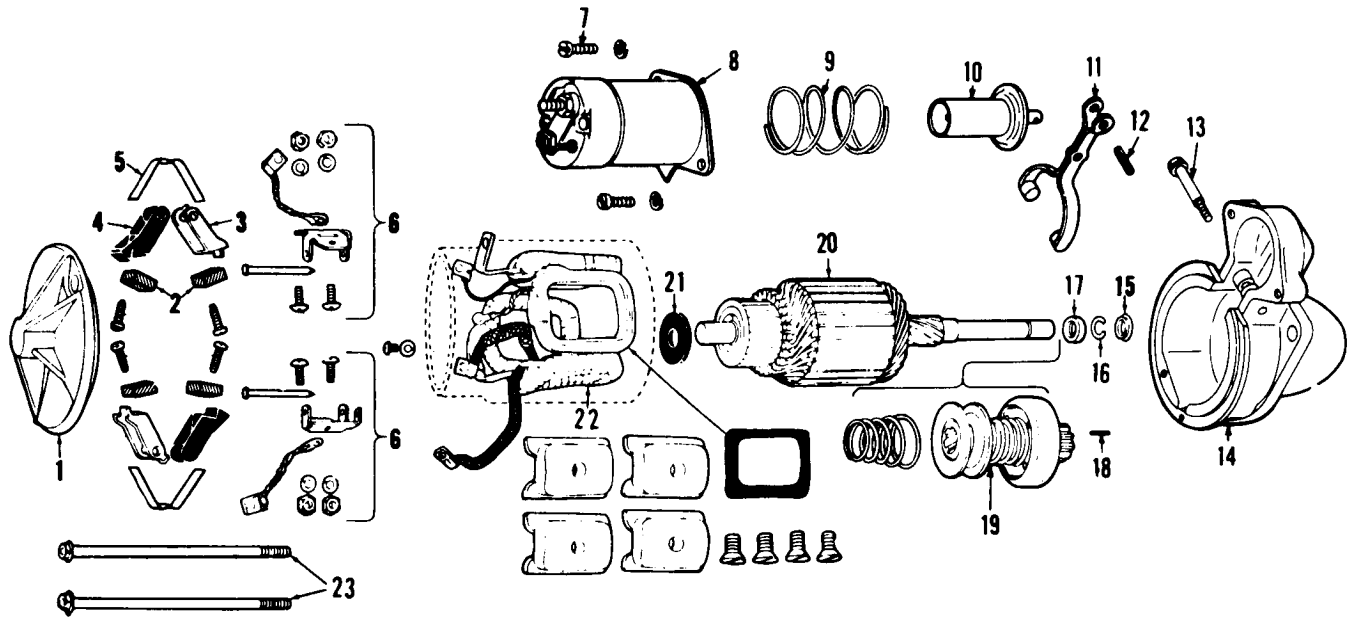
REF. NO.	HYSTER PART NO. 1 2 3 4	NAME OF PART	QTY.
	981833 A	STARTING MOTOR ASSEMBLY	1
2	886044 A	COVER ASSMEBLY	1
3	986045	SCREW	1
4	983402	NUT	1
5	986066 A	SHIELD ASSY.-C.E.	1
6	985069	BEARING	1
7	986046	BOX-BRUSH	4
	983435	RIVIT	8
	986047	BUSHING-INSULATING	4
	986048	SPACER-BRUSH BOX	4
	986049	INSULATOR-BRUSH BOX	4
13	986050	NUT-TERMINAL	1
12	983445	SPRING-BRUSH	4
13	986050	NUT-TERMINAL	1
14	986051	LOCKWASHER	1
15	986052	SPACER-TERMINAL	1
16	986053	BRUSH SET	1
17	983448	SCREW-BRUSH	4
18	992746	WASHER	4
19	983403	SCREW-POLE	4
20	986054	COILS-FIELD	2
21	986055	INSULATOR-FIELD	8
22	983407	PIN-DOWEL	1
23	983397	BOLT-THRU	2
24	986056	LOCKWASHER	2
25	985254 A	RESISTOR ASSEMBLY	1
	983429 A	SOLENOID ASSEMBLY	1
28	983438	CONTACT-MOVING	1
29	136572	PLUNGER AND SPRING	1
30	983437	SPRING-RETURN	1
31	986059	PLATE AND CONTACTS	1
32	983432	TRIGGER AND GUIDE	1
33	983433	SPRING-TRIGGER	1
34	983435	RIVET	4
35	986027	STOP-CONTACT	1
36	983430	COIL	1
37	986060	SCREW	1
38	986043	SCREW	1
39	992746	LOCKWASHER	2
40	983401	WASHER	2
41	983441	SCREW	1
	983442	WASHER	1

REF. NO.	HYSTER PART NO. 1 2 3 4	NAME OF PART	QTY.
	983409 A	SHIELD ASSY.-D.E.	1
	983411	PLUG-CORE	1
43	983412	SPRING-OILER	1
	983462	PAD-FELT,WIDE	1
	983415	PAD-FELT, NARROW	1
	992294	WICK-COTTON	1
44	983410	BEARING	1
50	983408	PLUG-CORE	1
51	986061	TERMINAL-SMALL	1
	983427	NUT	1
	992746	WASHER	1
52	983401	WASHER	1
	983452	BUSHING	1
	98314	INSULATOR-INTERNAL	1
	986062	TERMINAL-LARGE	1
	986050	NUT	1
	983398	LOCKWASHER	1
	983420	WASHER	1
57	983419	WASHER-INSULATING	1
	983418	BUSHING	1
	983417	INSULATOR-INTERNAL	1
	983423	SCREW	1
	992672	WASHER	1
66	983455 A	END CAP ASSEMBLY	1
67	983454	CLIP	1
68	983396	SHIM-.008	AR
	983682	SHIM-.012	AR
69	983453	WASHER-THRUST	2
70	983452	WASHER	1
71	983451	BALL-STEEL	1
72	983450	SPRING-SHAFT	1
73	138626	ARMATURE	1
74	986064	BALL-STEEL	4
75	983394	SNAP RING	1
76	983393	COLLAR	1
77	983393	SPRING-LOCKING	1
78	983391	COLLAR-LOCKING	1
79	986065	PINION	1
80	983388	SPRING-PINION	1
81	132872	SLEEVE KIT	1
	.....	SLEEVE	1
82	.....	KEY	1
83	.....	SNAP RING	1

STARTING MOTOR ASSEMBLY

FOR DIESEL ENGINE.

FIRST USED ON SERIAL NO. B2A-1899



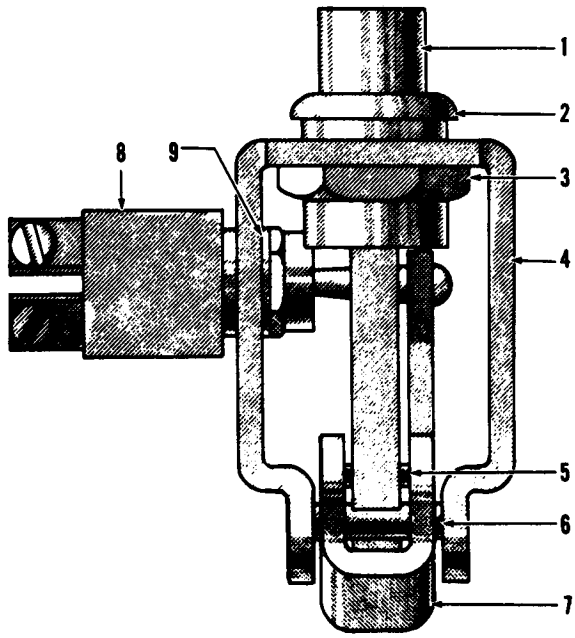
163-22

REF. NO.	HYSTER PART NO. 1 2 3 4	NAME OF PART	QTY.
	88890 A	STARTING MOTOR ASSEMBLY	1
1	97344	FRAME-C.E.	1
	55965	BUSHING	1
	200555	WICK-OIL	1
2	97345	BRUSH	4
3	236067	HOLDER-BRUSH, GROUND	2
4	236068	HOLDER-BRUSH, INSULATED	2
5	236069	SPRING-BRUSH	4
6	236070	SUPPORT KIT-BRUSH HOLDER	2
7	236071	SCREW-MOUNTING	2
	236072	LOCKWASHER	2
8	97346	SWITCH-SOLENOID	1
9	236074	SPRING-PLUNGER RETURN	1
10	236075	PLUNGER-SOLENOID	1
11	236076	LEVER-SHIFT	1
12	19869	PIN-ROLL, 3/16 X 13/16	1
13	97349	SCREW-SHIFT LEVER	1
	97351	LOCKWASHER	1
	97350	NUT	1

REF. NO.	HYSTER PART NO. 1 2 3 4	NAME OF PART	QTY.
14	98054	HOUSING-DRIVE	1
	97353	BUSHING-D.E.	1
	97496	WICK-OIL	1
15	236080	WASHER-SPACER, D.E.	1
16	236081	RING-PISTON STOP	1
17	236082	COLLAR-PISTON STOP	1
18	55894	PIN-DOWEL, D.E.	1
19	97360	DRIVE ASSEMBLY	1
20	97358	ARMATURE	1
21	55901	WASHER-SPACER, C.E.	1
22	97359	FIELD COIL ASSEMBLY	1
23	97361	BOLT-THRU	2
	77118	CENTER BEARING } NOT	1
	97500	BUSHING } ILLUS.	1

SWITCH ASSEMBLY

FOR MONOTROL TRANSMISSION



120-60

REF. NO.	HYSTER PART NO. 1 2 3 4	NAME OF PART	QTY.
	114649 A	SWITCH ASSEMBLY	1
1	114658	BUTTON-PUSH, PARK	1
	114657	BUTTON-PUSH, DRIVE	1
2	114653	SWITCH-BEZEL	2
	104506	O-RING	2
3	114655	NUT-SPECIAL	2
	114654	LOCKWASHER-SPECIAL	2
4	114650	BRACKET-SWITCH	1
5	19973	ROLL PIN-1/8 X 5/8	2
6	19871	ROLL PIN-3/16 X 5/16	1
7	114656	PLATE-ROCKER	1
8	114651	SWITCH-TOGGLE	1
9	114652	LOCKWASHER-SPECIAL	1

SECTION A—ENGINE

TABLE OF CONTENTS

GASOLINE ENGINE—F162, F163

GENERAL

This section covers the F162 and F163 gasoline engines. Both have four cylinders and "L" heads. Each is the four stroke cycle type.

Although some internal specifications will vary between models their general construction remains the same. The service procedures outlined below apply to both.

Each model can be identified by the name plate on the right side of the engine, near the center of the crankcase.

REMOVAL

1. Tilt the hood back and remove it from the truck. Unscrew the counterweight mounting bolt from the rear of the truck.

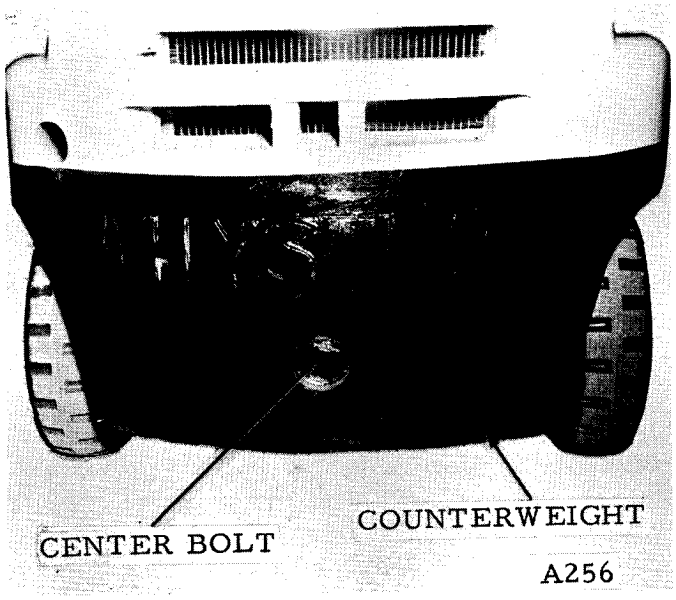


Figure 1

2. Loosen the two mounting nuts, one on each side, in the engine compartment. Fig. 2. Attach a hoist to the counterweight and lift it from the truck. Remove the floor plates.

3. Drain the radiator. Disconnect the upper and lower radiator hoses. If the truck is equipped with a powershift transmission, disconnect the hoses from the oil cooler in the bottom of the radiator. Unscrew the radiator mounting bolts and lift the radiator out.

4. Disconnect the ground strap and cable from

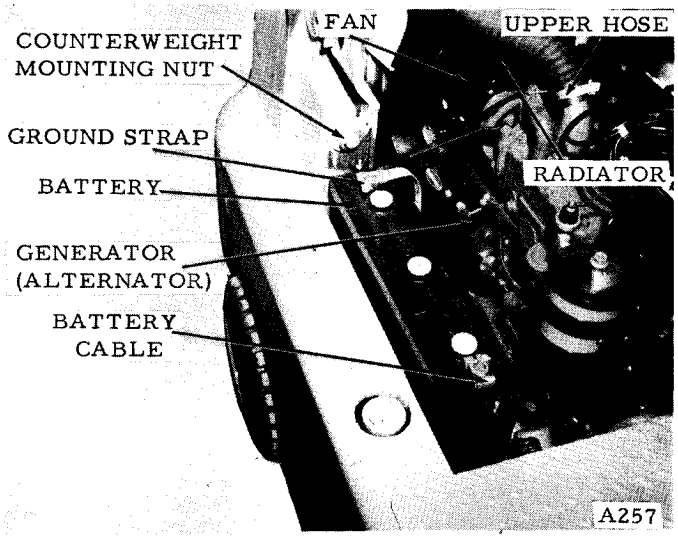


Figure 2

the battery. Unscrew the battery hold-down wing nuts. Remove the battery hold-down and lift the battery out. Disconnect the wires from generator (alternator). Fig. 2.

5. Disconnect: the wire from the oil pressure sender; the high and low tension wires from the ignition coil; the wire from the temperature sender. Fig. 3.

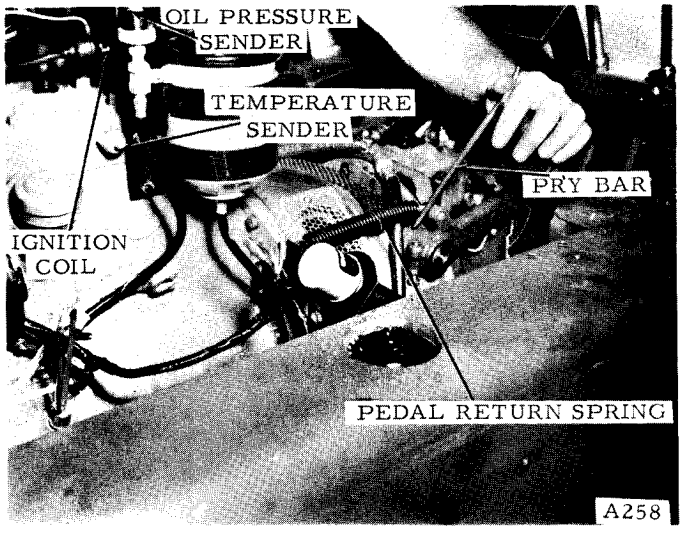


Figure 3

6. Disconnect: the cable from the starter or starter solenoid; the wires from the solenoid; fuel gauge sender; generator regulator (alternator regulator).

7. Disconnect the fuel line from the fuel pump;

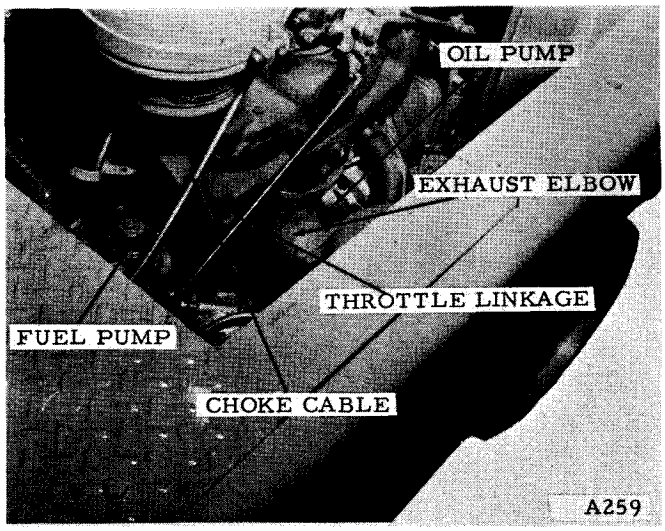


Figure 4

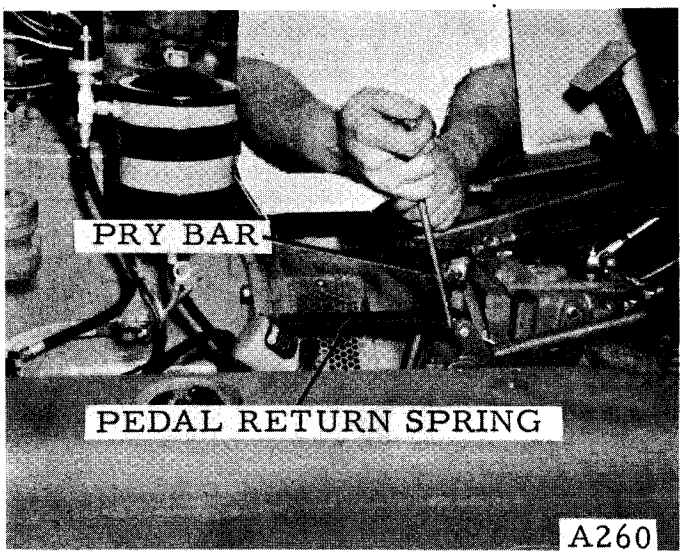


Figure 5

the exhaust elbow at the muffler; the hydraulic lines from the oil pump. Fig. 4. Cap all hydraulic openings.

8. Refer to Step "a" if the truck is equipped with a standard transmission; Step "b" if the transmission is powershift.

a. Remove the two front engine mount nuts. Remove the foot pedal return springs at the foot pedals. Fig. 3. Place a block beneath the transmission, attach a hoist to the engine and remove the capscrews from the clutch housing to bell housing. Move engine away from the clutch housing while removing the bottom capscrews from bell housing, at the point where the parking brake interferes. Lift the engine from the truck.

b. Remove the foot pedal return springs, at the foot pedals. Fig. 5. Index the converter to flywheel. Remove the converter mounting capscrews from the engine flywheel through the access holes located on the top of the converter housing. Remove the oil cooling hoses at the valve and cap. Remove the 2 front engine mount nuts. Attach a hoist and support the engine weight. Place a block beneath the converter housing and remove the capscrews holding it to the engine converter housing adaptor plate. Lift the engine from the truck.

CYLINDER HEAD

A. Removal

NOTE: To aid in obtaining correct ignition timing, remove distributor cap and record rotor position.

Remove the distributor, the coil mount bracket, the governor spring bracket, and the spark plugs. Loosen and remove the nuts holding the cylinder head to the block. Remove the head from the engine.

B. Cleaning and Inspection

1. Remove all carbon from combustion areas, using a scraper and wire brush. Fig. 6. Clean the cylinder head thoroughly with a solvent or degreasing solution and blow it off with compressed air. Make sure the gasket contact surface of the head is clean, smooth and flat. Check flatness with straight edge and feeler gauge in three positions lengthwise and five crosswise. The maximum permissible is .004" low in the center lengthwise, gradually decreasing toward the ends, or .003" crosswise or in localized low spots. Fig. 7 and Fig. 8.

2. Inspect for cracks. Wipe planed surface with a rag saturated with kerosene, wipe head dry then tap lightly throughout entire surface. Cracks will be indicated by the kerosene being vibrated out of the crack and appearing on the planed surface.

3. Clean and check cylinder block, being careful not to allow carbon to enter intake and exhaust

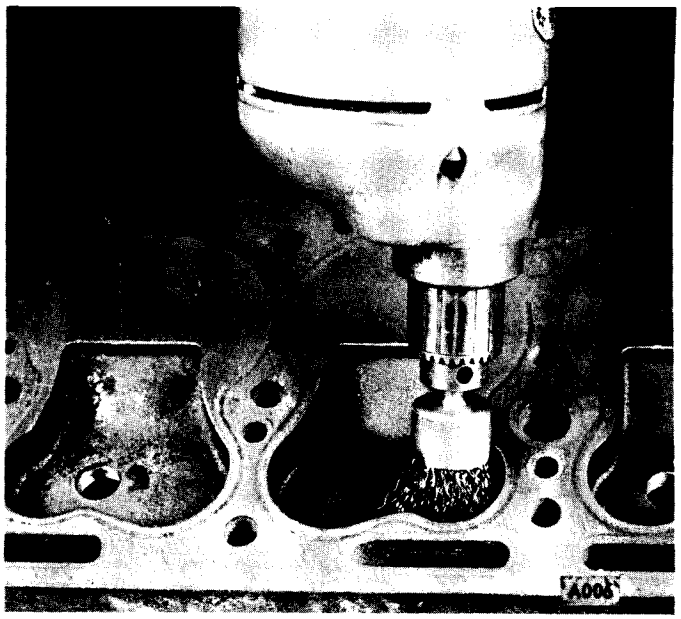


Figure 6

Figure 8

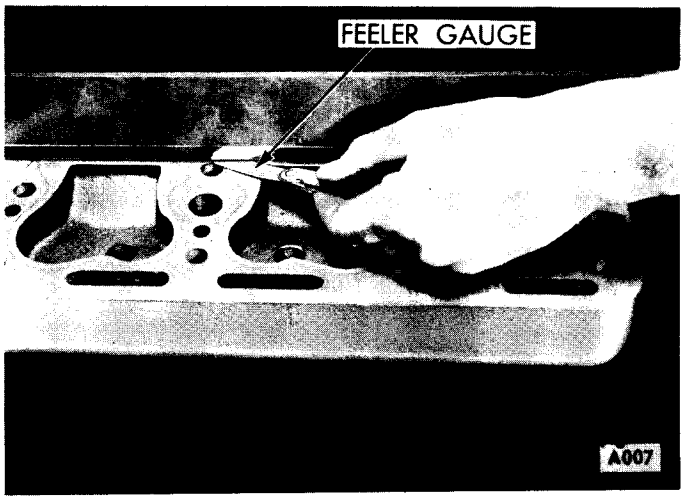
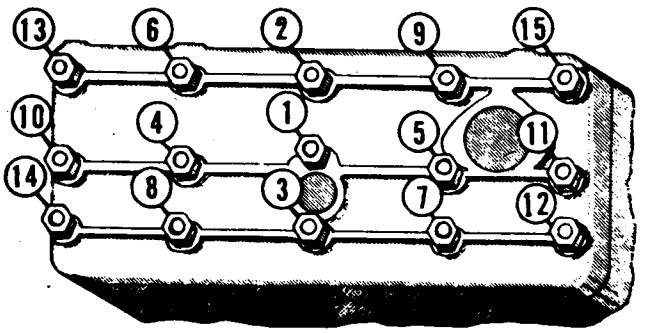


Figure 7



A261

Figure 9

ports.

4. Clean threads of the head studs and nuts.

C. Installation

Use the reverse of removal procedure.

Tighten with torque wrench in recommended sequence to the correct torque by going over the head nuts two times before pulling them down to the final torque specification on the third round. Fig. 9 and Fig. 10.

VALVE ASSEMBLIES

A. Valve Removal

Remove head and tappet cover. With a valve spring lifter, compress the springs and remove the keepers from the valve stems which are in a closed position. Fig. 11. Close the other valves by rotating the crankshaft and remove the keepers from these valves in the same manner. Remove all valves and place in correct order to prevent mixing while handling.

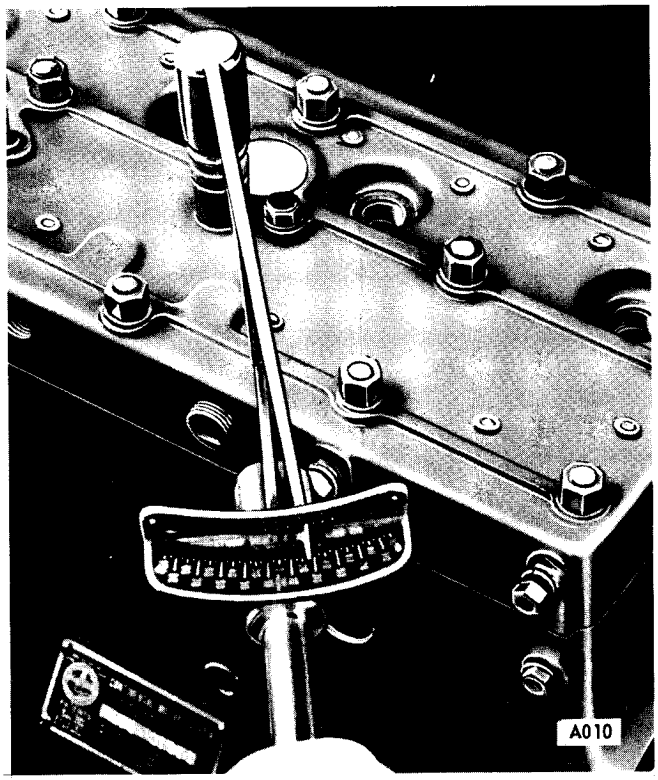


Figure 10

B. Valve Guides

1. Clean the valve stem guides, removing lacquer or other deposits by running a valve guide cleaner or wire brush through the guides.

2. Check guides for wear by using a "go and no go" plug gauge or a telescope gauge and 1" micrometer. Replace all guides that are worn bellmouthed and have increased .0015" in diameter. See Specification Listing for maximum diameter permissible to determine actual amount the diameter has increased.

3. Remove all valve guides when necessary by driving them out from the combustion chamber side with a driver slightly smaller than the O.D. of the valve guide. Fig. 11.

4. Install new guides as required by driving from the combustion side to the correct depth below the valve seat as given in the Specification Listing.

5. Ream new valve stem guides to size given in the Specification Listing, using a straight

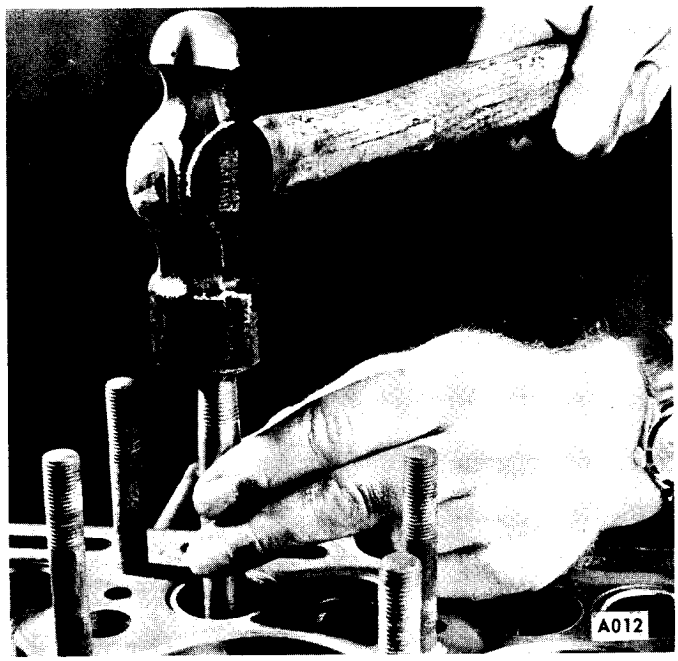


Figure 11

reamer ground to correct size and having a pilot which will properly locate it and keep it from wandering from the original reamed hole.

CAUTION: When replacing with guides that are ferrox coated, do not ream since these are all pre-reamed before being ferrox coated. Further reaming will remove the coating.

C. Valve seat inserts

1. The exhaust valve seat insert is held in place by a shrink fit. Inspect all exhaust valve seat inserts in the block and replace any that are loose, cracked or otherwise damaged. Use a puller for removing a faulty insert as shown in Fig. 12. When replacement of a new insert is required, clean and counterbore for .010" larger insert using a counterbore tool with a correct fitting pilot. When machining the counterbore, be sure to go deep enough with the tool to clean up the bottom so that the insert will have full contact to carry away the heat. Do not install new inserts having the same outside diameter as the one removed. Dimensions of standard inserts and counterbores are given in the Specification Listing.

2. When oversize inserts are used, dimensions of the insert and counterbore increase

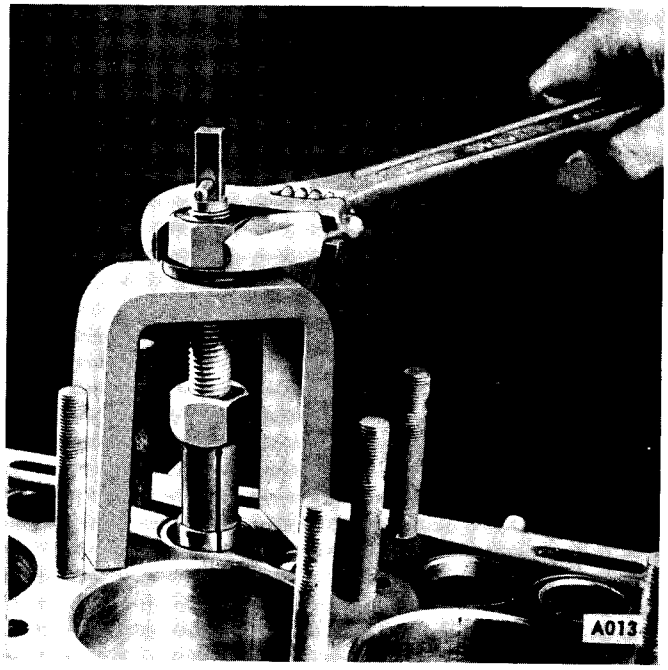


Figure 12

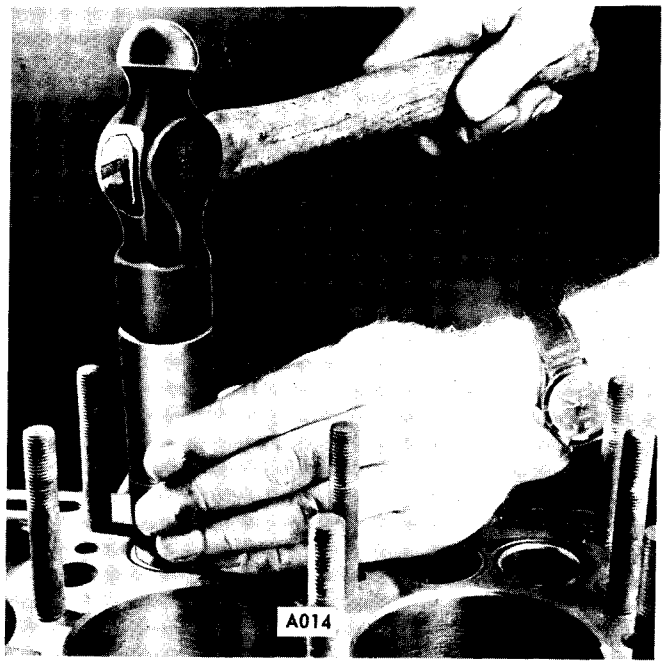


Figure 13

proportionately (.010", .020", .030", depending on the oversize). New insert installation should have a press fit. Chill insert with dry ice for 20 minutes before assembling. Insert may then be installed in the counterbore using a piloted driver, tapping in place with very light hammer blows, without shearing the side walls. Fig. 13. This assures a firm seating in the bottom of the counterbore, after which it should be rolled in place.

3. Grind the intake and exhaust valve seats, fig. 14, in the block in accordance with Specification Listing. Before removing the arbor, check seat for runout. Total indicator reading of the run-out must not be more than .002". Use a solid stem pilot with a long taper, as all valve seats must be ground concentric and square with either new or worn valve stem guide holes. Fig. 15.

D. Valves

1. Inspect valves and replace any that are cracked, burned or which have stems that are bent or worn more than .002" over the maximum allowable limits. Reface or replace all valves.

2. All valves having less than 50% margin

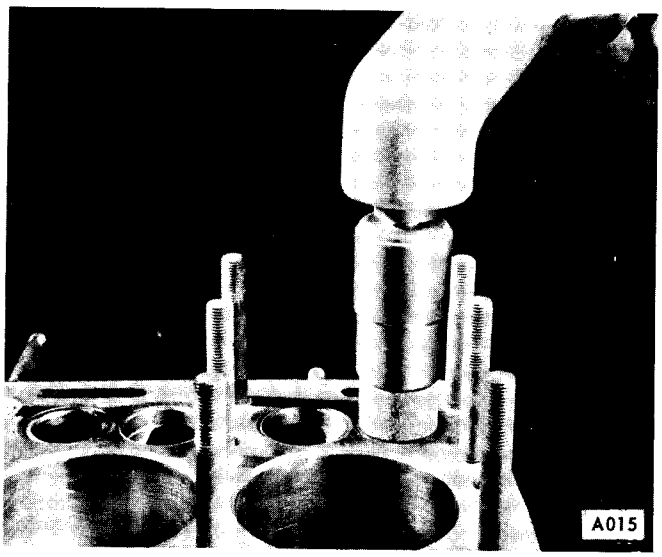


Figure 14

thickness (outer edge of valve head) after refacing has been completed, should be replaced. To check this dimension, compare the refaced valve with a new valve. Fig. 16.

3. Check all refaced or new valves in V-blocks with indicator to determine if the contact face is true with the stem within .002". Fig. 17. If not, repeat the refacing operation.

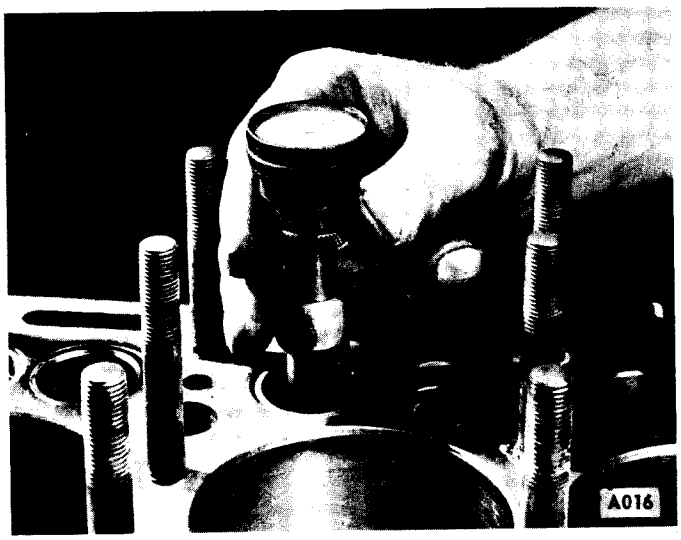


Figure 15

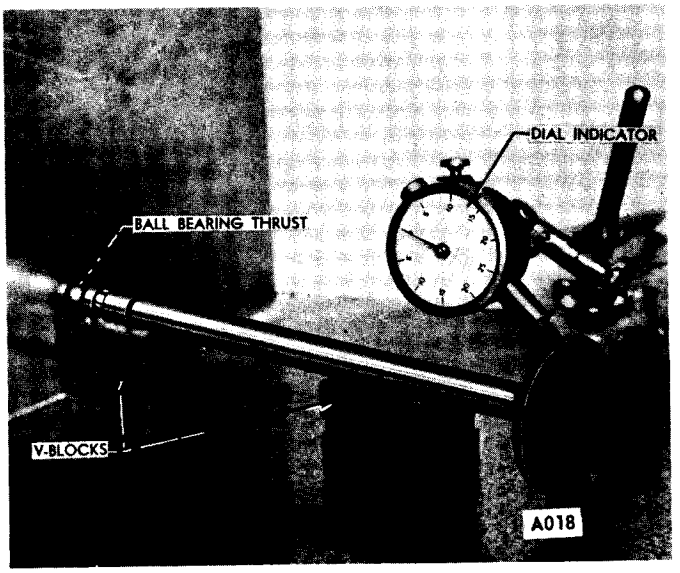


Figure 17

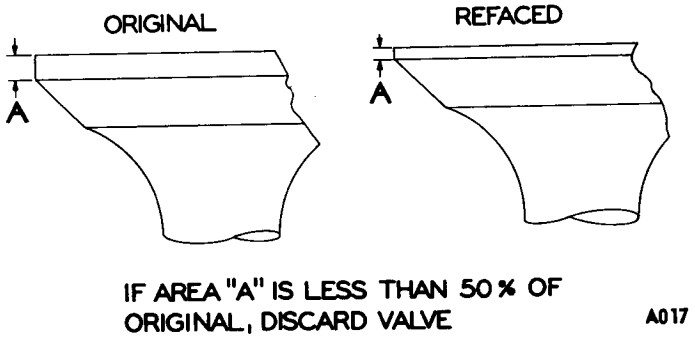


Figure 16

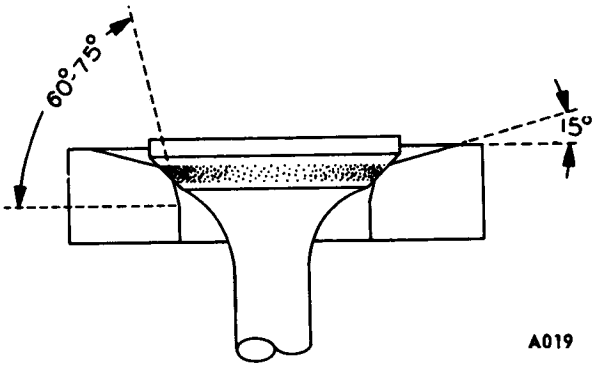


Figure 18

4. After the valves and seats have been refaced and reground, coat the seat lightly with "Prussian Blue" and drop the valve into position, oscillating it slightly to transfer the blue pattern to the valve face. This should show a contact width of 1/16" to 3/32" and should fall well within the width of the valve face, leaving at least 1/64" on either side where the blue does not show. If the valve contact is over 3/32" wide, the seat in the block may be narrowed by using a 15° stone to reduce the outside diameter or using a 60° or 75° stone to increase the inside diameter. Fig. 18. Never allow valves to sit down inside the seat. Fig. 19.

5. After the narrowed-down seat is brought within specifications, the seat should be retouched lightly with the original stone to remove burrs or feathered edge. Coat the valve stem with a light film of engine oil.

E. Valve Springs

Check all valve springs on the spring tester to make sure they meet specifications regarding force and length. Fig. 20. Springs, when compressed to the "valve open" or "valve closed" length, must fall within correct specifications when new, and must not show more than 10% loss in order to re-use. Reassemble the valves and springs in the block with the retainer and retainer pin.

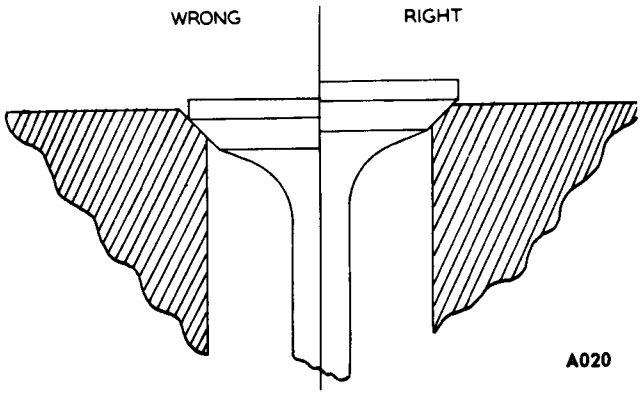


Figure 19

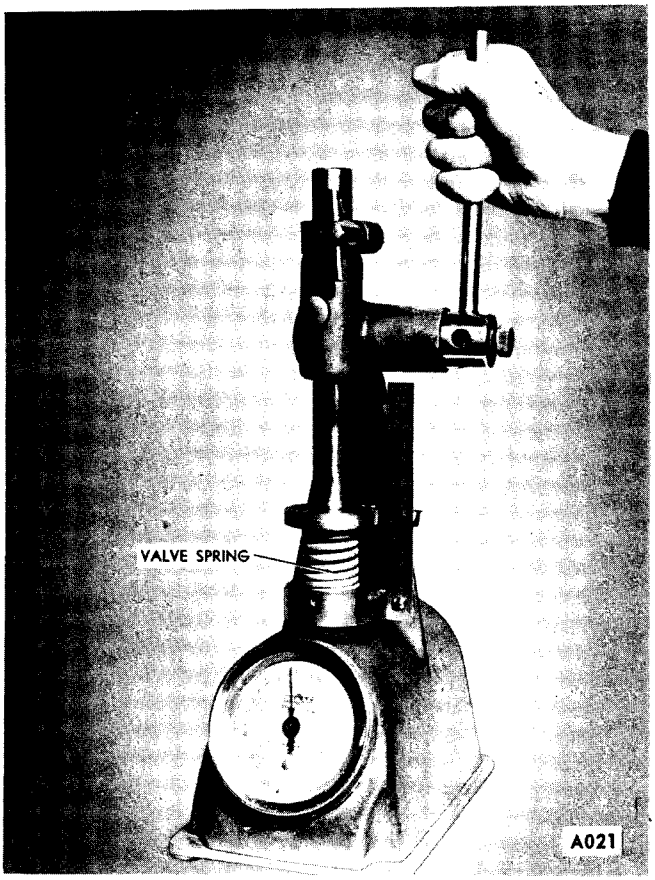


Figure 20

CHECKING BORE WEAR

A. Clean the ring of carbon from around the top of the cylinder formed above the travel of the top ring.

B. Determine the original diameter of the cylinder by checking the unworn area with inside micrometer at intervals of approximately 45° Fig. 21.

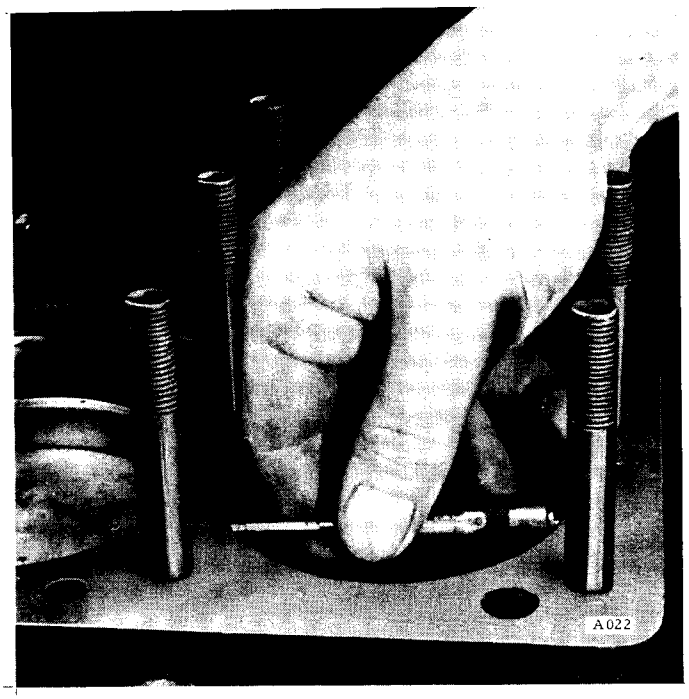


Figure 21

C. Check in same manner the top of the ring travel area approximately 1/4" below the shoulder.

D. The maximum difference in the above checks, indicates the amount of cylinder wear. If less than .008" reringing will be suitable; and if over .008", rebore.

PISTONS AND RODS

A. Removal

1. Ridge ream the cylinders to remove the unworn area at the top so that the new rings when assembled will not bump and distort both themselves and the piston lands. Several good makes of ridge reamers are available which will ream the top of the bore in direct relation to the worn area so that should the worn area be off center slightly, there will be no partial ridge remaining. Fig. 22.

2. Drain the crankcase and remove the oil pan.

3. Remove capscrews from the connecting

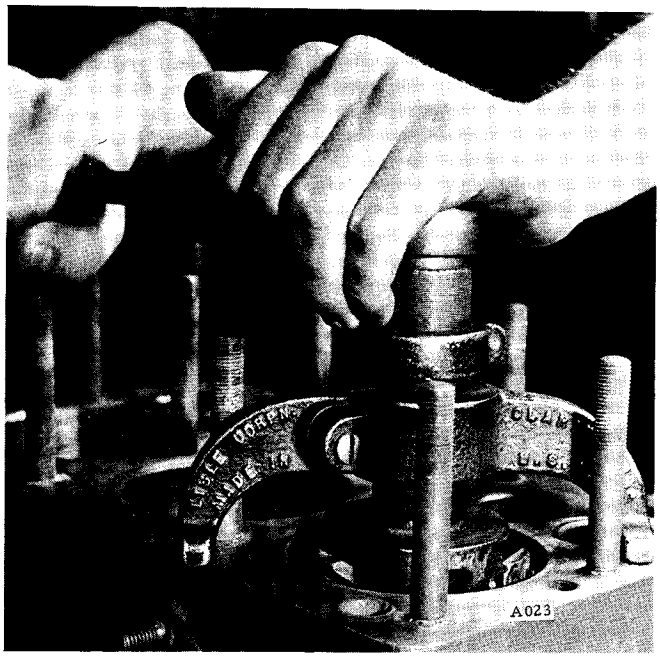


Figure 22

rods, permitting removal of caps. Keep the caps and bolts in numerical order so that when the pistons and rods are removed from the engine, the cap can be reassembled and kept with its mating part. If not already numbered, do so at this time.

4. Push the pistons and connecting rods up through the top of the cylinders.

5. Cut the glaze on the cylinder bores with a de-glazer to assure quick seating of the new piston rings. Fig. 23. Protect the crankshaft with oily (not dirty) rags during the deglazing operation.

NOTE: The de-glazer, fitted with 220 grit stones, may be run up and down the cylinder bore while being turned with an electric drill until the shiny surface (glaze) is removed. These surfaces must then be throughly cleaned by wiping with a clean, oiled rag which will pick up the small particles of dust that are embedded in the pores of the iron.

6. Failure to do this cleaning carefully, raises one of the big objections to using a de-glazer or other means for roughing the cylinder bores. However, if the glaze is not removed, there is no assurance as to when the rings will begin to function properly and control the oil.

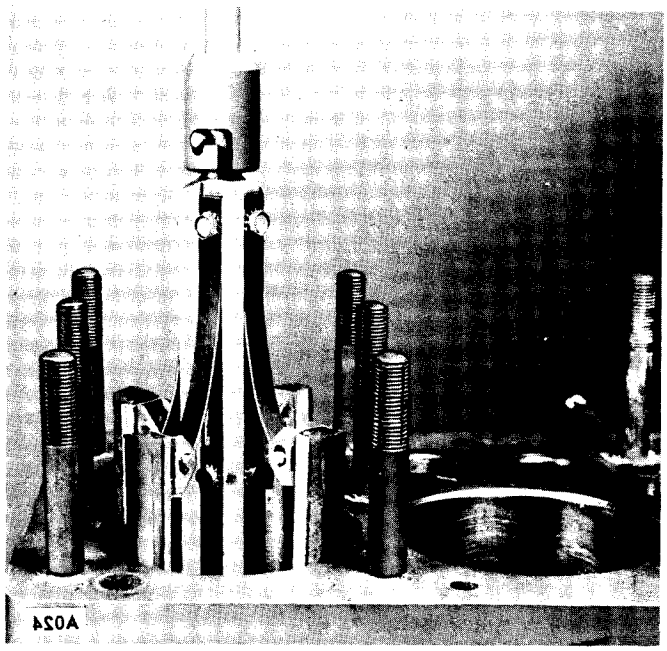


Figure 23

7. Cross hatches should be clearly visible after glaze breaking operations. Fig. 24.

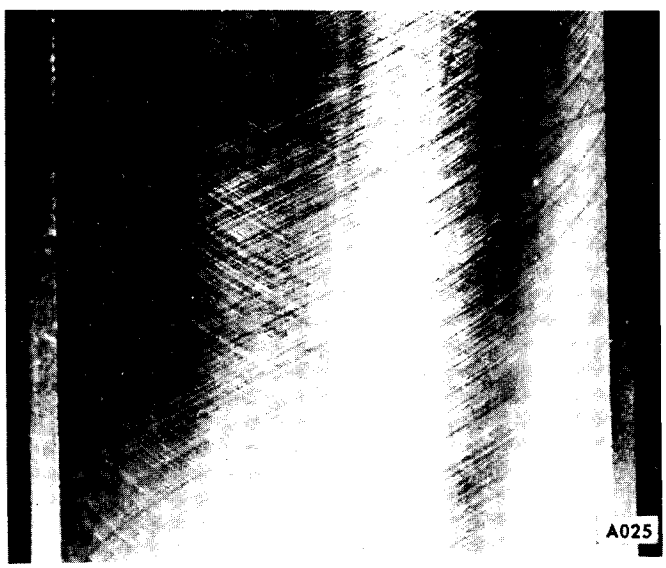


Figure 24

B. Piston Fit

1. Check the piston fit in the bore using a half-inch wide strip of .003 inch feeler stock attached to a small scale of approximately 15 lbs. capacity.

2. Insert the feeler between the piston and the cylinder, midway between the piston pin bosses. When the correct fit is obtained, a pull of 5-10 pounds on the scale will be needed to withdraw the feeler. **Fig. 25.** The pistons must be fitted with the block and pistons at room temperature (68°-70°).

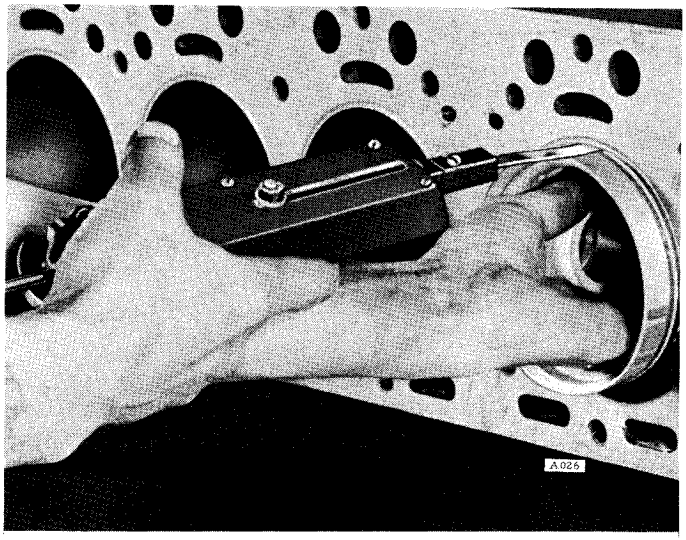


Figure 25

3. Check the fit of the piston when it is approximately 2'' down in the cylinder bore in an inverted position.

C. Piston Rings

1. Check all piston rings in the cylinders for gap whether using a re-ring set of piston rings in cylinder bores which have been ridge reamed or an oversize set for rebored cylinders.

2. To do this, insert a piston in the cylinder in an inverted position and then insert each ring, one at a time, about 2'' down in the bore. Bring the bottom edge of the piston up against the ring to square it up in the cylinder bore.

3. Check the gap between the ends of the ring with a feeler gauge in accordance with specifications. If any of the rings do not have enough gap, they may be filed by clamping the file in a vise and holding the ends against opposite sides of the file as shown in **fig. 26.**

D. Piston Pins

1. Check the bushing in the upper end of the

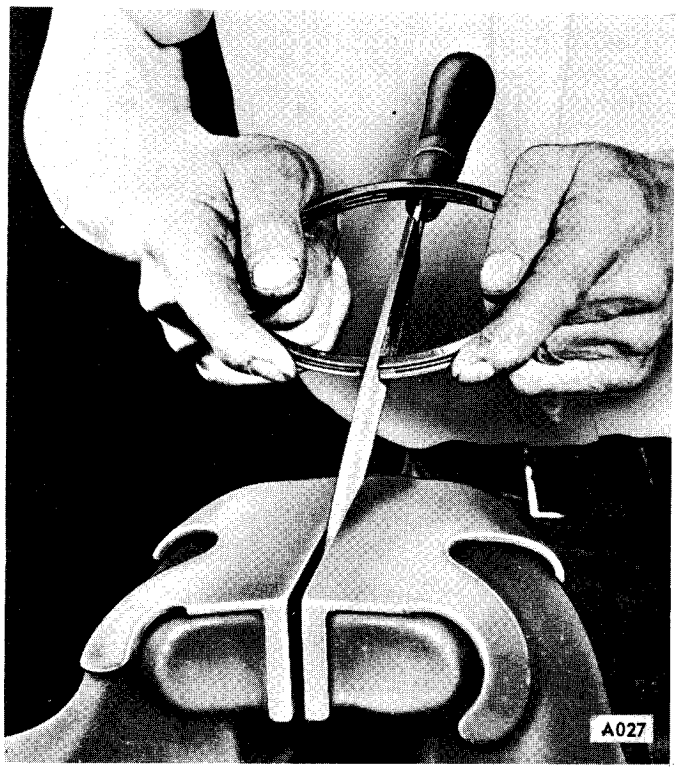


Figure 26

connecting rod for wear. If worn, and the original pistons are to be used with a service set of rings, an oversize piston pin may be obtained.

2. The piston pin hole in the piston and the bushing in the connecting rod may be honed to increase their diameter to obtain the desired fit. Replace the bushing in the connecting rod, if new pistons are used. Using an arbor press, press out the old bushing and press in the new one. **Fig. 27.** Then the bushing must be honed to obtain the correct fit of the pin in the bushing.

3. If there is an excess of stock in the piston pin bushing, it may be reamed first, then honed. In any event, the final operation should be done with a hone to obtain the desired fit with better than 75% bearing area on the pin.

NOTE: For bearing inspection refer to Main Bearing Section.

E. Assembly and Aligning

1. Assemble the pistons on the connecting rod by first heating them in some form of oven or in hot water to a minimum temperature of 160° F.

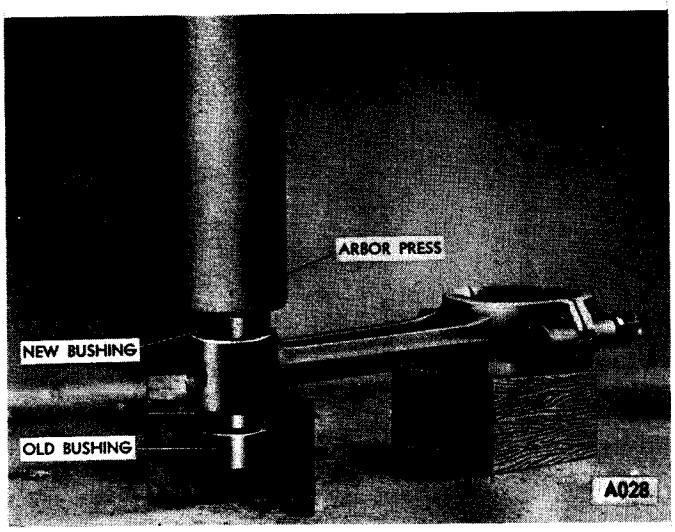


Figure 27

2. With the piston heated, the pin will enter the piston easily and can be pushed on through the connecting rod and into place, without distorting the piston.

3. The snap rings must be assembled in the grooves. Make sure they are fully seated.

4. The piston pin hole in the connecting rod must be parallel to, and in the same plane as, the large bore in the bearing end of the connecting rod. This may be checked on a fixture with the piston. Fig. 28 (Parallelism) and fig. 29 (Twist).

5. The completed piston and rod assembly must be rechecked and there must not be more than .002" twist or out-of-squareness checked over a spread of approximately 4 inches. The connecting rod can be bent or twisted to meet this specification. Fig. 30.

NOTE: Pistons are cam and taper ground. This must be taken into consideration when checking alignment of the assembly, since the diameter in line with the piston pin would be less at the top of the skirt than at the bottom.

F. Recommended Method of Installing Rings

1. Grip the connecting rod in a vise with lead lined jaws. Roll each of the straight side rings in its groove to be sure there are no burrs or other

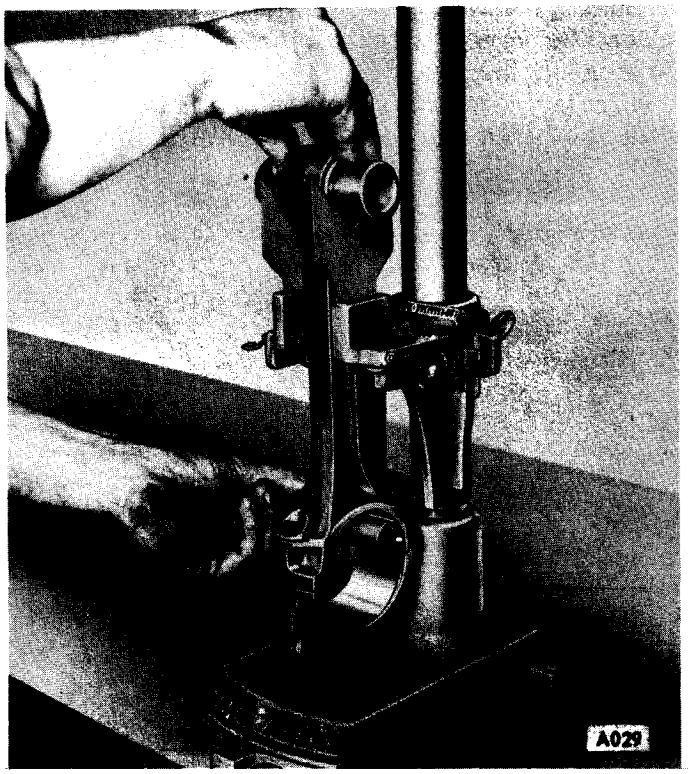


Figure 28

interference with the free action of the ring in the groove.

2. Check the ring side clearance at various positions with a feeler in accordance with the tolerances. Fig. 31. If any of the rings lack clearance in the grooves they can be removed and lapped on a flat plate. Use crocus cloth to narrow them down to the desired clearance.

3. Hold the ring tool with recess side up and place the ring in the groove with the bottom side up. Fig. 32. Start with the lowest ring first. Some piston rings are taper-faced. These are clearly marked "TOP" on the side to be up when assembled on piston. Fig. 33.

4. Position ring in the tool so the expanding fingers will fully engage both ends.

5. Apply pressure on handles so ring is completely expanded. Pass the expanded ring and tool, recessed side down, over the piston to the proper groove.

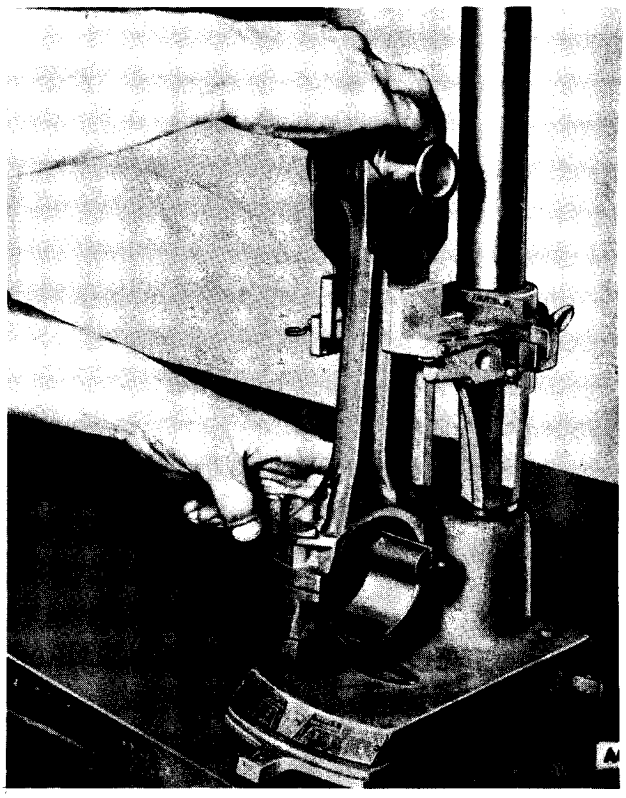


Figure 29

CRANKSHAFT AND BEARINGS

1. Using a puller, remove pulley from crankshaft. Take out screws and remove gear cover. Drop the oil pump by removing nut or capscrews holding pump to center main bearing cap. Fig. 34.

2. Remove each main bearing cap, one at a time, and inspect the bearing and crankshaft journal.

a. If there is any indication of flaking out, scoring or actual wear, the bearing must be replaced.

b. Some models have tri-metal bearings which, when new, are smooth and highly polished. A few hours of operation will change their appearance completely. The bearing surface becomes a leaden gray in color and develops minute craters, almost cellular in appearance as indicated in fig. 35. This appearance is a natural characteristic of this type bearing and in no way indicates failure.

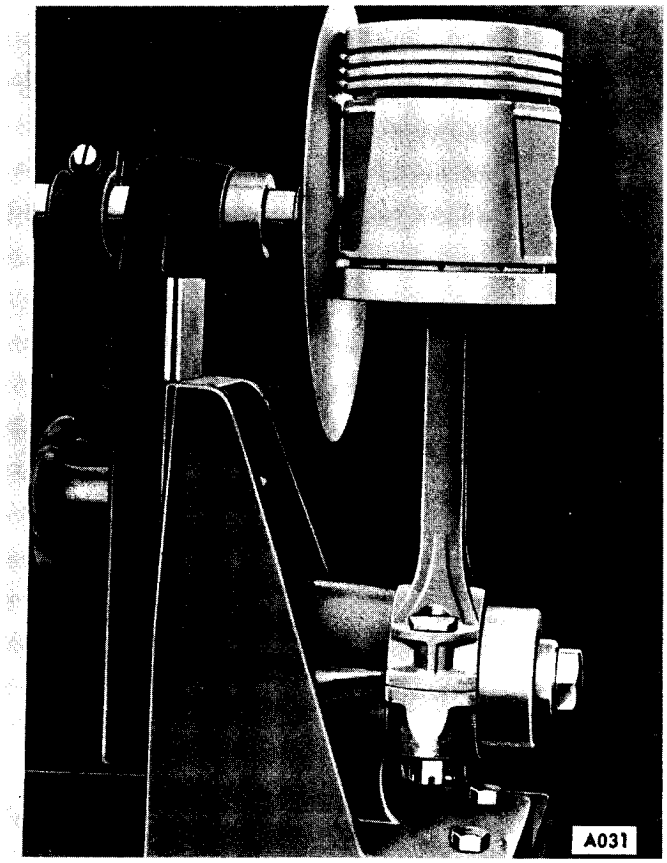


Figure 30

3. If the visual inspection appears satisfactory, the bearings should be removed and checked for thickness using a ball micrometer. Fig. 36.

NOTE: Bearing thickness wear must not exceed more than .0005 inch.

a. To remove the upper half of the main bearing shell, use a special tool obtainable at most parts houses, which is a pin with an angular head.

b. Insert the pin in the oil hole of the crankshaft. Fig. 37. As the crankshaft is turned in a clockwise direction, the head of the pin will pick up the bearing shell and force it out of the bore in the block. The bearing can be replaced by reversing this removal procedure. Fig. 38.

4. If visual inspection of the crankshaft shows no indication of excessive wear or scoring, the clearance of the bearing should be checked. Use

Figure 31

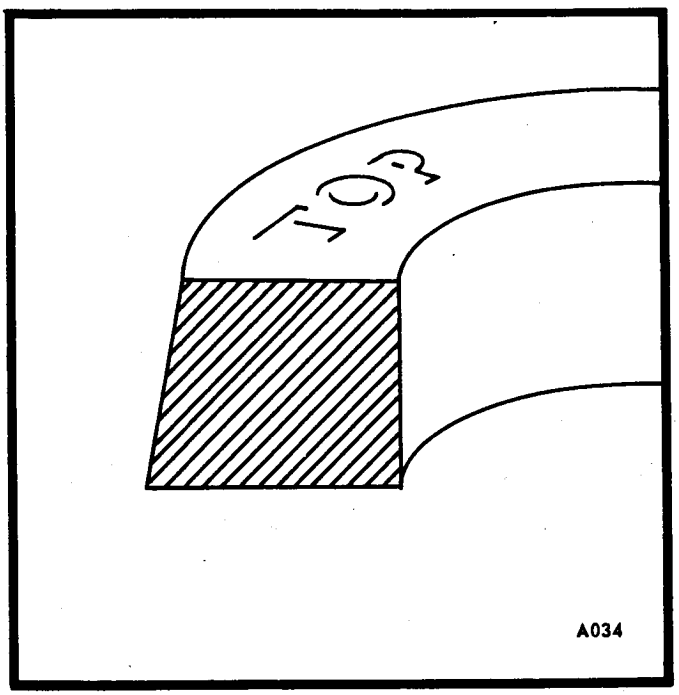


Figure 33

Figure 32

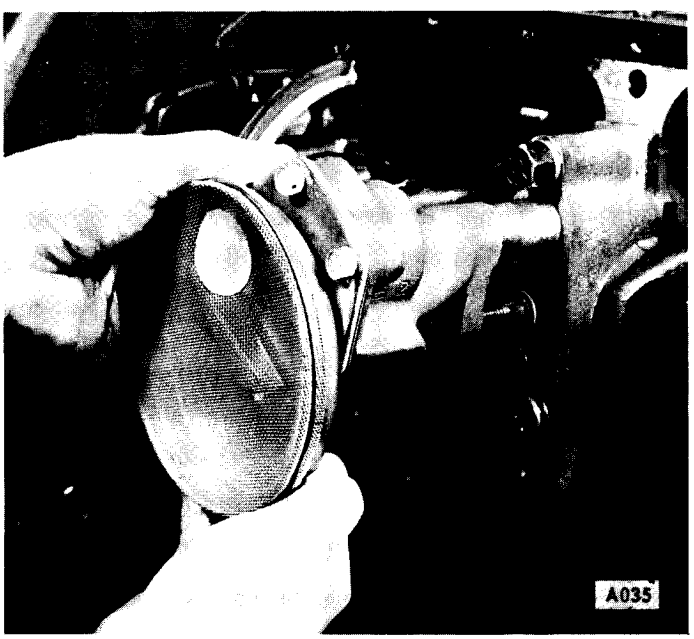


Figure 34

a piece of feeler stock 1/2" wide and approximately 1/8" shorter than the length of the bearing. Dress all edges carefully to be sure there are no burrs to mark the bearing.

5. Check each bearing, one at a time, by placing the feeler stock (the thickness of which should be equivalent to the maximum clearance permissible in the bearing) lengthwise, in the

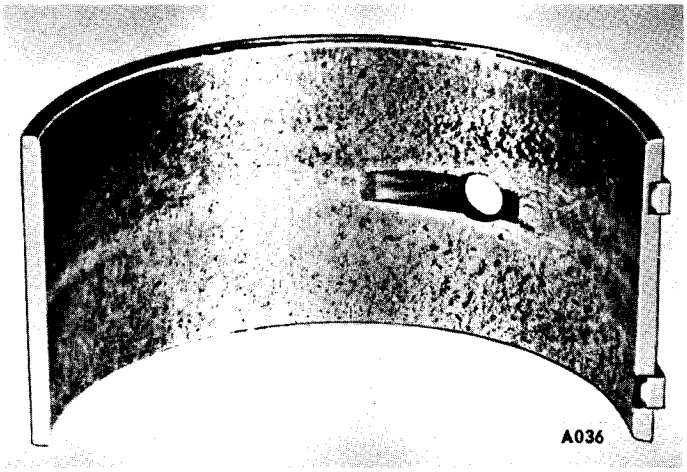


Figure 35

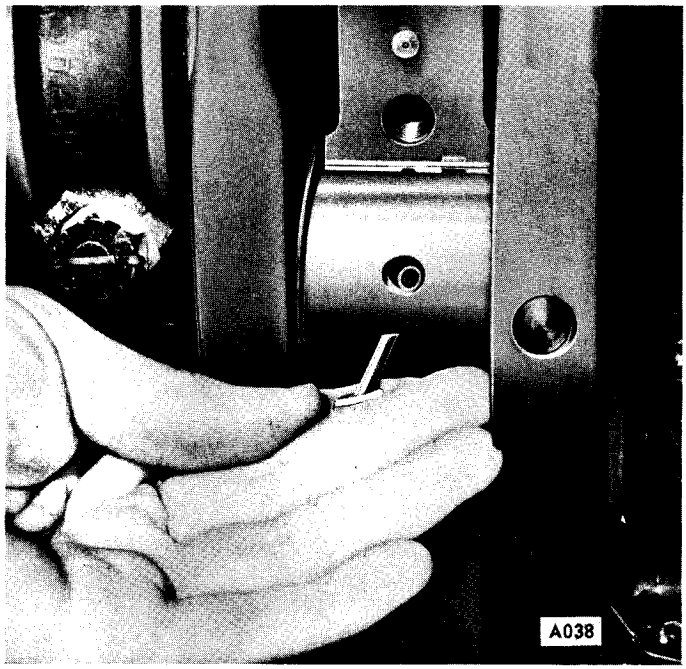


Figure 37

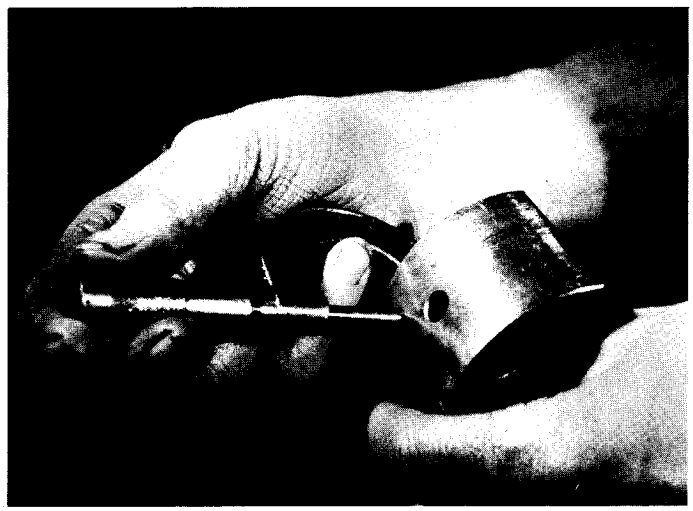


Figure 36

bearing shell, on a film of oil. Fig. 39. Assemble the bearing cap and tighten the screws, torquing them to specifications. Try to turn the crankshaft by hand to determine whether or not there is any drag.

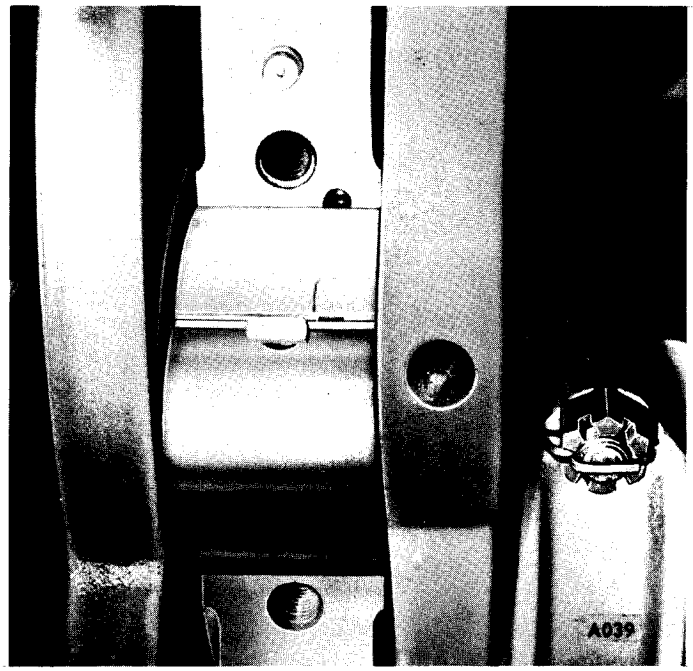


Figure 38

6. If a definite drag is felt and the piece of feeler stock is equivalent to, but no more in thickness than the maximum clearance specified, neither the crankshaft or bearing is worn excessively as far as clearance is concerned. When using new bearings and the crankshaft is not worn, checking with a piece of feeler stock as outlined above should lock up the crankshaft,

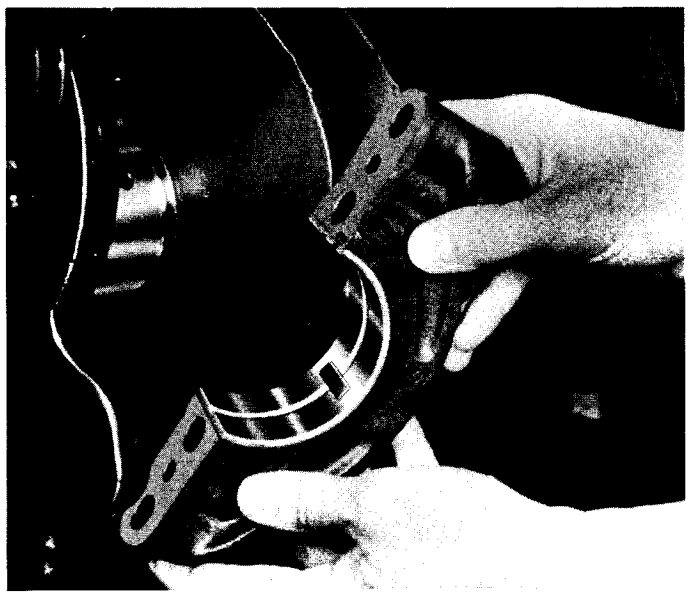


Figure 39

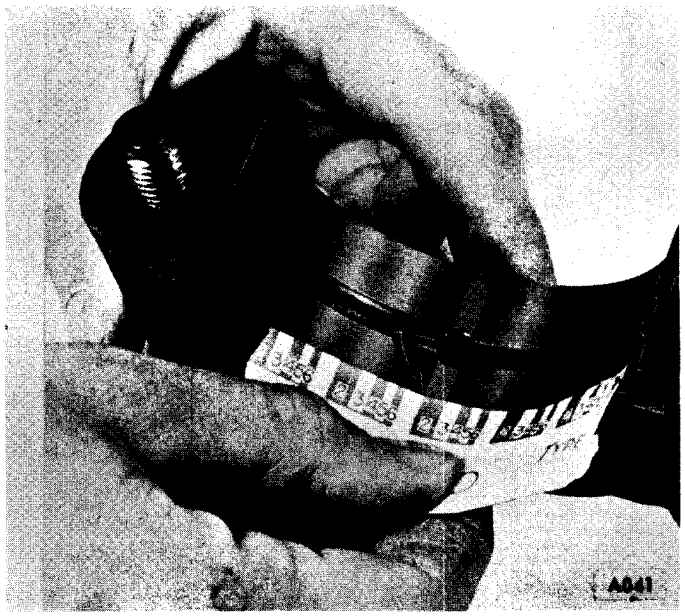


Figure 40

making it possible to turn only by use of a bar or wrench.

7. The same check can be made by using a piece of Plastigage.

CAUTION: When using this method, do not turn the crankshaft as that would destroy the Plastigage. Compare the width of the plastic material with the gauge printed on the Plastigage envelope, fig. 40, to determine the bearing clearance.

8. If crankshaft is scored, or worn enough so that new bearings will not fit with the required clearance, it should be removed and reground. Crankshaft main bearing journals may be reground to decrease the diameter a maximum of .040 inch.

9. Connecting rod bearings and crank pins may be checked in the same manner with one exception; instead of trying to turn the crankshaft when the connecting rod bearing is tightened on it with a piece of feeler gauge assembled, try to move the connecting rod from side to side. When the connecting rod is perfectly free, it will have from .006" to .010" side play and can be moved by a light touch of the fingers. With feeler stock assembled having a thickness equal to the maximum specified clearance, enough drag should be felt to require pressure to move the rod from side to side.

CAMSHAFT, TAPPETS AND TIMING-GEARS

A. Removal

1. Remove valve cover. Then, using a puller, remove the cam and crank gears. Fig. 41 and 42.

2. Remove the screws holding the camshaft thrust plate to the front of the cylinder block, which makes it possible to pull the camshaft forward out of the bearings. Unless engine is laying on its side, tappets must be removed or lifted before camshaft can be pulled.

3. Remove tappet cover. Tappets can then be lifted out and lined up in sequence, for installation in the same location, unless inspection shows that they require replacement.

4. Before pulling the camshaft completely, check the clearance of the bearing journals in the bushing. To do this, use strips of feeler stock 1/4" wide with edges dressed with a stone to eliminate any burrs or feathered edges.

5. If clearance is equal to or greater than the

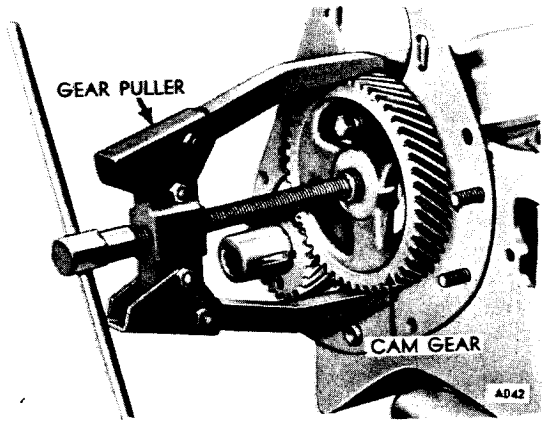


Figure 41

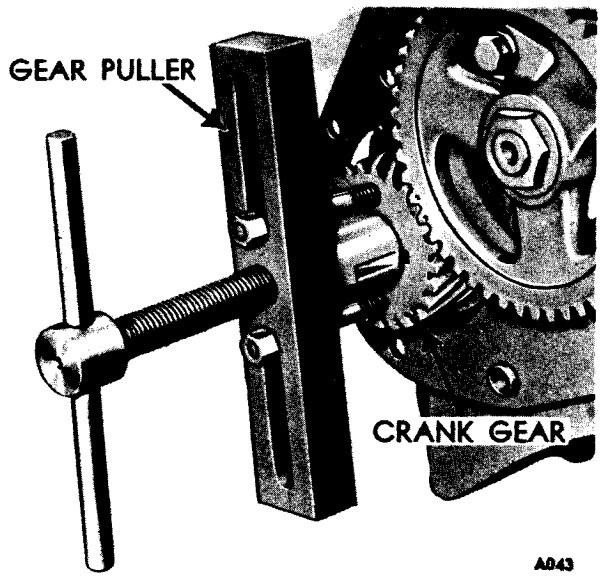


Figure 42

amount indicated under wear limits, check the diameter of the camshaft journals to determine the next step. Excessive wear at these positions requires replacement of the shaft.

NOTE: If wear is found to be in the bushings instead, these must be replaced using precision service bushings which require no reaming. Fig. 43 illustrates bushing installation.

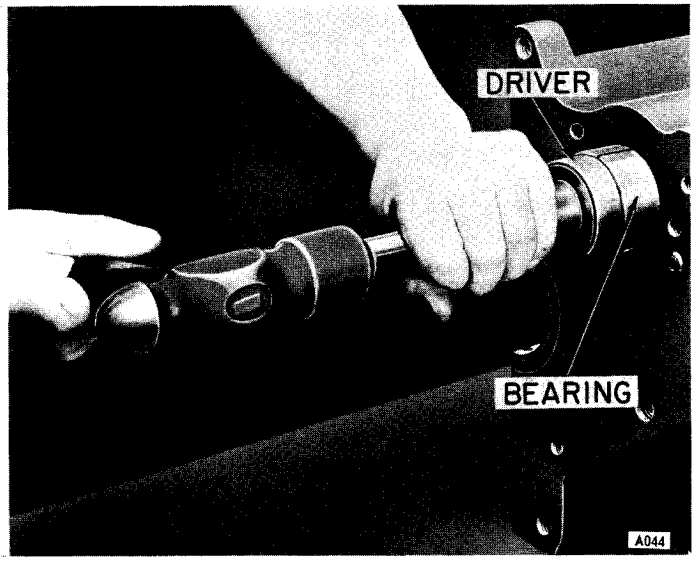


Figure 43

B. Inspection and Assembly

1. Tappets must be inspected visually for scores or damage to the contact face. Two or three small pits in the latter is acceptable. More than that calls for replacement of the tappets. Fig. 44.

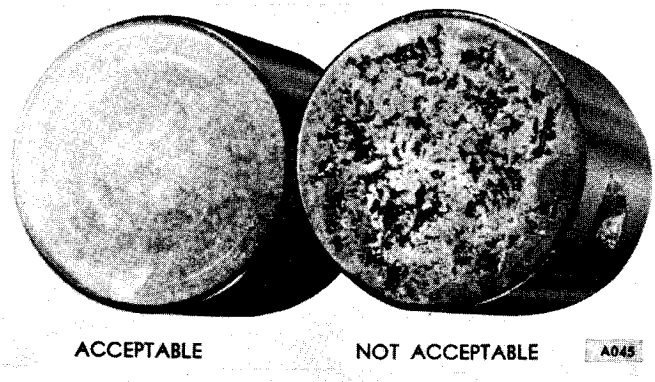


Figure 44

2. Check the outside diameter with a micrometer to determine if replacement is necessary.

3. Tappet guides or guide bushings may be checked for wear with a plug gauge or preferably with a telescope gauge and micrometers.

4. Timing gears and timing gear fits must be checked carefully while the engine is being over-

hauled. To check the fit, use a screw driver to force the mating teeth as far apart as possible. Check the clearance with a feeler gauge. Fig. 45. If the clearance is .002" or greater, or if the gear teeth are badly scuffed and worn, the gear must be replaced. Timing gears must be replaced in pairs.

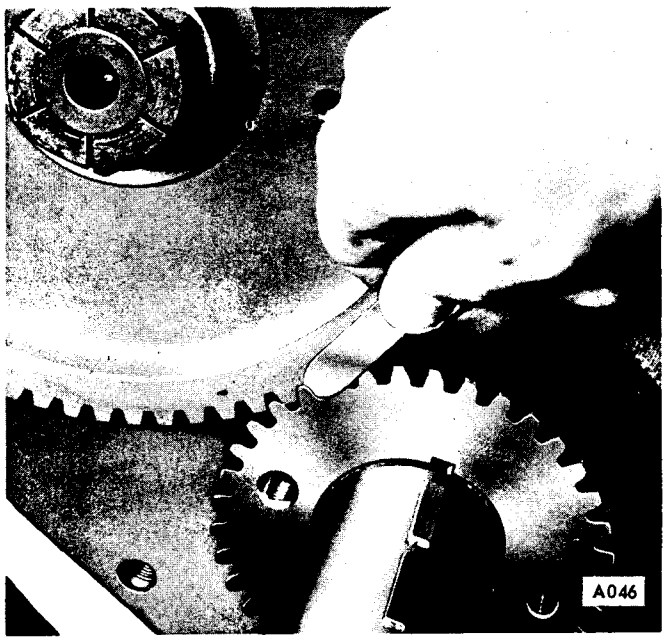


Figure 45

5. Crankshaft gears and camshaft gears are furnished in standard, undersize, and oversize. Gears marked "S" are standard; if they are marked with figures "1" or "2" in a letter "U" they are undersize. If they are marked with figures in the letter "O" they are oversize.

6. Examine the camshaft thrust plate fig. 46, carefully for scoring and wear. If there is evidence of either, a new thrust plate should be installed.

7. Assemble the cam gear to the camshaft. Hold the camshaft forward so there is no possibility of its bumping the expansion plug at the rear end, forcing it out of position, and causing an oil leak. Check end play. Fig. 47.

8. Inspect crankshaft thrust washers, fig. 48, for wear and scoring. Replace if necessary before reassembling gear.

9. Drive the crank gear on to the shaft, fig. 49,

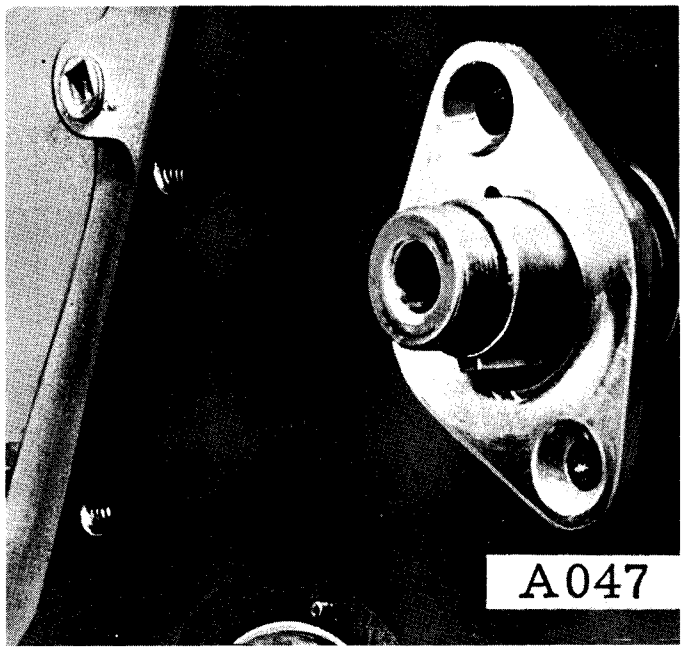


Figure 46

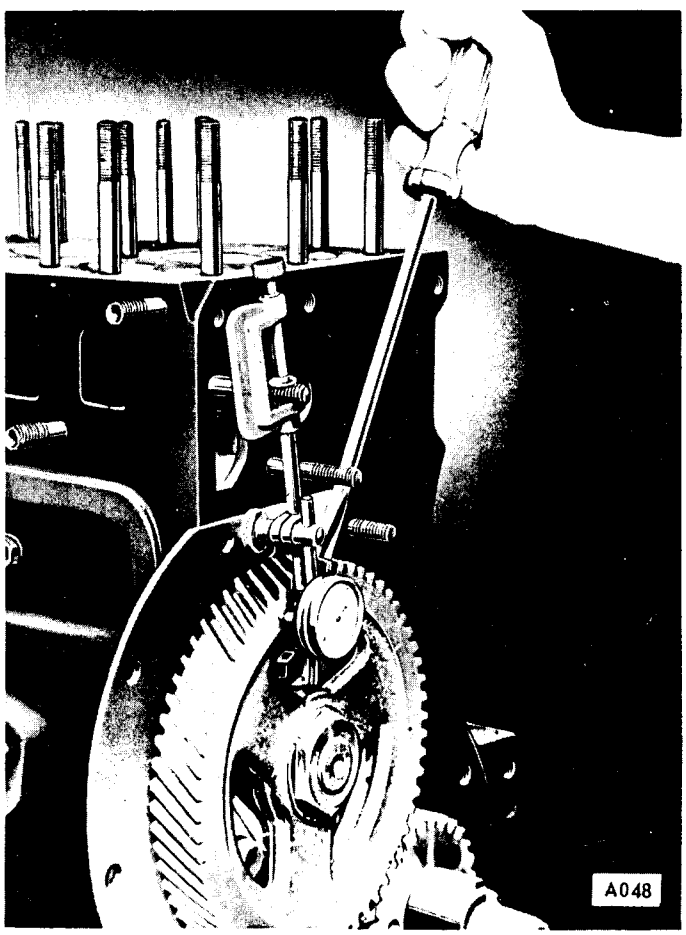


Figure 47

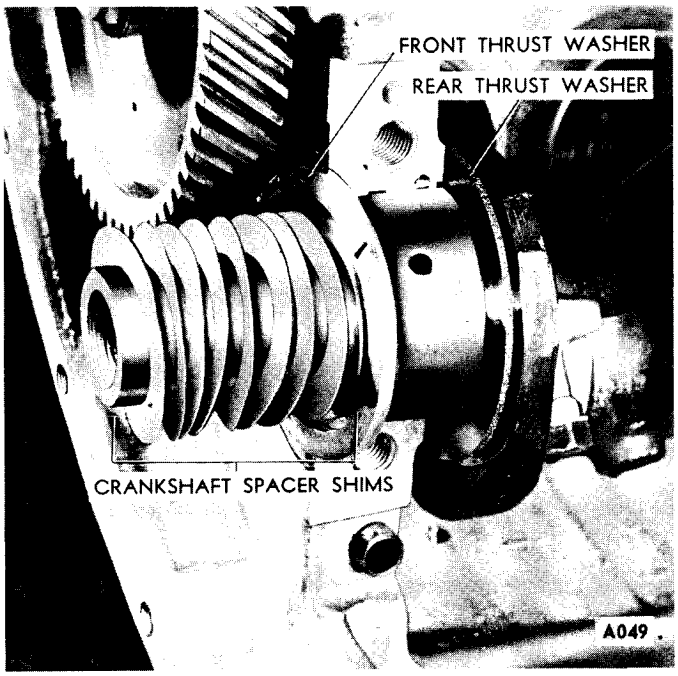


Figure 48

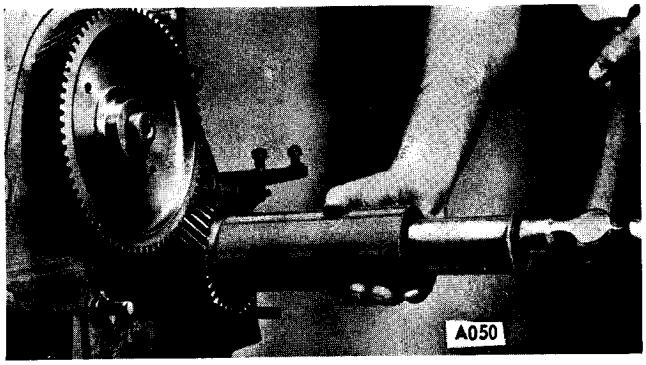


Figure 49

making sure that the marked teeth on the cam gear straddle the marked tooth on the crank gear. Fig. 50.

10. Check the clearance with the above gears assembled in place. Using a screwdriver, pry the teeth as far apart as possible and check the clearance with a feeler gauge. If a .0015" feeler will not enter the gap, the clearance is not excessive.

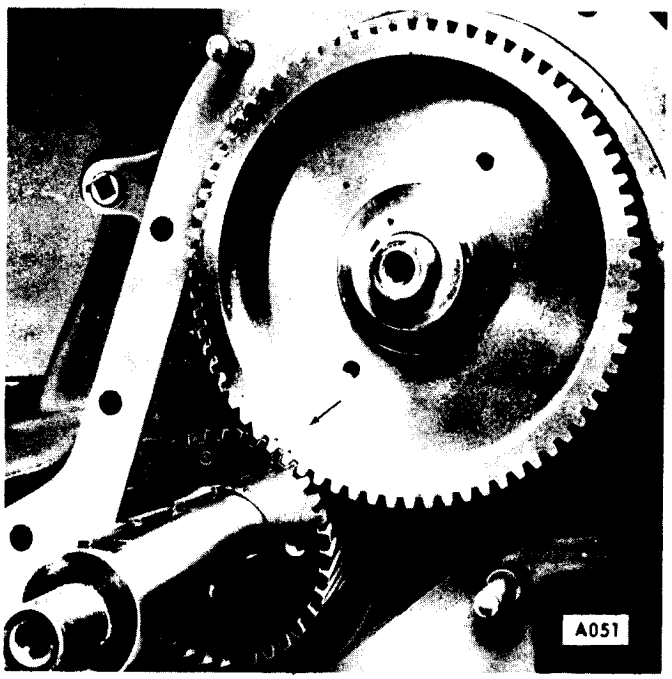


Figure 50

11. To be certain that there is enough clearance, hold your finger at the junction of the two gears and, with a light hammer, tap the rim of the cam gear and note if there is vibration felt at this point. Fig. 51. If there is vibration and a .0015" feeler gauge will not enter the gap between the two gear teeth, the gear fit is within specifications.

12. Check crankshaft end play before replacing the gear cover.

NOTE: On the F162 a shim pack containing shims of .002" and .008" thickness is incorporated in the assembly between the front end of the main bearing journal and crankshaft gear. Fig. 48. Removal or addition of shims will bring the end play to correct specifications. The crankshaft gear must be tightened firmly against the shim pack when checking end play. This can be done by using a sleeve or the regular pulley. Slip it over the crankshaft and use the standard assembly parts to tighten the pulley and gear in place. On the F163 engine thrust is controlled by flanged center bearings, which require no shims.

13. After end play is adjusted, remove pulley. Replace crankshaft seal in the gear cover. Cement gasket to cover with quick-drying cement. Install cover and pulley.

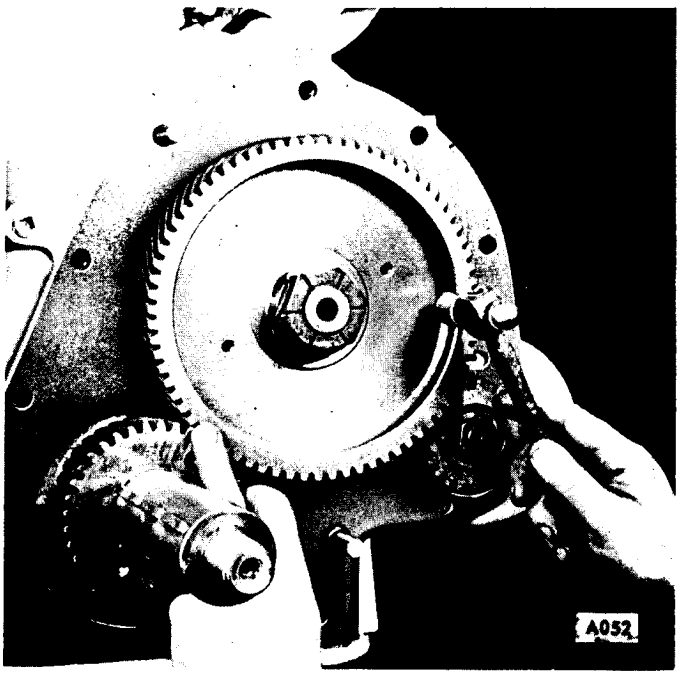


Figure 51

REAR CRANKSHAFT SEAL

A. General

To replace this packing and reassemble this rear seal, follow instructions carefully.

B. Removal and Installation

1. Remove the filler block and oil guard, the latter being the semi-circular die casting which fits in the cylinder block, in a groove machined just to the rear of the rear main bearing.

2. Clean all surfaces and grooves thoroughly. If a scraper or wire brush is used, be very careful not to scratch or gouge the sealing surfaces. All dried cement or other material must be removed from these surfaces. Check filler block contact faces for flatness. Replace if warped.

3. The jute packing, as it is received, has a diameter approximately one-third greater than the width of the grooves. This must be crushed in a vise, or otherwise flattened narrow enough to be inserted in the grooves.

4. Press it into the grooves of both the filler block and oil guard as well as possible by hand.

Then, using a piston pin, smooth hammer handle or some other tool with a smooth, rounded surface, iron the packing into the groove so that it is seated firmly and expanded to grip the sides. Fig. 52. In its present condition the packing is long enough to protrude from the groove at both ends.

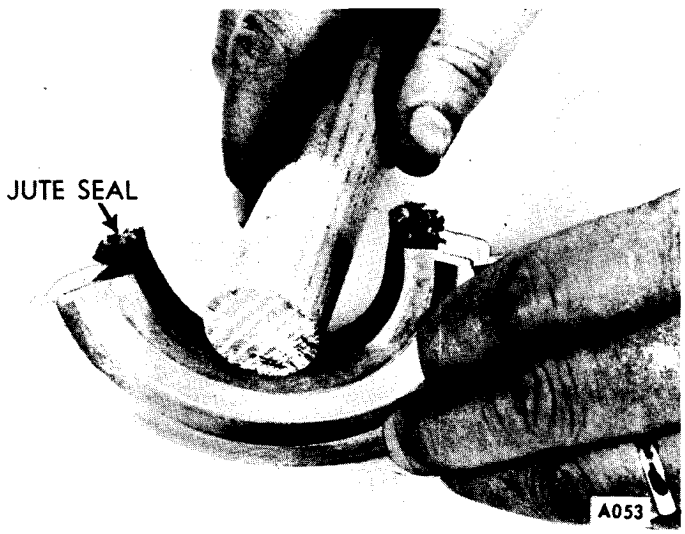


Figure 52

5. With a sharp knife or razor blade, cut this off parallel to the surface of the casting, allowing it to protrude 1/32 inch.

C. Installation

1. Coat the outer or sealing surface of the oil guard with a non-hardening cement.

2. Slide into place around the crankshaft if engine is still assembled; or directly into the recess, if crankshaft is out.

3. Apply a light coat of non-hardening cement to hold the oil pan to filler block seal. Fig. 53.

OIL PUMP. Fig. 34

A. General

The oil pump is assembled to the center main bearing and held in vertical position against a machined pad by studs. The extended portion of the body acts as a pilot, fitting closely in a reamed hole in the main bearing web, maintain-

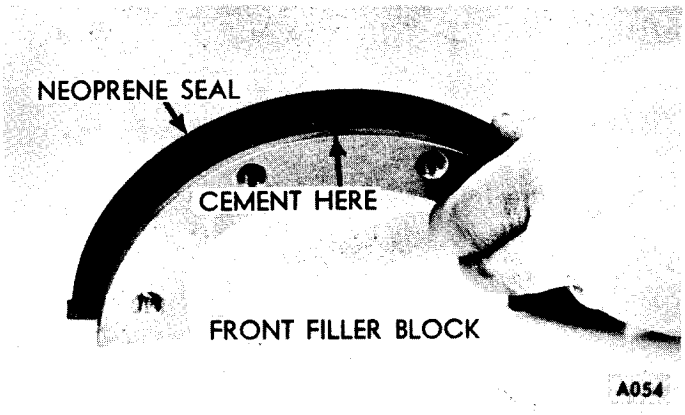


Figure 53

ing a definite relationship between the camshaft and the oil pump drive shaft. A gear assembled to the upper end of this shaft is driven by a mating gear cut on the camshaft, and drives the oil pump gear which is assembled to the lower end of the pump shaft.

The pump shaft is carried in two bronze bushings assembled in the cast iron housing, which is also a part of the oil distributing system. The capacity is well in excess of that required by the engine.

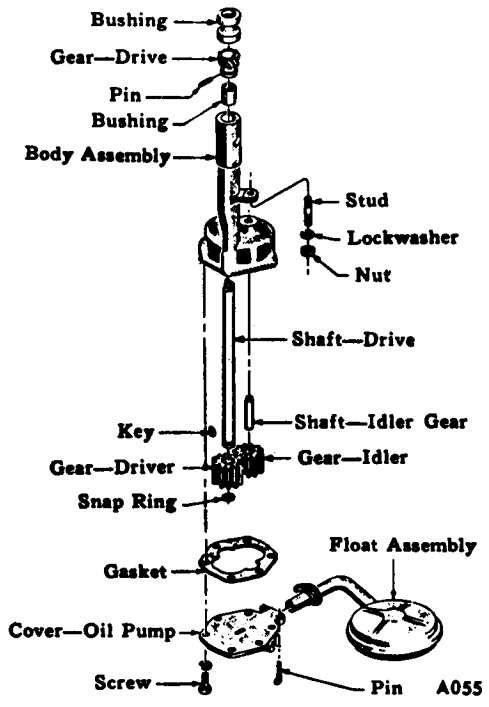


Figure 54

B. Service. Fig. 54.

1. Note distributor rotor position before removing the pump. When the pump is removed, examine the drive gear carefully for wear. Inspect the gear on the camshaft at the same time. The camshaft and pump gear must be replaced, if scored or badly worn.

2. Examine the pick-up screen for clogging or damage. Remove the cover. Be careful not to damage the lead gasket which acts as a spacer as well as a gasket. Examine the gears and pump body for any sign of wear indicating lack of clearance. The gears should have from .001" to .003" clearance in the chamber and should make no contact with the walls. Fig. 55. Inspect the gear, cover and faces for excessive wear or scoring. With the gasket assembled in the body, there should be .0015" – .006" clearance between the gears and the cover. Worn or scored gears and a worn cover may be replaced. If the body shows wear in the chamber, it can be replaced, but complete pump replacement would be more economical.

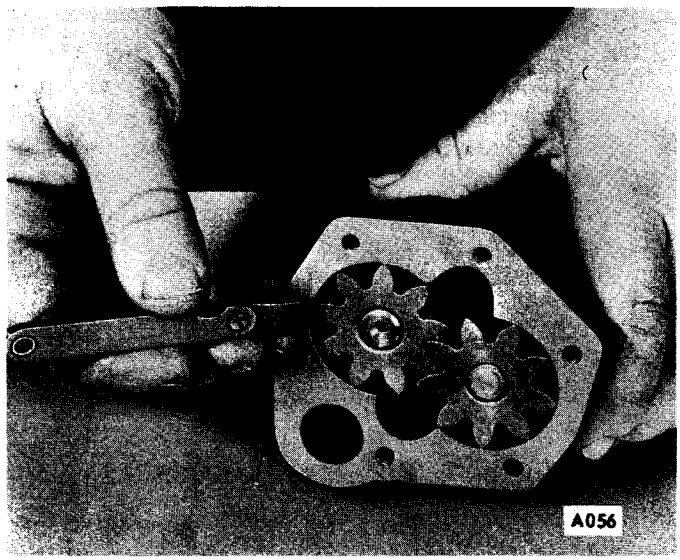


Figure 55

3. Engine oil pressure must be maintained at 40 PSI at engine governed speed for satisfactory engine life. Pressure relief is located externally on the right-hand side, near the oil pan flange, at the center. Fig. 56. Pressure is

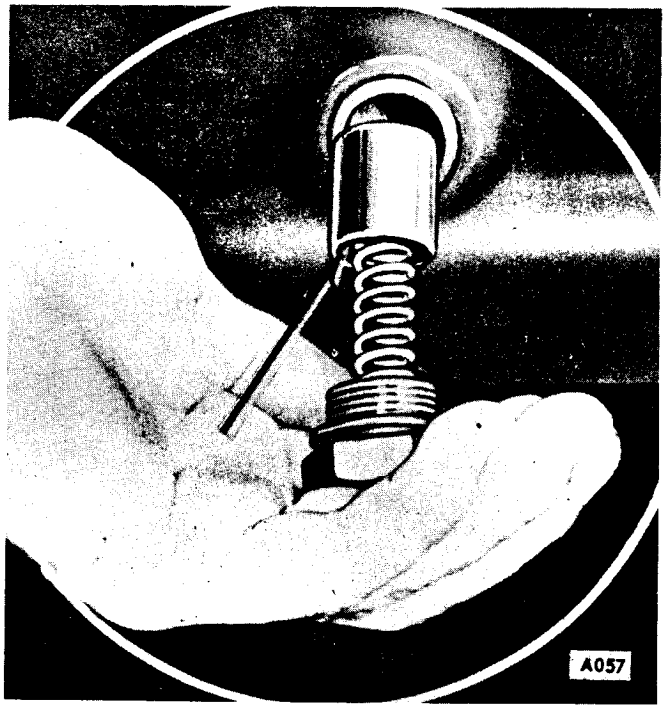


Figure 56

controlled by a plunger and spring, the latter specifically for a certain range. The only adjustment variation is either to change springs or add or remove washers from behind the present spring. Up to four washers are permissible. When replacing oil pump drive gear, it is necessary to line up the hole in the gear with the hole in the shaft.

NOTE: Pressure check can be made at the oil-filter-inlet-line and block junction.

FLYWHEEL AND FLYWHEEL HOUSING (Run-out)

A. Flywheel

1. The flywheel is machined and balanced so that the clutch face and locating counterbore will run true with its axis. To be sure that the crankshaft flange, or the counterbore in the flywheel which locates it on the crankshaft, has not been sprung or damaged, mount an indicator on the flywheel housing and check the flywheel for runout. **Fig. 57.** Remove spark plugs before checking runout to allow free engine turnover.

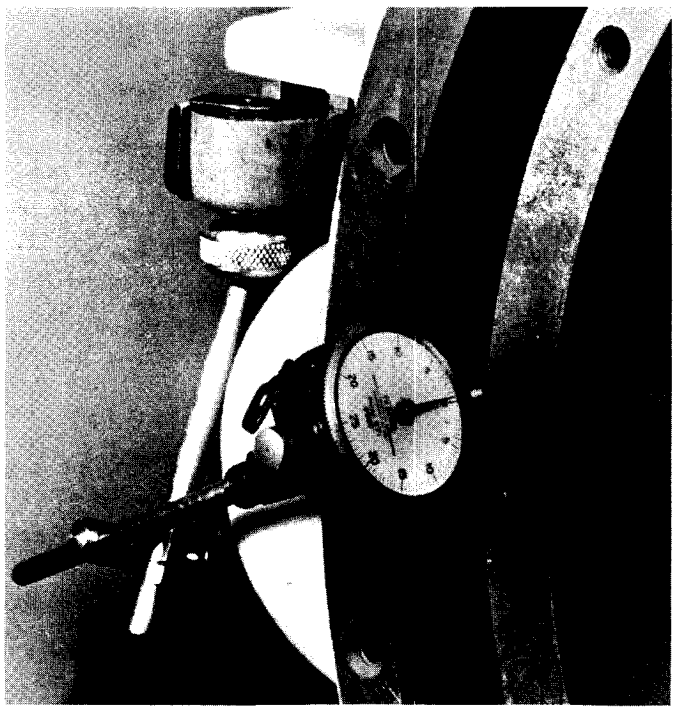


Figure 57

2. The indicator should be set up so that it contacts the clutch face on the vertical surface of the clutch counterbore, then turn the flywheel one full revolution, at the same time holding against the crankshaft to offset the possibility of end play. Excessive runout of the flywheel in either position will probably be caused by dirt in, or damage to, the counterbore locating the flywheel on the crankshaft flange. Relocate the indicator to check the inside diameter of the counterbore. **Fig. 58.** In both cases the maximum indicator reading must not be more than .008"

B. Housing

When assembled, mount the indicator on the flywheel so that it contacts the housing face and turn the crankshaft, at the same time holding against it to counteract end play. The maximum indicator reading must not exceed .008". **Fig. 59.** Relocate the indicator to contact the housing bore and check in the same manner. The same runout limit prevails. **Fig. 60.**

Figure 58

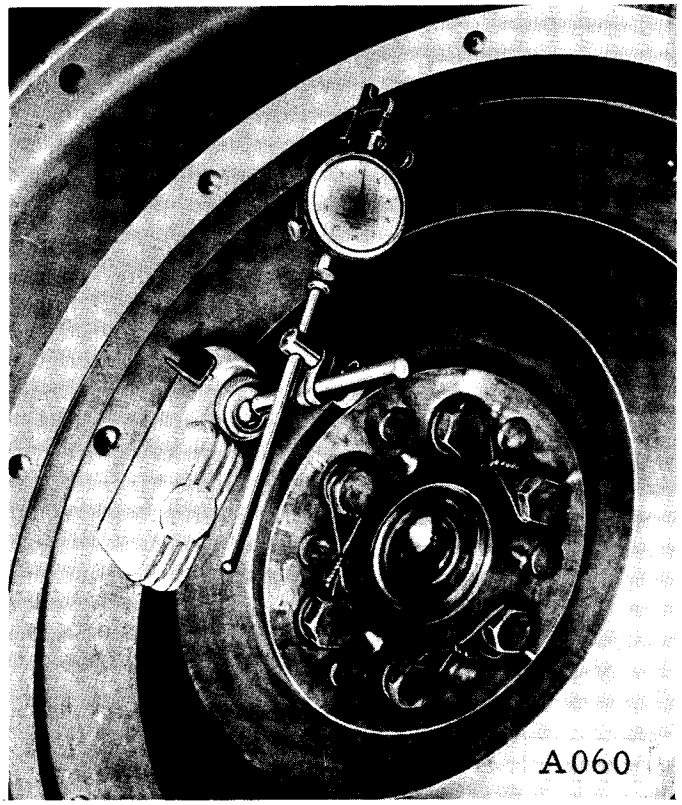


Figure 59

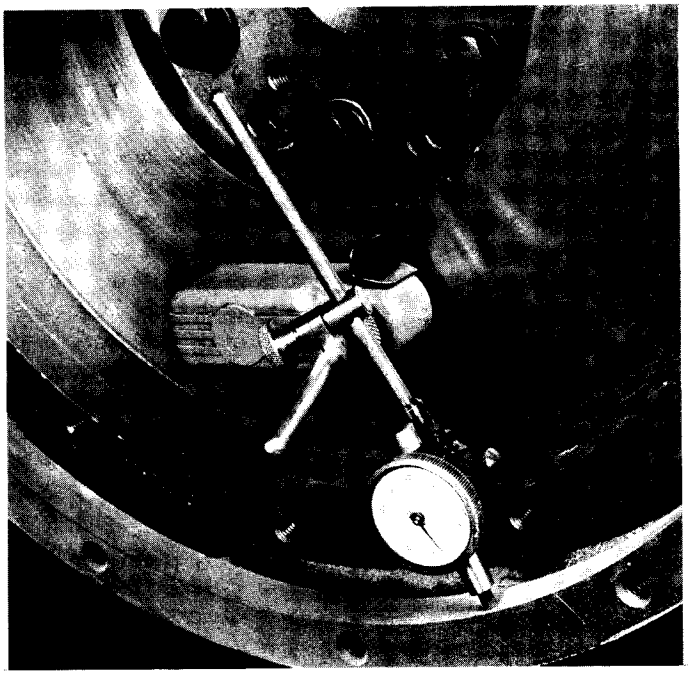


Figure 60

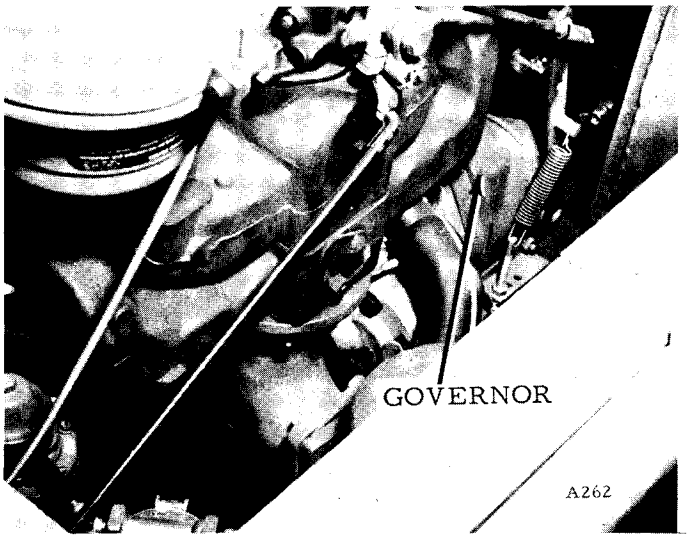


Figure 61

GOVERNOR

A. General. Fig. 61

This governor differs from conventional centrifugal governors principally in that round steel balls are used as the motivating force

producer instead of masses of weight. The balls move out and in radially from the governor shaft on two hardened steel races. One race is a flat surface, the other conical in shape. As the balls move in and out they tend to raise or lower the conical shaped race, the motion of which is transferred through a fork or finger to the governing lever on the outside of the governor housing. The force created by the balls in their centrifugal movement is opposed by a spring on the governing lever, the other end of which is hooked to the speed adjusting screw lever. The balls move in a slotted driver which is pinned to the governor shaft; the two races are free floating on the shaft. When the engine is running at a fixed speed, all parts go around with the governor shaft and the thrust is taken on the thrust bearing between conical shaped race and fork base. When a change in speed due to change in load takes place, the relative speed between the balls and races is changed. Consequently, wear is distributed over the entire operating surface of the races and balls. Since the surfaces are hardened, little or no wear other than a polish should ever take place on the parts.

B. Adjustment

The hook-up of governor lever to carburetor lever should be done in the following manner:

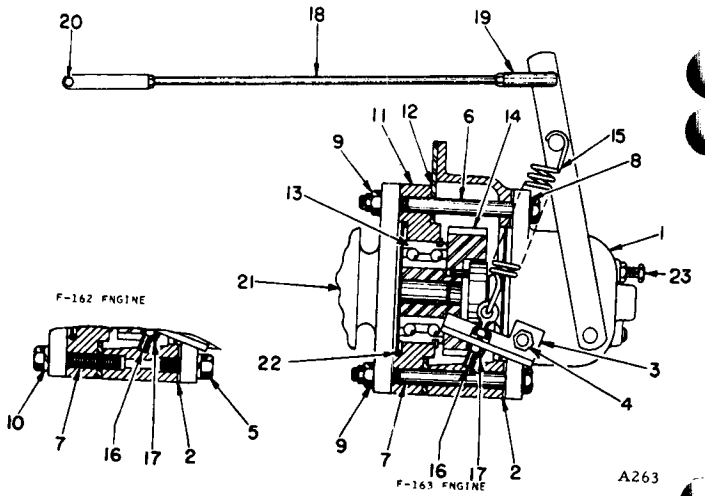
1. Make sure carburetor shaft does not stick nor bind.

2. With governor lever in its normal position under spring tension, with engine shut-off, with carburetor lever in wide open throttle position, a rod of exact length to connect the two levers is inserted.

3. Make sure there is no bind nor sticking in the assembly of rods and levers. This is very important.

4. The spring tension is adjusted by repositioning the spring anchor nuts. Fig. 62. Turning the nuts clockwise increases the spring tension thus raising the engine speed. Turning the nuts counterclockwise decreases the spring tension. After making the adjustment, be sure to tighten the two locknuts.

5. Should governor surge at no load high idle, screw bumper screw, fig. 62, in until surge is



1. Governor
2. Gasket
3. Spring Anchor
4. Stud, Lockwasher, Nut
5. Capscrew, Lockwasher
6. Capscrew
7. Stud, Capscrew
8. Copper Washer, Gasket
9. Lock Nut, Copper Washer
10. Lockwasher, Nut
11. Pump Adaptor
12. Gasket
13. Ball Bearing
14. Pump Gear
15. Governor Spring
16. Adjusting Screw
17. Adjusting Nut
18. Governor Rod
19. Ball Joint
20. Yoke, Lockwasher, Nut
21. Hydraulic Pump
22. O-Ring
23. Bumper Screw

Figure 62

eliminated. Do not run bumper screw in far enough to increase speed.

C. Service

The driver must always be tight to the shaft. The races must be free on the shaft. In assembly of the governor a space of .004" to .006" is provided between the driver and the flat race. This is to assure freedom for movement of the flat race. When servicing the governor, make sure that both races revolve freely on the shaft. When the balls are "in", that is, in the bottom of the driver slots, the space between the top of the conical shaped race bushing and hair pin clip should be .230" – .240". Use .010" spacer washers to obtain required space. The governor shaft is pressed into the gear and secured with a screw that is partially in the shaft and partially in the gear.

ASSEMBLY

1. When reassembling pistons and connecting

rods, use a good ring compressor and oil the bores thoroughly. A hammer handle may be used to tap the pistons out of the ring compressor into the cylinder bore.

2. Use care to prevent damage to cylinder bore finish by the connecting rods when the connecting rods are assembled over the crank pin. Locate them carefully to prevent damage to the bearing surfaces, and crank shaft journals.

3. Always lubricate the bearings with clean engine oil when assembling. Tighten the bearings to specified torque. Use lockwires as required to prevent loosening of nuts and screws.

4. Clean the cylinder head and block surfaces thoroughly before installing the gasket. Tighten all cylinder head capscrews evenly and in specified sequence. Torque to specification.

5. Make certain the gasket surfaces are flat and clean, before assembling the oil pan with new gaskets. Tighten screws in accordance with specified limits. When engine is assembled and filled with proper oil, set tappets. **Fig. 63.** See Specification Listing.

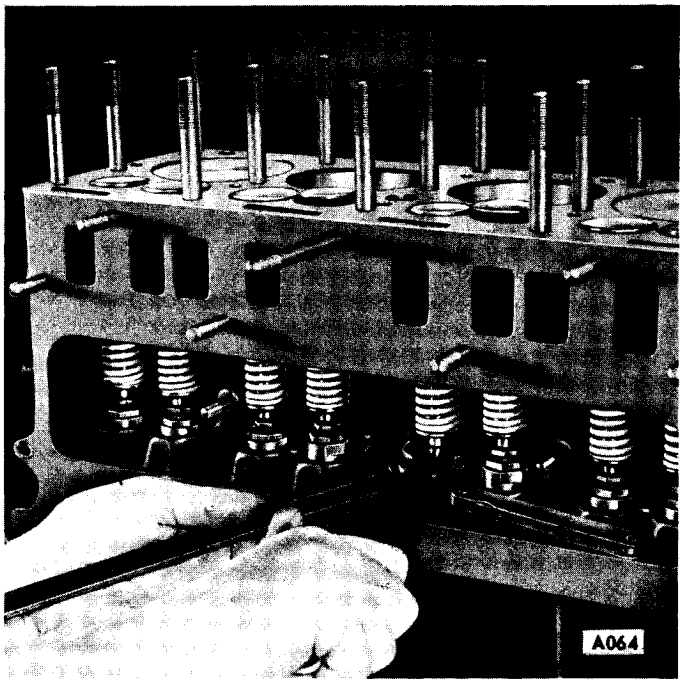


Figure 63

INSTALLATION

After engine is placed in the chassis and major components are installed, perform the following:

1. Connect hydraulic lines. Torque enough to prevent vacuum and pressure leaks. Clean all electrical terminals and connect wire. Connect vacuum lines with sufficient torque to prevent leaks.

2. Fill hydraulic tank, engine and transmission, with specified oils.

3. Connect and tighten fuel lines. Check fuel supply and replace battery.

4. Re-check installation. If all is in order, start engine. As soon as engine is running, oil pressure should rise as lubricating system is charged. This takes several seconds.

CAUTION: Shut down engine if oil pressure does not rise within a reasonable length of time.

5. Run engine at a fast idle while installing the hood and checking installation for leaks.

6. After engine and transmission are at operating temperature, re-check oil levels, and power-shift transmission linkage.

MAINTENANCE

A. Daily Inspection

Perform the following daily, or according to operating conditions.

1. Over-all visual inspection of engine. Look for evidence of fluid leakage on floor, cylinder head and block, indicating loose fuel, oil or water connections – tighten if found.

2. Check oil level.

3. Fill with clean fuel. This should be done at end of day's operation to prevent condensation forming in tank. Clean filler cap and area around spout before filling to prevent entrance of dust into fuel system.

4. Check air cleaner. **Fig. 64.**

5. Check oil pressure.

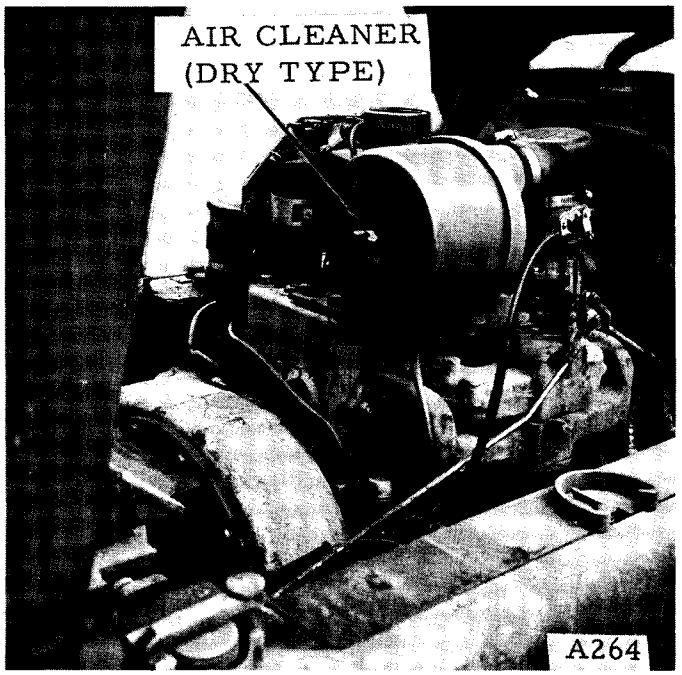


Figure 64

6. Operators familiar with daily engine operation soon become alert to any noise not normally present. This is very valuable in correcting defects in the early stages and preventing expensive repairs or delays.

B. Radiator

Drain the radiator every 1000 hours and flush with fresh water to remove rust and other foreign deposits. To completely drain the cooling system, open the drain cocks on the bottom of radiator and left side of cylinder block. Chemical mixtures should not be used to attempt to stop radiator leaks. Use only permanent-type anti-freeze in winter. If water only is used in the system, add a good commercial rust inhibitor in the proportion recommended by the inhibitor manufacturer.

C. Reverse Flush the Radiator, fig. 65, as follows:

1. Disconnect the hoses at the engine.

2. Tighten radiator cap.

3. Clamp the flushing gun in the lower hose with a hose clamp.

4. Turn on the water and let it fill the radiator.

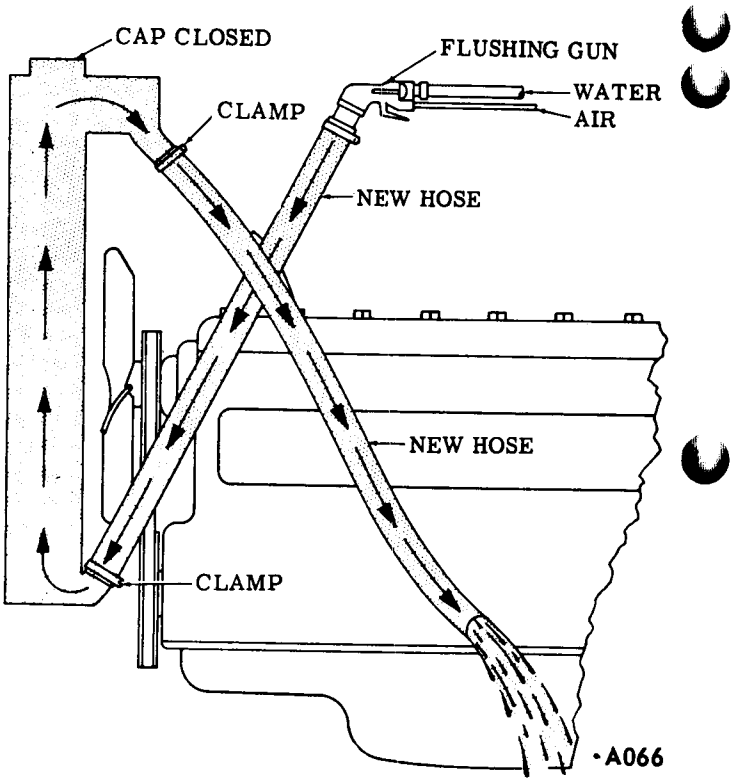


Figure 65

5. Apply air pressure gradually, to avoid radiator damage. (Not more than 10 PSI)

6. Shut off air, again fill the radiator with water and apply air pressure – repeat until the flushing stream runs clear.

7. Clean and inspect radiator cap.

D. To reverse flush the engine. Fig. 66.

1. Remove the thermostat.

2. Clamp the flushing gun in the upper hose.

3. Partly close the water pump inlet to fill the engine water jacket before applying the air.

4. Follow the same procedure outlined above for the radiator by alternately filling the water jacket with water and blowing it out with air (80 PSI) until the flushing stream is clear

E. Testing Thermostat

1. Remove thermostat housing cover and

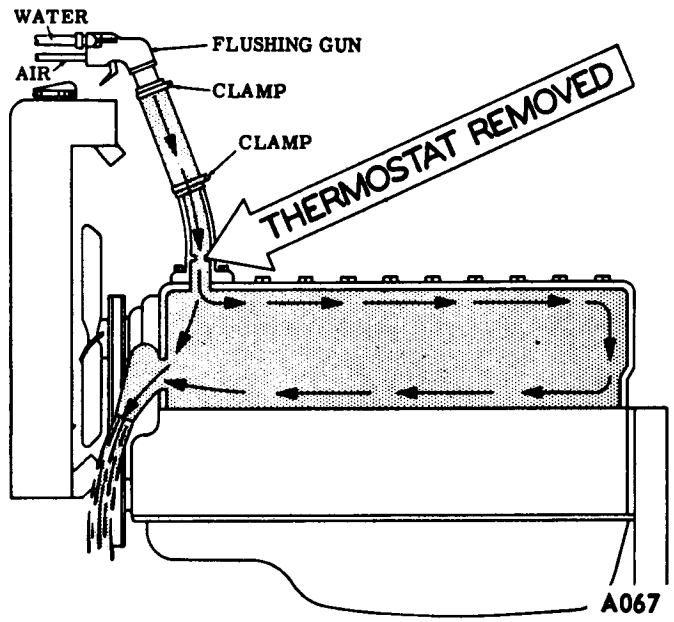


Figure 66

thermostat. Before testing, clean and examine the bellows for rupture or distortion. If the valve can be pulled or pushed off its seat with only a slight effort when cold or it does not seat properly, the unit is defective and must be replaced.

2. The thermostat can be tested by the following method:

a. Hang thermostat by its frame in a container of water so that it does not touch the bottom.

b. Heat the water and check temperature with a thermometer.

c. If the valve of a 180° thermostat does not start to open at temperature of 165-175°F. or if it opens well before the 165° point is reached, the thermostat should be replaced. Thermostat should be fully open between 180° and 185°. When checking thermostats of different rating, the foregoing temperatures will vary accordingly. When replacing the thermostat, be sure seal is in place and seal seat, as well as counterbore, is clean. Assemble new gasket to housing contact surface. Thermostat flange must seat in counterbore with gasket sealing contact between it and the cover.

F. Fan Belt

When tightening fan belts, loosen the generator mounting and adjusting bolts and pull out on the generator by hand until the belt is just snug. Under no consideration should a pry bar be used on the generator to obtain fan belt tension or damage to the bearings will result. When adjusted correctly, the fan belt should have between 3/4" to 1" deflection on the long side. Tighten generator mounting and adjusting bolts when adjustment is completed.

G. Compression

Warm up engine to operating temperature. Remove all spark plugs and block throttle wide open. Insert compression gauge in first spark plug hole and hold it firmly. Fig. 67. Crank

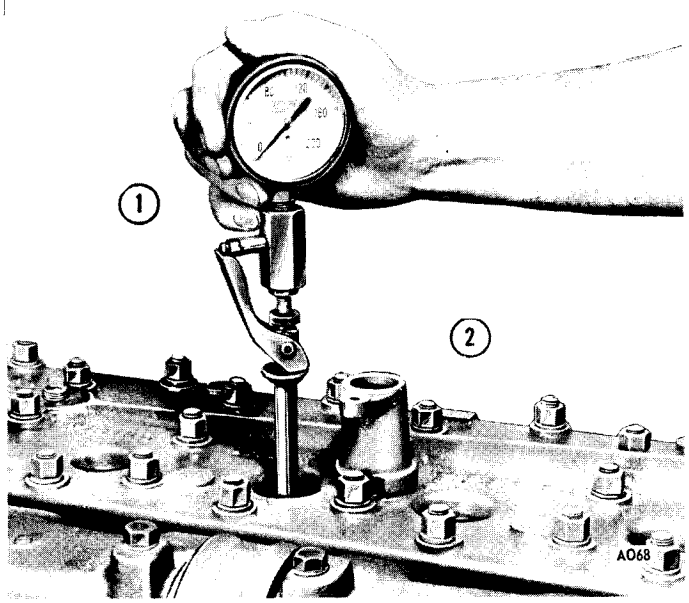


Figure 67

engine until the highest gauge reading is obtained. Check all cylinders in this manner. If readings are low in two adjacent cylinders, a blown head gasket is indicated. If readings are low and vary widely (more than 10 PSI), pressure is being lost either at the pistons, rings or valves. To determine where pressure loss is occurring, insert about one tablespoon of SAE 30 engine oil through the spark plug hole. Take a new reading. If this reading is higher than the initial reading, the piston rings are faulty. If

reading is the same as the initial reading, the valves may be leaking or the cylinder head gasket is damaged.

H. Adjust Valve Tappet Clearance

Check and adjust if necessary to specified clearance both intake and exhaust valves after the engine has warmed up to running temperature and is idling. Turn the adjusting screws in or out until the correct feeler gauge clearance is obtained.

TROUBLESHOOTING GUIDE

Cause	Remedy
Engine Will Not Crank	
1. Dead or weak battery	1. Recharge or replace battery.
2. Poor ground connections, poor connections at battery terminals	2. Disconnect battery cable. Clean battery terminals and cable ends. Inspect and replace cable if necessary.
3. Faulty ignition switch	3. Replace switch.
4. Defective starter	4. Replace or repair starter as necessary.
5. Internal engine seizure	5. If unable to turn engine manually, check for damaged flywheel gear and starter pinion, foreign matter on top of piston or piston seizure.
Engine Cranks But Will Not Start	
1. Out of fuel	1. Fill tank. Open shut-off valve.
2. Slow cranking speed	2. Recharge or replace battery. Check starter, repair if necessary. Clean, inspect and replace battery cable if necessary.
3. Low compression	3. Re-seat valves, install rings or rebore block. Install oversize pistons as necessary.
4. No ignition	4. Check and repair ignition system if necessary. Refer to ELECTRICAL Section.
5. No fuel at the carburetor	5. Fill fuel tank. Check and repair fuel pump. Inspect fuel lines, repair and tighten connections as necessary.
6. Defective choking mechanism	6. Make sure the cable is free to operate and that the cable opens and closes the carburetor choke valve completely.
Engine Misses Intermittently	
1. Spark plugs dirty, cracked or shorted by moisture on electrodes	1. Clean, replace or dry spark plugs as necessary.
2. High tension wires broken or shorted	2. Replace wires.
3. High tension wires corroded in distributor cap	3. Clean or replace terminals if necessary. Replace distributor cap if necessary.

Cause	Remedy
4. Faulty distributor points, condenser or coil	4. Clean, adjust, or replace parts as necessary.
5. Valve tappets adjusted too close.	5. Adjust to specified clearance.
6. Worn valve guides	6. Ream guides and replace valves with ones having larger stems.
7. Leaking head gasket	7. Tighten cylinder head nuts to proper tension and adjust valves. Replace head gasket if necessary.
8. Cracked cylinder head	8. Replace head.
9. Cracked valve seat or water jacket	9. Install valve seat insert. Replace block if necessary.
10. Air leak in intake manifold	10. Tighten intake manifold capscrews, carburetor mounting nuts, vacuum advance line or vacuum hose. Replace gaskets and other parts as necessary

Loss Of Power

1. Engine missing intermittently	1. Refer to "Engine Misses Intermittently".
2. Engine ignition out of time	2. Check distributor advance mechanism. Adjust or replace parts as necessary. Adjust timing to specifications.
3. Valves or valve seats worn and leaking	3. Reseat valves or replace.
4. Piston rings worn, stuck in grooves or broken	4. Replace rings. Bore cylinders oversize and install new piston assemblies if necessary.
5. Tappets set too close or sticking	5. Adjust to specified clearance. Remove and clean tappets.
6. Power leakage past spark plugs	6. Install new spark plug gaskets, and tighten spark plugs.
7. Worn cylinders	7. Bore cylinders to oversize and install new piston assemblies.
8. Valve springs weak or broken	8. Replace valve springs.
9. Incorrect valve timing	9. Reset timing. Install new chain sprockets or camshaft as necessary.
10. Water or sediment in fuel tank of fuel filter	10. Drain and clean fuel tank. Replace fuel filter element.
11. Air cleaner clogged	11. Service air cleaner.

Cause	Remedy
10. Defective or mis-adjusted ignition system.	10. Adjust spark plug gaps. Adjust distributor point gap. Adjust timing to specifications. Repair ignition system as necessary.
Over Heating	
1. Lack of coolant	1. Add coolant.
2. Fan belt improperly adjusted	2. Adjust fan belt deflection to 1/2 inch.
3. Carburetor choke valve partly closed	3. Adjust choke cable so that the choke valve will open completely.
4. Thermostat sticking in the closed position.	4. Clean, test and, if necessary, replace thermostat.
5. Cooling system dirty	5. Clean and flush cooling system. Refill with clean coolant containing rust inhibitor.
6. Hoses deteriorated	6. Replace hoses.
7. Inlet hose collapsing, especially during acceleration	7. Replace hose.
8. Defective water pump	8. Rebuild or replace water pump.
9. Dirt or insects in radiator air passages	9. Remove foreign particles.
10. Exhaust system restricted	10. Replace muffler and exhaust pipes as necessary. Make sure the heat control valve is functioning.
Over Cooling	
1. Thermostat sticking open	1. Clean, check, and, if necessary, replace thermostat.
2. Low ambient temperature	2. Cover radiator sufficiently to bring water temperature into operating range.
Excessive Exhaust Smoke	
1. Too much oil in the crankcase (blue smoke)	1. Drain oil to "Full" mark on gauge.
2. Worn rings, pistons, cylinders or intake valve guides (blue smoke)	2. Install new rings. Bore cylinders and install oversize piston assemblies. Ream valve guides and install valves with oversize stems.
3. Too much fuel entering the combustion chamber	3. Install new needle and seat and adjust carburetor float level. Install new fuel pump if pump pressure is too high.
4. Oil leaks at screws, gaskets and oil seals	4. Tighten screws. Replace gaskets and oil seals as necessary.

Cause	Remedy
5. Inferior grade of oil (blue smoke)	5. Drain crankcase and refill with good grade of oil.
6. Over heating	6. Refer to "Overheating."
7. Ring gaps too great or not staggered (blue smoke)	7. Install new rings, with gaps staggered.
8. Main or connecting rod bearings loose (blue smoke)	8. Replace bearings as needed.
9. Air cleaner clogged (blue smoke)	9. Service air cleaner.
10. High oil pressure	10. Free-up relief valve in the oil pump. Replace spring if necessary.
Bearing Failures	
1. Continuous overspeeding of the engine	1. Continuous operation at maximum speed or close to it is to be avoided. Exercise caution when going down grade. Do not allow vehicular speed to exceed same speed obtainable in same gear on level terrain.
2. Lack of oil	2. Keep oil level at "Full" mark on bayonet gauge.
3. Inferior grade of oil or oil of improper viscosity	3. Use good quality oil of proper viscosity.
4. Low oil pressure	4. Check oil level. Fill to "Full" mark on gauge. Check oil pump and relief valve spring. Replace parts as necessary.
5. Bent connecting rod	5. Replace connecting rod.
6. Crankshaft rough or out of round	6. Regrind or replace shaft.
7. Restricted oil passages	7. Clean oil lines and passages. Replace oil filter element.
8. Bearings loose or improperly fitted	8. Replace main or connecting rod bearings.
9. Dirt or other matter in lubricating oil	9. Drain crankcase and refill with clean oil. Service breather air filter regularly. Replace oil filter element.
Low Oil Pressure	
1. Oil pressure gauge defective	1. Replace gauge.
2. Oil pump strainer screen in oil pan clogged	2. Clean screen.
3. Oil too hot, resulting in low viscosity	3. Correct cause of overheating.

Cause	Remedy
12. Exhaust pipe or muffler restricted	12. Replace parts as necessary. Free-up heat control valve.
Engine Knocking	
1. Loose or worn main bearings (heavy, dull knock when accelerated under load)	1. Replace main bearings. Grind crankshaft and install undersize bearings if necessary.
2. Loose connecting rod bearings (condition noted at idling speed or light load and knock diminishes as load is increased)	2. Replace rod bearings. Grind crankshaft and install undersize bearings if necessary.
3. Loose piston pins (sharp metallic rap at idling speed or when starting cold engine)	3. Install oversize pins or piston assembly.
4. Loose pistons (noted at low speeds, especially with a cold engine)	4. Bore cylinders and install oversize piston assemblies.
5. Overheated engine	5. Refer to "Overheating."
6. Insufficient lubricating oil	6. Drain oil, and refill to "Full" mark on guage.
7. Loose flywheel	7. Replace flywheel if mounting holes are elongated or pilot hole is out-of-round. Tighten mounting nuts to correct tension. Replace crankshaft if flywheel mounting flange is out-of-round.
8. Excessive crankshaft end play (indicated by an intermittent knock which will come and go when clutch is operated or load is released and engaged.)	8. Install new crankshaft thrust bearing.
9. Excessive camshaft end play (noise usually occurs at half engine speed)	9. Install new camshaft thrust bearing.
10. Bent connecting rod	10. Straighten or, if necessary, replace the connecting rod. Replace the piston assembly if necessary.
Operating Knocks	
1. Pre-ignition	1. Clean spark plugs. Install spark plugs of a lower heat range.
2. Ignition timed too early	2. Adjust timing to specifications.
3. Low octane fuel	3. Fill tank with fuel of higher octane rating.
4. Overloading	4. Use lower gear or reduce load.
5. Excessive accumulation of carbon in combustion chamber	5. Clean or remove carbon deposits.

Cause	Remedy
6. Hot spot in combustion chamber due to carbon deposit or clogged water passage	6. Remove carbon and open water passage.
7. Engine operating too hot	7. Refer to "Overheating."
8. Carburetion or fuel mixture incorrect	8. Check carburetor. Reset, repair or replace as necessary.
9. Spark plug gaps too wide	9. Adjust gaps correctly.
Explosion In Muffler	
1. Ignition too late	1. Correct ignition timing.
2. Weak spark	2. Check condenser, distributor, coils and wires. Adjust and replace parts as necessary.
3. Exhaust valves holding open	3. Check tappet clearance, springs and guides. Clean and replace parts as necessary.
4. Exhaust valves warped	4. Reface or replace.
Explosion In Carburetor Or Air Cleaner	
1. Fuel mixture too lean	1. Clean carburetor, check fuel level in bowl.
2. Intake valves holding open	2. Check tappet clearance, springs, guides, etc.
3. Intake manifold leaking	3. Tighten manifold nuts. Replace gaskets if necessary.
Excessive Fuel Consumption	
1. Carburetor worn or improperly adjusted	1. Repair carburetor as necessary.
2. Fuel leaks	2. Repair fuel system as necessary.
3. Sticking controls	3. Oil controls and eliminate binding.
4. Excessive idling	4. Shut engine off when not in operation.
5. Excessive use of choke	5. Push choke button in when engine is warm. Adjust choke cable so choke valve will open completely.
6. Dirty air cleaner	6. Service air cleaner.
7. Engine over heating	7. Refer to "Overheating."
8. Engine running too cold	8. Refer to "Overcooling."
9. Engine in poor condition	9. Repair engine as necessary.

Cause	Remedy
4. Pressure regulator piston worn or clogged	4. Clean or replace piston or spring if necessary.
5. Excessive main and connecting rod bearing clearance	5. Check shaft, regrind if necessary, and replace bearings.
6. Oil pressure gauge line bent or clogged	6. Clean, straighten or replace line.
7. Loose camshaft bearings	7. Replace bearings and/or camshaft as necessary.
Rapid Cylinder Or Piston Wear	
1. Breather and air cleaner not properly serviced	1. Clean frequently and at regular intervals.
2. Leaking air cleaning system. Inferior grade of lubricating oil	2. Tighten connections. Replace ruptured element and hoses. Use good quality oil.
3. Lack of oil	3. Keep oil at "Full" mark on bayonet gauge.
4. Dirty oil	4. Change oil and replace oil filter element.
5. Piston rings not properly fitted to cylinders or rings too severe	5. Replace piston rings. Rebore cylinders if necessary.
6. Carburetor fuel mixture too rich	6. Replace worn jets. Replace needle and seat. Adjust float level. Check fuel pump pressure.
7. Cold operation of engine	7. Refer to "Over Cooling".
Valves Sticking	
1. Incorrect valve tappet clearance	1. Adjust clearance.
2. Valve springs weak or broken	2. Replace springs.
3. Valve stems or guides scored, dirty or gummy	3. Clean or replace.
4. Incorrect clearance between valve stem and guide	4. Fit valve stems to correct clearance in guides. Ream valve guides and install valves with oversize stems.
Burnt Valves Or Valve Seats	
1. Valve tappet clearance adjusted too close	1. Adjust clearance.
2. Weak valve springs	2. Replace springs.
3. Excessive carbon	3. Remove carbon deposits.
4. Camshaft not timed correctly	4. Retime camshaft.

Cause	Remedy
5. Lean fuel mixture	5. Clean and adjust carburetor. Check for vacuum leaks and repair as necessary.
6. Valve seats too narrow	6. Cut seats to correct width.
7. Low grade fuel	7. Use good quality fuel.
8. Valve heads cut too thin	8. Replace valve.

SPECIFICATION LISTING

GASOLINE ENGINE

	F—162	F—163
General Specifications		
Number of Cylinders	4	4
Bore	3-7/16 in.	3-7/16 in.
Stroke	4-3/8 in.	4-3/8 in.
Displacement	162 cu. in.	162 cu. in.
Horsepower	45	52
at RPM	2600	2600
Idle Speed	550-600 RPM	550-600 RPM
Governed Speed:		
Standard Trans.	2500 RPM	2500 RPM
Powershift Trans.	2600 RPM	2600 RPM
Stall Speed	1275-1325 RPM	1500-1550 RPM
Valve Lash (Hot):		
Intake	.014	.014
Exhaust	.016	.016
Timing:		
Firing Order	1-3-4-2	1-3-4-2
No. 1 Fires (at 600 RPM)	2°BTDC	2° BTDC
Compression:		
Ratio	7.25:1	7.5:1
Normal at 150 RPM	125 PSI	160 PSI
Oil Pressure:		
Normal at 2000 RPM	20-30 PSI	20-30 PSI
Minimum at Idle	7 PSI	7 PSI
Lubrication:		
Capacity (includes filter)	4 U.S. Quarts	4 U.S. Quarts
Oil Type*	SAE 20	SAE 20

* Oil type given is for average atmospheric temperatures. Refer to Miscellaneous Section for the type of oil used in trucks operating in various atmospheric temperatures.

Dimensions (In inches)	
Valve Guide, Intake and Exhaust:	
Length	2-5/16
Outside Diameter	.6565/.6575
Stem hole diameter	.3422/.3432
Wear limits—max. dia.	.3447
Contact face to guide	1-15/32
Intake Valves:	
Stem diameter	.3406/.3414
Wear limits—min. dia.	.3386
Seat angle	30°
Stem clearance limits	.0008/.0026
Wear limits—max. cl.	.0046
Desired stem clearance	.0015
Exhaust Valves:	
Stem diameter	.3377/.3385
Wear limits—min. dia.	.3357
Seat angle	45°
Stem Clearance	.0037/.0055
Wear limits—max. cl.	.0075
Desired stem clearance	.0045
Valve Springs, Intake and Exhaust:	
Outside diameter	31/32
Length—valve closed	1-45/64
Load—valve closed	47-53 lbs.
Wear limit—min. wgt.	42 lbs.
Length—valve open	1-27/64
Load—valve open	96-104 lbs.
Wear limit—min. wgt.	86 lbs.
Valve Seat Inserts:	
Standard outside dia.	1.3485/1.3475
Press fit	.003/.005
Camshaft:	
Brg. journal dia. No. 1	1.8715/1.8725
Wear limits—min. dia.	1.8705
Brg. journ. dia. No. 2	1.7455/1.7465
Wear limits—min. dia.	1.7445
Brg. journ. dia. No. 3	1.2465/1.2475
Wear limits—min. dia.	1.2455
Bush inside dia. No. 1	1.8745/1.8755
No. 2	1.7495/1.7502
No. 3	1.2495/1.2505

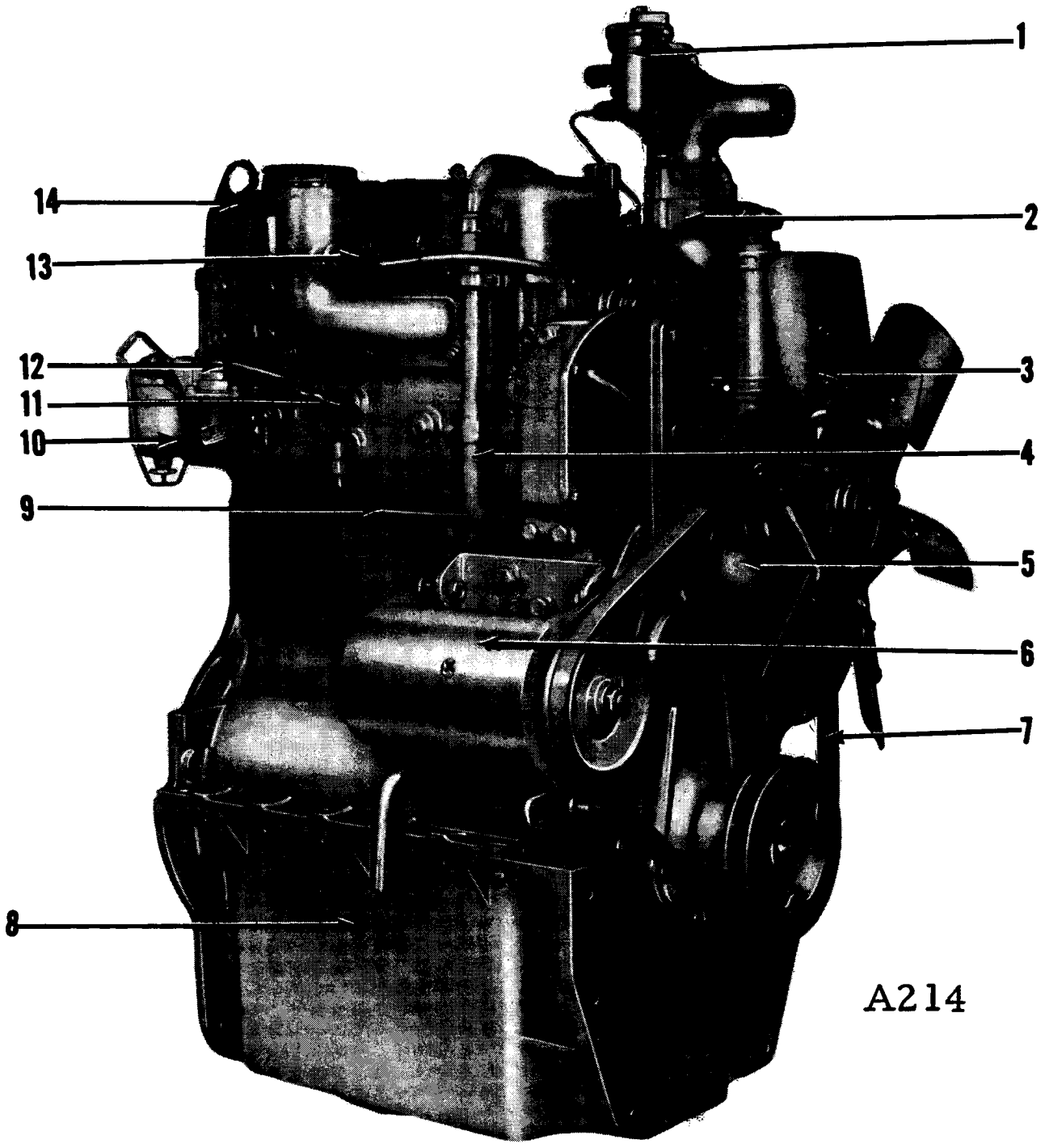
ENGINE

Bush. clearance limits	.002/.004
End play	.005/.009
F-162 Connecting Rods:	
Bush. hole dia.	.9130/.9140
Brg. hole dia.	2.0615/2.0620
Brg. thickness	.061651/.06190
Wear limits — min. thk.	.06115
Dia. — crank pin	1.9365/1.9375
Wear limits — min. dia.	1.9355
Clearance limits	.0002/.0022
Desired clearance	.001
Wear limits — max. cl.	.0032
Side play	.006/.010
Desired Side play	.006
F-163 Connecting Rods:	
Bush. hole dia.	.9130/.9140
Brg. hole dia.	2.1865/2.1870
Brg. thickness	.06130/.06155
Wear limits — min. thk.	.0608
Dia. — crank pin	2.0619/2.0627
Wear limits — min. dia.	2.0609
Clearance limits	.0007/.0025
Desired clearance	.0015
Wear limits — max. cl.	.0035
Side play	.006/.010
Desired Side play	.006
F-162 Main Bearing:	
Dia. of brg. bore in blk.	2.4365/2.4372
Brg. shell thickness	.09290/.09315
Wear limits — min. thk.	.0924
Dia. of main brg. journ.	2.2490/2.250
Wear limits — min. dia.	2.248
Clearance limits	.0002/.0024
Desired clearance	.001
C/S end play	.003/.008
F-163 Main Bearing:	
Dia. of brg. bore in blk.	2.5615/2.5622
Brg. shell thickness	.09250/.09275
Wear limits — min. thk.	.0920
Center Flange Brg. thik.	.09315/.09290
Wear limits — min. thk.	.09240
Clearance limits	.000/.002
Desired Clearance	.0008
Dia. of main brg. journ.	2.3744/2.3752
Wear limits — min. dia.	2.3734
Clearance limits	.0008/.0028
Desired clearance	.0015
C/S end play	.002/.006
Piston Pin:	
Length — F-162	2.489/2.504
Length — F/163	2.868/2.878
Diameter	.8591/.8593
Wear limits — min. dia.	.8588
Desired fit	Light push
Bush. Hole Dia. — Fin.	.8597/.8595
Wear limits — max. dia.	.8607
Pin Cl. in Bushing	.0006/.0002
Desired Pin Fit	.0004
F-162 Pistons:	
Cylinder dia.	3.4375/3.4395
Wear limits, cyl. bore	.008
Piston pin hole dia.	.8595/.8597
Ring groove width No. 1,2 & 3	
Max. wear limit	.1305
Ring groove width No. 4	.252/.253
Max. wear limit	.255
Piston fit-feeler gauge	.003
Lbs. pull	5 to 10
F-163 Pistons:	
Cylinder dia.	3.4375/3.4395
Wear limits, cyl. bore	.008
Piston pin dia.	.8595/.8597
Ring groove width No. 1	.096/.097
Max. wear limit	.099
Ring groove width No. 2 & 3	.1275/.1285
Max. wear limit	.1305
Ring groove width No. 4	.2515/.2530
Max. wear limit	.255
Piston fit-feeler gauge	.003
Lbs. pull	5 to 10
F-162 Piston Rings:	
Ring width No. 1, 2 & 3	.123/.124
Wear limits — min. width	.121
Ring width No. 4	.2485/.249
Wear limits — min. width	.2465
Ring gap clearance	
No. 1, 2 & 3	.007/.017
No. 4	.007/.017
Ring side clearance	
No. 1, 2 & 3	.0035/.0055
No. 4	.003/.0045
F-163 Piston Rings:	
Piston Rings:	
Ring width No. 1	.0930/.0935
Wear limits — min. width	.091
Ring width No. 2 & 3	.1235/.1240
Wear limits — min. width	.1215
Ring width No. 4	.2485/.249
Wear limits — min. width	.2465
Ring gap clearance	
No. 1, 2 & 3	.010/.020
No. 4	.015/.055
Ring side clearance	
No. 1	.0025/.004
No. 2 & 3	.0025/.005
No. 4	.0025/.0045

ENGINE

Torques

Size Diameter	5/16"	3/8"	7/16"	1/2"	9/16"	5/8"
Cylinder heads		35-40	70-75	100-110	130-140	145-155
Main bearing caps and connecting rods	20-25	35-40	70-75	85-95	100-110	
Flywheels	20-25	35-40	70-75	85-95	100-110	145-155
Manifolds	15-20	25-30	50-55	80-90	100-110	130-140
Gear covers, water pumps, front and rear end, oil pans	15-20	25-30	50-55	80-90		
Flywheel housings	15-20	25-30	50-55	80-90	115-125	
Camshaft nut (7/8") Steel camshaft	120-130					



1. Cold Start Aid Fuel Reservoir
2. Thermostat Housing
3. Fan
4. Breather Pipe
5. Water Pump
6. Generator or Alternater
7. Fan Belt
8. Lubricating Oil Pan
9. Inlet Pipe to Camshaft Reducer
10. Fuel Oil Pre-Filter
11. Outlet Pipe from Camshaft Reducer to Rocker Shaft
12. Fuel Oil Lift Pump
13. Cold Start Aid
14. Lifting Bracket
15. Injector
16. Leak-off Pipe
17. Exhaust Manifold
18. Final Fuel Filter
19. Cylinder Block Drain
20. Connection for Oil Pressure Gauge
21. Lubricating Oil Filter
22. Bayonet Gauge
23. Fuel Injection Pump
24. Oil Filler Cap
25. Lifting Bracket

Figure 68

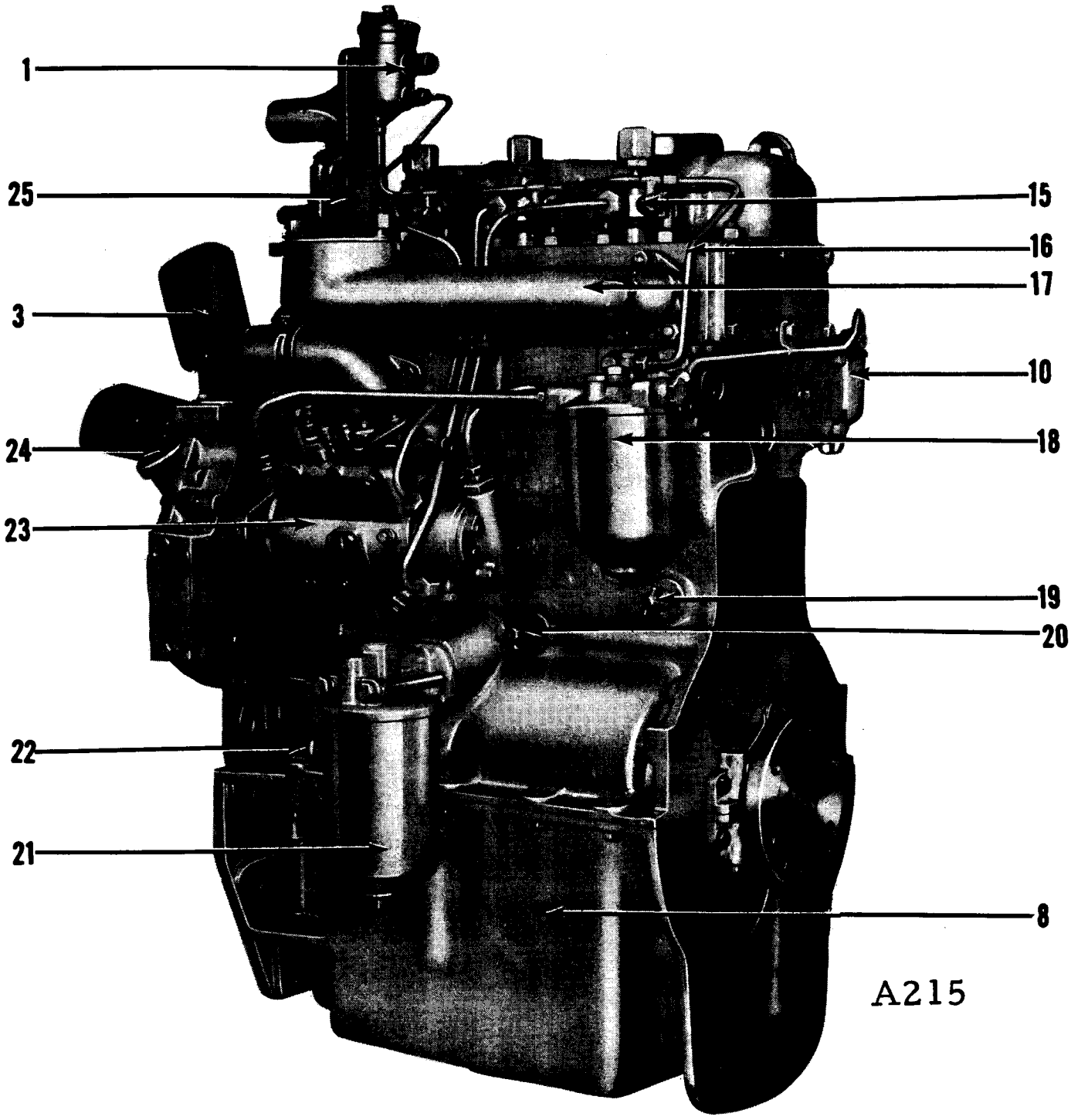


Figure 69

DIESEL ENGINE—3-152

GENERAL. Fig. 68 and 69

The diesel engine used in the trucks covered by this manual is a liquid-cooled, 3-cylinder overhead valve unit.

The diesel engine closely resembles its gasoline counterpart inasmuch as the mechanism is essentially the same. Its cylinders are arranged above its closed crankcase. Its crankshaft is one of the same general type as that of a gasoline engine and it has the same sort of valves, camshaft, pistons, connecting rods and lubrication system.

The removal and installation procedures of this engine are much the same as those for the gasoline engine. Therefore, these procedures are not in this section.

CYLINDER HEAD

A. General

The cylinder head is a one-piece cast iron alloy casting secured to the cylinder block by 15 high tensile steel studs. Valves and tappets are carried directly in the head on top of which the rocker shaft is mounted, the latter being enclosed in the rocker cover. It is important to note that removal of the cylinder head does not disturb the engine timing. All valves are of special alloy steel, the inlet being larger to insure maximum volumetric efficiency. The spherical combustion chamber is formed half in the cylinder head and half by a detachable steel cap.

B. Removal

1. Drain coolant. Taps for this purpose are provided, one on the right side of the cylinder block and one on the base of the radiator.

2. Disconnect the water outlet hose from the thermostat housing.

3. Disconnect the exhaust pipe flange from the exhaust manifold.

4. Remove the air cleaner connection from the air intake and disconnect the fuel oil supply pipe and the electrical connection from the cold starting aid.

5. Remove the oil pipe from the camshaft oil reducer to the cylinder head.

6. Remove the fuel injection pipes taking care to cover the fuel injection pump outlets with suitable caps or clean lint-free cloth.

7. Disconnect the injector leak-off pipes and remove the injectors. Fig. 70.

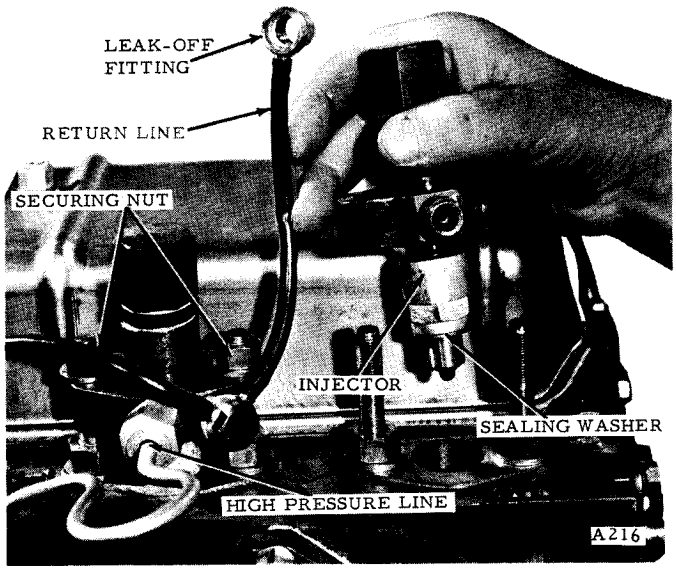


Figure 70

8. Remove the cylinder head cover.

9. Disconnect the oil pipe to rocker shaft.

10. Remove the rocker shaft assembly bringing above-named oil pipe with it.

11. Remove the cylinder head nuts.

12. Remove the cylinder head. Do not insert a screwdriver or any other sharp instrument between the cylinder head and block. Place the cylinder head on a flat surface, preferably wood, to avoid damage.

C. Disassembly

1. Depress the spring cap and springs by means of a valve lifter and remove the two half conical collets. Remove the spring caps, springs and washers thus releasing the valves which can be taken out.

NOTE: Fig. 71 is an exploded view of the valve assembly.

D. Inspection and Service

1. Remove all traces of carbon from the valves,

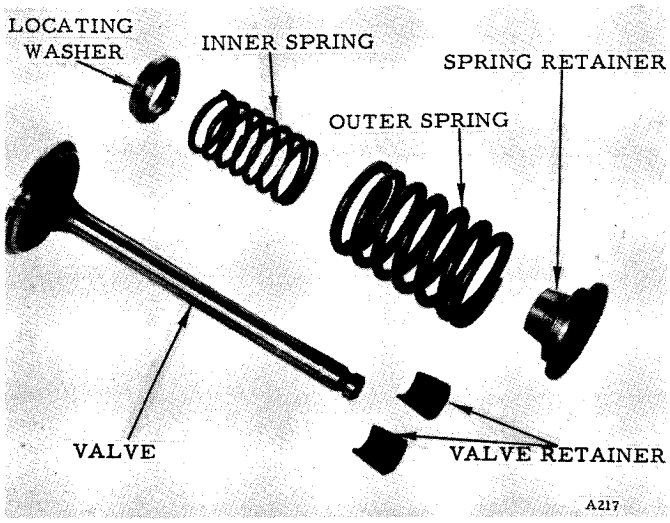


Figure 71

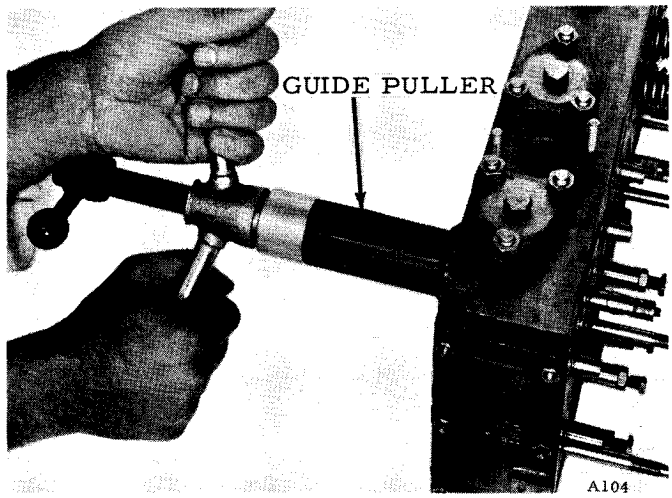


Figure 72

valve guides and cylinder head ports.

2. Examine the valve guides for wear. If necessary replace with new guides. Fig. 72. Clean the new guide to remove any burrs.

NOTE: When pressing in a valve guide, care must be taken to insure it is fitted the right way. Both ends are chamfered, one at 45°, the other at 20°. The end that is chamfered at 20° is also recessed in the bore. This end should be inserted into the cylinder head top face and pulled into the parent bore until the opposite end (chamfered at 45°) protrudes .584/.594 in. (14.83 to 15.09 mm) above the top face. Reface the seat whenever a new guide is installed.

3. Reface the valves and seats to 45°. Lap them together with lapping compound until a clean, even seat of a dull grey finish is obtained. The seat width should be between 1/16 and 3/32 in. (1.58 and 2.38 mm). All valves are numbered and care should be taken to see that they are replaced correctly. Number all new valves to correspond with the numbering of the old ones. Care should be taken to avoid unnecessary grinding away of the seat as the maximum clearance between the valve head and the cylinder head bottom face should not exceed .140 in. (3.5 mm). This can easily be checked by means of a gauge and feelers. Fig. 73.

If valve is too high, reface the valve. If the valve is too low, try a new valve; install a new seat if the valve is still too low. Install a new valve seat

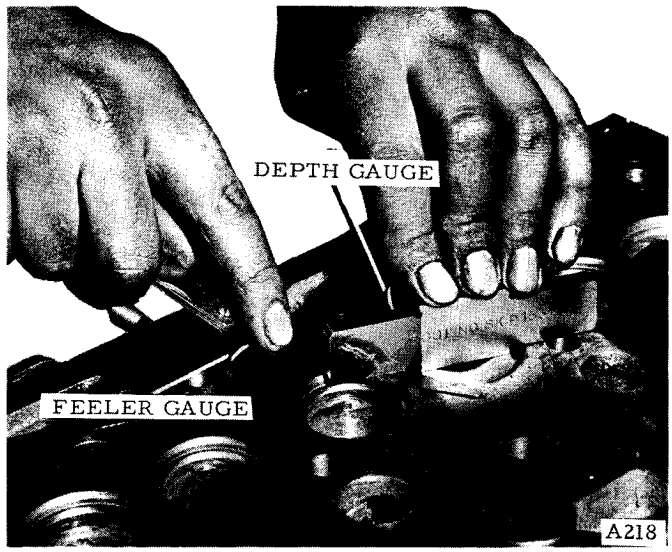


Figure 73

insert as follows:

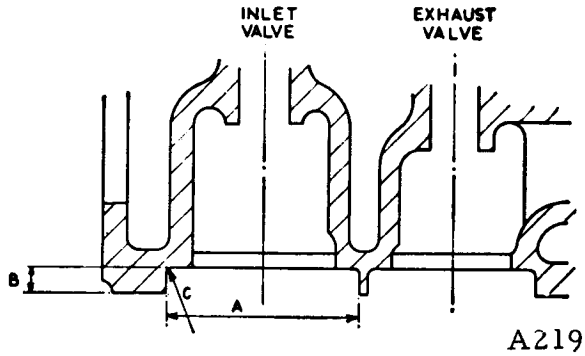
a. Install a new valve guide.

IMPORTANT: Always install a new guide in the port receiving the new seat.

b. Cut away the old seat and machine the port as indicated in fig. 74.

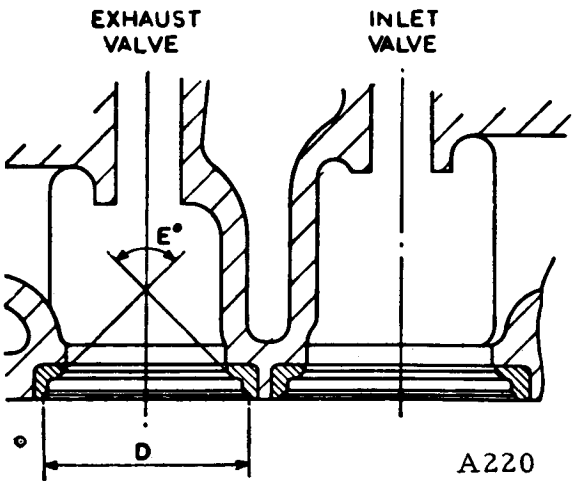
c. Press the new insert into position using tool shown in fig. 75.

CAUTION: Do not hammer the insert into position.



Inlet
A. 1.874 to 1.875 in (47.60 to 47.62 mm).
B. .248 to .250 in (6.30 to 6.35 mm).
C. .040 to .050 in (1.02 to 1.30 mm) Radius.
Exhaust
A. 1.624 to 1.625 in (41.25 to 41.28 mm).
B. .248 to .250 in (6.30 to 6.35 mm).
C. .040 to .050 in (1.02 to 1.30 mm) Radius.

Figure 74

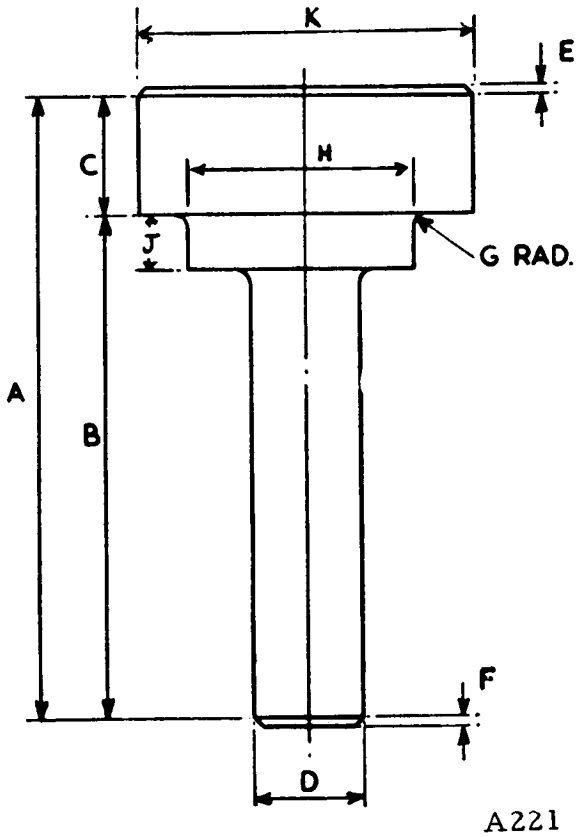


Inlet
D. 1.704 to 1.714 in (43.28 to 43.53 mm).
E. 90°
Exhaust
D. 1.485 to 1.495 in (37.72 to 37.97 mm).
E. 90°

Figure 76

d. Finish the insert to the dimensions shown in fig. 76. Reface the seat and lap the valve.

4. Wash the rocker shaft assembly thoroughly in solvent. Examine the rocker bushings for wear. The rockers should be an easy fit on the shaft without excessive side play. If the rocker bushings



Inlet Dimensions
A. 2-3/4 in (69.85 mm).
B. 2 in (50.80 mm).
C. 3/4 in (19.05 mm).
D. .309 to .310 in (7.84 to 7.87 mm).
E. 1/16 in (.06 mm) at 45°.
F. 1/16 in (.06 mm) at 45°.
G. 1/32 in (.03 mm) Radius.
H. 1.401 to 1.402 in (35.58 to 35.61 mm).
J. .212 to .215 in (5.38 to 5.46 mm).
K. 1.855 to 1.865 in (47.12 to 47.37 mm).
Exhaust Dimensions
A. 2-3/4 in (69.85 mm).
B. 2 in (50.80 mm).
C. 3/4 in (19.05 mm).
D. .309 to .310 in (7.84 to 7.87 mm).
E. 1/16 in (.06 mm) at 45 .
F. 1/16 in (.06 mm) at 45 .
G. 1/32 in (0.03 mm) Radius.
H. 1.182 to 1.183 in (30.02 to 30.05 mm).
J. .212 to .215 in (5.38 to 5.46 mm).
K. 1.605 to 1.615 in (40.77 to 41.02 mm).
Case Hardened and Ground

Figure 75

are worn, it will be necessary to replace with a new rocker.

NOTE: To disassemble the rocker shaft assembly, remove the snap rings from the ends of the rocker

shaft and slide off the components noting the positions of support brackets, rocker arms, springs, spacers and lube oil supply pipe. When re-assembling, insure that all components are fitted to the rocker shaft in the correct order. Fig. 77.

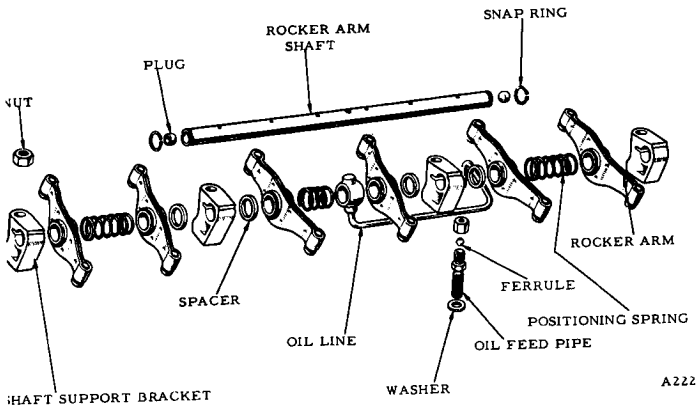


Figure 77

5. Clean the carbon, if any, from the combustion chamber caps. If, for any reason, these covers are removed, new copper gaskets should be fitted when they are replaced.

NOTE: It is not as a rule necessary to remove the covers of the combustion chambers during top overhaul as carbon rarely forms in these chambers.

6. All studs on the cylinder head and top face of the cylinder block should be examined for looseness, damaged threads, etc. The cylinder head nuts should also be examined to ensure the threads are not damaged.

7. All gasket faces should be examined for pitting and defacement.

8. Wash out and thoroughly clean the water passages in the head, subsequently drying out and finally cleaning with compressed air.

9. If the water jacket of the cylinder head shows signs of excessive scale, descaling solution should be used.

10. The cylinder head should be water tested for leaks with warm water at a water pressure of 30 lbs. per sq. in. (2.11 KG/sq. cm).

IMPORTANT: Should the cylinder head bottom face become damaged, it is permissible to resurface, providing the overall thickness is not reduced below 2.980 in. (75.69 mm). The relative valve head depth, however, must afterwards be checked and if necessary corrected to conform with the limits quoted in the Specification Listing.

E. Assembly

1. Install valves, washers, springs, spring retainers and valves, taking care that the numbers on the valves correspond to the numbers stamped adjacent to the valve seats.

2. Replace combustion chamber caps and gaskets, if these have been removed.

NOTE: Before replacing the cylinder head, it is extremely important to insure that the faces of the cylinder block and cylinder head are perfectly clean.

NOTE: A new cylinder head gasket should be used. The gasket is marked to indicate how it should be replaced.

3. Cover both sides of the gasket with a thin coating of gasket cement and place over the cylinder head studs.

4. Make sure the underside of the head is clean. Then, lower it into position. Tighten the cylinder head nuts to 55 to 60 pound feet; in the sequence shown in fig. 78.

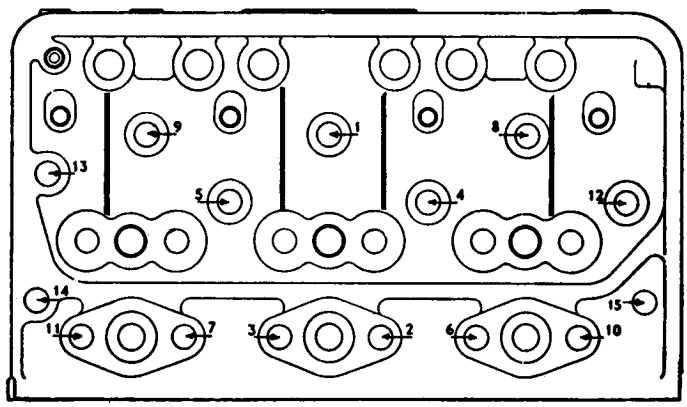


Figure 78

5. Install the injectors and rocker arm assembly.

NOTE: The rocker shaft should be set to insure correct lubrication before tightening the securing nuts. The correct position for the shaft is when the slot in the end of the shaft is set 30° before the

vertical position. On production this position is pre-marked by means of a punch dot on No. 1 rocker shaft bracket. Fig. 79.

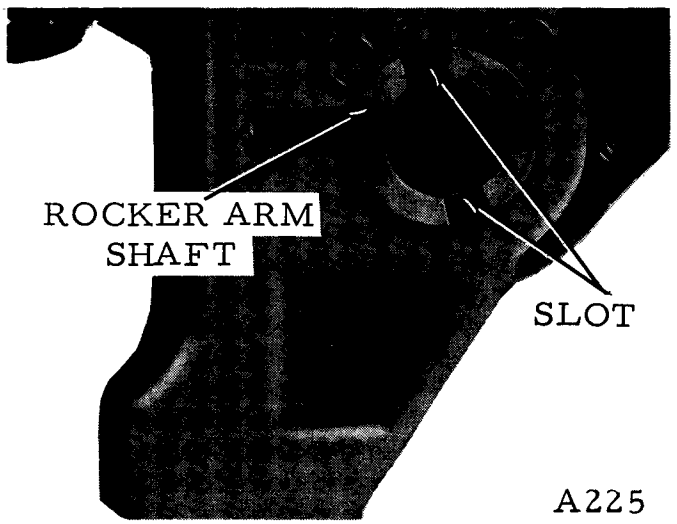


Figure 79

6. Adjust the valve clearance to .012 in. (30 mm).

7. Connect the fuel pipes to the injection pump and injectors. Bleed the air from the system.

8. Fill the cooling system. Start the engine. Make sure that the lubricating oil is reaching the rocker shaft. Install the valve cover; use a new gasket.

CAUTION: On no account must the engine be started without a thermostat installed, otherwise overheating of the engine may occur.

9. After a short running-in period, check the torque settings on the cylinder head nuts and reset the valve clearances to .010 in. (.25 mm) with the engine at operating temperature. Fig. 80.

PISTONS AND CONNECTING RODS

A. General

The pistons are of high silicon aluminum. Grooves are provided to take three compression rings and one oil control ring above the piston pin and one oil control ring below the piston pin. Fig. 81.

The full-floating piston pin is retained in position by two snap rings.

Because the chrome cylinder liners are replaceable, the pistons are obtainable in the "standard" size only.

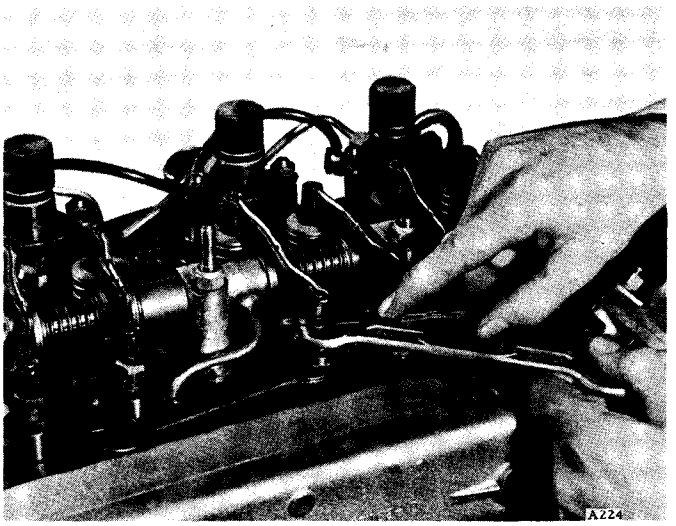


Figure 80

The connecting rods are of high tensile steel "H" section forgings. The rod end is split at right angles to the axis of the rod, the cap being secured by place bolts, secured by self-locking nuts.

The big end bearings are of the thin wall type consisting of a thin steel shell lined with plated copper lead or alternatively aluminum tin.

To insure correct replacement, the pistons are marked 1 to 3, number 1 being at the front of each piston crown.

The connecting rods and caps, are also marked. On one side they are stamped with a number corresponding to their position in the engine. Always fit the cap to the connecting rod so that the numbers are both on the same side. Never reassemble the cap to the connecting rod incorrectly.

B. Removal

NOTE: When removing a piston assembly from the engine, check whether or not the connecting rod and cap have been marked, as they may have been replaced at some time after the engine left the factory, in which case the numbering may not have been carried out. Such connecting rods and caps should be marked.

1. Remove the cylinder head assembly.
2. Remove the oil pan and oil pump.

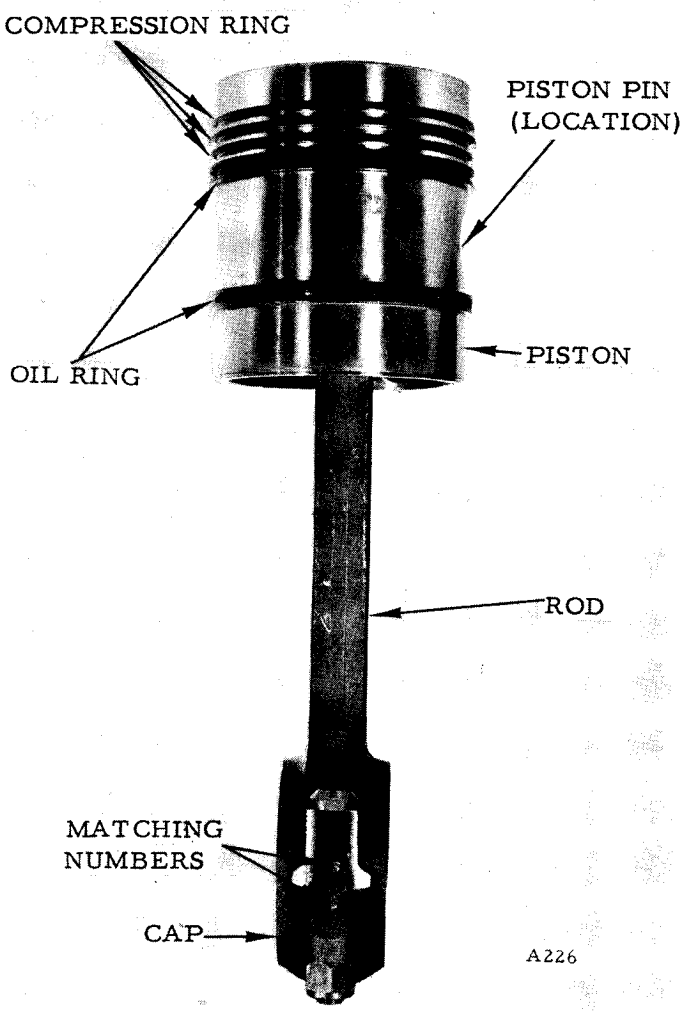


Figure 81

3. Turn the crankshaft until the piston to be removed is at the bottom of its stroke.

4. Carefully remove any carbon that may have formed at the top of the cylinder bore.

5. Remove the connecting rod cap and both top and bottom half bearing shells. Fig. 82.

6. The piston and connecting rod can then be pushed out of the top of the cylinder block. Fig. 83.

7. Continue operations until all three pistons and connecting rods have been removed.

8. Reassemble the bearings and caps to the connecting rods.

C. Disassembly

NOTE: Insure that the piston is numbered, as it

Figure 82

Figure 83

may have been installed at some time after the engine left the factory without being marked. If the piston removed is to be used again, be sure that it is marked relative to the connecting rod so that it can be replaced in the same position on the rod.

1. Carefully remove the rings using either guide strips or piston ring expanders. Remove the top ring first.

2. Remove the two snap rings retaining the piston pin in the piston.

3. Warm the piston in hot water or oil and push out the piston pin.

D. Cleaning and Inspection

1. All parts may be washed in solvent.

2. Remove all carbon from the piston crown and grooves, taking care not to damage the piston. Do not cut away any metal, especially from the ring lands.

3. Make sure that all piston rings and piston ring grooves are perfectly clean, that the grooves are not damaged, or the pistons scored.

4. In addition to visually examing the connecting rod for damage, the piston pin bushings should be checked for condition and fit of piston pin.

5. If necessary, remove the old bushing by pressing in the replacement bushing. The oil hole in the new bushing must first be carefully aligned with the hole in the top of the connecting rod. The new bushing must be reamed after installation.

6. Check rod alignment. It should not be bent or twisted. Method of checking aligning depends on equipment available.

7. The bearing on the crankshaft end of the rod must not be scratched or excessively worn. See that the back of each bearing and the bearing bore of each rod are clean. No foreign particles should exist between the mating surfaces. The mating surfaces should make a metal-to-metal contact with each other and bear no evidence of bearing-to-bore movement.

8. Check the side clearance of the ring in the ring groove of the piston on which the ring is to be installed. Check the ring gap with the ring at the bottom of the liner bore that coincides with the piston on which the ring is to be installed.

9. The pistons and liners should be checked for scuffing and excessive wear.

E. Assembly

1. With the piston thoroughly clean, fit one new snap ring in position in the piston to serve as a locator for the piston pin when installing pin.

2. Heat the piston in hot water or oil to allow easy replacement of the pin.

3. Insert the connecting rod between the piston bosses so that the marks made at the time of disassembly are in line. If a new piston is being used, it may be fitted to connecting rod either way around. Mark the new rod according to location and piston relationship.

4. Insert the piston pin and fit the second snap ring into the piston.

5. See that both snap rings are fully seated in their grooves.

NOTE: When a new piston is installed, it is necessary to machine the piston crown to provide the correct clearance of .000/.005 in. below the top face of the cylinder block with the piston at top dead center. Fig. 84.

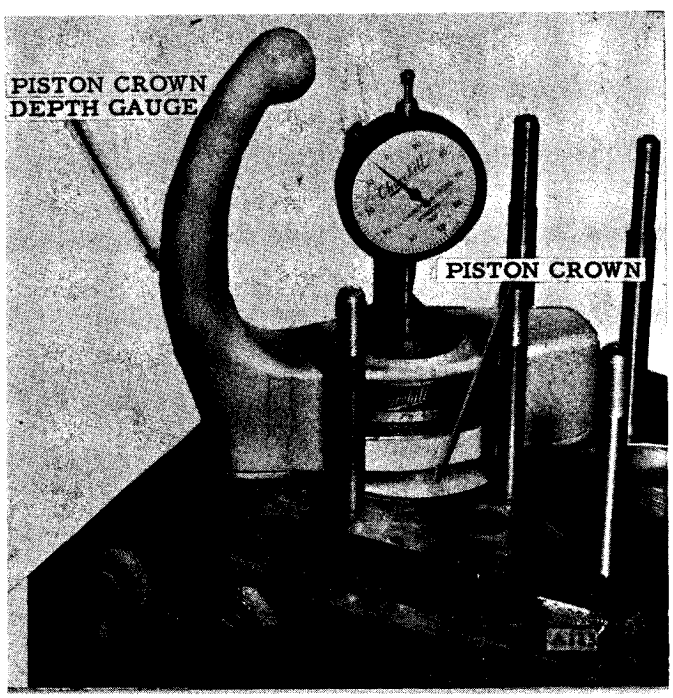


Figure 84

6. Install the piston rings.

NOTE: The piston ring layout is as follows:

a. Top compression ring — cast iron parallel.

b. Second compression ring — cast iron taper-faced.

c. Third compression ring — laminated.

d. Oil control ring above the piston pin — cast iron slotted scraper.

e. Oil control ring below the piston pin — cast iron slotted scraper.

NOTE: Taper-faced rings are marked "top", and the side thus marked must be toward the top of the piston.

7. Procedure: laminated ring

a. Install the first segment to the piston so that when held horizontally in the palm of the hand and radially compressed, the ring ends point downwards. Position this ring at the bottom of the groove with the gap over the piston pin bore.

b. Install the second segment on the top of the first so that when held compressed, as described above, the ring ends point upwards. Position the gap at 180° to the first segment gap.

c. The third segment should be fitted on the top of the second so that when compressed, as described, the ring ends point downwards. Position the gap immediately above that of the first segment.

d. Install the fourth segment on the top of the third so that when held and compressed, the ring ends point upwards. Position the gap above that of the second segment.

F. Installation

1. Clean out the cylinder bore with a clean, dry lint-free rag and apply a liberal coating of lubricating oil to the cylinder bore.

2. Stagger ring gaps around the piston so the gaps are equal distance apart.

3. Affix ring compressor, making sure all sliding surfaces of the compressor, rings and piston are lubricated. Do not install piston-rod assembly without lubricating the piston.

4. Connecting rods and caps are plainly marked to indicate their original position in the engine. Fig. 81.

5. See that the connecting rod number is on the camshaft side of the engine and insert the connecting rod and piston into the bore.

6. Push the piston down into its bore through the ring compressor. Fig. 85.

Figure 85

7. Turn the crankshaft until the journal is at the bottom center.

8. Lubricate and install the top half bearing in the connecting rod, being sure that the tongue on the bearing engages in the machined recess in the rod bore.

9. Pull the connecting rod to the crankshaft and install cap bolts insuring that they are fully seated. The bolt head is machined so that the bolt fits in the connecting rod in one position only.

10. Lubricate the bottom half bearing and install the bearing cap so the numbers match.

11. Use new rod nuts and tighten to specified torque.

12. Where necessary, replace the oil pump suction and delivery pipes. Install oil pump.

13. Install oil pan and cylinder head.

CYLINDER LINERS

A. General

Great care must be taken in handling and storage of the chrome plated liners, as the slightest burr or damage to this thin wall liner is sufficient to cause considerable local distortion of the liner bore, when installed.

Whenever it is determined that a liner condition is not suitable for future service, it must be replaced.

B. Removal

1. Remove the piston and connecting rod assemblies and crankshaft.

2. Remove cylinder head studs from the cylinder block.

3. Press or pull the liners out through the top of the cylinder block, being sure that no damage is done to parent bore. Fig. 86.

C. Preparation for Installation

1. The parent bore must be thoroughly cleaned both in the top recess for the flange and in the bore itself. A check must be made to insure that the areas of contact with the liners in the cylinder block are free from burrs, corrosion or damage. Remove any burrs present.

2. Insure that the new liner is thoroughly clean before fitting. If solvent is used to wash the liner, it is important that the liner be thoroughly dried and well oiled before fitting.

3. Throughout the whole operation, extreme cleanliness is essential as the entry of the smallest particle of grit or other foreign matter is sufficient to cause local distortion of the liner bore.

D. Installation

1. Lubricate the outside diameter of the liners

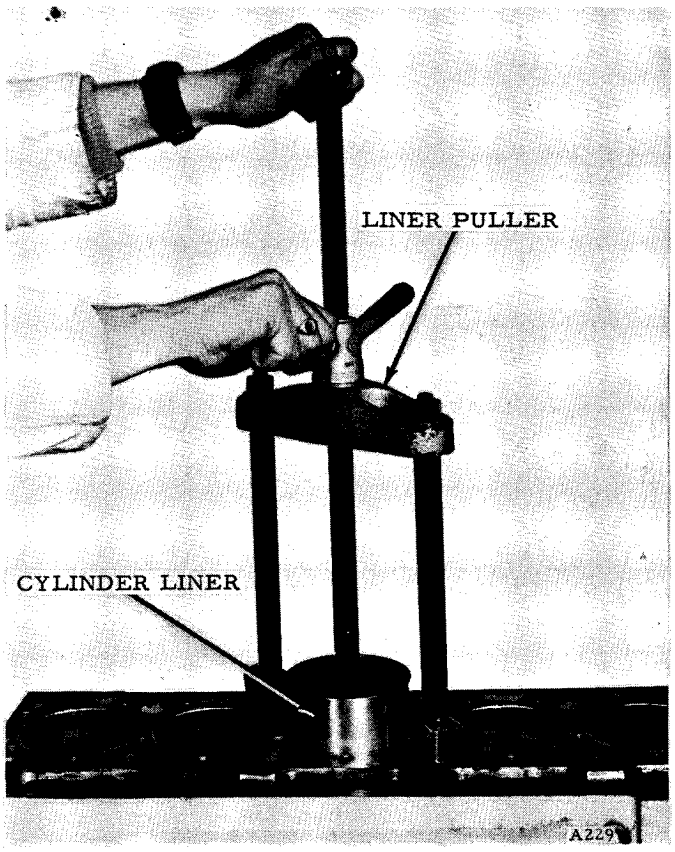


Figure 86

with clean oil which should be applied by means of a pressure can. The use of a brush is not recommended.

2. Press or pull in the new liners using a shouldered metal disc making sure that the flanges at the top of the liners do not foul the counterbore at the top of the parent bore causing distortion at the top of the internal diameter of the liner. Fig. 87.

NOTE: When seated, the top face of the liner flange should be between .001 inch and .009 inch below the top face of the cylinder block. The fit of the new liners in the parent bore is a transition fit. That is, the limits extend from minus .001 to plus .001 inch.

3. Allow a settling period to elapse. Then, check the internal bore diameter of the liner.

NOTE: In Step 3, the acceptable limit is 3.600/3.603 inch. Each new liner should be checked in three positions—top, center and bottom; the read-

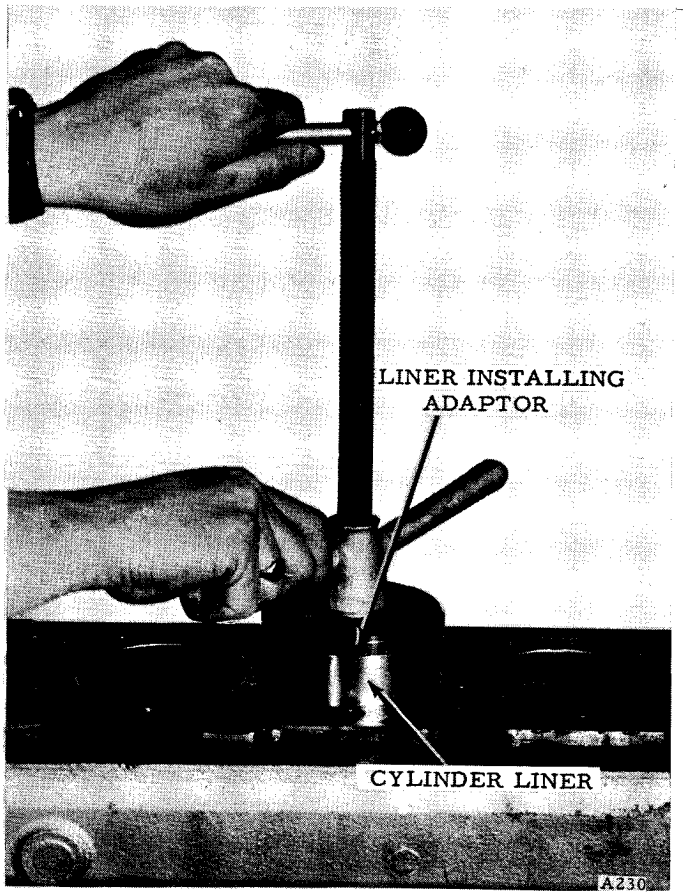


Figure 87

ings being taken transversely and parallel to the center line of the cylinder block at each position.

4. Check new rings for size and correct gap, and assemble to pistons.

5. Install new pistons. See that the dimension between the piston crown and cylinder block face is maintained. (Zero to .005 inch below cylinder block face).

6. Having installed the new liners and piston-rod assemblies, the remainder of the reassembly operations are a reversal of removal procedure.

CRANKSHAFT

A. General

The crankshaft is supported by a bearing between each cylinder and has induction-hardened main journals. It is machined from a solid chrome molybdenum steel forging.

The rear end of the shaft is machined to provide an oil slinger and oil return groove. Oil seals are provided at the front and rear ends of the crankshaft. The front oil seal is of the spring loaded lip type fitted into the timing case cover, and the rear seal is of the rubber-bonded asbestos type retained in a split housing.

Crankshaft end play is limited by steel backed copper lead thrust washers at each side of the rear main bearing. Two cast iron counter weights are used, one at the front crank web and one at the rear crank web.

The crankshaft is supported by four main bearings. The bearings which are pre-finished consist of thin wall shells lined with plated copper lead metal. Alternative bearings are lined with aluminum tin. They are located by tabs which fit into notches machined into the crankcase and bearing caps.

The main bearing caps are located by two large diameter dowels and are securely fastened to the crankcase by high tensile steel set bolts. Fig. 88.

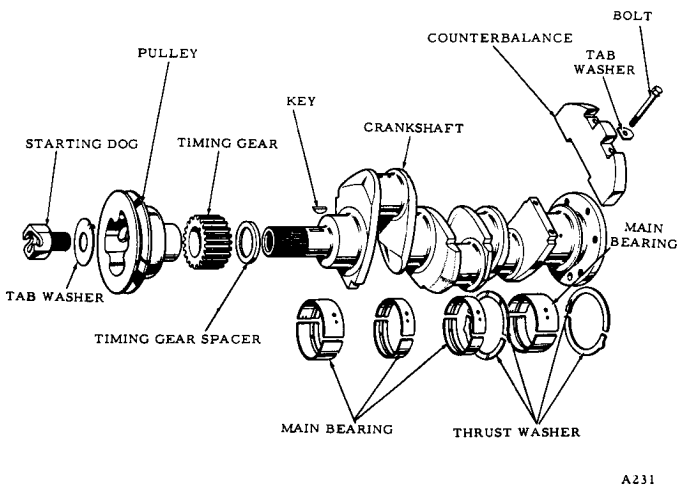


Figure 88

B. Removal

1. Drain lubricating oil. Remove engine.

2. Separate engine and transmission. Remove adaptor plate.

3. Remove the water pump, crankshaft pulley, timing case cover and idler gear.

4. Remove the lubricating oil pan and pump.

5. Remove the bolts and self-locking nuts se-

curing the two halves of the rear main oil seal housings.

6. Remove the connecting rod caps and bearings.

7. Remove main bearing bolts and discard tab washers (if fitted).

8. Detach the main bearing caps taking care not to drop either the bearing shells or thrust washers.

9. Lift the crankshaft from the cylinder block.

10. Make sure all the main bearings are identified with their corresponding cap or cylinder block housing.

C. Cleaning and Inspection

1. Clean all parts in solvent, paying particular attention to the oil passages. Blow dry with filtered compressed air.

2. Check oil passages in the block. Make sure they are open and clean.

3. Examine the main bearing place bolts for stretch and thread damage.

4. Remove the half housings of the rear main oil seal from the cylinder block and rear main bearing cap. Fig. 89.

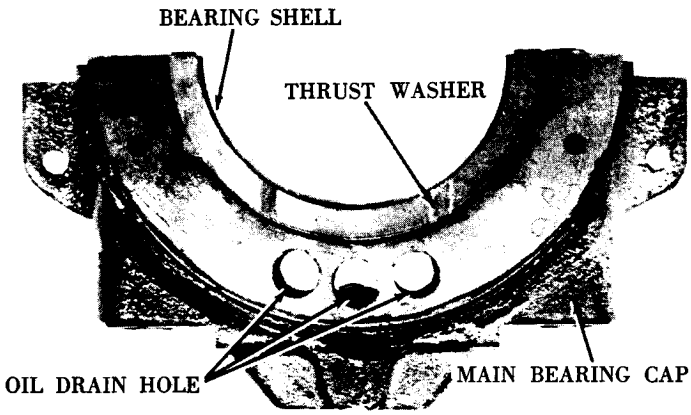


Figure 89

5. Check shaft for cracks. The bearing journals must not be scored, out-of-round or tapered. If shaft is cracked, replace with a new one. Otherwise the shaft may be reground and undersize bearings installed.

NOTE: If there is any doubt as to whether or not the shaft is cracked, "Magnaflux" it.

6. Before the shaft is reground, it should be demagnetized.

7. The surface finish on all reground journals must not exceed 16 micro-inches.

8. It is most important that the radii on the main journals and crankpins are maintained to the figures quoted in the Specification Listing.

9. After regrinding, the sharp corners on the oil holes must be removed and the crankshaft checked for cracks and demagnetized.

10. Be sure to remove all foreign particles from the oil passages of a reground shaft. Lubricate all journals.

D. Installation

1. Clean bearing housings and place top half bearings in position.

2. Place crankshaft in position.

3. Lightly smear the two upper thrust washers with lubricating oil and slide in recesses provided on either side of the rear main bearing housing.

4. Position lower halves of main bearings in bearing caps and place in position insuring that the thrust washers on No. 4 main bearing cap are fitted correctly. Fig. 90.

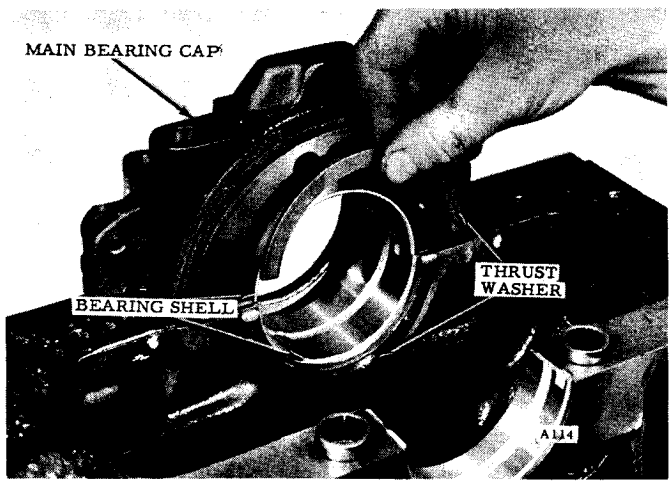


Figure 90

NOTE: When replacing the main bearing caps, insure that they are installed in their respective positions, and that they are fitted correctly. The

caps are numbered, No. 1 commencing at the front of the engine. Each cap is also marked with a serial number and, when fitted, this number should read in line with the serial number stamped on the cylinder block bottom face. Fig. 91.

Figure 91

5. Install main bearing bolts. Do not use tab washers.

6. For final tightening of the setscrews, a torque wrench should be used. Tighten to 110-115 pound feet of torque.

7. If the crankshaft has been reground, remove the cylinder head, assemble the connecting rods to the crankshaft and check the distance between the cylinder block top face and the piston crown. Fig. 84.

8. Assemble the remainder of the engine. Attach the accessories.

9. Install the engine. Add lubricating oil and coolant.

CRANKSHAFT REAR OIL SEAL

A. General

The housing consists of two halves bolted around the rear of the crankshaft which has a shallow spiral oil return groove recessed to a depth of .004 to .008 in. The bore of the housing is machined to accommodate a rubber cored asbestos strip. The strip consists of two sections, one for each half of the oil seal housing.

B. Removal

1. Separate engine from transmission housing.

2. Remove clutch or torque converter assembly and flywheel.

3. Remove the adaptor plate from the cylinder block and engine sump.

4. Release and remove the self-locking nuts from the two clamping bolts that pass through the housings of the crankshaft rear oil seal retainers and remove the bolts.

5. Unscrew the three screws from each half housing and remove the housings from the cylinder block and rear main bearing cap.

C. Installation

1. Set up one half housing in a vise with the seal recess toward the top.

2. Press approximately one inch of the new asbestos strip into each end of the groove in the housing allowing the strip to project .010/.020 in. beyond either end of the joint face.

3. The middle of the strip will bulge out of the groove and should be pushed in with the fingers, working from the center, until well bedded in the groove. Use a smooth round bar of metal to further bed in the strip by rolling and pressing, insuring that the strip projections at each end remain as set.

4. Remove all traces of the old joint from the cylinder block and rear main bearing cap face and fit new joint treated with a suitable jointing compound. Lightly paint with joint faces of the housing with a suitable jointing compound. Spread a film of graphited grease over the exposed inside diameter surface of the strip.

5. Assemble the half housings around the crankshaft rear journal and fasten together by the two setscrews.

6. Swivel the complete seal housings on the shaft to bed in the strips and to establish that the assembly turns easily on the shaft.

7. Bolt the seal housing in position on the block and main bearing cap and finally tighten with setscrews and shakeproof washers.

8. Install the transmission adaptor plate on the dowels at the rear of the cylinder block and secure in position.

9. Secure the flywheel in position and check the run-out.

MAIN BEARINGS AND THRUST WASHERS

A. Removal — Engine Installed

1. Drain lubricating oil. Remove the oil pan.

2. Remove the cap of the bearing to be removed. No more than one bearing cap may be removed at one time.

3. Loosen the remaining bearing bolts.

4. Remove the top half of the bearing by rotating it on the crankshaft applying a soft tool, such as a wooden dowel, to the side opposite the locating tang. Fig. 92.

Figure 92

5. Remove the lower half bearing from the cap.

B. Installation

1. Liberally oil the bearing shells to be installed.

2. Install the new top half bearing by rotating it on the crankshaft, inserting the plain end first, and pushing it into position with a soft tool, such as a wooden dowel.

3. Roll the bottom half bearing into the cap.

4. Attach the cap to its respective rod using new locking tab-washers and tighten the rod bolts lightly before proceeding to the next bearing.

5. Tighten the rod bolts to 110 to 115 lb. ft.

NOTE: The thrust washers fit in recesses provided on either side of the main bearing and cap. Fig. 93.

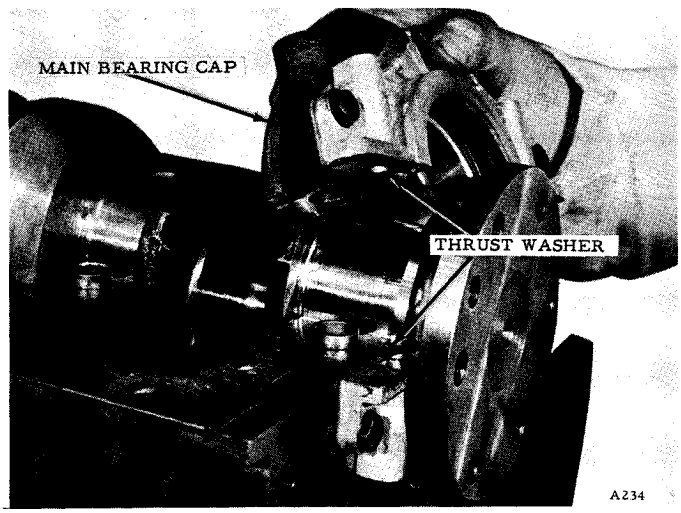


Figure 93

6. To remove the thrust washers, remove the rear main bearing cap. Before doing this, it will be necessary to remove the two nuts securing the two halves of the rear main oil seal. Remove the two bottom half thrust washers from the main bearing cap. The two top half thrust washers can be removed by sliding them round from one side with a piece of wood or the like and rotating them until they can be removed.

7. To install new thrust washers, lightly coat the two upper halves with lubricating oil and slide in the recesses provided on either side of the rear main bearing housing. The steel side of the thrust washers should be towards the bearing housing.

8. Place the two lower halves on either side of the rear main bearing cap and install the cap. Tighten main bearing bolt to 110 to 115 lb. ft.

9. Finally, secure the two halves of the rear main oil seal housing by means of the two self locking nuts.

OIL PUMP

A. General. Fig. 94

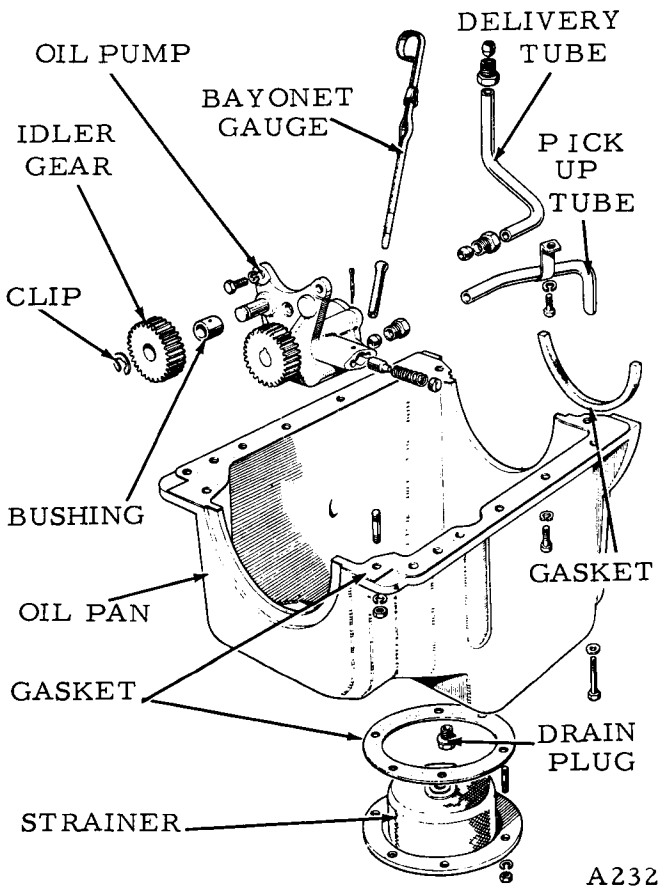


Figure 94

The oil pump is secured to the front main bearing cap by three capscrews. A protrusion of the idler gear shaft locates it in a hole in the bearing cap to give positive location.

The idler gear transmits the drive from the crankshaft gear to the oil pump gear.

A pressure relief valve mounted on the pressure side of the pump body controls the maximum oil pressure at 40 to 65 lbs. per square inch. Any excess oil returns directly to the sump.

B. Removal

1. Drain the oil. Remove the bayonet gauge and oil pan.

2. Remove the strainer. Fig. 95. Unscrew the bolts securing the pan to the crankcase. Jar the pan to break the bond between it and the crankcase.

3. Remove the three bolts at the bottom of the timing case front cover and the two nuts at the bottom of the timing case. Remove the case.

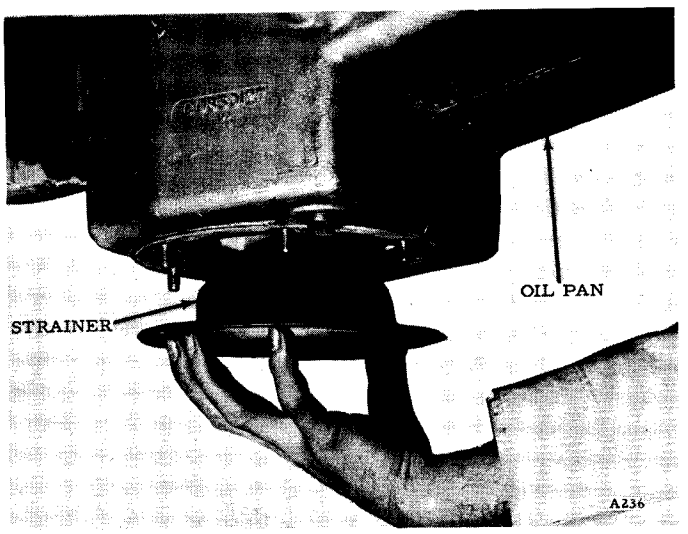


Figure 95

4. Disconnect the delivery pipe from the oil pump to cylinder block.

5. Remove snap ring and move idler gear forward.

6. Unscrew the three bolts securing the oil pump to the front main bearing cap and remove oil pump. Fig. 96.

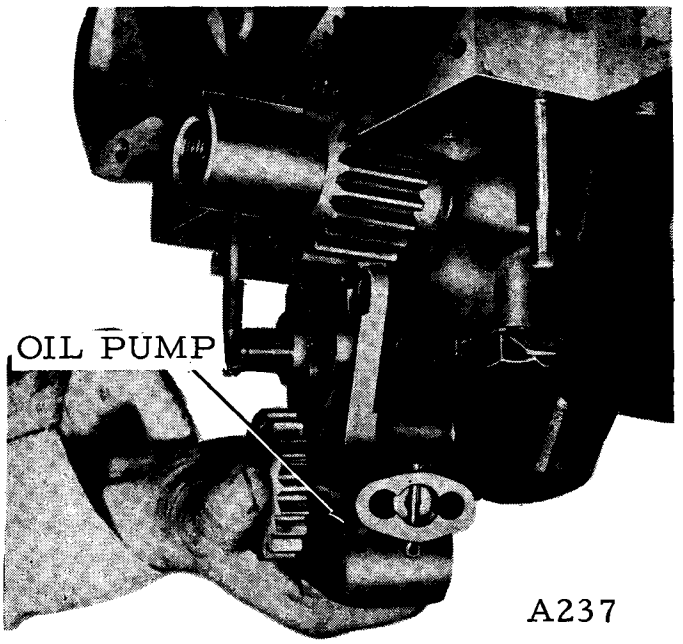


Figure 96

C. Disassembly

1. Remove suction and delivery pipes.

2. Remove idler gear.

3. The idler gear shaft is pinned to the pump body and if this shaft is to be removed, the pin must be driven out first.

4. Withdraw driven gear by means of the extractor holes provided.

5. Using a special screwdriver, unscrew the three screws and remove the pump end plate.

6. Remove the O-ring. Fig. 97. The shaft, inner and outer rotor can then be removed.

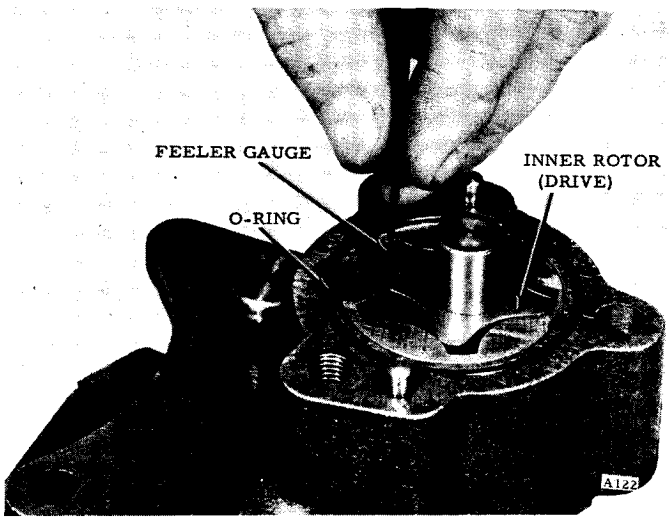


Figure 97

NOTE: The oil relief valve is located in the body of the lubricating oil pump. It is an adjustable valve but unless special test equipment is available, no attempt should be made to dismantle it. The cracking pressure is set and adjusted before the engine leaves the factory.

D. Inspection

1. Thoroughly clean all the parts and inspect the rotors for cracks or scores.

2. Install the inner and outer rotors in the pump body making sure the chamfered edge of the outer rotor enters the pump body first. Check the clearance between the maximum diameter of the inner rotor and the minimum diameter of the outer rotor at all points. Fig. 97. If the clearance exceeds 0.006 in. (1.15 mm), replace the oil pump.

3. Check the clearance between the outer rotor and the pump body. Fig. 98. If the clearance exceeds .010 inches, replace the pump.

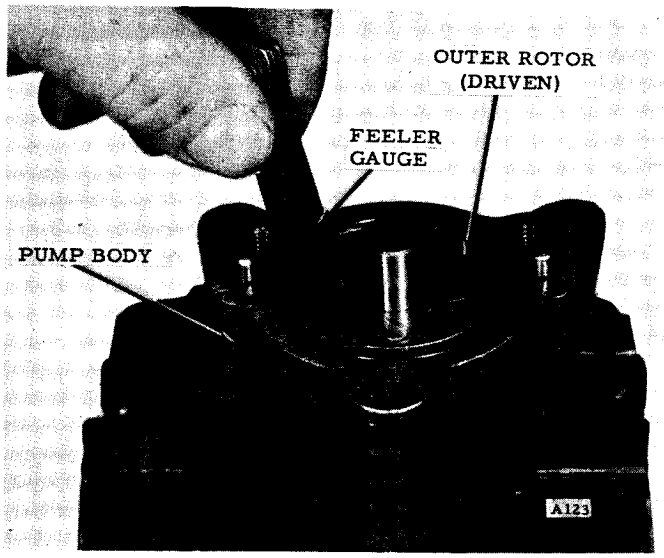


Figure 98

4. Check the clearance between the top of the rotors and the surface of the pump body with a feeler gauge and straight edge. Fig. 99. If the clearance exceeds .003 inches, replace the pump.

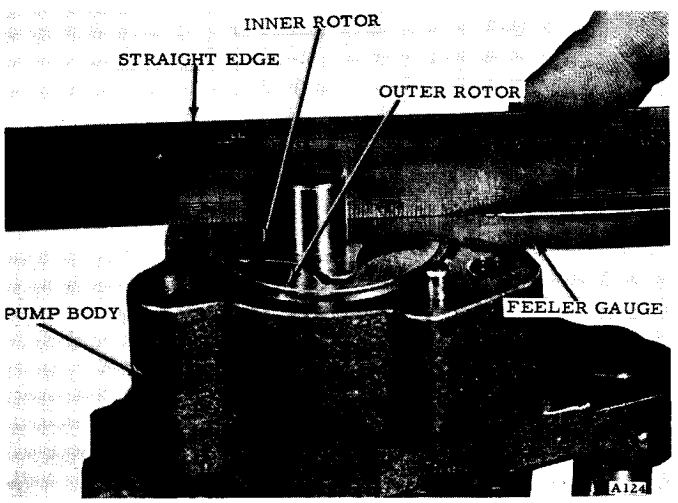


Figure 99

E. Assembly

1. Replace outer rotor, inner rotor and shaft in oil pump body.

2. Replace rubber sealing ring.

3. Replace end cover and secure with three screws.

4. Press on drive gear and insure pump rotates

freely.

5. Fit idler gear shaft, if this has been removed, and lock with pin.

6. Replace idler gear.

F. Installation

1. Attach oil pump to front main bearing cap and secure with three setscrews.

2. Secure idler gear with snap ring.

3. Connect suction and delivery pipes to and from oil pump.

4. Position timing case bottom half and secure with two nuts and washers to timing case top half.

5. Screw the three bolts into the bottom of the timing case front cover.

6. Remove all traces of old gaskets and cork strips from timing case bottom cover and rear main bearing cap.

7. Lightly smear crankcase faces with a thin coating of gasket compound and place gaskets in position so that all holes line up.

NOTE: When placing pieces in position, it is important that the mitered ends go right up into the recesses of the timing case bottom cover and rear main bearing cap.

8. Lightly coat cork pieces with gasket compound and place in the grooves provided in the timing case bottom cover and rear main bearing cap.

9. Place pan in position and screw bolts lightly into position.

10. Where applicable, replace bolts, securing rear of pan to flywheel housing, and tighten.

11. Tighten bolts securing pan to crankcase.

12. Replace pan strainer with cover plate insuring the suction pipe enters the hole provided.

13. Replace bayonet gauge and pan drain plug. Fill pan with oil.

OIL FILTERS

A. General

The oil filtering apparatus consists of:

1. Oil Filler Strainer.

2. Sump Strainer.

3. Main (full flow) Filter. Fig. 100.

The purpose of the oil filler strainer is to prevent large objects entering the sump when the engine is being filled with lubricating oil.

The gauze sump strainer fits over the oil pump suction pipe. After a period, there may be a tendency for sludge to collect around this strainer, which should then be removed from the engine sump and thoroughly washed in fuel oil or kerosene.

The full flow filter is mounted on the right hand side of the engine crankcase, preventing any dirt or foreign matter in the lubricating oil from reaching the working and bearing surfaces. The element is of the replaceable non-washable type.

B. Service

1. Unscrew the center bolt at end of cover. Fig. 101.

2. Drop filter bowl clear. Fig. 102.

3. Remove element and discard.

4. Before replacing new element, clean inside of filter bowl with solvent or fuel oil.

5. Insure that the felt washer and rubber gaskets are in good condition. If not, replace by new.

TIMING GEARS AND CAMSHAFT

A. General. Fig. 103

The camshaft is carried high up on the intake side of the cylinder block, and is provided with journals of generous bearing area. This construction eliminates push rods.

The cams and bearings are lubricated by means of an oil bath formed by a chamber cast in the cylinder block and fed by oil draining from the rocker shaft.

All the timing gears are marked. These marks must be aligned when No. 1 piston is at top dead center on compression.

B. Removal

1. Drain the coolant and remove the radiator. Loosen the generator mounting bolts, remove the

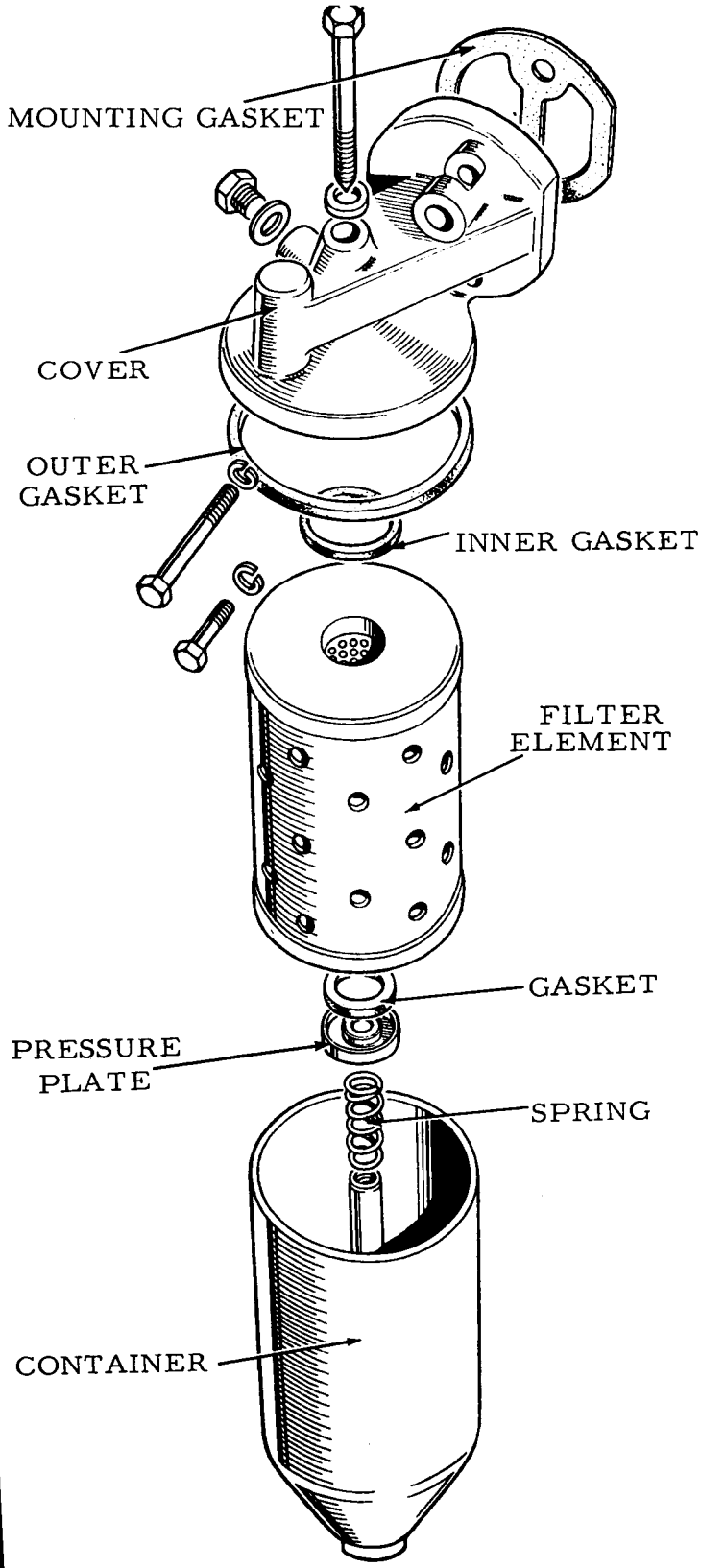


Figure 100

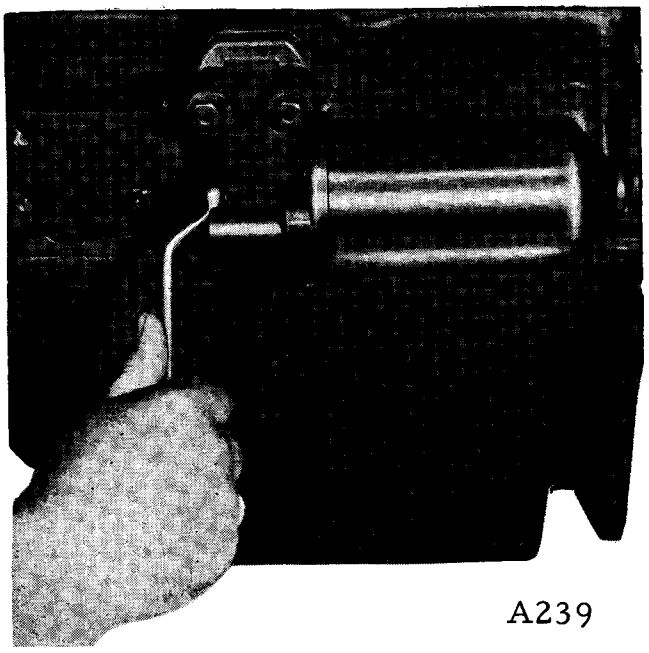


Figure 101

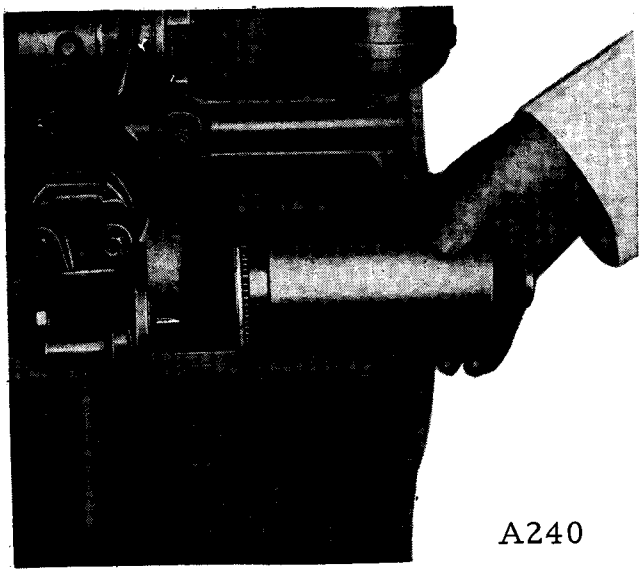


Figure 102

adjusting arm completely and ease the fan belt off the pulleys. Remove the fan.

2. Release the hose clamps on the hose to the water pump and remove the water pump.

3. Unscrew the crankshaft pulley retainer (right-hand thread) and pull the pulley.

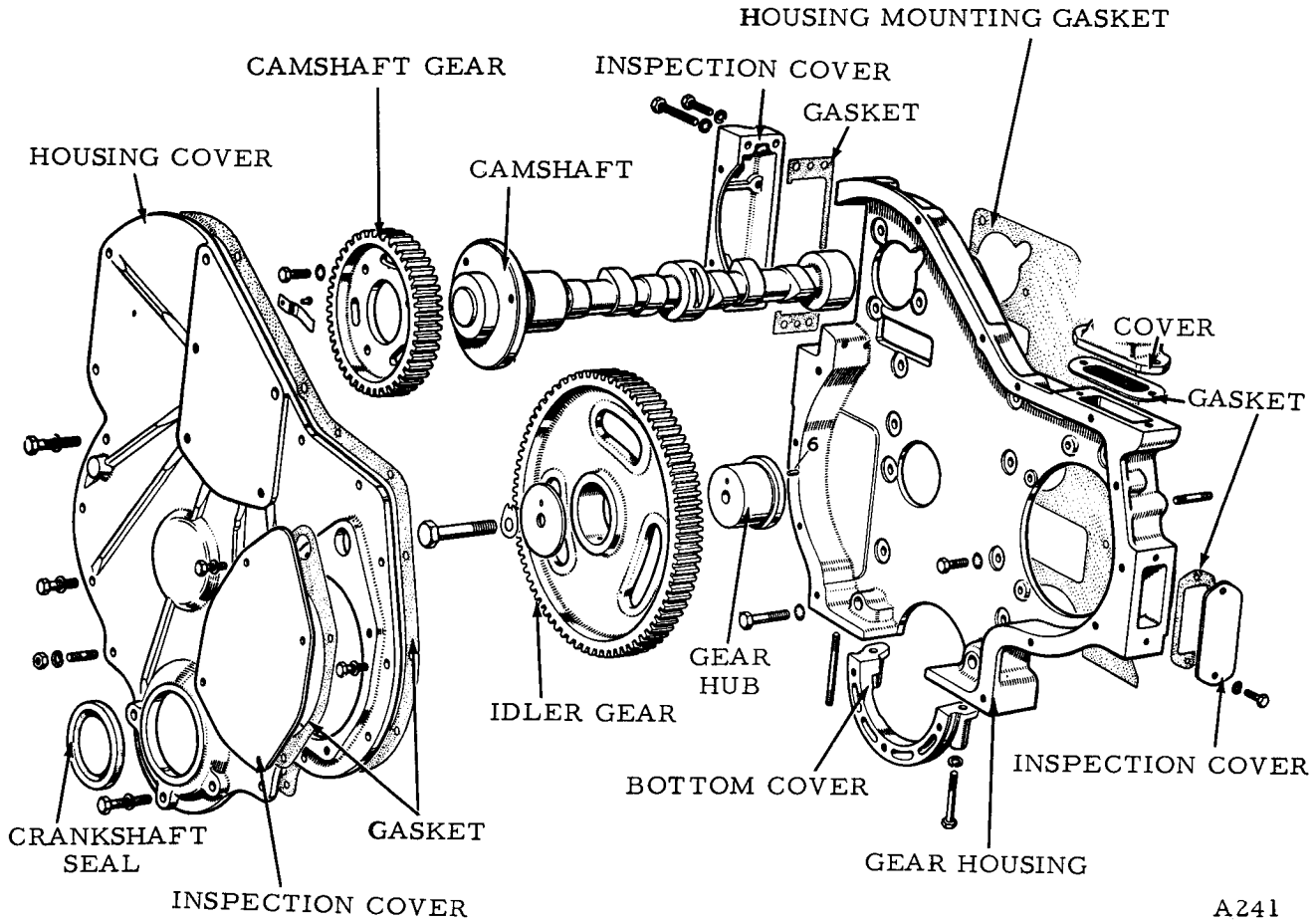


Figure 103

4. Remove the engine breather pipe, generator and generator bracket.

5. Unscrew the timing gear cover attaching bolts. Separate the cover from the case, taking care not to damage the crankshaft front oil seal. Press the seal out, if necessary.

6. Check the back-lash between the gears, fig. 104, using a feeler gauge. The back-lash should be between .003 inches and .006 inches (.076 mm to .152 mm).

NOTE: If the back-lash of the timing gears is within these limits, replace the timing case cover. If not, replacement gears, which are premarked on production, should be installed where necessary. The backlash between the crankshaft gear and oil pump idler gear should be 0.012 in. to 0.018 in. (.30 to .46 mm). Fig. 105.

NOTE: Steps 7, 8 and 9 refer to the removal of a specific unit. Unless the gear case is to be removed, Step 10, only the step referring to the specific unit need be followed.

NOTE: If only one gear is to be removed, always

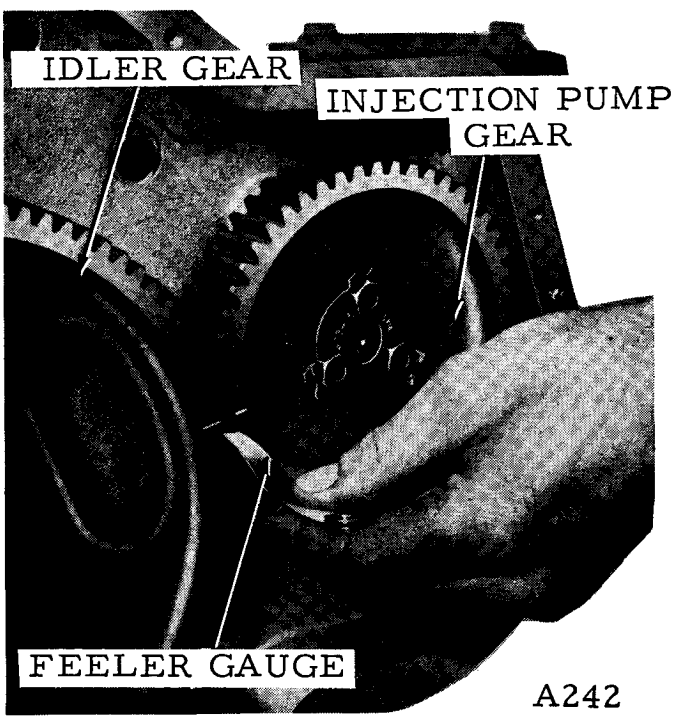


Figure 104

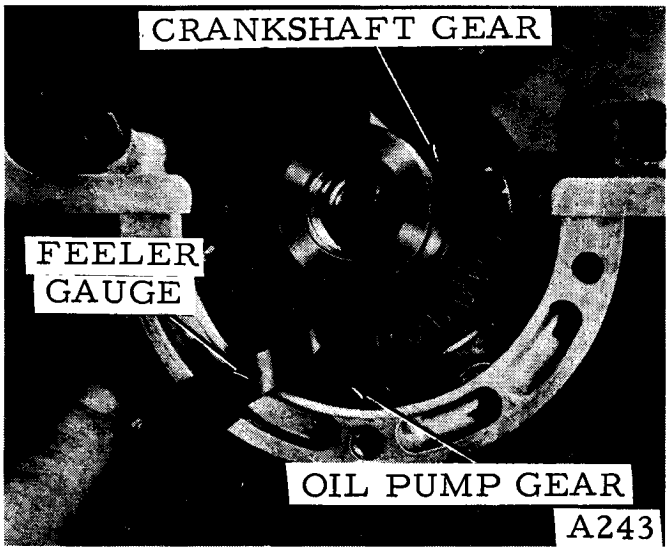


Figure 105

align the timing marks before doing so.

7. Remove the idler gear by releasing and unscrewing its retaining bolts. Remove the locking washer and retaining plate. Pull the idler gear off its hub. Remove the hub. Fig. 106.

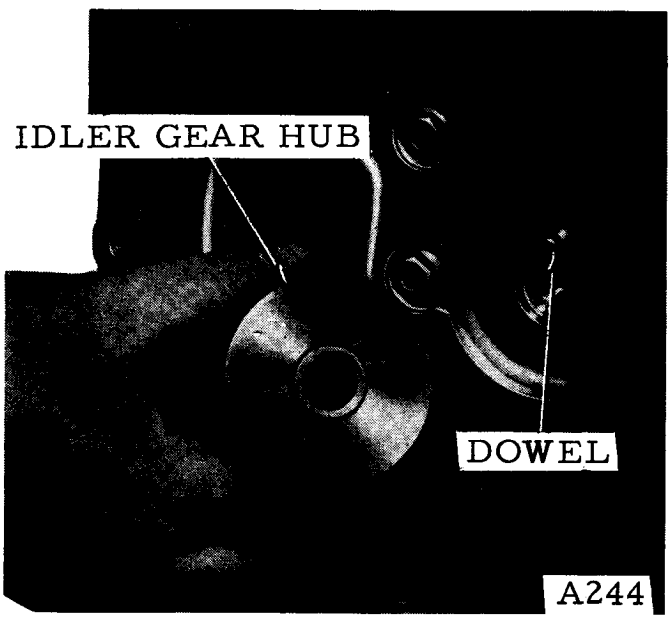


Figure 106

8. Remove the injection pump gear as follows: Release and unscrew its attaching bolts. Pull the gear off its mounting, being careful not to damage the dowel. Fig. 107. If the gear case is to be removed, remove the injection pump as follows:

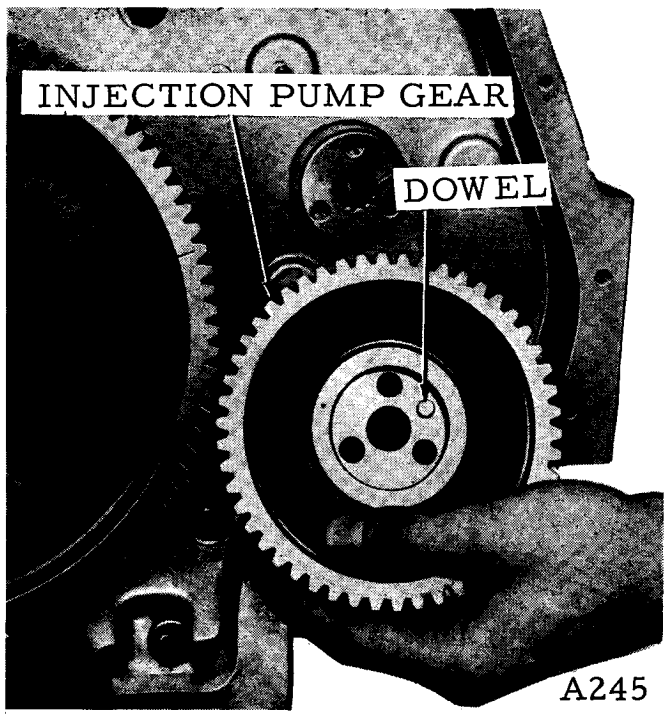


Figure 107

a. Disconnect the fuel pipes from the injection pump and injectors. Cap all openings.

b. Disconnect the throttle and stop controls from the pump governor housing.

c. Release and unscrew the three nuts, securing the pump mounting flange to the gear case. Remove the plain and lock washers. Pull the pump from its mounting. Fig. 108.

9. Remove the camshaft as follows:

a. Remove: the rocker arm shaft; the gear case cover; the fuel lift pump. Fig. 109.

b. Lift the tappets and pull the camshaft out of the block. Be careful not to damage the journal bearings, cams or tappets. Fig. 110.

10. Remove: the oil pan; timing case bottom cover, fig. 111; the bolts and washers securing the case to the block. Tap the case lightly to loosen it. Separate the case from the block.

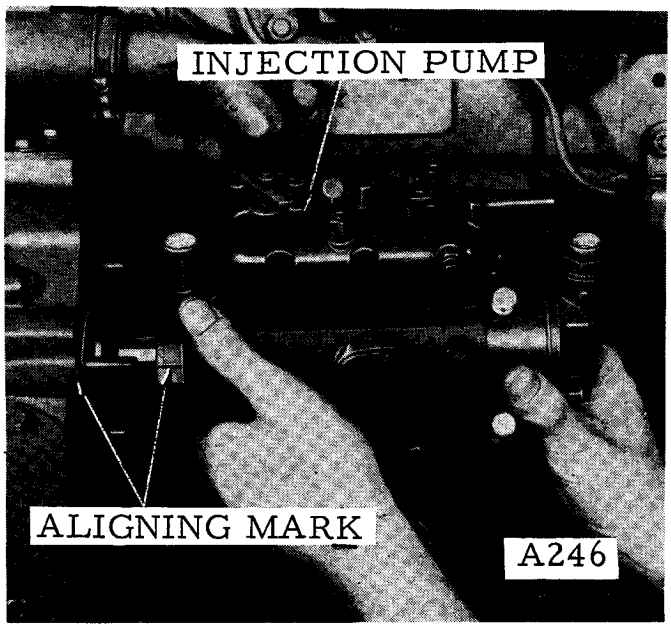


Figure 108

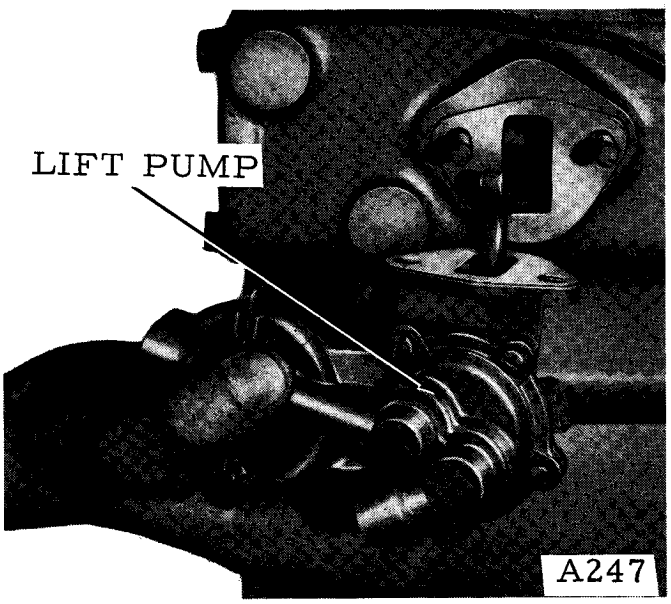


Figure 109

C. Installation

1. Place a new gasket in position on the face of the block. Attach the gear case loosely. Attach the idler gear hub. Tighten the case maintaining bolts. Remove the hub.

2. Attach the timing case bottom cover so that it is correctly aligned with the front face of the timing case. Fig. 112.

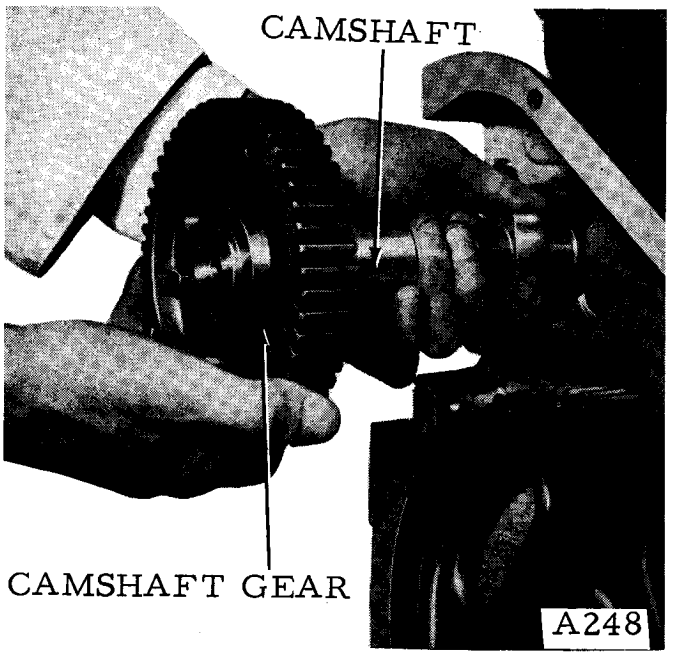


Figure 110

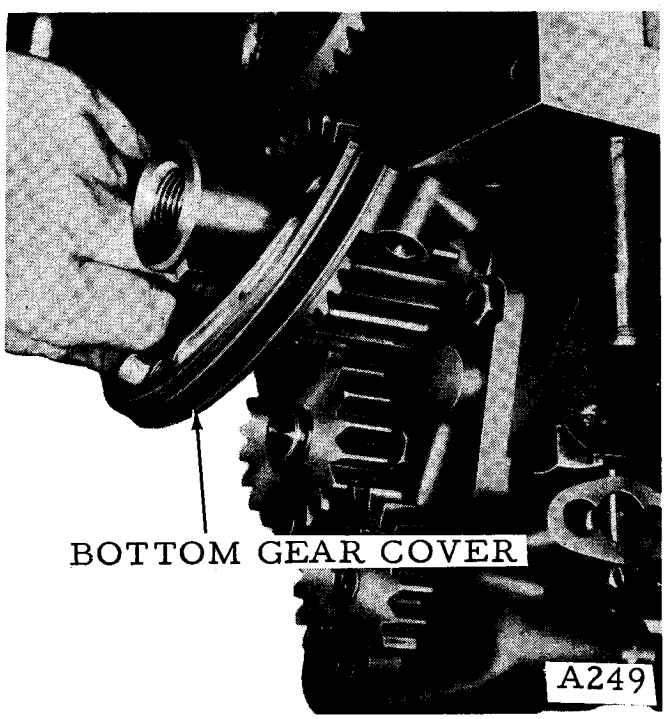


Figure 111

3. Fasten the pump on the back of the timing case. Retain with the three plain and spring wash-

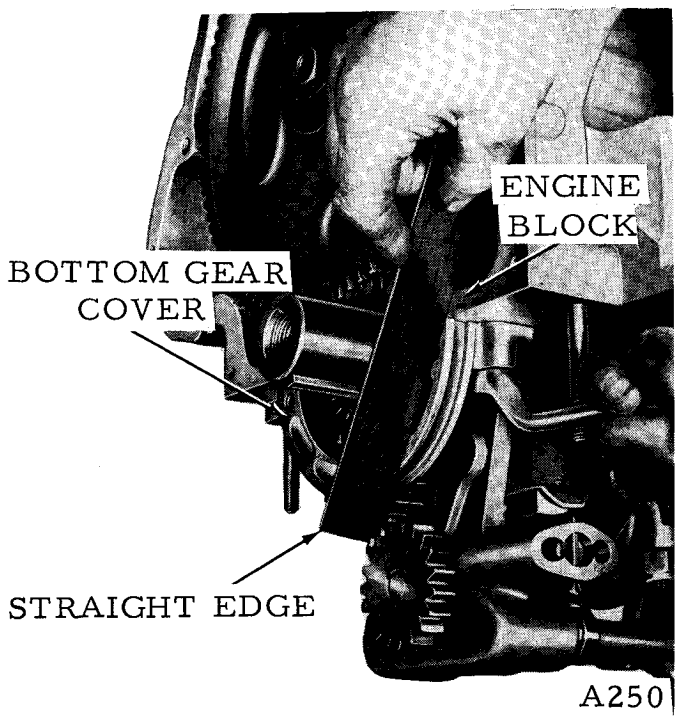


Figure 112

ers and nuts, but do not tighten the nuts. Index the dowel in the pump driving gear, fig. 107, to the slot in the fuel pump shaft. Secure the gear to the pump by the three setscrews and washers.

NOTE: Be sure the scribed lines on the pump flange and the back face of the timing case are in line before tightening pump into place.

4. Attach the throttle and stop controls. Connect the fuel pipes to the injection pump and injectors.

5. Lift the tappets and push the camshaft into position, taking care not to damage the journal bearings, cams or tappets.

6. Place the camshaft gear on the camshaft, so that the holes with the letter "D" stamped adjacent them are in line. Fig. 113. Secure it with the three bolts and washers.

7. Turn the camshaft until Nos. 4 and 6 cams are upright, this can be checked by watching the tappets, and this is the approximate position for aligning timing marks.

8. Turn the engine crankshaft until No. 1 piston is at top dead center (key on the front of the crankshaft vertically upwards).

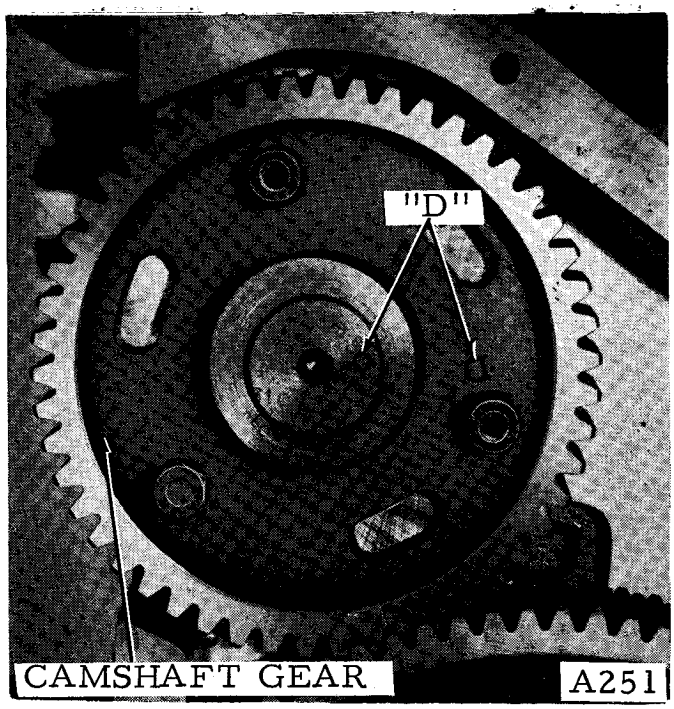


Figure 113

9. Place the idler gear hub in position. Make sure the locating dowel enters its hole in the hub.

NOTE: The flange of the hub should be flush with the timing case.

10. Press the idler gear on the hub with the long tapered center boss towards the cylinder block and the timing marks on the crankshaft gear, fuel pump gear, camshaft gear and idler gear in line.

11. Secure the idler gear with the retaining plate, tab washer and bolt. Bend the tab on the washer against bolt head. Check the endplay; it should be between .005 and .015 in. (.13 and .38 mm).

NOTE: The engine is properly timed when the scribed lines on the idler gear correspond with the lines on the camshaft, fuel pump and crankshaft gears respectively and the No. 1 piston at T.D.C. on the compression stroke. Fig. 114.

12. Attach the rocker shaft assembly, oil pan and lift pump.

13. Place a new gasket on the face of the gear case. Position the case cover, taking care not to damage the crankshaft seal as the shaft passes through it.

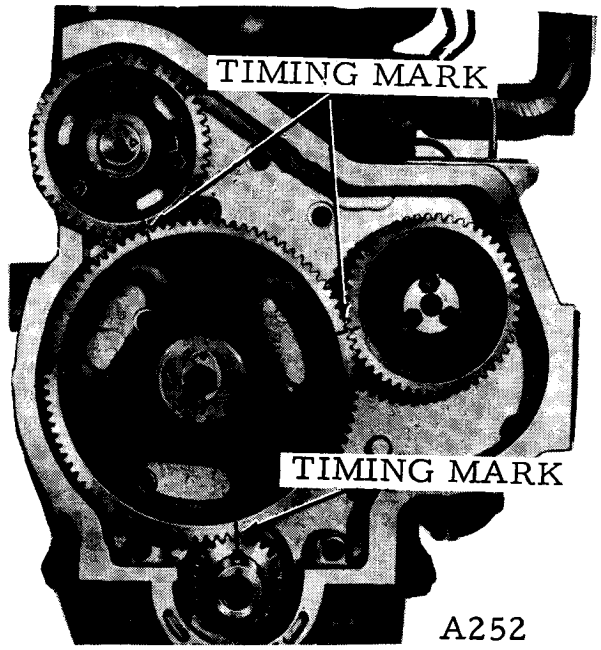


Figure 114

14. Press the crankshaft pulley onto the shaft and secure it with the washer and nut. Attach the inspection cover and water pump. Connect the hoses to the pump.

15. Attach the generator bracket and generator. Install and adjust the fan belt.

16. Attach the fan and radiator. Fill the cooling system. Adjust the valve clearance and attach the rocker shaft cover.

FLYWHEEL AND FLYWHEEL HOUSING

A. Installing a New Ring gear

NOTE: The flywheel ring gear is shrunk onto the flywheel.

1. To remove it, partly cut through the gear and chisel cut it from the flywheel. Alternatively, localized heat in a flame form would expand the ring gear sufficiently to tap it off the flywheel.

2. Clean the location of the flywheel front face.

3. Heat the new ring gear to an approximate temperature of 475° F.

4. Fit the gear over the flywheel with the chamfer on the teeth facing the front of the flywheel and allow to cool.

B. Alignment of Adaptor Plate Pilot

It is most important that the adaptor plate be correctly aligned with the crankshaft. Misalignment may cause difficulty in changing gear, etc. If the plate has been removed, care must be taken on replacement to insure accurate alignment.

1. See that the face of both the rear of the cylinder block and adaptor plate are perfectly clean and free from burrs.

2. Fasten the plate to the block with capscrews and washers. Secure the base of a dial indicator to the crankshaft flange.

3. Set the needle of the gauge to the top of the machined pilot on the adaptor plate.

4. Turn the crankshaft and check that the pilot is truly centered. The adaptor is adjusted until the pilot is centered. Eccentricity should not exceed .006 inches (.152 mm).

NOTE: For convenience in turning the engine, it is advisable to release (but not remove) the nuts holding the injectors in place.

C. Alignment of Adaptor Plate

1. With the base of the dial indicator gauge still bolted to the crankshaft flange, adjust the dial so the needle sets against the vertical machined face of the adaptor plate and again, turning the crankshaft, check that the face is perpendicular to the crankshaft axis. The total indicator reading must not exceed .006 inches (.152 mm).

2. All adjustments to bring the adaptor plate within the limits must be on the adaptor plate and under no conditions must the rear of the cylinder block be altered.

3. When the housing is properly aligned to the above limits, tighten the capscrews evenly.

D. Installation — Flywheel

1. With the flywheel and crankshaft flange perfectly clean and free from burrs, place the flywheel on the crankshaft flange.

2. Insert the setscrews complete with locking plates into the flywheel holes and tighten evenly.

3. Secure the base of the dial indicator to the block with the plunger set on the periphery of the flywheel. Fig. 115. Turn the crankshaft to check "flywheel out of round". The total indicator reading should not exceed .005 inch.

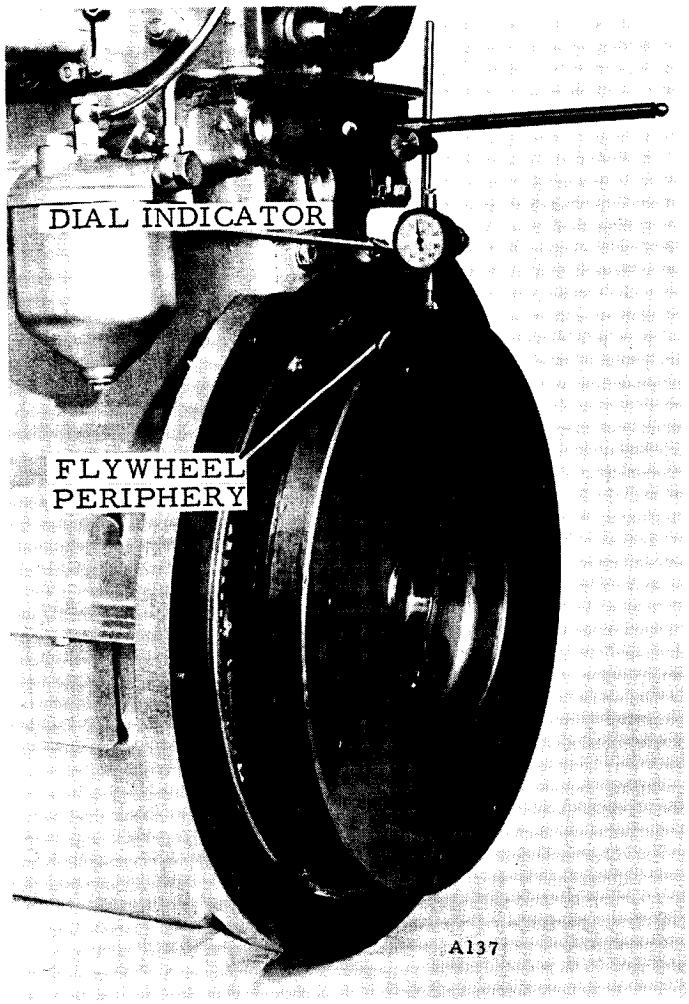


Figure 115

4. With the base of the dial indicator secured to the cylinder block, set the clock so that the plunger rests against the vertical machined face of the flywheel. Fig. 116.

5. Turn the crankshaft and check "run out". Push against the flywheel with a hammer handle or similar tool to take up the crankshaft end play. The total indicator reading should not exceed .005 inches (.127 mm).

6. Tighten the capscrews with a torque of 75 pounds feet.

7. Lock the capscrews with the plate tabs.

WATER PUMP

A. General. Fig. 117

A centrifugal-type water pump is attached to the timing case front cover and is belt-driven from the

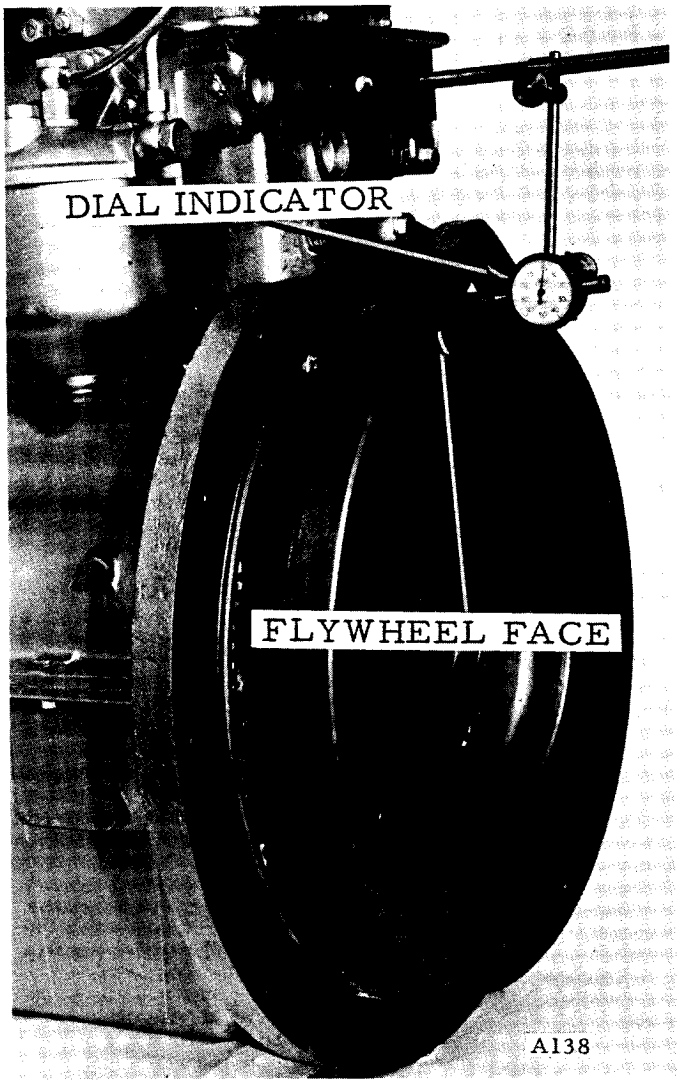


Figure 116

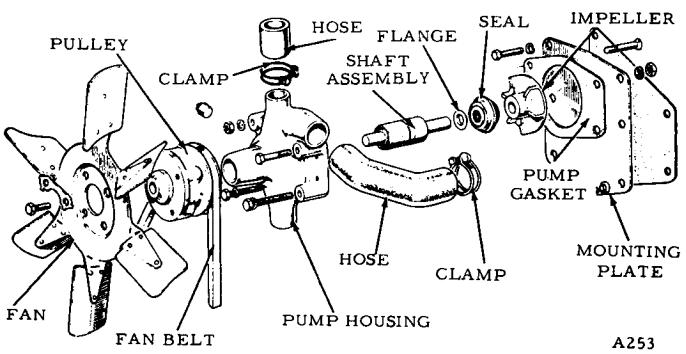


Figure 117

crankshaft pulley.

The pump does not require greasing as the bearings are treated with a special quality grease before assembly.

B. Removal

1. Drain coolant. Release the clamps on the hoses from the water pump.

2. Release the securing bolt on the generator adjusting arm and remove the fan belt.

3. Disconnect the temperature gauge capillary tube.

4. Remove the fan.

5. Unscrew the capscrews and nuts securing the water pump to the timing case cover, and remove the pump.

C. Disassembly

1. Remove the self-locking nut holding the water pump pulley to the shaft and remove with washer.

2. Remove the water pump pulley from the front of the shaft.

3. Withdraw the water pump impellor from shaft. Two extractor holes are provided.

4. Press the water pump shaft and bearings out from the water pump body, and remove seal. The shaft and bearings are manufactured as one component and cannot be dismantled.

D. Inspection

1. If the water pump shaft shows signs of wear in the region of the bearings, the shaft must be replaced.

2. Clean the impeller and examine it for cracks and broken blades.

3. Examine the casing for cracks.

4. Wash the bearings in thin lubricating oil, examine them for pitting, corrosion or wear and if necessary, install new ones.

E. Assembly

1. Press shaft and bearing assembly into the water pump body, the longer end of the shaft to the rear.

2. Install water pump seal.

3. Press on water pump pulley until front face is 11/16 in. (17.46 mm) from end of shaft.

4. Press impellor onto the rear of the shaft so that .010 in. to .020 in. (0.25 mm to 0.51 mm) clearance is maintained between the blades of the impellor and the pump body. Fig. 118.

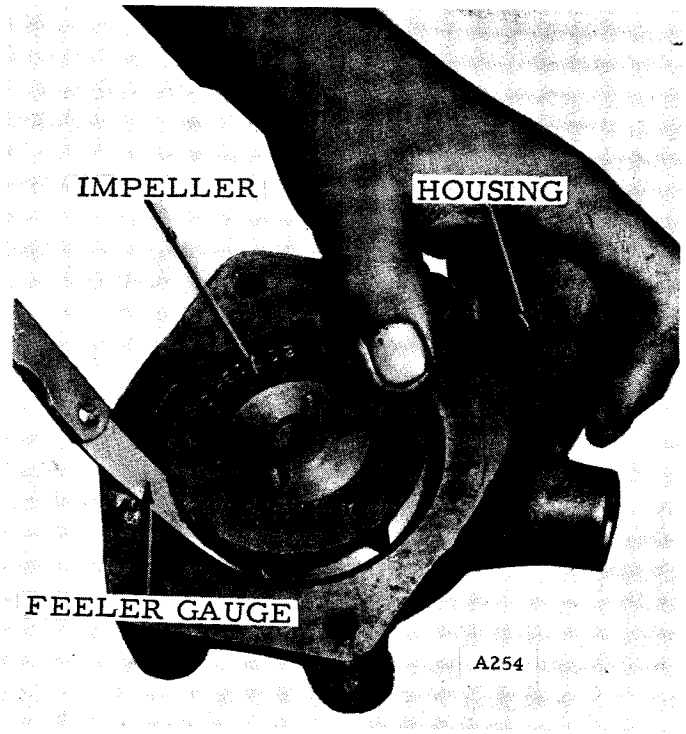


Figure 118

F. Installation

1. Clean the back face of the pump body, and using a new gasket install the pump, locating the hoses as the pump is placed against the front cover. Attach water pump to back-plate.

2. Tighten the clamps on the water hoses.

3. Secure temperature gauge connection.

4. Reinstall the belt and adjust.

NOTE: The correct tension of the belt is such that when it is depressed by hand midway between the fan belt pulley and crankshaft pulley, the deflection is approximately 3/4 of an inch. A new belt will "bed-in" and may require adjusting after a few hours service.

5. Replace fan.

NOTE: Provision is made in the cylinder head water outlet for the housing of a thermostat. On no account should the engine be operated without this thermostat, otherwise, overheating of the engine may occur.

THERMOSTAT

A. General

A bellows-type thermostat is in the water outlet body.

B. Removal

1. Drain coolant. Remove the water hose between the top of the radiator and the water outlet connection adaptor.

2. Remove the two nuts and washers.

3. Remove the adaptor and gasket.

4. Extract the thermostat from the recess in the housing.

C. Testing

If it is suspected that the thermostat is not operating correctly, it may be tested in the following manner:

Immerse the thermostat in a container of water and gradually heat. Check the water temperature at frequent intervals with an accurate thermometer. The valve should commence to open at 176° F.

If the thermostat does not function properly, no attempt should be made to adjust it. Replace with a new unit.

STARTING THE ENGINE

A. Preparation for Starting

1. Check the radiator water level.

2. Check the engine sump oil level.

3. See that there is fuel oil in the tank.

4. Be sure that the battery is fully charged and that all electrical connections are properly made and all circuits are in order.

NOTE: In the case of a new engine or an engine which has been standing idle for any length of time, it is important that the fuel system be bled. Bleeding is necessary to remove any air entrained in the fuel system. The bleeding procedure is outlined in the Fuel Section.

B. Starting the Engine

Place the engine speed control in the fully open position and engage the starter motor by turning the starter switch in a clockwise direction. If the battery is well up, enough to turn the starter motor quickly, the engine should start. Do not keep the starter engaged for more than fifteen seconds. If engine fails to start during that period, turn the switch to "off" position and allow the starter to cool for twenty seconds.

NOTE: With a cold engine and in cold weather it may be necessary to use the "Cold Starting Aid". A cold engine will emit white smoke from the exhaust pipe. The smoke will turn to blue when the fuel is hot enough to ignite. Stop the engine if oil pressure fails to register within 30 seconds. Allow engine to run at 1000 RPM until coolant is at 160° F.

NOTE: Should the engine surge, a steady idling may be obtained by careful adjustment of the idling speed adjusting screw. The engine should be at operating temperature before adjusting the idling speed.

COLD STARTING AID

A. General

Referring to fig. 119, the cold start unit comprises a tubular valve body carried in a holder which screws into the inlet manifold, and surrounded by a heater coil, an extension of which forms an igniter coil. The valve body houses a needle, the stem of which holds a ball valve in position against its seating. The whole is surrounded by an open perforated shield. Fuel oil from the container enters through an adaptor.

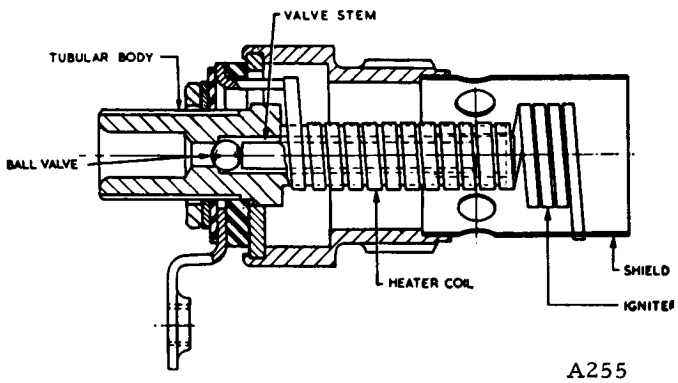


Figure 119

When the unit is cold, the ball valve is held closed. On switching on the coil, the valve body is heated and expands, opening the ball valve and permitting the entry of fuel. The fuel is vaporized by the heat of the valve body and when the engine is cranked and air is drawn into the manifold, the

vapor is ignited by the coil extension and continues to burn, thus heating the inlet air.

When the coil is switched off, the flow of air in the manifold cools the valve body rapidly and the valve closes.

The cold start aid is a sealed unit and cannot be dismantled. If the unit ceases to function, it must be renewed.

B. Using the Starting Aid

1. Set the engine stop control in "run" position.

2. Depress the heater button for ten seconds (fifteen to twenty seconds in very cold weather).

3. With the engine speed control in the fully open position, turn the starter switch clockwise, engaging the starter motor. If the engine does not start after ten to fifteen seconds, depress heater button for five seconds and then re-engage starter motor.

4. As soon as the engine starts, the switch should be returned to the "off" position.

NOTE: The above procedure is not necessary when the engine is hot.

C. Things to Note

Always be sure that the starter pinion has stopped revolving before re-engaging the starter, otherwise the ring or pinion may be damaged. Make sure that the electrical connection to the cold starting aid is correctly made.

Always insure that the reservoir feeding fuel to the cold starting aid is fully primed and not leaking.

Extended use of the cold starting equipment above the time periods already stated should be avoided, otherwise the cold start aid in the induction manifold may be damaged.

In the event of difficult starting, be sure that fuel is reaching the cold starting aid in the intake manifold by unscrewing the inlet fuel union. If fuel is reaching it satisfactorily, then it may be that the cold starting aid itself is not working correctly. This can be checked by removing the air cleaner and watching the cold starting aid while the equipment is used. When the heater button is depressed, the element should become red hot and on engagement of the starter motor, it should burst into flame.

FUEL OIL

It is essential to use clean oil free from water, dirt or sand. Providing clean fuel is used, no trouble should be experienced with the fuel system, but dirty oil will lead to trouble due to choked pipes, choked filters, damaged fuel pump and injectors. If the engine tends to run well for a short period and then to die away or stop altogether, the fuel system should immediately be suspected. The trouble may be due to improper working of lift pump, to a loose pipe connection (allowing air to get into the fuel system), to a dirty fuel filter, or to a choked fuel pipe. The pre-filter should be cleaned by washing in clean fuel oil, but the final filter should not need attention more than once in 1,000 hours, when a new filter element should be installed. If the operating conditions lead to early contamination of the fuel, decrease the maintenance interval.

ENGINE

TROUBLESHOOTING GUIDE

Cause	Remedy
Engine Will Not Start Or Starts Hard	
1. No fuel in the tank	1. Fill tank and bleed the fuel system.
2. Stop control lever not in the "run" position	2. Push the stop control button all the way in. Check for weak or broken stop cable pull back spring. Replace if necessary. Check the cable securing screw on the injection pump stop lever. Adjust cable and tighten as required.
3. Wrong type of fuel – fuel with poor burning qualities	3. Drain and refill tank with No. 2 diesel fuel (dark). Bleed the fuel system to remove undesireable fuel.
4. Air in the fuel system	4. Bleed the fuel system. If system becomes aerated again, check for air leaks on pick-up side of the injection pump. Repair as necessary.
5. Engine not cranking fast enough	5. Check battery starter, and battery cables. Recharge battery. Repair or replace electric components as necessary.
6. Engine too cold	6. Use cold start aid.
7. Water in the fuel system	7. Drain fuel tank. Refill with clean fuel. Bleed the fuel system.
8. Low compression caused by valves not seating, worn rings, blown head gasket, injectors not properly seated.	8. Reface valves. Replace pistons and rings as necessary. Rebore or replace liners. Replace head gasket. Clean dirty injector seats and install injectors, using new gaskets.
9. Plugged air cleaner	9. Service air cleaner as necessary.
10. Restriction in fuel lines	10. Service fuel filters. Locate and remove restriction in the fuel lines.
Insufficient Power/Speed	
1. Accelerator linkage out of adjustment	1. Check linkage for binding. Free up as necessary. Adjust linkage so that the governor shaft is rotated to fully open position, with the accelerator pedal touching the floor board.
2. Air Cleaner partially blocked	2. Service the air cleaner, making sure all connections are air tight, and that hoses do not collapse when the engine is accelerated.
3. Stop control lever not in "run" position	3. Push control button all the way in. Check return spring. Replace if weak or broken.

Cause	Remedy
4. Wrong type of fuel – fuel with poor burning qualities	4. Drain tank and refill with No. 2 diesel fuel (dark). Bleed the system to remove the improper fuel remaining in the lines.
5. Air in the fuel system	5. Bleed the fuel system. If system becomes aerated again, check for air leaks on the pick-up side of the injection pump. Repair as necessary.
6. Restriction in fuel lines	6. Service the fuel filters. Locate and remove restriction in fuel lines.
7. Retarded fuel injection timing	7. Check injection pump timing. Reset if necessary. It may be necessary to repair the timing train. Check the advance device on the injection pump. Repair or replace as necessary.
8. Wrong Injectors	8. Replace injectors with the correct type.
9. Defective lift pump	9. Check pump and actuating cam on the camshaft. Clean pump filter screen. Repair or replace parts as necessary.
10. Choked air cleaner	10. Service air cleaner as necessary.
11. Water in the fuel system	11. Drain fuel tank. Refill with clean fuel. Bleed the fuel system.
12. Exhaust sytem partially blocked	12. Check muffler. Replace if necessary.
13. Governed RPM set too low – weak or wrong governor spring	13. Adjust governed RPM. Replace governor spring.
14. Injection pump not calibrated correctly	14. Re-calibrate pump.
15. Worn injection pump	15. Repair injection pump. Replace parts as necessary.
16. Brakes dragging	16. Adjust or repair brakes as necessary.
17. Engine misfires intermittently	17. Refer to "Erratic or Intermittent Engine Misfire".
18. Low compression caused by valves not seating, worn rings, blown head gasket, injectors not properly seated.	18. Reface valves, replace pistons and rings as necessary. Rebore or replace liners, if necessary. Replace head gasket. Clean dirty injector seats, and install injectors, using new gaskets.
19. Worn valve stems or guides	19. Replace valves or guides as necessary. Reface valve and valve seats.
20. Tappets set too close or sticking	20. Reset tappets. Remove, clean and reface sticking valves.

Cause	Remedy
21. Valve spring weak or broken	21. Replace the defective valve springs.
22. Truck overloaded	22. Reduce load.
Erratic Governing and Engine Operation	
1. Restriction in fuel lines	1. Service the fuel filters. Locate and remove the restriction in fuel lines.
2. Air cleaner partially blocked	2. Service air cleaner, making sure all connections are air tight and that hoses do not collapse when engine is accelerated.
3. Incorrect injection timing	3. Check injection pump timing. Reset if necessary. It may be necessary to repair the timing train. Check advance device on injection pump. Repair or replace as necessary.
4. Engine mounting loose	4. Tighten mounting bolts. Replace mounting pads if necessary.
5. Injection pump loose on its mounting	5. Remove pump. Check pump drive. Replace parts as necessary. Install pump. Bleed fuel system.
Engine Overheating	
1. Lack of coolant	1. Fill the system with proper coolant mixture. Use rust inhibitor.
2. Fan belt too loose or slipping	2. Check fan belt. If worn, hard, cracked or frayed, replace. Check pulleys for crack or misalignment, and replace as necessary.
3. Thermostat stuck closed	3. Clean and test thermostat. Replace if defective.
4. Cooling system dirty	4. Clean and flush the cooling system. Fill cooling system with proper coolant mixture. Use rust inhibitor.
5. Restricted radiator air passages	5. Clean or blow out with compressed air. Straighten bent fins.
6. Hoses deteriorated or inlet hose collapses when engine is accelerated	6. Remove and check inside of hoses. Replace if rubber is soft, swelled or deteriorated in any way.
7. Water pump not functioning	7. Repair or replace water pump.
8. Exhaust system partially blocked	8. Check muffler. Replace if necessary.
9. Truck overloaded	9. Reduce load.

Cause	Remedy
10. Leaking cylinder head gasket	10. Tighten head bolts to correct torque. Replace gasket if necessary.
11. Defective injector	11. Check injectors. Clean defective injectors. Replace parts as necessary.
12. Incorrect fuel injection	12. Check and change injection pump timing, as necessary.
13. Incorrect radiator cap – cap not seating in filler – leaking radiator or hoses	13. Install correct pressure cap. Clean rubber gasket on the cap. Clean the cap seat. Repair leaks.
Engine Overcooling	
1. Thermostat stuck open – no thermostat	1. Clean, test and replace thermostat if necessary. Install thermostat of correct heat range.
2. Climate too cold to allow thermostat to hold the proper temperature	2. Cover the radiator to bring the coolant temperature into operating range.
Erratic or Intermittent Engine Misfire	
1. Wrong type of fuel – fuel with poor burning qualities	1. Drain and refill tank with No. 2 diesel fuel (dark). Bleed the fuel system to remove improper fuel remaining in the lines.
2. Water in the fuel system	2. Drain fuel tank. Refill with clean fuel. Bleed the fuel system.
3. Sticking nozzle valves in the injectors	3. Remove, check, clean and repair injectors. Drain fuel tank. Refill with clean fuel. Bleed fuel system.
4. Low compression caused by valves not seating, worn rings leaky head gasket, injectors not properly seated	4. Adjust tappets. Reface valves. Replace rings, pistons, liners as necessary. Replace head gasket. Clean dirty injector seats and install injectors, using new gaskets.
5. Worn valve stems or guides	5. Replace valves or guides, as necessary. Reface valves and valve seats.
6. Fuel tank vent plugged	6. Open vent in filler cap.
7. Valve springs weak or broken	7. Replace the defective valve springs.
Blue Exhaust Smoke	
1. Too much oil in the crankcase	1. Fill only to the "full" mark on bayonet gauge.
2. Worn rings, pistons, liners, valve stems or valve guides	2. Overhaul engine as necessary.

Cause	Remedy
3. Injection timing too late	3. Check and adjust injection pump timing as necessary.
4. Incorrect grade of lubricating oil	4. Drain crankcase and fill with correct grade of lubricating oil.
White Exhaust Smoke	
1. Low combustion temperature	1. Use cold start aid.
2. Low compression in one or more cylinders caused by valves not seating, worn rings, blown head gasket, injectors not seating	2. Reface valves. Replace rings and pistons as necessary. Rebore or replace liners. Replace head gasket and install injectors, using new gaskets.
3. Water in the fuel system – wrong type of fuel	3. Drain and refill tank with No. 2 diesel fuel (dark). Bleed the fuel system to remove improper fuel remaining in the lines.
4. Coolant entering combustion chamber caused by defective head gasket, cracked head, cracked block	4. Replace gasket, head or block as necessary.
5. Injection timing too late	5. Check and adjust injection pump as necessary.
Brown or Black Smoke	
1. Air cleaner partially blocked	1. Service air cleaner, making sure all hose connections are air tight and hoses do not collapse when engine is accelerated.
2. Wrong type of fuel – fuel with poor burning qualities	2. Drain and refill tank with No. 2 diesel fuel (dark). Bleed the fuel system to remove the improper fuel rmaining in the lines.
3. Defective injector	3. Check injector spray pattern and injection pressure. Clean and repair injector as necessary.
4. Injection timing too early (usually accompanied with "fuel knocks" or a noisy running engine)	4. Check and adjust injection pump timing as necessary.
5. Injection timing too late (engine runs smooth and quiet)	5. Check and adjust injection pump timing as necessary.
6. Engine not at operating temperature	6. Refer to "Engine Over Cooling"
7. Injection pump not calibrated correctly	7. Re-calibrate the injection pump.

Cause	Remedy
8. Defective cold start aid – cold start switch stuck closed or wires shorted	8. Replace manifold unit. Check wiring and repair as necessary.
Low Oil Pressure	
1. Low oil level	1. Add oil to dipstick level.
2. Oil pressure gauge or line faulty	2. Inspect lines and check with Master Gauge.
3. Oil too light – diluted	3. Change oil and follow lubrication recommendations.
4. Dirt in relief valve or broken spring	4. Clean or replace spring if required.
5. Suction screen plugged	5. Remove screen and clean in solvent.
6. Worn bearings	6. Check bearings and crankshaft journals. Grind shaft, replace bearings as necessary.
7. Worn oil pump	7. Remove, repair or replace pump.
8. Oil cooler clogged – restricting flow	8. Remove and clean.
High Oil Consumption	
1. Oil leaks	1. Location and repair.
2. Too high oil level maintained	2. Maintain oil level between high and low marks on bayonet.
3. Incorrect grade of oil used	3. Used recommended type and SAE number of lubricating oil.
4. Clogged crankcase breather (or pipe)	4. Clean thoroughly.
5. Oil pressure too high – relief valve stuck	5. Clean and free up valve – check spring tension. Replace parts as necessary.
6. Worn, broken or stuck piston rings and clogged oil control rings	6. Re-ring. Rebore liner and install new pistons if necessary.
7. Worn pistons and sleeves	7. Rebore or replace sleeves. Install new pistons and rings.
8. Worn bearings	8. Check bearings and crankshaft journals. Grind shaft and replace bearings as necessary.
9. Worn valve guides	9. Check and replace if necessary.

ENGINE

SPECIFICATION LISTING
DIESEL ENGINE-3-152

Bore		3.6 in.
Stroke		5 in.
Displacement:	Per cylinder	50.77
	Total	152
Torque		120 ft. lbs. @ 1350 RPM (SAE)
Horse Power		48.5 @ 2400 RPM
Governed Speed:		
	High	2400 RPM
	Low	500-550 RPM
Thermostat (Fully Open)		194° F. (90° C)
Valves:	Clearance	.010 inches (Hot)
	Intake opens	13° BTDC
	Exhaust Closes	10° ATDC
	Seat Angle	45°
Firing Order		1-2-3
Injectors:	Code letter	K
	Pressure Setting	1750-1800 PSI
	Timing	Preset
Fuel Pump Timing Letter		E

Oil:

-20°F. to +30°F.	30°- 80°F	80°F Plus
SAE 10W DM	SAE 20W or 20 DM	SAE 30 DM

Military Specification	MIL-L-2104B
Capacity w/filter	6 U.S. qts.
Oil Pressure	40 PSI
Stall Speed	1475-1525 RPM

Dimensions and Clearances (Inches)

Oil Pump:	Housing rotor-bore diameter	1.603-1.604
	Housing rotor-bore depth	.750-.751
	Housing shaft-bore	.500-.501
	Shaft: Diameter	.498-.4985
	Clearance	.0015-.003
	Gear backlash	.012-.018
Camshaft and Bearings:		
	No. 1: Journal diameter	1.869-1.870
	Bearing inside diameter	1.874-1.877
	Clearance	.004-.008
	No. 2: Journal diameter	1.859-1.860
	Bearing inside diameter	1.864-1.867
	Clearance	.004-.008
	No. 3: Journal diameter	1.839-1.840
	Bearing inside diameter	1.844-1.847
Clearance		.004-.008
Cam lift		.3085-.3165
Timing gear backlash		.003-.006
Cylinder Block Assembly:		
Block bore diameter		3.6875-3.6885

Cylinder liner:	Outside diameter	3.6885-3.6875
	Inside diameter	3.6005-3.603
	Transition fit	.001
Piston crown depth		.000-.005
Compression ring:	Groove width	.0957-.0967
	Ring width	.0928-.0938
	Clearance	.0019-.0039
	Ring gap	.009-.013
Scraper ring:	Groove width	.252-.253
	Ring width	.249-.250
	Clearance	.002-.004
	Ring Gap	.009-.013
Crankshaft and Connecting rods:		
	Crankshaft rod journal diameter	2.248-2.249
Connecting rod bearing:		
	Diameter	2.251-2.252
	Clearance	.002-.0035
Crankshaft rod journal:		
	Width	1.562-1.565
Connecting rod bushing diameter		1.2505-1.2515
Wrist pin:	Diameter	1.2498-1.2515
	Clearance	
Main bearing bore		2.7513-2.7528
Crankshaft journal:	Diameter	
	Clearance	.0023-.0043
Crankshaft end play		.0062-.0142
Thrust bearing width:		
	Standard	.123-.125
	Oversize	.1305-.1325
Cylinder Head and Valve Train:		
Rocker Arm:	Bore diameter	.6245-.6258
	Shaft diameter	.6223-.6238
	Clearance	.0008-.0035
Valve:	Stem diameter	.311-.312
	Guide bore	.314-.3155
	Clearance	.002-.0045
Valve tappet:		
	Stem diameter	.6223-.6238
	Cylinder head bore diameter	.6245-.6258
	Clearance	.0008-.0035
Torques: (Pound-Feet)		
Cylinder head nuts		55-60
Connecting rod nuts (plain)		65-70
Connecting rod nuts (plated)		45-50
Main bearing capscrews		110-115
Flywheel capscrews		75

SECTION B — FUEL

TABLE OF CONTENTS

AIR CLEANER

A. General. Figs. 1, 2 and 3

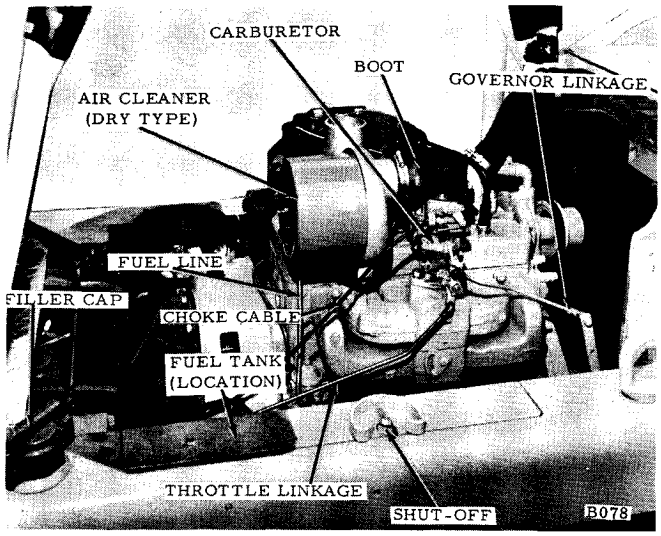


Figure 1

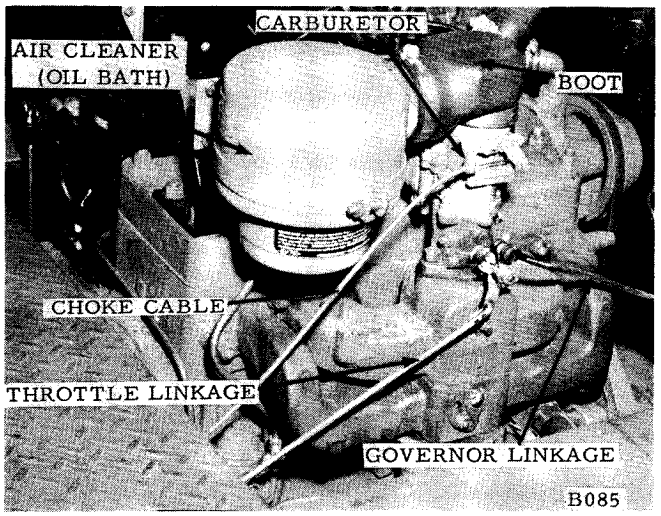


Figure 2

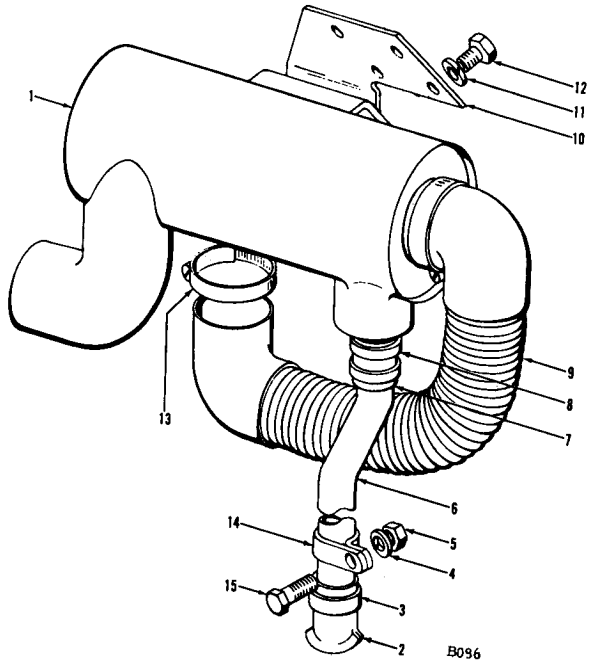
Regardless of type, oil bath or dry, the air cleaner may be serviced without removing it as an assembly.

Service the cleaner periodically. The service period depends upon the operating conditions and can be established observing the dust concentration and the inspection of the air cleaner.

When operating in severe dusty atmosphere, inspect and service the air cleaner daily, oftener if necessary.

AIR CLEANER ASSEMBLY

FOR DIESEL ENGINE



1. Bar Assembly
2. Dust Element Unloader
3. Clamp Assembly
4. Lockwasher
5. Nut
6. Tube
7. Hose
8. Clamp
9. Intake Hose
10. Mounting Bracket
11. Lockwasher
12. Capscrew
13. Clamp
14. Clamp
15. Capscrew

Figure 3

B. Servicing — Oil Bath Type. Fig. 4

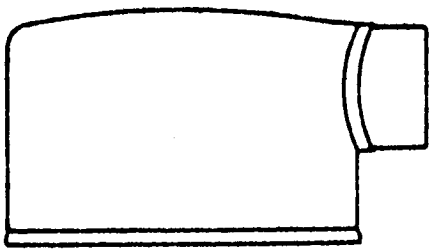
NOTE: Service when the reservoir is one-fourth full of sediment or the oil has thickened to the approximate viscosity of SAE 60 oil at 70° F.

1. Unsnap the latches and lower the cup. Remove vortex chamber or disc.

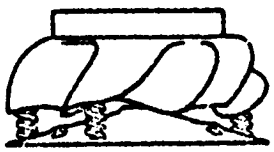
2. Empty the oil and sediment. Wash the cup and vortex chamber thoroughly in solvent.

3. Fill cup to the indicated level with specified oil. Lower the vortex chamber or disc into position.

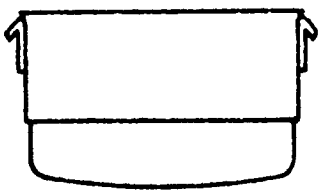
NOTE: For air entering the air cleaner at temperatures above 100° F, use SAE 30 oil; 50° F to 100° F, use SAE 20 oil; 25° F to 50° F, use SAE 10 oil; -30° F to 25° F, use SAE 5; below 30° F, dilute oil with kerosene to the viscosity of SAE 20 oil at 70° F.



BODY



VORTEX CHAMBER



CUP

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Figure 4

4. Attach the cup to the bottom of the body, making sure that it is properly seated and that latches snap over-center.

5. Check to make sure that the boot is in good condition and that the clamps are tight.

C. Servicing — Dry Type

NOTE: Either the gasoline or diesel element should be serviced every 100 hours, more often if necessary.

1. Remove the element from the gasoline engine air cleaner as instructed in Step a; refer to Step b. for diesel.

a. Unscrew the wing nut. Pull the cover off. Slide the spring and element off the link. Discard the gasket if defective. Fig. 5.

b. Loosen the retainer bar screw. Slide the retainer bar to one side then pull it out. Pull the

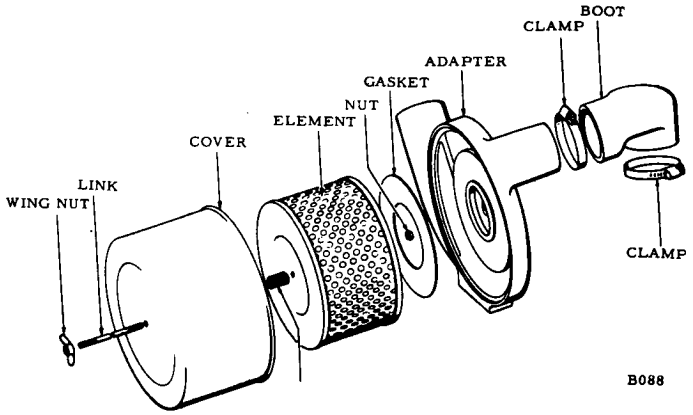


Figure 5

element out of the container. Fig. 3.

2. Tap the element lightly on a smooth surface, altering ends until the dust is removed.

NOTE: The end of the element should contact the surface squarely.

3. Discard the element after no more than ten such cleanings.

4. Install the element in the reverse order in which it was removed. Check all intake connections. Tighten all clamps.

GASOLINE FUEL SYSTEM

GENERAL

The fuel system of truck engines using gasoline as a fuel consists of the following: a welded sheet metal tank, mechanical fuel pump and filter and air cleaner. Fig. 1.

CARBURETOR

A. General. Fig. 1

The carburetor is a downdraft unit incorporating both primary and secondary venturi. The upper, pressed-in section of the secondary venturi is sometimes referred to as the discharge nozzle venturi.

Balanced construction is also used. This is a method of venting the fuel bowl to maintain proper air-fuel mixtures even though the air cleaner may become restricted. This balancing is frequently referred to as an "inside bowl vent." A completely sealed bowl cover is essential in this type of construction.

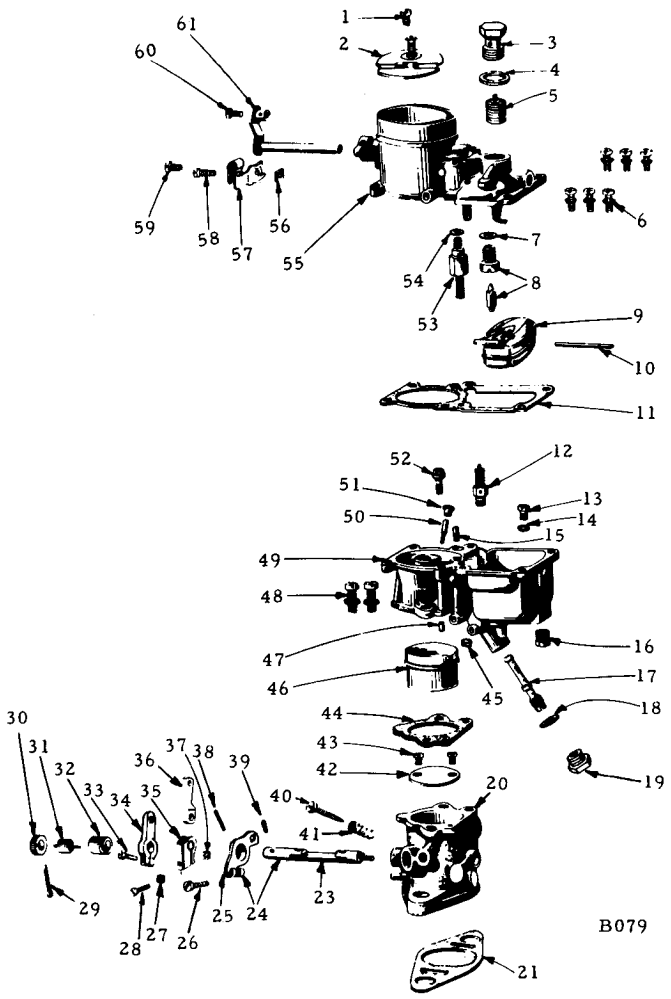
B. Removal

1. Disconnect the choke cable governor link and throttle link at the carburetor.

2. Disconnect the fuel line. Remove the air inlet boot and two mounting nuts holding carburetor to the manifold.

3. Lift carburetor from the manifold. Then remove excessive dirt from carburetor exterior.

C. Disassembly. Fig. 6



1. Choke Plate Screw
2. Choke Plate
3. Filter Head
4. Head Washer
5. Filter Element
6. Air Horn Screw
7. Gasket
8. Needle and Seat
9. Float
10. Float Axle
11. Gasket
12. Power Jet and Valve
13. Main Jet
14. Gasket
15. Well Vent Jet
16. Plug
17. Main Discharge Jet
18. Washer
19. Plug
20. Throttle Body
21. Gasket
23. Throttle
24. Shaft and Stop Lever
25. Lever Stop
26. Lever Stop Screw
27. Washer
28. Clamp Stop Screw
29. Cotter Pin
30. Spring Retainer
31. Spring
32. Lever Bushing
33. Clamp Screw
34. Clamp Lever
35. Lever Stop
36. Floating Lever
37. Clamp Nut
38. Taper Stop Pin
39. Throttle Shaft Pin
40. Idle Adjusting Needle
41. Spring
42. Throttle Plate
43. Throttle Plate Screw
44. Gasket
45. Plug
46. Venturi
47. Bushing
48. Bowel Screw
49. Bowl Assembly
50. Accelerator Jet
51. Plug
52. Idle Jet
53. Vacuum Cylinder
54. Washer
55. Air Horn
56. Clamp Nut
57. Choke Bracket
58. Clamp Screw
59. Bracket Screw
60. Swivel Screw
61. Shaft and Lever

Figure 6

1. Remove the large hex plug (3) and fibre washer (16) from top of the air intake assembly (55) using a 13/16" wrench.

2. Remove the screws and lockwashers (6) which attach the air intake assembly (55) to fuel bowl assembly.

3. Raise the air intake assembly (55) and loosen gasket from the fuel bowl assembly. Lift the air intake (55) with gasket clear of the bowl. Avoid damage to the float (9).

4. Remove gasket from air intake assembly (55).

5. Remove float axle (10) as follows: Press screwdriver against float axle at slotted side of float hinge bracket and force through hinge bracket. Remove the float axle completely with fingers from opposite side and remove float (9).

6. Remove fuel valve needle (8), valve seat (8) and fibre washer (7) from the air intake assembly.

7. Remove vacuum cylinder assembly (53) and fibre washer (7) from air intake assembly (55).

8. Remove the choke plate screw (1), choke plate (2) and choke plate lever and shaft assembly (61) as follows: File off rivited end of the choke plate screw (1). Remove choke plate screw (1). Pull out the choke plate shaft lever assembly (61) and choke plate (2).

9. Remove the lower hex plug (19) and fibre washer (18) from bottom of fuel bowl assembly (49) using a 1/2" wrench.

10. Remove the screws and lockwasher (48) which attaches the fuel bowl assembly to throttle body (22).

11. Separate the fuel bowl assembly from the throttle body (22). Remove the venturi (46) and gasket (44).

12. Remove idle jet (52) from the top surface of fuel bowl assembly (49).

13. Remove well vent jet (15) from top surface of fuel bowl assembly (49).

14. Remove the main jet (13) and fibre washer (14) from inside bottom of the fuel bowl.

15. Remove power jet valve assembly (12) from inside bottom of fuel bowl.

16. Remove the main discharge jet (18) from the passage in the outside bottom of fuel bowl assembly.

17. Do not attempt to remove idle channel bushing (47) or nozzle bushing, as these parts are pressed in at the factory and need not be removed to service the carburetor.

18. Remove the lead channel plugs and the accelerating jet channel plug (51) by first making a center-punch mark in center of each plug.

NOTE: In some models, the accelerating jet channel plug (51) is drilled at the factory to receive a plug extractor. Drill a #46 hole in center of plug.

Be careful to drill only through the plug to avoid damage to casting. Insert tapered thread end of a plug extractor tool into holes just drilled and screw down, counterclockwise, until tool is firmly fastened into plug. Then strike opposite end of tool sharply with a light hammer drawing plugs out of casting.

The threaded tip of the extractor tool can easily break off unless the casting and tool are held firmly, and the extractor driven away from casting without tipping. Use plug extractor for the accelerating jet channel plugs. Remove corrosion, dirt or gum from the four passages after the plugs are removed by using an 1/8" drill with the cutting tip ground blunt to avoid damaging the casting. Clean fuel bowl thoroughly with cleaning solution and rinse in solvent. Remove the two throttle plate screws (43) and remove the throttle plate (42) and throttle shaft lever assembly (23).

NOTE: Threaded ends of throttle plate screws are rivited and must be filed flat before removal to avoid breakage or stripping of threads in shaft. Use caution in this operation to avoid scarring the side of the throttle body bore or the throttle plate. Do not attempt to remove the idle port plug from side of throttle body.

D. Cleaning and Inspection

1. Clean all metal parts thoroughly with carburetor cleaning solution and rinse in solvent.

2. Blow out all passages in the air intake assembly, fuel bowl assembly and throttle body.

3. Be sure all carbon deposits have been removed from throttle bore and idle port. It is advisable to reverse the flow of compressed air in all passages to insure removal of all dirt. Never use a wire or drill to clean out jets.

4. Float Assembly: Replace float assembly if loaded with gasoline, damaged, or if float axle bearing is worn excessively. Inspect top side of float hinge for wear where it contacts fuel valve needle.

5. Float Axle: Replace if any wear can be visually detected on the bearing surface.

6. Fuel Valve Seat and Needle Assembly: Replace fuel valve seat and needle because both parts wear, and may cause improper float level.

7. Idle Adjusting Needle and Spring: Inspect point of needle. This must be smooth and free of ridges.

8. Throttle Plate: Inspect plate for burrs or damaged edges. Never clean a throttle plate with a buffing wheel or a sharp instrument.

9. Throttle Shaft and Lever: Replace shaft and lever assembly if the shaft is badly worn or if lever is loose on shaft.

10. Vacuum Cylinder Assembly and Power Jet Valve: Replace these parts because extent of wear cannot be determined by visual inspection. Wear can result in poor idling and power jet action.

11. Choke Plate Assembly: Inspect for bends, burrs, or damaged edges. See that poppet valve is in good condition and works freely.

12. Choke Plate Shaft and Lever Assembly: Check bearing surfaces for wear. See that shaft is straight and that lever is tight on shaft.

13. Air Intake Assembly: Inspect machined surfaces of air intake for dents, warpage or other damages.

14. Air cleaner must fit tight or dirt will get into the engine.

15. Fuel Bowl: Examine for loose discharge nozzle bushing. Examine inside bottom of bowl and all passages for evidence of corrosion (Metallic oxides) or gum deposits.

16. Gaskets: Replace all gaskets and fibre washers every time the carburetor is disassembled.

E. Assembly. Fig. 6

1. Place choke plate in air intake assembly with poppet valve toward gasket surface.

2. Insert shaft and lever assembly.

3. With choke plate closed, align hole in shaft with hole in plate.

4. Center the choke plate in a closed position and tighten screw. Do not attempt to rivet threaded end of screw.

5. Install vacuum cylinder assembly and new fibre washer in air intake assembly.

6. Install new fuel valve seat and fibre washer.

7. Install fuel valve needle in seat, followed by float and float axle. Insert tapered end of float axle (27) into float bracket on side opposite slot and push through the other side. Press float axle into slotted side until the axle is centered in bracket.

8. Set float level to the standard setting using a 6" depth gauge. Fig. 7. Do not bend, twist or apply pressure on the float body. With air intake assembly in inverted position, as viewed from the free end of float, float body should be centered at right-angle to bowl cover. The float setting is measured from the machined surface of air intake assembly to top side of float body at highest point. The standard setting for this carburetor is 1-1/2 inches. To change the distance between float and the machined surface of air intake, bend float lever close to the float body.

9. Drive each of the lead plugs into channels until plug heads are flush with surface of the casting. Only one or two light hammer blows are required to seal lead plug in channel. Avoid driving plugs too deep, otherwise plug may block off other fuel passages.

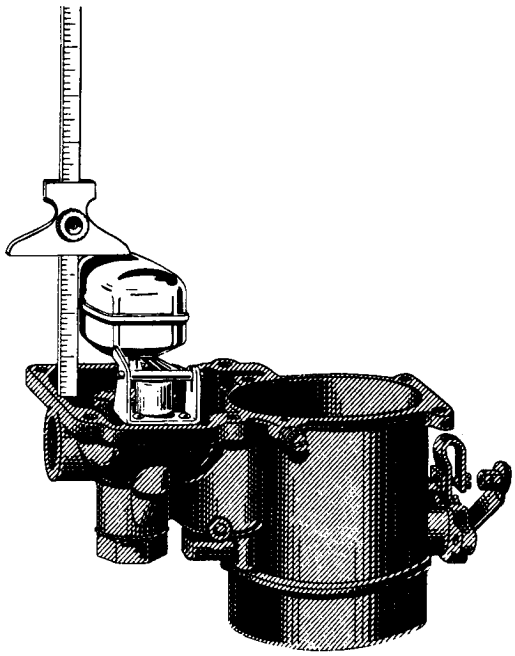


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Figure 7

10. Install idle jet in top surface of fuel bowl (no gasket is used).

11. Install main jet and fibre washer in bottom of fuel bowl and seat firmly.

12. Install power jet valve assembly.

13. Install main discharge jet into passage in outside bottom of fuel bowl.

14. Install lower plug and fibre washer in passage on outside bottom of fuel bowl, using a 1/2" wrench.

15. Install well vent jet in top surface of fuel bowl assembly.

16. If the fit of the throttle shaft is sloppy in the throttle body and it is desired to use the same throttle body for re-assembly of the carburetor, then it is absolutely necessary to install throttle shaft bushings. A poor fitting throttle shaft will upset engine idle, cause incorrect throttle plate location in relation to the idle discharge port, and allows air and dirt to be admitted into the throttle body around the shaft.

The following procedure should be adhered to for proper installation of the throttle shaft bushings. To properly re-bush the throttle body of the carburetor, it is absolutely necessary to have available the proper counterbore reamer, line reamer

and bushing drive tool.

a. Place a suitable centering cone in the bed of a drill press. With one throttle shaft hole on this center, bring the spindle down until the counterbore reamer contacts the opposite shaft hole. Use correct reamer to obtain proper press fit on the outside diameter of the throttle shaft bushing.

b. With the casting still in place as described in the above paragraph, set the stop on the press to the length of the bushing. Check that the proper length bushing is being used for the particular shaft hole being counterbored.

c. The hole is then counterbored to accomodate the bushing.

d. A throttle shaft bushing is driven into place using the proper bushing driver tool.

e. The bushing is then reamed with the line reamer. Use the opposite shaft hole as a "pilot" to align the line reamer in the bushing.

f. Now turn the casting over and prepare the opposite hole to take the bushing. It will be necessary to reset the stops on the spindle again as described before. Then counterbore the hole.

g. Drive the second throttle shaft bushing into position.

h. Then line ream the inside diameter as the final machining operation. Pilot line reamer from side opposite bushing that is being reamed. A lathe may be substituted for the drill press in performing the counter-boring and line reaming operations.

17. Install throttle shaft and lever assembly and throttle plate in throttle body.

18. Any deviation from the following instructions will result in poor idle and low speed performance. Use new screws and do not attempt to rivet threaded ends. (A drop of shellac may be used for sealing.)

a. Back out throttle stop screw in throttle lever. Place the throttle body assembly on bench with mounting flange up.

b. Insert throttle shaft and lever assembly with throttle lever pointing down.

c. Rotate the throttle shaft to face the cut-out section in center. The threaded ends of the screw holes will then be facing the idling port plug.

d. Insert the throttle plate, starting the side of the plate with the shortest distance between screw holes and the beveled edge, into the shaft first. Center it, and then rotate shaft counterclockwise to close.

e. Turn the throttle body over and start the screws into shaft loosely. Tap the plate lightly to center it and tighten screws firmly. Throttle plate screws are never installed from the mounting flange side of the casting.

f. To properly center the plate in the throttle body bore, the screws should be started in the shaft and then with the plate closed, it should be tapped on the mounting flange side. Pressure on the throttle plate must be maintained with the finger until the screws are tightened.

g. The edges of the throttle plate are beveled so that they will fit flush against the sides of the throttle body bore when the throttle plate is closed. If the throttle plate is not installed correctly, it will not close flush with the sides of the throttle body bore.

19. Place venturi in position in fuel bowl assembly. The notch in the venturi fits over the discharge arm of the fuel bowl assembly.

20. Place throttle body-to-fuel bowl gasket in position around venturi. One hole in this gasket is reinforced with a metal ring. The idle channel bushing in fuel bowl assembly (46) should pass through this ring.

21. Assemble the throttle body to the fuel bowl assembly.

22. Place gasket on air intake, assemble same to fuel bowl with screws and lockwashers. Tighten screws evenly and firmly.

23. Install large hex plug in top of fuel bowl cover. Tighten with 13/16" open end wrench.

24. Hold throttle lever in a closed position and turn throttle stop screw in until it just contacts stop on body, then turn screw in 1-1/2 additional turns.

F. Installation

1. Make sure mounting surfaces of carburetor and manifold are clean. Use a new mounting gasket.

2. Mounting nuts should be tightened down evenly and air intake connections tightened.

3. Adjust carburetor with engine hot and running at idle speed.

FUEL PUMP AND FUEL FILTER

A. General

Mounted at the clutch end of the engine is a mechanical, single-acting fuel pump, which is actuated by a lobe on the engine camshaft. Fig. 8.

Figure 8

The filter is attached to the inlet side of the pump.

B. Removal

1. Disconnect the fuel line from the pump and the fuel line from the filter.

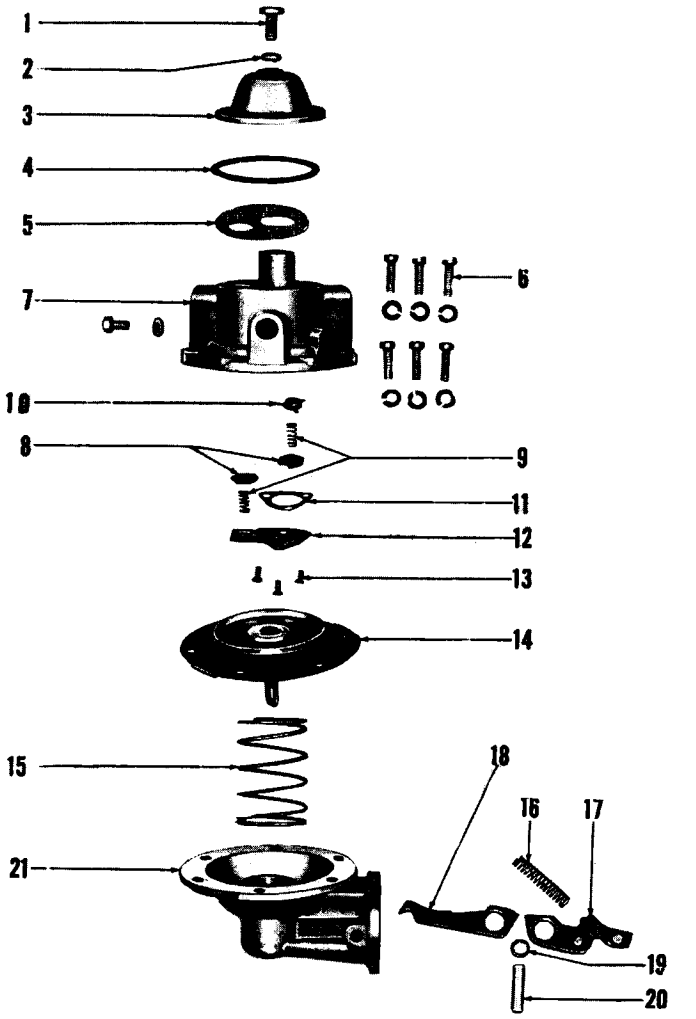
2. Unscrew the two mounting capscrews. Separate the filter from the pump.

C. Disassembly. Fig. 9

NOTE: Refer to fig. 10 for filter disassembly.

1. File match marks across a point at the union of the head (7) and body (23). Unscrew the assembly screws (6) and remove the head (7).

2. Unscrew the dome bolt. Remove the dome (3), dome gasket (4) and filter screen (5).



1. Dome Bolt
2. Gasket
3. Dome
4. Dome Gasket
5. Filter Screen
6. Assembly Screws
7. Head
8. Valves
9. Valve Springs
10. Spring Retainer
11. Gasket
12. Valve Plate
13. Valve Plate Screws
14. Diaphram
15. Diaphram Spring
16. Rocker Arm Spring
17. Rocker Arm
18. Link
19. Bushing
20. Rocker Arm Pin
21. Body

Figure 9

3. Unscrew the three valve plate screws (13). Lift out the valve plate (12), plate gasket (11), valves (8), valve springs (9) and the valve spring retainer (10).

4. Pry the rocker arm spring (17) out of position, using a screw driver inserted in the coils of the spring.

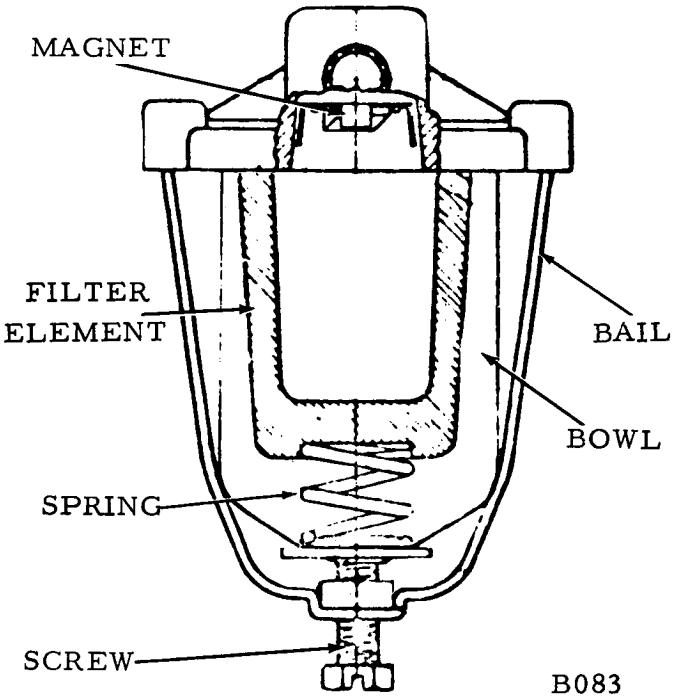


Figure 10

5. With the heel of the hand on the diaphragm (14), compress the diaphragm spring (16) and unhook the diaphragm from the link (19).

6. Drive the rocker arm pin (21) out. Remove rocker arm (18), linkage (19) and bushing (20).

D. Cleaning and Inspection

1. Clean all parts with solvent.

NOTE: The following are points where wear affects fuel pump performance as noted:

a. Worn linkage causes slow priming and lack of fuel.

b. Worn pull rod causes improper diaphragm action.

c. Dirty valve seats or worn valves result in reduced fuel flow.

d. Ruptured diaphragm reduces the fuel pressure and flow.

2. Visually check the cover and body for cracks and breakage. Inspect for diaphragm flange warpage by testing on a smooth flat surface. Examine all threaded holes for stripped or crossed threads. Broken, damaged or severely warped castings must be replaced.

3. Replace valves if obviously worn or damaged.

4. Replace obstructions from filter screen. Replace screen if damaged or if it does not fit snugly in the head.

5. Inspect the rocker arm for scoring or wear on the push rod pad, and at the point of contact with link. Check the link for wear at point of contact with the rocker arm and diaphragm pull rod. Replace parts as necessary.

6. Replace diaphragm spring and valve springs. Replace diaphragm spring only if it is broken, distorted, rusted or pitted.

7. Replace the diaphragm if it is ruptured, cracked or worn.

E. Assembly. Fig. 9

1. Soak the new diaphragm in clean kerosene, fuel oil, or gasoline until it is needed for installation. Assemble link, rocker arm, and bushing. Place the assembly in the body. Align rocker arm pin hole with body and drive in the rocker arm pin.

2. Install valves, springs and spring retainer. Put a drop of light oil on the valves, and use a new gasket between the plate and body.

3. Place the filter screen in the head. Install the vapor drum, using a new gasket.

4. Install the diaphragm spring and diaphragm.

5. Install the head on pump body. Be sure to line up the file marks. Install assembly screws and lockwashers loosely until screws just engage lockwashers. Actuate rocker arm several full strokes to flex diaphragm.

CAUTION: Sufficient diaphragm cloth must be pulled inside of the pump body or pump will deliver too much pressure. Tighten the cover screws alternately and securely.

6. Test operation of pump valves by attaching pressure gauge to outlet and operate rocker arm. Pressure should not fall off rapidly.

F. Installation

1. Place a new mounting gasket on the fuel pump mounting flange. Use a non-hardening cement to hold gasket in position while installing the pump.

2. Insert the rocker arm through the fuel pump mounting pad opening of the adapter.

CAUTION: Make sure that the rocker arm pad rests against the fuel pump. Push rod in the adapter. Broken rocker arm or broken link and possible engine damage will result if pump is not properly installed.

3. Holding the pump in position against the adapter, insert the bolts with lockwashers in the holes provided for them.

4. Start the bolts and turn them in finger tight. This will prevent damage to the threads. Then tighten bolts with a wrench.

5. Check the fuel lines for condition, cleanliness and alignment with the pump outlet. Start the fitting nuts and turn on finger tight. Using two wrenches, one on the nut and one on the fuel pump fitting, tighten enough to prevent vacuum and fuel leaks.

G. Pressure Test

NOTE: The pressure test is made to check for excessively high pressures developed by the pump which may cause rich fuel mixtures, and in a few cases, flooding of the carburetor. A rich mixture is one of the causes of excessive fuel consumption and poor performance.

1. Disconnect the gasoline line at the carburetor, and insert a "T" fitting between the carburetor and the fuel line. Fig. 11.

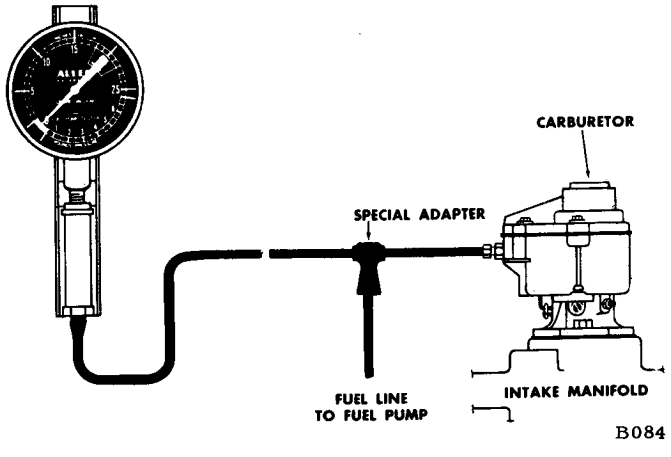


Figure 11

2. Start the engine and run it at low idle speed.

3. Read on the pressure scale the pounds pressure developed by the fuel pump and compare with the specifications.

H. Capacity Test

NOTE: The capacity test determines the ability of the pump to produce a sufficient amount of fuel within a specified time. It is important that both a pressure and a capacity test be made to determine the condition of the fuel pump.

1. Disconnect the rubber hose at the tester and insert it in a suitable container. The container must be marked to show a one-pint level.

CAUTION: Disconnecting the line between the carburetor and the pump removes the normal pressure on the fuel pump diaphragm causing it to flex abruptly. This may cause loose particles of dirt to enter the carburetor fuel line. Therefore, before connecting the line to the carburetor, it is recommended that the fuel line and pump be flushed. To do so, operate the starter until 1/4 to 1/2 pint of gasoline has been flushed out into a container.

2. Start the engine, and measure the time required to pump one pint of fuel into the container, at 1800 RPM. This should take one to 1-1/2 minutes.

3. If the capacity of the fuel pump is low, it may be due to leakage of air into the system. Check the vapor dome for looseness and also the gasoline line to the fuel tank and the inlet fitting on the pump for air leaks. Restrictions in the fuel line will also reduce pump capacity.

TROUBLESHOOTING GUIDE

Cause	Remedy
ENGINE	
Engine Will Not Start Or Is Hard To Start	
1. Clogged air cleaner	1. Clean. Service more often.
2. Low on fuel	2. Refill fuel tank.
3. Low grade of fuel	3. Change to higher grade of fuel.
4. Restricted fuel lines	4. Service fuel filter. Remove foreign particles from fuel system. Check source of supply.
5. Ice in fuel system	5. Thaw out entire system. Drain fuel tank and refill with clean fuel.
6. Insufficient fuel from pump	6. Refer to FUEL PUMP — Troubleshooting Guide, Insufficient Fuel.
7. Carburetor choke valve inoperative	7. Check and adjust carburetor choke valve so that it will open and close completely.
8. Defective carburetor (too rich or too lean)	8. Refer to the CARBURETOR — Troubleshooting Guide.
9. Filler cap vent plugged	9. Clean the vent in the filler cap.
Black Exhaust Smoke At Idle	
1. Carburetor choke valve partially closed	1. Push choke button in. Check and adjust choke valve so that it opens and closes completely.
2. Air-fuel mixture too rich	2. Refer to CARBURETOR — Troubleshooting Guide.
3. Excessive pump pressure	3. Refer to FUEL PUMP — Troubleshooting Guide.
Black Exhaust Smoke Under Load	
1. Restricted exhaust system	1. Check heat control valve. Loosen, if stuck. Replace restricted muffler and exhaust pipes.
2. Clogged air cleaner	2. Clean. Service more often.
3. Low grade of fuel	3. Change to a better grade of fuel.
4. Rich air-fuel mixture, defective carburetor or fuel pump	4. Refer to CARBURETOR — Troubleshooting Guide, and FUEL PUMP — Troubleshooting Guide.
Loss Of Power	
1. Restricted exhaust system	1. Check heat control valve; loosen, if stuck. Replace restricted muffler and exhaust pipes.
2. Clogged air cleaner	2. Clean. Service more often.
3. Low grade of fuel	3. Change to a better grade of fuel.
4. Rich or lean air-fuel mixture, defective carburetor or fuel pump	4. Refer to CARBURETOR — Troubleshooting Guide and FUEL PUMP — Troubleshooting Guide.
5. Carburetor throttle valve not opening completely	5. Adjust throttle control so that the throttle valve will open and close completely.

Cause	Remedy
6. Carburetor choke valve partially closed	6. Push choke button in. Check and adjust choke valve so that it opens and closes completely.
7. Fuel filter clogged or low fuel pump pressure	7. Clean. Service more often. Check fuel in tank. If dirty, drain and clean tank. Refill with clean fuel. Refer to FUEL PUMP—Troubleshooting Guide.
Engine Cannot Reach Governed RPM	
1. Clogged air cleaner	1. Clean. Service more often.
2. Clogged fuel filter or low fuel pump pressure	2. Clean. Service more often. Check fuel in tank. If dirty, drain and clean tank. Refill with clean fuel. Refer to FUEL PUMP—Troubleshooting Guide.
3. Rich or lean air-fuel mixture, defective carburetor or fuel pump	3. Refer to CARBURETOR—Troubleshooting Guide, and FUEL PUMP—Troubleshooting Guide.
4. Dirty or improper governor adjustment	4. Clean and calibrate governor. Adjust governed engine RPM.
Flat Spot In Acceleration Or Poor Acceleration	
1. Defective carburetor	1. Refer to CARBURETOR—Troubleshooting Guide.
Excessive Fuel Consumption	
1. Restricted exhaust system	1. Check heat control valve. Loosen if stuck. Replace restricted muffler and exhaust pipes.
2. Clogged air cleaner	2. Clean. Service more often.
3. Low grade of fuel	3. Change to a better grade of fuel.
4. Rich or lean air-fuel mixture, defective carburetor or fuel pump	4. Refer to CARBURETOR—Troubleshooting Guide, and FUEL PUMP—Troubleshooting Guide.
5. Carburetor choke valve partially closed	5. Push choke button in. Check and adjust choke valve so that it opens and closes completely.
Erratic Idle Speeds	
1. Low grade of fuel	1. Change to a better grade of fuel.
2. Rich or lean air-fuel mixture, defective carburetor or fuel pump	2. Refer to CARBURETOR—Troubleshooting Guide, and FUEL PUMP—Troubleshooting Guide.
3. Looseness in carburetor throttle valve control mechanism	3. Remove slack. Replace parts as necessary. Check carburetor throttle shaft. The shaft should not be loose in the body.
4. Fuel not vaporizing before entering combustion chamber	4. Check and free-up stuck heat control valve.
5. Vacuum leak between the carburetor mounting flange and intake ports in the block	5. Replace gaskets as necessary. Tighten screws securely.
6. Vacuum hose loose or deteriorated	6. Tighten hose clamps. Replace hose if necessary.

FUEL

Cause	Remedy
Engine Stops Running	
1. Out of fuel	1. Fill fuel tank.
2. Low grade of fuel	2. Change to a better grade of fuel.
3. Clogged fuel filter or fuel pump defective	3. Service fuel filter more often. Check fuel in tank. If dirty, drain and clean tank. Refill with clean fuel. Refer to FUEL PUMP—Troubleshooting Guide.
4. Rich or lean air-fuel mixture, defective carburetor or fuel pump	4. Refer to CARBURETOR—Troubleshooting Guide, and FUEL PUMP—Troubleshooting Guide.
5. Filler cap vent plugged	5. Clean the vent in the filler cap.
Surging At Governed Speed	
1. Rich air-fuel mixture, defective carburetor or fuel pump	1. Refer to CARBURETOR—Troubleshooting Guide, and FUEL PUMP—Troubleshooting Guide.
2. Dirty or improper governor adjustment	2. Clean linkage and remove binding. Adjust governed engine RPM.
3. Vacuum leak between governor and carburetor; governor and intake manifold	3. Replace gaskets and tighten carburetor mounting screws.
Engine Misses	
1. Low grade of fuel	1. Change to a better grade of fuel.
2. Clogged fuel filter or defective fuel pump	2. Service fuel filter more often. Refer to FUEL PUMP—Troubleshooting Guide.
3. Rich or lean air-fuel mixture, defective fuel carburetor or pump	3. Refer to CARBURETOR--Troubleshooting Guide, and FUEL PUMP—Troubleshooting Guide.
4. Fuel not vaporizing before entering the combustion chamber	4. Check and free-up heat control valve.
CARBURETOR	
Erractic Idling	
1. Incorrect idle needle valve adjustment	1. Adjust needle valves. If unable to improve idling, clean throttle body. Replace worn needle valves.
2. Carburetor mounting is loose	2. Remove carburetor and governor. Check and replace gaskets, if necessary. Make sure gaskets are installed correctly. Tighten mounting nuts securely.
3. Idle tube or air bleed carbonized	3. Disassemble and clean carburetor. Blow carbon from air bleed orifice and passageway with compressed air.
4. Idle discharge holes gummed or plugged	4. Disassemble and clean carburetor. Blow foreign matter from the idle discharge holes and the secondary idle air bleed.
5. Throttle body carbonized or throttle shaft worn	5. Disassemble and clean throttle body. Remove carbon.

Cause	Remedy
6. Incorrect float level	6. Check and adjust float level as necessary. Replace float if leaking.
7. Worn needle valve and seat	7. Install new needle valve and seat. Adjust float level.
8. Loose throttle body-to-main body screws	8. Install new gasket between main body and throttle body, if necessary. Tighten throttle body mounting screws.
Carburetor Floods Or Leaks	
1. Cracked main body	1. Replace main body. Make sure main body-to-throttle body screws are tight.
2. Defective body gaskets	2. Replace gaskets. Tighten screws securely.
3. High float level	3. Check and adjust float level.
4. Worn needle valve and seat	4. Clean and check needle valve. If worn, replace valve and seat. If not worn, check fuel pump pressure.
5. Excessive fuel pump pressure	5. Refer to FUEL PUMP—Troubleshooting Guide.
Poor Acceleration	
1. Vacuum cylinder not operating correctly	1. If loose, replace gasket and tighten. Manually check; replace if operation is not smooth. Replace all body gaskets and the carburetor mounting gasket.
2. Power jet and valve dirty or not operating	2. Vacuum cylinder not operating, refer to No. 1. Clean power jet and valve. Manually check the valve operation, if not smooth, replace.
3. Incorrect float level	3. Check and adjust float level as necessary. Replace float if leaking.
4. Worn needle valve and seat	4. Clean and check needle valve and seat. If worn, replace. If not, check fuel pump pressure.
5. Choke valve partically closed	5. Open choke valve. Adjust choke cable so that the valve will open and close completely.
6. Manifold heat control valve stuck	6. Free-up. Replace bi-metal spring, if necessary.
Poor Performance (Air-Fuel Mixture Too Rich)	
1. Restricted air cleaner	1. Service air cleaner more often.
2. Float level too high	2. Check and replace float, if leaking. Adjust float level.
3. Excessive fuel pump pressure	3. Refer to FUEL PUMP—Troubleshooting Guide.
4. Vacuum cylinder or power jet and valve stuck	4. Free-up or replace stuck assembly. Clean out all passages.

FUEL

Cause	Remedy
Poor Performance (Air-Fuel Mixture Too Lean)	
1. Main metering jet damaged; wrong size or type used	1. Replace metering jet with a new one of correct size and type.
2. Top shoulder seat of main discharge jet bad or tip damaged	2. Remove main discharge jet, clean, inspect and replace, if necessary.
3. Vacuum cylinder worn or stuck	3. Free cylinder if stuck. Replace if worn.
4. Power jet corroded or not seating	4. Clean power jet and channels. If seating is faulty, replace the jet.
5. Low float level	5. Adjust float level.
6. Low fuel pump pressure	6. Refer to FUEL PUMP—Troubleshooting Guide.
7. Air leak between carburetor base and engine intake ports	7. Tighten intake manifold-to-engine screws and carburetor mounting screws. Replace gaskets, if necessary.
FUEL PUMP	
Pump Leaks Fuel	
1. Cover-to-body loose	1. Tighten. Check cover gasket. Replace gasket if faulty.
2. Ruptured body	2. Replace fuel pump.
3. Fuel line fittings loose	3. Tighten fittings as necessary to stop leakage. Replace fittings, if necessary.
Insufficient Fuel Or Low Pump Pressure	
1. Fuel line leaks	1. Tighten fittings or cover.
2. Ruptured pump body	2. Replace fuel pump.
3. Dirt under valves or valves not seating	3. Remove foreign particles from valves and seats. Install new valve bodies.
4. Weak or broken spring	4. Check fuel pump pressure. If low, install new spring.
5. Worn plunger or bore rocker pin or link	5. Replace parts as necessary.
Pump Noise	
1. Fuel pump loose on mounting	1. Tighten mounting screws.
2. Worn plunger assembly	2. Replace parts as necessary.
3. Broken or weak plunger spring	3. Replace plunger spring and plunger, if necessary.

Excessive Pump Pressure

1. Diaphragm improperly installed

1. Loosen body-to-cover screws, and press rocker tight as possible against the spring, then tighten the screws.

2. Wrong diaphragm spring or fuel pump

2. Replace spring or pump, if necessary.

IMPROVED CARBURETOR

A new, non-percolating carburetor is available which is directly interchangeable with the old one. The new carburetor is installed from unit serial number C2D-6690 and on.

The following improvements were made:

(a) An accelerator pump was added for improved engine response. Fig. 11A.

(b) The main jet was relocated from the bottom of the bowl to the base of the main discharge jet. Fig. 11A. This change permits air bubbles to escape through the bore which formerly housed the main discharge jet.

(c) The top opening of the well vent jet was enlarged to make it easier for air bubbles to escape to the air horn of the carburetor.

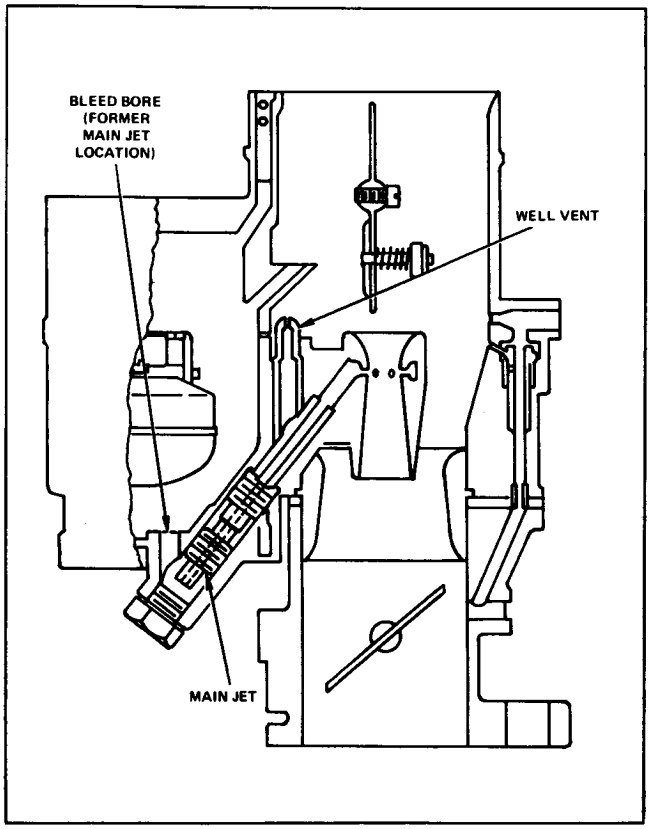


Figure 11A

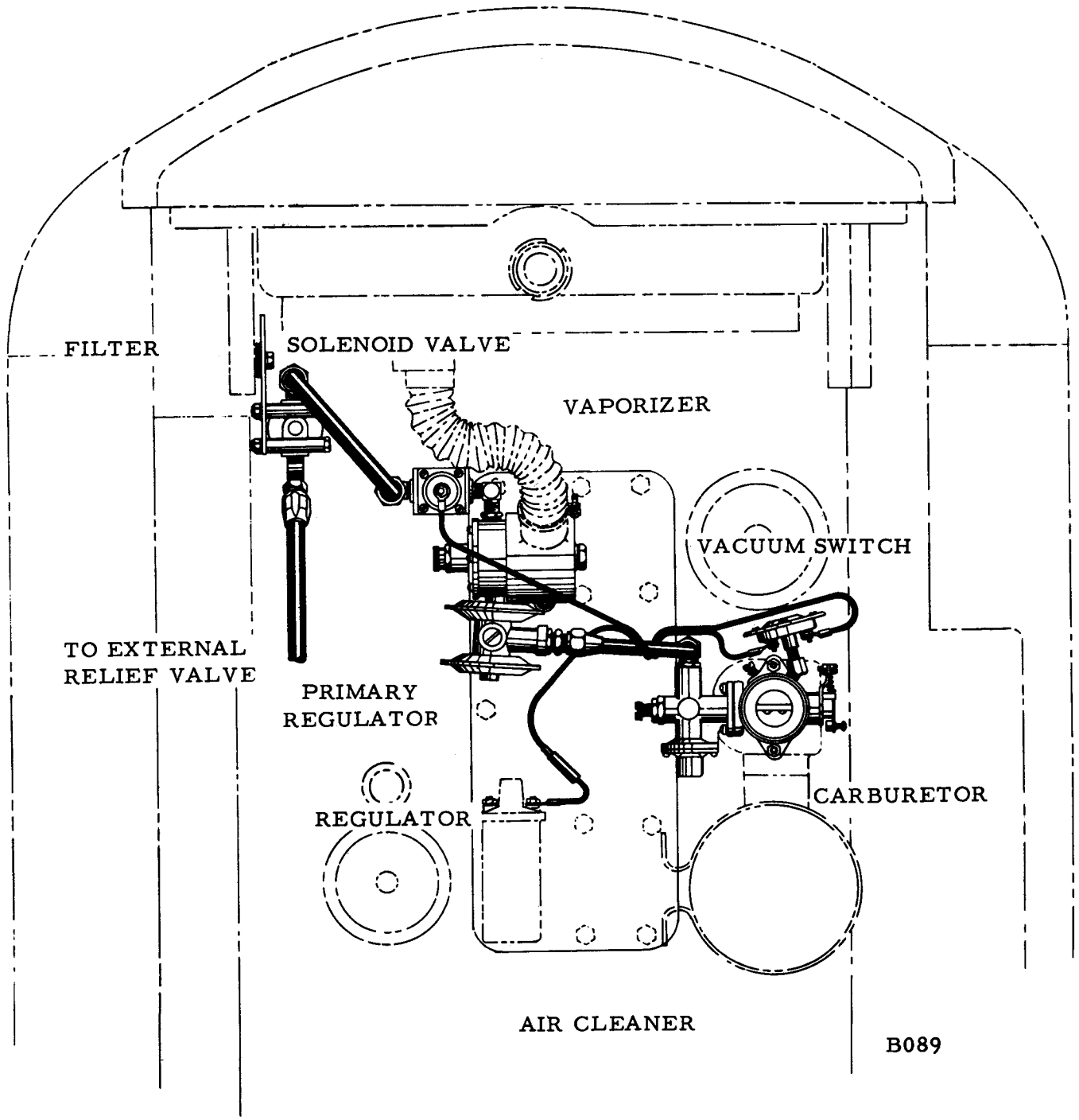


Figure 12

LIQUEFIED PETROLEUM GAS SYSTEM

GENERAL. Fig. 12

The L.P.G. system consists of the fuel tank or tanks with associated valves and fittings, fuel filter, hydrostatic pressure relief valve, solenoid valve, vacuum switch, vaporizer-primary regulator and second stage regulator, carburetor, interconnecting fuel lines, and a dry-type air cleaner.

Liquefied Petroleum Gas (L.P.G.) consists principally of petroleum fractions or derivatives known and identified commercially as Propane and/or Butane. The equipment required to use this fuel in internal combustion engines is very similar to the carburetor, fuel pumps, filters and other related equipment used with gasoline as an engine fuel.

Under normal atmospheric temperature, gasoline

has a low self-pressurizing tendency, or a low vapor pressure. It may, therefore, be stored and handled in light gauge tanks which are usually vented to the atmosphere. With this arrangement, loss in fuel does occur due to vehicle tank agitation in service and subsequent evaporation of the light fractions in the fuel.

By contrast, L.P.G. would boil violently and immediately evaporate if an attempt were made to store it in a vented tank at atmospheric temperature. This is due to the fact that the various commercial blends of Propane and Butane sold for motor fuel have a high vapor pressure at usual atmospheric temperatures. They must, therefore, be stored in strong steel tanks built to withstand working pressures in excess of 200 PSI.

CAUTION: Before disconnecting any fuel lines: Start engine, turn off fuel valve and let engine run on fuel in the lines until it stops.

FUEL TANK

A. General

The fuel tanks may be of the portable I.C.C. or fixed A.S.M.E. types. Figs. 13 and 14.

The I.C.C. tank, fig. 15, contains a fuel shut-off valve (4), adaptor, relief valve and rain cap (3), fuel gauge (2) and a quick disconnect coupling (14). The fuel line (11) is connected to an external relief valve (8).

Jointed straps hold the tank on the tank support straps (6). The upper and lower straps are hinged together at one end (5) and are provided with a locking mechanism (6) at the other end. Tension on the straps can be adjusted.

The A.S.M.E. tank, fig. 16, contains a filler valve (3), vapor return valve (2), internal relief valve (5), vapor and liquid service valves (the valve on the left being the vapor valve) (6), liquid level gauge (15), a fuel line that is connected to an external relief valve (8, 9, 13, 14), and a float-type liquid level gauge (15).

Cold engine starting, in lower atmospheric temperatures, is made easier by turning off the liquid service valve and opening the vapor service valve. This allows the engine to start on a completely vaporized fuel. The liquid service valve is turned on after the engine is warm, and the vapor service valve is turned off.

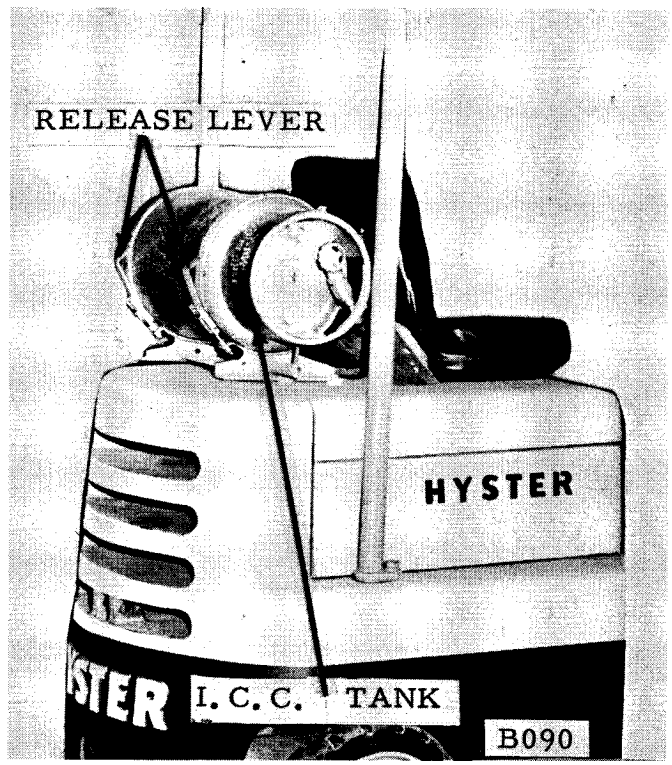


Figure 13

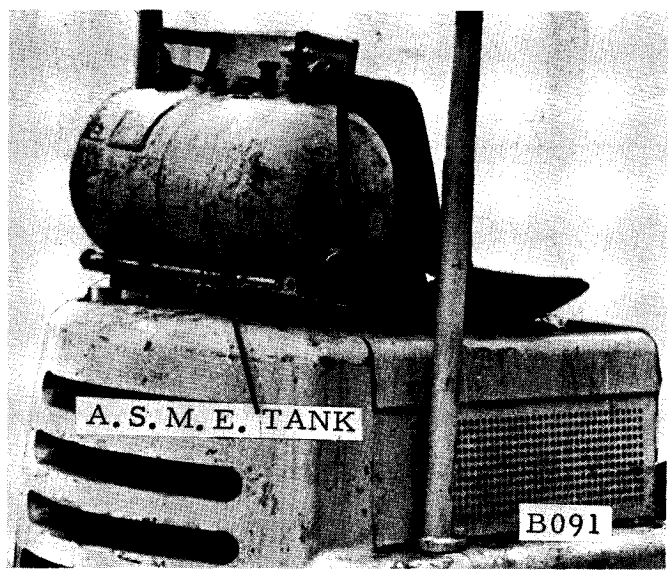
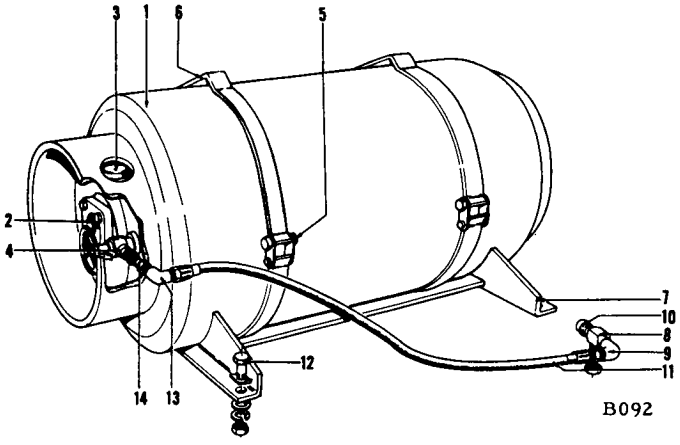


Figure 14

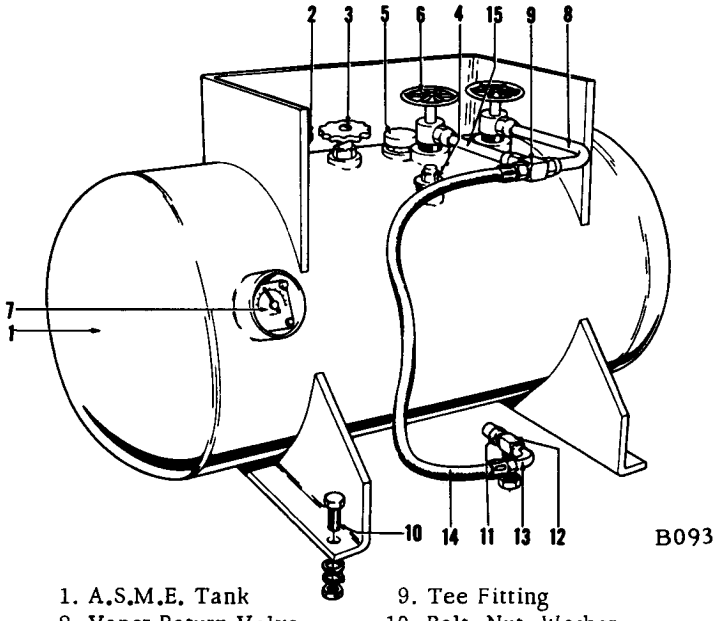
B. Service

1. The I.C.C. tank is removed from the truck



1. I. C. C. Tank
2. Fuel Gauge
3. Relief Valve
4. Shut-off Valve
5. Hinge Link
6. Upper Strap
7. Tank Support
8. Tee Fitting
9. Elbow
10. External Relief
11. Hose
12. Bolt, Nut, Washers
13. Elbow
14. Disconnect

Figure 15



1. A.S.M.E. Tank
2. Vapor Return Valve
3. Filler Valve
4. Liquid Level Gauge
5. Internal Relief Valve
6. Vapor and Liquid Valve
7. Fuel Gauge
8. Tube
9. Tee Fitting
10. Bolt, Nut, Washer
11. External Relief Valve
12. Tee Fitting
13. Elbow
14. Hose
15. Liquid Level Gauge

Figure 16

by pulling the quick disconnect coupling and unsnapping the two hold-down clamps.

2. The A.S.M.E. tank is removed from the truck in the following manner. Shut off valves, run engine on fuel in the lines until it stops, break fittings at the tank valve, unbolt the tank from the mounting.

3. Tank trouble symptoms will be: Inoperative fuel gauge — this will require replacement; defective service valves evidenced by frosting or failure to shut off, defective filling valves — evidenced by frosting during filling or slow filling, or failure to fill. Repair of fittings or valves should be accomplished by a man well qualified to service L.P.G. fuel tanks.

EXTERNAL RELIEF VALVE

A. General

An external hydrostatic relief valve is placed in the system to prevent excessive high pressure. If tank pressure for any reason is too high, the valve will upset to relieve the pressure. It will stay upset until the pressure drops to a safe level. The valve is always installed to allow gas to escape to the outside of the engine compartment.

B. Service

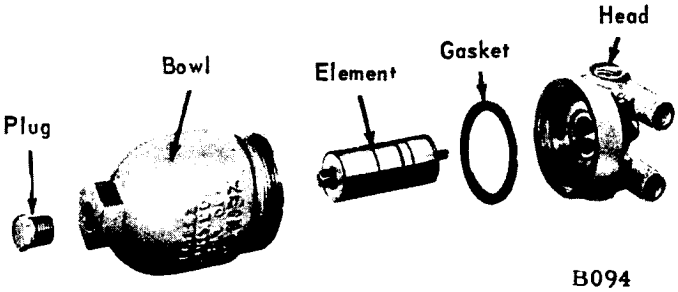
The relief setting is set and sealed at the factory. No attempt should be made to change the setting. This unit is serviced by replacement.

FUEL FILTER

A. General

All fuel systems should be protected with filters to prevent excessive wear or interference with operation from foreign matter in the fuel. Gasoline filters are not required to withstand fuel pressures in excess of 10 to 13 PSI. Filters for the L.P.G. fuel system must be designed for working pressures as high as 250 PSI.

B. Service. Fig. 17.



L.P.G. Fuel Filter

Figure 17

The only serviceable component of the filter assembly is the filter element. The element can be rinsed in clean solvent and blown dry with compressed air. Do not blast filter laminations with air. This may damage them and render the element useless.

SOLENOID VALVE

A. General. Fig. 18

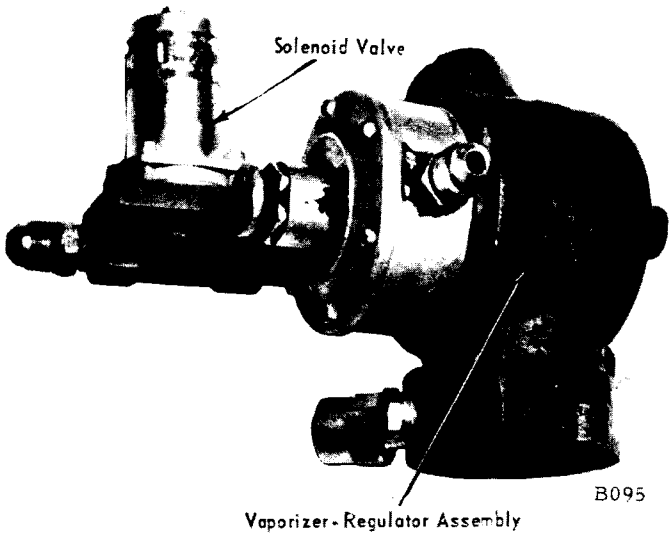


Figure 18

Mechanically, the solenoid valve is connected into the fuel system between the filter and vaporizer – regulator. Electrically, the solenoid is connected in series with the ignition switch, ignition coil, and a vacuum switch on the carburetor. With this arrangement, fuel is allowed to pass through the solenoid valve only when the ignition switch is on and vacuum is created in the engine intake manifold. Thus, the only time fuel can escape from the tank is during engine cranking or running. If the engine should stop running with the ignition switch on, vacuum will cease and the vacuum switch will open, breaking the solenoid electrical circuit and the fuel valve will close, shutting off the fuel.

B. Disassembly. Fig. 19

Remove four magnet flange screws, magnet assembly, flange and diaphragm.

C. Inspection

Inspect diaphragm, seating surface of body, magnet mounting shoulder and gasket for

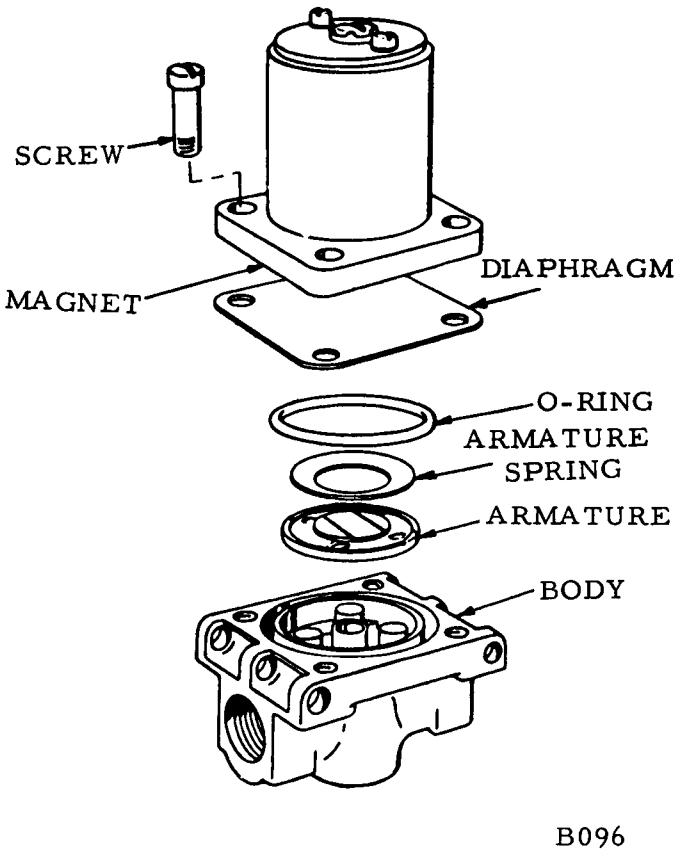


Figure 19

damage. Check armature assembly for deterioration of synthetic rubber. Immerse all parts except magnet in solvent and dry thoroughly. Wipe magnet assembly with a lintless cloth soaked in solvent. Replace all parts which appear damaged.

D. Assembly

Position armature on body seating surface. Add spring and diaphragm. Install magnet and flange and inspect magnet screws. Tighten diagonally opposite screws in pairs. Magnet retaining screws must be tightened evenly to prevent external leakage.

VACUUM SWITCH

A. General

Electrically, the vacuum switch is placed in the ignition circuit in series with the solenoid and ignition coil.

This vacuum sensitive switch is open when no low pressure exists in the engine intake manifold. During cranking and engine operation a lower than atmospheric pressure does exist in

the manifold, allowing atmospheric pressure to push against the switch diaphragm, closing electrical contacts in the switch. Thus the ignition circuit is opened and closed according to the engine status.

B. Service

NOTE: Although the service requirements are almost nil, a defective switch can cause trouble in fuel delivery, carburetion and ignition.

1. Check switch continuity while cranking the engine; the switch should close, and open when cranking ceases.

2. Replace a switch that is defective.

VAPORIZER AND PRIMARY REGULATOR
Fig. 20

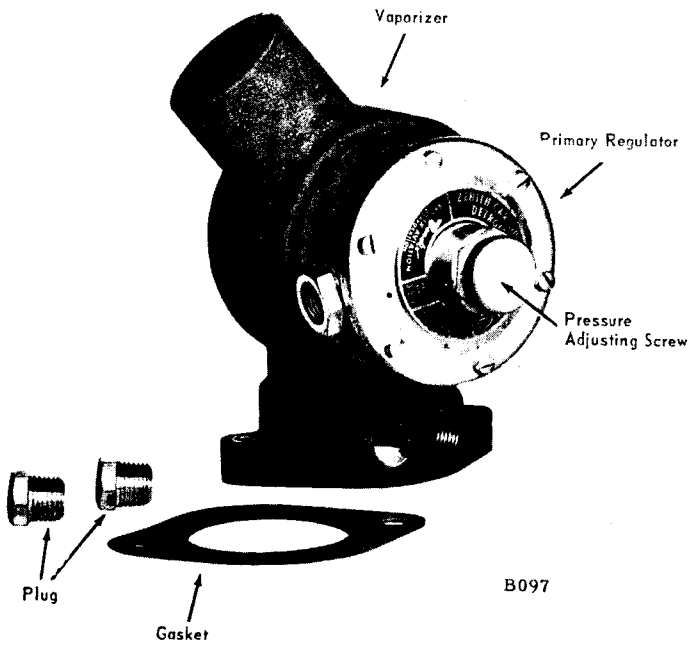


Figure 20

A. General

In the L.P.G. fuel system, no fuel pump is required, as the fuel develops sufficient pressure to move from the tank to the control device in the system.

A primary pressure regulator is used which reduces the liquid pressure in the fuel line and maintains the designed working pressure of the system. This regulator normally controls a flow of liquid fuel which is passed directly to the vaporizer. These units are joined together.

In the L.P.G. fuel system, fuel is vaporized, then metered as a dry gas which readily mixes with air, and consequently reaches the engine as a completely blended mixture. This process is accomplished by the vaporizer.

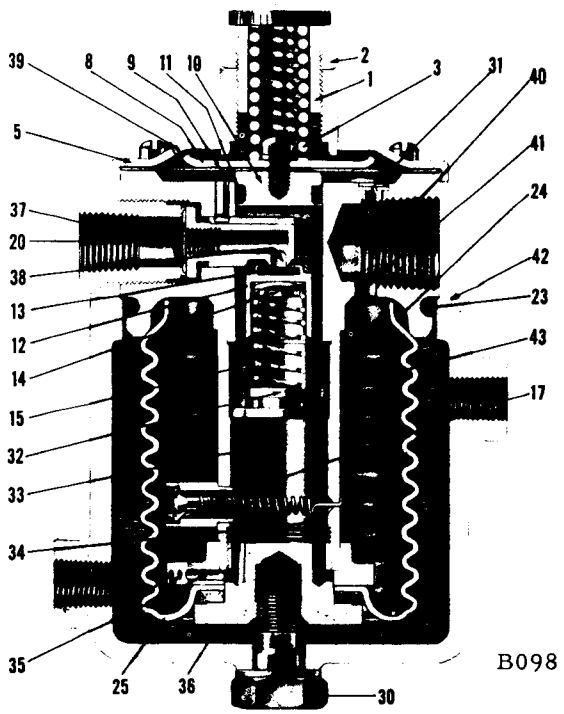


Figure 21

B. Operation. Fig. 21

When L.P.G. is allowed to expand and change to a gas in the vaporizer, an extreme drop in temperature occurs. Unless external heat were supplied, freezing would occur and the process would stop. The vaporizer chamber is therefore surrounded by a water jacket through which heated water from the engine cooling system is circulated. Heat, absorbed through the walls, permits the expansion process to continue and assures uniform delivery of vaporized fuel from the system.

Liquid fuel at tank pressure enters the vaporizer through the inlet (37), and is admitted through the inlet orifice (38). The inlet valve seat (13) is assembled in the seat retainer (12). The seat retainer assembly is held against the inlet orifice by the spring button (14) as a result of the pressure of the seat retainer spring (15) which, in turn, is supported by the spring base spool (32). Above the seat retainer assembly and operating in the same inlet cylinder is the

piston (10) fitted with an O-ring (11) and attached to the high pressure diaphragm (9) by means of a screw through the diaphragm plate (8). One side of the diaphragm chamber is vented to the atmosphere through the vent hole (39) in the diaphragm cover (5).

The pressure existing in the vapor outlet (41) is transmitted to the underside of the diaphragm through the vent channel (31). The tension of the regulator spring (3) is adjusted by turning the adjusting bonnet (1) clockwise to increase the tension and counterclockwise to decrease the tension. It is locked in the desired position by the locknut (2).

The liquid fuel enters the cold chamber (33) from which it flows through the outlet channels (34) and is sprayed through swirl discharge channels (35) against the inner surface of the heat exchanger shell (25). As the droplets of fuel contact this shell, which is surrounded by water (36) from the engine cooling system, the heat is absorbed from the water and the fuel changes to a dry vapor in the chamber (43).

Leakage of fuel is prevented by means of an O-ring (24). The vapor passes through the opening (41) and then through the outlet (40) to the secondary regulator. When the vapor pressure builds up, the pressure is transmitted through the orifice (31) against the diaphragm (9). If this pressure exceeds the pressure for which the adjustment is set, the inlet orifice is restricted by movement of the piston (10) and seat retainer assembly (12).

When the vaporizer is mounted horizontally, the swirl discharge holes are fewer and are located on the lower side of the cold chamber. This insures relieving the cold chamber of its wet fuel and by so doing the delivery is stabilized. If the flow demand becomes greater than the capacity of the discharge by 6 PSI, (pressure drop from the cold chamber section) the relief valve (17), which is also located on the lower side, will supply this additional flow.

Rapid closing of the throttle, with resulting reduction in fuel demand, causes expansion of the trapped vapor in the heat exchange (43) due to extended contact with the heated surface of the shell (25). The resulting increase in pressure tends to return the vapor back into the sub-zero cold chamber (33) through the swirl discharge channels (35) located at the lower side of the heat exchanger shell (25). Through this action, the fuel re-condenses at the lowered temperature to a wet gas. This avoids an excessively high fuel delivery pressure on reopening the throttle.

The vaporizer assembly is encased in a water jacket housing (42). Water cannot leak out because of the O-ring (23). The vaporizer and housing are held together by the assembly bolt (30).

C. Removal

1. Shut off fuel tank valve and drain radiator to below cylinder head level.

2. Disconnect wire from solenoid.

3. Remove hose from filter to solenoid, upper radiator hose and hose from primary regulator or hose from secondary regulator to carburetor, whichever the case may be.

NOTE: If secondary regulator is mounted on the primary regulator, unscrew the secondary regulator from the primary regulator.

4. Disconnect by-pass from housing base. Unscrew mounting nuts.

5. Lift vaporizer from the engine. The solenoid is also removed with this unit. Fig. 18.

D. Disassembly

Refer to fig. 22 for parts identification and follow the steps as outlined below.

1. Back off the assembly bolt located at the underside of the water jacket one or two turns. Tap the bolt sharply with a soft-nosed hammer to free the vaporizer assembly from the water jacket. Remove the bolt and washer.

2. To remove the corrugated heat exchanger, clamp the vaporizer head in a vise and remove the 1-1/4" brass nut with a thin wall socket wrench.

3. Remove the inlet valve seat retainer and the aluminum washer from the inlet valve seat bore.

4. Loosen the locknut on the adjusting screw and turn this screw all the way down to depress the inlet valve seat. The valve seat in its normal

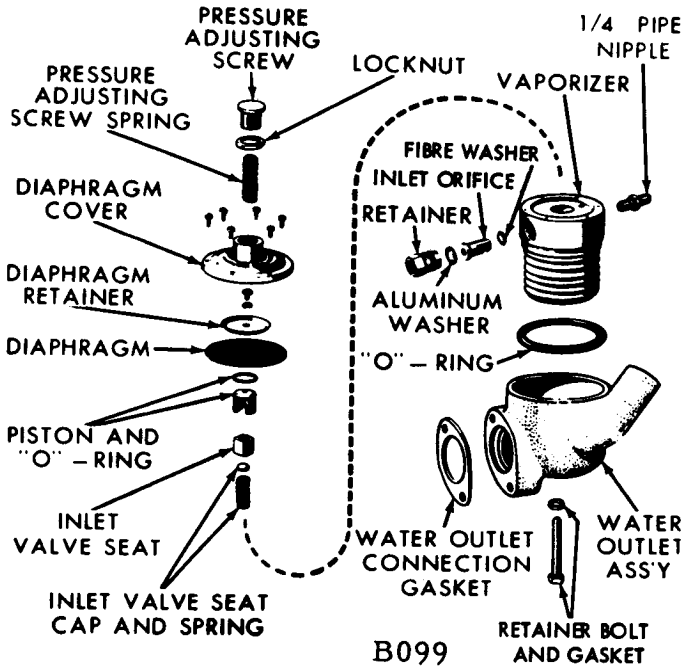


Figure 22

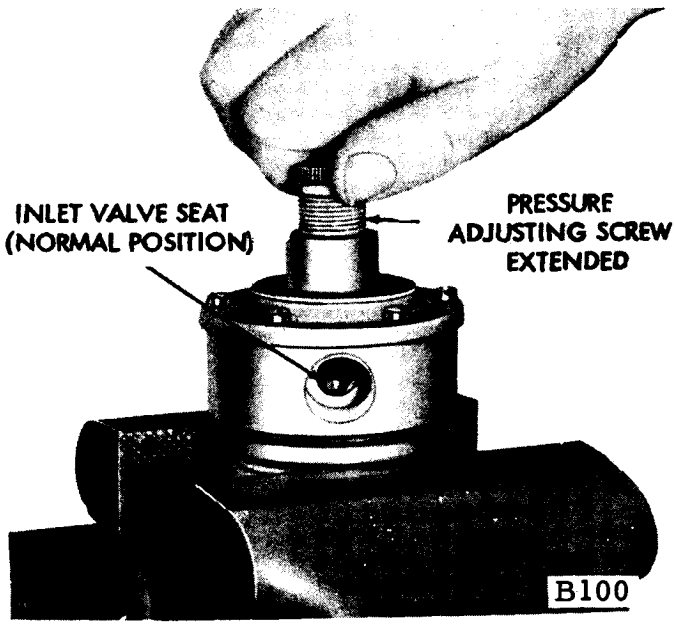


Figure 23

position interferes with the removal of the inlet valve. Fig. 23.

5. Screw a 1/4 - 20 bolt into the inlet seat, fig. 24, and remove the valve.

CAUTION: The spring-loaded inlet valve seat must be fully depressed during this operation to

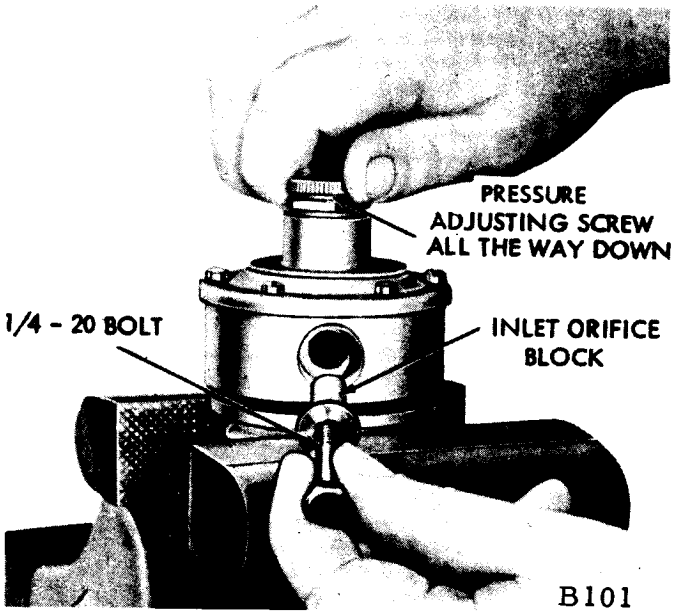


Figure 24

prevent damage to both the seat and valve parts.

6. Remove the pressure adjusting screw and spring.

7. Remove the six diaphragm cover screws and the diaphragm cover.

8. Lift the rubber diaphragm with the assembled piston from the bore. Fig. 25. Remove the screw that secures the diaphragm with the assembled piston from the bore. Fig. 25. Remove the screw that secures the diaphragm and retainer to the piston and discard the diaphragm.

9. Invert the vaporizer assembly and remove the inlet valve seat, spring and spring cap.

10. Remove the large O-ring from its groove on the outside of the vaporizer housing.

E. Inspection

Check the condition of the inlet valve. Replace if it is damaged at the orifice shoulder.

Check the inlet valve seat. If the neoprene disk is damaged or badly worn, replace the entire unit.

F. Assembly

1. Position a new diaphragm over the piston and lay the retainer (flange up) on the diaphragm. Secure these units with the diaphragm screw,

Figure 25

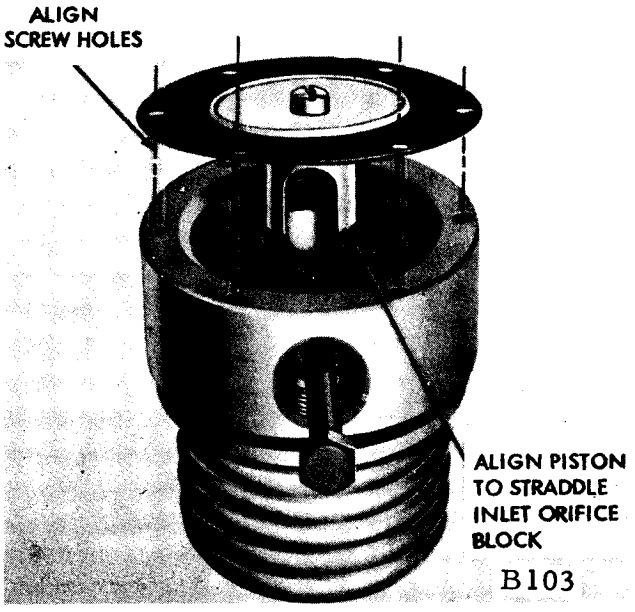


Figure 26

but do not tighten at this time.

2. Insert the inlet valve into its bore temporarily. This valve has a slot and rides on a dowel pin located in the bore to prevent the valve from being installed improperly.

3. Position the assembled diaphragm and piston into the bore so that the piston straddles the inlet valve without rubbing against it.

4. Align the six screw holes of the diaphragm with the holes in the vaporizer head and tighten the diaphragm screw. Hold the diaphragm and retainer to keep them from moving when tightening the screw. Fig. 26.

5. Remove the assembled diaphragm and piston plus the inlet valve from their respective bores after proper alignment has been determined.

6. Place the spring button on the spring and insert the button end of the spring into the inlet valve seat. Assemble these units into the bore as shown in fig. 27.

7. Install the assembled diaphragm and piston into the bore after replacing the O-ring on the piston. Coat the seal with a light film of oil

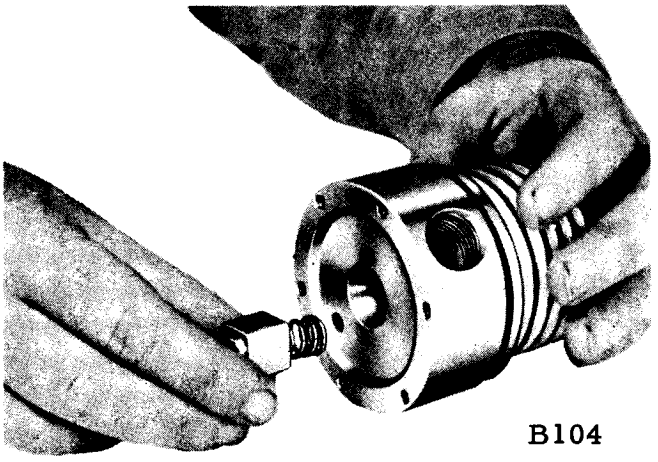


Figure 27

for easier installation. Recheck the piston alignment by sighting into the inlet valve bore. The yoke of the piston should line up with the inlet valve bore, and the six diaphragm holes should align with the holes in the top of the vaporizer.

8. Replace the cover over the diaphragm and secure it with the six cover screws. Place the adjustment screw spring into the bore through the top of the cover and install the adjusting screw and locknut.

9. Turn the adjusting screw all the way in to depress the inlet seat.

10. Install a new O-ring on the inlet valve and insert the valve in the bore using the slot as a guide. Remove the 1/4 - 20 bolt from the assembled valve.

11. Place a new aluminum washer into the valve bore. Thread the inlet valve seat retainer into the bore and tighten. Install a new large O-ring in the groove on the outside of the vaporizer assembly.

12. Insert the heat exchanger into the vaporizer head and install fibre washer and 1-1/4" brass nut. Tighten securely with thin wall socket wrench.

F. Adjustment

The vaporizer assembly must be adjusted for a working pressure of 12 PSI (Gauge Pressure) at each overhaul and at any time the pressure adjusting screw is moved.

1. Place the assembly in a vise or suitable clamp and connect to air hose which will apply approximately 75 PSI to the inlet connection.

2. Connect a 0 to 30 or 0 to 50 lb. pressure gauge to the outlet. Fig. 28.

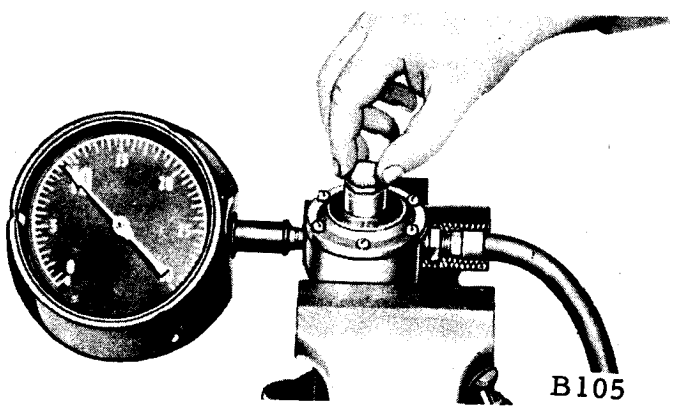


Figure 28

3. Back off the vaporizer adjusting screw until only one or two threads are holding the screw in the cover and apply air pressure to the unit.

4. Turn the pressure adjusting screw in slowly until a reading of 10 PSI shows on the gauge.

NOTE: To obtain an accurate gauge reading, it may be necessary to unscrew the gauge partially to bleed off some of the air. Retighten the gauge and readjust for 10 PSI. If gauge reading remains steady, the valve is not leaking. If pressure reading creeps up, it indicates a leaking valve. It will be necessary to check the components of the vaporizer for correct assembly procedures, or replace valve parts as needed.

5. With everything connected and adjusted as above, apply soapy water to the vent hole in diaphragm cover. Bubbles will appear if the diaphragm is leaking.

6. After the proper adjustment has been made, tighten the locknut on the pressure adjusting screw. Turn off the air pressure and disconnect the gauge and air line.

SECONDARY REGULATOR

A. General

The secondary regulator is located between the primary regulator and the carburetor of the L.P.G. fuel system.

It can be compared with the needle-seat assembly of a gasoline carburetor, because its function is to control the amount of fuel entering the carburetor.

B. Operation

The operation of this regulator is simple and effective. The outlet opening is connected to the carburetor. The fuel supply to the regulator is connected into the inlet orifice connection.

A depression or low pressure is created in the carburetor venturi. This lowered pressure is transmitted to the regulator through the outlet opening and this pressure then exists in the chamber of area between the regulator diaphragms. The diaphragms are then pushed inward by the higher atmosphere pressure transmitted through the vent holes in the regulator covers.

Connected to the diaphragm is an arm which moves as the diaphragm moves. As the diaphragm moves inward, the arm pushes against the leaf springs. This causes the springs to bend. As they bend the valve assembly is drawn off the inlet orifice.

The fuel is then admitted through the inlet orifice.

The leaf springs are attched to a stationary boss at the adjustment end and to the inlet valve block at the other. A rod extends from the valve through the body of the regulator and into the adjustment cap boss. Within this boss is a disc which receives the end of the rod. Between this disc and the regulator adjusting cap is a spring. The force of this spring is increased by turning the cap clockwise. This spring is a balance against the force of pressure on the inlet valve seat. This construction permits a minimum of depression to cause the valve to open and supply fuel to the engine.

C. Removal

See Vaporizer – Primary Regulator Removal.

D. Disassembly. Fig. 29.

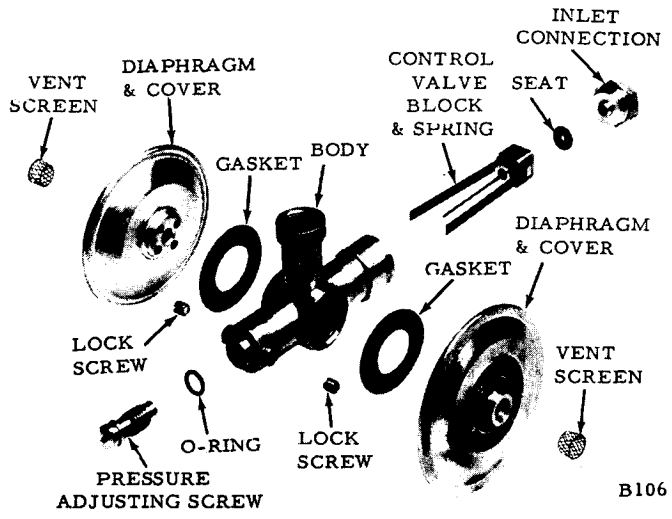


Figure 29

1. Remove diaphragm assemblies by turning counterclockwise.

2. Remove inlet orifice.

3. Remove regulator adjusting screw.

4. Remove both leaf spring retainer screws.

5. Remove valve block and spring assembly, do not take this assembly apart.

E. Cleaning and Inspection

Clean all parts except diaphragms with solvent.

Clean diaphragm covers by wiping with a cloth.

Check diaphragms for leaks as follows: Remove screen from vent opening in diaphragm cover. Blow into vent opening to extend plunger and then seal opening with thumb. Press on extended plunger, if diaphragm is leaking, plunger can be pressed in and will stay in. If resistance is felt and plunger springs back out upon being released, diaphragm is not leaking.

Discard all worn or damaged parts.

F. Assembly

1. Install a new regulator valve seat. Fig. 30.

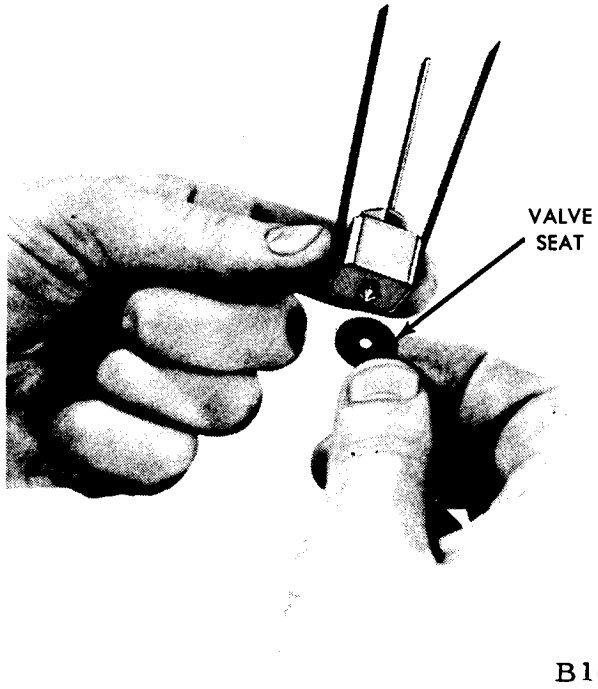


Figure 30

2. Insert block, spring, and valve assembly in regulator body, making sure that ends of leaf springs enter their respective slots in regulator body and are visible through leaf spring retainer screw holes. Fig. 31.

3. Install and tighten inlet orifice. Fig. 32.

4. With O-ring seal lightly lubricated, use finger pressure only to screw regulator adjusting screw into regulator body. Fig. 33.

NOTE: If resistance is felt, it indicates that

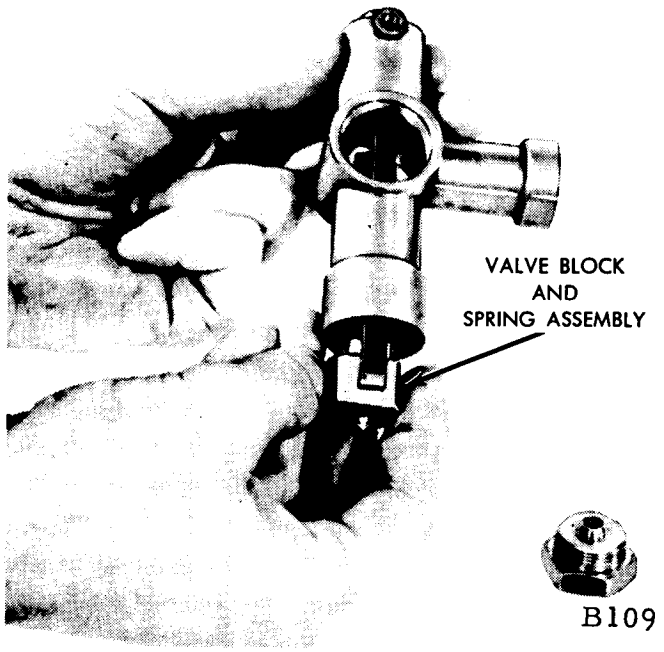


Figure 31

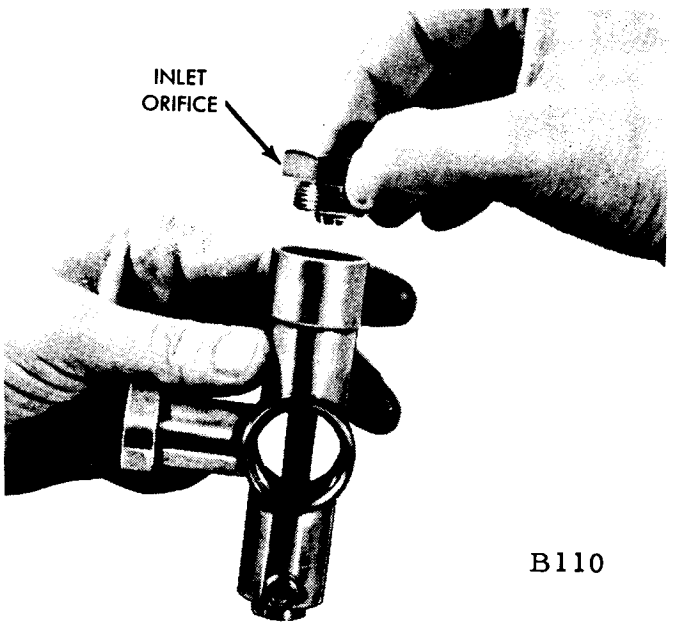


Figure 32

round valve rod has not entered hole in center of regulator adjusting screw. In this event, remove regulator adjusting screw and try again until screw can be turned in by hand until slotted head is almost flush with body.

5. Seat adjusting screw, lightly, with screw driver. Final setting will be given in adjustment procedure.

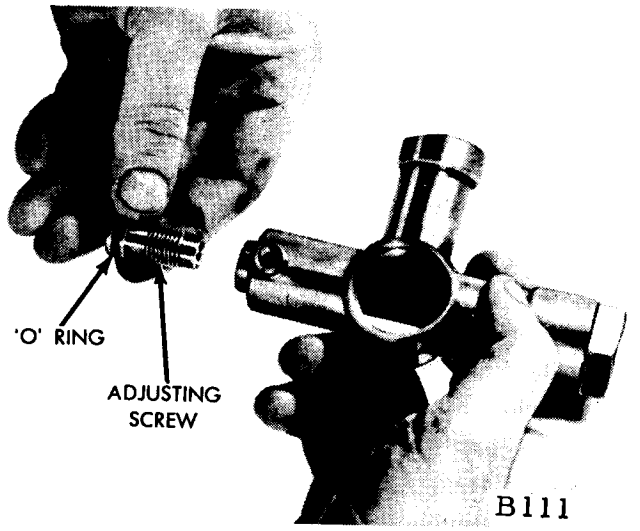


Figure 33

6. Insert leaf spring gauge set, part number Zenith C161-189, and hold in position while installing and tightening leaf spring lock screws. Fig. 34 and 35. Do not tighten excessively.

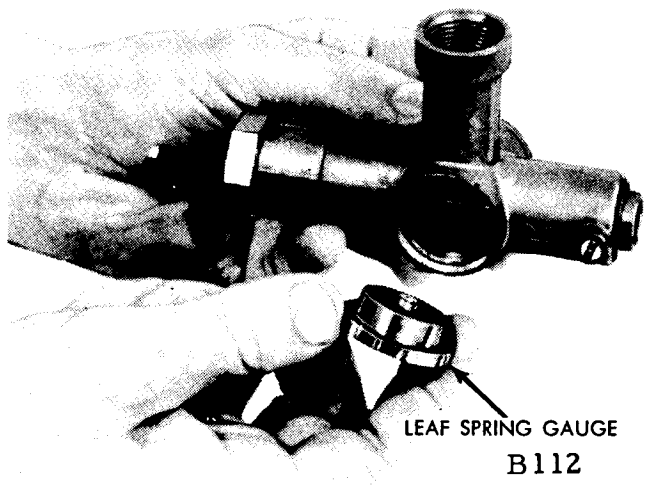


Figure 34

NOTE: See fig. 36 for gauge dimensions.

7. Install and tighten by hand both diaphragm assemblies. Use new cover-to-body gaskets when assembling. Fig. 37.

F. Leak Test

1. Connect air or gas at 12 PSI to regulator inlet.

NOTE: A previously adjusted vaporizer can be used as a source of air or gas at 12 PSI.

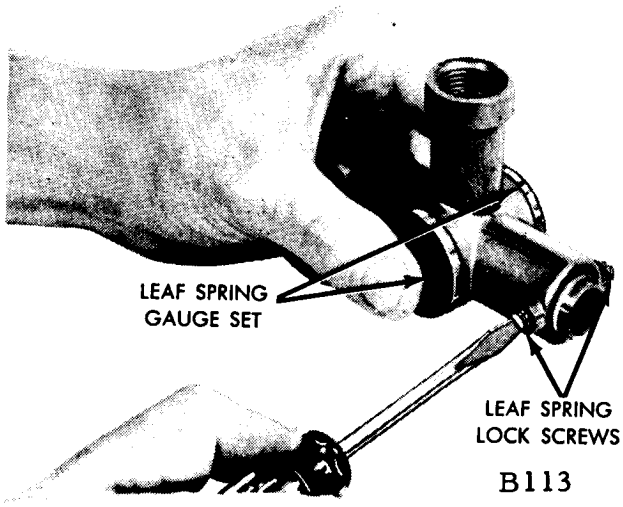


Figure 35

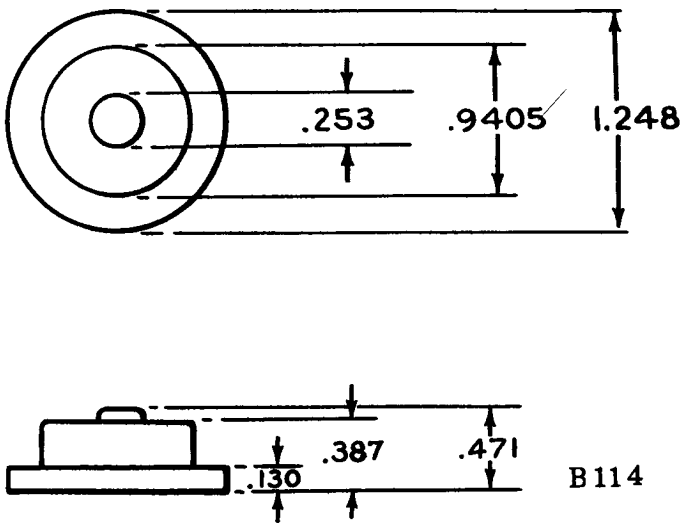


Figure 36

2. Apply soapy water to the regulator outlet. A leaking regulator valve will be indicated by an expanding bubble at regulator outlet. Fig. 38.

3. If regulator valve leaks, disassemble regulator and clean or replace valve parts as needed, then recheck for leak.

G. Adjustment

Adjustment settings can vary, check specifications. Following is a procedure for setting regulator valve to open at approximately 1/2 inch water vacuum:

1. Connect air or gas at 12 PSI to regulator inlet.

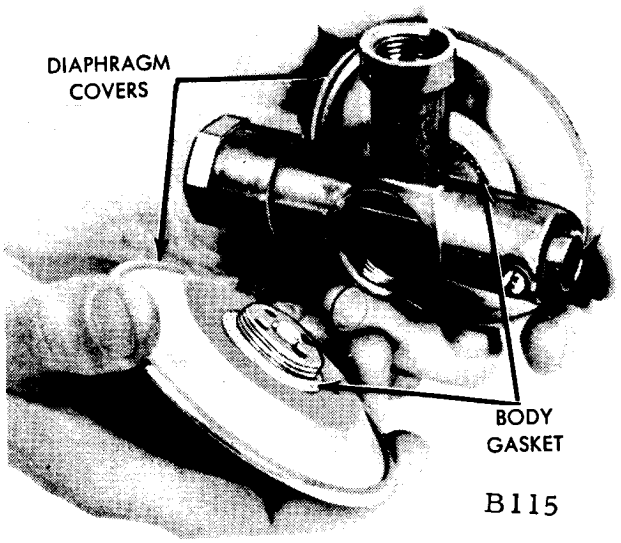


Figure 37

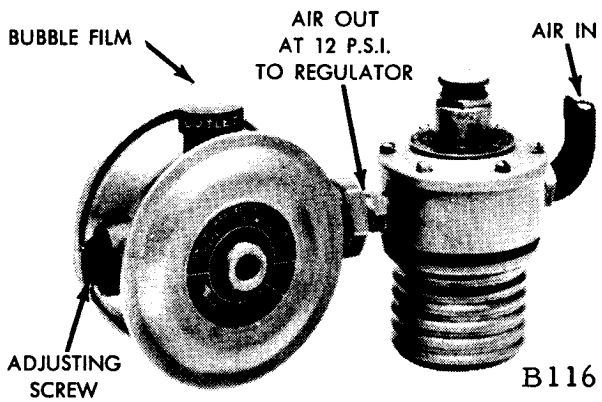


Figure 38

2. Seat adjusting screw, lightly, with a screw driver.

3. Cover regulator outlet with soapy water, then slowly back out regulator adjusting screw by turning counterclockwise until regulator just begins to leak. Point of leak will be indicated by a slowly expanding bubble at regulator outlet.

4. Find point of leak and turn regulator adjusting screw to right (clockwise) 3/4 to one turn from this position.

5. After setting as indicated above, blow sharply into diaphragm breather hole. This will open and reset inlet valve. Repeat several times and recheck setting as in Items 3 and 4.

CARBURETOR

A. General. Figs. 39 and 40

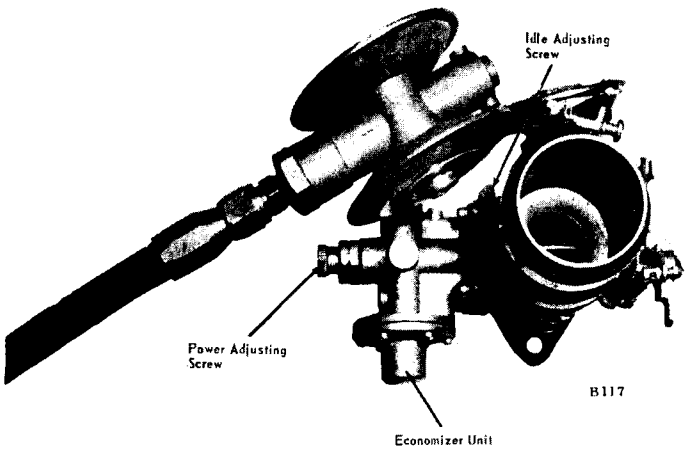


Figure 39

The only service instructions required will be those concerning adjustments. Should replacement of parts with a repair kit be required, disassembly procedures are simple enough not to warrant specific instructions.

B. Removal

Remove air inlet boot, disconnect throttle, choke and governor linkage at carburetor, electric wire to vacuum switch, and two carburetor mounting nuts.

C. Adjustment

Connect a vacuum gauge to the intake manifold by means of a tee installed between the vacuum switch and the carburetor. Install an exhaust gas analyzer and connect a tachometer to the engine. Start and run the engine until it reaches normal operating temperature. The idle adjusting screw is for adjusting idle fuel only. Rotate the screw clockwise for a richer mixture and counterclockwise for leaner mixture.

Rotate the idle adjusting screw until the highest steady vacuum is registered on the vacuum gauge at the desired engine idle speed. To obtain a minimum of carbon monoxide content in the exhaust gas, lean mixture until a decrease of approximately one-half inch of mercury is observed on the vacuum gauge. The exhaust gas analyzer will indicate an air-fuel ratio of 14.0:1 to 14.7:1 (13.4:1 to 14.0:1 on the gasoline scale). Correct engine idle speed must be observed. Adjust the throttle stop screw on the carburetor to correct the idle speed. Recheck mixture after correcting idle speed.

Adjust the fuel adjusting needle on the carburetor to give an air-fuel ratio of 14.0:1 to 14.7:1 (13.4:1 to 14.0:1 on gasoline scale) with engine at governed RPM. The best setting for maximum economy and minimum carbon monoxide is obtained when the adjustment is leaned sufficiently to cause a drop of approximately one-half inch of mercury as indicated on the vacuum gauge. The power adjustment can be made when the engine is operating at approximately three-fourths full load. The following procedure may be used for trucks equipped with torque converter:

1. Have available a timing light, vacuum gauge and electric tachometer.

2. Set the timing by adjusting to the highest vacuum at low idle speed with the truck in neutral.

3. Check the timing with a timing light to see if it reads according to engine specifications. Add two to four degrees advance for L.P.G.

4. Set the idle fuel mixture adjustment to the highest possible vacuum reading at the specified idle speed.

(Powershift models only) Adjust the power adjustment to the highest stall speed by watching the tachometer. To stall the truck, prevent the truck from moving and put it in the highest forward gear.

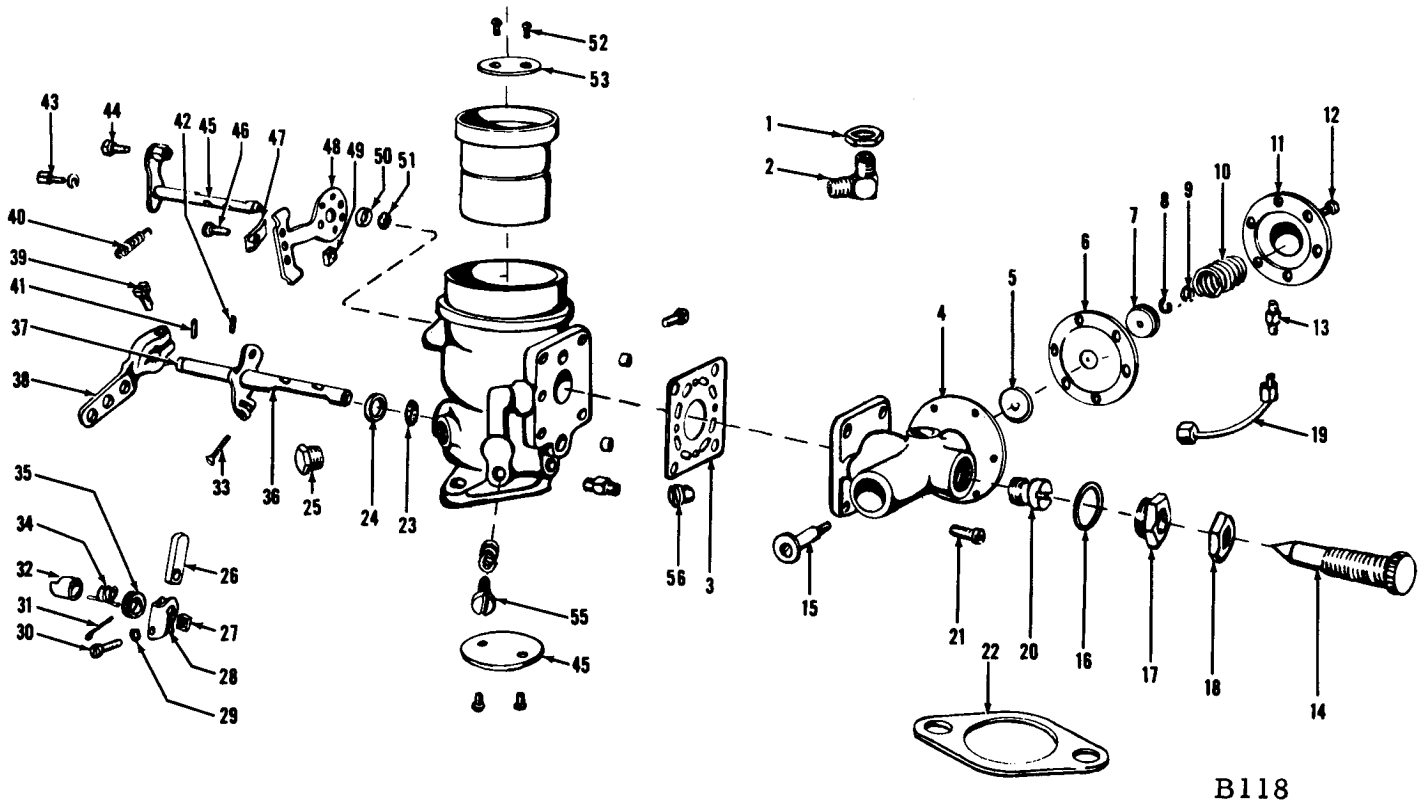
CAUTION: Do not overheat the transmission.

Tighten the locknut that secures the fuel adjusting needle. Recheck the idle adjustment, then accelerate the engine several times. If the engine dies or hesitates on acceleration, the idle adjustment is set too lean.

IGNITION TIMING ADJUSTMENT

1. Extreme care must be exercised in changing the initial ignition timing. The recommended setting used for premium grade gasoline will generally produce the most satisfactory results.

2. An engine that has been modified by increasing the compression ratio may require



1. Locknut
2. Outlet Elbow
3. Gasket
4. Metering Control Housing
5. Valve Stop
6. Diaphragm
7. Spring Guide
8. Lockwasher
9. Valve Nut
10. Diaphragm Spring
11. Diaphragm Cover
12. Screw
13. Tube Union
14. Adjusting Needle
15. Power Jet Valve
16. Washer
17. Screw
18. Locknut
19. Vacuum Control Line
20. Main Jet
21. Screw
22. Flange Gasket
23. Washer
24. Retainer
25. Plug
26. Lever
27. Nut
28. Lever
29. Washer
30. Screw
31. Cotter Pin
32. Driver
33. Screw
34. Spring
35. Retainer
36. Stop Lever and Shaft
37. Shaft
38. Clamp Lever
39. Screw
40. Spring
41. Pin
42. Taper Pin
43. Screw, Lockwasher
44. Screw
45. Shaft and Lever
46. Screw
47. Clamp
48. Bracket
49. Nut
50. Retainer
51. Nut
52. Plate Screw
53. Air Shutter
54. Throttle Plate
55. Idle Adjusting Screw and Spring
56. Power Jet

Figure 40

that the initial setting be retarded as much as ten degrees in some cases.

3. If the ignition is too far advanced, the engine will be rough during acceleration, operation under wide open throttle or full load condition, although detonation will not be observed unless the carburetor is set extremely lean.

ECONOMIZER. Figs. 39 and 40

Is mounted on the side of the carburetor. No service instructions are required.

TROUBLESHOOTING GUIDE

ENGINE

Cause	Remedy
Hard Starting	
1. Crankcase oil too thick or dirty	1. Replace oil with that of lower viscosity. Replace oil with clean oil.
2. No fuel at the carburetor	2. Refer to "No Fuel at the Carburetor."
3. Air cleaner element dirty	3. Clean or replace element. Service air cleaner more often.
4. Ignition system faulty	4. Repair and adjust the ignition system as necessary.
5. Improper carburetor operation	5. Re-adjust idle speed. Re-adjust choke valve. Check idle adjustment spring, install new one, if necessary.
Poor Idling	
1. Air leak at the intake manifold or carburetor mounting	1. Tighten mounting nuts. Replace gaskets, if necessary.
2. Air cleaner element dirty	2. Clean or replace element. Service air cleaner more often.
3. Secondary regulator faulty	3. Seat or replace diaphragm.
4. Faulty carburetor operation	4. Adjust idling. Check and install new idle adjustment spring, if necessary.
5. Ignition system faulty	5. Repair and adjust ignition system as necessary.
6. Oil in regulator or vapor line	6. Clean components, as necessary.
No Fuel At Carburetor	
1. Fuel tank empty	1. Refill tank or replace empty tank with a full one.
2. Tank shut-off valve closed	2. Open valve.
3. Tank relief valve sticking	3. Free-up or replace.
4. Faulty electrical circuit	4. Clean and tighten connections. Repair or replace defective wires. Replace fuse.
5. Dirty fuel filter	5. Service as necessary.
6. Vacuum switch operation	6. Eliminate vacuum leaks. Clean vacuum line. Replace switch.
7. Restricted vapor line	7. Remove restriction. Replace line if defective.
8. Secondary valve stuck	8. Clean and repair valve as necessary.
9. Solenoid valve operation faulty	9. Refer to Cause 4 and repair or replace solenoid valve.
Poor Economy	
1. Leaking fuel lines and connections	1. Replace fuel lines. Tighten connections or replace if necessary.

Cause	Remedy
2. Secondary regulator diaphragm leakage	2. Replace the diaphragm assembly.
3. Power adjustment on carburetor improper	3. Adjust carburetor.
4. Defective fuel gauge or sender	4. Replace fuel gauge and sender.
5. Dirty spark plugs	5. Clean and gap spark plugs. Install new plugs, if necessary.
Engine Quits Running	
1. Restrictions in fuel lines	1. Straighten fuels. Remove internal restrictions. Replace defective lines.
2. Vacuum switch operation faulty	2. Eliminate vacuum leaks. Clean vacuum lines. Replace switch.
3. Dirty fuel filter	3. Service fuel filter.
4. Secondary regulator valve improperly adjusted	4. Repair and adjust secondary regulator valve, as necessary.
5. Improper idle adjustment	5. Adjust carburetor, as necessary.
6. Air cleaner element dirty	6. Clean or replace air cleaner element. Service air cleaner more often.
7. Faulty governor operation	7. Service governor as necessary.
Loss Of Power	
1. Improper carburetor adjustment	1. Adjust choke valve. Adjust power jet.
2. Air leak at intake manifold or carburetor mounting	2. Tighten mounting nuts. Replace mounting gaskets, if necessary.
3. Dirty air cleaner element	3. Clean or replace air cleaner element. Service air cleaner more often.
4. Faulty governor operation	4. Service governor as necessary.
5. Restricted muffler	5. Replace muffler.
Excessive Fumes	
1. Improperly adjusted carburetor	1. Make complete carburetor adjustment.
2. Oil in regulator or vapor line	2. Clean components as necessary.
3. Primary regulator operation faulty	3. Adjust regulator. Clean and replace parts as necessary.
4. Secondary regulator operation faulty	4. Repair and adjust secondary regulator valve as necessary.
CARBURETOR	
Engine Stalls	
1. Engine idle RPM too low	1. Re-adjust throttle stop screw to increase idle RPM.
Rough Idle	
1. Improper adjustment	1. Adjust carburetor.

Cause	Remedy
Poor Acceleration	
1. Improper adjustment	1. Adjust carburetor.
Excessive Fuel Consumption	
1. Improper adjustment	1. Adjust carburetor.
Leaking Inlet Valve	
1. Dirt or damaged valve	1. Replace or clean valve parts as necessary.
VAPORIZER-REGULATOR	
Leaking Valve	
1. Dirt or damaged valve	1. Install a 0-30 PSI gauge in one of the outlet openings of the regulator head. With engine running, gauge should read 9-11 PSI and remain steady. Repair as necessary.
Vaporizer-Regulator Pressure Too Low	
1. Rusted or defective diaphragm springs.	1. Remove unit and repair as necessary.
Gas Entering Cooling System	
1. Leaking heat exchanger or seals	1. Replace heat exchanger coil and rubber seals. Cooling system should be treated with a rust inhibitor.
Frost on Vaporizer-Regulator Head When Starting Cold Engine	
1. Failure to drill 1/4 inch hole in thermostat valve	1. Drill thermostat so as to obtain immediate circulation of water to coil when starting engine.
2. Engine overheating	2. Fill radiator to proper coolant level. Blow debris out of the radiator core. Check and replace thermostat, if necessary.
SOLENOID VALVE	
Valve Will Not Open	
1. Open circuit in solenoid winding	1. Replace solenoid valve.
2. Faulty ground	2. Install lead from lower (ground) terminal on valve to a good ground.
3. No current to valve	3. Disconnect existing lead from insulated terminal on valve. Connect a jumper from this terminal to a good source of battery current. If solenoid does not click, replace valve. If click is heard, check oil pressure lock-off switch.
Valve Operation Erratic	
1. Connected to coil side of a by-pass ignition resistor.	1. Reconnect to battery side of by-pass resistor.
Solenoid Winding Burns Up	
1. 6-volt solenoid connected to 12-volt source	1. Use solenoid valve designed for system voltage.

Cause	Remedy
Solenoid Valve Does Not Close When Ignition Is Turned Off	
1. Wrong direction of fuel flow through valve	1. Observe "IN" and "OUT" markings on valve when connecting.
OIL PRESSURE LOCK-OFF SWITCH	
Solenoid Valve Will Not Open Unless Connected Directly to Battery	
1. Damaged or inoperative oil pressure switch	1. Replace switch.
FUEL FILTER	
Does Not Filter Dirt	
1. Foreign matter disolved in liquid fuel settles out after vaporization	1. Check with fuel dealer regarding contaminated fuel.
QUICK CONNECT FITTING	
Fitting Leaks	
1. Faulty seals	1. Have fitting repaired by fuel dealer.

SPECIFICATION LISTING

Vaporizer Working Pressure	10 PSI
Carburetor Air-Fuel Ratio	14:1 to 14.7:1 (13.4:1 to 14:1 on gasoline scale)

Fuel Tank Capacity
28" I.C.C. — 33-1/2 lbs.
34" I.C.C. — 44-1/2 lbs.
A.S.M.E. — Fill tank until fluid appears at liquid level gauge
Fluid will appear in the form of a white spray.

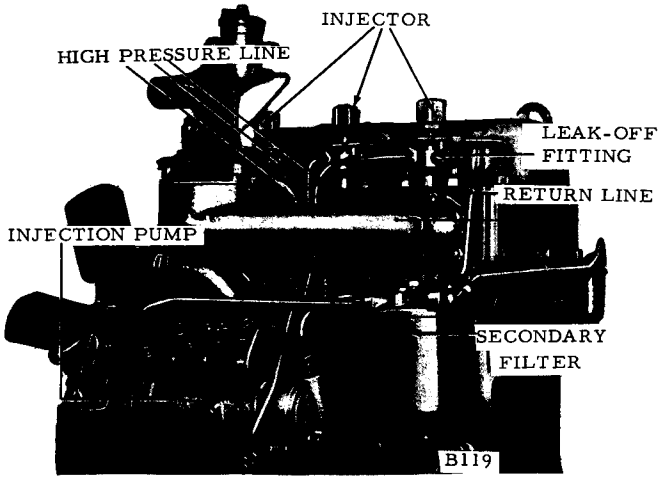


Figure 41

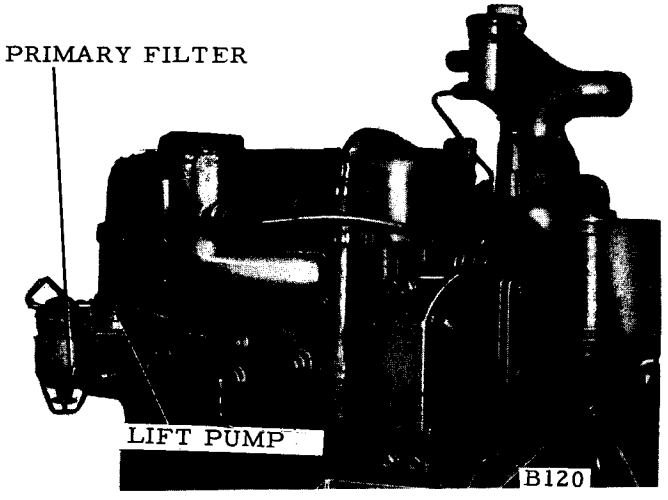


Figure 42

DIESEL FUEL SYSTEM

GENERAL. Figs. 41 and 42

The equipment for the supply, filtration and delivery of fuel to the engine cylinders comprises the following principal components:

1. Lift Pump.
2. Filters.
3. Injection Pump.
4. Injectors.

Fuel is drawn from the fuel tank through a prefilter by the lift pump and passed through the final filter by the injection pump. From the injection pump measured quantitles of fuel at the correct intervals are delivered through the fuel pipes and injectors into the engine combustion chambers.

Internal fuel leakage, needed for injector lubrication, and excess fuel from the injection pump are returned to the filter. Flexible lines return the fuel from injectors and a steel pipe returns the fuel from the pump. Fig. 41.

CAUTION: Absolute cleanliness is of the utmost importance. Overhaul of the injectors and injection pumps should not be attempted in a general work area. Use only lint-free rags for wiping the various parts.

FUEL FILTERS

A. General

Of all the factors on which satisfactory operation of a diesel engine depends, cleanliness of the fuel oil is the most important. The efficient operation and length of life of the fuel pump elements and of the injectors depends, first, on the use of clean fuel oil; second, the provision of suitable filters; third, attention to the filters.

Protection for the diesel engine is provided by the following filters, reading from the tank to the fuel pump.

(1) Primary (2) Secondary

B. Primary Filter. Fig. 43

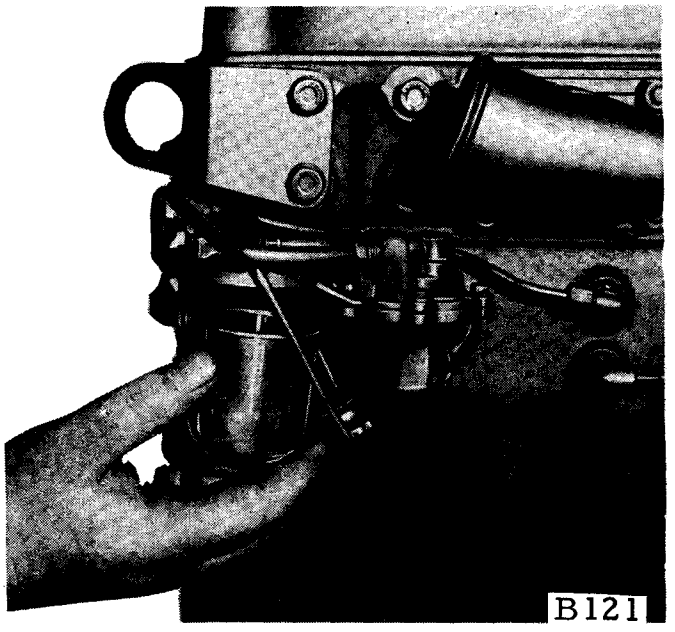


Figure 43

1. The main purpose of this filter is to protect the fuel lift pump. It has a comparatively coarse element that is contained in an easily removable bowl and should be cleaned every 100 hours. Fig. 44.

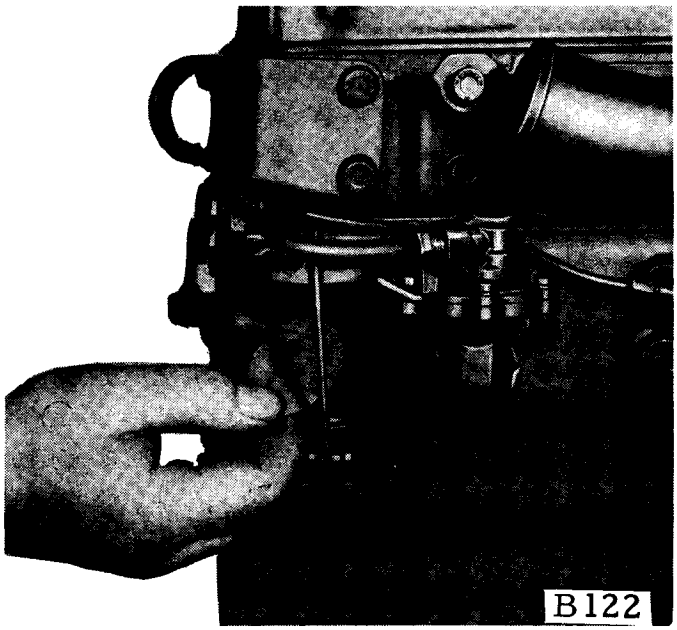


Figure 44

2. When re-assembling after cleaning, take care that a good seal is made between the top of the bowl and the filter body, as any leakage of air here, that is, on the suction side of the fuel pump, may cause air locks in the fuel system.

C. Secondary Filter

NOTE: It is not possible to clean the paper element in this filter.

1. Unscrew the bolt in the center of the top filter cover. Fig. 45.

2. Drop filter bottom cover clear. Fig. 46.

3. Remove the element and discard.

4. Before putting the new element into position, clean the filter top and bottom covers.

5. Insure that the rubber gaskets are in good condition; if not, replace.

NOTE: Whenever the filters are serviced, it is necessary to bleed the system to remove any air entrained in the fuel system.

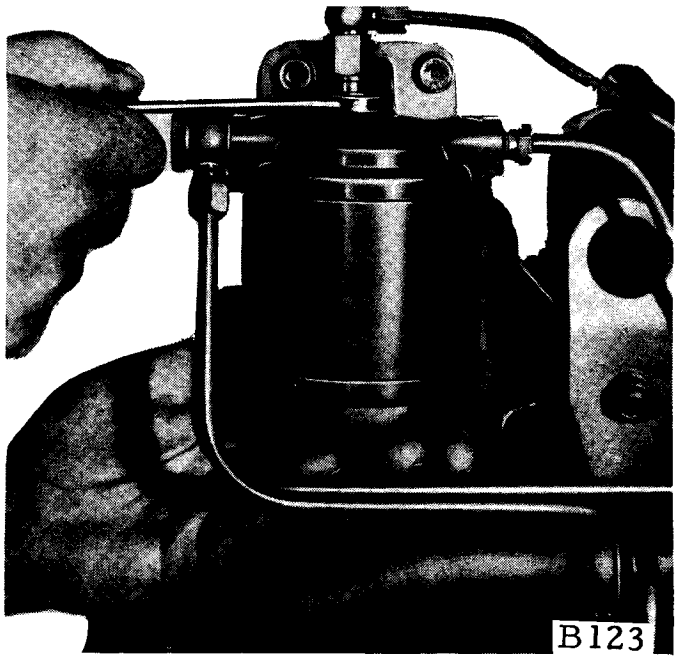


Figure 45

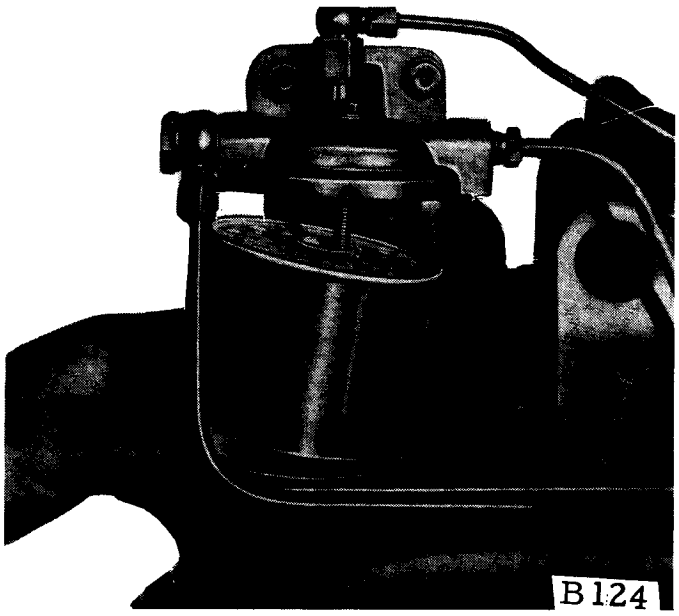


Figure 46

BLEEDING THE SYSTEM

A. In the case of a new engine or an engine which has been standing idle for any length of time, it is important that the fuel system be "bled". A typical fuel system is shown in fig. 47.

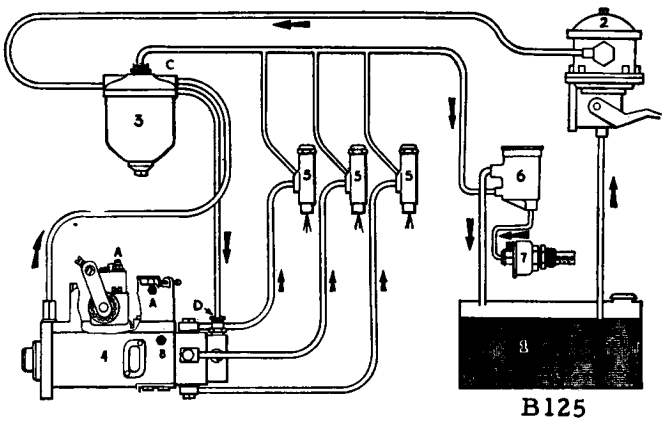


Figure 47

B. To bleed the system, proceed as follows:

1. Loosen the air vent screw (A) on the top of the control gear housing.

2. Loosen one of the two hydraulic head locking screws (B) on the side of the pump body.

3. Unscrew, by two or three turns, the vent plug (C) on the top of the filter cover (not the return pipe to the tank).

C. Operate the priming lever of the feed pump, and whenfuel, free from air bubbles, issues from each venting point, tighten the screws in the following order:

1. Filter cover vent screw (C).
2. Head locking screw (B).
3. Governor vent screw (A).

D. Loosen the pipe connection nut (D) at the pump inlet, operate the priming device and retighten when oil, free from air bubbles, issues from around the threads.

E. Loosen the connections at the injector ends of two of the high pressure pipes.

F. Set the engine speed control at the fully open position and insure that the "stop" control is in the "run" position.

G. Turn the engine until fuel oil, free from air bubbles, issues from both fuel pipes.

H. Tighten the connections on the fuel pipes, and the engine is ready for starting.

LIFT PUMP

A. General

The lift pump is of the mechanical diaphragm type, mounted on a boss centrally placed on the camshaft side of the cylinder block. Fig. 42.

The upper half of the pump body carries the inlet and outlet valve assembly and incorporates a gauze filter screen and sediment chamber.

The spring loaded diaphragm, in the lower half of the body, is operated by the pump rocker arm riding on an eccentric on the engine camshaft, manual pump operating being possible through an externally fitted hand primer lever.

The hand priming lever is used to facilitate initial priming of the fuel system or to "bleed" air from the system.

B. Servicing

If it becomes necessary to remove the lift pump, fig. 48, do so carefully. Do not bend the pipe to facilitate easier removal. Cap or plug all openings made in the fuel system.

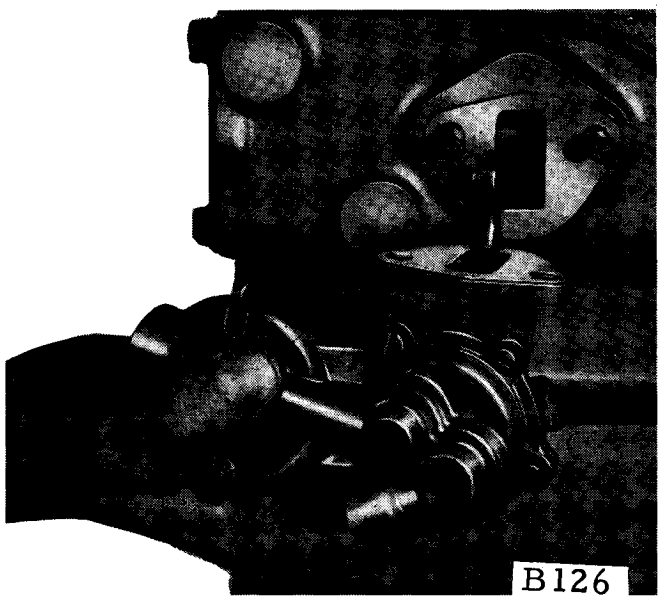


Figure 48

To aid in disassembling and assembling of the pump, refer to fig. 49. Mark the relationship be-

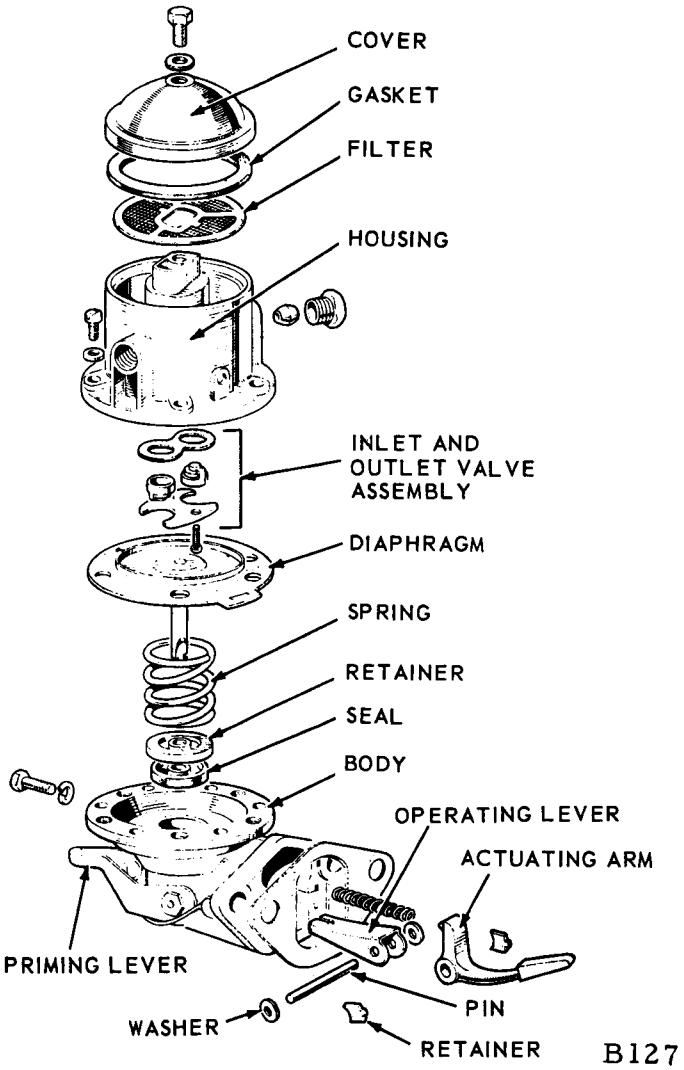


Figure 49

tween the housing and the body before separating them.

INJECTION PUMP

A. General

The fuel injection pump is secured to the back of the timing case on the left-hand side of the engine and the fuel pump driving gear is securely attached to the shaft of the pump by three setscrews. The location of the gear to the pump shaft is determined by a dowel.

On the timing case front cover is a small inspection cover forming an oil filter body and strainer. Removal of this oil filter inspection cover gives access to the setscrews securing the driving gear to the pump.

B. Removal

1. Turn the engine to T.D.C. No. 1 cylinder on compression.

2. Remove the fuel pipes to the pump and blank off all ports against the ingress of dirt.

3. Remove the throttle and stop controls from the governor housing of the pump.

4. Remove the inspection cover from the timing case front cover.

5. Remove the inspection plate from the side of the timing case and wedge the fuel pump drive gear in position to prevent it falling out of mesh when the three securing setscrews are removed.

6. Carefully remove the three setscrews and care must be exercised in removing these setscrews, for should one be dropped into the timing case, considerable time and labor would be involved in recovering it. Fig. 50.

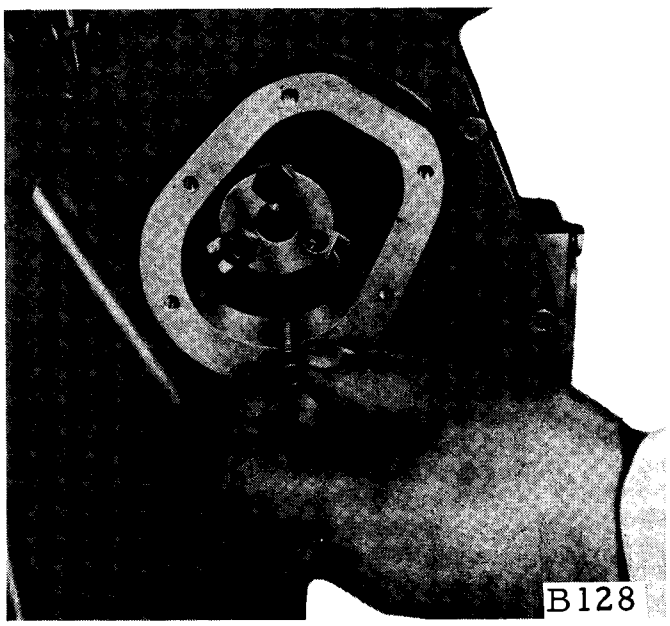


Figure 50

7. Release and remove the three nuts, plain and spring washers securing the flange of the fuel injection pump to the back of the timing case.

8. Remove the fuel injection pump. Fig. 51.

NOTE: Never loosen one end of a fuel pipe leaving the other end tight. Always remove the pipe entirely.

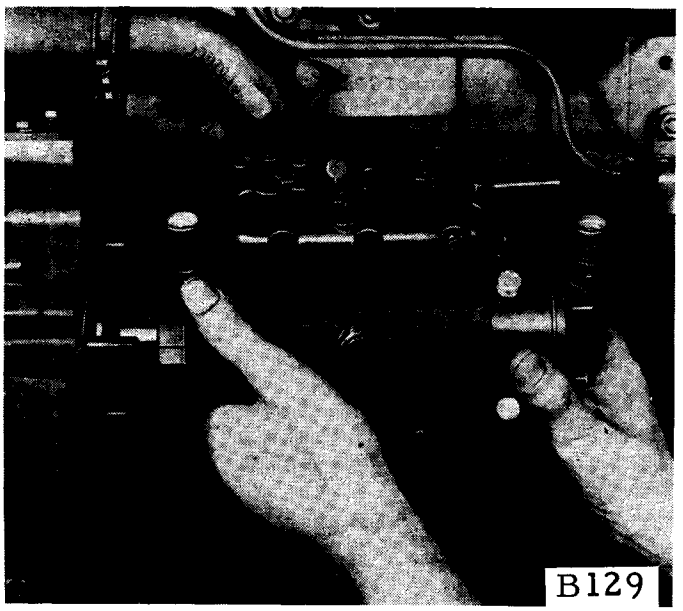
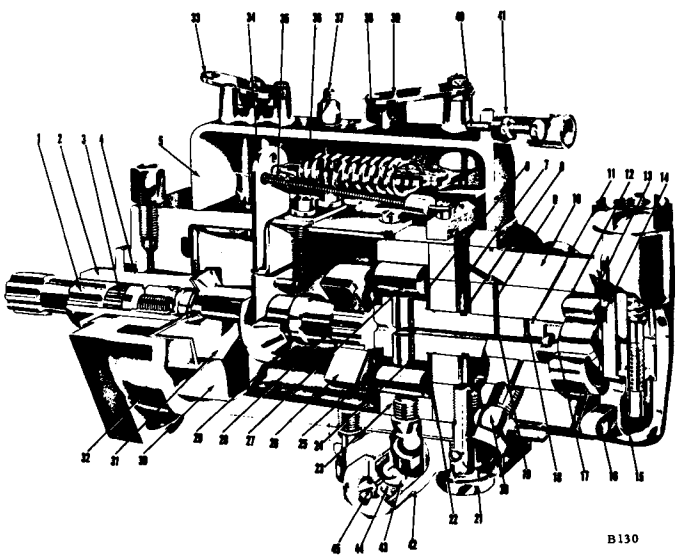


Figure 51

NOTE: Do not attempt to overhaul the pump unless proper test facilities are available.

C. Disassembly. Fig. 52



1. Input Shaft
2. Driving Hub
3. Socket Head Screw
4. Oil Seal
5. Cover
6. Adjusting Plate
7. Metering Valve
8. Metering Valve Chamber
9. Metering Port
10. Hydraulic Head
11. Pumping and Distributing Rotor
12. Liner
13. Seal
14. Transfer Pump Rotor
15. End Plate
16. Bolt
17. Transfer Pump Blade
18. Distributing Port
19. Inlet Port
20. High Pressure Fitting
21. Head Locating Fitting
22. Shoes
23. Cam Ring
24. Plunger
25. Adjusting Plate
26. Drive Plate.
27. Cam Rollers
28. Drive Shaft
29. Thrust Sleeve
30. Carrier
31. Governor Weight
32. Housing
33. Shut-off Lever
34. Governor Control Arm Port
35. Hook Lever and Spring
36. Governor Spring
37. Stud and Nut
38. Low Speed Adj. Screw
39. Throttle Lever
40. High Speed Adj. Screw
41. Securing Sleeve
42. Automatic Advance
43. Advance Piston
44. Spring
45. Adjusting Screw

Figure 52

1. Extract the splined shaft. Remove the inspection plate, and drain the pump. Attach the pump to a holding fixture. Fig. 53. Unscrew the nut retaining the shut-off and throttle levers. Lift the levers and lockwashers off the shafts. Fig. 54.

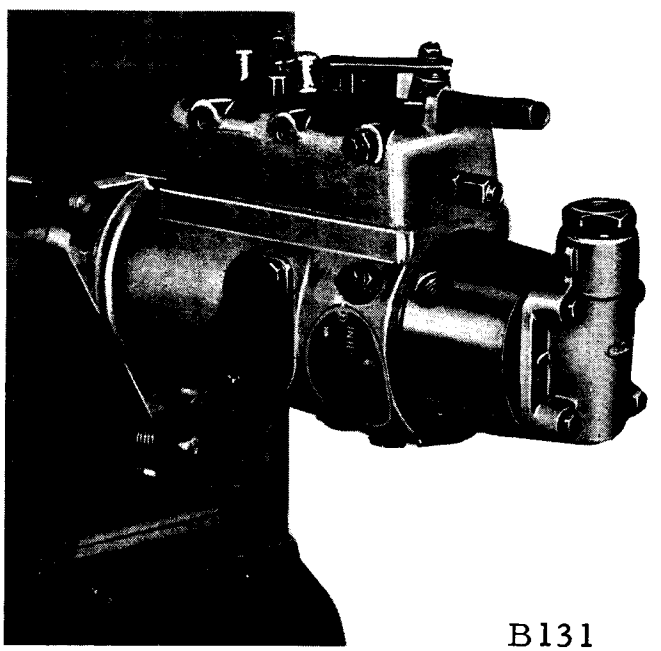


Figure 53

2. Unscrew the two acorn nuts securing the governor housing and lift off the lockwashers. Lift the governor housing off the pump while pushing down on the throttle lever shaft.

3. Straighten the tabs on the washers locking the two governor control cover studs. Unscrew the studs, and remove the keeper plate. Unscrew the small screw securing the governor bracket.

4. Lift off the governor linkage, together with

the metering valve (7) and shut-off arm. Fig. 54. Disconnect the metering valve from the hooked lever. Immerse the metering valve in clean fuel oil to protect it. Note through which governor arm hole the spring guide passes and in which link hole the governor spring is hooked; then, disassemble the governor linkage.

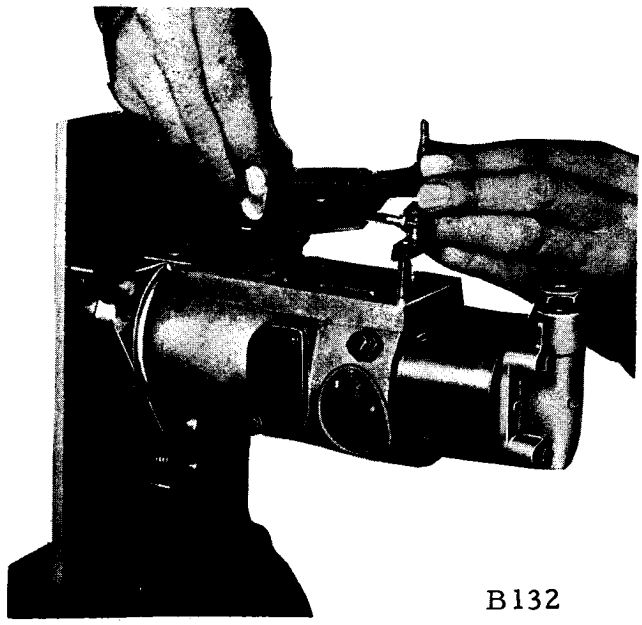

B132

Figure 54

5. With the bottom of the pump up, unscrew the nut from the securing stud. Unscrew the cap and remove the springs. Fig. 55.

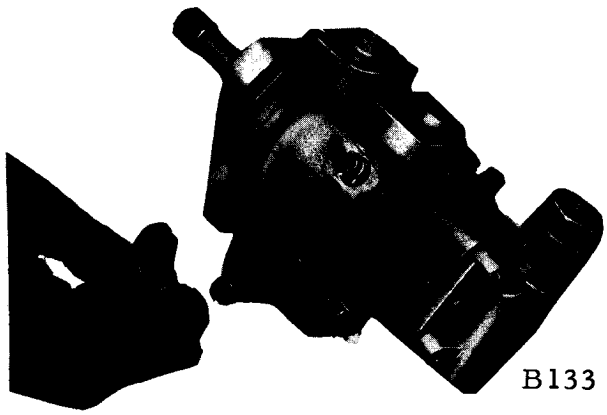

B133

Figure 55

6. Unscrew the head locating fitting (2), withdrawing the advance mechanism as the fitting is unscrewed. Remove and discard the gasket. Withdraw the piston plug. Withdraw the piston. Fig. 56.

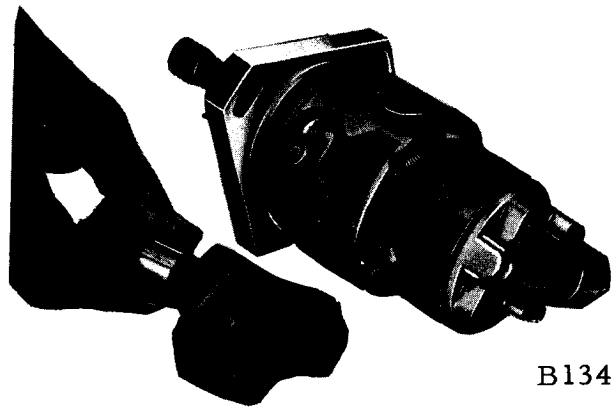

B134

Figure 56

7. Remove the lower O-ring and washers from the head locating fitting. Withdraw the fitting.

8. Unscrew the four screws securing the end plate to the hydraulic head. Lift off the end plate, and remove the O-ring beneath it.

9. Remove the fuel inlet connection from the end plate and spring installed immediately below it. Invert the end plate to allow the valve assembly to fall from its chamber. Fig. 57.

10. Lift the transfer pump vanes from the slots in the pump rotor. Fig. 58. Withdraw the transfer pump liner.

11. Hold the drive hub with tool (7044/894) and loosen the transfer pump rotor with tool (7044/889). Fig. 59.

NOTE: The direction in which the rotor is loosened is indicated by an arrow marked on the face of the rotor.

12. Unscrew the two screws locking the head. Remove the hydraulic head and rotor as an assemly.

13. Hold the drive plate with tool (7044/911), and loosen the two drive plate screws. Remove the O-ring from the annular groove in the hydraulic head.

14. Unscrew the transfer pump rotor. Separate the pumping and distributing rotor from the hydraulic head. Fig. 60.

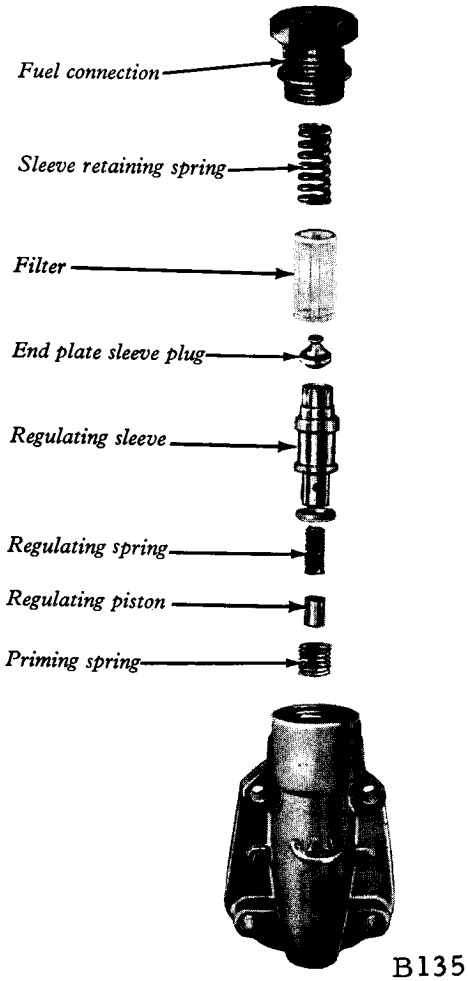


Figure 57

15. Unscrew the drive plate screws, releasing the drive plate. Remove the top and bottom adjusting plates and actuating rollers and shoes from the rotor.

16. Push the pump plungers from the rotor bore, and submerge them in clean fuel oil. Slide the rotor into the hydraulic head, protecting the working surfaces.

17. Remove the cam advance screw, using tool (7144/14). Withdraw the cam ring. Fig. 61.

18. Remove the timing ring from the pump housing bore. Fig. 62.

19. Unscrew the screw securing the hub, using tools (7044/894) and (7144/261). Fig. 21.

20. Withdraw the splined shaft and governor weights as an assembly. Fig. 63.

21. Remove the O-ring and governor weight assembly from the shaft. Remove the thrust sleeve, thrust washer and weights from the weight carrier.

Figure 58

22. Withdraw the drive hub from the pump housing and extract the oil seal, using tool (7044/260). Fig. 64.

D. Inspection

End Plate:

1. Check sleeve for foreign particles and rust, making sure the by-pass port is open.

2. Make sure the regulating plunger is free of nicks, scratches or scores, especially at the upper end. Check for excessive wear and freedom of movement in the sleeve.

3. Inspect end plate for thread damage, cracks, foreign particles, rust and excessive wear from pump end thrust. Check end plate plug for thread damage and bottom surface for wear. Inspect inlet screen for damage, foreign particles.

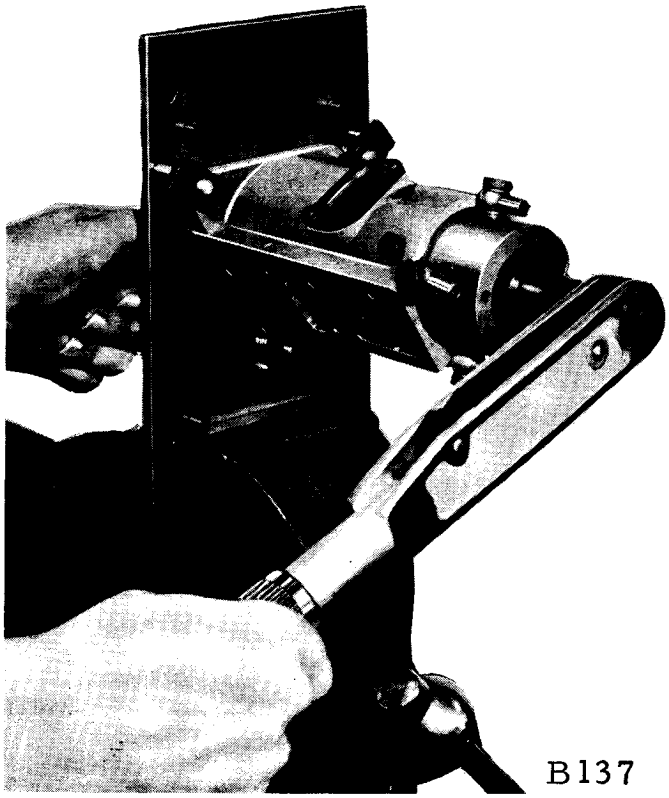


Figure 59

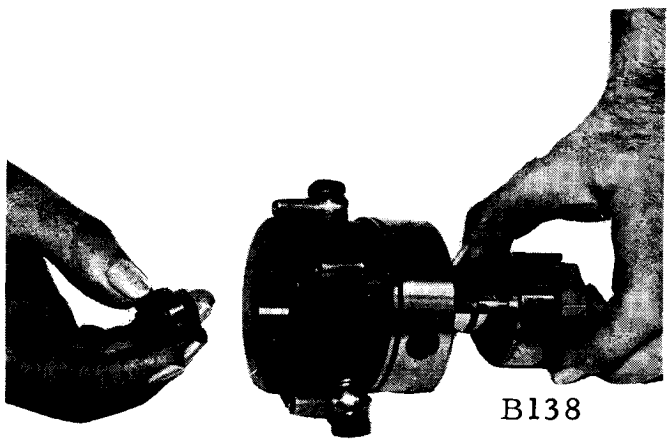


Figure 60

Transfer Pump:

1. Check inside diameter and flat surfaces of the liner for wear and foreign particles. If scratches, scores, or pits are present, replace liner.

2. Inspect pump blades with the utmost care.

3. Check for chipping on any of the edges or extremities; pitting, imbedded foreign particles or wear on the radiused ends. Inspect flat surfaces visually for uniform polishing and, if any discrepancies are noted, replace both blades. Inspect both ends of the rotor for circular scores, foreign particles, rust, distortion and free sliding of new blades in the slots.

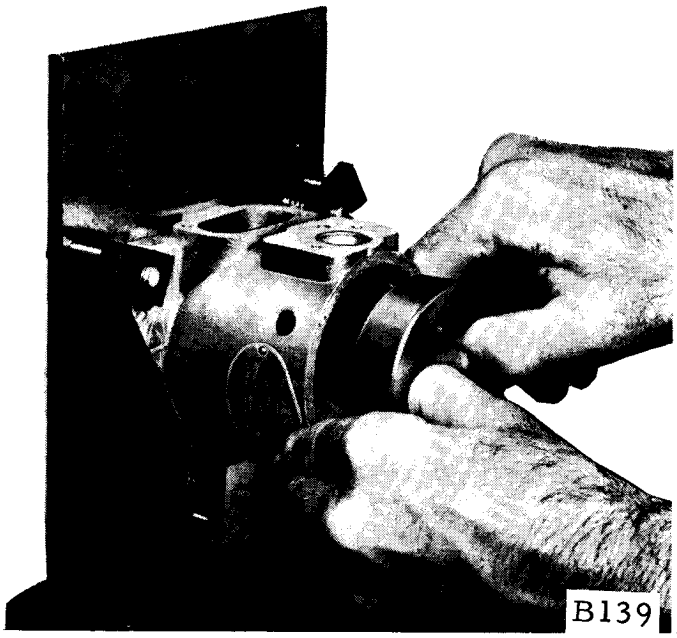


Figure 61

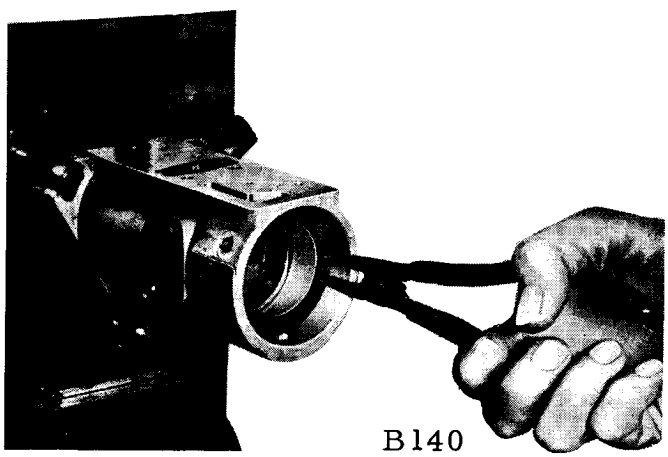
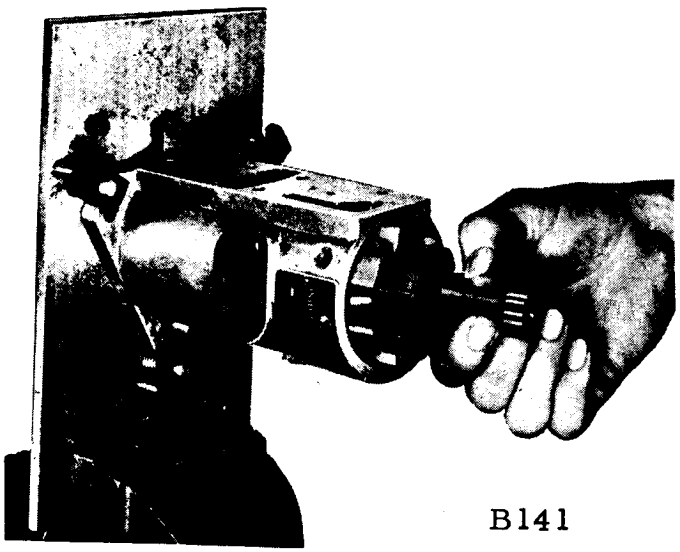


Figure 62

Hydraulic Head and Rotor:

1. Inspect for excessive wear, foreign particles, rust and thread damage. Specifically inspect central metering valve and port.



B141

Figure 63

B142

Figure 64

SECTION B — FUEL

2. Check plungers for complete freedom of movement in the rotor, then remove and examine them for scratches, nicks or signs of excessive wear. If the plungers were sticking, but not visibly damaged, clean both plungers and bore with a soft brush and lacquer-removing solvent such as lacquer thinner or acetone.

3. Plungers and mating surfaces must be free of scratches, scores, or other defects.

4. Check the rotor plug screw carefully for tightness. Attempts to further tighten this screw can cause serious rotor distortion, resulting in seizure.

Automatic Advance:

1. Check the springs for pitting, rusting and distortion. All sliding surfaces should be free of scratches and burrs that would hinder operation.

2. The cam advance screw should not have any flat surfaces on the ball portion, nor should the inner piston be worn where contact is made with the cam advance screw.

E. Assembly

1. Drive a new seal onto its seat in the hub, using draft (7144/260). Check seal installation with checking plug (7144/13).

NOTE: With the plug inserted in the seal, a continuous black line should be seen when the seal is viewed through the flange end of the plug.

2. Pass the mandrel of tool (7144/123 through the weight carrier. Fit the mandrel into the base plate, trapping the carrier between the shoulder on the mandrel and upper face of the base plate.

3. Place the weights in position on the upper surface of the weight carrier, with the weight slots up nearest the mandrel.

NOTE: Each weight should be aligned with a carriage pocket and with its inner end resting against the mandrel. Fig. 65.

4. Place the thrust washer and then the thrust sleeve over the mandrel and in position against the governor weights. Push down on the thrust sleeve until it enters the weight carrier. Withdraw the mandrel, and remove the assembly from the base plate of the tool.

5. Pass the drive hub through the oil seal in

Figure 65

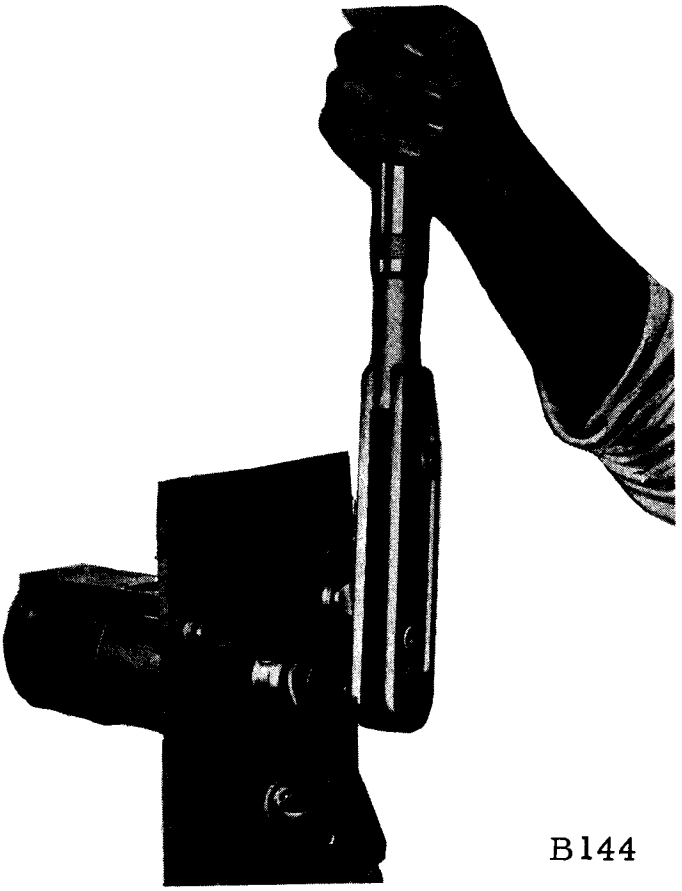


Figure 66

the pump housing, seating the hub flange against the housing.

6. Slide the governor weight on the splined shaft. Install a new O-ring in the surface groove of the shaft, using tool (7044/890) to protect the O-ring.

7. Slide the shaft and weight assembly into the pump housing. Engage the shaft splines with the splines in the inner end of the drive hub.

NOTE: In this position the weight carrier is trapped between the end face of the drive hub and a shoulder on the splined shaft.

8. Install the support washer in the recess between the two sets of splines in the drive hub. Secure the splined shaft to the drive hub with the socket head screw. Hold the drive hub with tool (7044/894) while tightening the screw to 285 lbs. in. and using adaptor (7144/261) and torque wrench. Fig. 66.

9. Install the timing ring so that the timing mark scribed on the ring is positioned near the timing aperture in the pump housing. Fig. 62. Place the cam ring in position against the timing ring.

NOTE: The direction indicated by an arrow on the cam ring face should correspond with the direction of pump rotation marked on the name plate.

10. Screw the cam advance into the cam ring, and tighten to 300 lb. in., using tool (7144/14) and torque wrench.

11. Place the bottom adjusting plate in position on the pump and distributing rotor.

NOTE: In correct position of assembly the "cut-out" in the periphery of the rotor is aligned with the "cut-out" in the periphery of the adjusting plate. Also, the eccentric slots in the adjusting plate are in line with the roller shoe guides.

12. Insert the plungers in the transverse bore of the rotor. Install the roller and shoe assemblies in the roller shoe guides.

NOTE: In Step 12, the contours of the projecting ears on the shoes should conform with the contour of the eccentric slots in the adjusting plate.

13. Install the top adjusting plate, engaging the integral lug with the bottom adjusting plate. Secure the drive plate to the end of the rotor with the two drive screws lightly tightened.

NOTE: The underside of the drive plate is recessed.

14. Place the pumping and distributing rotor in the bore of the hydraulic head and secure it with the transfer pump rotor lightly tightened.

15. Apply 230 PSI to two high pressure outlets. Turn the pump rotor until the plungers are forced to the maximum fuel position. Set the roller-to-roller dimension to by moving the adjusting plates. Hold the drive plate with the (7044/911) and tighten the drive plate screws to 160 lb. in. Release the pressure being applied to the high pressure outlets.

NOTE: Tool (7144/262) and an injector tester may be used to supply the pressure needed in Step 15.

16. Position an O-ring on the hydraulic head. Lubricate that portion of the head which fits into the pump housing. Slide the hydraulic head into the pump housing, engaging the splines on the inner end of the shaft with those of the drive plate. Rotate the head and rotor assembly to prevent damaging the O-ring as it enters the pump housing.

17. Secure the hydraulic head to the housing with the two locking screws tightened finger tight. Hold the drive hub with tool (7044/894) and tighten the transfer pump rotor to 65 lb. in., using tool (7044/889) and a torque wrench. Fig. 59.

18. Slide the transfer pump liner in the counterbore in the end of the hydraulic head. Slide the pump vanes into the slots of the pump rotor. Rotate the liner to insure that the vanes do not bind on the liner.

19. Place the piston retaining spring into the base of the valve sleeve of the end plate. Slide the piston into the valve sleeve. With the large diameter of the sleeve up, position the regulating spring on top of the piston. Insert short end of the spring guide into the upper end of the sleeve.

20. Retain the assembly in the upright position, and seat the filter on the upper end of the valve sleeve. Place the retaining spring on top of the spring guide. Install a new sealing washer on inlet connection, and place the assembly on top of the retaining spring.

21. Stand the assembly on the inlet connection. Lower the end plate over the inverted assembly. Secure the assembly by tightening the connection to 360 lb.-ft.

22. Place a new O-ring in the recess in the end face of the hydraulic head. Engage the dowel on the inner face of the end plate with the slot in the transfer pump liner. Secure the end plate to the hydraulic head with the four plate screws tightened to 45 lb. in.

23. Install new O-rings on the piston spring cap and piston plug of the advance mechanism. Use tool (7044/898) to protect the O-rings during installation. Screw the piston plug into the advance housing where the fuel passage joins the cylinder. Slide the piston into the housing bore, with the counterbored end out. Check for free piston movement.

24. Install a new upper O-ring on the head locating fitting, using tool (7044/897) to protect the O-ring. Push the fitting into its bore advance housing. Install the lower O-ring and washer on the fitting, using tool (7144/18) to protect the O-ring. Place a new gasket against the pump housing. Engage the cam screw with the piston and screw the locating fitting into the hydraulic head. Place a washer over the locating stud and screw the nut against it. Draw the advance mechanism down progressively.

NOTE: If a rubber gasket is used between the advance mechanism, tighten the locating fitting to 300 lb.in. If a cork gasket is used, torque the fitting to 350 lb.in.

25. Tighten the two head locking screws to 170 lb.in. Check for free movement by moving the piston. Insert the springs and install the spring cap. Place a sealing washer on the capscrew and screw it into the spring cap.

26. Engage the governor arm with the governor bracket. Connect the two components with the small retainer spring (T). Fig. 67. Install O-rings to the throttle and shut-off shaft, using protection cap (7144/45) when installing the low-

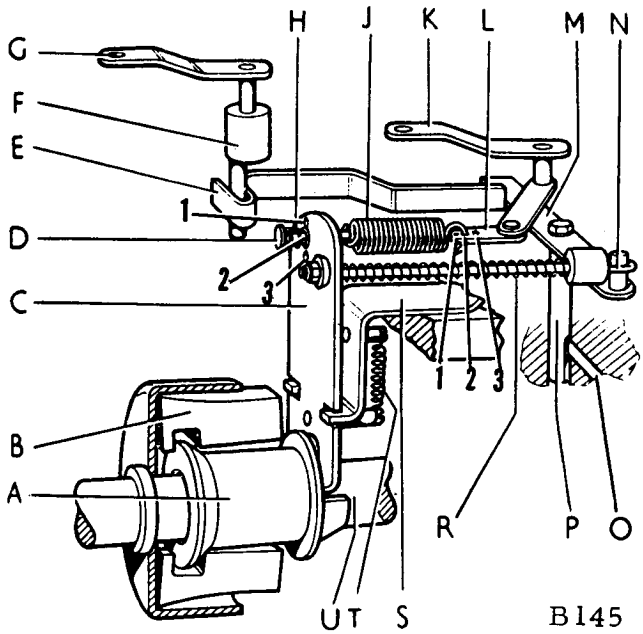


Figure 67

er ones and protection cap (7144/459) when installing the upper ones. Pack the groove between the O-rings with grease.

27. Slide the idling spring on the shank of the spring guide. Pass the guide through its original hole in the governor arm, and couple the governor spring to the guide.

NOTE: There are three holes in the governor arm; the correct hole to be used is indicated in the test specifications, and the hole can be identified by referring to fig. 67.

28. Slide the spring over the hook lever. Pass the threaded end of the lever through the governor arm. Place the special washer over the threaded end and secure it screwing the nut onto the shaft. Attach the hooked end of the lever to the metering valve.

29. Hook the free end of the governor spring into its original hole in throttle shaft link.

NOTE: Three holes are provided in the throttle shaft link; the one to be used is indicated in the test specifications.

30. Install the governor linkage on the pump housing, engaging the lower end of the governor arm with the thrust sleeve and inserting the metering valve in its housing in the hydraulic head.

31. Place the keeper plate in position on the governor control bracket. Place new tab washers on the governor cover studs. Pass the stud through the plate and bracket; then, screw them into the pump housing. Screw the small screw into the end of the bracket near the metering valve. Install the shut-off bar.

32. Install new O-rings on the throttle and shut-off shafts. Press each shaft assembly into its respective bore in the control cover, using protecting cap (7144/459) to protect the O-rings.

NOTE: When the shut-off shaft is installed, the pin engaging the shut-off bar must be toward the inside of the cover.

33. Set the distance between one governor control stud and the metering valve lever pin to the dimension listed in the test specifications. Fig. 68.

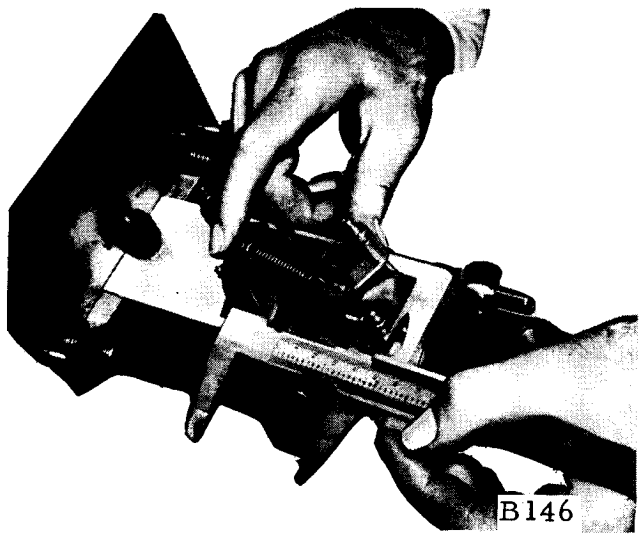


Figure 68

NOTE: The adjustment is made by tightening or loosening the nut on the end of the hooked lever. Light pressure must be applied to the governor arm to hold the metering valve in fully open position. The vernier must be parallel to the axis of the pump.

34. Place the control housing gasket on the upper face of the pump. Lower the cover over the securing stud and onto the gasket. Make sure that the crank pin on the shut-off shaft engages the slot of the shut-off bar. Secure the cover by tightening the stud nuts to 30 lb.in. Attach the control levers to the top of the throttle and shut-off shafts.

35. Adjust the position of the locking screw in the splined shaft so that it engages the socket head of the hub securing screw when the shaft is in the drive hub. Use tool (7144/117) and adjust as follows:

a. Position the drive end of the pump up. Grasp the tool by the fixed handle and with the female splines up.

b. Swing the movable hand to the extreme left. Insert the splined shaft of the pump into the splines of the tool body.

c. Push down on the shaft and swing the movable handle to the right until the head of the locking screw enters the socket in the dummy splined shaft of the tool.

NOTE: In Step c., the movable handle should not move more than half of its complete travel if this operation is effected correctly.

d. Engage male splines of the tool with the splines in the drive pump hub.

NOTE: If the hexagon guide on the tool immediately engages the socket head of the securing screw, the movable handle must be carefully raised until it can be moved to the right.

e. Press down on the splined shaft, and squeeze the two handles together, until the male hexagon guide enters the socket head of the drive hub screw.

NOTE: In step e., the guide will drop approximately 1/8 inch when the correct position is attained. If screw becomes fully tightened before the guide enters the hub screw, a new screw must be installed and steps "a" through "e" repeated.

f. Remove the drive shaft and tool. Slide the splined shaft onto the hub.

NOTE: The locking screw should now be engaged with the drive hub screw.

36. Test and adjust the injection pump.

F. Testing and Adjusting

1. The following are the basic required features of the testing equipment:

a. A mounting bracket to which the pump is secured during the test, and a splined drive coupling through which the pump can be driven in either direction of rotation at all speeds specified in the Specification Listing.

b. A set of high-pressure pipes of equal length which couple the outlet connections on the pump to a matched set of injectors.

c. A set of graduated measuring glasses arranged below the test injectors, for measurement of the pump output, and a single measuring glass of larger capacity for measurement of the volume of backleakage oil.

d. An automatic trip mechanism which directs the fuel issuing from the injectors into the glasses during a period of 100 pumping cycles and then diverts the fuel into a drainage trough.

e. A fuel system which ensures an adequate fuel supply at constant pressure at the pump inlet.

f. One pressure gauge and one vacuum gauge for testing the output and efficiency of the transfer pump.

2. Observe the following precautions prior to and during testing:

a. Insure that the test machine is set to run in the corresponding direction of rotation to the pump undergoing test. Reversal of the pump prevents the entry of oil and seizure may results from lack of lubrication.

b. Do not run the pump for long periods at high speed with low fuel output.

c. Do not run the pump for long periods with the shut-off control in the closed position.

d. Prime the pump thoroughly before commencing test and at other times when indicated in the test plan.

3. Prime the pump after it has been mounted on the test machine. To prime the pump, proceed as follows:

a. Loosen the vent valves on the governor control housing and the head locking screw.

b. Connect the fuel feed pipe on the test machine to the back leakage connection on the pump. Turn on the fuel supply and fill the pump housing.

c. Connect the fuel feed pipe to the pump inlet. Connect the back leakage pipe.

d. Loosen the connections at the injector end

of the high-pressure pipes.

e. Run the pump at 100 RPM. Close the vent valves and tighten the high-pressure pipe connections when oil, free from air, issues from each venting point.

f. After priming the pump, examine for oil tightness at all jointing faces, pipe connections and oil seals.

g. The pump must be free from leaks both while stationary and when running.

4. Pump Output:

The fuel delivery is checked at one or more speeds of rotation with the throttle lever in the fully open position. Measurement is made of the volume of fuel which passes through each of the injectors during 200 pumping cycles. The average delivery is quoted in the Specification Listing, together with an overall tolerance and the maximum permissible delivery variation (spread) between the different injectors.

5. Shut-off Control:

The shut-off control is checked while running at a specified speed with the shut-off control in the closed position. A maximum permissible fuel delivery is quoted. See the Specification Listing.

6. Maximum Fuel Setting:

Maximum fuel delivery is checked at a specified speed with both throttle and shut-off control in the fully open position. If the fuel delivery is not within the specified limits, adjustment is made as follows:

a. Loosen the screws securing the cover plate to the side of the pump housing, thus permitting the fuel to drain from the housing.

b. Remove the cover plate.

c. Loosen the two drive plate screws.

d. Engage tool (7044/990) with the slot in the drive plate and with the slot in the periphery of the adjusting plate. Fig. 69.

NOTE: In fig. 69, the pump head and rotor, etc., have been removed from the housing to enable setting operation to be seen.

e. Make the necessary adjustment by turning the adjusting screw on the tool.

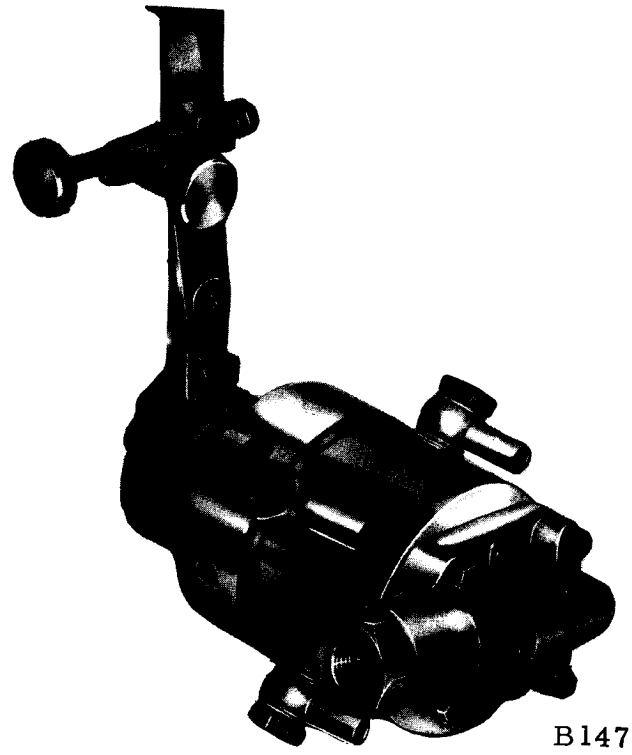


Figure 69

f. Tighten the drive plate screws to a torque value of 125 lb/in using the adaptor, (7144/482) and a torque wrench.

g. Replace the cover plate, refill the pump housing, and then check the maximum fuel delivery. Repeat the operations until the fuel delivery is within the specified limits.

The adaptor (7144/482), used for tightening the drive plate screws, is used in conjunction with a non-cranked ring spanner (flat box end wrench). The center of the ring spanner must be 2.6 in. from the center of the adaptor. The torque wrench and ring spanner must be in line while tightening the screws, and care must be taken to insure that the spanner does not contact the side of the opening in the pump housing.

7. Governor Setting:

a. With the pump running at a speed greater than half the maximum permissible speed of the engine to which it will be fitted, the maximum speed stop is adjusted until a specified fuel delivery is obtained. The volume of fuel specified is considerably less than the volume of fuel at the maximum fuel setting.

b. The speed of rotation is then reduced, and the fuel delivery should increase to a specified volume approximately equal to the maximum fuel delivery.

8. Transfer Pump:

a. Transfer pump suction is checked while running the pump at low speed, with a two-way cock in the fuel feed pipe turned to the position which cuts off the fuel supply and connects the pump inlet to the vacuum gauge. A given vacuum reading must be attained in a specified time.

NOTE: The pump must be reprimed after this test.

b. Transfer pressure is checked at one or more specified speeds. A special adaptor (7044/-892) is screwed into the thread normally occupied by one of the head locking screws to enable a pipe to be fitted between the pump and the pressure gauge on the test machine. Transfer pressure can thus be read directly from the gauge.

9. Automatic Advance:

NOTE: The operation of the automatic advance is indicated on a special tool (7044/896). Fig. 70. To check advance mechanism, proceed as follows:

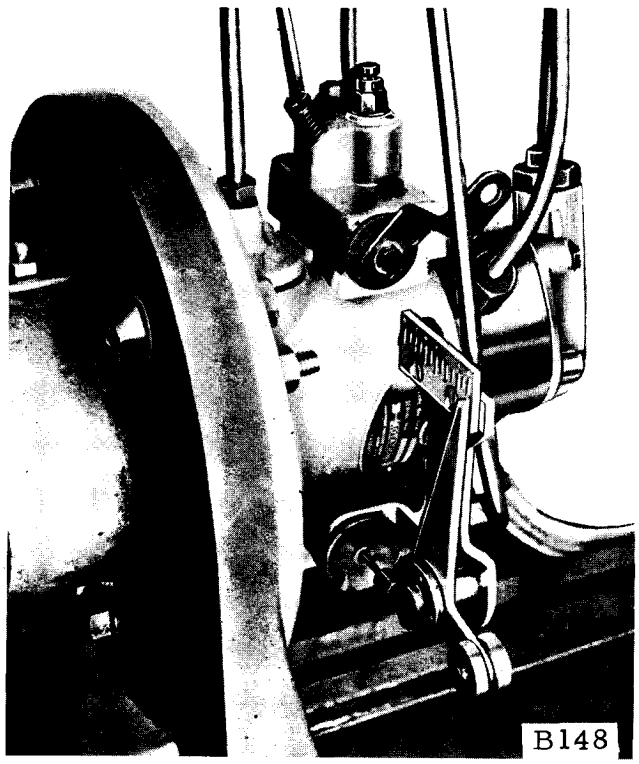


Figure 70

SECTION B — FUEL

a. Remove the small screw from the piston spring cap on the advance device.

b. Pass the threaded bushing of the tool through the hole in the tool bracket.

c. Insert the end of the plunger in the hole in the spring cap and then screw the bushing into the spring cap screw hole.

d. Adjust the pointer to zero on the scale.

e. Refer to the Specification Listing for the specified degrees of advancement.

f. Adjust the automatic advance, if necessary, by increasing or decreasing the shim thickness. The shims are located between the outer-piston spring and piston cap.

NOTE: A single .5 mm washer between the inner piston and its spring is installed at the factory and must not be removed.

10. Timing:

a. Remove the injection pump from the test machine. Drain the fuel from the housing, by removing the side cover plate.

b. Connect one end of the stirrup pipe (7144/-262) to the outlet specified in the Specification Listing. Connect the other end of the pipe to the opposite outlet.

c. A relief valve (7144/155) is secured to the stirrup pipe and the complete tool is connected by a high-pressure pipe to an injector tester.

d. Apply 450 PSI. This will force the plungers apart as the pump is turned. Such movement brings the actuating rollers to a position where they will strike the cam lobes. When contact is made, resistance to further movement is encountered. With the pump held in this position, the timing ring is moved until the scribed line on the ring is aligned with a specified mark on the drive plate. The timing mark on the pump flange is made while the pump is held in the same position. Tool (7144/112) is set to the specified indexing figure and is then engaged with the splines on the drive shaft. The line is scribed by passing a scriber down the scribing guide on the tool.

G. Installation

1. Place a new gasket on the injection pump

mounting face.

2. Check that the slot in the fuel pump shaft is in approximate position to the dowel in the gear. Place the pump on the three studs on the back of the timing case and retain with the three plain and spring washers and nuts, but do not tighten the nuts.

3. After insuring that the dowel in the fuel pump driving gear is in line with the slot in the fuel pump shaft, secure the gear to the pump by the three setscrews and locking plate.

4. If necessary, move the fuel pump body until the scribed line on the pump mounting flange aligns with the scribed line on the back of the timing case. Fig. 71. Secure the pump by tightening the three mounting nuts.

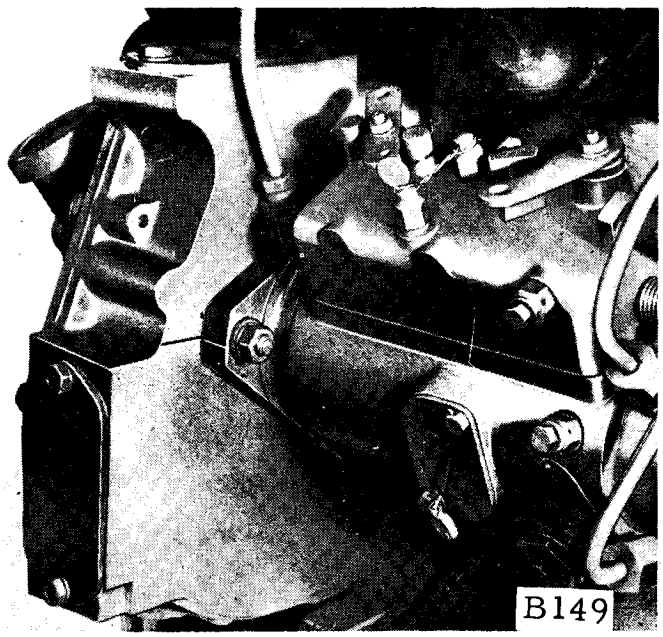


Figure 71

5. Connect the throttle and stop controls to the respective levers and the fuel pipes to the pump and injectors.

H. Adjustment

1. Turn engine in the normal direction of rotation until No. 1 piston is 20° BTDC on compression. This can be checked by dropping a valve onto the top of No. 1 piston and by means of a dial indicator, checking the piston movement BTDC which should be .193 inch.

CAUTION: The valve will drop completely into the cylinder if the crankshaft is turned too far.

2. Remove the inspection plate on the fuel pump enabling the rotor to be seen.

3. With No. 1 piston on static timing point, the scribed line on the fuel pump rotor marked with the letter "E" should be in alignment with the scribed line on the snap ring. Fig. 72.

Figure 72

NOTE: The snap ring on some pumps may not have a scribed mark. The end of these will be square; this end of the ring should be in line with the letter "E". Fig. 73.

4. If it is not and the scribed line on the fuel pump flange is in alignment with the line on the rear of the timing case, then the fuel pump drive gear must be one or more teeth out of correct mesh with the idler gear. The fuel pump gear is

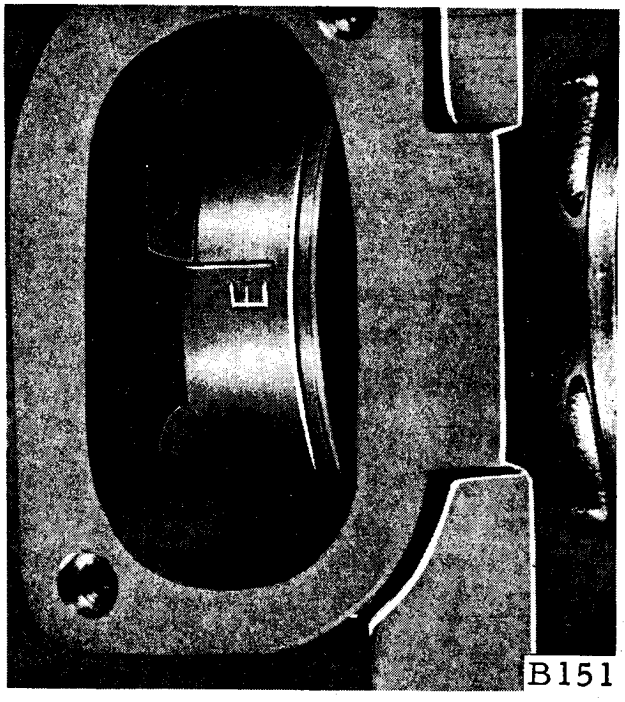


Figure 73

dowelled to the fuel pump drive shaft and no adjustment is provided. The only adjustment that can be made is by releasing the fuel pump securing setscrews and turning the fuel pump in the direction required.

ENGINE SPEED

A. General

There are two engine speed adjustments, idle speed and governed speed. Both adjustments are externally made. The governed speed is sealed to prevent tampering.

B. Adjustments. Fig. 74

NOTE: The engine should be at operating temperature before attempting adjustments.

1. Adjust the idle speed as follows:

a. Start the engine and allow it to idle. Loosen the lock nut on the low speed adjusting screw.

b. Turn the low speed adjusting in or out, as necessary to obtain the desired speed. Secure the adjustment by tightening the lock nut.

2. Adjust governed speed as follows:

a. Start the engine. Break the seal and unscrew the securing sleeve.

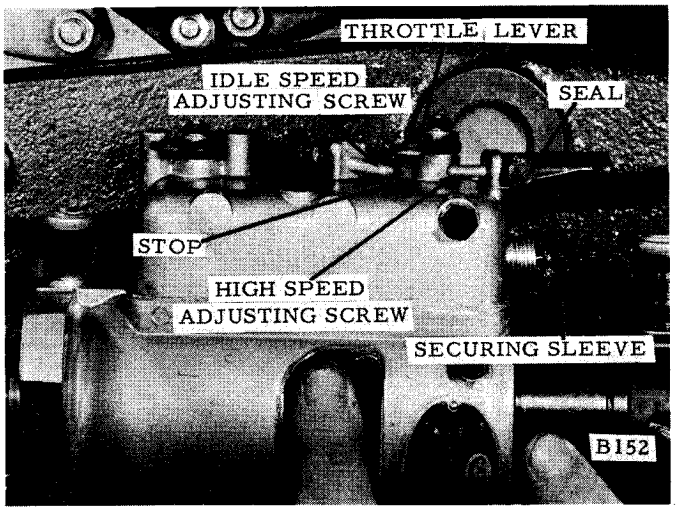


Figure 74

b. Loosen the lock nut securing the high speed adjusting screw.

c. Hold the throttle lever stop against the end of the high speed adjusting screw; turn the adjusting screw in the desired direction to obtain the specified governed speed.

d. Tighten the lock nut. Check governed speed; re-adjust, if necessary. Screw the securing sleeve snugly into position and seal in position.

CAUTION: Do not disturb the governor setting before making absolutely sure it is incorrect. Otherwise, engine overspeed may result, causing extensive damage to the engine.

INJECTORS

A. General

The injector assemblies are located in the cylinder head of a Diesel engine, one per cylinder, very much as spark plugs in a gasoline engine. Fig. 41. The function of these assemblies is to receive the metered quantity of fuel from the injection pump, atomize it mechanically, and direct it into the engine combustion chamber in a definite spray pattern and in such a manner as to produce the most efficient engine performance.

Fuel is fed to the mouth of the nozzle through small holes drilled vertically in the nozzle, which terminate in an annular gallery just above the valve seat. A valve in the nozzle is raised from

its seat by the pressure of fuel fed from the injection pump. Thus, the fuel in the gallery is forced by the upward movement of the plunger in the pump, through the holes in the nozzle, to form a spray in the engine combustion chamber.

A certain amount of seepage of fuel between the lapped guide surfaces of the nozzle valve and the nozzle is necessary for lubrication. This leakage accumulates around the spindle and in the spring compartment, from which it drains back to the tank through the leak-off connections and return lines at the top of the injection.

NOTE: Injectors should be examined periodically. The frequency depends upon operating conditions. When combustion conditions are good and the fuel tank and filtering systems are correctly maintained, yearly checks are often sufficient.

B. Checking for Faulty Injector

Misfiring of a cylinder is usually due to a faulty injector — which can be located by loosening the high-pressure line fitting on each injector in turn. This allows the fuel to escape and not enter the cylinder. The injector least affecting the engine performance is the faulty one.

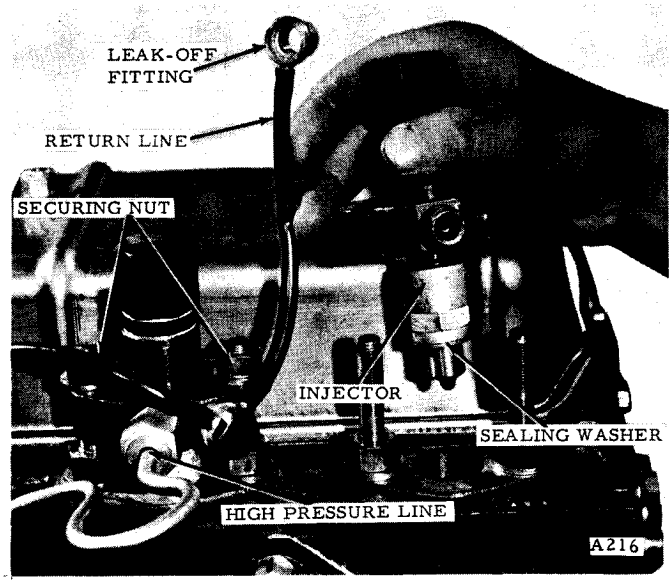


Figure 75

C. Removal. Fig. 75

1. Clean the side of the engine before disconnecting the injection pipes. Use clean fuel to flush the injection pipe fittings so that there is no possibility of dirt entering the injection system.

2. Disconnect the fuel injection lines from the pump and injectors. As each pipe is removed, plug the pump opening, cap the injector openings and tape the ends of the injection tube.

NOTE: Plastic plugs and caps are recommended for keeping injector and pump openings clean.

3. Unscrew leak-off fitting that connects the return line to the top of the defective injector. Cover all openings.

4. Remove the securing nuts. Extract the injector.

CAUTION: Do not strike nozzle tips against hard surface or damage will result.

5. Remove remaining injectors in the same manner.

D. Disassembly. Fig. 76

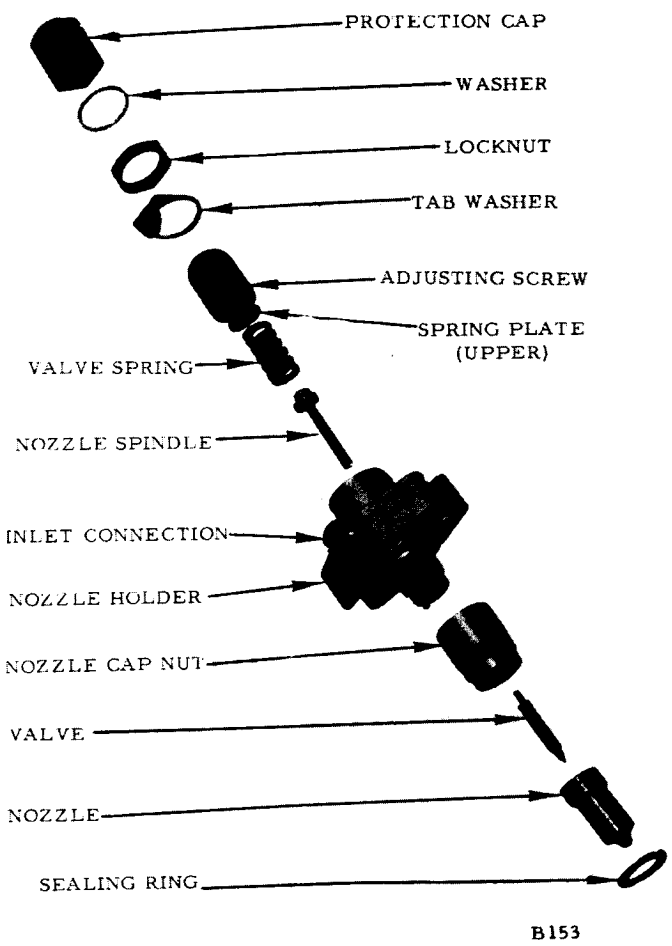


Figure 76

NOTE: Place parts in clean fuel oil as they are removed.

1. Place injector in a holder. Fig. 77. Unscrew the nozzle cap nut.

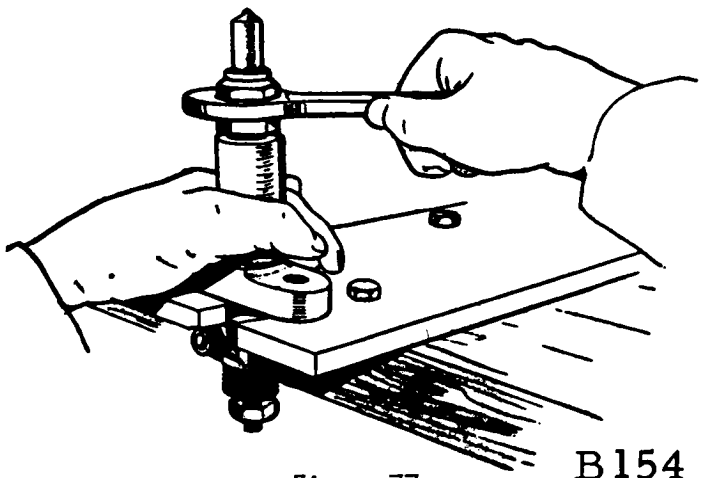


Figure 77

2. Remove the nozzle and valve.

NOTE: To avoid damaging the valve, do not separate it from the body until the assembly is ready for cleaning and inspection.

3. Turn the injector over in the holder. Unscrew the protecting cap.

4. Loosen lock nut. Unscrew the adjusting screw.

5. Lift out the upper spring plate, spring and spindle.

NOTE: The lower spring plate is pressed on the spindle. Do not remove it.

6. Unscrew the fuel inlet connection.

E. Cleaning and Inspection

1. Wash all parts in clean fuel oil. Use a separate container to wash the nozzle and valve in, and replace the fuel frequently.

NOTE: To avoid touching the close fitting lapped surfaces of the nozzle and valve, assemble them while they are submerged in fuel oil.

2. Remove the valve from the nozzle. Replace the assembly if either the valve or the nozzle is blue from overheating.

CAUTION: Do not use rags to wipe injector parts. Lint from the rags is detrimental to the valve operation.

3. Brush the carbon from the outside of the nozzle, fig. 78, being careful not to touch the lapped surface with the hands. Use fuel oil to soften carbon, if necessary.

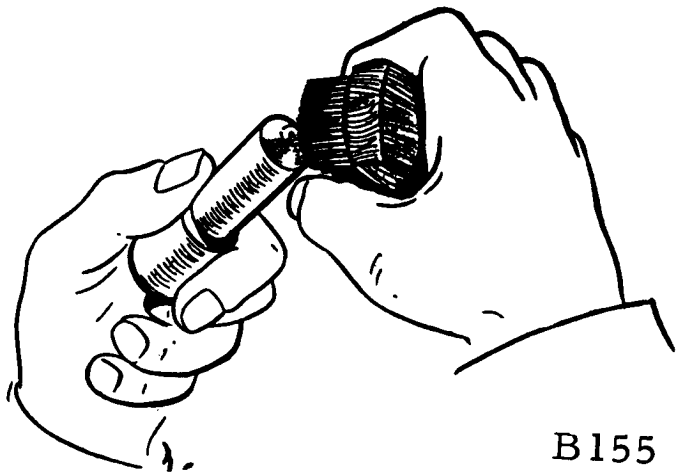


Figure 78

4. Clean out the feed channels (G), fig. 79, with a drill or wire. Insert the tool by hand.

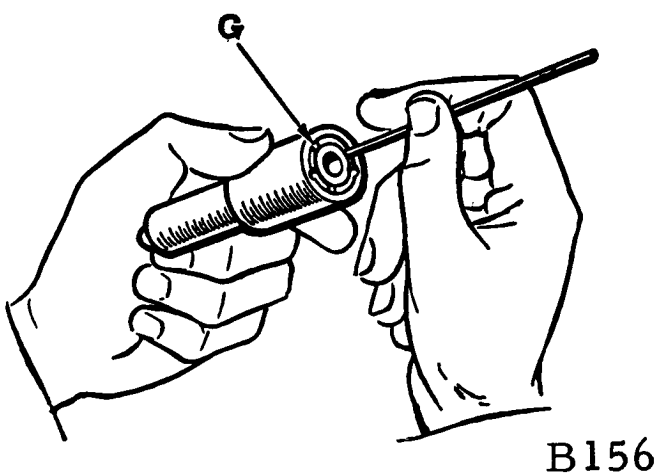


Figure 79

5. Insert groove scraper into nozzle bore until it locates in the fuel gallery, fig. 80. Press hard against the side of the cavity and rotate to clear this area of carbon. Clean the dome the same way, using a dome cavity scraper. Fig. 81.

6. Clean the valve seat (J), fig. 82, by rotating and pressing the seat scraper on the seat.

7. Remove the carbon from the spray holes with a probing tool. Fig. 83. The wire should

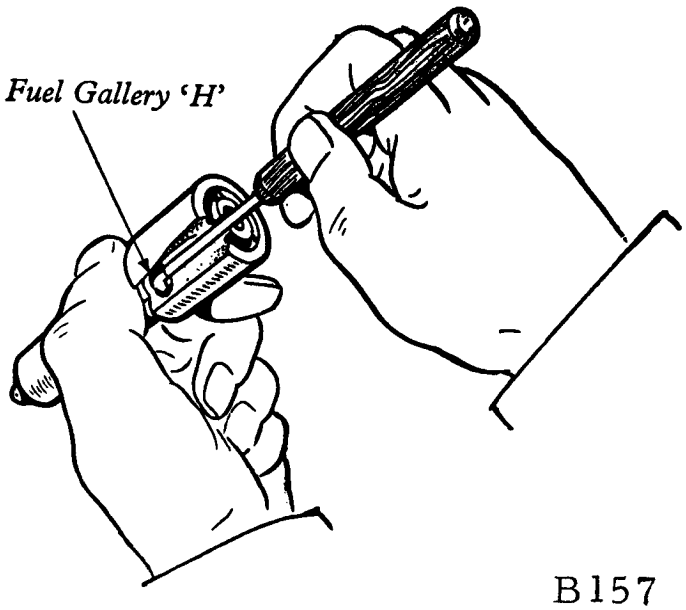


Figure 80

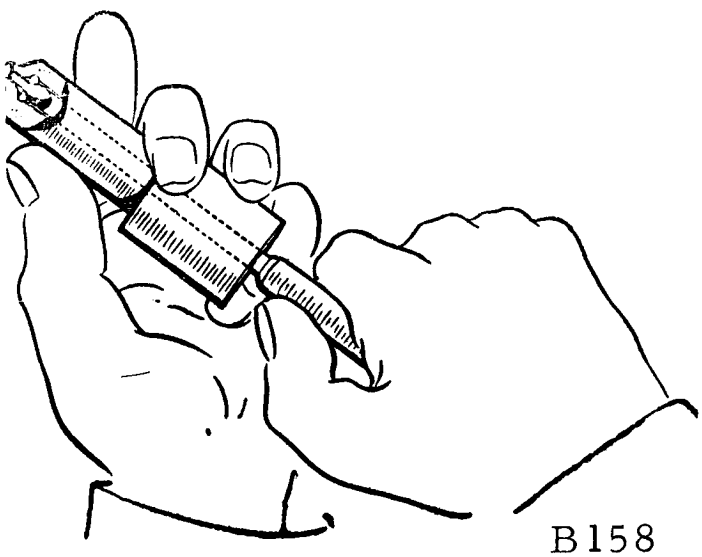


Figure 81

extend about 1/16 inch from the end of the holder, to provide maximum resistance to bending. Rotate the tool until carbon is clear.

8. Place nozzle in a flushing tool as shown in fig. 84 and wash out all foreign particles. If tool is not available, wash nozzle in clean fuel oil and blow dry with filtered compressed air. Then rinse in fuel oil and blow dry again.

9. Inspect the nozzle. It should be free from all damage, and it is important that it is not

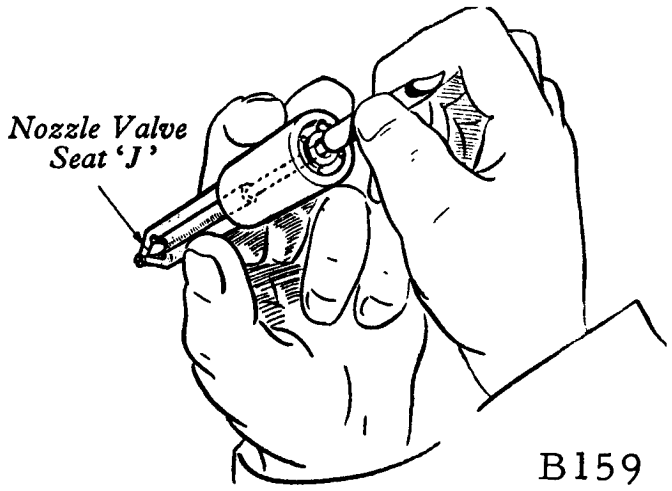


Figure 82

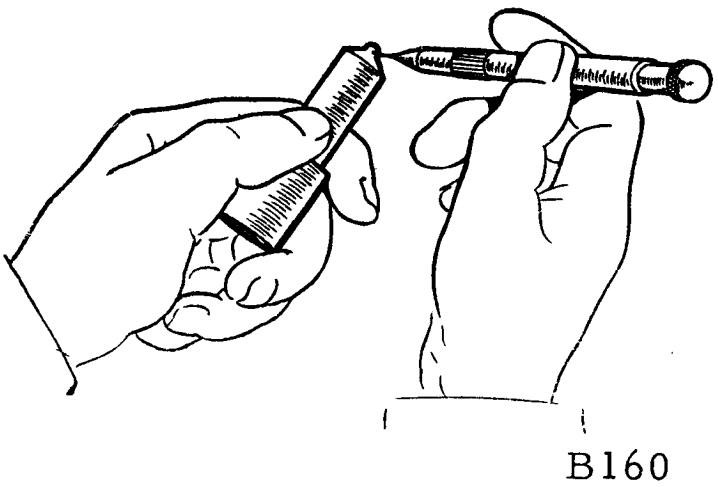


Figure 83

blued, due to overheating. All polished surfaces should be relatively bright without scratches. If any of these conditions exist, replace the nozzle and valve. It is essential that the pressure surfaces (1), (2) and (9), fig. 83, are absolutely clean.

NOTE: Dull appearing pressure surfaces (1), (2) and (9), fig. 83, may be lapped on a lapping block to remove carbon or discoloration, other than blue, and obtain a bright finish. Coat the lapping block with clean mutton tallow, making certain the entire surface is covered.

10. Clean the valve with a brass wire brush, fig. 85, and wash in clean fuel oil. Check for linear scratches. Check the seat contact area (12). Fig. 86. It should be flat and free of radial scratches. Replace the valve if it is scratched or

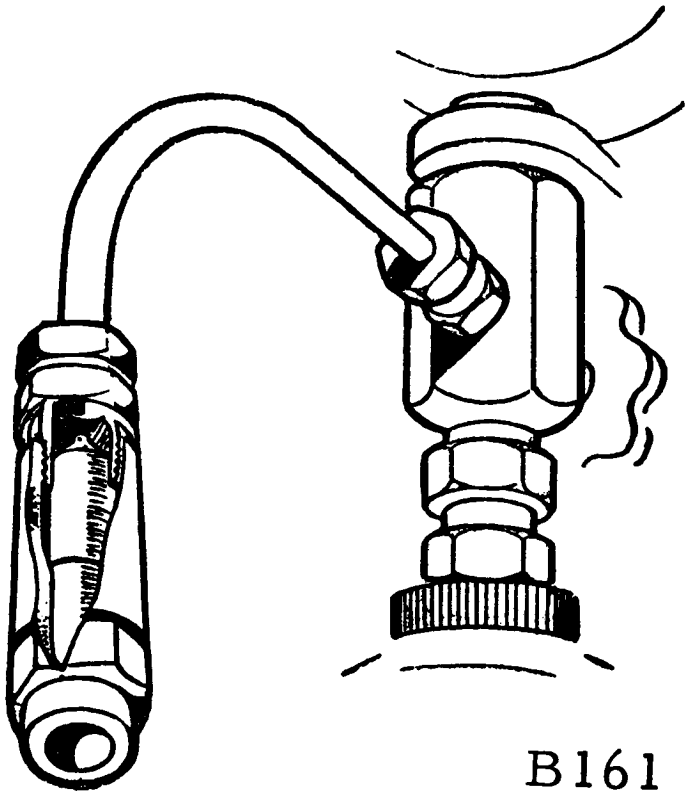


Figure 84

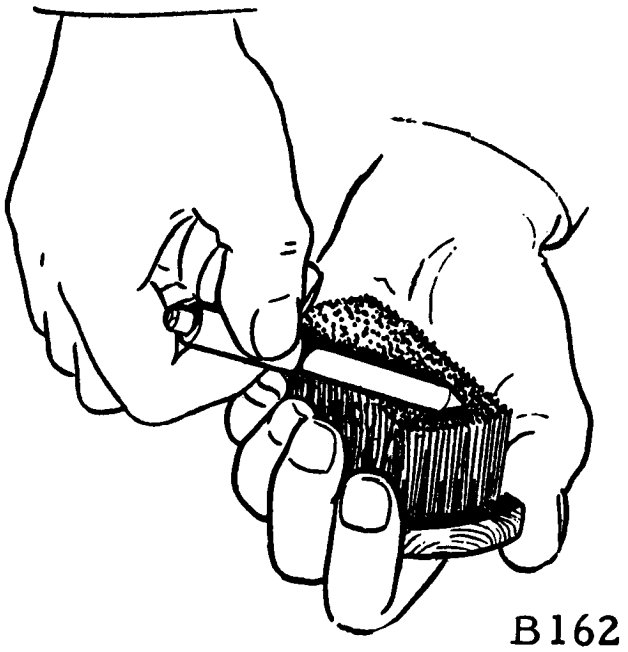
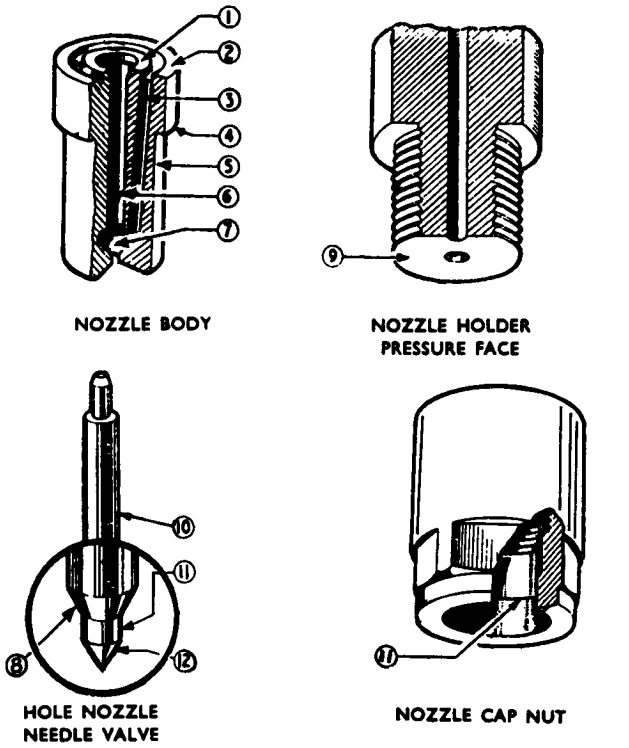


Figure 85
SECTION B — FUEL



1. Pressure Face
2. Pressure Face
3. Fuel Feed Hole
4. Nozzle Shoulder
5. Nozzle Trunk
6. Fuel Gallery
7. Valve Seat
8. Valve Cone
9. Pressure Face
10. Valve Stem
11. Retaining Shoulder
12. Seat Contact Area

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Figure 86

imperfect.

11. Submerge the nozzle and valve in clean fresh fuel oil. Slide the valve into the nozzle bore. Check the valve fit. It should rotate and slide freely. If the movement is not smooth and cleaning does not correct the default, replace the valve and nozzle.

12. Clean the nozzle holder with the nozzle cap in place to protect the lapped pressure surface. Check the pressure surface (9), fig. 86, for scratches, nicks, pits or dull patches. This surface should not be damaged. Refer to the above "NOTE".

13. Clean the nozzle cap, making sure that all carbon is removed.

14. Inspect the spindle and spring for damage and wear. If the spring is corroded or pitted, replace it.

F. Assembly. Fig. 76

NOTE: Flush each part of the injector before it is

assembled.

CAUTION: Do not touch lapped surfaces with fingers after flushing. Moisture from the fingers is very corrosive.

1. Slide the valve into the body while both are submerged in fuel oil.

2. Place nozzle assembly on holder, fig. 87, and secure it with the nozzle cap.

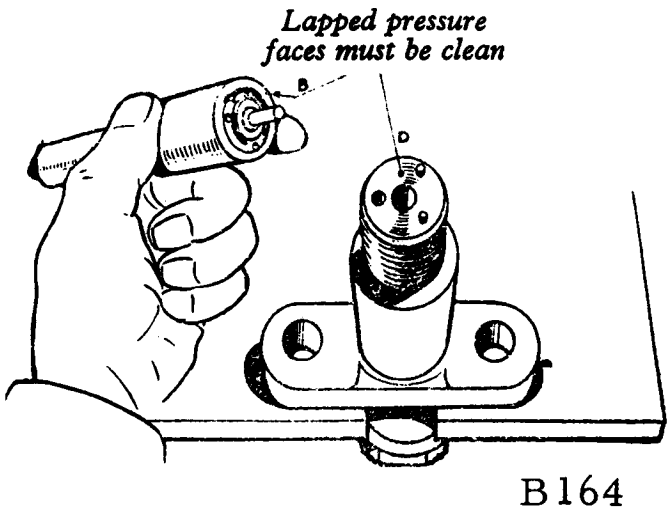


Figure 87

3. Install the spindle, spring and upper spring plate. Retain assembly with adjusting screw. Do not attempt adjustment at this time.

4. Install new lock nut gasket. Screw lock nut onto the adjusting screw finger tight.

5. Place injector in an injector tester, and test as outlined under "H. Testing". The injection pressure is obtained by turning the spring clockwise to increase the pressure, and counterclockwise to decrease it. Secure the adjustment with the lock nut.

6. Slide a new protecting cap gasket over the spring cap and tighten the protecting cap against it.

7. Place a new gasket in the injector inlet port and tighten the fuel inlet connection against it.

G. Installation

1. Clean carbon and dirt from counterbore and gasket seat in the cylinder head before installing injector assembly. Small carbon particles on seating surfaces will cock assembly and permit blow-by. The carbon can be removed with a piece of hard wood.

2. Crank engine with starting motor to blow out particles.

3. Place a new soft copper washer over the nozzle and carefully insert the injector so that the tip does not strike the wall.

4. Tighten hold-down nuts evenly so as not to bind or cock the injector. Tighten nuts to specified torque.

5. Re-assemble high-pressure and leak-off connections and tighten, always holding the fitting with a wrench to keep it from turning while tightening the nut.

H. Testing

1. An injector test pump such as in fig. 88 should be available. This unit has been specially designed to provide a reliable means of testing and setting the atomisers.

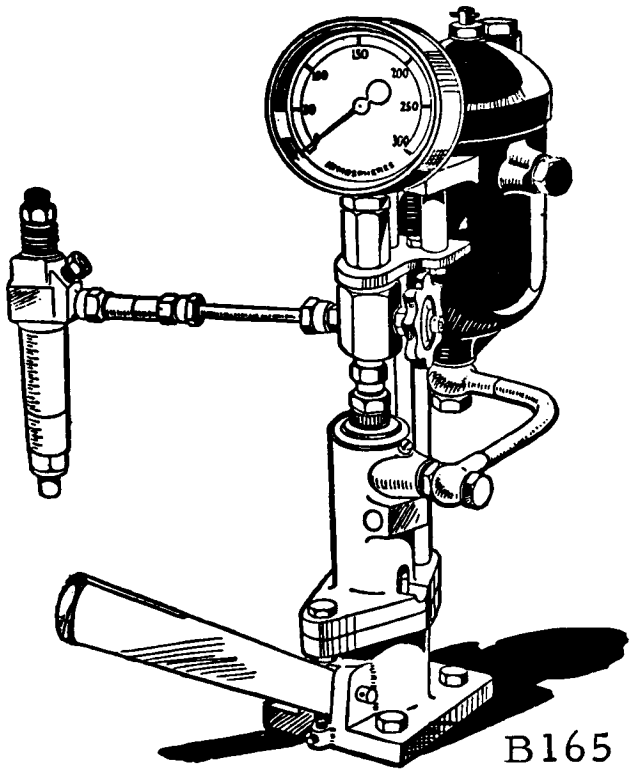


Figure 88

2. The doubtful injector should be fitted nozzle downwards, and still unwipped to an injector

test pump.

3. No observations should be made until at least ten full strokes of the hand pump have been given to expel air from the system.

4. The pressure at which the spray breaks should then be recorded and checked against the recommended pressure, which is 1750 to 1800 pounds per square inch.

5. The spray should now be observed for uniformity at a rate of pumping of not less than 20 strokes per minute.

6. Each should be a misty spray spreading to about 3 inches diameter at about one foot away from the injector nozzle, then breaking into a very fine mist. There should be two sprays from each injector nozzle, one pointing outwards from the top hole, and the other pointing downwards from the lower hole, when the injector is in a position corresponding to its working position.

7. An injector is good for service if, when operating the injector test pump at the above speed, it gives two effective sprays as above described.

8. An injector is dirty and requires reconditioning if (a) when proceeding as above it throws out solid wet jets and not broken up spray, or (b) if either of the holes is choked or partially choked so that spray issues from one hole in the injector only or appreciably more spray issues from one hole than the other.

9. When removing an injector from the testing pump, close the valve by rotating the handwheel and screw off the connection nut a little at a time so that the pressure falls gradually.

TROUBLESHOOTING GUIDE

Cause	Remedy
Engine Starts Hard	
1. Engine engaged with load	1. Disengage load.
2. Cranking speed too low	2. Check and repair as necessary.
3. Intake air temperature low	3. Use starting aid.
4. Pump timed incorrectly to engine	4. Correct timing.
5. One or more connector screws obstructed	5. Replace.
6. Fuel lines clogged or restricted	6. Blow out all fuel lines with filtered air. Replace if damaged. Remove and inspect all flexible lines.
7. Air leaks on suction side of system	7. Pressurize system with air to locate leaks. Repair as needed. Carefully check end plate inlet fitting seals.
8. Filters or inlet strainer clogged	8. Remove and replace clogged elements. Clean strainer.
9. Fuel too heavy	9. Drain tank and fill with specified fuel.
10. Lube oil too heavy at low temperature	10. Drain sump and fill with specified oil.
11. Water in fuel	11. Drain fuel system and pump housing, provide new fuel, prime system.
12. Engine compression poor	12. Correct compression.
13. Low cetane fuel	13. Provide fuel with higher octane.
14. Transfer pump blades worn or broken	14. Replace.
15. End plate regulating piston sticking	15. Remove piston and inspect for burrs, corrosion or varnishes. Replace if necessary.
16. Transfer pump faulty, pressure too low	16. Remove and inspect parts. Check; repair lift pump.
17. Shut-off device interfering with governor linkage	17. Check and adjust governor linkage dimension.
18. Metering valve sticking or closed	18. Check for governor linkage binding, foreign matter, burrs, etc.
19. Governor linkage out of adjustment	19. Adjust governor.
20. Governor not operating; parts or linkage worn, sticking or binding, or incorrectly assembled	20. Disassemble, inspect parts, replace if necessary and re-assemble.
21. Maximum fuel setting at low limit or too low	21. Reset.
22. Cam, shoes or rollers worn	22. Remove and replace.
23. Injection pump plungers sticking	23. Disassemble and inspect for burrs, corrosion or varnishes.

Cause	Remedy
24. Excessive fuel leakage past injection pump plungers	24. Replace rotor and hydraulic head assembly.
25. Wrong cam hole cover (incorrect cam position)	25. Install correct cover.
26. Lift pump defective	26. Check valve seating, diaphragm and spring. Replace parts as necessary.
27. Automatic advance faulty or not operating	27. Remove, inspect, correct and re-assemble.
28. Rotor plug screw leaking	28. Tighten or replace, if necessary.
29. Nozzles faulty	29. Replace or correct nozzles.
30. Engine valves faulty or out of adjustment	30. Correct valves or valve adjustment as in engine section.
31. Rotor badly scored	31. Replace hydraulic head and rotor assembly.
Engine Starts and Stops	
1. Fuel lines clogged or restricted	1. Blow out all fuel lines with filtered air. Replace if damaged. Remove and inspect all flexible lines.
2. Water in fuel	2. Drain fuel system and pump housing, provide new fuel, prime system.
3. Air intake restricted	3. Check and repair as necessary.
4. Return oil line restricted	4. Remove line, blow clean with filtered air and re-assemble. Replace if damaged.
5. Engine overheating	5. Correct as in engine section.
6. Filters or inlet strainer clogged	6. Remove and replace clogged elements. Clean strainer.
7. Air leaks on suction side of system	7. Pressurize system with air to locate leaks. Repair as needed. Carefully check end plate and inlet fitting seals.
8. Failure of shut-off	8. Re-adjust or remove and inspect parts and replace if necessary.
9. Metering valve sticking or closed	9. Check for governor linkage binding, foreign matter, burrs, etc.
10. Transfer pump blades worn or broken	10. Replace.
11. Cam roller shoes sticking	11. Remove, check for size and burrs and re-assemble.
12. Plungers sticking	12. Disassemble and inspect for burrs, corrosion or varnishes.
13. Lift pump defective	13. Check valve seating, diaphragm and spring. Replace parts as necessary.

Cause	Remedy
Erratic Engine Operation — Surge, Misfiring, Poor Governor Regulation	
1. Injection pipes leaking or connected to wrong engine cylinders	1. Relocate pipes for correct engine firing sequence.
2. Fuel lines clogged or restricted	2. Blow out all fuel lines with filtered air. Replace if damaged. Remove and inspect all flexible lines.
3. Filters or inlet strainer clogged	3. Remove and replace clogged elements. Clean strainer.
4. Pump timed incorrectly to engine	4. Correct timing.
5. Water in fuel	5. Drain fuel system and pump housing, provide new seal, prime system.
6. Low cetane fuel	6. Provide fuel with higher octane.
7. Pump housing not full of fuel	7. Operate engine for approximately 5 minutes until pump fills with fuel. Check and repair lift pump.
8. Air leaks on suction side of system	8. Pressurize system with air to locate leaks. Repair as needed. Carefully check inlet fitting seals.
9. Nozzles faulty	9. Replace or correct nozzle.
10. Engine valves faulty or out of adjustment	10. Correct valves or valve adjustment as in engine section.
11. Nozzle return lines clogged	11. Remove lines, blow out, inspect and re-assemble.
12. Wrong cam hole cover (incorrect cam position)	12. Install correct cover.
13. Automatic advance faulty or not operating	13. Remove, inspect, correct and re-assemble.
14. Metering valve sticking or closed	14. Check for governor linkage binding, foreign matter, burrs, etc.
15. Governor not operating; parts or linkage worn, sticking or binding, incorrectly assembled	15. Disassemble, inspect parts, replace if necessary and re-assemble.
16. Governor spring worn or broken	16. Remove and replace.
17. Governor linkage out of adjustment	17. Adjust.
18. Governor sleeve binding on drive shaft	18. Remove, inspect for burrs, dirt, etc. Correct and re-assemble.
19. Governor spring rate too low	19. Remove and replace with proper spring, and hooked in correct link hole.
20. Transfer pump blades worn or broken	20. Replace.
21. Transfer pump faulty, pressure too low	21. Remove and inspect parts.

Cause	Remedy
22. End plate regulating piston sticking	22. Remove piston and sleeve and inspect for burrs, corrosion or varnishes. Replace if necessary.
23. Rotor plug screw leaking	23. Tighten or replace screw, if necessary.
24. Cam roller shoes sticking	24. Remove, check for size and burrs and re-assemble.
25. Lift pump defective	25. Check valve seating, spring and diaphragm. Replace parts as necessary.
26. Water in fuel	26. Drain fuel system and pump housing, provide new fuel, prime system.
27. Engine compression poor	27. Correct compression.
Engine Exhausts Black Smoke	
1. Exceeding rated load	1. Reduce load on engine.
2. Air intake restricted	2. Clean or replace element, service air cleaner more often.
3. Engine overheating	3. Correct as in engine section.
4. Pump timed incorrectly to engine	4. Correct timing.
5. Nozzles faulty	5. Replace or correct nozzles.
6. Engine valves faulty or out of adjustment	6. Correct valves or valve adjustment as in engine section.
7. Automatic advance faulty or not operating	7. Remove, inspect, correct and re-assemble.
8. Low cetane fuel	8. Provide fuel with higher octane.
9. Wrong cam hole cover (incorrect cam position)	9. Install correct cover.
10. Engine compression poor	10. Correct compression.
11. Cam, shoes, or rollers worn	11. Remove and replace.
12. Maximum fuel setting too high	12. Reset.
Exhaust Smoke Blue	
1. Engine cold	1. Check thermostats; warm to operating temperature.
2. Pump timed incorrectly to engine	2. Correct timing.
3. Wrong cam hole cover (incorrect cam position)	3. Install correct cover.
4. Automatic advance faulty or not operating	4. Remove, inspect, correct and re-assemble.
Engine Does Not Develop Full Power or Speed	
1. Throttle arm travel not sufficient	1. Check installation and adjust throttle linkage.
2. Shut-off device interfering with governor linkage	2. Check and adjust governor linkage dimension.

Cause	Remedy
3. Governor high-idle adjustment incorrect	3. Adjust.
4. Fuel lines clogged or restricted	4. Blow out all fuel lines with filtered air. Replace if damaged. Remove and inspect all flexible lines.
5. Air leaks on suction side of system	5. Pressurize system with air to locate leaks. Repair as needed. Carefully check end plate regulating sleeve, end plate plug and inlet fitting seals.
6. Filters or inlet strainer clogged	6. Remove and replace clogged elements. Clean strainer.
7. Pump timed incorrectly to engine	7. Correct timing. See engine section.
8. Return oil line restricted	8. Remove line, blow clean with filtered air and re-assemble. Replace if damaged.
9. One or more connector screws obstructed	9. Replace.
10. Governor not operating; parts or linkage worn, sticking or binding, or incorrectly assembled	10. Disassemble, inspect parts, replace if necessary and re-assemble.
11. Metering valve sticking or closed	11. Check for governor linkage binding, foreign matter, burrs, etc.
12. Governor linkage out of adjustment	12. Adjust.
13. Wrong cam hole cover (incorrect cam position)	13. Install correct cover.
14. Automatic advance faulty or not operating	14. Remove, inspect, correct and re-assemble.
15. Transfer pump blades worn or broken	15. Remove, inspect, correct and re-assemble.
16. Transfer pump faulty, pressure too low	16. Remove and inspect parts. Check and repair lift pump, if necessary.
17. Maximum fuel setting at low limit or too low	17. Reset.
18. Cam shoes or rollers worn	18. Remove and replace.
19. Injection pump plungers sticking	19. Disassemble and inspect for burrs, corrosion or varnishes.
20. Excessive fuel leakage past plungers (worn or badly scored)	20. Replace rotor and hydraulic head assembly.
21. Rotor badly scored	21. Replace hydraulic head and rotor assembly.
22. Low cetane fuel	22. Provide fuel with higher cetane.
23. Rotor plug screw leaking	23. Tighten or replace screw.
Engine Idles Imperfectly	
1. Water in fuel	1. Drain fuel system and pump housing, provide new fuel, prime system.
2. Pump housing not full of fuel	2. Operate engine for approximately 5 minutes until pump fills with fuel.

Cause	Remedy
3. Air leaks on suction side of system	3. Pressurize system with air to locate leaks. Repair as needed. Carefully check end plate regulating sleeve, end plate plug and inlet fitting seals.
4. Pump timed incorrectly to engine	4. Correct timing.
5. Transfer pump blades worn or broken	5. Replace.
6. Governor not operating; parts or linkage worn, sticking or binding, or incorrectly assembled	6. Disassemble, inspect parts, replace if necessary and re-assemble.
7. Metering valve sticking or closed	7. Check for governor linkage binding, foreign matter, burrs, etc.
8. Governor linkage out of adjustment	8. Adjust.
9. Idling spring incorrect or missing	9. Replace with proper spring.
10. Nozzles faulty	10. Replace or correct nozzles.
11. Wrong cam hole cover (incorrect cam position)	11. Install correct cover.
12. Automatic advance faulty or not operating	12. Remove, inspect, correct and re-assemble.
13. End plate regulating piston sticking	13. Remove piston and sleeve and inspect for burrs, corrosion or varnishes. Replace if necessary.
14. Fuel lines clogged or restricted	14. Blow out all fuel lines with filtered air. Replace if damaged. Remove and inspect all flexible lines.
15. Low cetane fuel	15. Provide fuel with higher cetane.
16. Governor spring worn or broken	16. Remove and replace. Hook spring in correct hole in link.
17. Engine valves faulty or out of adjustment	17. Correct valves or valve adjustment as in engine section.
18. Governor linkage broken	18. Remove, replace and re-adjust.
19. Excessive fuel leakage past plungers (worn or badly scored)	19. Replace rotor and hydraulic head assembly.
20. Plungers sticking	20. Disassemble and inspect for burrs, corrosion or varnishes.
Fuel Not Reaching Pump	
1. Tank valve closed	1. Open valve.
2. Seizure of distributor rotor	2. Check for cause of seizure. Replace hydraulic head and distributor rotor assembly.
3. Lift pump defective	3. Check valve seating, spring and diaphragm. Repair pump as necessary.
4. Filters or inlet strainer clogged	4. Remove and replace clogged elements. Clean strainer.

Cause	Remedy
5. Fuel too heavy	5. Drain tank and fill with specified fuel.
6. Transfer pump liner located wrong	6. Re-install properly.
7. Transfer pump blades worn or broken	7. Replace.
8. Fuel lines clogged or restricted	8. Blow out all fuel lines with filtered air. Replace if damaged. Remove and inspect all flexible lines.
9. End plate regulating piston sticking	9. Remove piston and sleeve and inspect for burrs, corrosion or varnishes. Replace if necessary.
10. Air leaks on suction side of system	10. Pressurize system with air to locate leaks. Repair as needed. Carefully check inlet fitting seals.
Fuel Delivered From Transfer Pump But Not To Nozzles	
1. Shut-off device at "stop"	1. Move to "run" position.
2. Failure of shut-off	2. Re-adjust or remove and inspect parts and replace if necessary.
3. One or more connector screws obstructed	3. Replace.
4. Metering valve sticking or closed	4. Check for governor linkage binding, foreign matter, burrs, etc.
5. Governor spring worn or broken	5. Remove and replace. Hook spring in correct link hole.
6. Governor linkage broken	6. Remove, replace and re-adjust.
7. Governor not operating; parts or linkage worn, sticking or binding, or incorrectly assembled	7. Disassemble, inspect parts, replace if necessary and re-assemble.
8. Torque screw incorrectly adjusted	8. Adjust.
9. Fuel lines clogged or restricted	9. Blow out all fuel lines with filtered air. Replace if damaged. Remove and inspect all flexible lines.
10. Cam backwards in housing	10. Re-assemble correctly.
11. Cam roller shoes sticking	11. Remove, check for size and burrs and re-assemble.
12. Plungers sticking	12. Disassemble and inspect for burrs, corrosion or varnishes.
13. Passage from transfer pump to metering valve clogged with foreign matter	13. Disassemble and flush out hydraulic head.
14. Rotor badly scored	14. Replace hydraulic head and rotor assembly.
Fuel Reaching Nozzles but Engine Won't Start	
1. Cranking speed too low	1. Charge or replace batteries.
2. Engine engaged with load	2. Disengage load.

Cause	Remedy
3. Pump timed incorrectly to engine	3. Correct timing.
4. Throttle arm travel not sufficient	4. Check installation and adjust throttle linkage.
5. Intake air temperature low	5. Provide starting aids. See engine section.
6. Water in fuel	6. Drain fuel system and pump housing, provide new fuel, prime system.
7. Injection pipes leaking or connected to wrong engine cylinders	7. Relocate pipes for correct engine firing sequence.
8. Wrong cam hole cover (incorrect cam position)	8. Install correct cover.
9. Shut-off device interfering with governor linkage	9. Check and adjust governor linkage dimension.
10. Torque screw incorrectly adjusted	10. Adjust.
11. Cam, shoes or rollers worn	11. Remove and replace.
12. Maximum fuel setting at low limit or too low	12. Reset.
13. Excessive fuel leakage past plungers; worn or badly scored	13. Replace rotor and hydraulic head assembly.
14. Automatic advance faulty or not operating	14. Remove, inspect, correct and re-assemble.
15. Rotor badly scored	15. Replace hydraulic head and rotor assembly.
16. Nozzles faulty or sticking	16. Replace or correct nozzles.
17. Fuel too heavy	17. Drain tank and fill with specified fuel.
18. Low cetane fuel	18. Provide fuel with higher cetane.
19. Engine compression poor	19. Correct compression.
20. Lube oil too heavy at low temperature	20. Drain sump and fill with specified oil.
Incorrect Vacuum	
1. Loose or damaged inlet connections	1. Tighten or replace as necessary.
2. Damaged inlet adaptor to end plate copper washer	2. Check sealing surfaces of mating parts. Replace copper washer and other parts as necessary.
3. End plate plug loose	3. Tighten or replace as necessary.
4. Damaged outer seal on regulating sleeve	4. Check sealing surfaces of mating parts. Replace seal and parts as necessary.
5. Regulating spring missing, weak, broken or incorrect	5. Install or replace spring as necessary.
6. End plate not evenly tightened	6. Loosen screws and tighten attaching screws to correct torque.
7. Defective transfer pump seal	7. Check sealing surfaces of mating parts. Replace seal and parts as necessary.

Cause	Remedy
8. Worn or damaged transfer pump blades	8. Disassemble, clean, inspect and assemble injection pump replacing parts as necessary. Test pump after assembling.
9. Transfer pump liner not installed correctly	9. Remove, clean and install liner, making sure it is correctly seated and located.
Low Transfer Pressure	
1. Incorrect vacuum	1. Refer to "Incorrect Vacuum", above.
2. Regulator valve inner seal damaged	2. Check sealing surfaces of mating parts. Replace seal and parts as necessary.
3. Defective washers on the head locking screws and locating stud	3. Check sealing surfaces of mating parts. Replace washers and other parts as necessary.
4. Damaged seals on head locating fitting	4. Check sealing surfaces of mating parts. Replace seal and parts as necessary.
High Transfer Pressure	
1. Sticking regulating valve	1. Disassemble valve, clean and blow dry. Inspect parts for defects and replace as necessary.
2. Regulating spring too strong	2. Install correct spring.
3. Test being performed with pressure feed	3. Change to gravity feed.
Low And Fluctuating Transfer Pressure	
1. Regulating sleeve inner seal defective	1. Check sealing surfaces of mating parts. Replace seal and parts as necessary.
2. One transfer pump vane chipped or broken	2. Disassemble, clean, inspect and assemble injection pump, replacing parts as necessary.
Low Advance Reading	
1. Low transfer pressure	1. Refer to "Low Transfer Pressure."
2. Too many shims between piston spring cap and piston spring	2. Delete shims as necessary.
3. Incorrect spring, too stiff	3. Install correct spring.
4. Sticking advance piston	4. Remove piston, clean and blow dry. Inspect piston and mating surfaces for defects. Replace parts as necessary.
5. Sticking cam ring	5. Remove cam ring, clean and blow dry. Inspect ring and mating surfaces for defects. Replace parts as necessary.
6. Excessive clearance between piston and housing	6. Replace parts as necessary.
High Advance Reading	
1. High transfer pressure	1. Refer to "High Transfer Pressure."
2. Insufficient shims between the piston spring cap and piston spring	2. Add shims as needed.

Cause	Remedy
3. Incorrect spring, too weak	3. Install correct spring.
Incorrect Maximum Fuel Delivery	
1. Throttle not fully open	1. Adjust linkage or throttle arm on its shaft, as necessary.
2. Incorrect maximum fuel setting	2. Adjust maximum fuel setting to specifications.
3. Rotor plug loose or washer damaged	3. Tighten plug. Replace parts as necessary.
4. Sticking metering valve	4. Remove metering valve, clean and blow dry. Inspect valve and mating surfaces for defects. Replace parts as necessary.
5. Air in system	5. Check all connections on inlet side of pump. Tighten all loose connections. Replace defective fittings. Bleed the system.
6. Sticking plungers or roller shoes	6. Remove plungers and roller shoes, clean and blow dry. Inspect plungers and shoes. Replace parts as necessary.
7. Damaged washers on outlet connections	7. Check sealing surfaces of mating parts. Replace washers and parts as necessary.
8. Incorrect transfer pressure	8. Refer to "Low Transfer Pressure," "High Transfer Pressure" and "Low and Fluctuating Transfer Pressure."
9. Shut-off mechanism interfering with metering valve	9. Disassemble governor to locate difficulties. Replace parts as necessary.
10. Incorrect assembly of rack and pinion	10. Disassemble governor and assemble correctly.
11. Cam ring reversed	11. Remove cam ring and install it according to pump rotation.
Low Fuel Delivery at 100 RPM	
1. Low transfer pump pressure	1. Refer to "Low Transfer Pressure," "High Transfer Pressure" and "Low and Fluctuating Transfer Pressure."
2. Throttle not fully opened	2. Adjust linkage or adjust throttle arm on its shaft, if necessary.
3. Rotor plug screw loose or washer damaged	3. Tighten plug. Replace parts as necessary.
4. Sticking or scored metering valve	4. Remove metering valve, clean and blow dry. Inspect valve and mating parts for defects. Replace parts as necessary.
5. Sticking plungers and roller shoes	5. Remove plungers and roller shoes, clean and blow dry. Inspect plungers and roller shoes for defects. Replace parts as necessary.
6. Damaged washers on outlet connections	6. Check sealing surfaces of mating parts. Replace washers and parts as necessary.

Cause	Remedy
7. Plungers scored	7. Replace plungers and rotor.
8. Excessive clearance between rotor and hydraulic head	8. Replace parts as necessary.
9. Air in system	9. Check all connections on inlet side of pump. Tighten loose connections. Replace defective fittings. Bleed the system.
Cut-Off Not Working	
1. Cut-off lever installed incorrectly on its shaft	1. Remove cut-off lever and install it correctly.
2. Cut-off lever not turning its shaft	2. Repair or replace lever and shaft as necessary.
3. Sticking metering valve	3. Remove metering valve, clean and blow dry. Inspect valve and mating parts for defects. Replace parts as necessary.
4. Metering valve nut loose	4. Tighten nut.
INJECTORS	
Nozzle Does Not Buzz While Injecting	
1. Needle valve too tight, binding or valve not seating	1. Clean nozzle. Examine cap nut. Replace parts as necessary.
2. Nozzle cap distorted	2. Replace nozzle cap and nozzle if necessary.
Excessive Leak-Off	
1. Needle valve loose in nozzle	1. Replace valve and nozzle as an assembly.
2. Foreign matter between pressure faces of nozzle and nozzle holder	2. Remove nozzle. Clean nozzle and cap and blow dry.
3. Nozzle cap not tight	3. Remove nozzle. Clean nozzle and cap. Inspect parts and replace as necessary.
Nozzle Bluing	
1. Faulty installation, tightening or cooling	1. Replace nozzle and needle valve. Clean nozzle port in head. Install injector, using a new washer and correct torque.
Opening Pressure Too High or Too Low	
1. Adjusting screw not locked into position	1. Adjust opening pressure to specification, and lock adjusting screw position.
2. Needle valve seized or corroded	2. Replace nozzle and needle valve.
3. Needle valve dirty or sticking	3. Remove nozzle. Clean needle valve and nozzle. Inspect and replace parts if necessary.
4. Nozzle openings clogged (pressure too high)	4. Remove nozzle, remove foreign particles from openings. Check spray pattern. Replace nozzle and needle valve if the spray patterns are not satisfactory or identical.

Cause	Remedy
5. Injector spring broken (pressure too high)	5. Remove spring and adjust opening pressure to specifications.
Nozzle Drip	
1. Carbon deposit on needle valve or seat; sticking needle valve	1. Remove nozzle and needle valve, clean and blow dry. Replace parts if necessary.
Spray Pattern Distorted	
1. Carbon on tip of needle valve	1. Remove needle valve, clean and blow dry. Remove carbon from needle valve and nozzle.
2. Holes in nozzle partially blocked	2. Remove nozzle, clean and blow dry. Remove carbon from holes.

SPECIFICATION LISTING

Injector:	
Working Pressure	1760 PSI
Setting Pressure	1835 PSI
Injection Timing (Static)	20° BTDC
Injection Pump:	
Rotation	Clockwise
Roller to Roller Dim.	1.978 In.
Gov. Link Length	2.05-2.12 In.
Gov. Spring Position:	
Control Arm Hole	No. 2
Throttle Link Hole	No. 3
Injection Pump Test Stand Specification:	
Injectors	BKB50SD 19b
Nozzles	BDN12SD 12
Opening Pressure	2583 PSI
High Pres. Pipes	.2362" x .0787"
High Pres. Pipes	.2362" x .0787" x 34"
Measure Glass Capacities	10cc & 21cc Gravity

NOTE: To avoid fuel starvation and irregular pump behavior, there should be a fuel flow at the pump inlet of not less than 1000 cc per minute.

If this flow cannot be obtained, it is permissible to use a pressure feed of 2 PSI maximum.

Throttle and shut-off levers to be fully open except where otherwise stated.

Where marked thus * use 30 seconds glass draining time and allow fuel to settle for 15 seconds before taking reading.

Leaks: All pumps must be completely free from leaks both while running and when stationary.

Delivery values: All calibration and setting values are for 200 strokes except where otherwise stated.

Unscrew maximum stop screw and idling stop screw to allow full movement of throttle arm before commencing tests.

Test Procedure

NOTE: Attach auto-advance measuring device and set scale to zero before commencing. A .0197 inch shim is assembled to the piston spring cap on assembly; this must not be removed. No further shimming is required.

Test No.	Description	R.P.M.	Requirements
1	Priming	100 max.	Fuel delivery from all injectors.
2	Transfer pump vacuum	100	Note time to reach 16 in. Max. time allowed 60 seconds.
3	Transfer pressure	100	11 PSI Minimum
4	Transfer pressure	750	52 to 64 PSI

NOTE: On tests 5 and 6, to obtain the required degree of advance use the metering valve adjuster on the end of the governor housing.

Test No.	Description	R.P.M.	Requirements
5	Delivery Setting	1000	Fit shut-off lever adjustment tool to pump. Obtain average delivery 7.2 to 7.8 c.c. by shut-off lever adjustment. NOTE: Advance indicator must show zero.
6	Advance setting	1000	With shut-off lever as at (5) set external adjustment to obtain 1-3/4° to 2-1/4° advance.
7	Delivery check	1000	With shut-off lever and external adjustment as at (5) and (6), average delivery to be 7.4 to 8.0 c.c.
8	Advance check	1000	With shut-off lever fully closed, advance to be 3-1/2° to 4-1/2°.
9	Back leakage Throttle lever fully closed	600	5 to 50 c.c. for 100 shot time cycle.
10	Max. fuel delivery	800*	Set to 13 c.c. Delivery tolerance + 0 — 0.2 c.c. Spread between lines not to exceed 1.0 c.c. NOTE: Advance indicator must show zero.
11	Max. fuel delivery check	100*	Average delivery to be not less than average at (10) minus 2.0 c.c.
12	Cut-off operation	200	Average delivery not to exceed 0.8 c.c.
13	Throttle operation Throttle lever closed	200	Average delivery not to exceed 1.5 c.c.
14	Fuel delivery check	1080	Record average delivery.
15	Governor setting	1200	Set throttle by maximum speed adjustment screw to give maximum average delivery of 2.0 c.c. No line to exceed 2.5 c.c.
16	Fuel delivery check	1080	With throttle set as at (15) average delivery to be not less than average at (14) minus 0.4 c.c.
17	Governor setting	1200	Set throttle to give average delivery of 2.0 c.c. Lock stop screw.
18	Timing		Using outlet "W" (450 PSI), set timing ring to letter "E" on drive plate. With pump in this position set indexing tool to 40° and scribe line on housing flange.

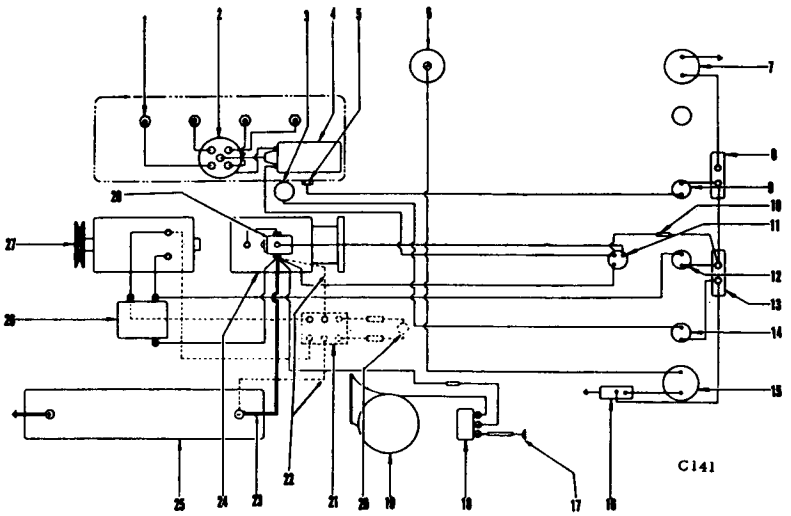
Torques (Lbs.-In.)

Injector Hold-down Nut	120-140
Hub Securing Screw	285
Cam Securing Screw	265
Cam Advance	300
Drive Plate Screws	160
Head Locating Screw	285
Head Locking Screw	170
Transfer Pump Rotor	65
End plate Screws	45
Inlet Fitting	360
Advance Device Locating Fitting:	
With Cork Gasket	350
With Rubber Gasket	300
Cover Securing Nuts	30

SECTION C — ELECTRICAL

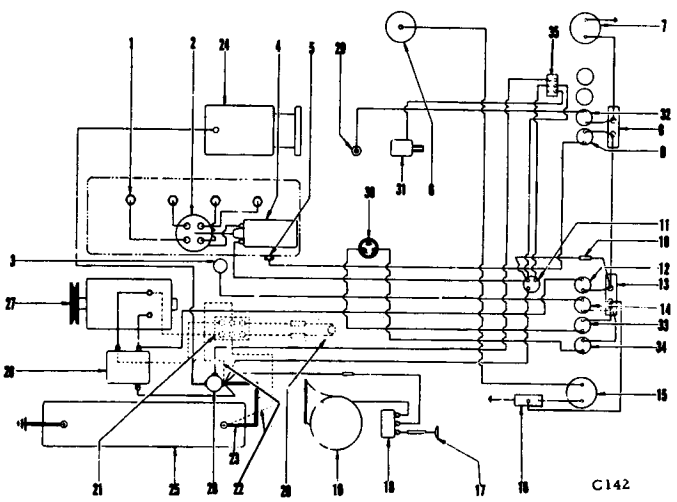
TABLE OF CONTENTS

ELECTRICAL



S30B - GASOLINE POWERED - 6 VOLT
(STANDARD TRANSMISSION)

Figure 1

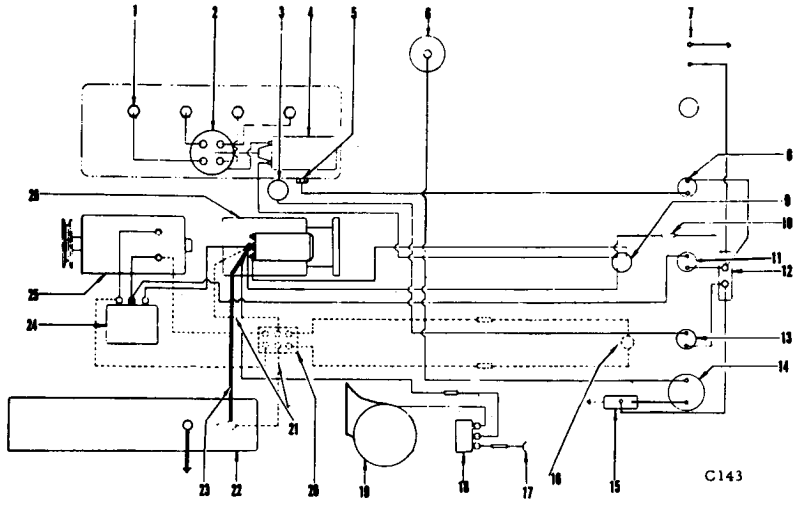


S30B - GASOLINE POWERED - 6 VOLT
(POWERSHIFTED TRANSMISSION)

Figure 2

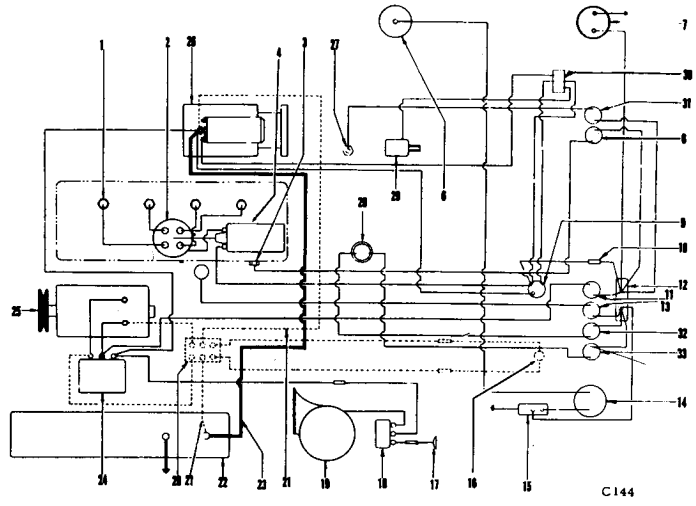
1. Spark Plug
2. Distributor
3. Oil Pressure Switch
4. Ignition Coil
5. Eng. Temperature Switch
6. Fuel Level Sender
7. Hour Meter
8. Fuse Block - 15 amp
9. Eng. Temp. Lamp
10. Fuse - 15 amp
11. Ignition Switch
12. Generator Lamp
13. Fuse Block - 15 amp
14. Oil Pressure Lamp
15. Fuel Gauge
16. Voltage Limiter
17. Horn Button
18. Horn Relay
19. Horn
20. Disconnect Switch Control *
21. Disconnect Switch *
22. Battery Cable *
23. Battery Cable (Std.)
24. Starter
25. Battery
26. Generator Regulator
27. Generator
28. Solenoid
29. Trans. Temperature Switch
30. Pressure Switch
31. Trans. Solenoid Valve
32. Trans. Temperature Lamp
33. Fwd. Indicator Lamp
34. Rev. Indicator Lamp
35. Park-Drive Switch

* Equipment indicated by dotted lines are for GS and LPS trucks only.



S30B - GASOLINE POWERED - 12 VOLT
(STANDARD TRANSMISSION)

Figure 3

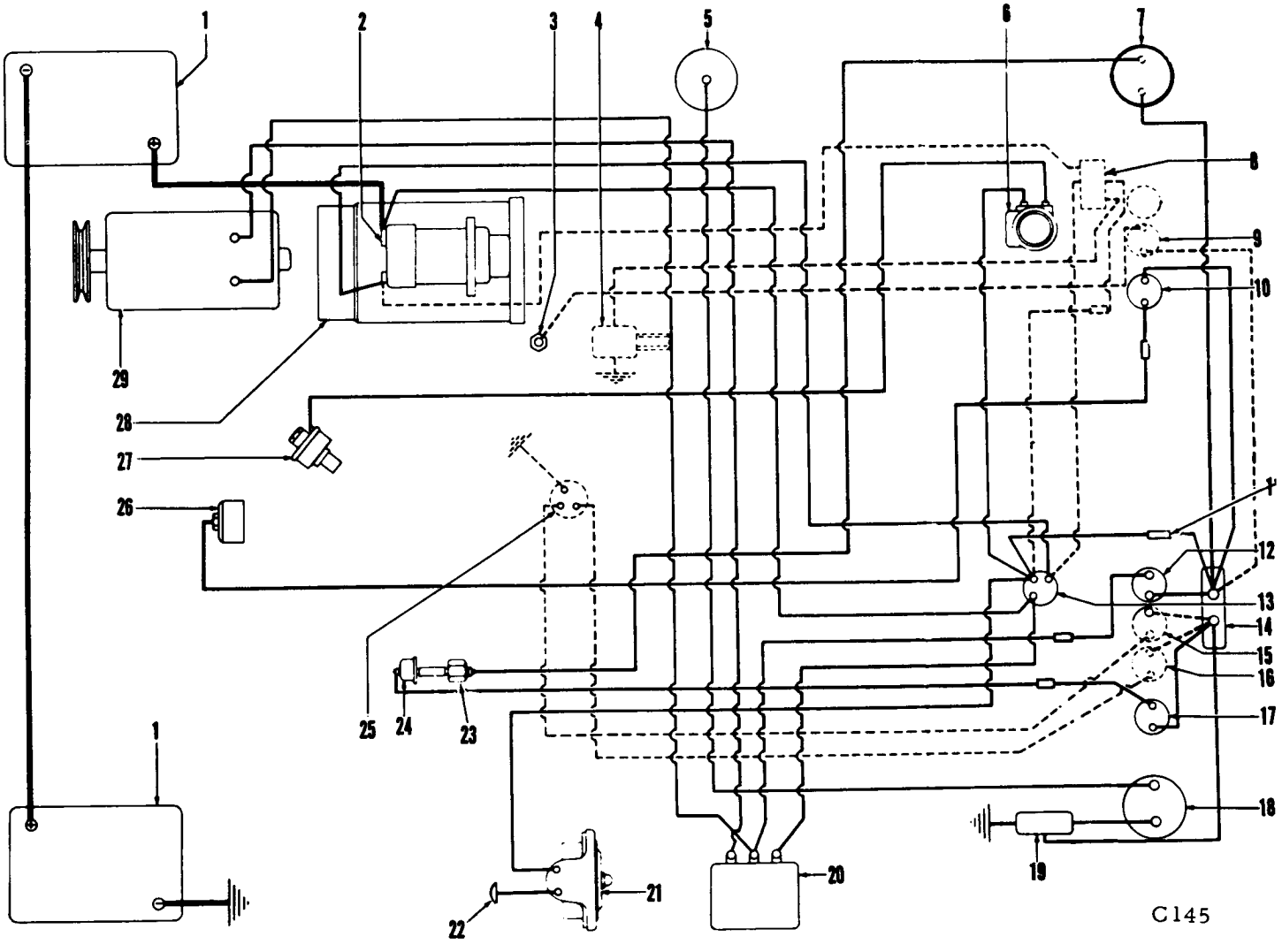


S30B - GASOLINE POWERED - 12 VOLT
(POWERSHIFTED TRANSMISSION)

Figure 4

1. Spark Plug
2. Distributor
3. Oil Pressure Switch
4. Ignition Coil
5. Eng. Temperature Sender
6. Fuel Level Sender
7. Hour Meter
8. Eng. Temperature Lamp
9. Ignition Switch
10. Fuse - 5 amp
11. Generator Lamp
12. Terminal Block
13. Oil Pressure Lamp
14. Fuel Gauge
15. Voltage Limiter
16. Disconnect Switch Control
17. Horn Button
18. Horn Relay
19. Horn
20. Disconnect Switch *
21. Battery Cable *
22. Battery
23. Battery Cable (Std.)
24. Generator R gulator
25. Generator
26. Starter & Solenoid
27. Trans. Temperature Switch
28. Pressure Switch
29. Trans. Solenoid Valve
30. Switch
31. Trans. Temperature Lamp
32. Fwd. Indicator Lamp
* 33. Rev. Indicator Lamp

* Equipment indicated by dotted lines are for GS and LPS trucks only.

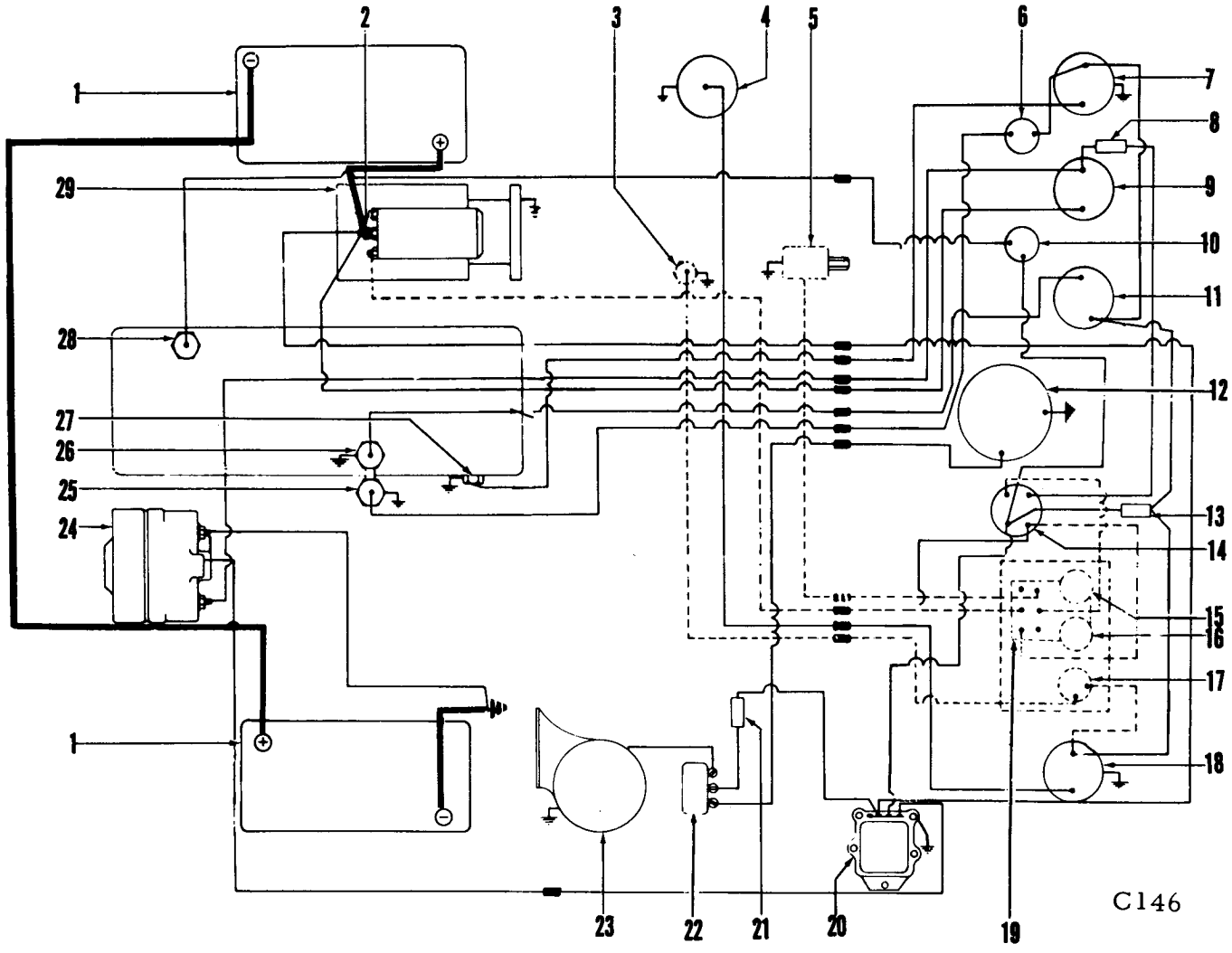


S30B - DIESEL POWERED

1. Battery
2. Starter Solenoid
3. Trans. Temperature Switch*
4. Trans. Solenoid Valve*
5. Fuel Level Sender
6. Cold Start Switch
7. Hour Meter
8. Park-Drive Switch
9. Trans. Temperature Lamp
10. Eng. Temperature Lamp
11. Fuse-5 amp
12. Generator Lamp
13. Ignition Type Switch
14. Terminal Block
15. Fwd. Indicator
16. Rev. Indicator Lamp*
17. Oil Pressure Lamp
18. Fuel Gauge
19. Voltage Limiter
20. Generator Regulator
21. Horn
22. Horn Button
23. Hour Meter Switch
24. Oil Pressure Switch*
25. Pressure Switch
26. Eng. Temperature Switch
27. Cold Start Heater
28. Starter
29. Generator

*Equipment indicated by dotted lines are for powershifted trucks only

Figure 5



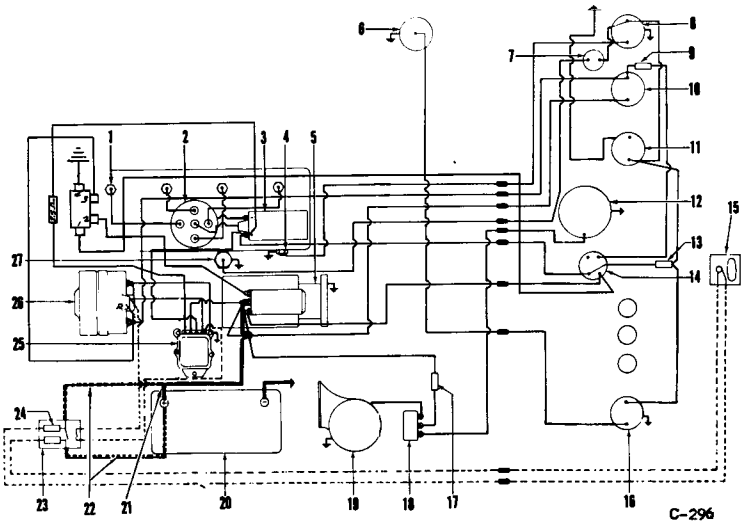
S30C - DIESEL POWERED

1. Battery
2. Starter Solenoid
3. Trans. Temperature Switch *
4. Fuel Level Sender
5. Trans. Solenoid Valve *
6. Oil Pressure Lamp
7. Eng. Temperature Gauge
8. Fuse - 30 amp
9. Ammeter
10. Cold Start Switch
11. Hour Meter
12. Horn Button
13. Fuse - 5 amp
14. Ignition Type Switch
15. Fwd. Indicator Lamp *
16. Rev. Indicator Lamp *
17. Trans. Temperature Lamp *
18. Fuel Gauge
19. Park-Drive Switch *
20. Alternator Regulator
21. Fuse - 10 amp
22. Horn R lay
23. Horn
24. Alternator
25. Oil Pressure Switch
26. Hour Meter Switch
27. Eng. Temperature Sender
28. Cold Start Heater
29. Starter

* Equipment indicated by dotted lines are for powershifted trucks only.

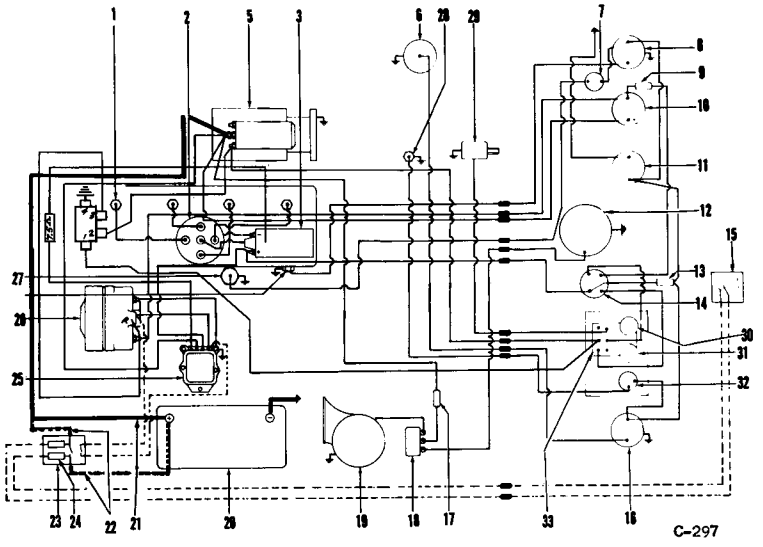
Figure 6

ELECTRICAL



S30C - GASOLINE POWERED
(STANDARD TRANSMISSION)

Figure 7



S30C - GASOLINE POWERED
(POWERSHIFTED TRANSMISSION)

Figure 8

1. Spark Plugs
2. Distributor
3. Ignition Coil
4. Eng. Temperature Sender
5. Starter & Solenoid
6. Fuel Level Sender
7. Oil Pressure Lamp
8. Eng. Temperature Gauge
9. Fuse - 30 amp
10. Ammeter
11. Hour Meter
12. Horn Button
13. Fuse - 5 amp
14. Ignition Switch
15. Disconnect Switch Control *
16. Fuel Gauge
17. Fuse - 10 amp
18. Horn Relay
19. Horn
20. Battery
21. Battery Cable (Std.)
22. Battery Cable *
23. Disconnect Switch *
24. Fuse - 10 amp
25. Alternator Regulator
26. Alternator
27. Oil Pressure Switch
28. Trans. Temperature Switch
29. Trans. Solenoid Valve
30. Fwd. Indicator Lamp
31. Rev. Indicator Lamp
32. Trans. Temperature Lamp
33. Park-Drive Switch

* GS or LPS equipment only. Wires and cables connecting these components are indicated by dotted lines.

GENERAL

There are two electrical systems covered in this section, the 6 volt system and 12 volt system. Although the components in each system are generally the same, they will vary between truck models.

Systems of the S30B, S40B and S50B gasoline powered trucks with serial numbers prior to B2D-3247 have 6 volt systems. Effective with this serial number these trucks are equipped with a 12 volt system. Fig. 3 and 4. Diesel powered trucks have 12 volt systems. Fig. 5. Regardless of voltage all systems will include a generator, generator regulator, battery, cranking motor, switches, instruments and the necessary wiring.

The S30C, S40C and S50C trucks have 12 volt systems. Figs. 6, 7 and 8. The components in these are similar to those above except that an alternator and alternator regulator replace the generator and generator regulator, respectively.

Besides the mentioned components all systems of gasoline and LPG powered trucks will have an ignition coil, distributor and spark plugs.

Although some components pertinent to the operation of LPG and diesel engines may operate electrically these are part of the fuel system and are covered in that section. Electrical components relative to the powershift transmission are covered in the clutch and transmission section.

BATTERY. Fig. 9

A. Maintenance

1. Electrolyte level in the battery should be checked at least once every two weeks. If the electrolyte level is found to be low, water should be added to each cell until the level rises to the bottom of the vent well. Do not overfill! Distilled water or water passed through a "demineralizer" should be used to eliminate the possibility of harmful impurities being added to the electrolyte. Many common impurities will greatly shorten battery life. Do not add any substance to the electrolyte except water.

2. The external condition of the battery and the battery cables should be checked periodically. The top of the battery should be kept clean and the battery hold-down bolts should be kept properly tightened. For best results when cleaning battery wash first with a dilute solution of ammonia or soda to neutralize any acid present, then flush off with clean water. Care must be used to keep vent plugs tight so that the neutralizing solution does not enter the cells. The hold-down bolts should be kept tight enough to prevent the battery from shaking around in its holder, but they should not be tightened sufficiently to place a strain on the battery case.

3. To insure good contact, the battery cable clamps should be tight on the battery posts. If the posts or cable clamps are corroded, the cables should be disconnected and the posts and clamps cleaned separately with a soda solution and a wire brush. Install clamps on battery posts and tighten firmly, then coat posts and clamps with petroleum jelly to help retard corrosion.

B. Tests

Before making any battery condition test, make sure the battery terminal posts are free of corrosion, dirt and oxidation. This is necessary to insure the lowest possible resistance for all electrical connections.

1. State of Charge

a. The hydrometer test is merely a means of determining the state of charge of the battery. This test will not necessarily indicate whether the battery is able to perform its normal functions, such as starting.

b. Measure specific gravity of electrolyte in each battery cell. The hydrometer tube must be held vertically. Do not draw too much electrolyte into the hydrometer. The float must be freely suspended in the electrolyte and the reading taken at eye level. If water has been recently added to the cells, or battery fast charged, the hydrometer reading will be false.

c. If the specific gravity readings are 1.215-1.270 at 80° F., and variation between cells is less than 25 gravity points (.025) the battery presumably is at least 3/4 charged and in good condition for further use.

d. If the specific gravity readings are below 1.215 and the variation between cells is less than 25 gravity points, the battery presumably is in sound condition, but its state of charge is too low for further use or testing electrical circuits.

e. If the specific gravity readings show a variation between cells of more than 25 gravity points, an unsatisfactory battery condition is indicated, which may be caused by shorted cells, acid loss, or a worn out battery.

2. Voltage Test

a. Connect the voltmeter from the positive post to the negative post of the battery. Be sure the clips make a positive connection with a clean portion of the battery posts. Under a no-load condition a fully charged battery should read at least 12.0 volts. (2.0 volts per cell).

b. If the reading is low, connect the voltmeter across each individual cell. If all cells are low but have equal readings, the battery is low and should be charged.

c. If some cell readings are 2.0 volts and another cell is discharged more than .5 volt, it indicates a short or the electrolyte is low in that cell.

C. Charging

1. Batteries removed from the vehicle for charging should be charged continuously at a low rate until fully charged. Batteries may be safely slow-charged at a rate in amperes equal to 7% of the battery's ampere-hour capacity. This is called the "normal" charge rate. The battery is fully charged when specific gravity readings taken at hourly intervals show no increase during three consecutive readings.

2. A very low rate—not more than one-half the normal charging rate—should be used for charging a sulfated battery. In the case of badly sulfated batteries, as much as 100 hours of charging time may be required before the battery becomes fully charged. Badly sulfated batteries may require a continuous slow charge for 48 hours or more before a rise in gravity reading occurs. If the specific gravity reading of any cell fails to reach 1.250 (corrected to 80° F.) or if there is a variation of more than 25 gravity points between cells after thorough slow charging, replace the battery.

3. Although the slow-charge method is recommended for charging all batteries, discharged batteries in otherwise good condition may be given a boost with a quick charger if time does not permit complete slow charging. When using a quick charger, it must be remembered that the battery is only receiving a partial charge and that the battery electrolyte temperature must not be allowed to exceed 130° F. If the battery heats up excessively, quick charging must be discontinued.

D. Cold Weather Care

A battery operated in an undercharged condition may freeze during severe winter weather. The freezing point of the electrolyte varies with specific gravity. A fully charged battery with 1.285 specific gravity corrected to 80° F. will not freeze at minus 80° F.

GENERATOR. Fig. 9

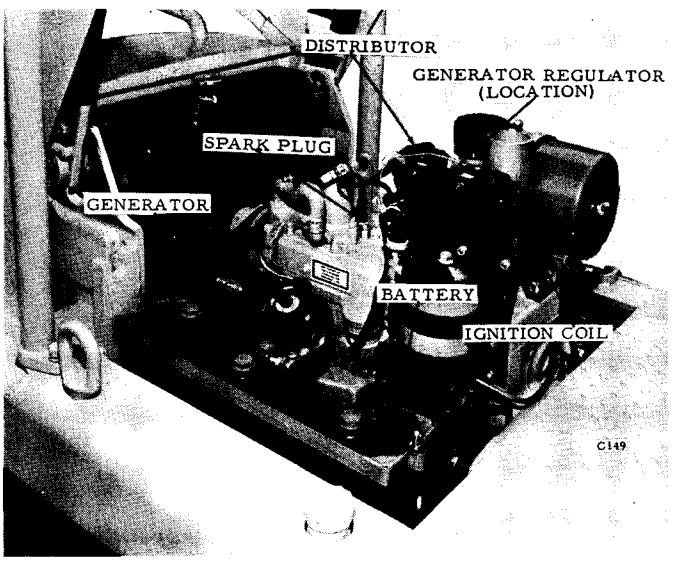


Figure 9

A. General

The 6 volt generator is a ventilated, three brush, shunt type unit, with a ball bearing supporting the armature at the drive end and a bronze bushing supporting the commutator end. The 12 volt generator has two brushes and the armature is supported by ball bearings at both ends.

B. Maintenance

1. Lubrication: The two hinge cap oilers should be supplied with medium engine oil every vehicle lubrication period.

CAUTION: Do not oil excessively. Never oil commutator.

2. Inspection

a. The 6 volt cover band should be removed and the commutator and brushes inspected at regular intervals. If the commutator is dirty, it may be cleaned with No. 00 sandpaper. Blow out all dust after cleaning. If the commutator is rough, out-of-round, or has high mica, it should be turned down on the lathe and the mica undercut.

Worn brushes should be replaced. Check brush spring tension which should be approximately 24 ounces.

b. Due to the type of construction, the 12 volt generator must be removed from the truck and disassembled in order to check the condition of the brushes and commutator.

CAUTION: Never use emery cloth to clean commutator.

NOTE: Brushes can be seated with a brush seating stone. When held against the revolving commutator, the abrasive material carries under the brushes, seating them in a few seconds. Blow out abrasive particles after seating brushes.

C. Removal

Remove both wires from the generator leads. Remove the adjusting bracket capscrew, V-belt, and the two lower mounting bolts. Lift the unit from the truck.

D. Dissassembly Fig. 10

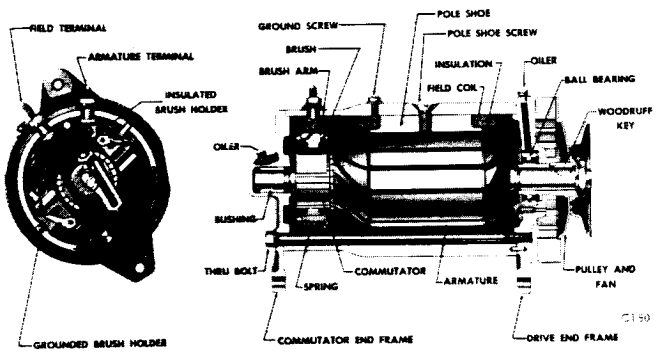


Figure 10

1. Remove the through bolts, commutator end frame, and the field frame.

2. Place the armature in a vise equipped with soft jaws and remove the shaft nut, pulley, key and drive end frame.

E. Service

1. If the brush holders must be replaced, it is necessary to drill out the rivets holding the present holders. Replace with new holders, securing them to the frame with screws, washers and nuts.

2. If the commutator is rough, out-of-round, or has high mica, it should be turned down in a lathe and the mica undercut 1/32 inch wide and 1/32 inch deep.

3. Wash bearings and repack with a good grade of ball bearing grease. Never clean the armature or field in a degreasing tank, or with grease dissolving materials, since the insulation might be damaged or destroyed.

4. Check all wiring and connections. Use rosin flux solder to make any soldered connections. Never use acid flux on electrical connections.

F. Assembly: Reverse dissassembly procedure.

G. Checking Faulty Generator

1. No output

a. Check for sticking or worn brushes and burned commutator bars. Burned bars, with other bars fairly clean, indicate open circuited field coils. If the brushes are making good contact with the commutator, and the cause of trouble is not apparent, use a set of test points and a lamp, as follows, to locate the trouble.

NOTE: Leads must be disconnected from the generator terminals.

b. Insulate the grounded brush from the commutator with a piece of cardboard. Check with the test points on the "A" terminal and generator frame. Test light should not light. If the lamp does light, the generator is internally grounded. Locate the ground by insulating both brushes from the commutator, and checking the brush holders, armature, and field separately. Replace parts as needed.

c. If the generator is not grounded, check the field for an open circuit with a test lamp. The lamp should light when one test point is placed on the field terminal and the other on the brush holder to which the field is connected. If it does not light, the circuit is open. Repair a bad connection or broken lead, but replace an "open" coil.

d. If the field is not open, check for a shorted field.

NOTE: If a shorted field is found, check the

regulator contact points for severe burning. Clean or replace points as needed.

e. If trouble has not yet been found, remove armature and check it on a growler for short circuit.

2. Unsteady or low output

a. Check fan belt tension.

b. Check brushes for correct operation and springs for proper tension.

c. If the commutator is dirty, out-of-round, rough, greasy, or has high mica, turn the unit in a lathe and undercut the mica. Burned commutator bars probably indicate an open circuit in the armature. Either locate and repair the "open", or replace the armature.

3. Excessive output

a. Excessive output usually results from an accidentally grounded generator field. Normal grounding of the generator field circuit on these trucks is through the regulator. Accidental internal grounding of the generator at the pole shoes, leads, or "F" terminal would prevent normal regulation of the generator output.

b. To find whether the generator is internally grounded use test points connected between the "F" terminal and the generator frame. Disconnect leads from the "F" terminal. The brush to which the field lead is connected inside the generator must be raised from the commutator. If the test lamp lights, the generator is internally grounded. Fig. 11.

4. Noisy generator

A noisy generator may be caused by loose mountings or drive pulley, worn, dry, or dirty bearings, or improperly seated brushes. Brushes may be seated with Allen W72 brush seating compound if the brush holders are not bent. Bent holders should be replaced.

H. Installation

1. Reverse removal procedure.

2. After the generator is installed, or at any time after the leads have been disconnected and

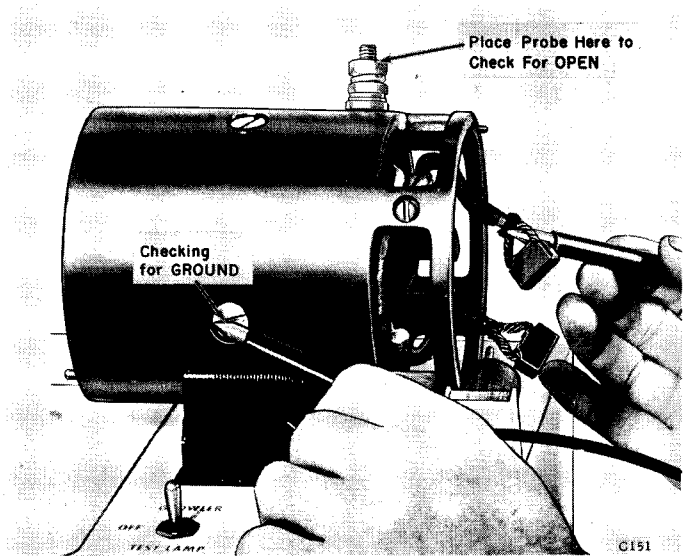


Figure 11

then reconnected to the generator, the generator MUST be polarized to prevent damage to the charging circuit.

3. Before starting the engine, momentarily connect a jumper lead between the battery terminal and armature terminal of the voltage regulator. This allows a surge of current from the battery to the generator and correctly polarizes the generator with respect to the battery it is to charge.

4. See the Specification Listing for correct fan belt adjustment.

GENERATOR REGULATOR—6 Volt. Fig. 9

A. General

This assembly contains two units, a cutout relay and a step voltage control. Fig. 12.

The cutout relay requires three checks and adjustments: air gap, point gap and point opening.

Five checks and adjustments are required on the step voltage control: flat spring tension, air gap, armature travel, point opening and voltage setting.

Mechanical checks and adjustments (air gaps, point openings, etc.) must be made with the battery disconnected and the step-voltage control preferably off the vehicle.

Electrical checks and adjustments may be made

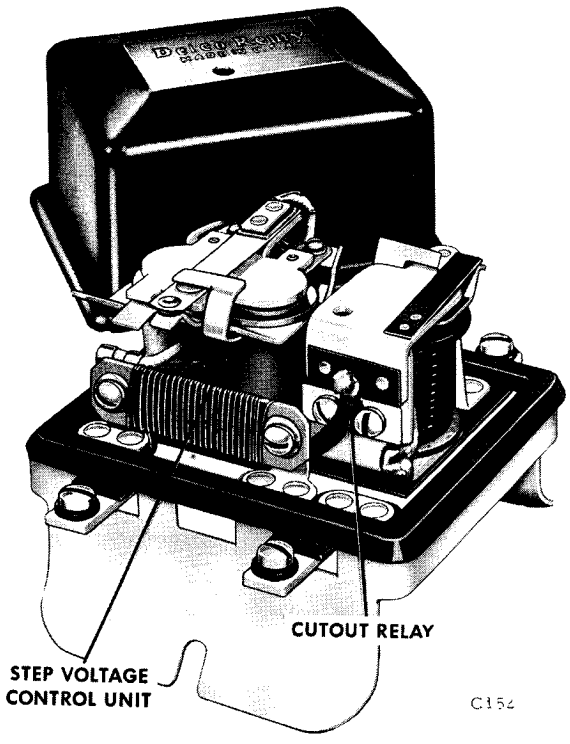


Figure 12

with the step-voltage control either on or off the vehicle.

The step voltage control must be at operating temperature and the cover must be in place when the step voltage control operating voltage is checked.

After any tests or adjustments, the generator on the vehicle must be repolarized after leads are reconnected but before the engine is started.

CAUTION: The cutout relay contact points must never be closed by hand with the battery connected to the step-voltage control. This will damage the relay contact points and may cause damage to other equipment.

B. Cutout Relay

1. Air gap: Hold armature down so contact points are closed and measure air gap between armature and center of the core. Fig. 13. Adjust by loosening two screws at the back of the relay and raise or lower the armature as required. Tighten screws after adjustment.

2. Point opening: Check point opening and adjust by bending the upper armature stop. Fig. 14.

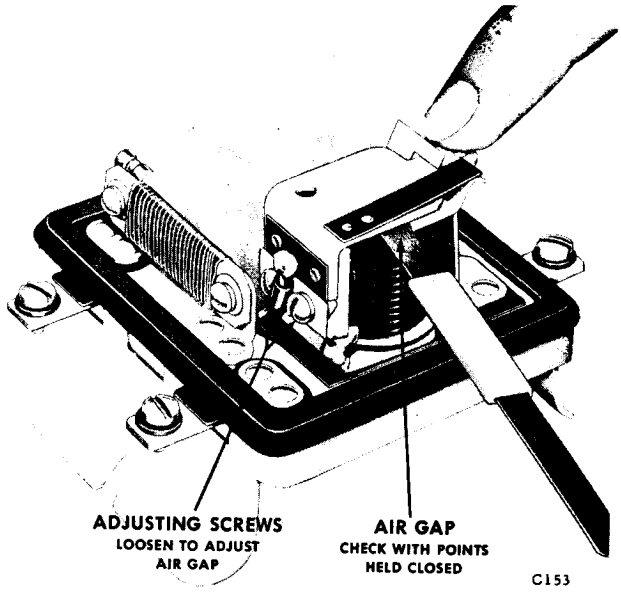


Figure 13

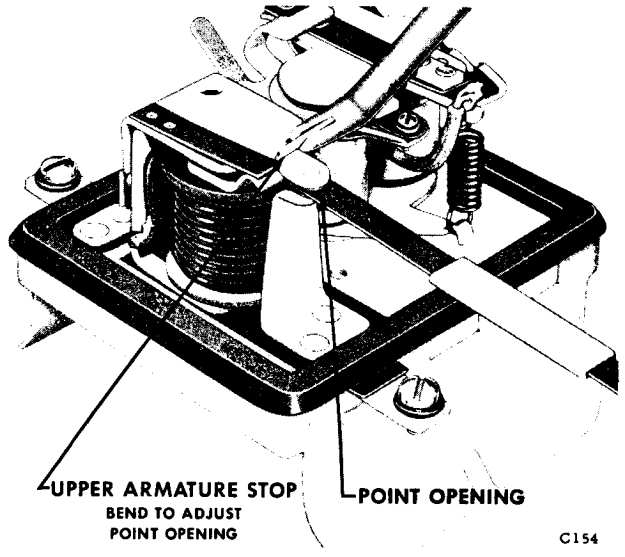


Figure 14

NOTE: Steps 1 and 2 are performed with battery disconnected.

3. Closing voltage: To check the closing voltage of the cutout relay, connect the step voltage control to the proper generator and battery and connect a voltmeter between the step-voltage control "GEN" terminal and ground. Fig. 15. Slowly increase generator speed and note relay closing voltage. Adjust closing voltage by bending the armature spring post. Fig. 16. Bend up to increase spring tension and closing voltage, and bend down to decrease closing voltage.

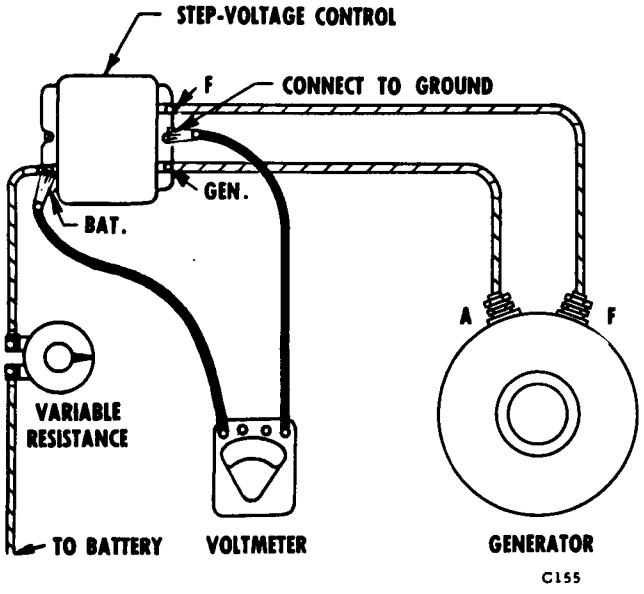


Figure 15

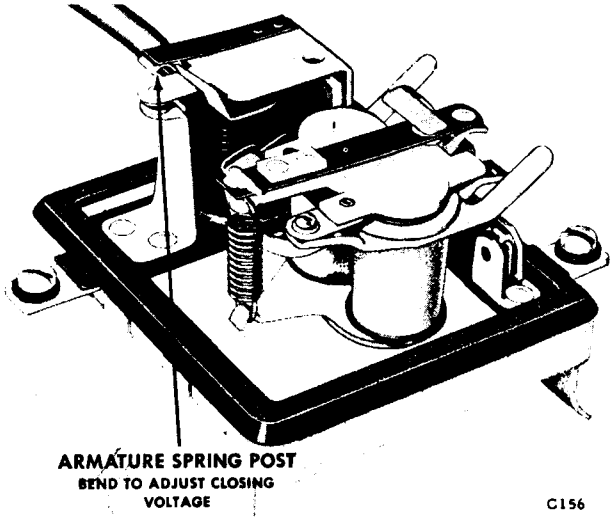


Figure 16

C. Step Voltage Control. Fig. 17

1. Flat spring tension: The flat spring tension determines the amount of pressure between the step-voltage contact points. The spring tension should be 3/4 ounce at the instant the points separate. This can be measured by pushing the armature down until the points almost open and then using a spring gauge to measure the upware pull required to open the points. Fig. 18. Adjustment can be made by bending the flat spring.

2. Air gap: To check air gap, hold the armature down against the lower armature stop by

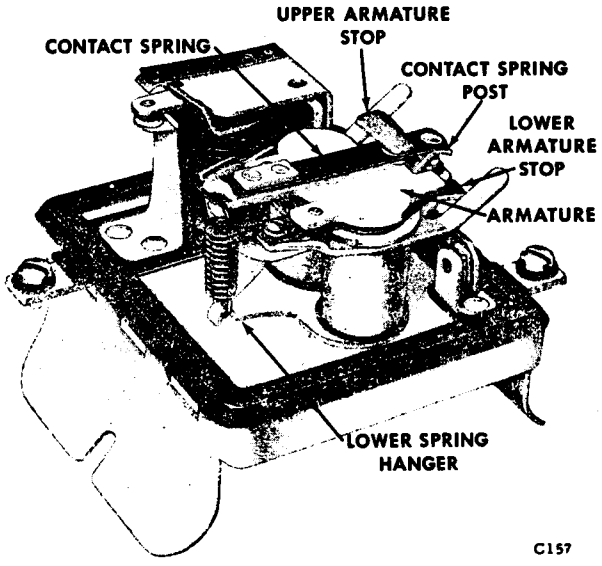


Figure 17

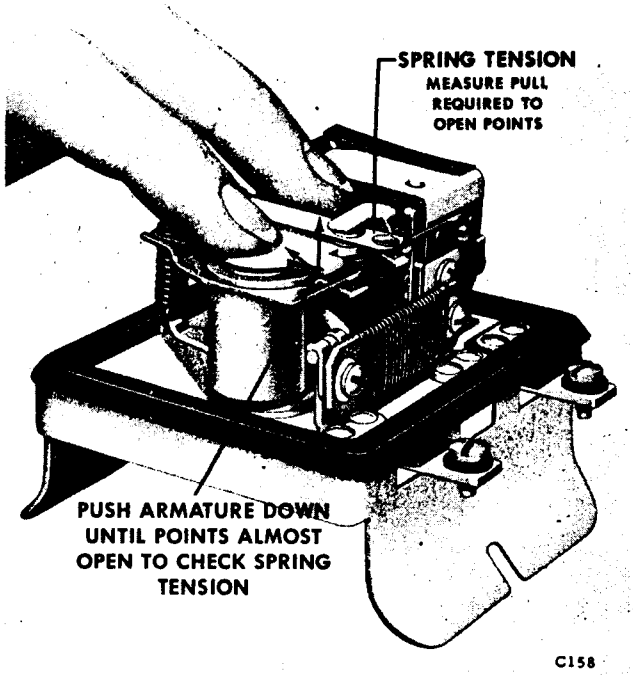


Figure 18

placing fingers on either side of the flat contact spring. Fig. 19. Adjust air gap by bending the lower armature stop.

3. Armature travel: To check the armature travel, release the armature so that it moves up against the upper armature stop and then meas-

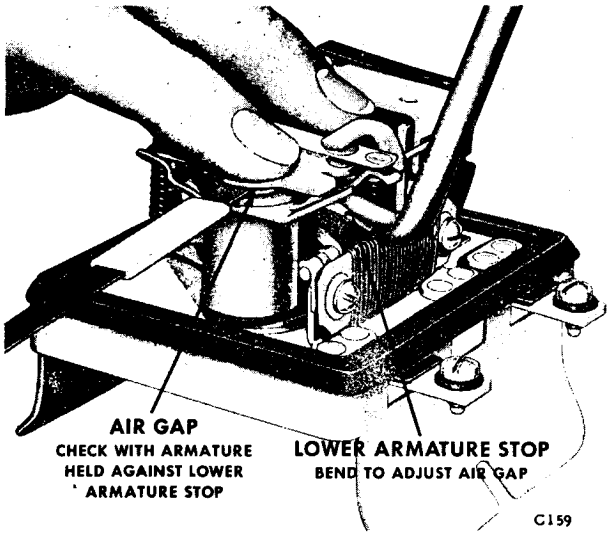


Figure 19

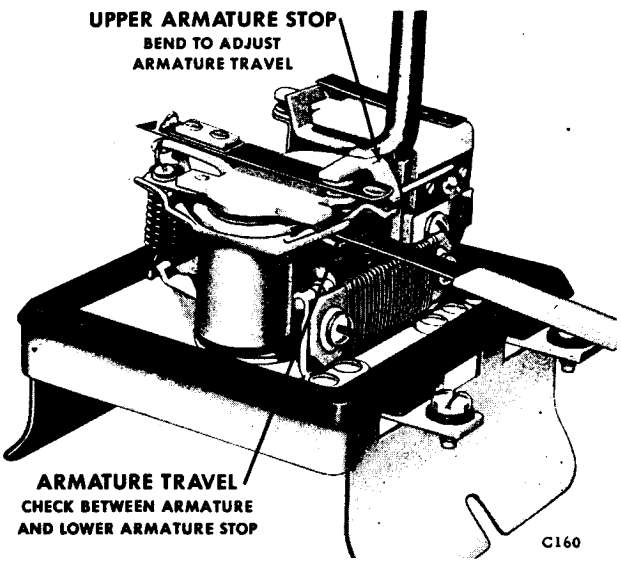


Figure 20

ure the gap or armature travel between the armature and lower armature stop. Fig. 20. Adjust armature travel by bending the upper armature stop.

4. Point opening: Hold the armature down against the lower armature stop with fingers placed on either side of the flat contact spring and measure the contact point opening. Fig. 21. Adjust point opening by bending the contact spring post.

5. Voltage setting: To check the voltage at which the step-voltage control contact points open,

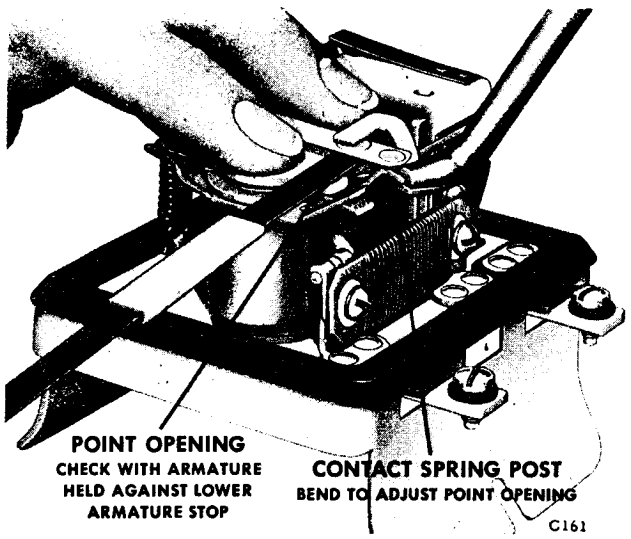


Figure 21

connect a voltmeter between the step-voltage control "BAT" terminal and ground, and connect a 1/4 OHM variable resistance into the charging circuit at the "BAT" terminal, Fig. 22. Gradually

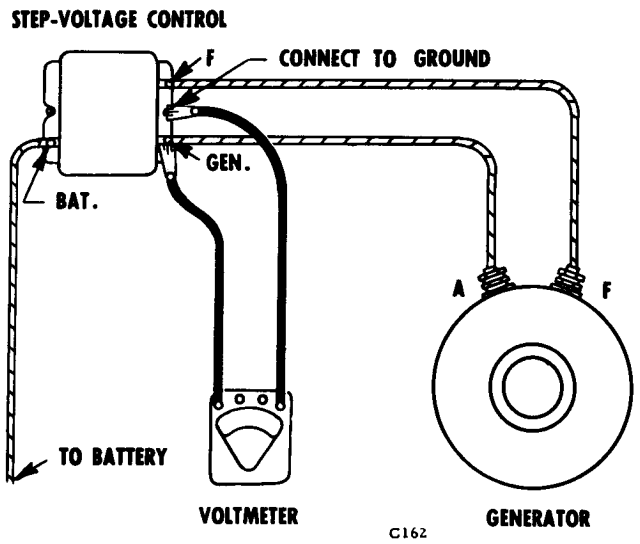


Figure 22

increase generator speed and note the voltage at which the contact points of the step-voltage control open. Decrease speed and note voltage at which the contact points close.

NOTE: Step-voltage control must be at operating temperature and the cover must be in place.

NOTE: If the battery is in a low state of charge,

the voltage will not increase sufficiently to cause the step-voltage control contact points to open. Under this condition, it will be necessary to slowly cut in resistance by means of the variable resistance with engine running at medium speed to cause the voltage to increase and the points to open.

6. Opening voltage adjustment: The voltage at which the step-voltage control contact points open is adjusted by bending the lower spring hanger. Fig. 23. Bend down to increase spring tension and opening voltage, and bend up to decrease the opening voltage.

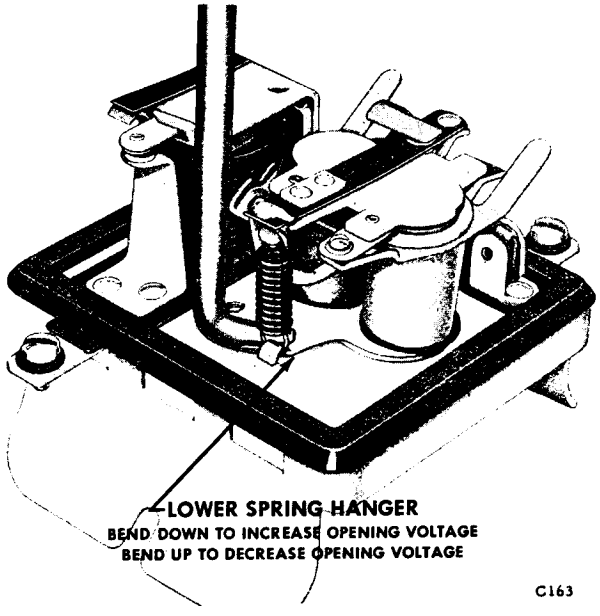


Figure 23

7. Closing voltage adjustment: The voltage at which the step-voltage control contact points will close is adjusted by adjusting the air gap. Increasing the air gap increases the closing voltage while decreasing the air gap lowers the closing voltage. After this adjustment, it may be necessary to slightly readjust the contact point opening in order to keep it within specifications.

GENERATOR REGULATOR— 12 Volt. Fig. 9

A. General

This assembly contains three units: cutout, current regulator and voltage regulator. Fig. 24.

Mechanical checks and adjustments (air gaps, point openings) must be made with the battery disconnected and the regulator preferably off the lift truck.

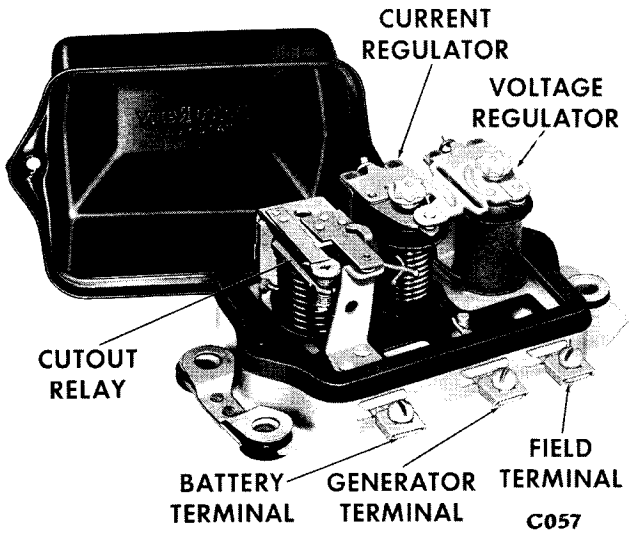


Figure 24

CAUTION: The cutout relay contact points must never be closed by hand with the battery connected to the regulator. This would cause a high current flow through the units which would seriously damage them.

Electrical checks and adjustments may be made with the voltage regulator either on or off the truck.

The voltage regulator must be at operating temperature with the cover in place when the regulator operating voltage is checked.

After any tests or adjustments, the generator must be polarized after the leads are reconnected but before the engine is started. To polarize the generator, momentarily connect a jumper lead between the "BAT" and "GEN" terminals of the voltage regulator.

B. Voltage Regulator

1. Air Gap: Push down on armature until contact points are just touching. Measure air gap between armature and winding core. Fig. 25. Adjust by turning contact mounting nut to raise or lower bracket as required. Be sure the contact points are aligned tightened after adjustment.

2. Voltage Setting

a. Connect a 1/4 OHM fixed resistor (not less than 25 watts) into the charging circuit

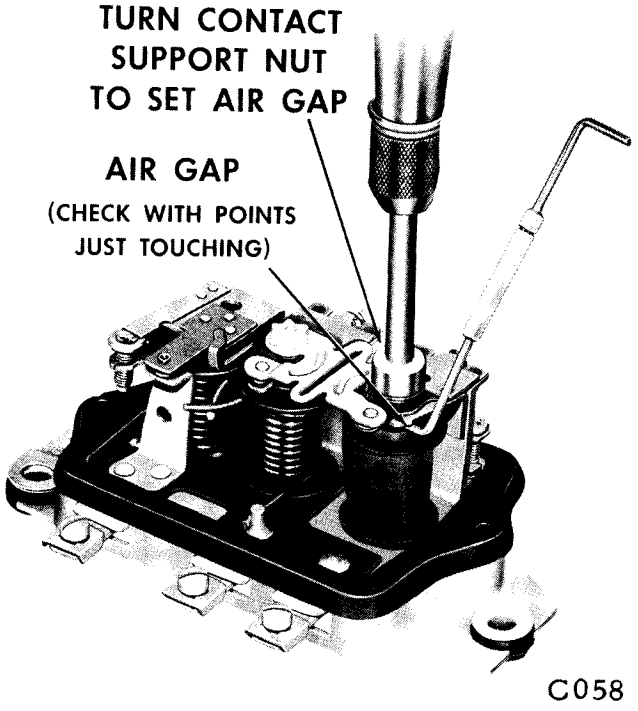


Figure 25

at the "BAT" terminal of the regulator and in series with the battery. Fig. 26. Connect a voltmeter from the "BAT" terminal to ground.

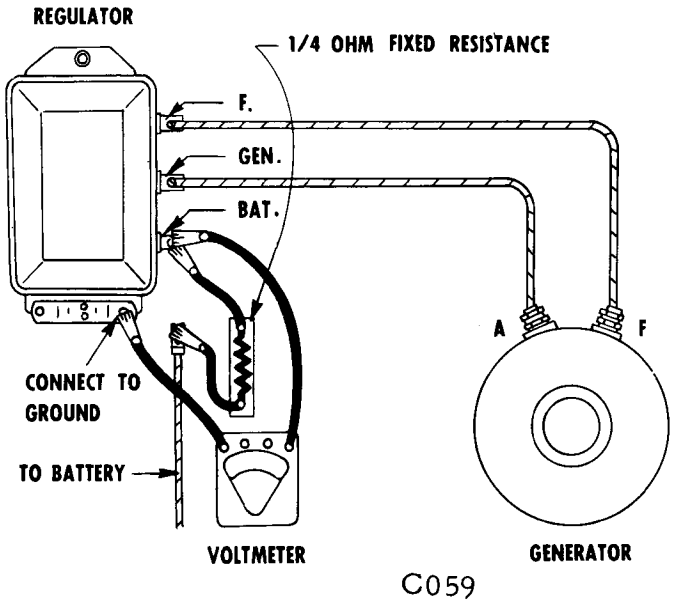


Figure 26

b. Operate the generator at 3500 RPM for 15 minutes to bring the regulator to operating temperature. The regulator cover must be in place.

c. Cycle the generator: Move the voltmeter lead from the "BAT" to "GEN" terminal. Retard generator speed until voltage is reduced to 4 volts. Move the lead back to the "BAT" terminal and bring the generator back to 3500 RPM. Note the voltage setting and compare with that shown in the Specification Listing.

d. To adjust the voltage setting, turn the adjusting screw clockwise to increase the setting or counterclockwise to decrease the setting. Fig. 27. If the setting is to be decreased, turn the adjusting screw out past the desired reading, then in to bring the reading back up.

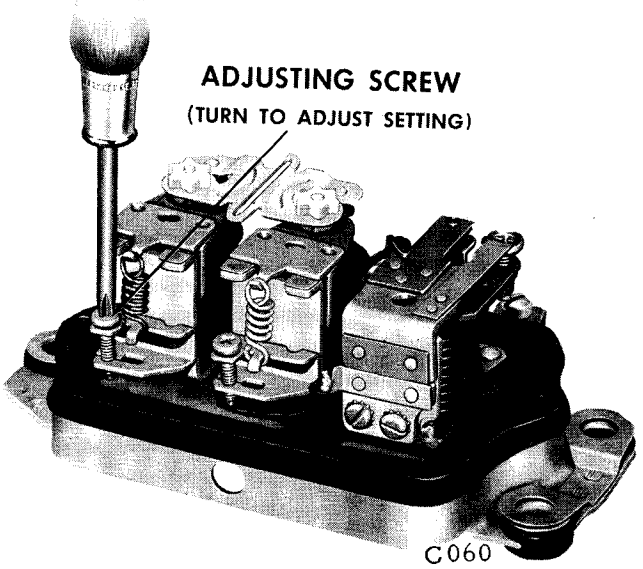


Figure 27

NOTE: After each adjustment, and before taking a new reading, replace the regulator cover and cycle the generator.

C. Cutout Relay

1. Air Gap: Battery must be disconnected when check is made. Place fingers on armature, directly above contacts. Move armature down until the points just close. Measure the air gap between the armature and the center of the core. Fig. 28. Adjust the air gap by loosening the two screws in the back of the relay, and raising or lowering the armature as required. When gap is the specified width, tighten the screws.

2. Point Opening: Check the point opening,

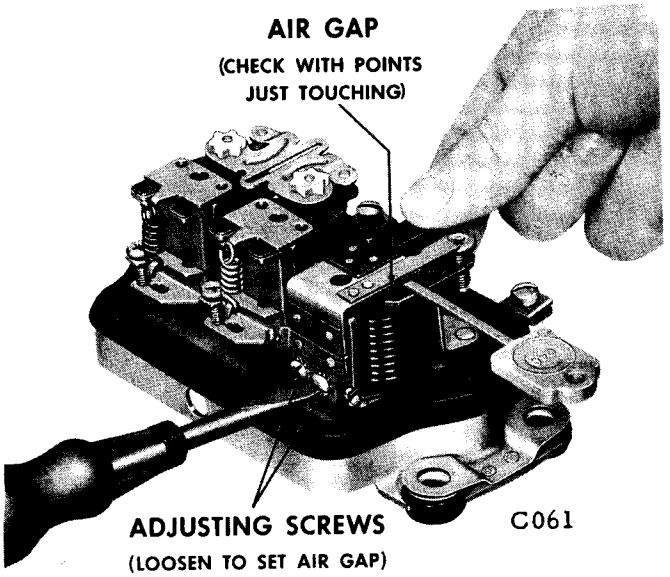


Figure 28

and adjust by bending the upper armature stop. Fig. 29. The battery must be disconnected when this check is made.

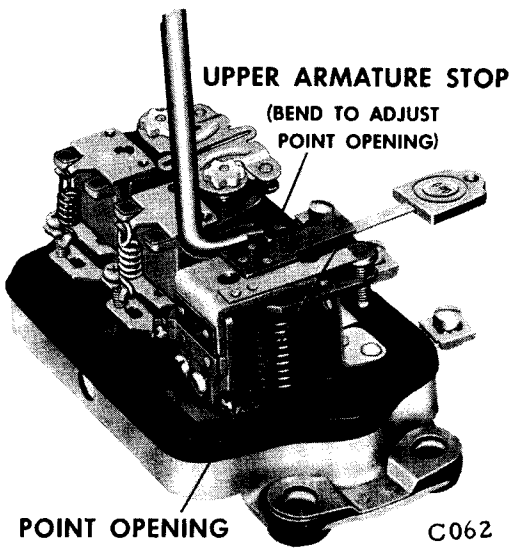


Figure 29

3. Closing Voltage

a. Connect the regulator terminals to the proper generator and battery wires. Connect a voltmeter between the regulator "GEN" terminal and ground.

b. Slowly increase generator speed and note relay closing voltage. Decrease generator speed and make sure the cutout relay points open.

c. Adjust the closing voltage by turning the adjusting screw. Fig. 30. Turn the screw in to increase the setting.

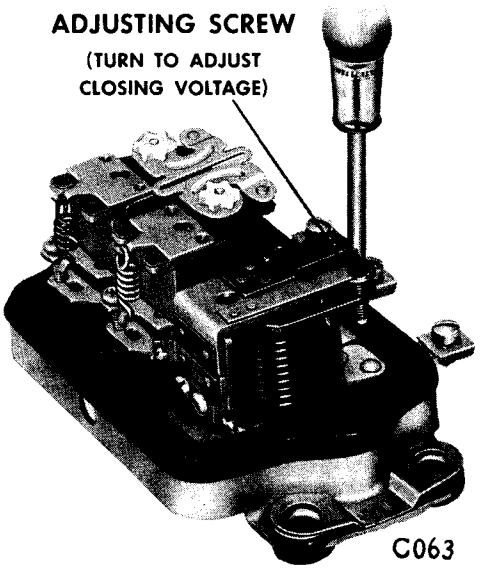


Figure 30

D. Current Regulator

1. Air Gap: Check and adjust in exactly the same manner as for the voltage regulator.

2. Current Setting

a. Connect an ammeter into the charging circuit, as in fig. 31. Connect a load across the battery so as to drop the system voltage one volt below the voltage regulator setting.

b. Operate the generator at 3500 RPM for 15 minutes with the regulator cover in place.

c. Cycle the generator and note the current setting. Adjust the setting in exactly the same manner as described for the voltage regulator unit.

ALTERNATOR. Fig. 32

A. General

The major parts of the alternator are the stator assembly, the rotor assembly and the two end

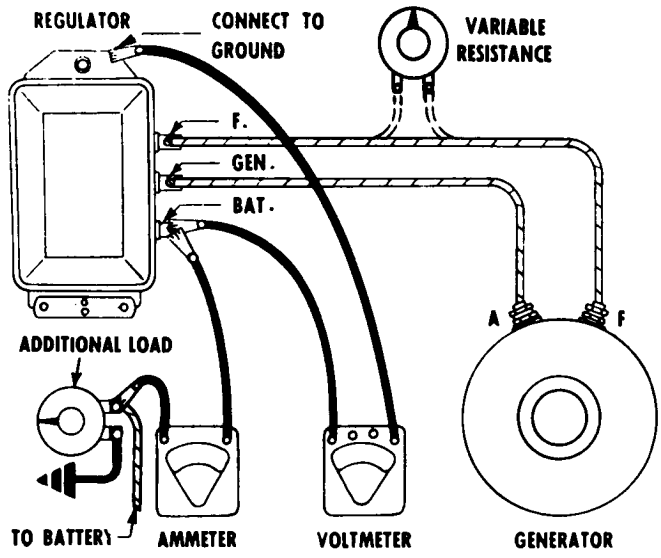


Figure 31

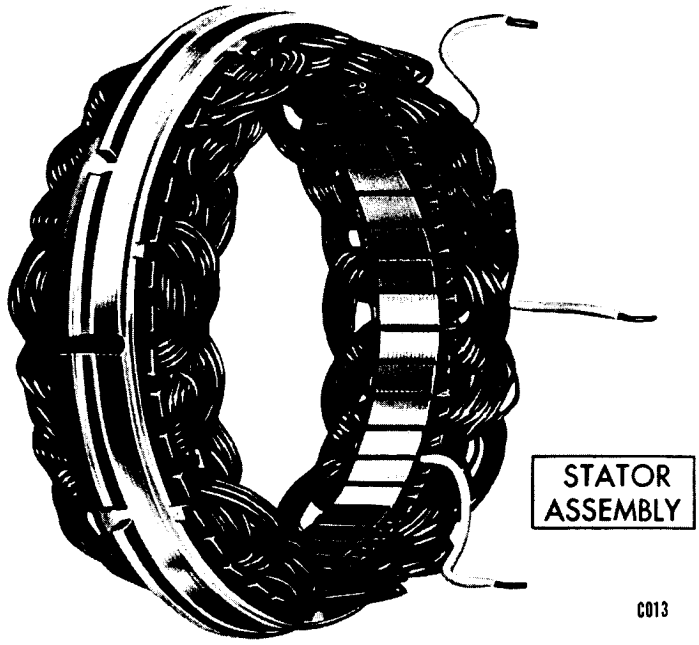


Figure 33

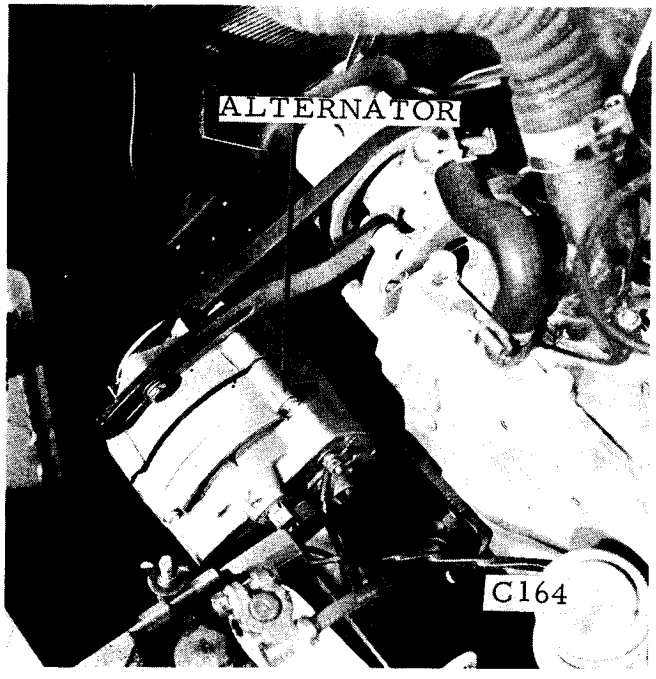


Figure 32

frame assemblies.

The stator assembly, fig. 33, is made up of a laminated iron frame and a stator or output winding which is wound into slots of the frame.

The stator assembly is sandwiched between two stationary end frames.

The rotor assembly contains a doughnut-shaped field coil mounted between two iron segments with several interlacing fingers which are called "poles". It is held together by a press fit on the shaft. The rotor turns inside the stator assembly.

The rotor shaft is supported by prelubricated bearings in each end frame, a ball bearing in the drive end frame and a roller bearing in the opposite end frame. Fig. 34.

Two slip rings upon which the brushes ride, are mounted on one end of the rotor shaft and

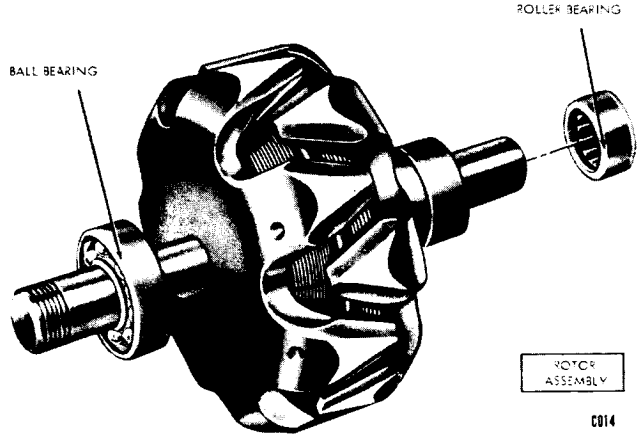


Figure 34

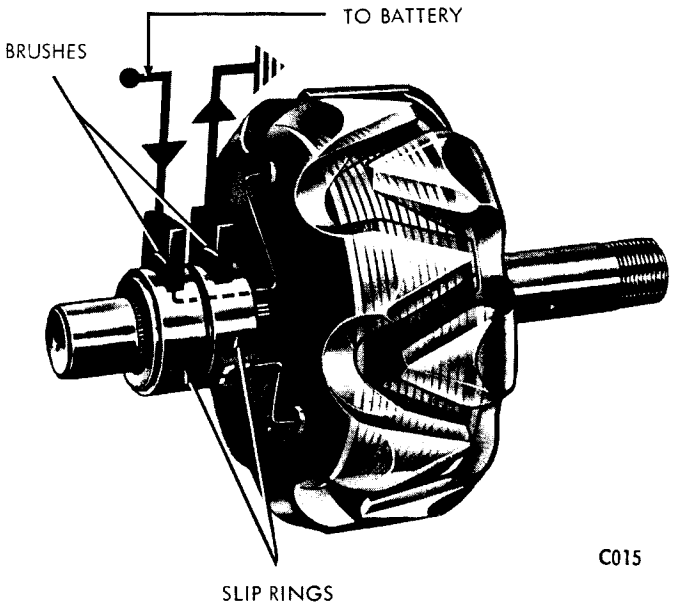


Figure 35

are attached to the leads from the field coil. Fig. 35. When the ignition switch is first closed, current from the battery passes through one brush, through the slip ring upon which the brush rides, and then through the field coil. After leaving the field coil, current flow continues through the other slip ring and brush before returning to the battery through the ground return path. This flow of electrical energy through the field winding is called field current.

Six electronic check valves called diodes are located in the end frame assembly nearest the slip rings. Three of these diodes are negative and are mounted directly to the end frame. Three positive diodes are mounted into a strip called a "heat sink", which is insulated from the end frame. These six diodes change the alternating current developed by the alternator into direct current to charge the battery and power the accessories. Fig. 36.

The only field coil in the alternator is located on the rotor shaft. This field coil is surrounded by the poles of the rotor segments. Since it is a part of the rotor assembly, the field coil turns with the rotor. Fig. 37.

The stator windings are attached to the stator frame and carry output current. They perform the same function as the rotating windings in the armature of a D.C. generator.

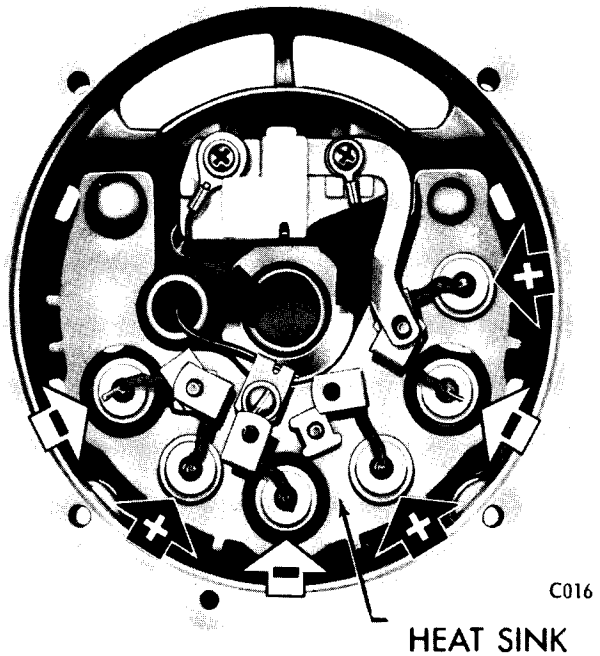


Figure 36

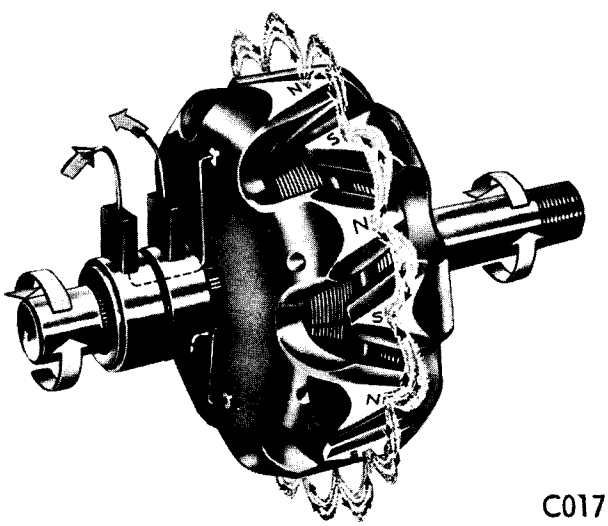


Figure 37

The brushes are connected in series with the field coil, and carry only the low field current.

IMPORTANT: Since the alternator and regulator are designed for use on only one polarity

system, the following precautions must be observed when working on the charging circuit. Failure to observe these precautions will result in serious damage to the electrical equipment.

1. When installing a battery, always make absolutely sure the ground polarity of the battery and the ground polarity of the alternator are the same.

2. When connecting a booster battery, make certain to connect the negative battery terminals together and the positive battery terminals together.

3. When connecting a charger to the battery, connect the charger positive lead to the battery positive terminal and the charger nagative lead to the battery negative terminal.

4. Never operate the alternator on open circuit. Make absolutely certain all connections in the circuit are secure.

5. Do not short across or ground any of the terminals on the alternator or regulator.

6. Do not attempt to polarize the alternator.

B. Removal

1. Disconnect wires from alternator terminals. Tag each wire for identification at time of installation.

2. Loosen the mounting bolts and adjusting arm cap screw to loosen drive belt. Remove belt from pulley.

3. Remove the adjusting arm cap screw and mounting bolts, then lift alternator assembly from engine.

4. If a replacement unit is to be installed, remove pulley and fan for installation on replacement unit.

C. Disassembly. Fig. 38

1. Scribe marks on the end frames and stator to help placing them in their original positions during assembly. Remove the through bolts.

2. Separate the drive end frame and rotor

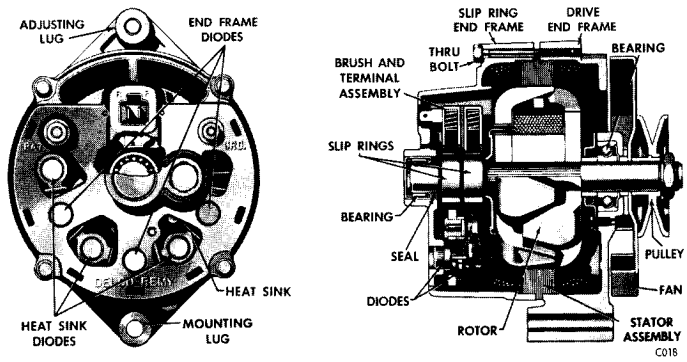


Figure 38

from the stator assembly, using a screwdriver to pry apart at the stator slot.

NOTE: The fit between the stator and frame is not tight, and the two can be separated easily. Note that the separation is to be made between the stator and drive end frame.

3. Tape the slip ring end frame bearing to prevent the entry of foreign materials. Tape the shaft on the slip ring end.

4. Place the rotor in a soft-jawed vise. Tighten the vise only enough to enable removal of the shaft nut. Unscrew the shaft nut. Remove the pulley, fan and collar.

5. Separate the drive end frame from the rotor.

6. Remove the diodes only when necessary. To remove a diode, support the end frame or heat sink on an arbor press and push the diode out.

CAUTION: Do not strike the diode, as the shock may cause damage.

7. Remove the drive end bearing retainer and press the bearing from the drive end.

8. Remove the bearing from the slip ring end frame only when necessary. To remove the bearing, press out with a tube or collar that just fits inside the end frame housing. Press from the outside of the housing towards the inside.

9. Remove the brush holder assembly from the end frame by detaching the two brush holder

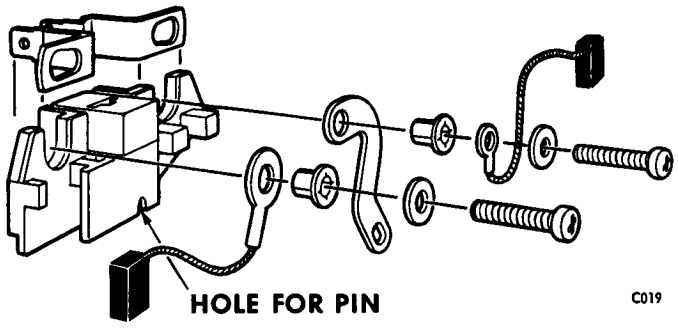


Figure 39

assembly screws. Fig. 39.

10. Remove the heat sink by removing the "BAT" and "GRD" terminals from the end frame, and the screw attaching the condenser lead to the heat sink. Fig. 44.

D. Cleaning and Servicing

1. Clean the drive end frame bearing in solvent.

2. Inspect the bearing. If it is in satisfactory condition, it may be re-used, and should be filled one-quarter full with proper lubricant before reassembly.

CAUTION: Do not overfill, as this may cause the bearing to overheat.

3. When the slip ring end frame assembly is separated from the rotor and drive end frame assembly, the brushes will fall down onto the shaft and come in contact with the lubricant. If the brushes are to be re-used, they must be thoroughly cleaned with a soft dry cloth. Also, the shaft must be thoroughly cleaned before reassembly.

4. The brush springs should be inspected for any evidence of damage or corrosion. If there is any doubt as to the condition of the brush springs, they should be replaced.

5. The bearing in the slip ring end frame should be replaced if its grease supply is exhausted. No attempt should be made to relubricate and reuse the bearing.

6. If the slip rings are dirty, they may be cleaned and finished with 400 grain or finer polishing cloth. Spin the rotor in a lathe, or otherwise spin the rotor, and hold the polishing cloth against the slip rings until they are clean.

CAUTION: The rotor must be rotated in order that the slip rings will be cleaned evenly. Cleaning the slip rings by hand without spinning the rotor may result in flat spots on the slip rings, causing brush noise.

Slip rings which are rough or out of round should be trued in a lathe to .002 inch maximum indicator reading. Remove only enough material to make the rings smooth and round. Finish with 400 grain or finer polishing cloth and blow away all dust.

E. Electrical Checks

1. Rotor:

NOTE: The rotor may be check electrically for grounded, open, or short circuited field coils.

a. To check for grounds, connect a 110-volt test lamp or an ohmmeter from either slip ring to the rotor shaft or to the rotor poles. If the lamp lights, or if the ohmmeter reading is low, the field winding is grounded. Fig. 40.

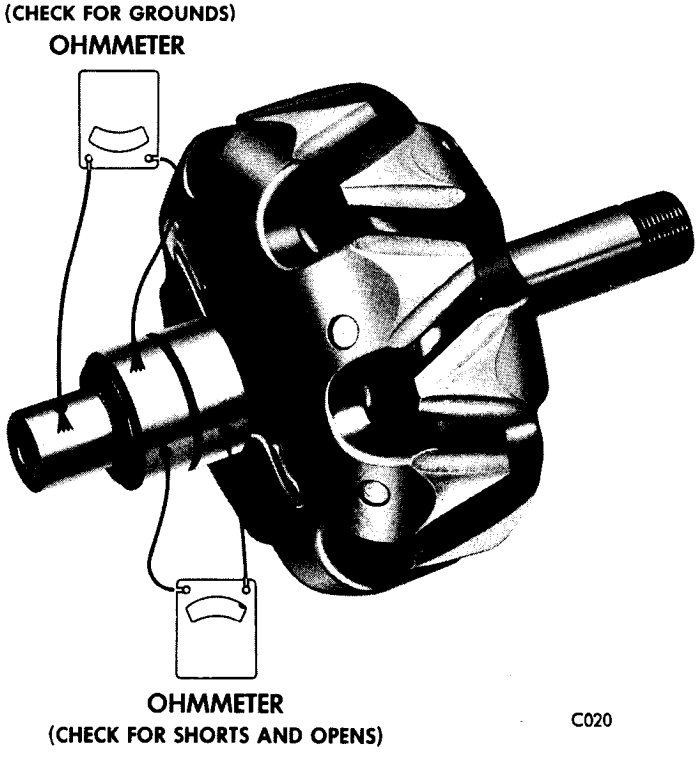


Figure 40

b. To check for opens, connect the test lamp or ohmmeter to each slip ring. If the lamp fails to light, or if the ohmmeter reading is high (infinite), the winding is open. Fig. 40.

c. The winding is checked for short-circuits by connecting a 12 volt battery and ammeter in series with the two slip rings. Note the ammeter reading. An ammeter reading above 2.3 amperes indicates shorted windings.

NOTE: If the rotor is not defective, and the alternator fails to supply rated output when checked, the trouble is in the stator or rectifying diodes.

2. Stator:

NOTE: To check the stator windings, remove all three stator lead attaching nuts, fig. 41, and then separate the stator assembly from the end frame.

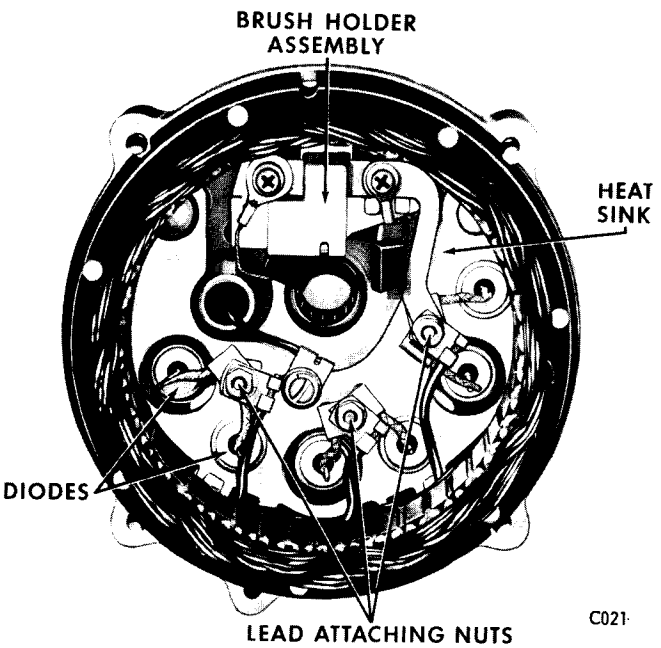


Figure 41

a. The stator windings may be checked with a 110-volt test lamp or an ohmmeter. If the lamp lights, or if the meter reading is low when connected from any stator lead to the frame, the windings are grounded. If the lamp fails to light, or if meter reading is high when

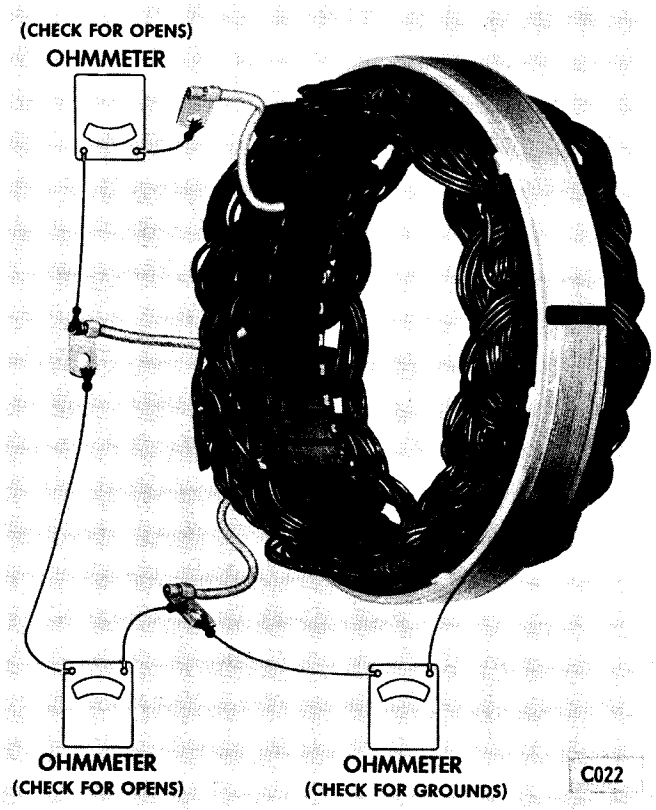


Figure 42

successively connected between each pair of stator leads, the windings are open. Fig. 42.

b. A short circuit in the stator windings is difficult to locate without laboratory test equipment due to the low resistance of the windings. However, if all other electrical checks are normal and the generator fails to supply rated output, shorted stator windings are indicated.

3. Diode:

NOTE: Each diode may be checked electrically for a shorted or open condition.

a. One method of checking diodes is to use an ordinary ohmmeter commonly found in service stations. The lowest range scale on the ohmmeter should be used, and the ohmmeter should have a 1-1/2 volt cell. To determine the cell voltage, turn the selector to the lowest scale, and then connect the ohmmeter leads to a voltmeter. The voltmeter will indicate the cell voltage.

b. With the stator disconnected, check a diode in the heat sink by connecting one of the

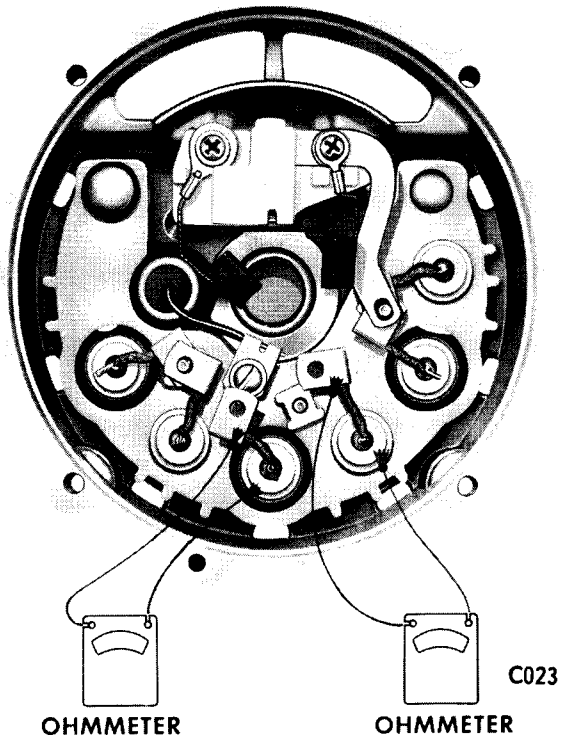


Figure 43

ohmmeter leads to the heat sink, and the other ohmmeter lead to the diode lead, and note the reading. Fig. 43. Then reverse the ohmmeter lead connections, and note the reading. If both readings are very low, or if both readings are very high, the diode is defective. A good diode will give one low reading and one high reading. Check the other two diodes in the heat sink in the same manner.

To check a diode mounted in the end frame, connect one of the ohmmeter leads to the end frame, and the other ohmmeter lead to the diode lead and note the reading. Fig. 43. Then reverse the ohmmeter lead connections, and note the reading. If both readings are very low, or if both readings are very high, the diode is defective. A good diode will give one low reading and one high reading. Check the other two diodes in the end frame in the same manner.

c. An alternate method of checking the diodes is to use a test lamp of not more than 12 volts in place of the ohmmeter. With the stator disconnected, connect the test lamp leads across each diode as described in item b. first in one direction and then in the other. If the lamp lights in both checks, or fails to light in both checks, the diode is defective. When checking a good diode, the lamp will light in only one of the two checks.

CAUTION: Do not use 110-volt test lamps to check diodes.

F. Assembly

1. If diodes have been removed, press new ones into place, using a tool which fits over the outer edge of the diode. Support the frame end and heat sink at the same time.

CAUTION: Do not tap the diode into place, as the shock may damage it and the other diodes.

2. If removed during disassembly, replace by pressing the bearing into the drive end frame, using a collar that just fits over the bearing outer race. Attach the retainer plate.

3. Secure the rotor in a soft-jawed vise with the drive end up. Tighten the vise only enough to permit tightening the shaft nut to the correct torque.

CAUTION: Excessive pressure will distort the rotor.

4. Slide the drive end assembly over the rotor shaft.

5. Install the collar, fan and pulley. Secure the assembly with the nut tightened to 50-60 pounds-feet. Remove the assembly from the vise.

6. To install a new slip ring end bearing, place a flat plate over the bearing and press in from the outside towards the inside of the frame until the bearing is flush with the outside of the end frame. Support the inside of the frame with a hollow cylinder to prevent breakage of the end frame. Use extreme care to avoid misalignment or otherwise placing undue stress on the bearing.

7. Saturate the felt seal with S.A.E. 20 oil, and then install the felt seal and steel retainer.

8. Install the springs and brushes into the brush holder, and insert a straight wire or pin into the holes at the bottom of the holder to retain the brushes. Fig. 39. Then attach the

brush holder assembly onto the end frame, noting carefully the proper stack-up of parts as shown in fig. 39. Allow the straight wire to protrude through the hole in the end frame.

9. Assemble the heat sink onto the slip ring end frame. Fig. 44.

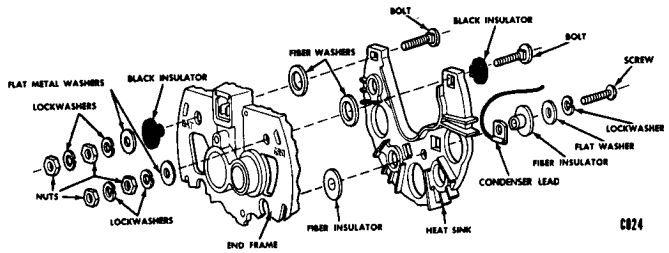


Figure 44

10. Remove the tape over the slip ring end frame bearing and slip ring end of the rotor shaft. Make sure the shaft is clean.

11. Slide the slip ring end frame over the rotor shaft. Align the scribe marks previously made. Secure the assembly with the through bolts, tightening them alternately and evenly.

12. Withdraw the wires or pins holding the brushes of the slip rings. Check the output of the alternator.

G. Output Check

1. Check the alternator on a test bench, make electrical connections as shown in fig. 45, operate at specified speed, and check for rated output.

2. Adjust the load rheostat, if necessary, to obtain the desired output.

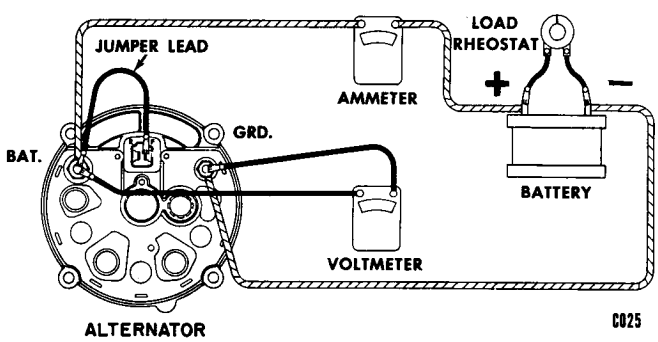


Figure 45

NOTE: Connect the negative battery post to the alternator frame.

H. Inspection

The frequency of inspection is determined largely by the type of operating conditions. High speed operation, high temperatures, and dust and dirt all increase the wear of brushes, slip rings and bearings.

At regular intervals, inspect the terminals for corrosion and loose connections, and the wiring for frayed insulation. Check the mounting bolts for tightness, and the belt for alignment, proper tension and wear. When tightening belt tension, apply pressure against the stator laminations between the end frames, and not against either end frame.

I. Installation

1. Position alternator at mounting bracket and install mounting bolts, nuts, and lock washers.

2. Place belt in alternator pulley, then attach adjusting arm to alternator drive end frame with cap screw and washers. Adjust belt tension then tighten adjusting arm cap screw and mounting bolts.

3. Connect wires to generator according to identification made at time of removal, or by referring to the wiring diagram. Make sure connections are tight.

ALTERNATOR REGULATOR

A. General. Fig. 46

The voltage regulator is shown in fig. 47. This regulator has four terminals. The terminals are of the slip-connection type, and a special connector body on the vehicle wiring harness is keyed to mating slots in the regulator base to insure proper connections. Also, a projection on the connector body serves to latch the assembly together. This prevents disconnections due to vibration. The assembly can be disconnected by lifting the latch slightly. Fig. 47.

A double contact voltage regulator unit and a field relay unit make up the regulator assembly. The voltage regulator unit operates to limit the generated voltage to a pre-set value

Figure 46

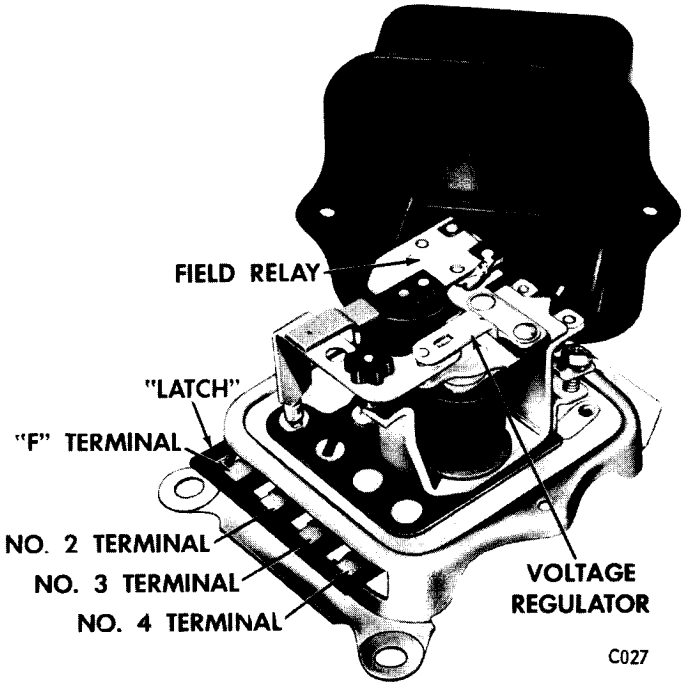


Figure 47

whereas the field relay connects the alternator field winding and regulator winding directly to the battery. The charge indicator lamp lights when the ignition switch is first turned on. Then, when the alternator begins to charge, the indicator lamp goes out, indicating the system is operating normally. If the lamp should come on when the vehicle is in operation, trouble in the system is indicated.

Each model regulator is designed for use on only one polarity system. Note the marking on the regulator base, or refer to the Specification Listing to determine the polarity.

A typical wiring diagram showing internal circuits of the regulator is illustrated in fig. 48.

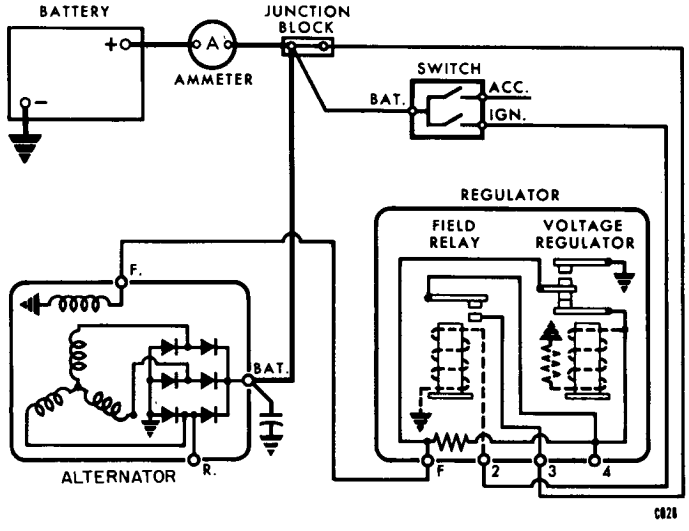


Figure 48

Automatic Disengagement and Lock-out System.
The automatic disengagement and lock-out, (ADLO) system consists of a resistor and relay. It protects the starter motor pinion and ring gear by eliminating the possibility of starter motor engagement with a running engine. Turning the ignition key closes the starter circuit. As soon as the engine fires, the output of the alternator will break the starter circuit in the relay and the pinion disengages. Disengagement takes place between cranking speed and low idle.

Following is a brief description of the operating principles of the units in this type of circuit. When the switch is closed, the field relay winding in the regulator is connected directly to the battery. The magnetism created in the winding attracts the relay armature toward the core, causing the contacts to close. This connects the alternator field winding directly to the battery, allowing field current to flow from the battery to the regulator No. 3 terminal, through the field relay contacts and then through the voltage regulator lower contacts. Current continues to flow to the regulator "F" terminal, and then through the alternator field winding to ground.

As the speed of the alternator increases, the

voltage at the "BAT" terminal of the alternator also increases. This impresses a higher voltage through the field relay contacts and across the voltage regulator shunt winding. The increased magnetism created by the higher voltage across the winding causes the lower contacts to separate, and field current then flows through a resistor resulting in reduced field current. This reduced field current causes the charging voltage to decrease, which decreases the magnetic pull of the voltage regulator shunt winding. The spring causes the contacts to close, and the cycle then repeats many times per second to limit the charging voltage to a pre-set value. As the alternater speed increases even further, the resistor connected across the contacts is not of sufficiently high value to maintain voltage control on the series contacts. Therefore the voltage increases slightly causing the upper or shorting contacts to close. When this happens, the alternator field winding is shorted and no current passes through the winding. With no current in the field winding, the charging voltage decreases. Also, the magnetism in the shunt winding decreases and the upper or shorting contact points open. With these points open, field current flows through the resistor and the field winding. As the voltage increases, the contacts close. This cycle then repeats many times per second to limit the charging voltage to a pre-set value at high generator speeds. The voltage regulator unit thus operates to limit the value of charging voltage throughout the alternator speed range. Consequently the electrical accessories are protected from too high voltage which would damage them.

There are two units included in the alternator regulator: (1) Voltage regulator, (2) Field relay. In the following procedures, each is considered separately.

B. Voltage Regulator

Three checks and adjustments are required on the double contact voltage regulator unit: (1) point opening, (2) air gap, and (3) voltage setting.

1. Point Opening: With the lower contacts touching, measure the point opening between the upper contacts. Adjust by bending the upper contact arm, being careful not to bend the hinge. Fig. 49.

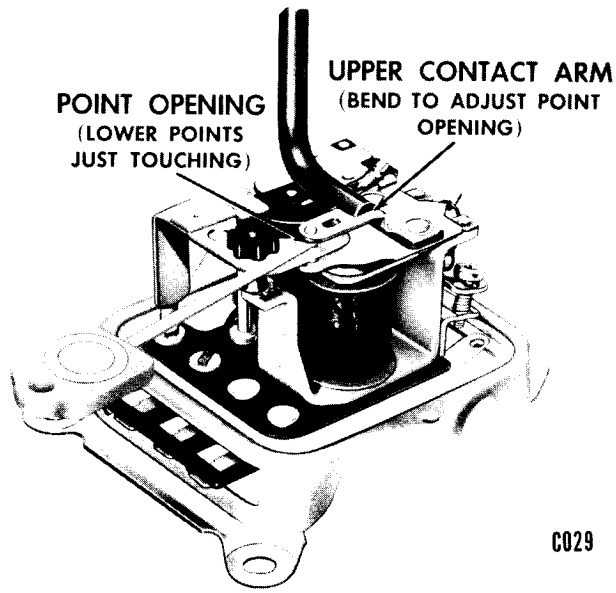


Figure 49

2. Air Gap: Measure the air gap with a feeler gauge placed between the armature and core when the lower contacts are touching. To adjust the air gap, turn the nylon nut located on the contact support. Fig. 50.

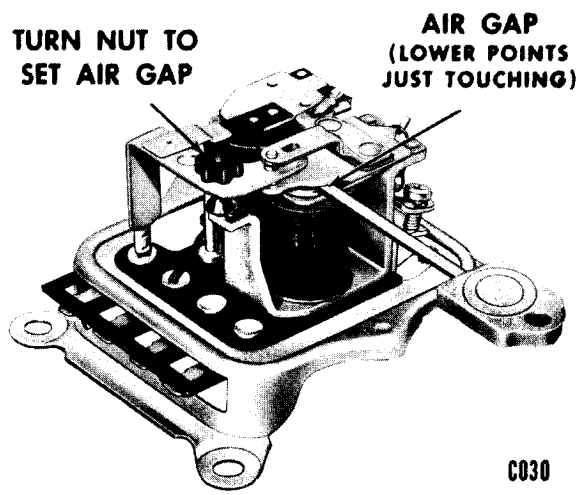


Figure 50

NOTE: Only an approximate voltage regulator air gap setting should be made by the "feeler gauge" method. The final air gap setting must be whatever is required to obtain the specified difference in voltage between the upper and lower sets of contacts.

3. Voltage Setting: The voltage at which the regulator operates varies with changes in regulator ambient temperatures. The ambient temperature is the temperature of the air measured 1/4 of an inch from the regulator cover.

To check and adjust the voltage setting, proceed as follows:

a. Connect an ammeter and a 1/4 ohm resistor with a rating of 25 watts or more in series in the circuit at the "BAT" terminal on the alternator. Fig. 51.

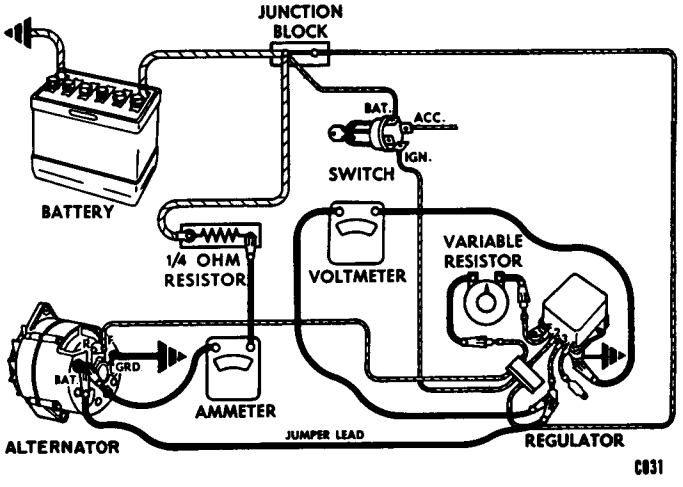


Figure 51

b. Make connections to the adapter as shown in fig. 52. Use a 25 ohm 25 watt variable resistor in series with the alternator field winding at the regulator "F" terminal, and connect a jumper lead from the adapter to the alternator "BAT" terminal as shown. Also, connect a voltmeter from the adapter to ground, as shown. Turn the variable resistor to the closed or "no resistance" position.

c. Operate the alternator for 15 minutes at approximately 1500 engine RPM (approximately 3500 alternator RPM). Leave cover on regulator to establish operating temperature. Accessories and lights must be turned off.

d. After the 15 minute warm-up period, cycle the alternator by the following procedure:

(1) Turn the variable resistor in the field circuit to the "off" or full resistance position.

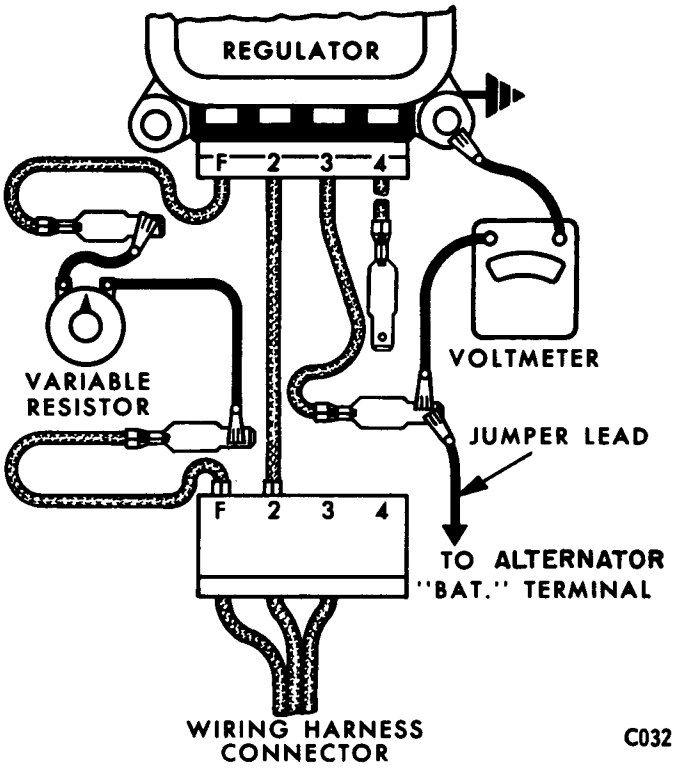


Figure 52

(2) Disconnect then reconnect the jumper lead at the "BAT" terminal of the "Alternator."

(3) Return the variable resistor to the closed or "no resistance" position.

(4) Bring engine speed up to 2500 RPM (approximately 6000 alternator RPM) and note the voltage setting. Refer to the Specification Listing for specifications. The regulator should be operating on the upper or shorting contacts. If it will not operate on the upper contacts, the battery is in an extreme state of discharge, and must be at least partially charged before proceeding.

e. To adjust the voltage setting while operating on the upper or shorting contacts, turn the adjusting screw. Fig. 53.

CAUTION: Always make final setting by turning the screw clockwise. This insures that the spring-holder will be against the head of the

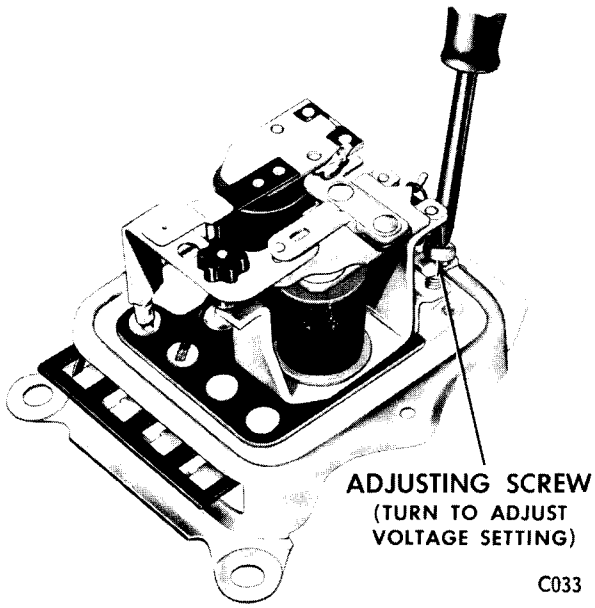


Figure 53

screw. If it is necessary to turn the screw counterclockwise, turn it until the screw head is approximately 1/8" above the adjusting bracket, then pry holder up against screw head, then turn clockwise to make setting.

f. After making the setting, cycle the alternator as covered in Step "d" above.

g. Then, operate at 2500 engine RPM (approximately 6000 alternator RPM), and note setting. Adjust if necessary.

h. Always cycle the alternator as covered in Step "d", before reading the final voltage setting on the voltmeter.

i. After making the voltage setting while operating on the upper set of contacts, check the voltage setting while operating on the lower set of contacts as follows: Slowly increase the resistance of the variable resistor with the engine operating at 2500 RPM (approximately 6000 alternator RPM) until the regulator begins to operate on the lower set of contacts. Then note the voltage reading, and refer to Specification Listing for specifications.

NOTE: If turning the variable resistor does not cause the regulator to operate on the lower set of contacts, return the variable resistor to the "no resistance" position, turn the carbon pile to slightly load the battery, and then adjust the variable resistor to cause the regulator to operate on the lower set of contacts.

NOTE: The most desirable method of determining that the regulator is operating on the lower set of contacts is to use earphones connected from the regulator "F" terminal to ground. As the variable resistor is turned, and operation changes from the upper set of contacts to the lower set, the earphone sound will fade away and stop completely and then return when the lower set of contacts begins to operate. The alternate method is to observe the voltmeter change from one value to another, but this is less desirable since it is not as accurate.

j. The difference in voltage between the operation of the upper set of contacts and the lower set is increased by slightly increasing the air gap between the armature and center of core and decreased by slightly decreasing the air gap. See fig. 51 for changing the voltage regulator air gap. If it is found necessary to make this air gap adjustment, it will be necessary to recheck the voltage setting of both sets of contacts.

C. Field Relay

NOTE: Three checks are required on the field relay: (1) air gap, (2) point opening, (3) and closing voltage.

1. Air Gap: With the regulator removed from the vehicle, check the air gap with the points just touching. Fig. 54. If adjustment is necessary, carefully bend the flat contact support spring.

2. Point Opening: Measure the opening between the points, and adjust by bending the armature stop. Fig. 55.

3. Closing Voltage: The closing voltage of the field relay may be checked as follows:

a. Connect a 50-70 ohm variable resistor and a voltmeter to the adapter. Fig. 56. Turn variable resistor to the open or "full resistance" position, and leave the ignition switch in the "off" position.

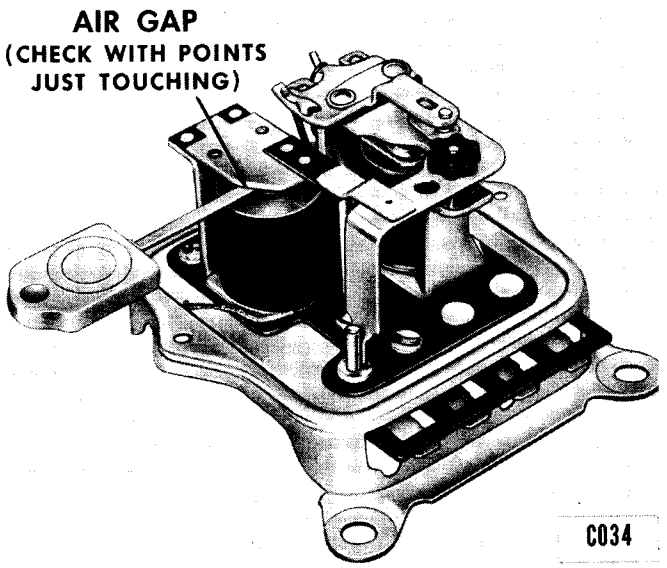


Figure 54

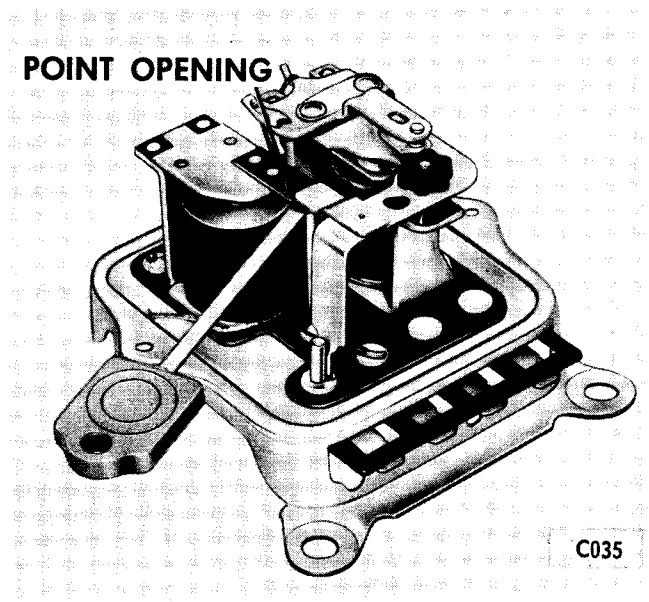


Figure 55

b. Slowly decrease resistance and note closing voltage of the relay. Adjust by bending heel iron. Fig. 57.

NOTE: If the field relay unit does not have an armature stop, a point opening check is not required.

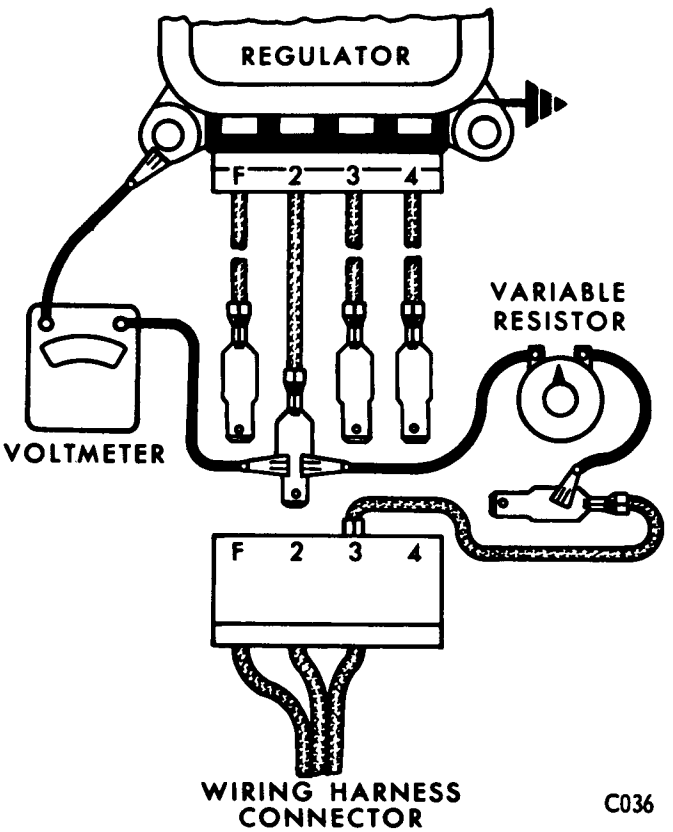


Figure 56

D. Maintenance

1. The voltage regulator contacts should not be cleaned unless the electrical performance indicates it is necessary. A sooty or discolored condition of the contacts is normal after a relatively short period of operation and is not an indication that cleaning is necessary. However, if the voltage fluctuates as evidence by an unsteady voltmeter reading when checking the voltage setting, the contacts may have excessive resistance or may be sticking and they, therefore, should be cleaned.

CAUTION: Before cleaning contacts, make sure the unsteady voltage is not being caused by loose connections or high resistance elsewhere in the system.

2. The contacts on the voltage regulator unit are of a soft material and must not be cleaned with a file. A strip of No. 400 silicon

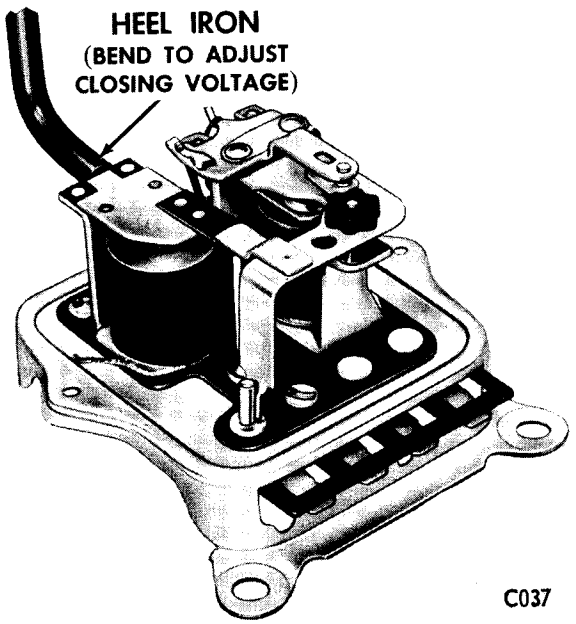


Figure 57

carbide paper or equivalent folded over and then pulled back and forth between the contacts is recommended as a satisfactory method of cleaning. After cleaning, the contacts should be washed with alcohol to remove any residue. If the voltage control has not improved, repeat the cleaning and washing process.

3. To clean the field relay contacts, use a thin, finecut, flat file. Remove only enough material to clean the points.

NOTE: Never use emery cloth or sandpaper to clean contact points.

E. Correction for Ambient Temperature

It is important to remember that the voltage setting for one type of operating condition may not be satisfactory for a different type of operating condition. Vehicle underhood temperatures, operating speeds, and nighttime service all are factors which help determine the proper voltage setting. The proper setting is attained when the battery remains fully charged with a minumum use of water.

If no circuit defects are found, yet the battery remains undercharged, raise the setting by .3 volt, and then check for an improved battery condition over a service period of reasonable length. If the battery remains overcharged, lower the setting by .3 volt, and then check for an improved battery condition. Recommended voltage setting procedures are charted below.

Ambient Temperature Degrees	Voltage Setting
65	13.9-15.0
85	13.8-14.8
105	13.7-14.6
125	13.5-14.4
145	13.4-14.2
165	13.2-14.0
185	13.1-13.9

NOTE: Operation on lower contacts must be .1 to .4 volt lower than on upper contacts.

CHECKING THE ALTERNATOR CHARGING SYSTEM

A. General

Trouble in the charging system will usually show up as an undercharged battery or an overcharged battery.

Before making any electrical checks, visually inspect all connections, including the slip-on connectors at the regulator and alternator to make sure they are clean and tight, then proceed. Since the regulator terminals are of the slip-on type, a special cable assembly or adapter must be used during testing so that meter connections can be made to the terminals.

CAUTION: To check the charging system, insert the adapter into the regulator, making connections only as shown in the illustrations. Avoid contact with the units when replacing the regulator cover.

B. Undercharged Battery

NOTE: This condition, as evidenced by slow cranking, can be caused by one or more of the following conditions:

1. A loose alternator drive belt.

2. A defective battery.

3. Malfunction of field relay.

4. A defective alternator.

5. A low voltage regulator setting.

1. Loose Drive Belt: The drive belt should be tightened to specification.

2. Defective Battery: A battery which is sulphated, or one with an intermittent open at a terminal post or in one of the cell connectors, will remain in an uncharged condition under normal operating conditions.

3. Malfunction of Field Relay: To check the relay, make connections to the adapter as shown in Fig. 58; turn the switch to the "IGN" position, and observe the voltmeter. The reading should be battery voltage. If the reading is zero, either the line between the switch to regulator

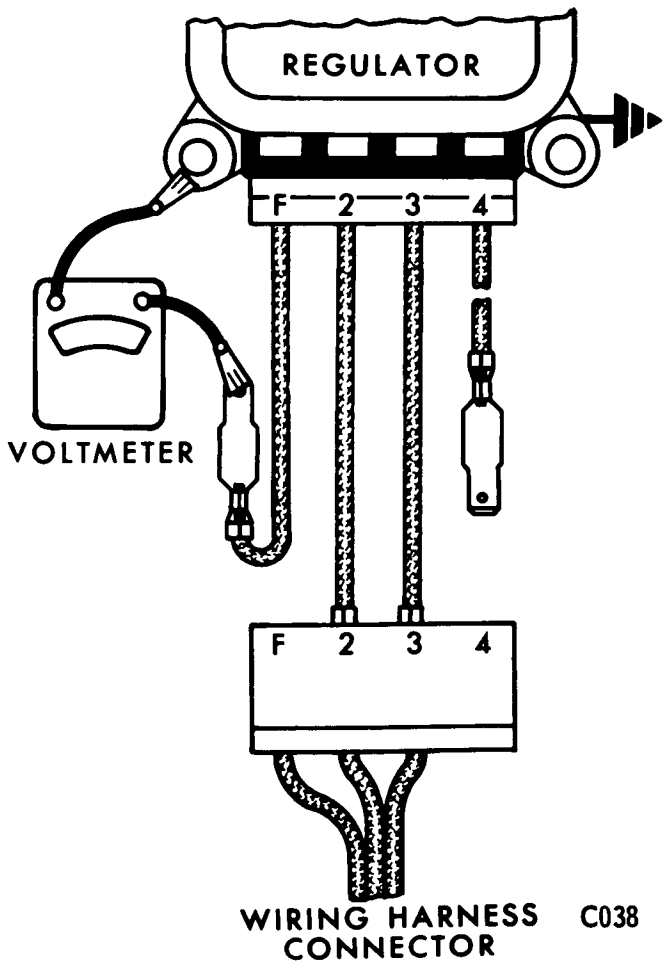


Figure 58

No. 2 terminal is open, or the field relay is defective, and must be checked.

4. Defective Alternator: To determine if the alternator is operating properly, proceed as follows:

a. Connect an ammeter in the circuit at the "BAT" terminal of the alternator and a voltmeter from the "BAT" terminal to ground.

b. Make connections to the adapter as shown in fig. 59.

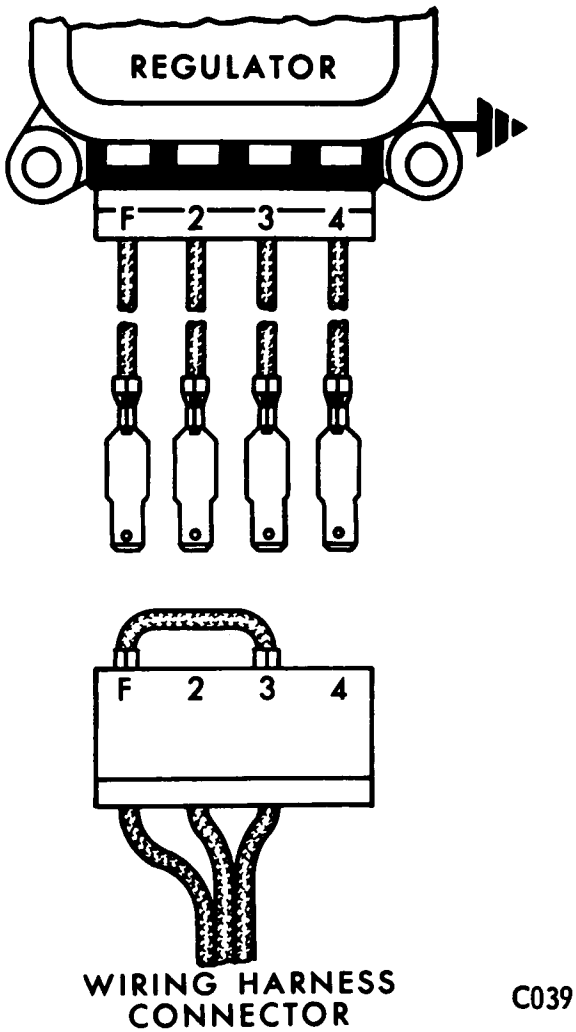


Figure 59

c. Turn on switch, operate engine at speed and check for rated output. If alternator does not provide rated output, it should be checked.

CAUTION: Load the battery with a carbon

rheostat or accessories to prevent high voltage. Do not allow the charging voltage to exceed the recommended voltage setting of the regulator.

5. Low Voltage Regulator Setting: If no circuit defects are found, yet the battery remains undercharged, the cause most likely is a low voltage regulator setting.

C. Overcharged Battery

NOTE: An overcharged battery, as evidenced by excessive water usage, can be caused by:

(1) A shorted battery cell.

(2) A high voltage regulator setting.

1. Shorted Battery Cell: Checks for shorted battery cells should be made as this can cause the battery to be overcharged.

2. High Voltage Regulator Setting: If no circuit defects are found, yet the battery remains overcharged, the cause is probably a high voltage regulator setting.

CRANKING MOTOR.

A. General

The 6 volt cranking motor on the standard transmission truck is a 4 pole, 2 field unit. Fig. 60. The armature rotates in bronze bearings at both the commutator end and in the pinion housing, and oiless bearing at the center. A Bendix drive, keyed to the armature shaft, automatically engages the cranking pinion with the flywheel ring gear when the cranking motor armature starts to turn. When the engine fires, the over-running effect of the flywheel on the pinion disengages it from the flywheel.

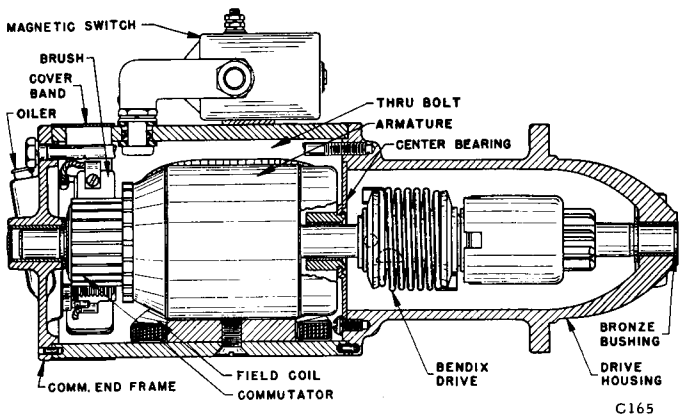


Figure 60

The 6 volt cranking motor on power-shift trucks is similar to that shown in fig. 60, except the magnetic switch is remote mounted instead of being attached to the motor frame.

The 12 volt cranking motor is a 4 pole, 4 field coil unit that has the solenoid, solenoid plunger, and solenoid shift lever mechanism enclosed in the drive housing. Fig. 61. A small diameter overrunning clutch type of drive is used to engage the

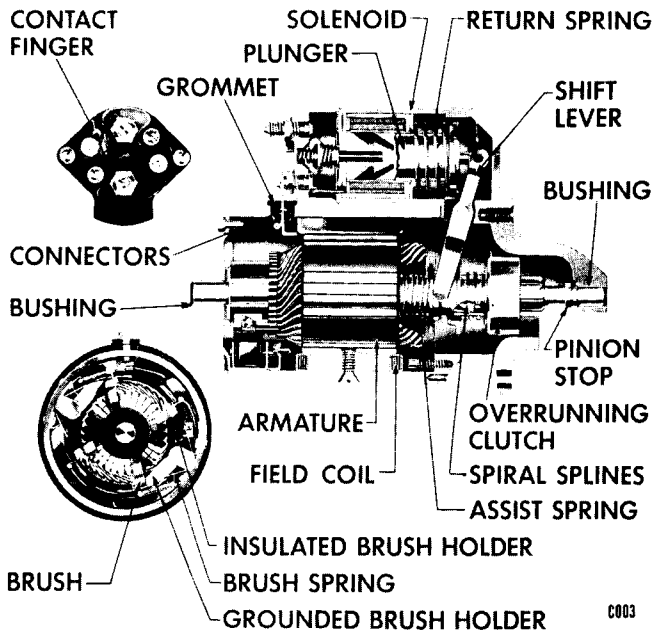


Figure 61

cranking motor pinion with the flywheel. The armature shaft and clutch have mating spiral spines that prevent transfer of full cranking power until the pinion is fully engaged with the flywheel ring gear.

Starter pinion is shifted into mesh with wheel ring gear teeth and starter circuit is completed by the solenoid when the solenoid is energized by the key starting-ignition switch. Primary circuit to ignition coil is also fed from the solenoid while the starter is operating.

The drive end housing is extended to enclose the entire shift lever mechanism and solenoid plunger.

The solenoid flange is mounted on the drive end housing, with sealing compound used between flange and field frame. The shift lever return spring is a compression type spring located inside the solenoid case. A special assist spring is located around the armature shaft between the end fiber of the armature and the collar of the clutch drive. This assist spring aids the solenoid in overcoming the return spring force in the first movement of the clutch along the armature shaft.

B. Periodic Maintenance

1. 6 volt cranking motor: Put 3 to 4 drops of medium engine oil in the hinge cap oiler at the commutator end every 50 hours. Whenever the cranking motor is removed from the engine, add 8 to 10 drops of medium engine oil to the oiler in the drive end and supply a few drops of oil to the oiless bushing in the center bearing. Never oil the commutator. The cover band should be removed and the commutator and brushes inspected at regular intervals. If the commutator is dirty, it may be cleaned with No. 00 sandpaper. Blow out dust. An otherwise defective assembly requires removal for further servicing.

2. 12 volt cranking motor: No periodic lubrication of the cranking motor solenoid is required. The cranking motor and brushes can be inspected only when the unit is disassembled. so no service is necessary between overhaul periods.

C. Starting Circuit Tests

NOTE: The following tests are for solenoid equipped cranking motors. However, they can be used as guides to check the starting circuits of cranking motors controlled by magnetic switches.

1. Disconnect the primary lead to the distributor to prevent engine starting. Referring to fig. 62, and with starter cranking engine during each check, measure V-1 (with voltmeter connected to the positive (+) battery post and the solenoid battery terminal), V-2 (with voltmeter connected to the solenoid battery terminal and solenoid motor terminal), and V-3 (with voltmeter connected to the negative (-) battery post and the starter field frame).

2. If V-1, V-2, or V-3 exceeds 0.5 volt, excessive resistance is indicated in that part of the circuit being checked. Locate and eliminate the cause for any excessive voltage drop in these circuits in order to obtain maximum efficiency from the

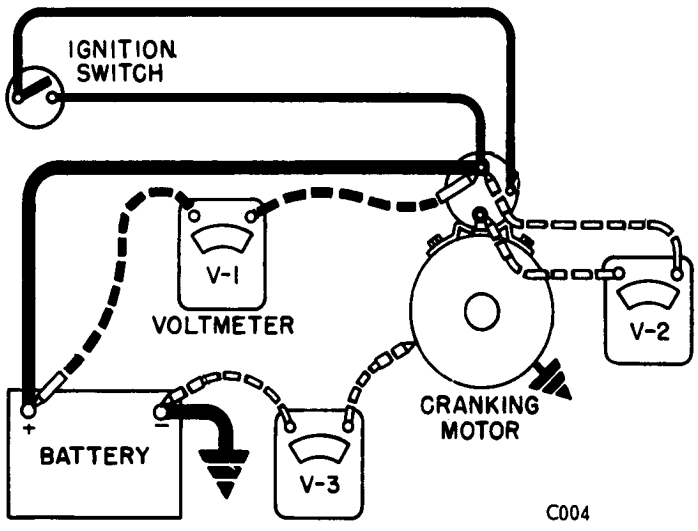


Figure 62

starting system.

3. If starter fails to crank engine, first make sure battery is not discharged, then check solenoid operation. If solenoid plunger fails to pull in, the trouble may be due to excessive resistance in the solenoid control circuit. Check all wiring and connections from ignition switch to solenoid for loose or corroded connections.

4. If cause of excessive resistance is not apparent, connect a short jumper lead across the solenoid "battery" and "S" terminals. If solenoid plunger pulls in, trouble is in solenoid control circuit. Check for defective ignition switch. If solenoid plunger does not pull in with jumper lead connected, solenoid is defective and must be replaced.

D. Removal

1. Disconnect: the battery ground cable from the battery; the cable from the cranking motor, solenoid or magnetic switch; the wires from the solenoid or magnetic switch.

2. Remove the two capscrews holding the motor to the flywheel housing. Lift the motor toward the rear of the truck.

E. Disassembly—6 Volt. Fig. 60

1. Remove the cover band and disconnect the brush leads from the brushes.

2. Unscrew the through-bolts. Separate the drive end, commutator end and frame. Unscrew the screws securing the center bearing to the drive end. Pull the armature out of the drive end.

3. Only if necessary, remove the drive by pushing in on the outer anchor so that the pilot screw (or pin) can be removed.

F. Disassembly — 12 Volt. Fig. 61

NOTE: Normally, the cranking motor should be dismantled only to the point where repair or replacement of parts can be made. However, the cranking motor should be disassembled completely at regular intervals for the cleaning and inspection of all parts.

1. Remove screw and lock washer attaching field coil connector strap to lower terminal on solenoid.

2. Remove through-bolts attaching commutator end frame and field frame to drive end housing. Remove commutator end frame.

3. Remove field frame from armature and drive housing.

4. Remove armature and drive assembly from drive housing, tilting armature as necessary to disengage lugs on shift lever from drive collar.

5. Remove two screws and lock washers attaching solenoid to drive housing. Remove solenoid and return spring from drive housing and plunger.

6. Remove over-running clutch drive assembly from armature shaft as follows:

a. Slide thrust collar, fig. 63, off end of armature shaft.

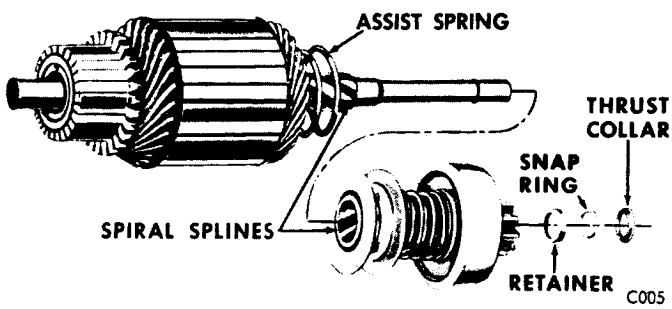


Figure 63

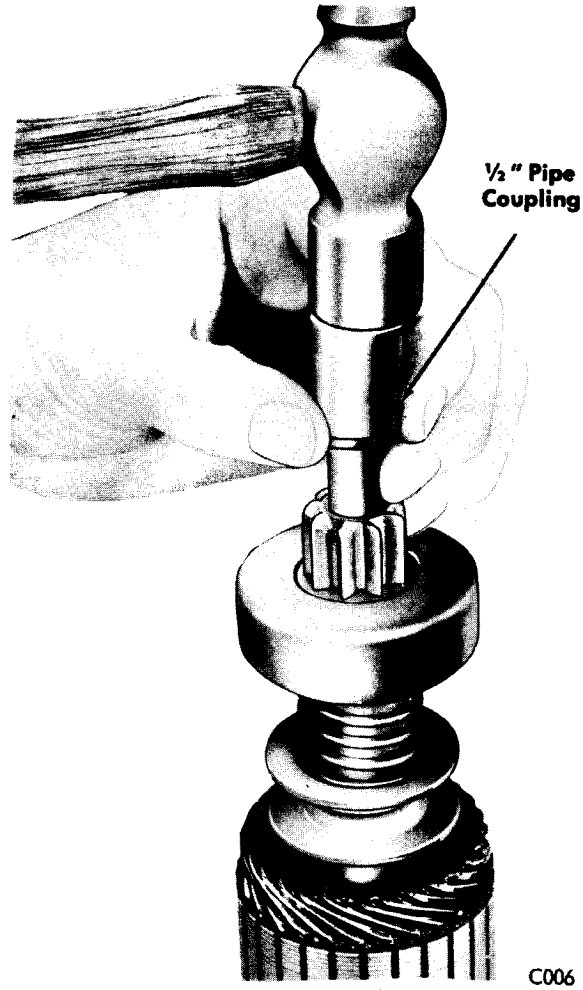


Figure 64

b. Slide a standard 1/2 inch pipe coupling or other metal cylinder of correct size onto shaft so end of coupling or cylinder butts against edge of retainer. Fig. 64. Tap coupling with hammer to drive retainer down toward armature and off snap ring.

c. Remove snap ring from groove in armature shaft. If snap ring is distorted during removal, it must be discarded and a new one obtained for assembly.

d. Slide retainer and over-running clutch assembly off armature shaft.

7. Remove the solenoid return spring and plunger. Remove the terminal assembly and the contact assembly. To disassemble the

contact assembly, push in on the metal cup and rotate 1/4 turn. Fig. 65. Slide the metal cup, spring, and washers off the push rod.

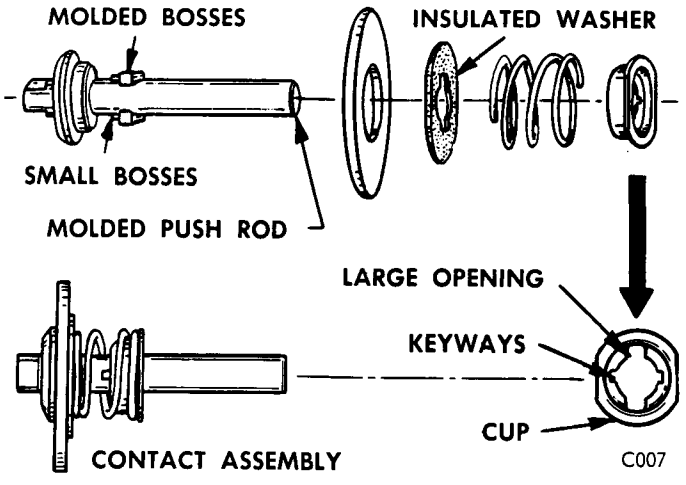


Figure 65

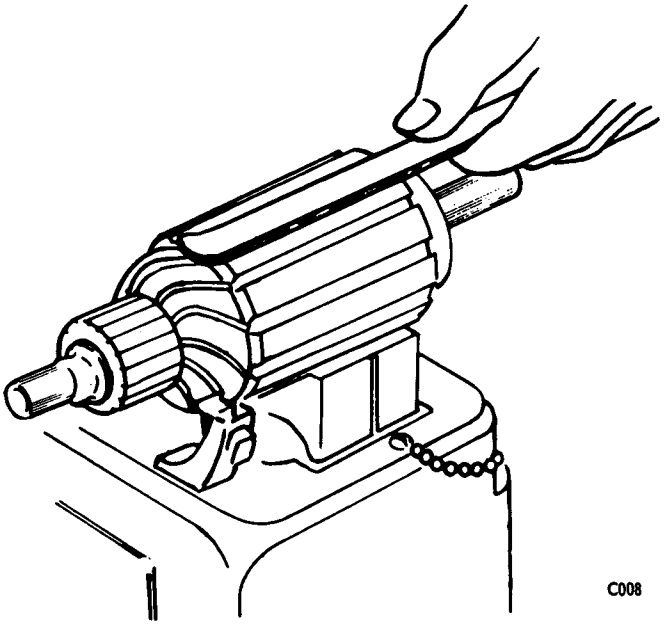


Figure 66

G. Service Procedures

NOTE: The over-running clutch, armature, and fields should never be cleaned in a degreasing tank or with grease dissolving solvents. All parts of the motor except the clutch should be cleaned with oleum spirits and a brush. Wipe the clutch with a clean cloth.

1. Armature

a. Check armature-to-commutator leads to make sure they are securely connected. Place one prod of test lamp on armature and the other prod on commutator. Fig. 66. If test lamp lights, armature is grounded and should be replaced if defect is not readily apparent and repairable.

b. Place armature on growler. Hold hacksaw blade over armature and slowly rotate armature. If saw blade vibrates, armature is short-circuited. Before replacing, inspect commutator slots for copper or brush dust deposits. Clean thoroughly and retest.

c. Burned commutator riser bars are sometimes caused by an open-circuited armature. If bars are not too badly damaged, armature can sometimes be repaired by resoldering the leads in the riser bars, using rosin flux solder. After soldering, turn down commutator and undercut the mica.

d. Examine bearing surfaces at each end of armature shaft for evidence of wear, and examine spiral splines for damage. Replace armature assembly if shaft is worn or damaged.

2. Commutator

a. Inspect commutator and if found to be rough, out-of-round, worn or has high mica, filled slots, or is burned, repair as follows:

b. Turning Down. Place armature in a lathe and turn down commutator to remove worn spots, out-of-round, or rough condition. Do not cut deeper than necessary to clean up. Fig. 67.

c. Undercut Mica. Mica between commutator segments must be below edges of segments. Start groove with a small three-cornered file, then use a hacksaw blade to undercut mica to a depth of 1/32 inch. Use No. 00 sandpaper to clean and smooth up commutator, then blow all dust and cuttings out of grooves.

3. Field Coils

NOTE: Before checking field coils on enclosed

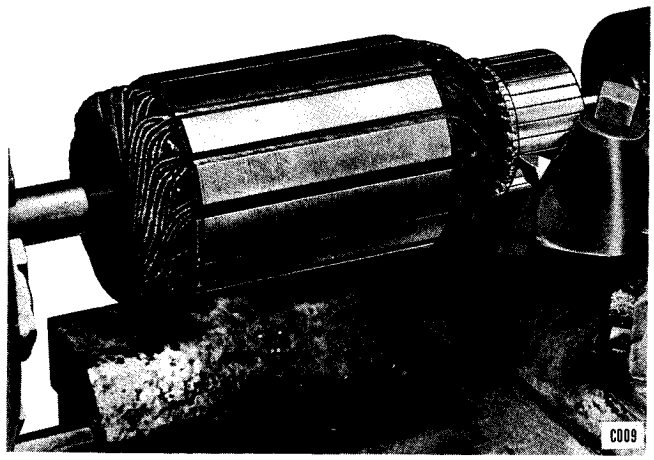


Figure 67

shift lever starter, disconnect shunt field coil lead from brush holder bracket.

a. Place one test prod on field coil connector and the other on each field coil lead. If lamp does not light, coils are open-circuited.

b. Place one test prod on field frame and the other on each field coil lead. If lamp lights, coils are grounded.

c. If ground or open circuit is indicated in series connected coils, break the connection between coils and test each coil separately to determine which one is defective and must be replaced. If any coil is replaced, make sure connections are securely soldered and properly insulated.

4. Commutator End Frame

a. On open shift lever type, brush holders are mounted on commutator end frame. Two brush holders are insulated from the end frame and two are grounded. Test each insulated brush holder by placing one test prod on insulated brush holder and one on end frame. If the lamp lights, brush holder is grounded and the insulation should be replaced.

b. On enclosed shift lever type, the insulated brush holders, mounted in the field frame, are made of a non-conductor and are mounted on the same pin as the grounded brush holders.

c. Examine armature shaft bushing in end frame for wear. Replace bushing if hole is elongated.

d. Check brush spring tension. If not within limits, replace with new springs. Examine hinge pins and brush holders for bent or damaged condition. Any condition which might prohibit free brush action must be corrected.

5. Brushes

a. If brushes are worn down to less than one-half their original length, they must be replaced. Compare old brushes with a new one to determine how much they are worn.

b. Be sure that clips are securely soldered to the brush leads. When installing new brushes, side having trade mark must be out away from holder.

6. Drive Housing. Examine bushing in drive housing if worn excessively. Also replace oiler wick, if used. If necessary to replace shift lever (or solenoid plunger on enclosed shift lever type), remove bolt securing shift lever in drive housing.

7. Overrunning Clutch. Drive pinion must rotate freely in overrunning direction and must not slip in cranking direction. If drive pinion turns roughly or slips, replace complete overrunning clutch assembly.

8. The Bendix drive should be cleaned and a film of light oil applied to the screw shaft, as any accumulation of dirt on drive might restrict the free movement of the pinion.

H. Assembly. Fig. 61

NOTE: The following procedure is for the 12 volt cranking motor. The 6 volt unit is assembled in the reverse order in which it was disassembled.

1. Place a few drops of engine oil on bushing in commutator end frame and in drive housing. Spread oil evenly on bushing.

2. If shift lever and solenoid plunger were removed from drive housing, assemble plunger to shift lever and secure lever in housing with bolt, lock washer, and nut. Make sure shift

lever pivots freely on bolt.

3. Install overrunning clutch assembly on armature shaft as follows:

a. Apply a light coat of engine oil on armature shaft spiral splines.

b. Place assist spring over armature shaft with small end of spring against armature, then slide overrunning clutch assembly on shaft with drive pinion toward end of shaft.

c. Slide retainer onto shaft with cupped side facing end of shaft.

d. Install snap ring over end of shaft and place in groove in shaft. Use care not to distort snap ring while installing.

e. Install thrust collar on shaft with shoulder on collar next to snap ring.

f. Position retained and collar next to snap ring, then use two pairs of pliers as shown in fig. 68 to force retainer over snap ring.

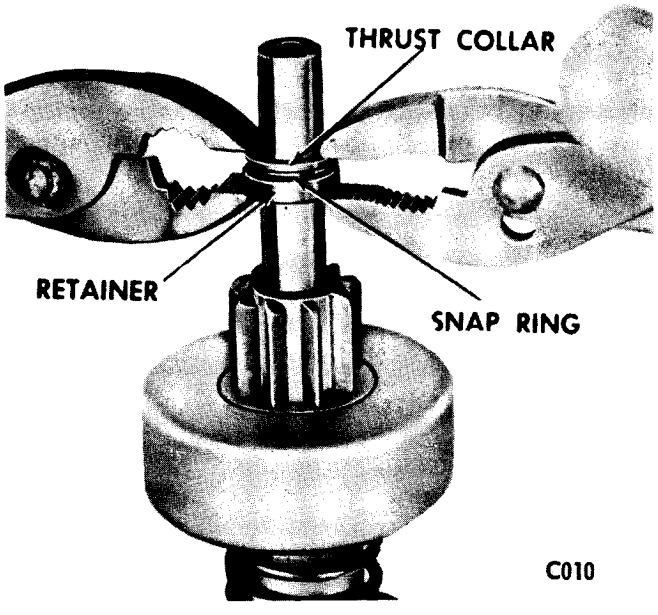


Figure 68

4. Install thrust washer over end of armature shaft, then install armature and overrunning clutch assembly in drive end housing, tilting armature as necessary to make lugs on shift lever yoke engage collar on overrunning clutch.

5. Assemble solenoid and return spring to drive housing, with solenoid plunger inserted into solenoid case, and secure with two screws and lock washers.

6. Apply sealing compound to extended portion of solenoid case flange contacted by field frame. Make sure all brush holders, springs, and brushes are installed in field frame and all leads are securely connected.

7. Place field frame over armature shaft, pulling brushes out over commutator, and engage dowel pin in field frame in hole in drive housing. Install commutator end frame over armature shaft, then install through-bolts through commutator end frame and thread into tapped holes in drive housing. Tighten through-bolts firmly.

8. Attach field coil connector to solenoid terminal with screw and lockwasher.

9. Check drive pinion clearance as directed later under "Drive Pinion Clearance."

10. If testing equipment is available, No-Load and Torque Tests may be made to determine if starter is up to specifications.

I. Drive Pinion Clearance

NOTE: This check pertains to 12 volt units only.

1. The drive pinion clearance should be checked whenever the starter has been overhauled. There is no means of adjusting the pinion clearance. If clearance is not within specified limits, it may indicate excessive wear of the solenoid linkage or shift lever yoke lugs. Clearance between the end of the pinion and the pinion stop, with the pinion in cranking position, is shown in Specification Listing.

2. To check clearance, connect a voltage source of approximately 6 volts (three battery cells in series or a 6-volt battery) between the solenoid switch terminal (S) and ground.

CAUTION: Do not connect the voltage source to ignition coil terminal (R) of the solenoid. Do not use a 12-volt battery instead of the 6 volts specified as this will cause the motor to operate. As a further precaution to prevent motoring, connect a heavy jumper lead from the solenoid motor terminal to ground.

3. After energizing the solenoid with the clutch shifted forward, push the pinion back as far as possible to take up any movement, and check the clearance with a feeler gauge as shown in fig. 69. If not within specifications, disassemble and replace worn parts in solenoid and shift lever linkage.

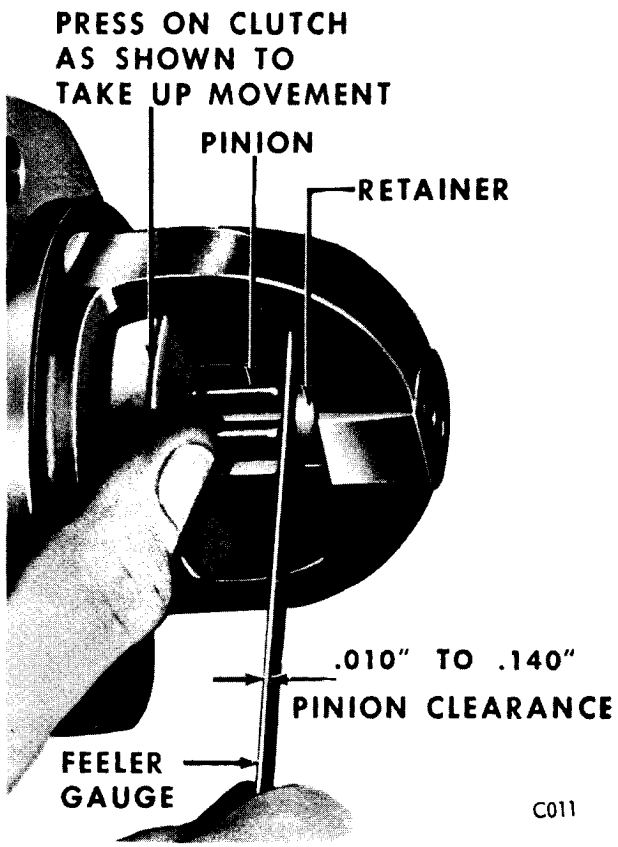


Figure 69

J. Testing

If the brushes, brush spring tension, and commutator appear to be in good condition, the battery and external circuit are found to be satisfactory, and the cranking motor still does not operate correctly, make the following tests:

1. No – load test: Connect the cranking motor in series with a battery of specified voltage and an ammeter capable of reading several hundred amperes. Read the armature RPM in addition to the current draw. Fig. 70.

2. Torque test: It is advisable to use in the circuit a high current-carrying variable resistance, so that the specified voltage at the motor can be obtained. A small variation of the voltage will produce a marked difference in the torque developed. Fig. 71.

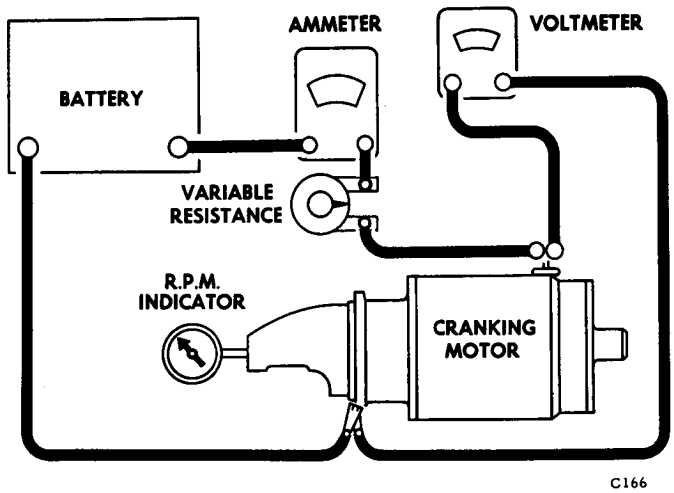


Figure 70

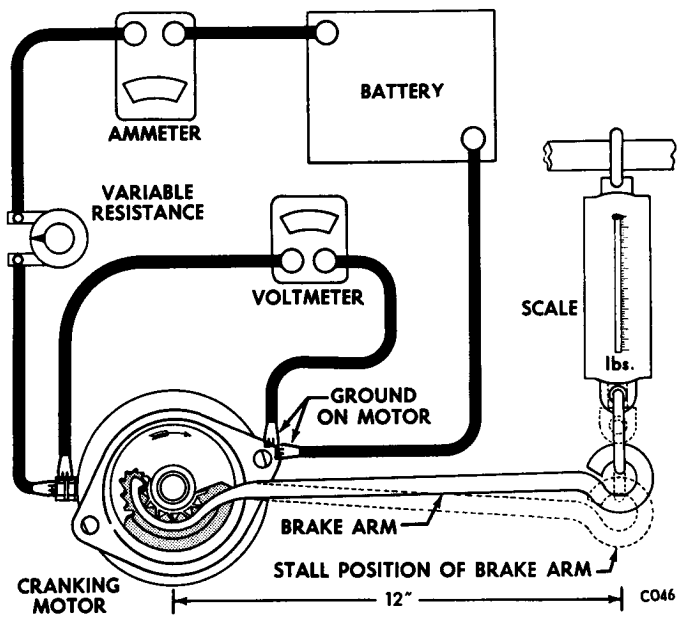


Figure 71

3. Interpreting results of No-load and Torque Test:

a. Rated torque, current draw and no-load speed indicate normal condition of cranking motor.

b. Low free speed and high current draw with low-developed torque may result from:

(1) Tight, dirty, or worn bearings, bent armature shaft or loose field pole screws which

would allow the armature to drag.

(2) Shorted armature: Check armature further on growler.

(3) Grounded armature or field: Check by raising grounded or return brushes and insulating them from the commutator with cardboard and then checking with a test lamp between the insulated terminal and the frame. If test lamp lights, raise other brushes from commutator separately to determine whether it is the fields or armature that is grounded.

c. Failure to operate with high current draw:

(1) A direct ground in the switch, terminal or fields.

(2) Frozen shaft bearings which prevent the armature from turning.

d. Failure to operate with no current draw:

Open circuit: The open circuit may be in the fields, armature, at the connections or brushes, or between the brushes and commutator. Trace the circuit with the test lamp.

e. Low no-load speed, with low torque and low current draw:

(1) An open field winding. Raise and insulate ungrounded brushes from commutator and check fields with test lamp.

(2) High internal resistance due to poor connections, defective leads, dirty commutator, weak or broken brush springs, worn brushes, high mica on the commutator or other causes which would prevent good contact between the brushes and commutator.

f. High free speed with low-developed torque and high current draw indicates shorted fields. There is no easy way to detect shorted fields, since the field resistance is already low. If shorted fields are suspected, replace the fields and check for improvement in performance.

K. Installation

1. Place the cranking motor in position against the flywheel housing. Secure it with bolts, nuts and lockwashers.

NOTE: If Bendix pinion is manually rotated to a fully extended locked position do not attempt to force it in a reverse direction. Proceed to install the drive (meshing pinion with flywheel) and when engine starts, the centrifugal force will return the pinion to the demeshed position.

2. Connect: the cable to the solenoid, magnetic switch or starter whichever the case may be; the wires to the solenoid or magnetic switch; the ground cable to the battery.

L. Magnetic Switch and Solenoid Maintenance

1. Magnetic switches and solenoids require no periodic maintenance other than keeping the terminals clean and tight. Always check action of solenoid if it has been removed.

2. If unit fails to function, first check wiring before condemning the solenoid or switch.

3. Solenoid coil, terminals, and switch plunger can be replaced if burned or otherwise damaged. Magnetic switches are serviced as an assembly.

DISTRIBUTOR. Fig. 9

A. Removal

Remove the distributor cap, coil to distributor wire, and distributor mounting nut. Note location of rotor in relation to distributor before removing distributor from engine.

B. Disassembly Fig. 72

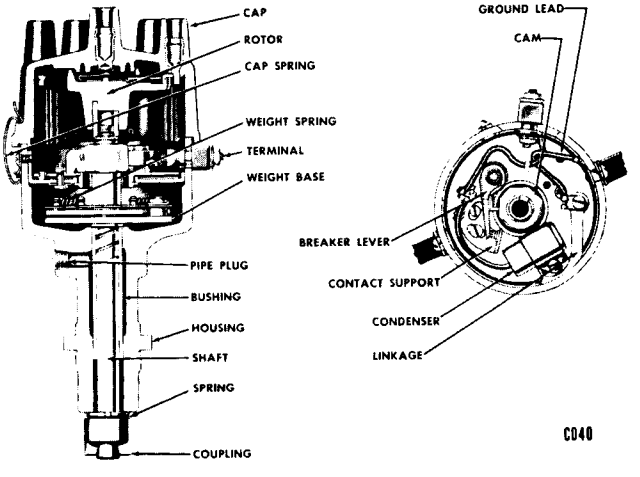


Figure 72

Unsnap the cap springs, remove cap and rotor. Then disassemble terminal, take off breaker plate attaching screws, and lift out breaker plate. Remove coupling or gear by grinding or filing off the peened-over head of pin and then driving pin out. Shaft and advance mechanism can then be lifted out. Advance mechanism is disassembled by taking off nuts fastening hold-down plate in place.

C. Assembly and Testing

1. Reverse disassembly procedure to assemble distributor.

2. After reassembly, the contact point opening and cam angle should be checked and adjusted. Breaker lever spring tension should also be checked and adjusted, if necessary. Then the distributor should be carefully tested on a distributor tester that will check the centrifugal advance mechanism.

D. Installation

1. Be sure the distributor mounting is clean so there will be a good ground connection for the distributor.

2. Check engine breather pipes, since clogged pipes cause crankcase pressure which will force oil up into the distributor.

3. If the advance mechanism of the old distributor was found to be worn, check the engine for worn timing gears or oil pump, since these cause backlash which produces torsional vibration; such vibration causes rapid advance mechanism wear.

4. Be sure to install the new distributor all the way down in its mounting well. If the distributor is not pushed all the way down, the distributor shaft is likely to seize in the distributor housing and ruin the distributor.

E. Timing With Engine Running

1. Hook-up the timing light to the No. 1 spark plug (nearest the counterweight).

2. Paint or chalk the timing marks on the crankshaft pulley.

3. Run engine at 1000 RPM. No. 1 plug should fire 9 degrees before top dead center. Loosen distributor clamp screw and rotate distributor clockwise to advance or counterclockwise to retard timing. Tighten clamp screw. Recheck timing with the light.

F. Timing With Engine Not Running

1. Locate No. 1 cylinder spark plug wire on distributor cap; mark distributor body adjacent to No. 1 wire socket in cap. Remove distributor cap.

2. Intermittently operate starter until crankshaft pulley comes to rest with the timing mark aligned with pointer. With pointer and timing mark aligned, rotor segment should point toward mark made on distributor body in step 1., above. (Instead, rotor segment may point 180 degrees away from mark; in this case, engine must be rotated one complete revolution and timing mark realigned with pointer.)

3. With timing mark and pointer aligned and with rotor segment pointing to No. 1 spark plug wire position, points should just begin to open. Loosen distributor mounting cap screw and turn distributor housing clockwise until points close. Remove high tension wire from center socket in distributor cap. Turn on ignition switch and hold end of high tension wire (still connected at coil) 1/4 inch from a ground; then turn distributor housing counterclockwise until a spark jumps the gap between high tension wire and ground. When spark occurs, points are open. Hold distributor in this position while tightening mounting cap screw or clamp screw. Turn ignition switch off and install distributor cap. Install high tension wire in center socket in cap.

G. Manual Advance Adjustment

1. After engine has been thoroughly warmed up, drive vehicle, using grade of fuel expected to be used in service. Engine should not ping or knock excessively under load and full throttle.

2. If knock is evident, loosen distributor mounting cap screw and turn distributor housing clockwise to retard spark until knock is eliminated.

3. Manual advance should be set to obtain the best possible engine performance with the particular grade of gasoline being used.

H. Maintenance

1. Lubrication: This distributor incorporates a built-in oil reservoir from which shaft lubrication is obtained through a porous bushing. This reservoir back of the shaft bushing is filled with light engine oil and sealed before the unit is shipped. The supply of oil is sufficient to last for approximately 200 hours under normal operating conditions. The oil reservoir should be refilled every 100 hours of operation or more frequently when unusual heat or other operating conditions are experienced. To refill remove the pipe plug at the base of the distributor, add oil until it flows out the plug hole, then replace the plug. In addition, a trace of high melting point ball bearing grease should be placed on the breaker cam every 100 hours. Also at 100 hours put one drop of light engine oil on the breaker lever pivot and a few drops on the felt wick under the rotor.

2. Inspection: The cap should be removed at regular intervals and the contact points, rotor and cap examined. Check the high tension wiring for frayed or damaged insulation and poor connections at the cap. Replace if necessary. Replace the cap or rotor if they are cracked or show carbonized paths indicating the secondary current is leaking to ground over the surface of the material.

3. Contact Points: Contact points that are burned or pitted should be replaced or dressed with a clean, fine-cut contact file. The file should not be used on other metals and should not be allowed to become greasy or dirty.

Never use emery cloth to clean contact points. Contact surfaces, after considerable use, may not appear bright and smooth, but this is not necessarily an indication that they are not functioning satisfactorily.

4. Oxidized Contact Points: Oxidized contact points may be caused by high resistance or loose connections in the condenser circuit, oil or foreign materials on the contact surface, or most commonly, high break-current. Check for these conditions where burned contacts are experienced.

5. Contact Point Opening: Contact point opening must be set to specification. Points set too closely may tend to burn and pit rapidly. Points with excessive separation tend to cause a weak spark at high speed. The point opening of new points may be checked with a feeler gauge. Use of a feeler gauge on used points is not recommended since the roughness of used points make it impossible to set the point opening accurately by this method. A dial indicator is recommended to check the point openings of used points. When necessary to check and adjust point opening with a feeler gauge, proceed as follows: Rotate breaker cam until breaker lever rubbing block is on the high point of the cam lobe thus giving the maximum point opening. Loosen the clamp screw holding the contact support and adjust point opening by turning the eccentric screw in the contact support. Tighten clamp screw, check with gauge again after tightening clamp screw. The contact points should be cleaned before adjusting if they have been in service. The cam or contact angle is the angle in degrees of cam rotation through which the points remain closed.

6. Contact Point Pressure: Contact point pressure must fall within the limits given. Weak tension will cause point chatter and ignition miss at high speed while excessive tension will cause undue wear of the contact points, cam and rubbing block.

7. Use of Distributor Test Fixture

a. The distributor test fixture accurately checks cam angle, spark advance and synchronization on distributors removed from the truck. It will also show excessive distributor shaft eccentricity as indicated by variation in synchronization.

b. After a distributor has been repaired, the calibration of the centrifugal advance mechanism should be checked. Proper engine performance cannot be obtained unless the centrifugal curve is within the limits specified for the particular engine.

8. Condenser: Four factors affect condenser performance, and each factor must be considered in making any condenser test.

a. "Breakdown" is a failure of the insulating material, a direct short between the metallic elements of the condenser. This prevents any condenser action.

b. "Low insulation resistance" or leakage

prevents the condenser from holding a charge. A condenser with low insulation resistance is said to be "weak". All condensers are subject to leakage, which up to a certain limit is not objectionable. When it is considered that the ignition condenser performs its function in approximately 1/12,000 of a second, it can be seen that leakage can be large without detrimental effects. It must be considered, however, in any condenser test.

c. "High series resistance" is excessive resistance in the condenser circuit due to broken strands in the condenser lead or defective connections. This will cause burned points and ignition failure upon initial start and at high speeds.

d. "Capacity" is built into the condenser and is determined by the area of the metallic elements and the insulating and impregnating materials. For a complete check of the condenser, it is desirable to use a tester which will check for the above four conditions.

IGNITION COIL **Fig. 9**

A. Ignition Coil is mounted on the side of the cylinder block near the distributor.

B. Coil should be tested with conventional coil tester, following instructions furnished by manufacturer of testing equipment. Defects indicated by test are:

1. Open primary circuit.
2. Open secondary circuit.
3. Shorted turns in primary or secondary.
4. High voltage breakdown in secondary.
5. High resistance in primary connections.

D. If any of the above conditions are evident, coil must be replaced.

SPARK PLUGS

A. General

Spark plug life is governed to a large extent by operating conditions, and plug life varies accordingly. To insure peak performance, spark plugs should be checked, cleaned and regapped every 500 hours.

Worn and dirty plugs may give satisfactory operation at idling speed, but under operating conditions they frequently fail. Faulty plugs are evident in a number of ways such as wasting gas, power loss, loss of speed, hard starting and general poor engine performance.

Spark plug failure, in addition to normal wear, may be due to dirty or leaded plugs, excessive gap, or broken insulator.

Refer to Specification Listing as the use of spark plugs in the proper Heat Range is of vital importance to good engine performance. Frequently, the wrong type of spark plug, one with an improper heat range for the engine, may have been installed when replacing spark plugs originally fitted by the engine manufacturer, and such misapplication may lead to poor performance.

Where abnormal operating conditions cause chronic carbon or oil fouling of the plugs, the use of a type with one of two numbers higher (a "hotter" type) than recommended in Specifications, will generally remedy the trouble; and by the same formula, where chronic preignition or rapid electrode wear is experienced, a type with one or two numbers lower (a "cooler" type) will generally be found satisfactory.

B. Removal

IMPORTANT: Before removing any spark plug, blow all dirt out of plug socket in cylinder head with compressed air.

1. Pull wires off spark plug terminals, using caution to avoid damaging wire terminals. Remove wires by firmly grasping large end of boot.

2. Use spark plug wrench and unscrew plugs from cylinder head. Ordinary wrenches may damage porcelain. If gaskets do not remain on plugs, remove them from cylinder head.

C. Service

1. Inspect plugs for cracked porcelain and burned points, and check point gap. Also check for loose terminals. Replace plugs which have excessively burned electrodes or cracked porcelain. Plugs should be cleaned with conventional sand-blast cleaning equipment.

2. Setting spark plug gap is a precision operation and should be treated as such. Refer to Specification Listing for proper gap dimensions.

All plugs must be set to the same dimension, using a standard round feeler gauge.

CAUTION: Before adjusting gap, file center electrode flat. In adjusting the spark plug gap, never bend the center electrode which extends through the porcelain center as this may break the lower insulator. Always make adjustment by bending the ground or side electrode. Fig. 73.

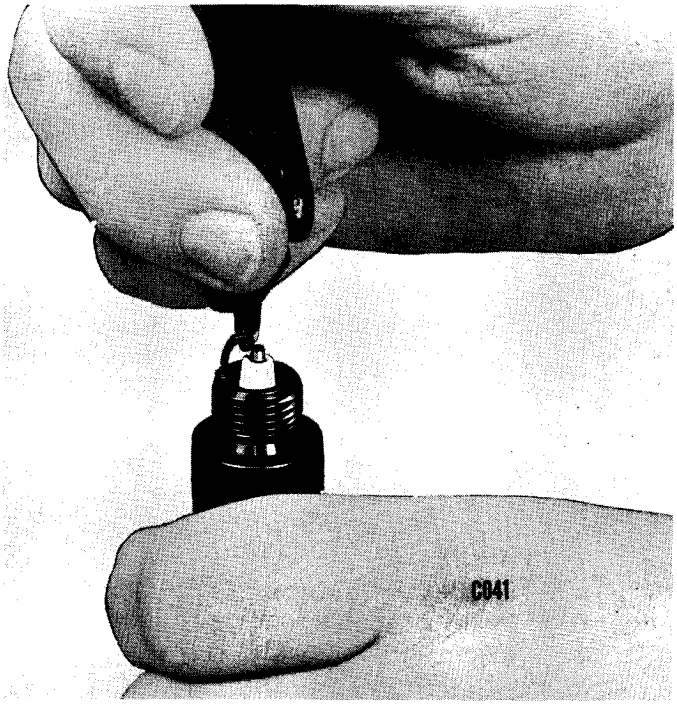


Figure 73

D. Installation

1. Be certain that the old gasket is removed before installation of plug, and that the gasket seat is clean and smooth. Check also that the spark plug threads and the cylinder head threads are not dirty or damaged. Dirty or damaged threads cause a faulty torque reading, resulting in incorrect installation and consequent poor spark plug life and faulty operation.

2. Install the spark plugs in the engine with new gaskets and tighten. If torque wrench is not available, turn plugs in until they are finger-tight against the gasket, then using a proper fitting socket wrench, tighten 2/3 additional turn. Care must be exercised when tightening.

3. Spark plugs which are not tightened correctly will result in too high an operating temperature if too loose, or distortion of the spark plug body and change in gap setting or damage to the gasket if too tight.

CHECKING GAUGES AND INDICATOR LIGHTS

A. General

Do not remove any unit from the truck unless it is known to be defective.

Check wiring, connections and indicator lights before condemning any unit.

B. Engine Oil Pressure and Hydraulic Oil

1. These lights should be checked periodically for good connections and lighting ability.

2. The lights may be checked by turning on the ignition switch. The lamps should light when engine is not running.

Although the oil pressure light functions normally, the oil pressure should be checked to help determine the generator and engine condition.

Substitute an oil pressure gauge for the oil pressure sending unit, to determine the oil pressure.

C. Checking Gauges

Before checking a gauge or sending unit, make sure all electrical connections are tight and free of dirt or moisture.

Wiring should be checked for broken or frayed insulation which may cause a short or ground in the circuit.

Any of these causes may have been the reason for failure.

The following equipment is necessary to make a complete check of these gauges:

1. One new fuel tank sending unit. If there is any question about the new tank unit being correct, then hook it up in series with a receiver unit known to be satisfactory. Operate tank unit by hand and see if receiver unit reads zero with tank unit float in bottom position.

2. Two 5 foot lengths of insulated wire equipped with clip terminals at each end. These long lengths will permit individuals making the check to sit in seat of truck and observe gauge being checked. To check, proceed as follows:

a. Disconnect sender unit being checked and hook in tank unit as shown in fig. 74. Turn on ignition switch and operate float rod of tank unit by hand.

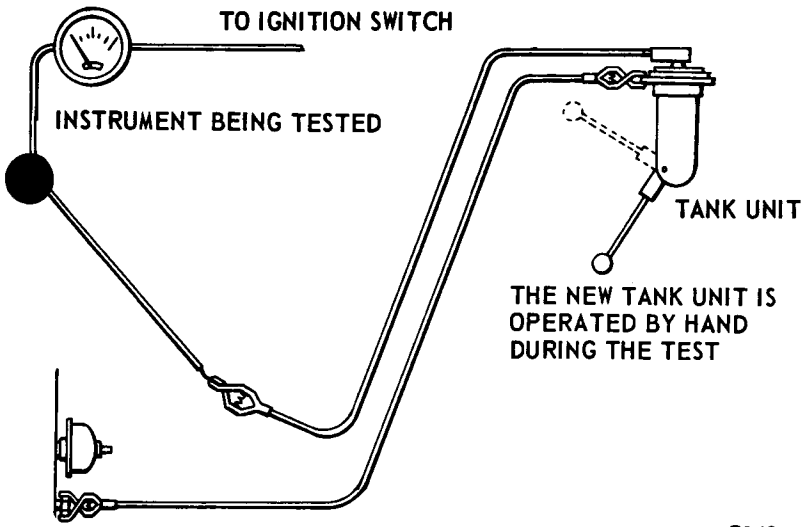


Figure 74

NOTE: If so equipped, connect the instrument being tested to the voltage limiter instead of to the ignition switch, as indicated in fig. 75.

b. With float of tank unit at bottom position, receiver unit should register at bottom mark on dial.

c. Move float rod up to top position, then the needle of the unit being checked should move to top mark on dial.

NOTE: Allow one minute for receiver to come to rest.

d. If the receiver unit operates correctly, it is then known the sending unit or wiring is at fault.

NOTE: Do not attempt to repair the sender unit. When installing a new engine unit, do not use thread compound on unit threads, as this will increase electrical resistance of unit and cause faulty operation.

e. If the receiver does not operate correctly, then check the wire lead to the receiver unit.

(1) Attach one end of the ten foot length of wire to the terminal of the receiver unit to which the wire lead is attached.

(2) Ground the other end of the long lead and turn the ignition switch.

(3) If the gauge operates now and did not operate with the regular wire connection, the wiring is at fault.

f. If wiring is satisfactory, then replace receiver unit and check again with tank unit.

TROUBLESHOOTING GUIDE

A. Starting Circuit

For trucks not equipped with running lights, a sealed beam light can be made up for test purposes. Attach one side of the filament to the battery terminal on the generator and ground the other side of the filament on the truck chassis.

Cause	Remedy
No Cranking, No Lights	
1. Battery dead	1. Recharge or replace battery.
2. Open circuit	2. Clean and tighten connections. Replace wiring.
No Cranking, Lights Go Out When Cranking Is Attempted	
1. Poor connection, probably at the battery terminals	1. Clean battery terminals and cable ends.
2. Defective cables	2. Replace defective cables.
No Cranking, Lights Dim Slightly When Cranking Is Attempted	
1. Pinion not engaging with the flywheel ring gear	1. Clean or replace defective parts.
2. Excessive resistance or open in cranking motor	2. Clean commutator. Replace brushes. Check and repair solenoid contacts. Repair poor connections.
No Cranking, Lights Glow Very Dim When Cranking Is Attempted	
1. Engine locked or turns too hard	1. Check engine. Repair as necessary.
2. Battery low	2. Recharge or replace battery.
3. Pinion jammed; defective mechanism	3. Free up and replace defective parts.
4. Damaged shaft bearings; dragging armature; short in cranking motor	4. Repair cranking motor.
No Cranking, Lights Stay Bright When Cranking Is Attempted	
1. Open in control circuit	1. Check ignition switch, connections and wiring. Check solenoid contacts and connections. Repair or replace as necessary.
Engine Cranks Slowly, But Does Not Start	
1. Battery in a discharged condition	1. Check, charge or replace battery.

ELECTRICAL

Cause	Remedy
2. Very low temperature	2. Battery must be fully charged, eliminate all resistance possible.
3. Undersized cables	3. Install cable of correct diameter.
4. Mechanical trouble in the engine	4. Check and repair as necessary.
Engine Cranks At Normal Speed But Does Not Start	
1. Defective engine systems other than the starting system	1. Check other engine systems.
Solenoid Plunger Chatters	
1. Hold-in winding of solenoid open	1. Replace solenoid.
B. Battery And Charging Circuit	
Remains In An Overcharged State	
1. High charging voltage	1. Check and reset voltage regulator.
2. Excessive resistance in the regulating circuit	2. Remove the resistance in the voltage regulating circuit. Clean and tighten connections. Replace wires having broken strands.
3. High ambient temperature	3. Adjust voltage regulator accordingly.
Uses Excessive Water	
1. Overcharging	1. Check charging circuit.
2. Cover seal leaking	2. Reseal or replace battery.
3. Case cracked	3. Replace battery.
Will Not Remain In A Charged State	
1. Defective alternator, regulator or external short	1. Check alternator regulator and wiring. Repair as needed.
2. Excessive load demands	2. Reduce electrical load.
3. High self discharge	3. Clean battery top and recharge. Replace if necessary.
4. Defective or old	4. Recharge and make high discharge test. Replace if defective.
Cracked Case	
1. Battery not secured or hold-down loose	1. Install new battery. Tighten hold-down correctly.
2. Battery frozen	2. Install new battery. Keep battery charged.

Cause	Remedy
Bulging Case	
1. Battery overheated	1. Battery overcharged.
2. Hold-down too tight	2. Loosen and tighten properly.
C. Ignition Circuit	
Engine Cranks Normally But Will Not Start	
1. Open primary circuit	1. Check connections, coil, contact points and ignition switch for open.
2. Coil primary grounded	2. Replace coil.
3. Points not opening	3. Adjust.
4. Burned points	4. Clean or replace.
5. Out of time	5. Check and adjust timing.
6. High tension leakage	6. Check coil head, distributor cap, rotor and leads. Remove all carbon deposits, residue and dirt.
7. Spark plugs fouled	7. Clean, adjust or replace. Correct reason for fouling.
Engine Runs But Misses On One Cylinder	
1. Defective spark plug	1. Clean and adjust or replace.
2. Distributor cap cracked or dirty; defective lead	2. Clean or replace distributor cap. Replace lead.
Engine Runs But Misses Different Cylinders	
1. Points worn, dirty or out of adjustment	1. Clean, adjust or replace as necessary.
2. Defective condenser or loose on mounting	2. Tighten, replace if necessary.
3. Frayed insulation on pig tail from points to condenser; pig tail broken	3. Replace condensor.
4. Advance mechanism defective; bushings in distributor worn	4. Repair or replace distributor.
5. Defective high tension wiring	5. Replace.
6. Weak coil	6. Replace.
7. Loose connections	7. Clean and tighten.

Cause	Remedy
Engine Misses At High Speed	
1. Weak distributor contact springs; point gap too wide	1. Adjust spring tension and point gap. Replace as necessary.
2. Worn distributor shaft or bushings	2. Repair or replace distributor.
3. Advance mechanism sticking or worn	3. Repair or replace distributor.
Engine Lacks Power Or Overheats	
1. Ignition timing off	1. Adjust timing.
2. Advance mechanisms defective	2. Adjust centrifugal advance. Replace vacuum advance unit if defective.
Engine Backfires	
1. Ignition timing off	1. Adjust timing.
2. Ignition crossfiring	2. Check high tension wiring, distributor cap or rotor for leakage paths.
3. Spark plugs of wrong heat range	3. Install spark plugs of a lower heat range.
Engine Knocks Or Pings	
1. Ignition timing fast	1. Retard timing.
2. Advance mechanism defective; distributor shaft or bushings worn	2. Rebuild or replace distributor.
3. Spark plugs of the wrong heat range	3. Install plugs of a lower heat range.
Rapid Wear Of Centrifugal Advance Mechanism	
1. Loose or worn timing chain or worn drive and camshaft gears	1. Replace parts as necessary.
Pitted Contact Points	
1. Condenser of wrong capacity	1. Install condenser of correct capacity.
2. Leads to coil reversed	2. Re-arrange leads.
3. Voltage regulator setting too high	3. Adjust voltage regulator.
4. Weak distributor contact spring	4. Adjust spring tension or replace spring and contact points.
5. Oil or crankcase vapors entering the distributor	5. Clean engine breather. Avoid over-lubricating the distributor.
6. Loose or dirty connections in the coil primary circuit	6. Clean and tighten connection. Replace wires that are corroded or have broken strands.

Cause	Remedy
Spark Plugs Defective	
1. Excessive gap	1. Reset points.
2. Cracked insulator	2. Careless installation. Install new plug.
3. Plug sooty or wet with fuel	3. Clean and adjust. Repair defect in fuel system, most likely in carburetor. Check at plug.
4. Plugs have carbon deposits	4. Dry deposits indicate plugs are too cold. Install hotter heat range plug. Wet oily deposits indicate engine pumping oil. Repair as necessary.
5. Plug white or gray with blistered insulator	5. Install plug of a cooler heat range.

SPECIFICATION LISTING

Electrical System	
6 Volt	Positive Ground
12 Volt	Negative Ground
Generator — 6 Volt	
Rotation	Clockwise
Cold Output	16-18 amps
and	8-8.3 volts
at	1600 Gen. RPM
	650 Eng. RPM
Spring Tension	24 oz.
Field Current Draw	2.2—2.6 amps
at	6 volts
Generator — 12 Volt	
Rotation	Clockwise
Cold Output	10 amps
and	14 volts
at	1170 Gen. RPM
	600 Eng. RPM
Field Current Draw	1.69—1.79 amps
at	12 volts
Alternator	
Rotation	Clockwise
Cold Output	25 amps
and	14 volts
at	2000 Alt. RPM
	1670 Eng. RPM
Pulley Nut Torque	50-60 lb.-ft.
Fan Belt Deflection	1/2—3/4 in.
Generator Regulator — 6 Volt	
Step Voltage Control Contacts:	
Air Gap	.035 in.
Point Opening	.010 in.
Spring Tension	.8 oz.
Opening Voltage:	
Range	6.9—7.5 volts
Initial Setting	7.2 volts
Closing Voltage	6.2 volts max.
Open and Close Diff.	1.5 volts
Cutout Relay Contacts:	
Air Gap	.015 in.
Point Opening	.020 in.
Closing Voltage:	
Range	6.0—7.1 volts
Initial Setting	6.6 volts
Generator Regulator — 12 Volt	
Voltage Control:	
Air Gap	.075 in.
Voltage Setting:	
Range	13.9—14.8 volts
Initial Setting	14.3 volts
Cutout Relay:	
Air Gap	.020 in.
Point Opening	.020 in.
Closing Voltage:	
Range	11.8—13.5 volts
Initial Setting	12.7 volts
Current Regulator:	
Air Gap	.075 in.

Current Setting:	
Range	9-11 amps
Initial Setting	10 amps
Alternator Regulator	
Voltage Control:	
Air Gap	.067 in.
Point Opening	.014 in.
Voltage Setting:	
Regulated and Upper Points	13.8—14.8 volts
at	85°
Lower Points	.1-.4 volts lower than upper point setting
Cranking Speed	150 RPM min.
Cranking Motor — 6 volt (Std. Trans.)	
Rotation	Clockwise
Brush Spring Tension	24 oz.
No Load Test:	
Speed	5500 RPM
Current Draw	80 amps
at	2.5 volts
Cranking Motor — 6 volt (P. S. Trans.)	
Rotation	Clockwise
Brush Spring Tension	24 oz.
No Load Test:	
Speed	6000 RPM
Current Draw	60 amps
at	5 volts
Lock Test:	
Torque	15 ft.-lb.
Current Draw	600 amps
at	3 volts
Cranking Motor — 12 Volt (Gasoline Engine)	
Rotation	Clockwise
Brush Spring Tension	35 oz.
No Load Test:	
Speed	6200-9400 RPM
Current Draw*	49-76 amps
at	10.6 volts
Resistance Test (Lock Test):	
Current Draw*	270-310 amps
at	4.3 volts
Pinion Clearance	.010-.140 in.

* Includes Solenoid

Cranking Motor — 12 Volt (Diesel Engine)	
Rotation	Clockwise
Brush Tension	35 oz.
No Load Test:	
Speed	6450—8750 RPM
Current Draw*	75-100 amps
at	10.6 volts
Resistance Test (Lock Test):	
Current Draw*	720—870 amps
at	5 volts

* Includes Solenoid

Distributor	
Rotation (viewing rotor)	Counterclockwise
Point Gap	.022 in.
Dwell	25°—40°
Point Pressure	19—23 oz.
Centrifugal Advance:	
Dist. RPM	Degrees Advance
300	.5-2.5
400	3-5
800	5.5-7.5
1100	7.5-9.5
Timing	
Initial Timing	TDC at 500 RPM
Firing Order	1-3-4-2
Battery	
Specific Gravity State of Change	
1.260-1.285	Full
1.210-1.225	Half
1.150	Low to discharged
Spark Plugs	
Type	D-16 or equivalent
Gap	.025 in.
Tightening Torque	30 lb.-ft.

ELECTRICAL

AUTOMATIC DISENGAGEMENT AND LOCK-OUT SYSTEM

A. GENERAL

The automatic disengagement and lock-out, or ADLO system consists of a resistor and a relay. It is shown in the wiring diagram for gasoline and diesel engines.

The ADLO system protects the starter motor pinion and engine ring gear by eliminating the possibility of starter motor engagement with a running engine. Turning the ignition key closes the starter circuit. As soon as the engine fires, the output of the alternator will break the starter circuit in the relay and the pinion disengages. Disengagement takes place between cranking speed and low idle.

B. TESTING

1. With engine stopped, remove relay cover and observe contacts which should be closed. If contacts are not closed, adjust contacts until they close by bending armatures.

2. Observe contacts while starting the engine in a normal manner; do not speed up the engine but allow it to idle in a normal manner. (Recommended idle speed.)

3. If contacts remain closed during cranking and open when engine starts, the relay operation is satisfactory and no further adjustments are required. Repeat Step 2 once more to insure that operation is satisfactory, then stop engine and replace cover.

4. If contacts open during cranking before engine starts, bend armatures and repeat Steps 2 and 3.

5. If contacts do not open when engine starts, operate at idle speed and bend upper contact armature until contacts open. Repeat Steps 2 and 3.

6. If relay contacts cannot be adjusted to open at engine idle, replace the relay.

C. TROUBLESHOOTING

1. Resistor

   a. If the resistor burns out, the starter can be engaged with the engine running and the ADLO system becomes ineffective.

   b. The resistor is rated 7.5 ohms, maximum power dissipation: 25 watts. Check the resistor with the unit cold, using an ohm meter or Multimeter. Replace a defective resistor.

2. Relay

   a. A burnt coil will cause the points to stay closed. Thus, the starter can be engaged with the engine running.

   b. If the points fuse, the starter can be engaged with the engine running.

   c. If the points become pitted, coated or make no proper contact, the engine can not be started. Replace the relay in these cases.