

# TORO

Model Series	Bore	Stroke	Displacement	Rated Power
VM	64.0 mm (2.52 in.)	44.0 mm (1.73 in.)	141 cc (8.6 cu.in.)	3.0 kW (4 hp)

NOTE: Metric fasteners are used throughout engine.

## ENGINE INFORMATION

The Toro (Suzuki) VM engine model series is used on Toro walk-behind lawn mowers. The engine is an air-cooled, four-stroke, single-cylinder engine with a vertical crankshaft and an overhead valve system. Engine identification numbers are stamped in the blower housing.

## MAINTENANCE

**LUBRICATION.** The engine is lubricated by oil supplied by a rotor type oil pump located in the bottom of the crankcase, as well as by a slinger driven by the camshaft gear.

Change oil after first two hours of operation and after every 25 hours of operation or at least once each operating season.

Engine oil level should be maintained at full mark on dipstick. Engine oil should meet or exceed latest API service classification. Manufacturer recommends SAE 30 or SAE 10W-30 oil.

Crankcase capacity is 0.55 L (18.6 fl. oz.). Fill engine with oil so oil level reaches, but does not exceed, full mark on dipstick.

**AIR CLEANER.** Engine may be equipped with a foam filter element or with a paper filter element and a foam precleaner element.

Foam filter elements should be cleaned after every 25 hours of operation. Paper filter elements should be cleaned or replaced after every 50 hours of operation. Service either type filter element more frequently if severe operating conditions are encountered.

Clean a foam filter in soapy water and squeeze until dry. Inspect filter for tears and holes or any other opening. Discard filter if it cannot be cleaned satisfactorily or if it is torn or otherwise damaged. Pour clean engine oil into the filter, then squeeze to remove excess oil and distribute oil throughout.

Clean a paper filter by tapping gently to dislodge accumulated dirt. Renew fil-

ter if dirty or damaged. Do not apply oil to the foam precleaner element or the paper element.

**FUEL FILTER.** The engine is equipped with an inline fuel filter in the fuel hose. Renew filter if dirty or damaged.

**CRANKCASE BREATHER.** The engine is equipped with a crankcase breather that provides a vacuum for the crankcase. A reed valve located in the top of the crankcase acts as a one-way valve to maintain crankcase vacuum. The breather system must operate properly or excessive oil consumption may result. Remove the flywheel for access to breather cover.

**SPARK PLUG.** Recommended spark plug is NGK BPR6ES. Specified spark plug electrode gap is 0.8 mm (0.032 in.).

**CARBURETOR.** The engine is equipped with a Mikuni BV 18-13 float

type carburetor. Refer to Fig. TO51 for exploded view of carburetor. Carburetor is equipped with a fixed idle mixture jet (7) and a fixed high speed jet (22).

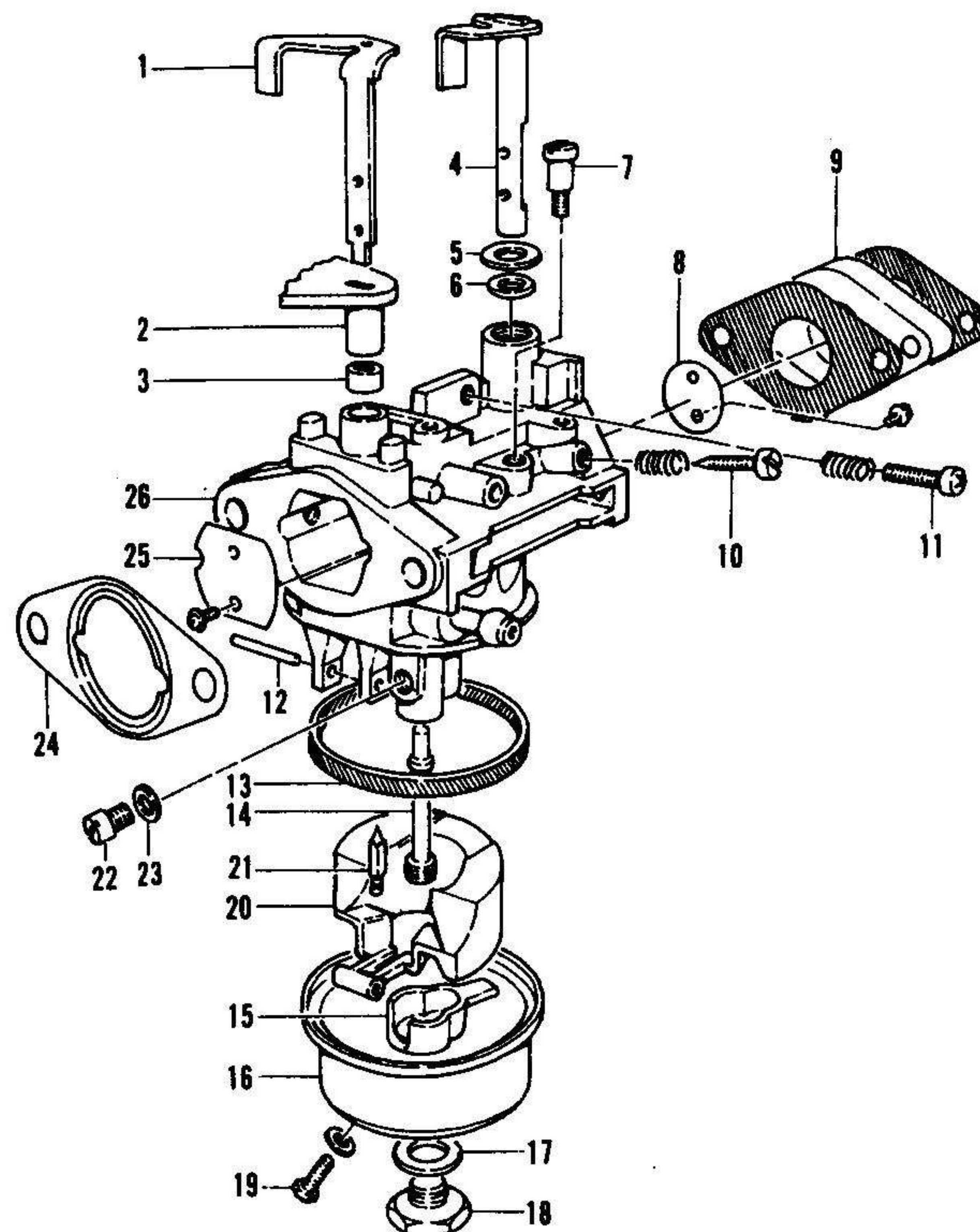
Initial adjustment of idle pilot screw (10) should be one turn open from a lightly seated position. Make final carburetor adjustment with engine at normal operating temperature and running. Adjust pilot screw to obtain smoothest idle operation and acceleration.

To remove carburetor, drain fuel and remove fuel tank. Remove air cleaner assembly. Note the connecting points of carburetor control linkage and springs to insure correct reassembly, then disconnect choke rod and throttle rod and remove carburetor. To install carburetor, reverse the removal procedure. Note that a gasket should be installed on both sides of insulator block (9—Fig. TO51) and raised rib on air cleaner gasket (24) should be toward the air cleaner.

Remove float pin by pushing against round end of pin towards the square end of pin. Float is plastic and float level is not adjustable. Fuel inlet valve (21) is

Fig. TO51—Exploded view of carburetor.

1. Choke shaft
2. Choke detent
3. Spacer
4. Throttle shaft
5. Washer
6. Dust seal
7. Idle pilot jet
8. Choke plate
9. Insulator block
10. Pilot screw
11. Idle speed screw
12. Float pin
13. Gasket
14. Nozzle
15. Spacer
16. Float bowl
17. Gasket
18. Screw
19. Drain screw
20. Float
21. Fuel inlet valve
22. Main jet
23. Spacer
24. Gasket
25. Throttle plate
26. Carburetor body





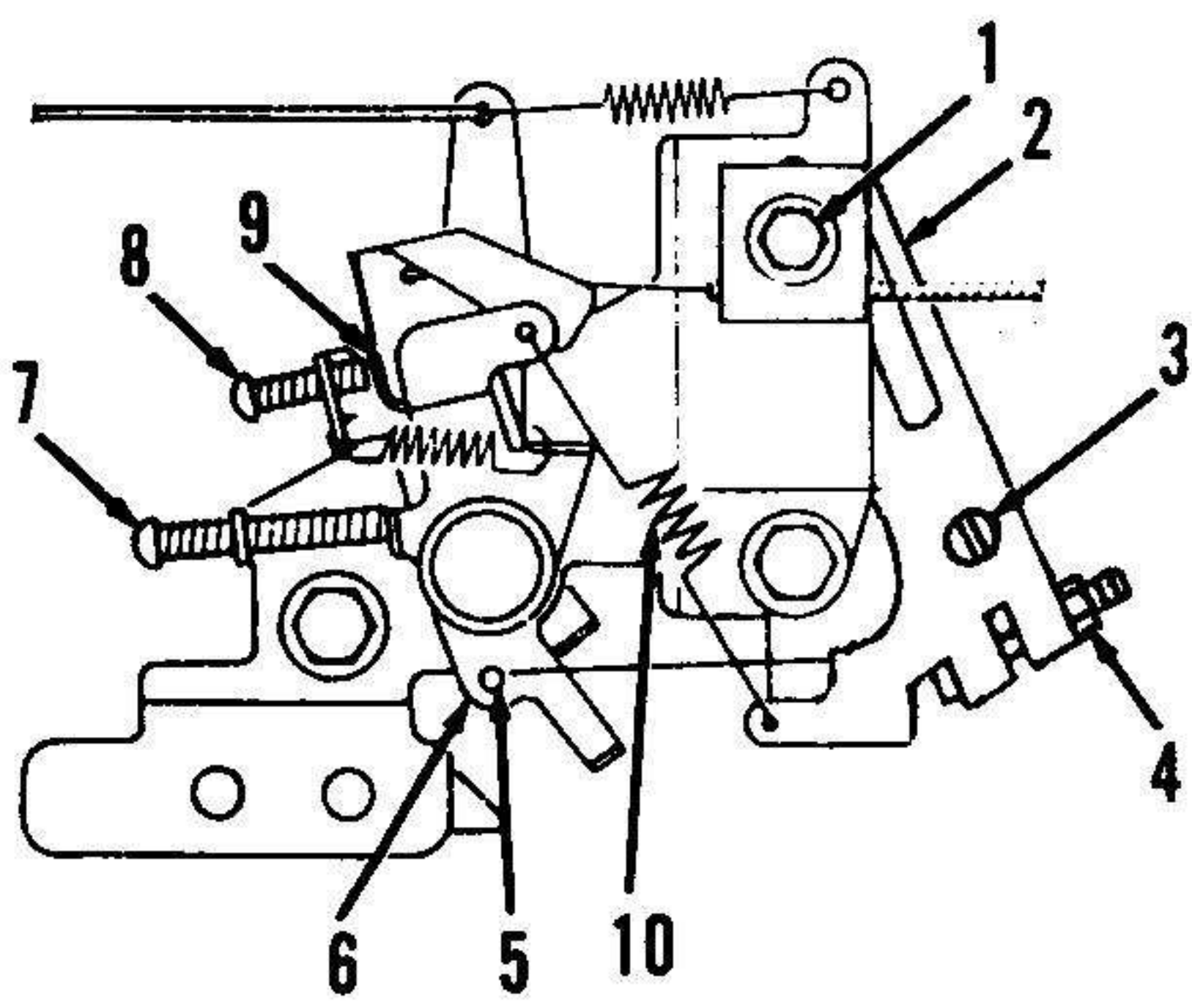


Fig. TO52—Drawing of governor and speed control linkage.

- |                   |                        |
|-------------------|------------------------|
| 1. Screw          | 6. Speed control lever |
| 2. Governor lever | 7. Maximum speed screw |
| 3. Governor shaft | 8. Stop screw          |
| 4. Nut            | 9. Tang                |
| 5. Alignment hole | 10. Governor spring    |

renewable but valve seat is not removable and body must be renewed if seat is damaged.

Metal parts should be cleaned in carburetor cleaner. Use compressed air to blow out all orifices and passageways. Do not use wires or drill bits to clean orifices as enlargement of the orifice could affect the calibration of the carburetor.

Apply Loctite 271 thread locking compound to threads of choke and throttle plate screws when assembling carburetor.

**SPEED CONTROL CABLE.** When the speed control is in the "FAST" position, holes (5—Fig. TO52) in speed control lever (6) and bracket should be aligned. Unscrew throttle cable clamp screw (1) and relocate cable to align holes, then retighten clamp screw.

**GOVERNOR.** All engines are equipped with a mechanical (flyweight) type governor. Maximum governed speed is adjusted by turning adjusting screw (7—Fig. TO52). With speed control in the "FAST" position so holes (5) in speed control lever (6) and bracket are aligned, rotate adjusting screw so engine runs at 3000 rpm. Rotate stop screw (8) so screw end is 0.00-0.05 mm (0.000-0.020 in.) from tang (9).

To adjust the governor linkage, refer to Fig. TO52 and loosen governor lever clamp nut (4). Rotate governor shaft (3) clockwise as far as possible. Move the governor lever until carburetor throttle shaft is in wide open position, then tighten governor lever clamp nut.

**IGNITION.** The engine is equipped with a breakerless ignition system. All components are located outside the flywheel. Armature air gap should be 0.38-0.50 mm (0.015-0.020 in.).

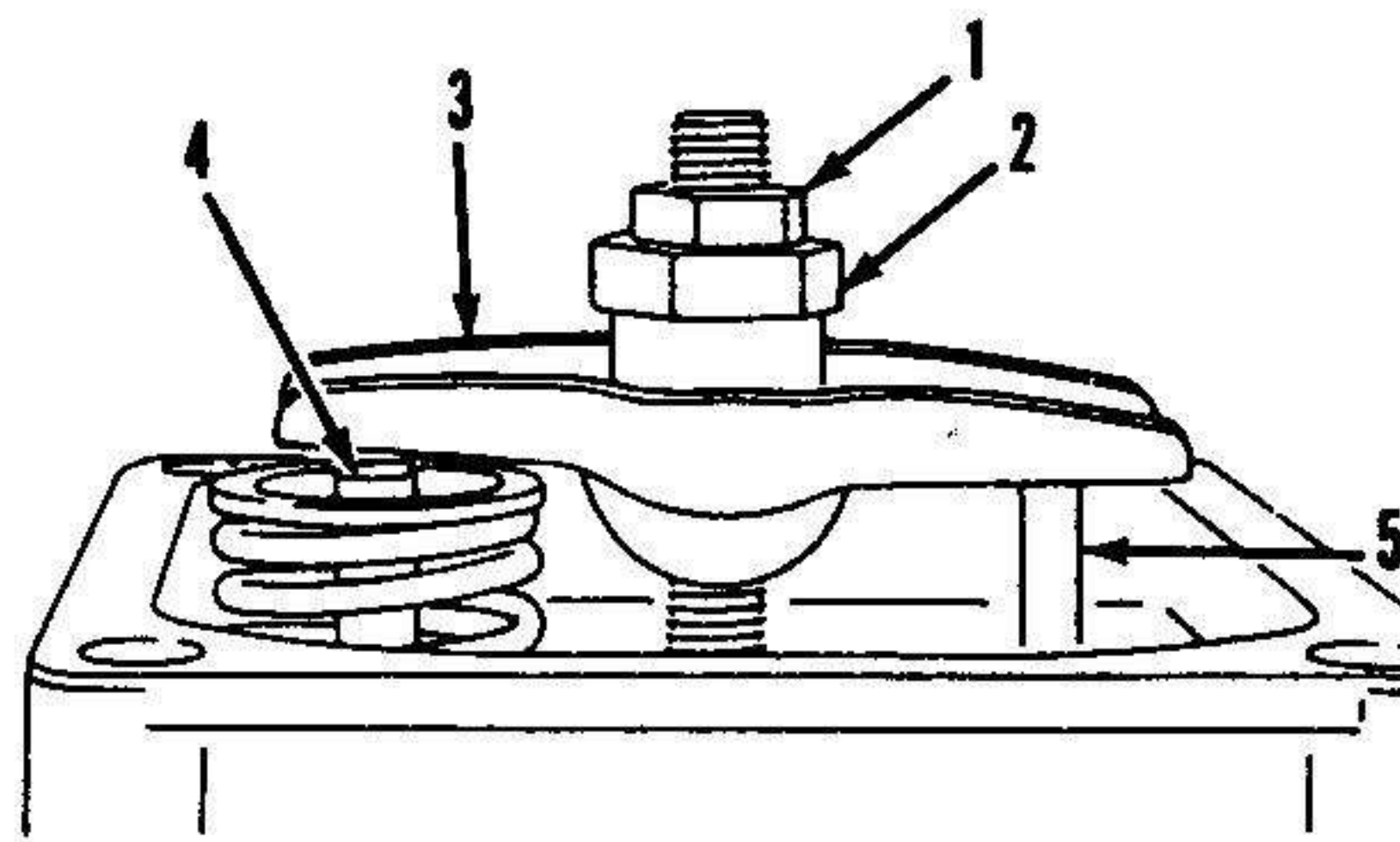


Fig. TO53—View of rocker arm and related parts.

- |                   |                         |
|-------------------|-------------------------|
| 1. Jam nut        | 4. Valve stem clearance |
| 2. Adjustment nut | 5. Push rod             |
| 3. Rocker arm     |                         |

**VALVE ADJUSTMENT.** Specified clearance between rocker arm (3—Fig. TO53) and end of valve stem (4) is 0.025-0.13 mm (0.001-0.005 in.) for both valves. To adjust valve clearance, remove rocker arm cover. Rotate crankshaft so piston is at top dead center (TDC) on compression stroke. Insert a suitable thickness feeler gauge between rocker arm and end of valve stem. Loosen rocker arm jam nut (1) and turn adjusting nut (2) to obtain desired clearance (a slight drag should be felt when withdrawing the feeler gauge). Tighten jam nut and recheck clearance. Install rocker arm cover. Note that cutaway portion of cover mounting flange must be adjacent to spark plug.

**REPAIRS**

**TIGHTENING TORQUES.** Recommended tightening torque specifications are as follows:

- |                          |                                     |
|--------------------------|-------------------------------------|
| Connecting rod . . . . . | 5.9-9.8 N•m<br>(54-118 in.-lbs.)    |
| Cylinder head . . . . .  | 17.6-27.4 N•m<br>(156-242 in.-lbs.) |
| Flywheel . . . . .       | 55-63 N•m<br>(41-46 ft.-lbs.)       |
| Oil pan . . . . .        | 3.9-6.8 N•m<br>(35-60 in.-lbs.)     |

**CYLINDER HEAD.** To remove the cylinder head, first remove fuel tank, air cleaner, blower housing, carburetor, speed control bracket, muffler, and rocker arm cover. Loosen jam nuts, and remove rocker arm pivots (4—Fig. TO54), rocker arms (5) and push rods (6); mark all parts so they can be returned to original location. Unscrew cylinder head screws and remove cylinder head (8).

Clean cylinder head thoroughly, then check for cracks, distortion or other damage. Cylinder head warpage should not exceed 0.030 mm (0.0012 in.).

Install cylinder head using a new head gasket. Tighten cylinder head screws adjacent to spark plug hole first, then tighten screws adjacent to push rod opening in a crossing pattern. Final

torque reading should be 17.6-27.4 N•m (156-242 in.-lbs.). Adjust valve clearance as outlined in VALVE ADJUSTMENT section. Install rocker arm cover with the cut out side of the cover toward the spark plug. Be sure that a flat washer is installed on each rocker cover retaining screw, and tighten screws to 4.1-6.7 N•m (36-60 in.-lbs.).

**VALVE SYSTEM.** To remove valves (11 and 12—Fig. TO54) from cylinder head, compress valve springs (3) by hand or with a suitable spring compressor tool and remove slotted retainers (2). The intake and exhaust valve springs and retainers are identical and interchangeable.

Valve face and seat angles are 45 degrees. Standard valve seat width is 0.90-1.10 mm (0.035-0.043 in.).

Standard valve stem diameter is 5.460-5.475 mm (0.2150-0.2156 in.) for intake valve and 5.440-5.455 mm (0.2142-0.2148 in.) for exhaust valve.

Standard valve guide inside diameter is 5.500-5.512 mm (0.2165-0.2170 in.) for both valves. Standard valve stem-to-guide clearance is 0.025-0.052 mm (0.0010-0.0020 in.) for intake and 0.045-0.072 mm (0.0018-0.0028 in.) for exhaust. Maximum valve stem-to-guide clearance is 0.080 mm (0.0032 in.) for intake valve and 0.100 mm (0.0039 in.) for exhaust valve. Oversize valve guides may be installed.

Valve guides (9—Fig. TO54) can be renewed using Toro valve guide driver 81-4880 or other suitable tool. Press or drive guide out towards rocker arm side of head. Use Toro reamer 81-4850 or other suitable reamer so valve guide bore diameter in head is 9.300-9.315 mm (0.3661-0.3667 in.). Press or drive guide in from rocker arm side of cylinder head so valve guide is 27.5 mm (1.08 in.) below head gasket surface of cylinder head. Ream guide with Toro reamer 81-4840 or other suitably sized reamer to obtain desired valve stem clearance. Valve guide finished inside diameter should be 5.500-5.512 mm (0.2165-0.2170 in.).

Valve spring free length should be 32.0-34.0 mm (1.26-1.34 in.). Minimum allowable valve spring length is 31.0 mm (1.22 in.).

**R&R ENGINE.** The following procedure applies to engines equipped with a blade brake clutch. The procedure for engines with a flywheel brake (zone start) is similar, although the blade brake components are absent.

To remove engine, disconnect and properly ground spark plug lead. Disconnect any electrical wires to engine. Remove blade mounting assembly and



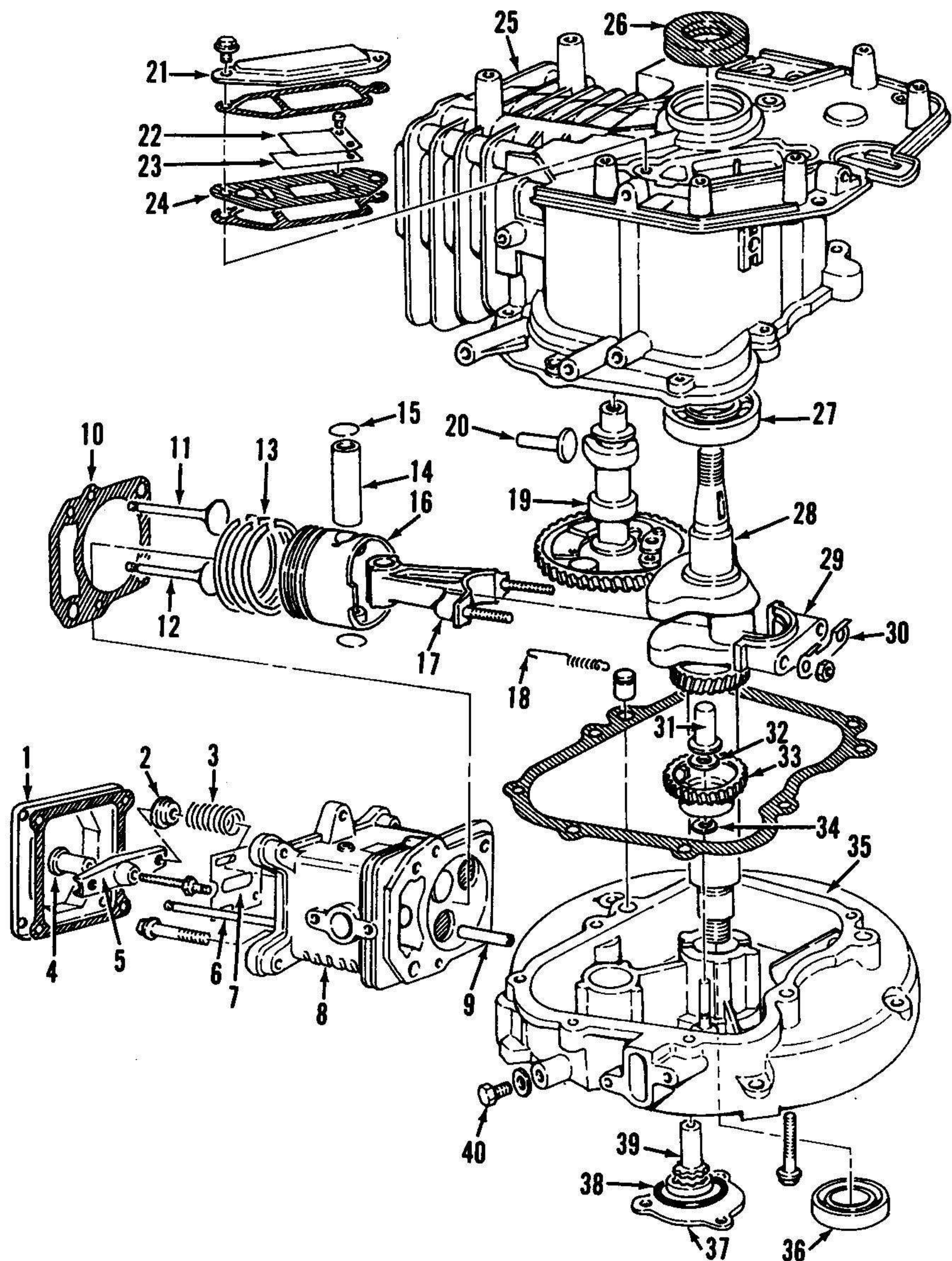


Fig. TO54—Exploded view of engine assembly.

1. Rocker cover
2. Valve retainer
3. Valve spring
4. Rocker arm pivot
5. Rocker arm
6. Push rod
7. Push rod guide
8. Cylinder head
9. Valve guide
10. Head gasket
11. Exhaust valve
12. Intake valve
13. Piston rings
14. Piston pin
15. Retaining ring
16. Piston
17. Connecting rod
18. Compression release spring
19. Camshaft
20. Tappet
21. Breather cover
22. Reed stop
23. Reed valve
24. Breather plate
25. Engine block
26. Oil seal
27. Ball bearing
28. Crankshaft
29. Rod cap
30. Lock plate
31. Thrust sleeve
32. Washer
33. Governor
34. Washer
35. Oil pan
36. Oil seal
37. Oil pump cover
38. "O" ring
39. Oil pump rotors
40. Oil drain plug

bottom cover. Unscrew crankshaft nut, push back belt idler, and remove bearing block, brake drum and flywheel plate. Separate transmission drive belt from drive pulley and remove drive pulley. If desired, drain engine oil. Unscrew engine mounting screws and remove engine while disconnecting throttle cable.

Reverse removal procedure to re-install engine while noting the following: Pegs on drive pulley must be toward bottom of crankshaft. Note that center of flywheel is tapered to fit crankshaft. Install flywheel so pegs on drive pulley fit in slots in flywheel plate.

**CAUTION: Drive pulley will be damaged if pegs on pulley do not fit properly in flywheel slots during assembly. Before tightening crankshaft nut, rotate flywheel slightly. If pegs are in slots, flywheel rotation will be stopped by pegs.**

Stepped side of bearing block fits in center of brake drum. Note that flat side on head of blade mounting bolts must be toward center of brake drum. Tighten bearing block retaining nut to 79 N·m (58 ft.-lbs.). When tightening nut, be sure blade brake drive belt is not trapped between drum and flywheel. Tighten blade retaining nuts to 37 N·m (27 ft.-lbs.).

**CAMSHAFT.** To remove camshaft (19—Fig. TO54) proceed as follows: Remove engine as previously outlined. Drain oil from crankcase. Clean pto end of crankshaft and remove any burrs or rust. Remove rocker arm cover (1), rocker arms (5) and push rods (6); mark all parts so they can be returned to original position. Unscrew fasteners and remove oil pan (35). Rotate crankshaft so timing marks on crankshaft and camshaft gears are aligned (this

will position valve tappets out of the way). Withdraw camshaft and remove tappets (20). Mark the tappets so they can be installed in their original positions if reused.

Specified camshaft lobe height is 30.517-30.577 mm (1.2014-1.2038 in.). Renew camshaft and tappets if lobes are excessively worn or scored.

Reverse removal procedure to reassemble components. Lubricate tappets and camshaft with engine oil during assembly. Install camshaft while aligning timing marks on crankshaft and camshaft gears. Note that roll pin in end of camshaft must engage oil pump drive shaft in oil pan during assembly. Tighten oil pan screws to 3.9-6.8 N·m (35-60 in.-lbs.) in a crossing pattern. Do not force mating of oil pan with crankcase. Be sure thrust sleeve (31) on governor does not fall off during assembly. Reassemble remainder of components.



**PISTON, PIN AND RINGS.** To remove piston and rod assembly, remove engine as previously outlined. Remove cylinder head and camshaft as previously outlined. Unscrew connecting rod cap nuts and remove piston and rod.

Measure piston diameter at points perpendicular to piston pin and 14 mm (0.55 in.) from bottom of piston skirt. Specified piston diameter is 63.960-63.975 mm (2.5181-2.5187 in.) with a wear limit of 63.915 mm (2.5163 in.). Specified piston-to-cylinder bore clearance is 0.025-0.055 mm (0.0010-0.0022 in.) with a wear limit of 0.120 mm (0.0047 in.). Oversize pistons are not available.

Specified piston ring end gap for compression rings is 0.2-0.4 mm (0.008-0.016 in.) with a limit of 0.70 mm (0.028 in.). Piston ring groove width for compression rings should be 1.52-1.54 mm (0.060-0.061 in.) and ring thickness should be 1.47-1.49 mm (0.058-0.059 in.). Specified piston ring side clearance in groove is 0.03-0.07 mm (0.001-0.003 in.) with a limit of 0.10 mm (0.004 in.).

Specified piston pin diameter is 14.995-15.000 mm (0.5904-0.5906 in.). Specified piston pin bore diameter is 15.006-15.014 mm (0.5908-0.5911 in.).

Top compression ring is chrome plated. One side of piston ring is marked with the letter "N" to indicate correct installation position. Install the piston rings on piston so that "N" on side of ring is toward piston crown.

When assembling piston and connecting rod, note that arrow on piston crown and arrow on side of connecting rod must point in same direction. Lubricate piston rings and pin with engine oil, then install piston and rod assembly in engine with arrow on piston crown toward push rod side of engine. Install rod cap on connecting rod so match marks on rod and cap are aligned. Tighten connecting rod nuts to 5.9-9.8 N·m (54-118 in.-lbs.).

Install camshaft and cylinder head as previously outlined.

**CONNECTING ROD.** Connecting rod rides directly on crankshaft journal. Connecting rod and piston are removed as an assembly as outlined in previous section.

Specified clearance between piston pin and connecting rod small end is 0.006-0.019 mm (0.0002-0.0007 in.) with a maximum allowable clearance of 0.050 mm (0.0020 in.).

Specified clearance between crankpin journal and connecting rod bore is 0.015-0.035 mm (0.0006-0.0014 in.) with a maximum allowable clearance of 0.080 mm (0.0031 in.). Specified con-

necting rod big end diameter is 26.015-26.025 mm (1.0242-1.0246 in.).

Install connecting rod as outlined in previous section.

**GOVERNOR.** The internal centrifugal flyweight governor is mounted on the oil pan. The governor is driven by the camshaft gear.

To remove governor assembly (33—Fig. FO54), first separate oil pan (35) from crankcase. Use two screwdrivers to snap governor gear and flyweight assembly off governor stub shaft.

Install governor by pushing down on the stub shaft until it snaps onto the shaft locating groove. Be sure that thrust washers (32 and 34) are positioned on either side of governor. A small amount of grease may be used to hold the thrust washer (32) and sleeve (31) in place on stub shaft. When installing oil pan, it may be necessary to turn crankshaft slightly to mesh the camshaft gear teeth with the governor gear. Do not force the oil pan into place.

Refer to MAINTENANCE section for external governor linkage adjustment.

**CRANKSHAFT, MAIN BEARINGS AND OIL SEALS.** The crankshaft is supported at flywheel end by a ball bearing (27—Fig. TO54) located in the crankcase. The crankshaft may be removed after removing piston and connecting rod as previously outlined.

Specified main bearing journal diameter is 21.960-21.980 mm (0.8646-0.8654 in.) for flywheel end and 24.959-24.980 mm (0.9826-0.9835 in.) for pto end. Specified crankpin journal

diameter is 25.99-26.00 mm (1.023-1.024 in.). Maximum allowable crankshaft runout is 0.05 mm (0.002 in.).

When installing crankshaft, make certain crankshaft and camshaft gear timing marks are aligned.

Inspect ball bearing and renew if rough, loose or damaged. Install oil seals (26 and 36) so lip is toward main bearing. Lubricate oil seals with engine oil prior to installing crankshaft. Be sure to align timing marks on crankshaft gear and camshaft gear.

**CYLINDER.** Renew cylinder if wear in bore exceeds 0.100 mm (0.0039 in.) or if out-of-round exceeds 0.030 mm (0.0012 in.).

**OIL PUMP.** A rotor type oil pump driven by the camshaft is located in the bottom of the oil pan.

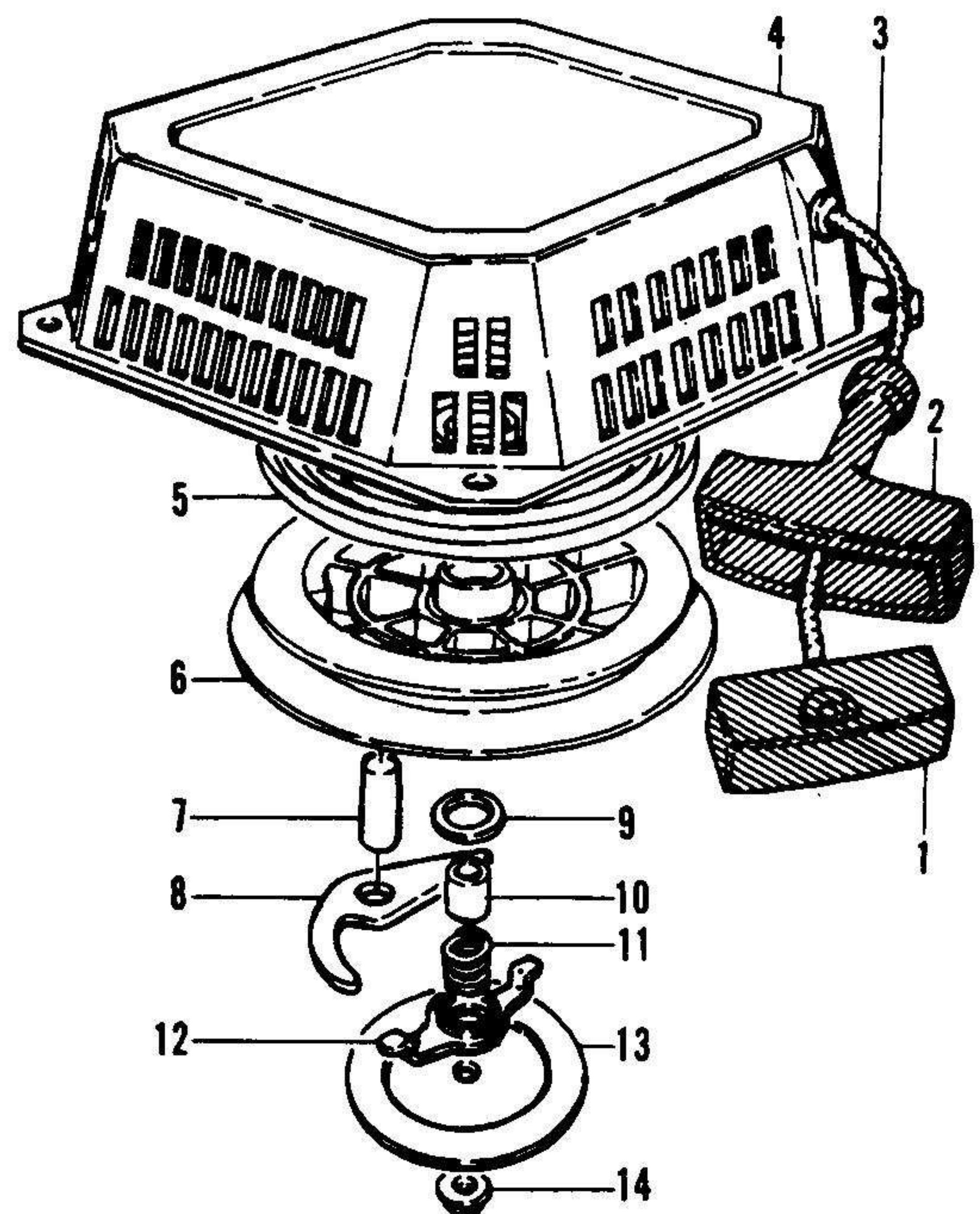
Remove engine from equipment for access to oil pump cover (37—Fig. TO54). Remove cover and extract pump rotors (39). Mark rotors so they can be reinstalled in their original position. Renew any components which are damaged or excessively worn.

**REWIND STARTER.** Refer to Fig. TO55 for exploded view of rewind starter.

To disassemble starter, remove rope handle and allow rope to wind into starter. Unscrew retainer nut (14). Remove retainer (13), pawl guide (12), spring (11), spacer (10), washer (9), pawl (8) and pivot pin (7). Wear appropriate safety eyewear and gloves before disengaging pulley (6) from starter as spring

Fig. TO55—Exploded view of rewind starter.

1. Rope retainer
2. Rope handle
3. Rope
4. Starter housing
5. Rewind spring
6. Pulley
7. Pivot pin
8. Pawl
9. Washer
10. Spacer
11. Spring
12. Pawl guide
13. Retainer
14. Locknut





(5) may uncoil uncontrolled. Place shop towel around pulley and lift pulley out of housing; spring should remain with pulley.

Inspect components for damage and excessive wear. A new starter rope is  $\frac{5}{32}$  inch (4 mm) in diameter and 70 inches (175 cm) long. A new rewind spring is provided with a retainer to hold it in the coiled position. When replacing the spring, first position it in the pulley, then remove the retainer. Note that rewind spring coils wind in counterclockwise direction from outer end. Install rope on pulley in a counterclockwise direction as viewed from engagement side of pulley. Be sure that pawl guide (12) is positioned as shown in Fig. TO55 when installing in pulley (6). Ap-

ply Loctite 242 to threads of retaining nut (14).

With starter assembled, pass rope through rope outlet and install rope handle. To apply spring tension to pulley, pull a loop of rope into notch in pulley and rotate pulley counterclockwise a couple of turns, then pull rope out of notch and allow rope to wind into starter housing. Rope handle should be snug against housing, if not, increase spring tension by rotating pulley another turn.

**ELECTRIC STARTER.** Some models may be equipped with an electric starter motor. Individual parts of starter drive assembly are available, however, motor unit is available only as a unit assembly. If starter malfunctions,

inspect and test components of starter circuit before replacing starter motor.

**ALTERNATOR.** Some engines may be equipped with an alternator. To test alternator output, disconnect alternator lead and connect a voltmeter to alternator lead and engine ground. With engine running at 3000 rpm, alternator output should be 13.2 volts DC. Test rectifier if output is low or zero.

To check for a faulty rectifier diode, connect positive lead of an ohmmeter to alternator lead and negative ohmmeter lead to alternator stator. Ohmmeter should read infinity. With ohmmeter leads reversed, ohmmeter should indicate approximately 700 ohms.

Alternator and rectifier are available only as a unit assembly.