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Section 1010

GENERAL SPECIFICATIONS 970 TRACTOR

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Piston Displacement	401 Cubic Inches (6 571.2cm ³)
Compression Ratio	16.5 to 1
Cylinder Sleeve	Removable Wet Type
No Load Governed Speed	2140 to 2180 RPM
Rated Engine Speed	2000 RPM
Engine Idling Speed	700 to 750 RPM
*Valve Tappet Clearance (Exhaust)	(Hot) .020 Inch (0.508mm)
	(Cold) .025 Inch (0.635mm)
(Intake)	(Hot and Cold) .015 Inch (0.381mm)

*Hot Settings Are Made After The Engine Has Operated At Thermostat Controlled Temperature For At Least Fifteen Minutes.

Piston and Connecting Rods

Rings per piston	3
Number of Compression Rings	2
Number of Oil Rings	1
Type Pins	Full Floating Type
Type Bearing	Replaceable Precision, Steel Back, Copper-Lead or Aluminum Alloy Liners

Main Bearings

Number of Bearings	7
Type Bearings	Replaceable Precision Steel Back, Copper-Lead or Aluminum Alloy Liners.

Engine Lubricating System

Oil Pressure	45 to 60 PSI (310 to 414 kPa) with Engine Warm and Operating at Rated Engine Speed.
Type System	Pressure and Spray Circulation
Oil Pump	Gear Type
Oil Filter	Full Flow Spin on Type

Fuel System

Fuel Injection Pump	Robert Bosch, Type PES (Multiple Plunger).
Pump Timing:	
Prior to Tractor SN8675001	29 Degrees Before Top Dead Center (Port Closing)
Starting with Tractor SN8675001	30 Degrees Before Top Dead Center (Port Closing)

Fuel System

Fuel Tank Capacity ----- 50 U.S. Gallons (189.3 litres)
 Carburetor (Zenith) (W/solenoid) ----- 1-1/2 Inch SAE Flange (38mm).
 Fuel Pump and Screen ----- A.C. Vacuum Type, Camshaft Actuated.
 Fuel Pump Operating Pressure at 1200 RPM ----- 3 to 5 PSI
 (20.7 to 34.5 kPa).

Distributor Ignition

Contact Point Gap ----- .020 Inches (0.508mm)
 Dwell Angle ----- 39°
 Spark Plugs ----- Prestolite 18 8
 Plug Gap ----- .025 Inches (0.635mm)
 Thread ----- 18 MM
 Shank Length ----- 1/2 Inch (12.7mm)

Engine Timing

Static Timing ----- TDC
 Running Timing ----- Engine Running at Rated Engine Speed: 27° BTDC

GENERAL SPECIFICATIONS

Cooling System

Capacity ----- 38 U.S. Quarts (36 litres)
 Type of System ----- Pressurized, Thermostat Controlled
 By-Pass Type: Forced Circulation, (Impeller Type Pump).
 Radiator ----- Heavy Duty Fin and Tube Type
 Thermostat ----- Starts to Open at Approximately 175°F. (79°C.)
 Fully Open at 202°F. (94°C.)
 Pressure Cap Required ----- 14 PSI Vented (96.5 kPa)
 or 10 PSI Non-Vented (68.9 kPa)

Electrical System

Type of System ----- 12 Volt Negative Ground
 Batteries ----- (2) 12 Volt Batteries Connected in parallel.
 (Spark Ignition) - Group Size 27H, Rated at 1.255 to 1.265
 Specific Gravity, Discharge Rate 300 Amps
 at 0°F., Voltage drops to 8.7 after 10 seconds,
 Voltage drops to 1.0 volts per cell after 3-1/2
 minutes.

Electrical System (Continued)

(Diesel) - Group Size 30H, Rated at 1.255 to 1.265 Specific Gravity. Discharge Rate 300 Amps at 0°F. Voltage drops to 9.2 after 10 seconds. Voltage drops 1.0 Volts per cell after 4 min.

Alternator ----- 12 Volt 55 Amp Output
 Voltage Regulator ----- 12 Volt, Solid State, Internal Component of Alternator
 Starter Motor ----- 12 Volt with Solenoid Switch
 Head Lights (2) ----- 12 Volt, 40/40 Watt Sealed High-Low Beam
 Front Flood Lights ----- 12 Volt, 35 Watt, Sealed Beam
 Rear Flood Light ----- 12 Volt, 60 Watt, Sealed Beam
 Flasher Lights (2) w/Directional Turn Signals ----- 12 Volt, Amber Lens
 Rear Tail Light ----- 12 Volt, 60 Watt Sealed Beam Combination
 Tail and Flood Lamp.
 Circuit Breaker System over load check ----- 12 Volt Twin 40 AMP Breakers
 connected in parallel, 80 AMP rating - 60 AMP. Min. Continuous capacity.
 Lights Circuit Breaker ----- 40 Amp., Located on Light Switch
 Parking Brake Warning Light ----- 12 Volt, Red Flasher Type

Parking Brake

Type ----- Cable Actuated by Orscheln Type Handle - Adjustable from
 Operator's Seat.

Hydraulic Brakes

Type ----- Hydraulic Actuated, Self-Adjusting Disc Type Differential Brakes.

Hydraulic Power Assist Brakes

Type ----- Hydraulic, Power Assisted, Self-Adjusting Disc Type Differential Brakes.

Mechanical Transmission

Type ----- 2 Speed Gear Range With a 4 Speed Gear Section.
 Gear Selection ----- 8 Speeds Forward - 2 Speeds Reverse.
 Shifting ----- Mechanical With Plunger Type Locks and Tube Type Interlocks.

Power Shift Transmission

Type ----- 3 Speed Compound Planetary With Hydraulically Actuated Clutches and a 4 Speed Gear Range Section.

Gear Selection ----- 12 Speeds Forward and 3 Speeds Reverse

Shifting ----- Hydraulic Power Shifting Controlled By a Lever on Operators Console. 4 Speed Range Controlled By a Mechanical Shifter From a Lever On Operator's Console.

Power Take-Off

Type Clutch ----- Hydraulically Operated

Rotation ----- Clockwise

Spline Size ----- 540 RPM ----- 6 Splines ----- 1-3/8 in. (34.9mm)
1000 RPM ----- 21 Splines ----- 1-3/8 in. (34.9mm)

Engine Speed 2000 RPM ----- 540 or 1000 RPM Shaft Speed

Belt Pulley

Method of Engagement ----- PTO Control Lever

Pulley Diameter ----- 10.5 in. (266.7mm)

Pulley Face Width ----- 7.25 in. (184.2mm)

Ratio Engine RPM:

(540 PTO) ----- 1.716 to 1

(1000 PTO) ----- 1.722 to 1

1 RPM of Belt Pulley ----- 2.75 feet (8.4m) Per Minute Belt Travel.

Draft-O-Matic System

Type of Sensing ----- Lower Link

Type Control ----- Hand Lever

Type Valve ----- 3 Positions - Raise - Hold - Lower

Type Draft Arms ----- Swinging, with Manual Float Adjustment

Type Hitch ----- 3 Point Category II

Convertible Hitch Coupler (Available) ----- Category III-II

Hydrostatic Power Steering

Pump Type ----- Large Volume, Spur Gear, Continuous Running.

Pump Capacity at 2000 Engine RPM ----- 8 GPM (30.3 l/mn)

HGA Hydrostatic Type ----- Integral and Bi-Directional Gerotor Metering Section, Actuated By the Steering Wheel.

Actuating Cylinders ----- 2 Way Cylinders Are Integral Part of Steering Gear Mechanism.

Drawbar

Standard or Yoke Type ----- Full Swing Roller Mounted. Will
Accommodate a 1-1/4 Inch (31.8mm) Dia. Pin

Remote Hydraulic System

Pump ----- Large Volume, Spur Gear, Continuous Running.

Type Valve ----- Dual Valve - Individual Hand Lever Control

Portable Cylinder Coupling ----- ASAE R366 Standard Quick
Detachable Break-Away Type

Pump Capacity at 2000 Engine RPM ----- 16 GPM (60.6 l/min)

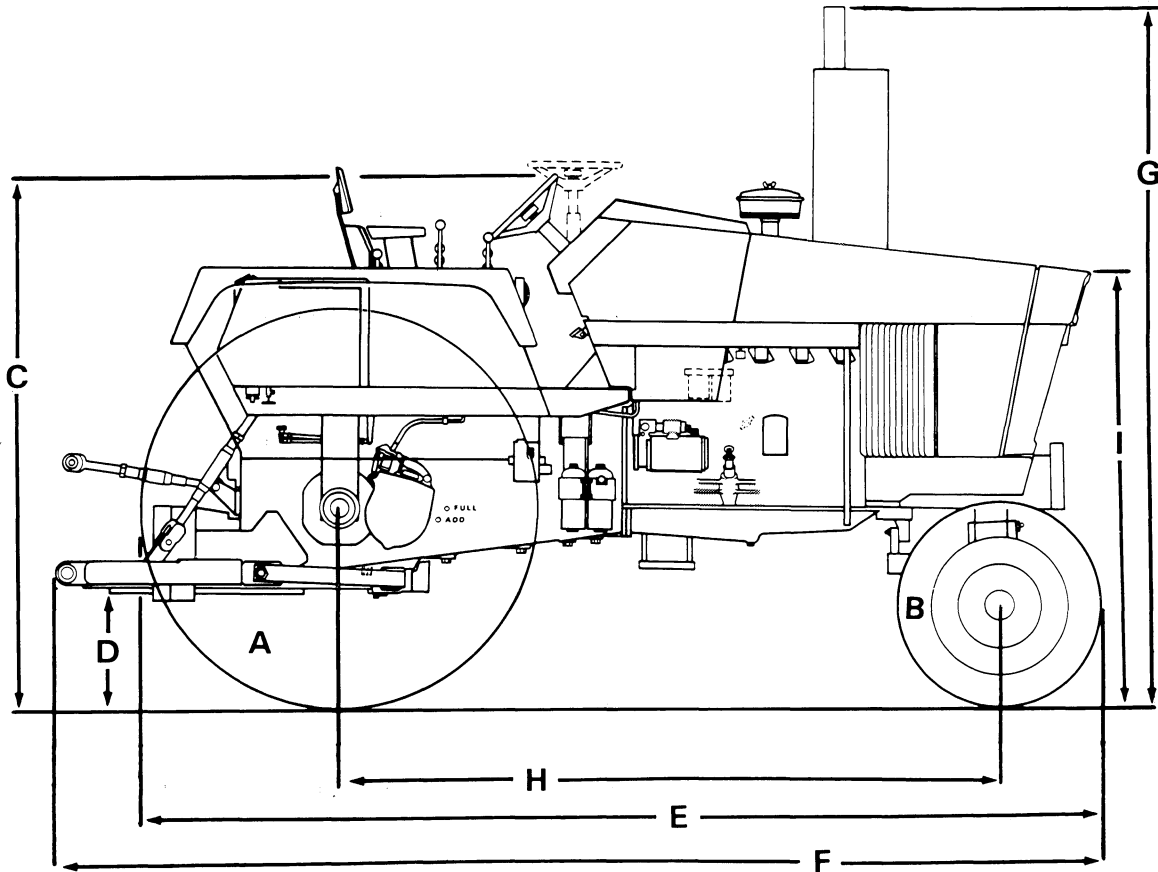
Relief Valve Pressure ----- 1700 to 1900 PSI (11 721 to 13 100 kPa)

Portable Cylinders ----- Case Cylinders Available

OPERATOR'S CAB

The Case Operator's Cab is equipped with Built-in Rollover Protection as specified in ASAE Standard S336.1, SAE Standards J168a, and OSHA Regulations 1928.53 and 1926.1002, Approval Number CAR317.

APPROXIMATE OVERALL MEASUREMENTS



A	18.4-34R1
B	10.00-16F2
C	85 in. (2 159mm)
D	15 in. (381mm)
E	157 in. (3 988mm)

F	172 in. (4 369mm)
G	110 in. (2 794mm)
H	109 in. (2 769mm)
I	70 in. (1 778mm)

Height Over Cab 113 Inches (2 870mm)

APPROXIMATE WEIGHT

970 Tractor Without Cab 9095 Pounds (4 125 kg.)

970 Tractor With Cab 9935 Pounds (4 506 kg.)

IMPORTANT: The Total Tractor Weight with ballast and weights must not exceed 12,200 lbs. (5 534 kg.).

TIRE AND WHEEL EQUIPMENT

Front

TIRE SIZE	TIRE PLY	RIM SIZE	TREAD TYPE	DUAL	ADJ.	TIRE PRESSURE
10.00-16	6	W8L-16	F2	//	X	28 PSI (198 kPa)
11.00-16	6	W8L-16	F2	//	X	36 PSI (248 kPa)

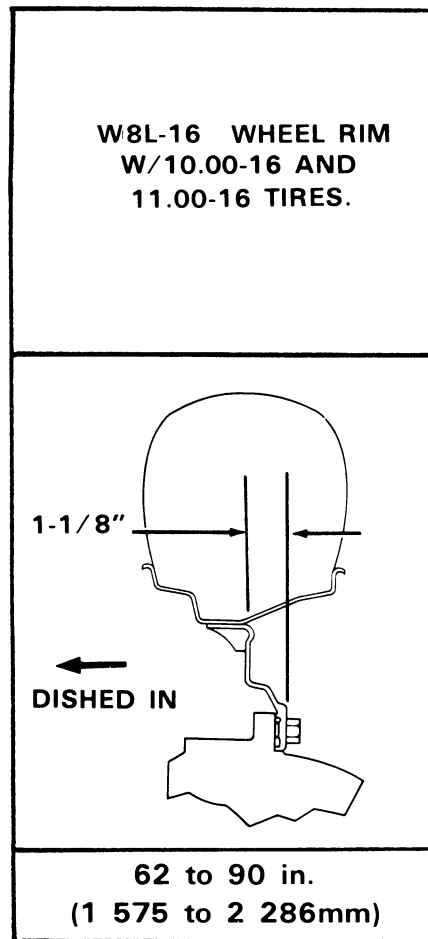
Rear

TIRE SIZE	TIRE PLY	RIM SIZE	TREAD TYPE	DUAL	ADJ.	TIRE PRESSURE
16.9-38	8	W14-38	R1	//	X	24 PSI (166 kPa)
18.4-34	6	W16L-34	R1 & R2	X	X	16 PSI (110 kPa)
18.4-38	6	W16L-38	R1 & R2	X	X	16 PSI (110 kPa)
18.4-38	8	W16L-38	R1	X	X	20 PSI (138 kPa)
20.8-34	6	W18L-34	R1	X	X	16 PSI (110 kPa)
20.8-34	8	W18L-34	R1	X	X	18 PSI (124 kPa)
23.1-30	8	DW20-30	R1 & R2	//	X	16 PSI (110 kPa)

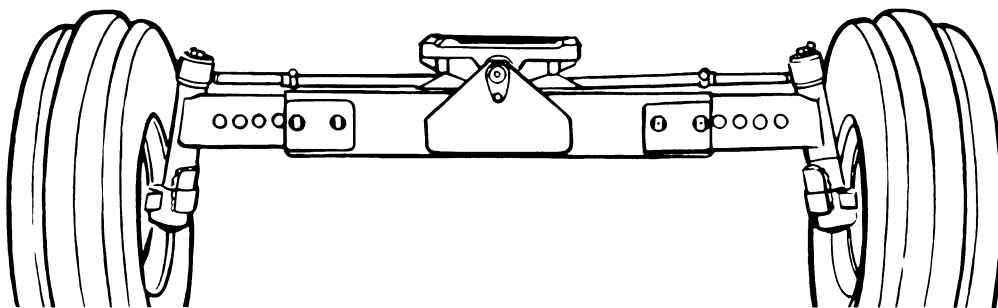
NOTE: Keep tires inflated to recommended pressures. Check pressures at least every 50 hours of operation or once a week, whichever occurs first. DO NOT reduce rear tire pressure to increase traction. When plowing, increase furrow wheel tire pressure 4 PSI (27.6 kPa).

IMPORTANT: Do not attempt to remove, repair or install a tractor tire on a rim. Take the tire and rim to an experienced and properly equipped tire shop where special safety equipment is available.

FRONT WHEEL TREAD SPACING (With Wheels Dished In Only)



WIDE ADJ. AXLE SPACING (1 TO 8 SETTINGS)



NOTE: Axle spacings listed above are from the narrow setting, in increments of 4 in. (101.6 mm) to the wide setting. When tightening the front wheel bolts, torque 5/8 in. dia. bolts 115 to 130 ft. lbs. (156 to 176 Nm) and 9/16 in. dia. bolts 85 to 100 ft. lbs. (115 to 136 Nm).

Section 2008

CYLINDER HEAD AND VALVES 251B, 301B AND 377B SPARK IGNITION ENGINES

SPECIFICATIONS

	Decimal System	Metric System
CYLINDER HEAD		
Warpage (Incl. Wear)	.005"	.127mm
SPARK PLUG		
Gap Setting (18mm)	.025"	.635mm
EXHAUST VALVE		
Tappet Clearance (COLD)	.025"	.635mm
(HOT)	.020"	.508mm
Face Angle	44°	
Face Run-out	.002"	.0508mm
Length (301B)	6.5915 to 6.6165"	167.42 to 168.06mm
Length (251B and 377B)	6.5245 to 6.5495"	165.72 to 166.36mm
O.D. of Head (301B)	1.671 to 1.681"	42.443 to 42.697mm
O.D. of Head (251B and 377B)	1.540 to 1.550"	39.116 to 39.370mm
O.D. of Stem (Incl. Wear)	.398 to .401"	10.109 to 10.185mm
Insert Seat Angle	45°	
Seat Contact Width	.0700 to .0900"	1.778 to 2.286mm
Seat Run-out	.002"	.0508mm
Insert Height	.251 to .254"	6.375 to 6.452mm
O.D. of Insert (301B)	1.761 to 1.762"	44.729 to 44.780mm
O.D. of Insert (251B and 377B)	1.630 to 1.631"	41.402 to 41.427mm
I.D. of Insert (301B)	1.483 to 1.489"	37.668 to 37.897mm
I.D. of Insert (251B and 377B)	1.352 to 1.358"	34.341 to 34.544mm
INTAKE VALVE		
Tappet Clearance (COLD AND HOT)	.015"	.381mm
Face Angle	44°	
Face Run-out	.002"	.0508mm
Length (301B)	6.5805 to 6.6055"	167.145 to 167.780mm
Length (251B and 377B)	6.5325 to 6.5575"	165.926 to 166.561mm
O.D. of Stem (Incl. Wear)	.400 to .403"	10.160 to 10.236mm
O.D. of Head (301B)	1.820 to 1.830"	46.228 to 46.482mm
O.D. of Head (251B and 377B)	1.715 to 1.725"	43.561 to 43.815mm
Seat Angle	45°	
Seat Run-out	.002"	.0508mm
Seat Contact Width	.0775 to .0975"	1.969 to 2.477mm

SPECIFICATIONS (Continued)

	Decimal System	Metric System
INTAKE AND EXHAUST VALVE GUIDE		
Length	3.625"	92.075mm
O.D. ....	.7510 to .7515"	19.075 to 19.088mm
I.D. (Installed and Reamed Incl. Wear) .....	.4045 to .4065"	10.274 to 10.325mm
Protrusion Above Cylinder Head .....	.953"	24.206mm
VALVE SPRING		
Free Length	2.28"	57.912mm
Total Coils	7.75	
Wire Diameter .....	.171"	4.343mm
I.D. ....	.980 to 1.000"	24.892 to 25.4mm
Compressed to 1.484" (37.69mm) (Valve Open)	135 to 145 lbs.	61.2 to 65.8 kg
Compressed to 1.937" (49.2mm) (Valve Closed)	40 to 50 lbs.	18.1 to 22.7 kg.
ROCKER ARM ASSEMBLY		
O.D. of shaft .....	.860 to .866"	21.844 to 21.996mm
I.D. of Rocker Arm .....	.8745 to .8760"	22.212 to 22.250mm
Shaft Assembly End Play (Both Ends) .....	.010 to .030"	.254 to .762mm
Shaft Spring:		
Total Coils (Working Coils)	4	
Wire Diameter .....	.080"	2.032mm
O.D.	1.018"	25.857mm
Compressed to 1-9/16 (39.7mm)	8.5 to 11.5 lbs.	3.86 to 5.22 kg
Lubrication	Engine Oil, Camshaft Metering.	
Shaft Oil Holes	Toward Valve Side of Engines. Shaft Cannot be Rotated.	

Special Torques

Cylinder Head Bolts	200 to 210 ft. lbs.	271.2 to 284.8 Nm
Intake and Exhaust Manifold Stud Nut	25 to 30 ft. lbs.	33.9 to 40.7 Nm
Rocker Arm Bracket Stud Nut and Bolt	40 to 45 ft. lbs.	54.2 to 61.0 Nm
Cylinder Head Cover Stud Nut	8 to 10 ft. lbs.	10.9 to 13.6 Nm
Spark Plugs	32 to 35 ft. lbs.	43.4 to 47.5 Nm

CHECKING COMPRESSION PRESSURE

1. Clean the engine thoroughly, preferably by steam cleaning.
2. Before cranking the engine for compression checking, make sure all operating controls are in neutral, brakes are set and the wheels are securely blocked.
3. Only the cranking method is advised to be used when checking compression pressure. **NOTE** The engine must be at operating temperature at the time of compression checking.
4. With the engine at operating temperature, shut the engine off. Close the fuel needle valve at the fuel tank. This will prevent excessive fuel from entering the cylinder and washing of the cylinder walls. Disconnect all high tension spark plug wires. Remove all spark plugs to provide minimum load on the starting motor and battery.
5. Check the compression pressure, using a reliable gauge and suitable adapter to fit in a 18 mm thread plug hole. Refer to chart on Page 3.

CHECKING COMPRESSION PRESSURE (continued)

6. Two common types of compression gauge equipment used are the remote control and the ignition switch operation type.

A. When using the remote control type of compression tester, Figure 1, make sure the wires are correctly attached to the starter terminals. Incorrect attaching of the wires will cause damage to the testing equipment, Figure 1.

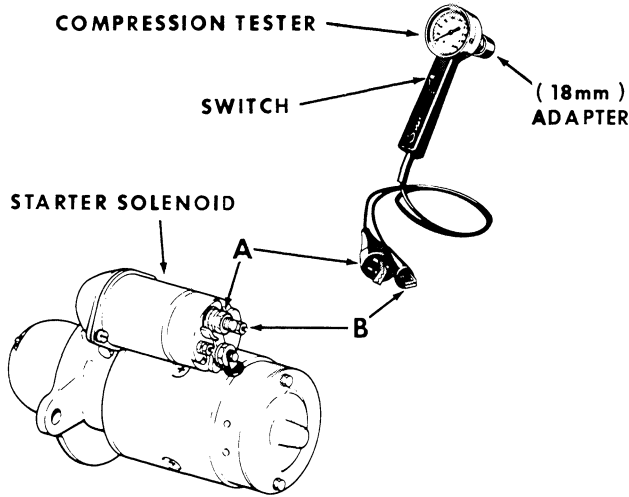


Figure 1

B. When using the ignition switch operation type of compression tester, Figure 2, be sure the carburetor throttle plate (butterfly) valve is held in the wide open position. Drain the carburetor to prevent fuel from entering the cylinders.

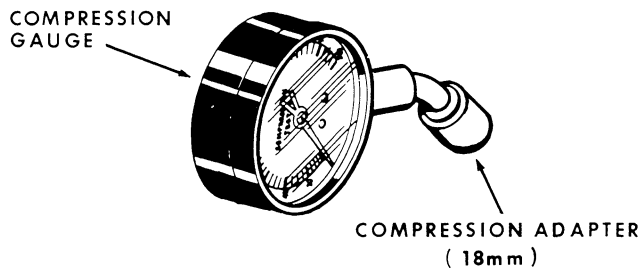


Figure 2

7. It is very important that all cylinder pressures be approximately alike. For the allowable compression pressure variation, refer to the chart below.

8. If the compression reading is below these figures, leaking valves or excessive ring clearance is indicated. **NOTE** To make a simple check when a compression leak is indicated, squirt a small amount (a teaspoon) of oil into the cylinder and recheck the compression. If the pressure rises to near normal, compression loss is past the rings. Very little change in compression indicates leakage past the valves. A low pressure reading will cause difficulty in starting particularly at low temperatures.

NOTE Always take a second set of readings for an accurate check. This will also indicate how much the loss of cranking speed, due to battery discharge, is affecting the compression pressure reading.

9. Before installing the spark plugs, clean them thoroughly and check them for burned electrodes or cracked insulation. Replace them if necessary. Regap all plugs to .025" setting, Figure 3.

10. Replace all spark plug gaskets, Figure 3, before installing for proper seating and sealing. Install the spark plugs finger tight. Using the exact size spark plug wrench or a thin wall deep socket, torque the spark plugs 32 to 35 ft. lbs.

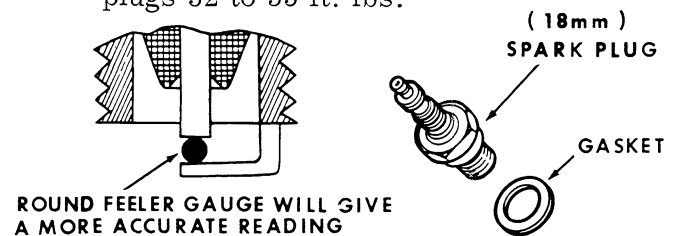


Figure 3

	ENGINE SPEED	NORMAL COMPRESSION PRESSURE	ALLOWABLE VARIATION BETWEEN CYLINDERS
CRANKING	Approximately 150 RPM	140 PSI*	15 PSI

*A 4% reduction in PSI must be allowed for every 1000 ft. above sea level.

CYLINDER HEAD AND COMPONENTS

(Refer to Figure 4)

Removal

Remove the muffler and hood from the vehicle. Steam clean the entire engine area where service work is to be performed. Disconnect and remove the air cleaner system.

1. Drain the cooling system. **CAUTION** If the engine is hot, do not remove the radiator cap until the coolant has had sufficient time to cool. Loosen the cap to the first stop carefully to relieve any excess pressure before removing it completely.
2. Remove the upper and lower hoses from the thermostat housing (28).
3. Disconnect the linkage and fuel line from the carburetor (1). Remove the carburetor assembly (1) with the mounting gasket (2). Discard the gasket (2). Disconnect the high tension wires from the spark plugs and remove the spark plugs (29) and gaskets (30).
4. Remove the air stack (3).
5. On the six cylinder 377B engine, remove the riser (14) with gasket (15), Inset A. Discard gasket (15).
6. Remove the water manifold (11), assembled with the thermostat housing (28). Remove the manifold gaskets (12) and discard. **NOTE** If the thermostats are to be serviced, refer to Section 25.
7. Remove bolt (13) that connects the intake manifold (19) to the exhaust manifold (18). Remove the manifolds stud nuts (16) and the clamps (17). Remove intake manifold (19) and the exhaust manifold (18). Remove the manifold gaskets (20) and discard.
8. Remove the breather tube (4) with the gaskets (5). Discard the gaskets (5).
9. Remove the valve cover nuts (6), bevel washers (7) and gaskets (8). Discard the gaskets (8). Remove the valve cover (9) and gasket (10). Discard the gasket (10).
10. Remove the studs (21) and bolts (22) from the rocker arm bracket. Remove the rocker arm assemblies (23) and tag them for proper installation. See Pages 8 and 9 for servicing of the rocker arm assembly.
11. Remove the cylinder head bolts (25). Remove the cylinder head (26) and gasket (27). Discard the cylinder head gasket (27).

Inspection

1. Replace all gaskets and worn or defective parts.
2. Clean the top surface of the cylinder block and sleeve flange carefully. The top of the pistons may be cleaned with a power driven wire brush. **NOTE** The pistons must be at top dead center when being cleaned. All traces of carbon and other deposits must be removed. During cleaning, the use of a rag dampened in solvent is recommended.
3. Clean all bolt and stud threads.
4. Clean and inspect the cylinder heads thoroughly. If evidence of fretting or erosion exists or if the head is warped more than .005" , the head must be resurfaced or replaced.
5. Inspect the push rods for straightness, cracked or worn ends. Replace if necessary.
6. Clean the valve covers and flush out the breather tube.
7. Clean and check the spark plugs. If replacement is required, regap the spark plugs to .025 setting.

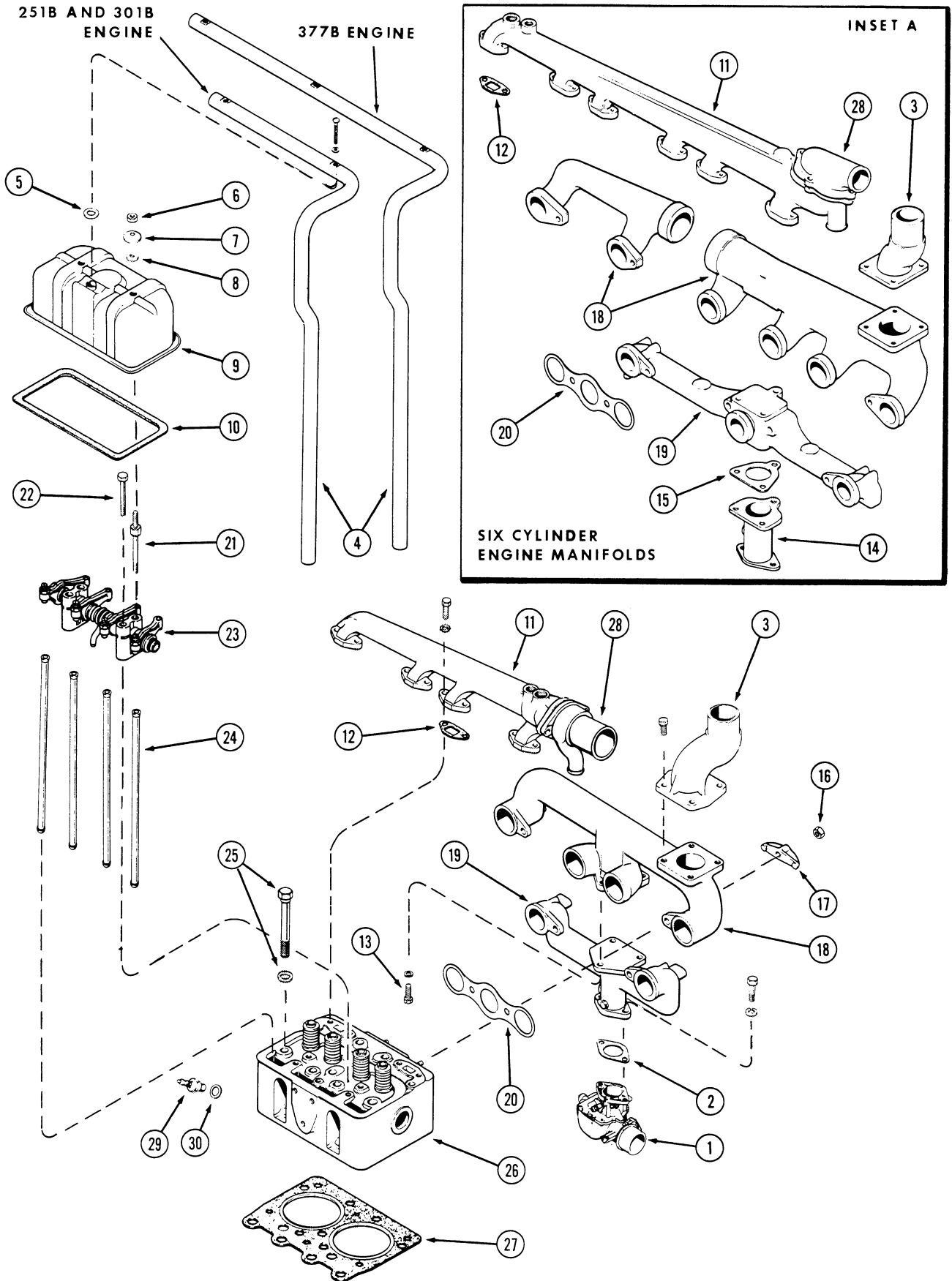


Figure 4

CYLINDER HEAD AND COMPONENTS (Continued)

(Refer to Figure 5)

Installation

1. Place new cylinder head gaskets (27) on the engine block. **NOTE** Two of the cap-screw holes in the head gaskets are slightly smaller and act as guides to position the head gasket with lineup guide studs or locating dowel pins.
2. For difficult installations, the use of dowel pins and a tong are recommended, Inset A. These can be purchased through a local Snap-On Tool dealer or the J.I. Case Service Parts Supply under the following part numbers.

SNAP ON TOOL CO.	CASE PART NO.
Tong CF83-1	A40952
Dowel CF83-5	A43450
3. Install the cylinder heads (26) and several bolts and washers (25) finger tight. Remove the A43450 dowels using the A40952 tong or guide studs. Install the remaining cylinder head bolts and washers (25) also finger tight. Install new intake and exhaust manifold gaskets (20). Install the intake manifold (19), exhaust manifold (18), clamps (17) and stud nuts (16) finger tight. Install the water manifold (11) assembled with the thermostat housing (28), new manifold gaskets (12) to the cylinder head with mounting bolts finger tight.
4. Torque the cylinder head bolts (25) in the proper sequence as illustrated in Inset D. The three recommended torque steps are 70 ft. lbs., 140 ft. lbs. and 210 ft. lbs. Torque the intake and exhaust manifold stud nuts (16) evenly 25 to 30 ft. lbs. Install the intake and exhaust bolts (13) and torque 25 to 30 ft. lbs. Torque the water manifold mounting bolts evenly 25 to 30 ft. lbs.
5. Coat all of the push rods (24) with clean engine oil and install them in their original locations.
6. Install the rocker arm assemblies (23) in their original location. Make sure all of the push rods (24) are engaged with the adjusting screws on the rocker arms. Install the bracket studs (21) and bolts (22) and tighten. Torque the studs and bolts evenly 40 to 45 ft. lbs.
7. Check the clearance at both ends of the rocker arm shafts. Maintain clearance between .010" to .030" at each end, Inset B, Page 9. Adjust the valve tappet clearance, refer to Pages 16 or 17.
8. On the six cylinder 377B engine, install new riser gasket (15), Inset B and the riser (14). Torque the retaining bolts 35 to 42 ft. lbs.
9. Install the exhaust stack (3) to the exhaust manifold. Secure with mounting bolts and torque the bolts 35 to 42 ft. lbs.
10. Install the carburetor (1) with new mounting gasket (2) to the intake manifold (19). Torque the mounting bolts 35 to 42 ft. lbs. Reconnect the linkage and fuel line to the carburetor.
11. Reconnect the hoses to the thermostat housing (28) and clamp securely. Make sure the drain valves are closed and refill the cooling system. Reinstall the air cleaner system, making sure all connections are tight. Install the spark plugs (29) with new gaskets (30) and torque 32 to 35 ft. lbs. Reconnect all of the high tension wires to the spark plugs.
12. Apply clean engine oil to the rocker arm assembly and start engine. Check that the rocker arms are receiving lubricating oil. Operate the engine for approximate one (1) hour, (under load if possible) to thoroughly warm up the engine and seat the head gaskets.
13. Shut the engine off. Using wrench A42393, Inset C, which can be purchased through the J.I. Case Co. Service Parts Supply, back off each head bolt individually 1/4 turn and retorque to 210 ft. lbs. in the proper sequence, Inset D. **NOTE** DO NOT BACK OFF ALL THE BOLTS AT THE SAME TIME. Recheck the torque to make sure all head bolts have retained the 210 ft. lbs. Recheck torque on rocker arm bracket bolts and stud nuts for 40 to 45 ft. lbs.
14. Install new valve cover gaskets (10) and valve cover (9). Install new gaskets (8) with bevel washers (7) and cover stud nuts (6). Torque nuts 8 to 10 ft. lbs. Do not over torque the stud nuts. Install new breather tube gaskets (5), breather tube (4) and secure with retaining screws.

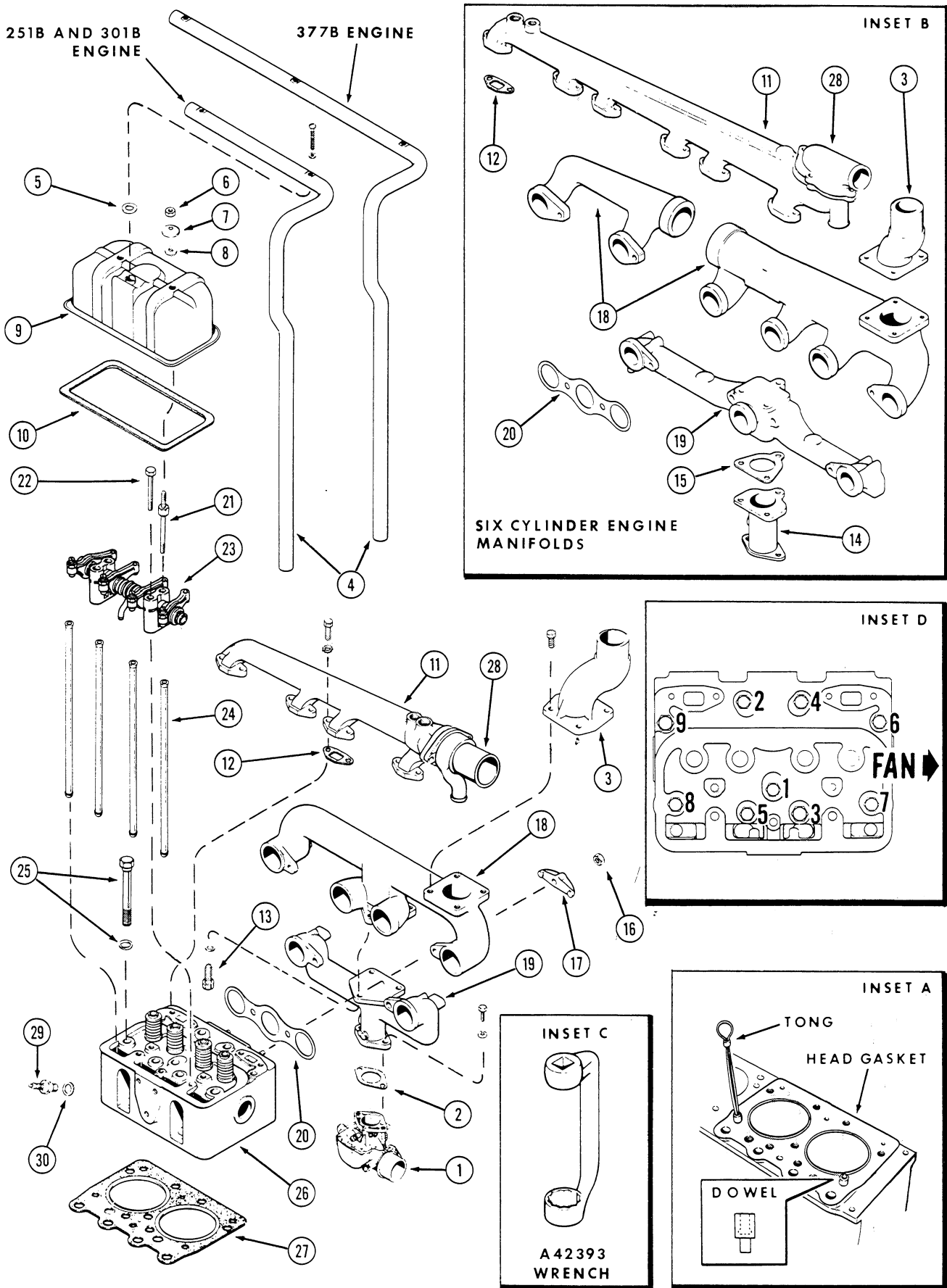


Figure 5

ROCKER ARM ASSEMBLY

(Refer to Figure 6)

Disassembly

Be sure the rocker arm assemblies are tagged so they are installed on the same cylinder head they were removed from. Tag component parts for proper assembly. Do not intermix parts from one assembly to another.

1. Remove the oil tube (1) with the "O" ring (2). Remove the "O" ring and discard it. Remove the snap rings (3) and spacer washers (5). Keep count of the number of washers used at each end of the shaft (4). Tag each rocker arm for original location.
2. Remove the intake rocker arms (8) and the shaft spring (9).

Remove the exhaust rocker arms (6) and the shaft brackets (7) from the shaft (4).

Inspection

Check the shaft spring for damage and proper tension.

Spring Specifications:

Total Coils (Working coils) ----- 4
Wire Diameter ----- .080"
Compressed to 1-9/16 ----- 10 lbs.

Flush the shaft to remove any residual material. Inspect the shaft for worn spots on the bottom side of the shaft. Replace the

shaft if a worn condition exists.

Inspect the rocker arms by installing each rocker arm on the shaft in its proper location. The rocker arm must be free on the shaft without any side wobble. If any is noted, replace the rocker arms. Clean the oil holes in the rocker arms to insure free oil flow. Inspect the valve stem contact area on the rocker arm for wear. Replace if worn. Inspect the tappet adjusting screw for wear marks or pitting.

Assembly

With all components parts cleaned thoroughly and worn parts replaced, coat them with clean engine oil.

1. Install the shaft spring (9) and the two intake rocker arms (8) on the shaft (4).
NOTE When installing the rocker arms, keep the shaft oil holes toward the valves, See Inset A.
2. Install the shaft brackets (7) on the shaft (4) with the split side toward the push rod side of the engine.
3. Install the exhaust rocker arms (6) on the shaft (4). Install the same number of spacer washers (5) at each end of the shaft as were removed during disassembly.
4. Install the snap rings (3) at each end of the shaft. Check the rocker arms for free movement. Install the oil tube (1) with a new "O" ring (2). Install the adjusting screws (10) and lock nuts (11) if they were removed for replacement.
5. Install the rocker arm and shaft assembly as instructed on Page 6.
6. Check the exhaust rocker arms for excessive end play. One or more spacer washers can be used between the exhaust rocker arms (6) and snap rings (3) to remove excessive end play. A clearance of .010" to .030" must be maintained at each end of the shaft and can be checked in the area shown in inset B.

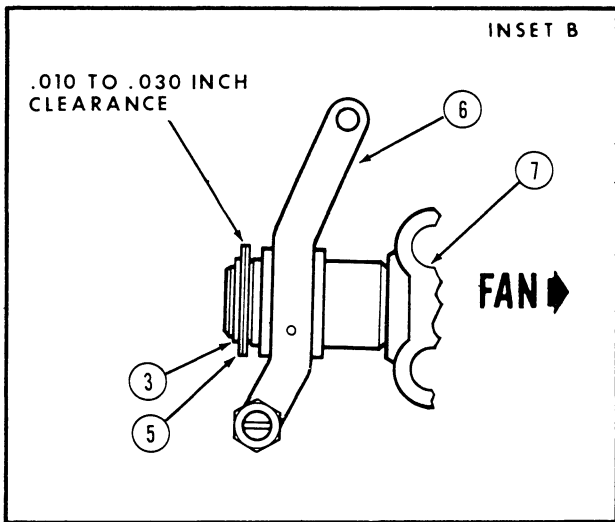
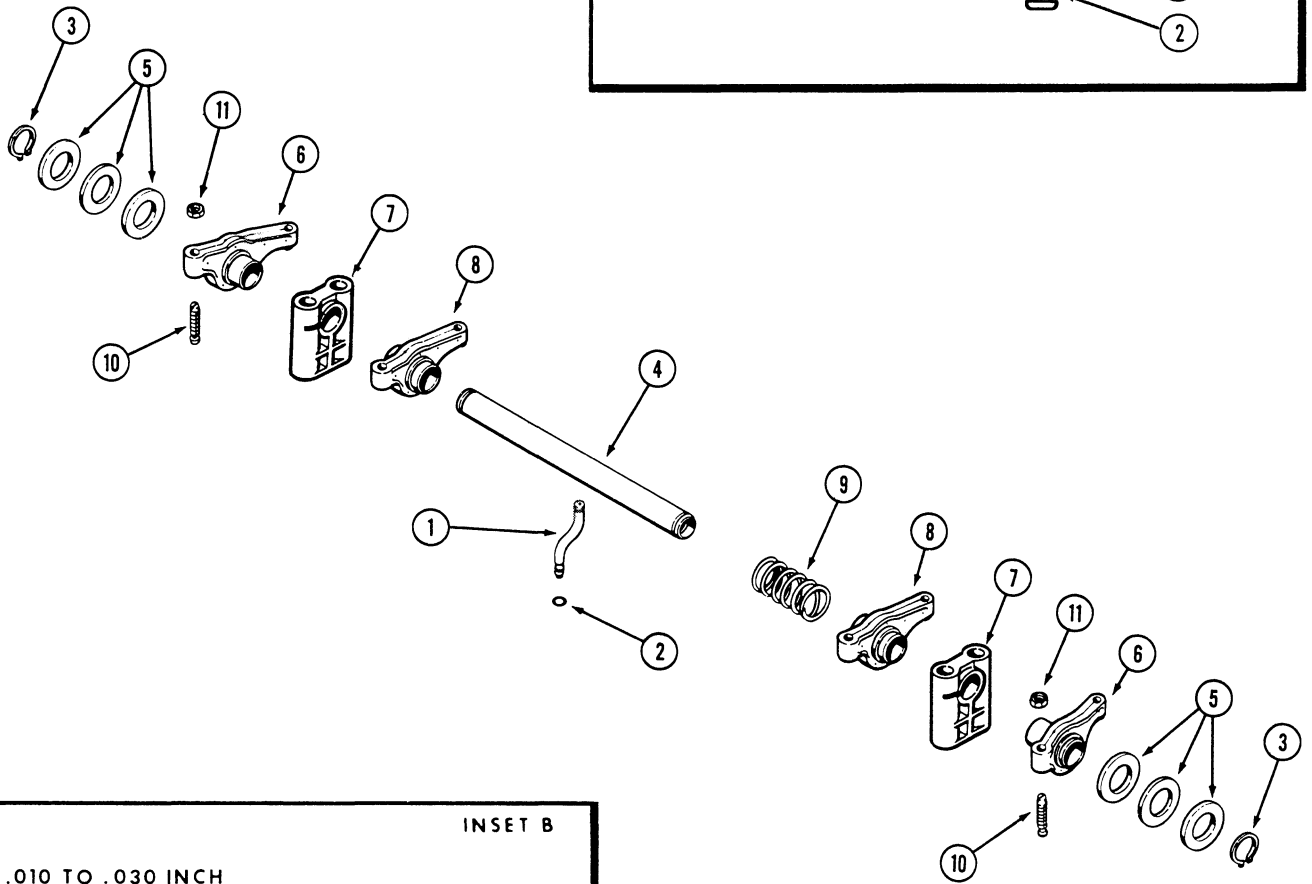
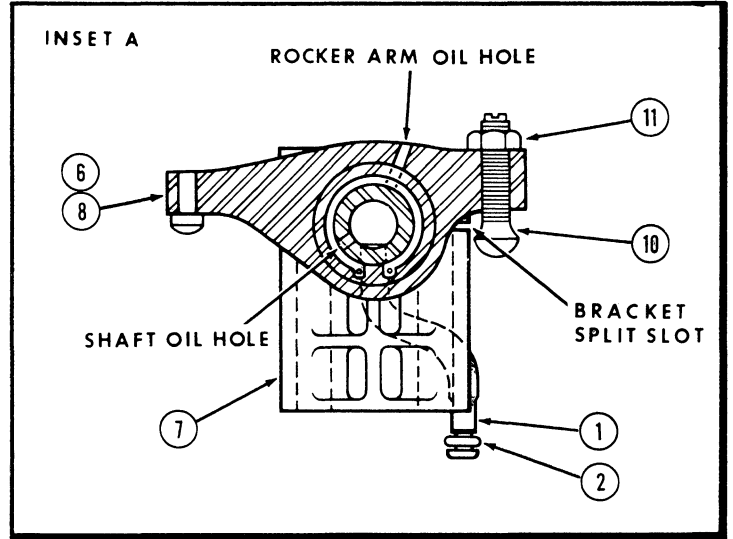
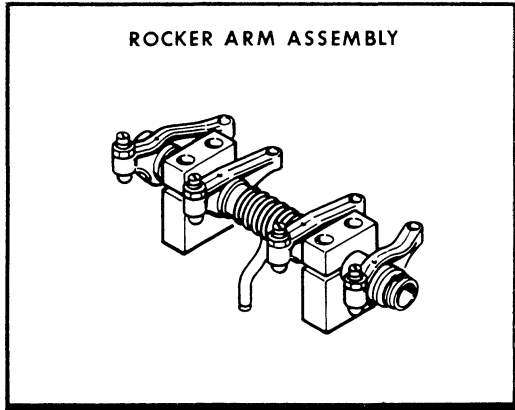


Figure 6

CYLINDER HEAD ASSEMBLY

(Refer to Figure 7)

Disassembly

1. Using a valve spring compressor, compress the spring (1) enough to remove the valve retainer locks (2). Release the spring compressor and remove the intake valve spring retainer (3) or exhaust valve rotator (4). Remove the valve spring (1), valve stem oil seals (5) and valve spring seats (6). **NOTE** Remove any carbon from the valve stems before they are removed from the cylinder head.
2. Remove the intake valves (7) and the exhaust valves (8) from the cylinder head (14) and set them in a rack or holder. Mark them on removal so they may be installed in their original location.
3. Drive the intake valve guide (9) and exhaust valve guide (10) down through the head using an arbor.
4. The exhaust valve seats (11) can be removed with a special seat removing tool, Inset C. **NOTE** Never attempt to remove a valve seat with a center punch, cold chisel or pry bar.
5. To remove the expansion plugs (12), they must be drilled and pried out.

NOTE Refer to Inspection and Servicing on Pages 12, 13, 14 and 15 prior to assembly.

Assembly

1. If the valve guides have been replaced, install the new guides (9 and 10) using an arbor. Press the guides into the head from the top of the cylinder head. The guides must protrude above the cylinder head (intake and exhaust) .953", Inset A.
2. To install new exhaust valve seats (11), clean the recess in the cylinder head. Place the valve seats in dry ice to shrink them. Insert the valve seats in the head and press them in place, using a suitable press.
3. Lubricate the intake valves (7) and exhaust valves (8) with clean engine oil and install them in their original locations.
4. Install the valve spring seats (6), valve springs (1), intake valve retainers (3) or exhaust valve rotators (4). Compress the valve springs so the valve stem seals (5) can be installed in the lower grooves of the valve stems. Install the valve retainer locks (2). **IMPORTANT** Assemble the exhaust valve rotators with the original exhaust valves because they tend to wear in as matched parts. If it is necessary to install a new exhaust valve, always install a new rotator and retainer locks.
5. Install new plugs (12) Inset B, if they were removed. If the manifold studs (15) are to be replaced, install until snug.

NOTE When engine assembly is complete, a check of the operation of the rotators must be made. It is impossible to determine whether or not the rotator is turning without an identifying mark.

Place a dab of white paint on each of the rotators and note its position. Start the engine and observe whether or not the rotator is turning. DO NOT attempt repairs on rotators.

There is not a set speed at which the rotators should turn. Some rotators will turn faster than others. As long as the rotator is turning the valve, it is functioning properly.

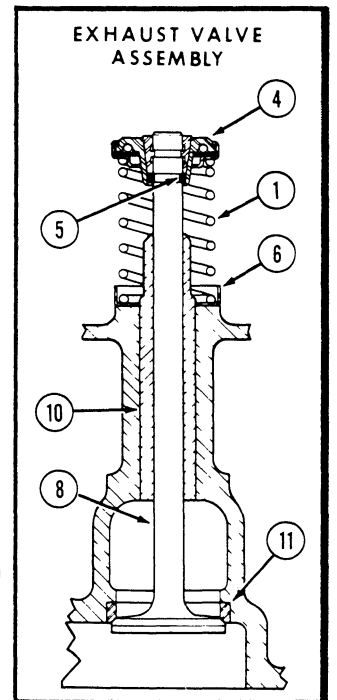
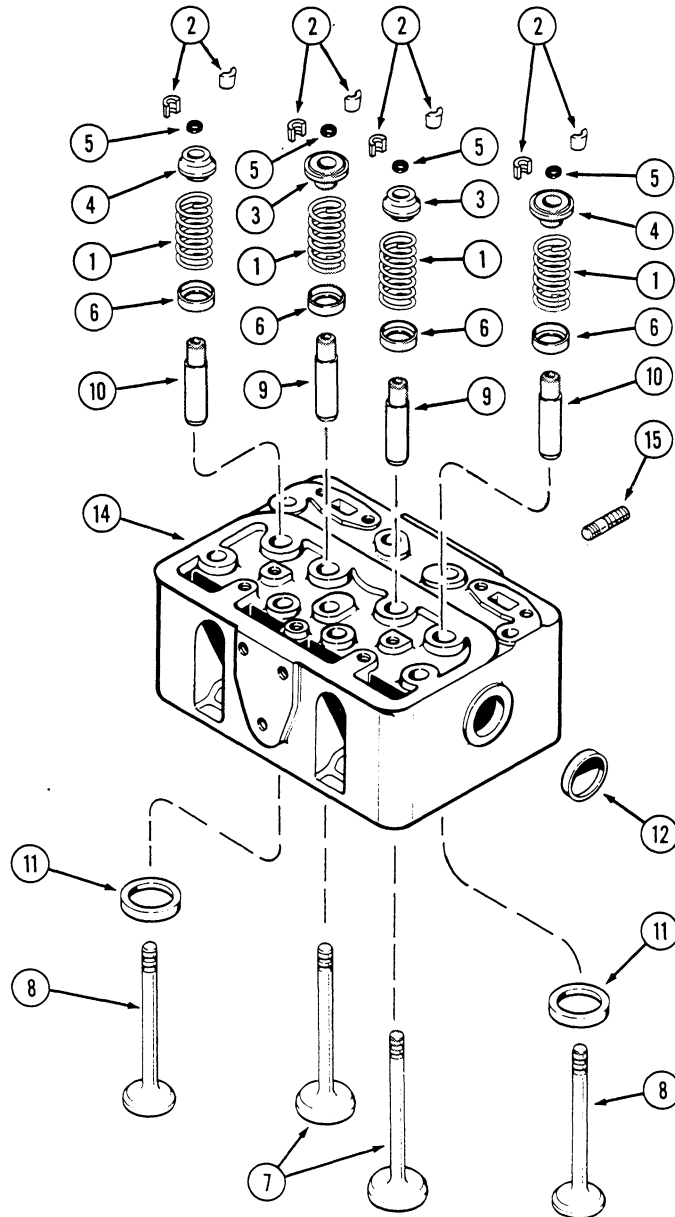
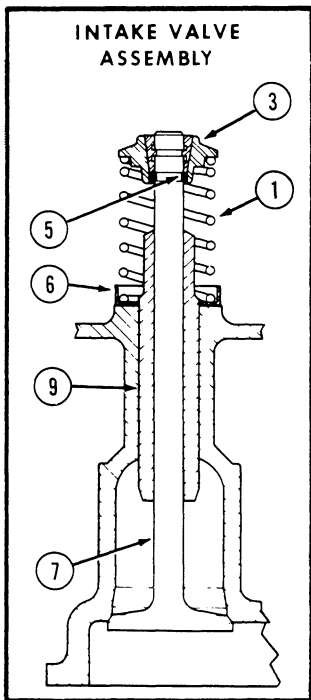
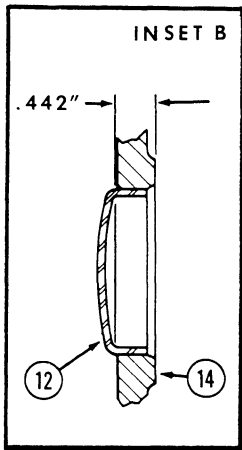
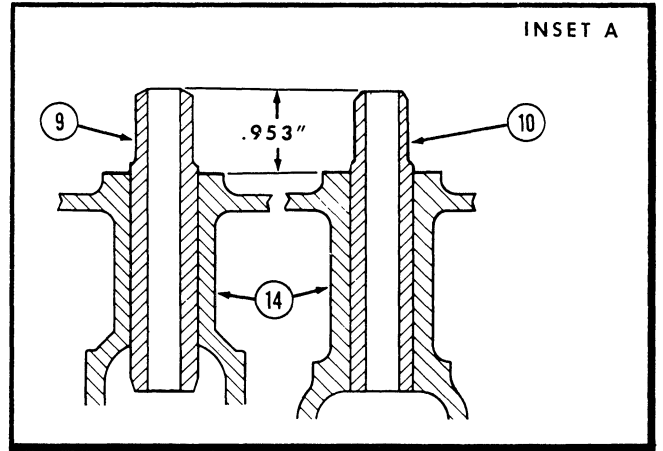
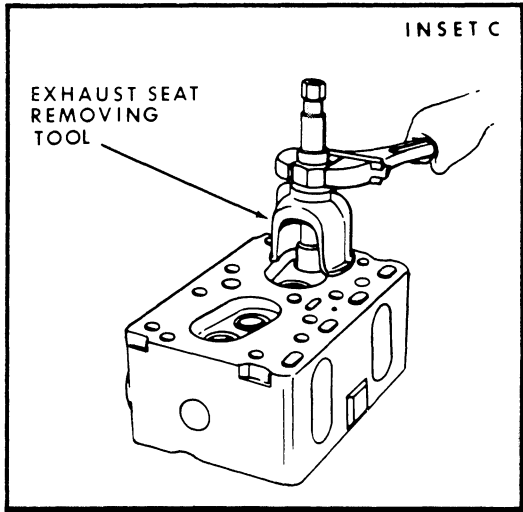


Figure 7

INSPECTION OF VALVES, GUIDES, HEAD AND SPRINGS

Clean the cylinder head completely. Remove all traces of carbon and other deposits. Check for cracks and any evidence of fretting or erosion. Check the head for evidence of warpage. If warpage exists and is more than .005", the cylinder head must be resurfaced or replaced.

Valve springs should be checked for flat squared ends, broken coils and correct spring pressure. Use a Valve Spring Tester referring to the spring specifications below:

Free Length ----- 2.28"
 Total Coils ----- 7.75"
 Wire Diameter ----- .171"

	Compressed Height	Spring Pressure	Replace if Less than
Valve Open	1-31/64"	140 lbs.	130 lbs.
Valve Closed	1-15/64"	45 lbs.	41 lbs.

Remove all carbon from the bore of the valve guides with a fine wire brush and blow clean with compressed air. Valve guides can be checked for wear by using a bore gauge and micrometer, refer to Figure 8, Inset A. The valve guides should be checked at the top, middle and bottom of the guide bore for wear, Figure 8. If the diameter is greater than .4056" at any point along the bore, the guide must be replaced. Use an arbor equal to the inside diameter of the valve guide to keep the guide from collapsing when pressed into place. Press in from the top of the head until the guide (Intake and Exhaust) protrudes a distance of .953" above the head, refer to Figure 7, Inset A, Page 11. Replacement guides must be rebored after installation. Rebore the guide area as shown, .4045" to .4055" diameter.

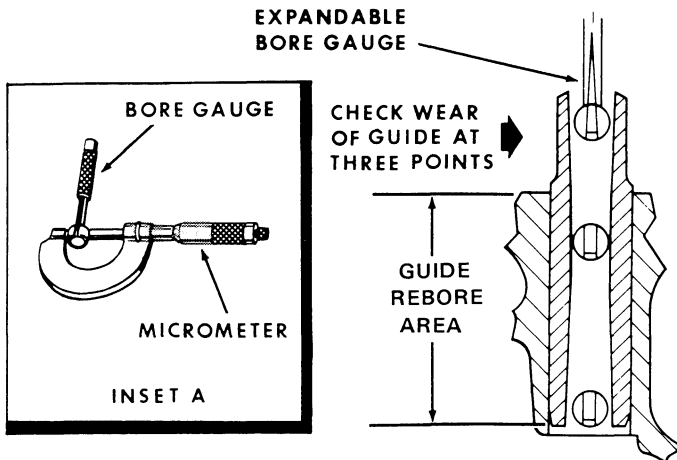


Figure 8

Clean the valves with a power driven fine wire brush, being very careful not to scratch the valve stems. Refer to Figure 9 for valve nomenclature.

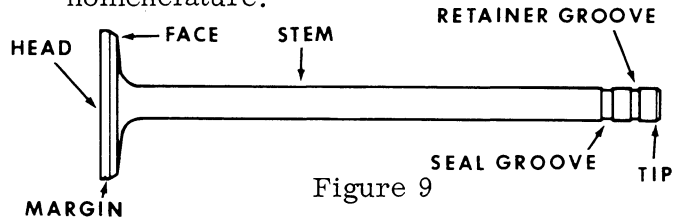


Figure 9

Inspect the valves for excessive wear or necked stems, Figure 10. This can be caused by lack of lubrication, plugged water passages or operating the engine under continuous overload at excessive engine RPM. Replace valves if this condition exists.

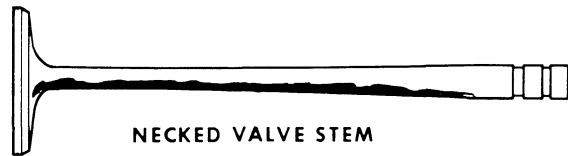


Figure 10

Inspect the valves for deep grooves in the face, Figure 11. This can be caused by abrasives entering the engine through the intake system or not servicing the air cleaner regularly. If grinding the valve face will not correct this condition, replace the valve.

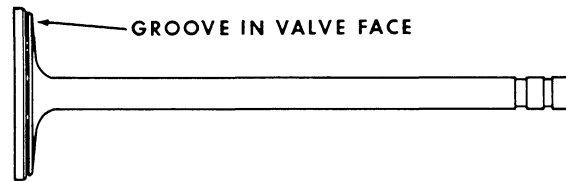


Figure 11

Inspect the valve face and stem for rust or pitting, Figure 12. Rust or pitting can usually be removed by grinding the valve face. If rust or pitting on the valve stem exists, replace the valve. These conditions can be caused by using poor quality engine oil or fuel that does not meet the specification given in the Operator's Manual and by improper storing of the engine.

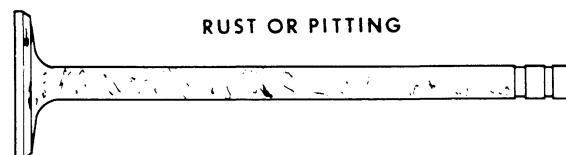


Figure 12



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INSPECTION OF VALVES, GUIDES, HEAD AND SPRINGS (Contd)

Heavy carbon or varnish deposits on the valves, Figure 13, should be removed before valves are ground. This condition is usually caused by worn piston rings and sleeves which allow too much oil to reach the combustion chamber. This condition could also be caused by worn valve guides or bad seals on the valves. Low operating temperature is still another cause.

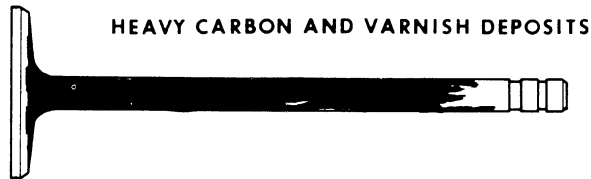


Figure 13

Inspect the valve head for dishing and the valve face for deep burned spots, Figure 14. These conditions cannot be corrected by grinding the valves. The valves must be replaced. These conditions are usually caused by running the engine under excessive loads at high engine temperatures.

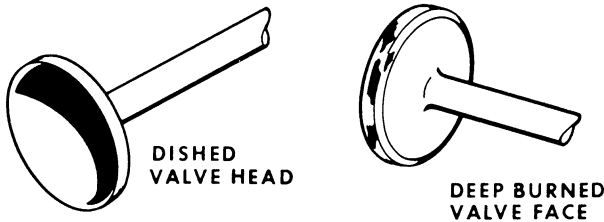


Figure 14

Valves with worn keeper grooves or if the stem tip is worn or dished beyond the chamfer, replace the valves, Figure 15.



Figure 15

The checking of the valve stem diameter can best be done with a good, accurate micrometer, Figure 16. The intake and exhaust valve stem being straight, should be measured at three points along the stem, Figure 16. Wear limit must not exceed .002" at all points of measurement. If the wear is greater, replace the valve.

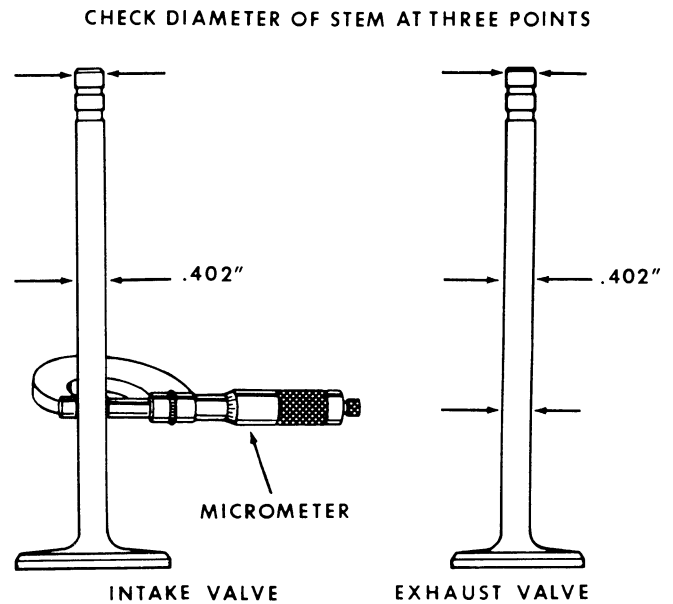


Figure 16

The checking of the valve face runout should be done after the valves have been ground. A Vee block type holder with a dial indicator, Figure 17 can be used to check the valve face and stem runout. The valve face runout should not exceed more than .002". The valve stem runout should not exceed .002". If the valve face and/or valve stem runout is greater, the valve must be replaced.

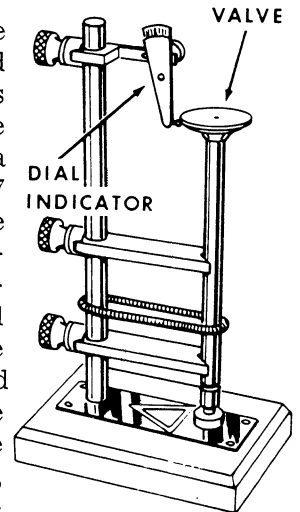


Figure 17

NOTE Small amounts of very fine pitting, Figure 18, may be found on the surfaces of the valves faces and seats after the valves are cleaned. These are normal and will not affect engine performance. This fine pitting is caused by a normal oxidation process and can happen on any engine during the run-in period. It is not necessary to grind valves or seats if this fine pitting is found as the pitting will generally reoccur after the engine is run for a few hours.

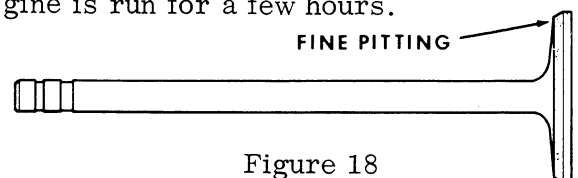


Figure 18

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