

SCOTT

McCULLOCH CORPORATION
6101 West Century Blvd.
Los Angeles 45, Calif.

CONDENSED SERVICE DATA

Series	Royal Scott	Flying Scott
1958.....	3885, 1338, 1538	332
1959.....	136A, 336A, 536A	332A
1960.....	A3HB, B3HB, C3HB, D3HB, F3HB	C3JB, D3JB
1961.....	61304010, 61304020, 61304030, 61304040, 61304050, 61304060	61307030, 61307040, 61307050, 61307070, 61307080, 61307090
1962.....	62304010, 62304030, 62304050	62307030, 62307050
1963.....	63304511, 63304521, 63304531, 63304541	63307531, 63307541

TUNE-UP

Hp @ rpm.....	40 @ 4900, 43.7 @ 5000	60 @ 4000, 75.2 @ 5200
Bore—Inches.....	3 1/4	3 1/4
Stroke—Inches.....	2 3/4	2 3/4
Number of Cylinders.....	2	3
Displacement—Cu. in.....	42.18	63.27
Spark Plug		
Champion.....	I4J*	I4J*
AC.....	M42K	M42K
Electrode Gap.....	0.035	0.035*

*1961 Custom Flying Scott and all 1962 and 1963 Models use Champion UJ-17V surface gap spark plug in which the gap is fixed and not adjustable.

Magneto		
Point Gap.....	0.020	0.015
Timing.....	See Text	See Text
Carburetor		
Make.....	Carter, Tillotson or Walbro	
Model.....	See Text	
Adjustment.....	See Text	
Fuel-Oil Ratio.....	40:1*	40:1*

*Using Scott Crown Imperial Oil. Use 20:1 ratio with other Outboard Motor Oils in motors before 1962.

SIZES—CLEARANCES

Cylinder—Diameter.....	.....	.....
Piston Rings		
End Gap.....	.....	.....
Side Clearance.....	.....	.....
Piston to Cylinder		
Clearance.....	.....	.....
Piston Pin Diameter.....	.....	.....
Crankshaft Journal Diameters		
Top Main Bearing.....	.....	.....
Center Main Bearings.....	.....	.....
Lower Main Bearing.....	.....	.....
Crankpin.....	.....	.....

See Note.

Note: Publication not authorized by manufacturer.

TIGHTENING TORQUES

(All Values in Inch-Pounds)

Connecting Rod.....	180	180
Crankcase Halves		
Main Bearing Screws.....	300	300
Flange Screws.....	150	150
Cylinder Head.....	220	275
Powerhead Mtg. Screws.....	70	70
Powerhead Adapter.....	250	250
Pump Hsg. to Motor Hsg.....	140	140
Gearcase to Pump Hsg.....	275	275
Gearcase Brng. Housing.....	250	250
Flywheel Nut.....	875	875
Spark Plug.....	250	250

LUBRICATION

The power head is lubricated by oil mixed with the fuel. On early motors, use 1/2-pint of approved outboard motor oil with each gallon of regular or white marine gasoline. Use 1/2-pint of Scott Crown Imperial outboard motor oil or 3/8-pint of other approved motor oil with each gallon of gasoline in 1960-1962 models. The manufacturer authorizes the use of 1/2-pint of any top-grade outboard motor oil per gallon of fuel in 1962 and 1963 motors. A fuel-oil mixture of 1 part oil to 100 parts regular gasoline is authorized for use in 1963 motors, provided Scott 100-1 Oil is used. Mix fuel and oil thoroughly, using a separate container, before pouring mixture in fuel tank.

The lower unit gears and bearings are lubricated by oil contained in the gearcase. Only EP 90 Hypoid gear lubricant should be used. Lower unit gearcase should be drained and refilled every 30 hours or 60 days of operation. Check or renew the lower unit lubricant by filling to the level of the fill plug located on the port side of the gearcase. Tighten fill and drain plugs securely, using new gaskets if necessary, to ensure a watertight seal.

FUEL SYSTEM

CARBURETOR, Carter, Tillotson or Walbro

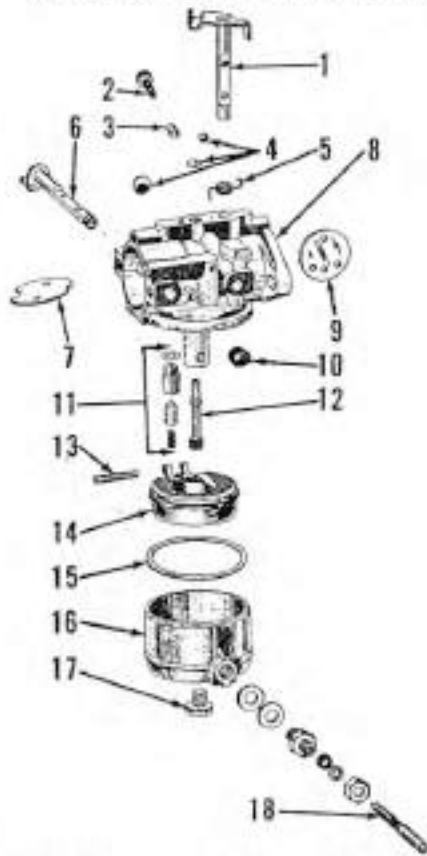


Fig. Mc100—Exploded view of the Carter N type carburetor used on early models.

- | | |
|-------------------|-------------------------|
| 1. Throttle shaft | 10. Spring |
| 2. Idle needle | 11. Inlet needle & seat |
| 3. Spring | 12. Main nozzle |
| 4. Plug | 13. Float shaft |
| 5. Spring | 14. Float |
| 6. Choke shaft | 15. Gasket |
| 7. Choke valve | 16. Float chamber |
| 8. Body | 17. Retaining screw |
| 9. Throttle valve | 18. High speed nozzle |

carburetors are used. Forty horsepower and Royal Scott motors after 1959 use two carburetors. All Flying Scott motors use three carburetors. Motors after 1959 use a fixed high-speed jet. Refer to the appropriate following paragraphs for service and adjustment procedures.

Carter Type N (Before 1960): Refer to Fig. Mc100. Carburetors are provided with two mixture adjustment needles. The idle mixture needle (2) and high speed adjustment needle (18) should both be initially adjusted to approximately 3/4-turn open, then readjusted under load for best performance after motor is warm. Both carburetors on two cylinder models or all three carburetors on three cylinder models must be adjusted for equal performance. Clockwise rotation of the needle leans the mixture. Readjust the idle mixture needle for smoothest and fastest idle speed whenever a major adjustment is made of high speed needle. Recheck high speed setting after adjusting idle mixture.

To disassemble the carburetor, first scribe a mark on body and bowl for proper location when reassembling. Remove high speed needle, packing nut and packing, then remove bowl retaining screw (17), gasket (15) and bowl (16). Float setting should be 11/64-

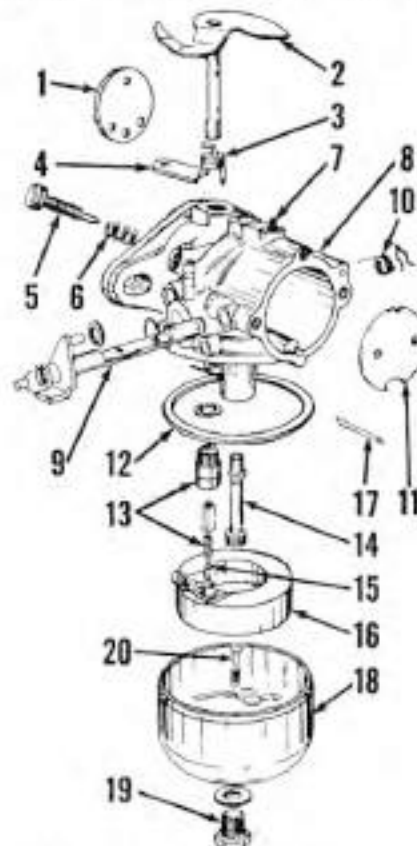


Fig. Mc101 — Exploded view of Carter carburetor used on some models. A fixed main jet is used.

- | | |
|-------------------|-------------------------|
| 1. Throttle valve | 11. Choke valve |
| 2. Throttle shaft | 12. Gasket |
| 3. Spring | 13. Inlet needle & seat |
| 4. Retainer | 14. Main nozzle |
| 5. Idle needle | 15. Pin |
| 6. Spring | 16. Float |
| 7. Metering rod | 17. Float shaft |
| 8. Body | 18. Float bowl |
| 9. Choke shaft | 19. Retaining screw |
| 10. Spring | 20. Metering rod pin |

inch, measured from nearest surface of float to carburetor gasket flange, with body in inverted position and inlet needle valve closed. Adjust by bending the tab which contacts inlet needle.

Slow speed jet is installed permanently and cannot be renewed. Throttle valve (9) must be installed with trademark "C" on side toward idle port and toward flange. Seat the valve by tapping lightly with small screwdriver, and use new screws when installing valve.

Model designations and Carter part numbers are as follows:

Models N-2684S, N-2750S, N-2890S, N-2890S and N-2930S

Flange gasket	1A-93
High speed needle (N-2684S)	37-77
High speed needle (N-2750S, N-2930S)	37-76
High speed needle (N-2890S, N-2890S)	37-61
Bowl	23-47
Inlet needle and seat (N-2684S, N-2880S, N-2890S)	25-375S
Inlet needle and seat (N-2750S, N-2930S)	25-368S
Idle needle (N-2684S, N-2890S, N-2890S)	30A-59
Idle needle (N-2750S, N-2930S)	30A-65
Main nozzle (N-2684S)	12-515
Main nozzle (N-2750S)	12-518
Main nozzle (N-2890S, N-2890S)	12-526
Main nozzle (N-2930S)	12-527
High speed jet (N-2684S)	159-169S
High speed jet (N-2750S, N-2930S)	159-166S
High speed jet (N-2890S, N-2890S)	159-172S

Carter Type N (After 1959): Refer to Fig. Mc101. Carburetor is provided with an idle mixture needle (5). High speed performance is determined by the adjustment of the metering rod (7). Both carburetors on two cylinder models or the three carburetors on three cylinder models must be carefully adjusted for equal performance. Clockwise rotation of the idle needle leans the mixture.

The metering rod adjustment can only be made with the carburetor removed from the motor. To make the adjustment, remove the carburetor and refer to Fig. Mc102. Open

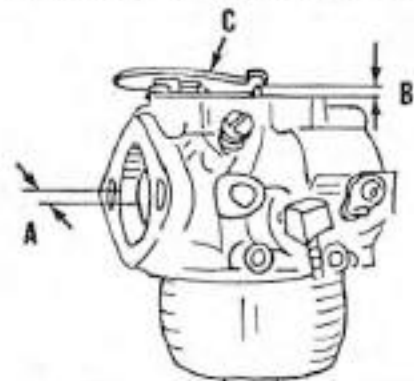


Fig. Mc102 — To adjust the metering rod, open the throttle valve 1/8 inch as shown at (A), then measure the distance between cam (C) and body at metering rod as shown at (B). The recommended measurement of 1/8 inch is obtained by bending cam (C).

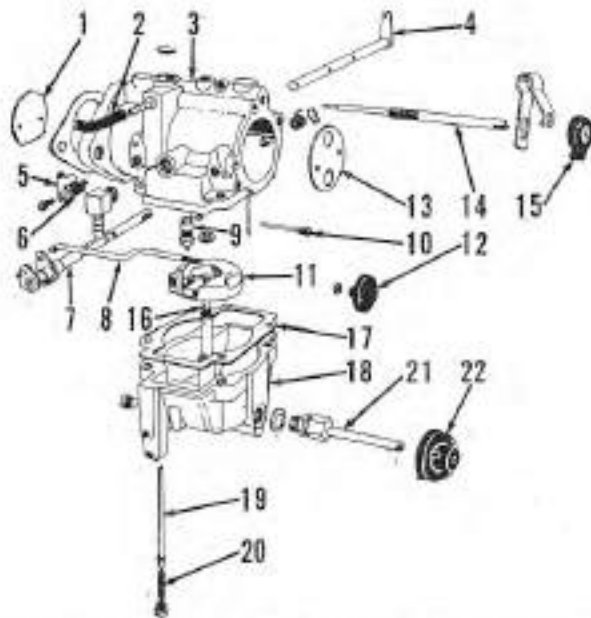


Fig. Mc103—Exploded view of the Tillotson carburetor used on some early models.

- | | | |
|-------------------|------------------------|-----------------------|
| 1. Throttle valve | 8. Choke rod | 16. Main nozzle |
| 2. Tube | 9. Inlet needle & seat | 17. Gasket |
| 3. Body | 10. Float shaft | 18. Float chamber |
| 4. Throttle shaft | 11. Float | 19. Jet valve stem |
| 5. Lever | 12. Choke knob | 20. Spring |
| 6. Spring | 13. Choke valve | 21. High speed needle |
| 7. Choke shaft | 14. Idle needle | 22. Knob |
| | 15. Knob | |

the throttle valve until a distance of 1/4-inch exists between valve and edge of barrel as shown at (A). A 1/4-inch twist drill or other gage can be used to obtain and maintain throttle position. With throttle valve correctly positioned, the metering rod should protrude 1/8-inch above machined surface of body casting as shown at (B). To adjust, bend the throttle shaft cam (C) at the angle near the throttle shaft. Metering rod is available in two sizes (Standard and 1 size lean). The alternate metering rod is recommended for operation in altitudes over 4,000 feet above sea level.

To disassemble the removed carburetor, open throttle lever past wide-open position until throttle lever cam clears metering rod; then remove metering rod. Remove the bowl

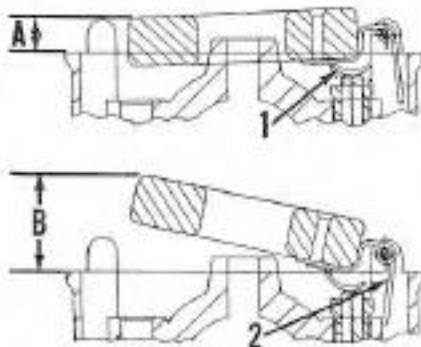


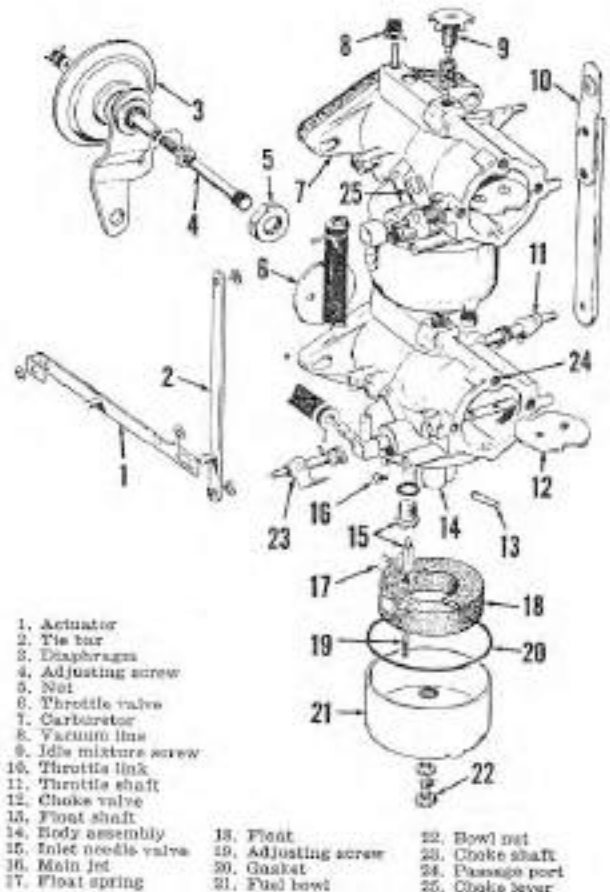
Fig. Mc104 — On Tillotson carburetors, closed float position (A) should be adjusted to 13/32 inch by bending tang (1). Maximum open position (B) should be adjusted to 1/8 inch by bending the other tang (2).

nut, being careful not to lose the metering rod pin and spring which are located in the nut. Low speed jet tube is not renewable and should not be removed. The recommended float setting is 1/4-inch, measured from nearest surface of float to gasket surface of carburetor body gasket flange, with body inverted and inlet needle valve closed. Adjust by bending the tab which contacts inlet needle. Throttle valve (1) must be installed with trademark "C" on side toward idle port and toward mounting flange. Seat the valve by tapping lightly with a small screwdriver, and use new screws when installing valve.

Model designations and Carter part numbers are as follows:

Models N-3008S, N-3027S

Flange gasket	1A-93
Nozzle	12-539
Float and lever assembly.....	21-163S
Bowl	23-59
Inlet needle and seat.....	25-399S
Idle needle	30A-59
Metering rod spring.....	61-612
Metering rod, Standard (N-3008S).....	75-1481
Metering rod, lean (N-3008S).....	75-1506
Metering rod, Standard (N-3027S).....	75-1509
Metering rod, lean (N-3027S).....	75-1510
Metering rod pin	150-280



- | | | |
|------------------------|---------------------|------------------|
| 1. Actuator | 18. Float | 22. Bowl nut |
| 2. Tie bar | 19. Adjusting screw | 23. Choke shaft |
| 3. Diaphragm | 20. Gasket | 24. Passage port |
| 4. Adjusting screw | 21. Fuel bowl | 25. Choke lever |
| 5. Nut | | |
| 6. Throttle valve | | |
| 7. Carburetor | | |
| 8. Venturi line | | |
| 9. Idle mixture screw | | |
| 10. Throttle link | | |
| 11. Throttle shaft | | |
| 12. Choke valve | | |
| 13. Float shaft | | |
| 14. Body assembly | | |
| 15. Inlet needle valve | | |
| 16. Main jet | | |
| 17. Float spring | | |

Fig. Mc104A—Exploded view of the dual Walbro carburetors used on Royal Scott. Three cylinder models are similar except three carburetors are used.

Tillotson Model OM4A: Refer to Fig. Mc103. Carburetor is provided with two mixture adjustment needles. The idle adjustment needle (14) should be initially adjusted to 1 1/2 turns open from the closed position. Recommended initial adjustment of the high speed adjustment needle (21) is 1/2-turn open. Final adjustment should be made under load after the engine is warm. First adjust the idle mixture needle for smooth operation; then adjust the high speed mixture needle with speed control FULLY advanced. Do not cut throttle back to the economy position. Clockwise rotation of either needle leans the mixture.

Two float settings are required as shown in Fig. Mc104. First adjust the float level (A) to a distance of 13/32-inch, measured from furthest edge of float to gasket surface of carburetor body as shown. Adjustment is made by bending the curved tang (1) which contacts inlet needle. Adjust maximum float drop (B) to 1/8-inch by bending the straight tang (2). Do not attempt to adjust float height (A) by pressing on the float, the inlet needle closes on a synthetic rubber seat, and an accurate adjustment is not possible.

Tillotson part numbers are as follows:

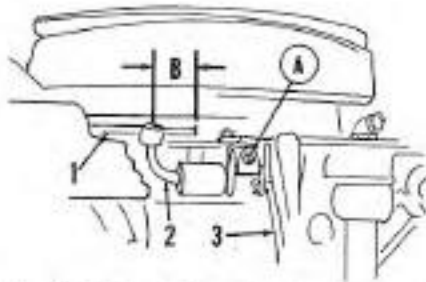


Fig. Mc105 — Schematic view of speed control mechanism used on early models with single carburetor. Refer to text.

- | | |
|--------------------|--------------------|
| 1. Synchronous cam | A. Adjusting screw |
| 2. Cam follower | B. Cam position |
| 3. Throttle link | |

Repair kit	RK-326
Gasket set	GS-109
Float	010310
Power jet valve	010958
Inlet needle and seat.....	010491

Walbro Models LOC-5A & LOC-6A: Refer to Fig. Mc104A for an exploded view of Walbro carburetor. The carburetor is provided with an idle mixture adjustment needle (..) and a fixed high-speed jet. Initial setting of the idle needle is one turn open from closed position. Final adjustment of slow speed mixture must be made under load with motor at operating temperature. All carburetors on one unit must be adjusted as nearly as possible alike.

The float should be adjusted to 5/32-inch when measured from nearest edge of float to carburetor gasket surface; with carburetor body (14) inverted, and float bowl (21) removed. Adjust float height by turning the adjusting screw (19). Check the total float drop after height is properly adjusted. The total drop when measured 180° from hinge should be 3/16-inch, and can be adjusted by bending the vertical tang on float.

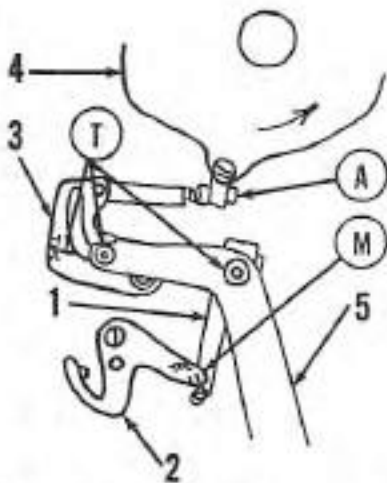


Fig. Mc106 — Schematic view of speed control mechanism used on two cylinder motors with dual carburetors. Refer also to Fig. Mc107.

- | | |
|-----------------|------------------|
| 1. Actuator arm | 5. Advance arm |
| 2. Throttle cam | A. Adjusting nut |
| 3. Advance cam | M. Timing marks |
| 4. Stator plate | T. Timing marks |

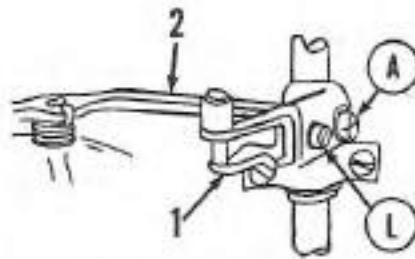


Fig. Mc107—Throttle actuating mechanism used on two cylinder models. Refer also to Fig. Mc106.

- | | |
|-----------------|----------------------|
| 1. Actuator arm | A. Angle adjustment |
| 2. Throttle cam | L. Length adjustment |

Model LOC-5A (upper) carburetor differs from Model LOC-6A (lower) carburetor only in the design of inlet elbow, and carburetors may be interchanged by changing the fitting. The port (24) is a drilling for fuel channel and must be plugged when carburetor is installed. The plug may be removed for cleaning. Main nozzle should not be removed except when absolutely necessary for cleaning, and a new service nozzle must be installed if original nozzle is removed. Tighten nozzle to a torque of 30-40 inch-pounds, and bowl retaining nut to a torque of 50-60 inch-pounds. Walbro part numbers are as follows:

Repair kit	300-563
Gasket kit	92-511
Inlet needle and seat.....	200-513
Power jet	112-62

SPEED CONTROL LINKAGE. The speed control lever on all models is connected to the magneto or distributor stator plate, and moves the plate to advance or retard the ignition timing. The carburetor throttle valve is synchronized to open as the ignition timing is advanced. It is very important that ignition timing and throttle valve opening be properly synchronized to obtain satisfactory operation. To adjust the speed control linkage, refer to the appropriate following paragraphs:

40 HP and Royal Scott Motors With Single Carburetor: Refer to Fig. Mc105. With the motor not running, move the speed control grip until the center of the follower arm (2) is one inch from end of cam (1) as shown at (B). Turn the adjusting screw (A) until the cam follower just touches the cam and

throttle valve is closed. When speed control grip is turned farther toward "FAST" position, the throttle valve should start to open. If engine idles unevenly, readjust the screw (A) a slight amount either way. If follower arm fails to stay in contact with stator cam, check for binding or damaged linkage.

40 HP and Royal Scott Motors With Dual Carburetors: Refer to Figs. Mc106 and Mc107. First adjust the ignition advance by moving the speed control lever to "Slow" position and shift lever to "Neutral." Move speed control lever toward "Fast" position until magneto stator plate (4—Fig. Mc106) strikes the neutral stop. (Speed control should be in "Fast Idle" position). With stator plate against the neutral stop, the TDC mark on the spark advance cam should be aligned with center of spark advance roller and tower shaft as shown at (7). If the TDC mark is not aligned, shorten or lengthen the spark control link (A).

To synchronize the throttle for each of the carburetors, loosen the length and angle adjusting screws which secure the throttle actuator arm (1) to the tower shaft (See Fig. Mc107). Check to make sure that the ignition timing marks (7—Fig. Mc106) are aligned as shown. Position the actuator arm (1), using both adjusting screws, until the actuator roller contacts the outer mark (6) on throttle cam (2), then tighten the length (rear) adjusting screw. Turn the angle (rear) adjusting screw until the actuator roller moves up cam (2) to the second (TDC) mark. Adjust the throttle actuator arm for the second carburetor in the same manner.

All Three Cylinder Models: Refer to Figs. Mc106, Mc109 and Mc110. First adjust the distributor timing by using a test light such as that shown in Fig. Mc108. Remove the spark plugs and turn the flywheel until "TDC" timing mark (TM—Fig. Mc109) is aligned with timing pointer (P) as shown. Loosen the two screws (A). Make sure the contact points are properly adjusted to 0.015 as outlined in IGNITION SYSTEM paragraph. Attach one clip of the test light to the primary terminal of the distributor, ground the other clip, then move the breaker plate back and forth to the point where the test light bulb just goes out. Position the spark advance cam (2) and cam roller (R) so that roller is centered in the timing marks (TM), then tighten the screws (A). To

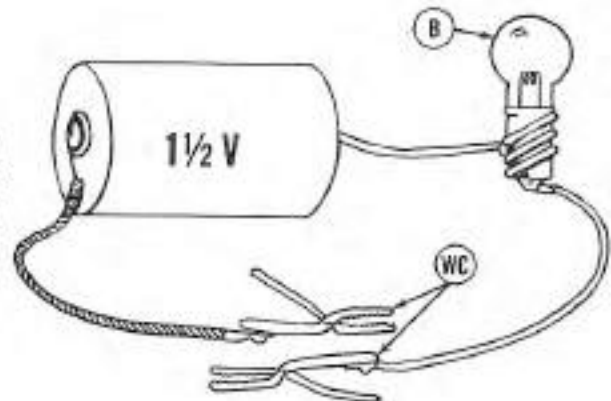


Fig. Mc108 — A test light for adjusting the timing can be constructed as shown using two wire clips (WC), a flashlight battery, bulb, and scrap pieces of insulated wire.

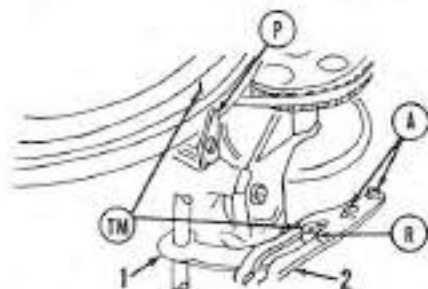


Fig. Mc109 — Schematic view of spark advance mechanism used on all three cylinder models. Refer to Fig. Mc110 for throttle mechanism.

- | | |
|----------------------|-------------------|
| 1. Spark advance arm | F. Timing pointer |
| 2. Spark advance cam | R. Cam roller |
| A. Adjusting screws | TM. Timing marks |

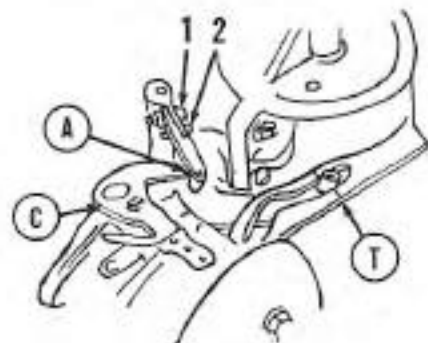


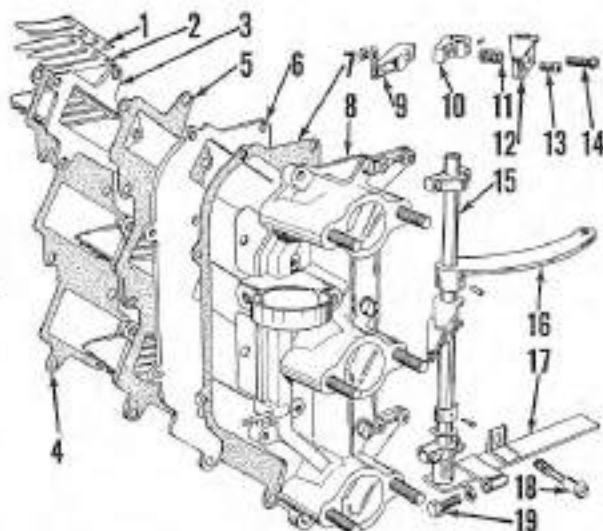
Fig. Mc110 — Throttle actuating mechanism used on three cylinder motors. Refer also to Fig. Mc109.

- | | |
|--------------------------|-----------------|
| 1. Angle adjustment | C. Throttle cam |
| 2. Length Adjustment | T. Timing marks |
| A. Throttle actuator arm | |

adjust the maximum advance, move the speed control lever to maximum advance. The cam roller (R) should move to within $\frac{1}{8}$ inch of the end of the slot in advance cam (2). To adjust the maximum advance, turn the stop screw (19—Fig. Mc111) until adjustment is correct.

To synchronize the throttle for each of the carburetors, refer to Fig. Mc110. Loosen the two adjusting screws (1 and 2) which secure the throttle actuating arm (A) to the throttle shaft. Move the speed control lever until spark actuating roller is centered in timing marks as shown at (T). Position the actuator arm (A) using both adjusting screws, until the scribe mark on throttle cam (C) is even with leading edge of roller on arm (A). Roller should be just touching, without having moved the cam. Tighten the length adjusting screw (2) securely. Adjust the throttle actuator arm for the other carburetors in the same manner.

REED VALVES. The inlet reed valve units are located between inlet manifold and crankcase as shown in Fig. Mc111. Reed petals (2) must be smooth and flat, and may stand open a maximum of 0.010 from the reed box. Seating surface of reed box on some models is nylon coated to improve reed life. Do not attempt to straighten a bent or damaged reed. Always renew a distorted reed or reed stop. Examine seating surfaces of reed box, and renew if damaged or worn.



1. Reed stop
2. Reed petals
3. Reed box
4. Gasket
5. Gasket
6. Cover plate
7. Gasket
8. Inlet manifold
9. Actuator arm
10. Throttle arm anchor
11. Spring
12. Actuator
13. Length adjustment
14. Angle adjustment
15. Throttle shaft
16. Spark advance arm
17. Lever
18. Adjusting screw
19. Advance stop screw

Fig. Mc111 — Exploded view of inlet manifold, reed valves and speed control mechanism used on three cylinder motors. Two cylinder motors are similar in major details.

FUEL PUMP. All motors are equipped with a two stage, diaphragm fuel pump. Older models use a reed-type check valve between the two fuel chambers as shown at (3—Fig. Mc112). Newer pumps use three identical check valves as shown in Fig. Mc113. Pressure and vacuum pulsations in crankcases of power head are directed to rear of diaphragm as shown in Fig. Mc112. When the power head piston moves upward in its cylinder, vacuum in crankcase draws diaphragm outward as shown. When piston moves downward in cylinder, crankcase pressure forces diaphragm inward into fuel chamber. The check valves permit the fuel to flow only toward the carburetor.

Outlet pressure of the fuel line (7—Fig. Mc113) should be maintained at a minimum of $\frac{1}{2}$ psi at idle speed and 2 psi at 3000 rpm. Fuel outlet pressure at 5000 rpm should

be maintained between the limits of 5-8 psi for two cylinder motors, or 6-9 psi for three cylinder motors. On the late motors, experience has shown that the length of the vacuum hoses is important for best performance. When renewing hoses, maintain the following recommended lengths: First stage hose (8—Fig. Mc113), 4 $\frac{3}{8}$ -5 $\frac{1}{8}$ inches on two cylinder motors; 13-13 $\frac{1}{4}$ inches on three cylinder motors. Second stage hose (9), 5 $\frac{3}{8}$ -6 $\frac{1}{2}$ on two cylinder motors; 5 $\frac{3}{8}$ -6 $\frac{1}{8}$ on three cylinder motors.

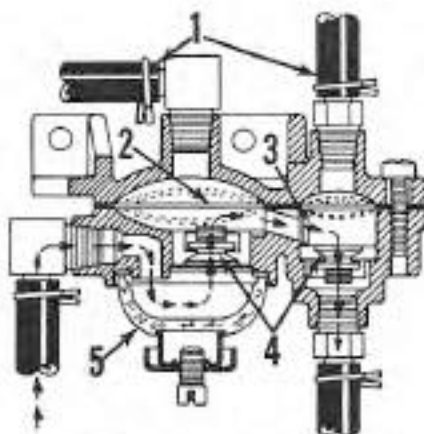


Fig. Mc112 — Schematic view of the two stage fuel pump. Hoses (1) connect to two of the crankcase chambers and provide vacuum and pressure pulsations which actuate the pump. Reed type check valve (3) was replaced by disc type check valve in later pumps. See Fig. Mc113.

- | | |
|-----------------|-----------------|
| 1. Vacuum hoses | 4. Check valves |
| 2. Diaphragm | 5. Filter bowl |
| 3. Reed valve | |

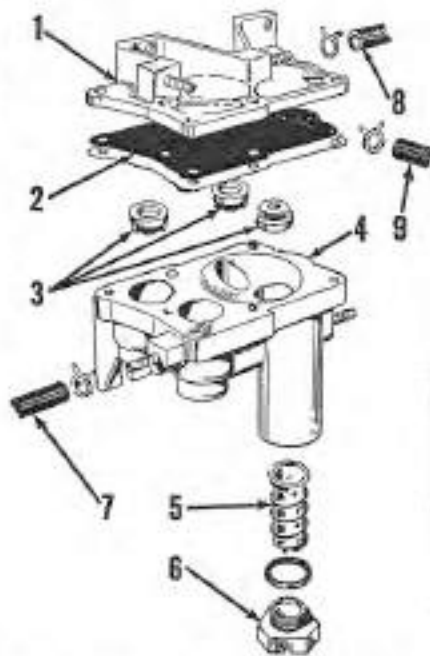


Fig. Mc113 — Exploded view of late diaphragm type fuel pump. Refer also to Fig. Mc112.

- | | |
|------------------|------------------|
| 1. Upper body | 8. Plug |
| 2. Diaphragm | 7. Fuel hose |
| 3. Check valves | 9. Pressure hose |
| 4. Lower body | |
| 5. Filter screen | |

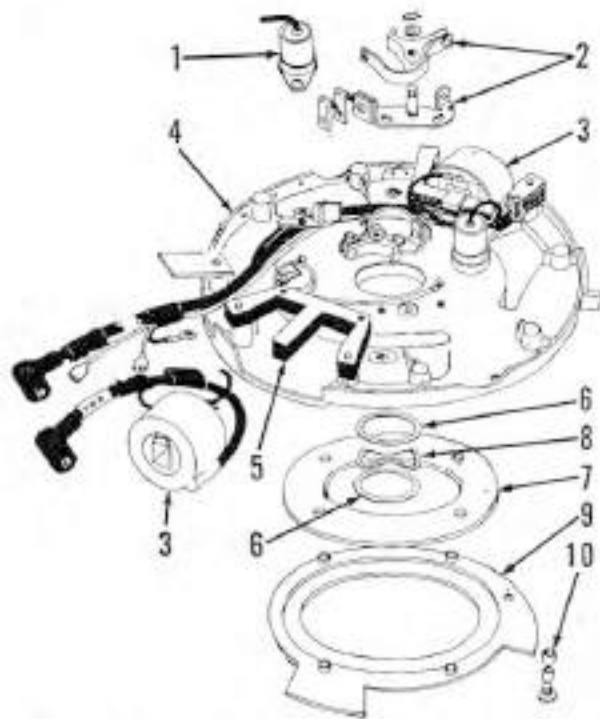


Fig. Mc114 — Exploded view of magneto of the general type used on early two cylinder motors with manual starting mechanism.

1. Condenser
2. Contact points
3. Coil
4. Stator plate
5. Laminated rotor
6. Washer
7. Adapter
8. Wave washer
9. Synchronous cam
10. Roller

When overhauling the fuel pump, all defective parts should be renewed. On older models with reed-type check valve, a gasket must be installed between diaphragm and lower body to prevent diaphragm striking reed valve. To remove the check valves on later style pumps, tap the inner portion of check valve using a $\frac{1}{8}$ -20 hot-tapping tap, and use a cap screw as a puller. Install new valves using an arbor press and a mandrel which contacts the outer edge, but will clear the body bore.

IGNITION

A flywheel magneto is used on all two-cylinder manual start models and, combined with a flywheel mounted alternator-generator, on early electric starting models. Late two cylinder electric starting models use a crankshaft mounted distributor and flywheel mounted alternator-generator. All three cylinder models use a unit distributor which is bolt driven from the flywheel. Refer to the appropriate following paragraphs.

SPARK PLUGS. On Custom Flying Scott beginning in 1961, and on all Royal Scott and Flying Scott motors beginning in 1962, Champion UJ 17V, surface gap spark plugs were used. These plugs offer greater resistance to fouling, burning and pre-ignition, and do not require adjustment. They cannot, however, be interchanged with different type plugs in other motors. In order to operate efficiently, this particular surface gap plug requires a secondary ignition current of 30,000 volts, a low oil to fuel ratio and carefully controlled water jacket temperature. These conditions are engineered into the motor designed for the plug and the system should not be modified when installing replacement ignition components or spark plugs.

MAGNETO IGNITION. Breaker point gap should be 0.020 and can be adjusted after recoil starter and flywheel have been removed.

For a quick test of magneto condition, remove the spark plugs and hold spark plug



Fig. Mc116 — Manual starting Royal Scott motor showing timing marks. Other two cylinder models are similar.

1. Advance timing mark
2. Second flywheel mark
3. First flywheel mark

wire about $\frac{1}{8}$ -inch away from cylinder head. Have someone spin the motor and note the condition of spark. Although spark may not be visible in bright daylight, a distinct snap will be noted as spark jumps the gap. If spark is weak or erratic, adjust the points as outlined above. Be sure to note point condition. If spark is weak although points are in good condition and properly adjusted, examine the condition of points, condenser and coil wiring, and the insulation on the magneto coils. Look for broken or worn insulation or broken wires. Also check for loose or corroded connections. Renew any parts which are damaged or in poor condition. Magneto coils on early electric start motors are grouped alternately with the generator coils as shown in Fig. Mc115.

On late model manual start models, it will be necessary to adjust the static advance of the magneto. To check the adjustment, remove the recoil starter and flywheel, then disconnect the coil primary wire and ground wire for the top cylinder and the stop switch wires. Attach one lead of a test light (See Fig. Mc100) to the wire leading to the insulated point for the top cylinder and ground the other test lead. Temporarily install the flywheel and recoil starter. Place the shift lever in "Forward" position and fully advance the speed control lever. Turn the flywheel until the second (advance) timing mark (3—Fig. Mc116) on flywheel aligns with the "A" timing mark (1) on starter housing. With the points properly adjusted, shorten or lengthen the spark advance link (A—Fig. Mc106) until the test light just goes out, indicating that the points have opened. This procedure adjusts the advance timing to the recommended 31° BTC position.

When installing the flywheel, tighten the retaining nut to a torque of 975 inch-pounds.

BATTERY IGNITION. All late model electric start models of two cylinder motors and all three cylinder models are equipped with

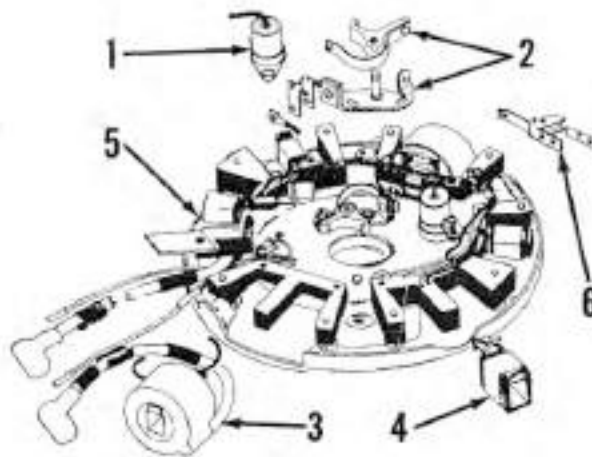


Fig. Mc115 — Exploded view of magneto-generator of the general type used on early electric models.

1. Condenser
2. Contact points
3. Magneto coil
4. Generator coil
5. Stator plate
6. Ground

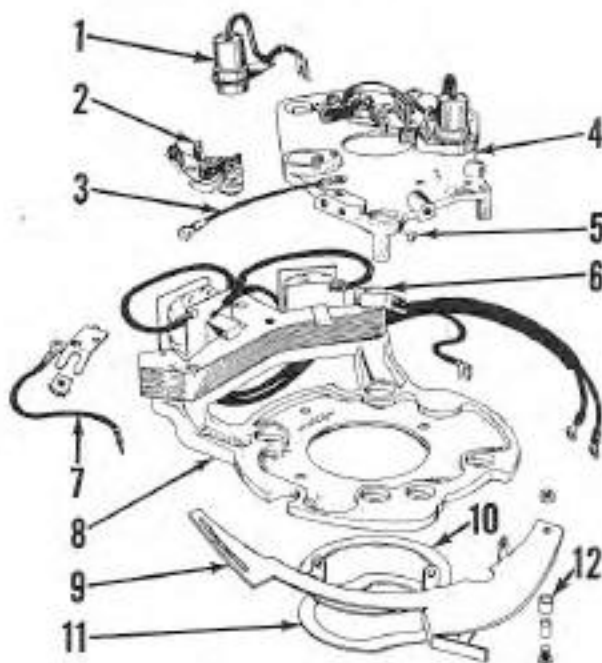


Fig. Mc117 — Distributor and alternator-generator of the general type used on late electric start, two-cylinder models.

1. Condenser
2. Contact points
3. Ground lead
4. Distributor plate
5. Friction button
6. Generator coils
7. Primary lead
8. Generator plate
9. Speed control bracket
10. Washer
11. Wave washer
12. Roller

battery ignition. Refer to the appropriate following paragraphs for adjustment and overhaul procedures.

Two Cylinder Models: The contact points are attached to a breaker plate mounted underneath the flywheel as shown in Fig. Mc117. A complete ignition system consisting of coil, condenser and contact points is used for each cylinder. Contact point gap should be 0.020 for each set of points. The ignition system incorporates an ignition switch and a ballast (resistor) unit which is mounted on the powerboard. The ballast is designed to prevent burning of the points if ignition switch is left on with motor not running and points closed. When ignition troubles are encountered, check the ballast (resistor) and ignition switch as well as points, condensers, coils and wiring.

To adjust the timing, set the contact points at the recommended 0.020, then re-install the flywheel. Place the shift lever in

"Neutral" and the throttle lever in "Fast" position. Rotate the flywheel until the 31° BTC timing mark (1—Fig. Mc118) on flywheel guard is aligned with timing mark (3) on flywheel. Attach one lead of a test light (See Fig. Mc108) to the top terminal of the ballast, located on port side of power head, and ground the other terminal. Rotate the flywheel back and forth through a slight arc and note flywheel position when the test light bulb goes out. The points should break as flywheel timing mark (1—Fig. Mc118) aligns with timing mark (3) on fly-

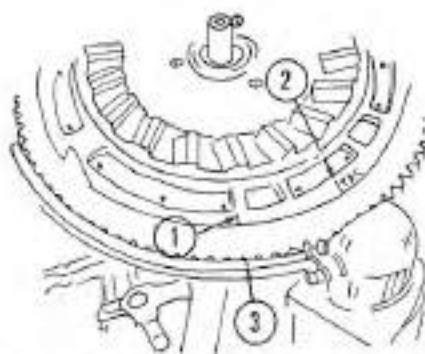


Fig. Mc118 — Timing marks used on Royal Electric models.

1. Advance flywheel mark
2. TDC flywheel mark
3. Timing mark

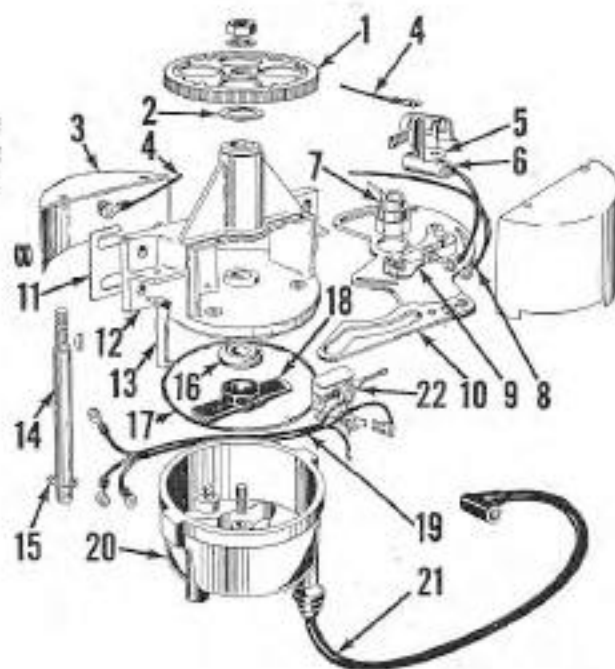
wheel guard. At the same time, the breaker plate should contact limit stop. Make minor adjustments as necessary, by adjusting link 1A—Fig. Mc106.

Three Cylinder Models: Three cylinder motors are equipped with a belt driven, unit distributor shown exploded in Fig. Mc119. The distributor rotates at 1/2 engine speed, and each arm of the rotor (18) forms a contact with one of the three secondary terminals in distributor cap (20) to permit each spark plug to fire with each crankshaft revolution. The breaker cam (7) has six lobes as shown. Contact point gap should be 0.015.

To install a drive belt or time the distributor, refer to Fig. Mc120. Remove the spark plugs to easily rotate the flywheel. Turn the flywheel until the "TDC" timing mark is on a line running through center of crankshaft and center of distributor shaft as shown at (A). Turn the distributor gear until the marked tooth bisects the same line as shown, then install the drive belt. Drive belt tension should be adjusted to 1/8-1/4-inch deflection midway between the pulleys by means of shims (11—Fig. Mc119). Shims are available in thicknesses of 0.005, 0.0142 and 0.025. To adjust the advance cam, turn the flywheel until the "TDC" timing mark (TM—Fig. Mc121) is aligned with timing pointer (P) as shown. Loosen the two screws (A). Attach one clip of a test light (See Fig. Mc108) to the primary terminal of the distributor, ground the other clip, then move the breaker plate back and forth to the point where the test light bulb just goes out. Position the spark advance cam (2—Fig. Mc121) and cam roller (3) so that roller is centered in the timing marks (TM) then tighten the screws (A). To adjust the maximum advance, move the speed control lever

Fig. Mc119 — Exploded view of distributor used on three cylinder models.

1. Drive pulley
2. Washer
3. Cover
4. Ground lead
5. Wiper
6. Condenser
7. Cam
8. Primary lead
9. Contact points
10. Advance cam
11. Shim
12. Body
13. Clip
14. Shaft
15. Retainer
16. Seal
17. Gasket
18. Rotor
19. Tachometer lead
20. Distributor cap
21. Secondary lead
22. Tachometer point



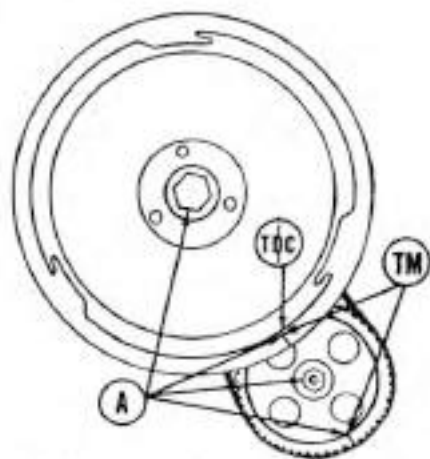


Fig. Mc120—To install timing belt or time distributor, align TDC timing mark on flywheel, timing mark (TM) on distributor pulley, and shaft centers of crankshaft and distributor as shown at (A).

toward the "Fast" position until the cam roller (R) moves to approximately 1/8-inch from opposite end of cam slot. Leave the test light installed. Turn the flywheel until the correct advance timing mark is aligned with the timing pointer (P). The recommended maximum advance timing is as follows:

- 1960 and Earlier 31° BTC
- 1961 Except Custom 28° BTC
- All Other Flying Scott Models 25° BTC

Move the speed control lever until the test light bulb goes out, then adjust the throttle advance stop screw (3—Fig. Mc122) until it contacts inlet manifold.

TACHOMETER. Some electric models are equipped with an electronic tachometer which is controlled by contact points mounted in the ignition distributor and activated by the distributor cam (See 22—Fig. Mc119). Three adjustments are necessary on the contact point assembly. To make the adjustments, depress the cam follower (1—Fig. Mc123) until the spring contact (3) touches

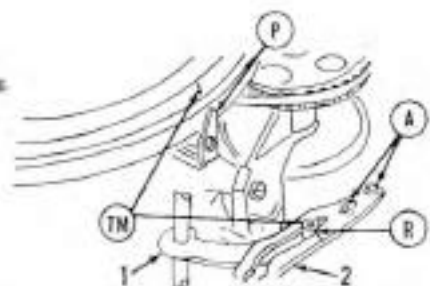


Fig. Mc121—Schematic view of ignition timing mechanism used on three cylinder models. Refer to text.

- 1. Spark advance arm
- 2. Spark advance cam
- A. Adjusting screws
- P. Timing pointer
- R. Cam roller
- TM. Timing marks

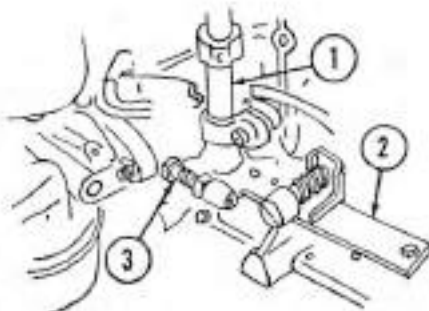


Fig. Mc122—Schematic view of throttle shaft showing maximum advance stop screw.

- 1. Throttle shaft
- 2. Laser
- 3. Advance stop screw

the stationary contact (4); then measure the air gap between spring contact and the opposite stationary contact (3). Adjust the gap to 0.013-0.015 by bending the contact (3). To adjust the cam follower stop screw (8), place a 0.025 shim between the nylon pad (5) and the spring of the movable contact (3). Loosen locknut (7), depress the cam follower (1) until spring contact (3) just touches stationary contact (4), then carefully turn stop screw (8) until points just open. Tighten the locknut and remove the 0.025 shim.

To install the tachometer contact assembly turn the distributor cam until follower (1) is in contact with the high point of one of the cam lobes. Place a 0.010 feeler gage between cam follower (1) and distributor cam. Slide the contact point assembly toward distributor cam until the nylon pad (5) touches the stop screw (8), then tighten the retaining screws.

COOLING SYSTEM

WATER PUMP. All motors are equipped with a rubber impeller water pump of the general type shown in Fig. Mc124. An identical pump is mounted directly above the cooling system pump which operates the "Bail-A-Matic" bilge pump. Operation and service procedures on the two pumps are identical.

The cooling system and bilge pumps are mounted in the lower motor support housing on early 40 horsepower models, and in a separate pump housing located just above the lower unit gearcase housing on all late models. On all models, the pumps are driven by the lower unit driveshaft.

The cooling system inlet is located above and aft of the propeller. When cooling system problems are encountered, first check the water inlet for plugging or partial stoppage, then if not corrected, remove lower unit gearcase housing and check the condition of the water pump, water passages, gaskets and sealing surfaces.

Pump housings are made of a bronze alloy with stainless steel insert. The manu-

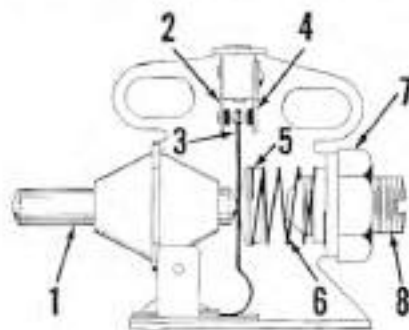


Fig. Mc123—Schematic view of tachometer point assembly showing method of adjustment. Refer to text.

- 1. Cam follower
- 2. Stationary point
- 3. Spring contact
- 4. Stationary point
- 5. Nylon pad
- 6. Spring
- 7. Locknut
- 8. Adjusting screw

facturer covers the pump mounting base and a small area of the pump housing with vinyl tape to act as a shield and prevent electrolysis. Make sure the tape is in place and in good condition when servicing the pumps. Pump impellers are marked "TOP" for correct installation in the housings. Pump bodies and impellers should be liberally coated with water pump grease during installation.

THERMOSTAT. Some models are equipped with a thermostat as shown in Fig. Mc126. Thermostat (2) is retained in cover plate (1) by a seal and snap ring which must be removed before thermostat can be withdrawn. Examine the neoprene dams (4) and

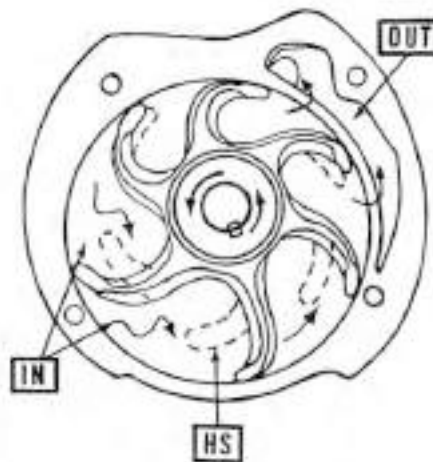


Fig. Mc124—Schematic view of the rubber impeller type water pump used for cooling and for the automatic bilge unit. Impeller blades flex at slow speeds as shown by solid lines. The offset housing causes water to be drawn into pump body (IN) and forces water out (OUT) due to differences in area between blades. At high speeds, blades remain curved as shown by broken lines (HS) and pump operates by centrifugal action.

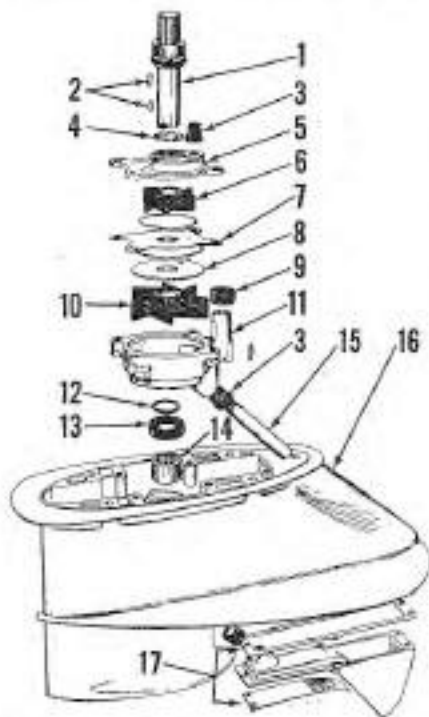


Fig. Mc125 — Exploded view of pump housing and associated parts used on late models. In early two cylinder models, pumps are located in lower motor housing.

- | | |
|-------------------|------------------|
| 1. Drive shaft | 10. Impeller |
| 2. Impeller keys | 11. Pump housing |
| 3. Grommet | 12. Seal |
| 4. Seal | 13. Seal |
| 5. Baller housing | 14. Bearing |
| 6. Impeller | 15. Inlet tube |
| 7. Cover plate | 16. Housing |
| 8. Cover plate | 17. Water inlet |
| 9. Grommet | |

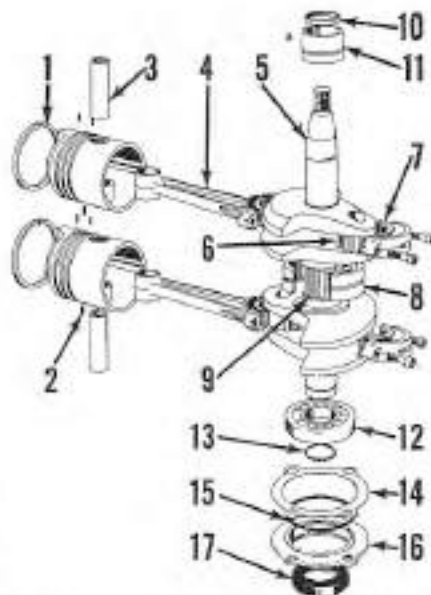


Fig. Mc127—Exploded view of crankshaft, pistons and associated parts used on two cylinder models.

- | | |
|-------------------|--------------------|
| 1. Piston ring | 10. Seal |
| 2. Locating pin | 11. Upper bearing |
| 3. Piston pin | 12. Lower bearing |
| 4. Connecting rod | 13. Retaining ring |
| 5. Crankshaft | 14. Shim |
| 6. Bearing needle | 15. "O" ring |
| 7. Bearing case | 16. Bearing cap |
| 8. Bearing race | 17. Seal |
| 9. Bearing needle | |

5) which are present in some models only. Dums must be in good condition and must completely block the water passages. Refer to CONDENSED SERVICE DATA table for torque specifications.

POWER HEAD

R&R AND DISASSEMBLE. To overhaul the power head, clamp the motor on a stand or support and remove the starter assemblies, shrouds and flywheel; then disconnect and remove the electrical system compo-

nents. Remove the powerhead to adaptor plate retaining screws, including those partially hidden by the motor support and shift handle, then lift off the complete powerhead assembly.

Remove the carburetors, inlet manifold and reed valve assemblies, the cylinder head, the inlet transfer ports, exhaust and water cover plates. Remove the bearing cap assemblies (16—Fig. Mc127 or 9 & 14—Fig. Mc129), then unbolt and separate the crankcase halves.

Pistons, rods, crankshaft and bearings are now accessible for removal and overhaul as outlined in the appropriate following paragraphs. When reassembling, make certain that main bearing dowels are properly aligned, and follow the procedures outlined in the ASSEMBLY paragraph.

ASSEMBLY. Because of the two-cycle design, crankcase and inlet manifold must be completely sealed against both vacuum and pressure. Exhaust manifold and cylinder head must be sealed against water leakage and pressure. Mating surfaces of water inlet, and exhaust areas between power head and lower unit must form a tight seal.

Whenever the power head is disassembled, it is recommended that all gasket surfaces, and mating surfaces without gaskets, be carefully checked for nicks, burrs and warped surfaces which might interfere with a tight seal. The cylinder head, cylinder head cover, head end of cylinder block, and some mating surfaces of manifolds and crankcase may be checked, and lapped if necessary, to provide a smooth surface. Use a regular lapping block or a sufficiently large piece of smooth plate glass. Lay a sheet of No. 00 emery cloth on the lapping block, then place the surface to be lapped on the emery cloth. Apply very light pressure and use a figure-eight motion, checking frequently to determine progress. Do not remove any more metal than is necessary. Finish lap using lapping compound or worn

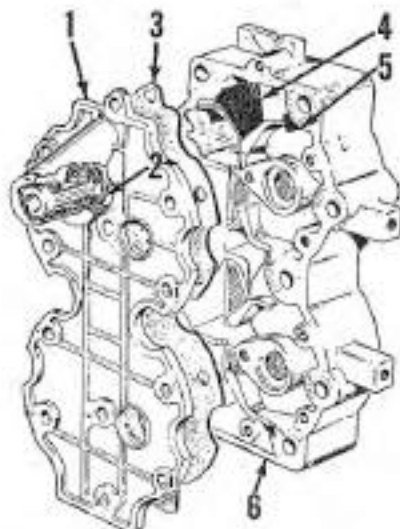
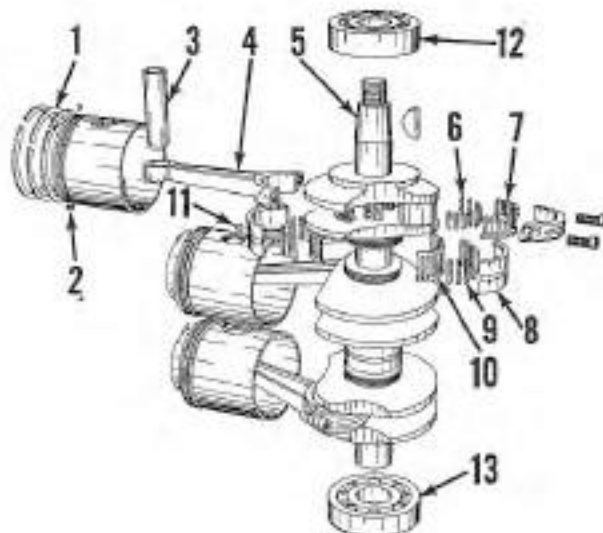


Fig. Mc126 — Thermostat installation in late two cylinder motor. Three cylinder motors are similar.

- | | |
|----------------|------------------|
| 1. Cover plate | 4. Neoprene dam |
| 2. Thermostat | 5. Neoprene dam |
| 3. Gasket | 6. Cylinder head |

Fig. Mc128 — Exploded view of crankshaft, pistons and associated parts used on three cylinder models.

- | |
|-------------------|
| 1. Piston rings |
| 2. Locating pin |
| 3. Piston pin |
| 4. Connecting rod |
| 5. Crankshaft |
| 6. Bearing needle |
| 7. Bearing case |
| 8. Bearing race |
| 9. Bearing needle |
| 10. Bearing case |
| 11. Dowel |
| 12. Upper bearing |
| 13. Lower bearing |



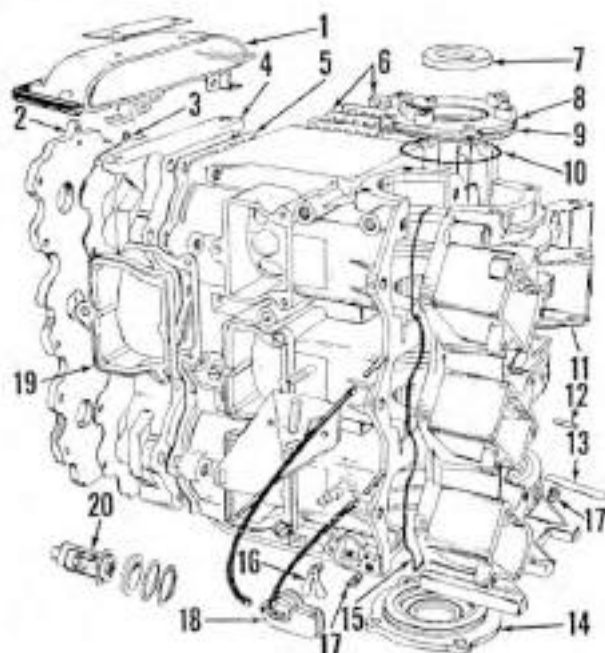


Fig. Mc129 — Exploded view of power head cylinder and crankcase assembly used on three cylinder models. Other models are similar.

1. Handle
2. Cover plate
3. Gasket
4. Cylinder head
5. Gasket
6. Exhaust covers
7. Seal
8. Bearing cap
9. Shim
10. Seal
11. Crankcase half
12. Dowel
13. Switch plate
14. Bearing cap
15. Seal strip
16. Check valve
17. Check valve
18. Drain cover
19. Transfer passage cover
20. Thermostat

emery cloth. Thoroughly clean the parts with new oil on a clean, soft rag, then wash with soapuds and clean rags.

Mating surfaces of crankcase may be checked on the tapping block, and high spots or nicks removed, but surface must not be lowered. If extreme care is used, a slightly damaged crankcase may be salvaged in this manner. In case of doubt, renew the crankcase assembly.

A heavy, nonfibrous grease should be used to hold loose needle bearings in position during assembly. The center main bearing outer race, upper main bearing race of late two cylinder motors, and upper and lower main bearing races of early two cylinder motors are prevented from rotation by dowels located in crankcase bores. All friction surfaces should be lubricated with new engine oil during assembly. Check frequently as power head is being assembled, for binding or locking of the moving parts. If binding or locking is encountered, remove the cause before proceeding with the assembly. Make sure the piston rings are properly assembled with end gap surrounding the locating pins in piston grooves. Be sure to inspect the scavenging check valves (16 and 17—Fig. Mc129) and to blow out the scavenging and oiling ports and lines.

Gasket and sealing surfaces should be lightly and carefully coated with a gasket cement. Make sure entire surface is coated, but avoid letting excess cement squeeze out into crankcase, bearings or other passages. On engines with ball type main bearings, adjust the crankshaft end play as outlined in the CONNECTING ROD, CRANKSHAFT

AND BEARINGS paragraph. Use the exploded views as a guide when assembling. Tighten the powerhead cap screws in the sequence shown in Fig. Mc130 or Fig. Mc131. Tightening torques are listed in the CONDENSED SERVICE DATA table.

PISTONS, PINS, RINGS AND CYLINDERS. Before detaching connecting rods from crankshaft, make certain rod and cap are properly marked for correct assembly to each other and in the correct cylinder.

Each piston is fitted with three rings which are interchangeable in grooves. Rings are pinned to prevent rotation in ring grooves as shown at (P—Fig. Mc132). NOTE: Middle ring is pinned at opposite side of piston from upper and lower rings.

Rings have a beveled inner edge which should be installed toward closed end of piston as shown at (B). Head end of piston is provided with a deflector (D) which directs the flow of the incoming fuel charge for proper scavenging of the cylinder. The long, sloping side of the deflector should be installed to the exhaust (Port) side of cylinder block.

Piston pin is a tight press fit in connecting rod and rides in caged needle bearings in piston bores. The manufacturer has de-

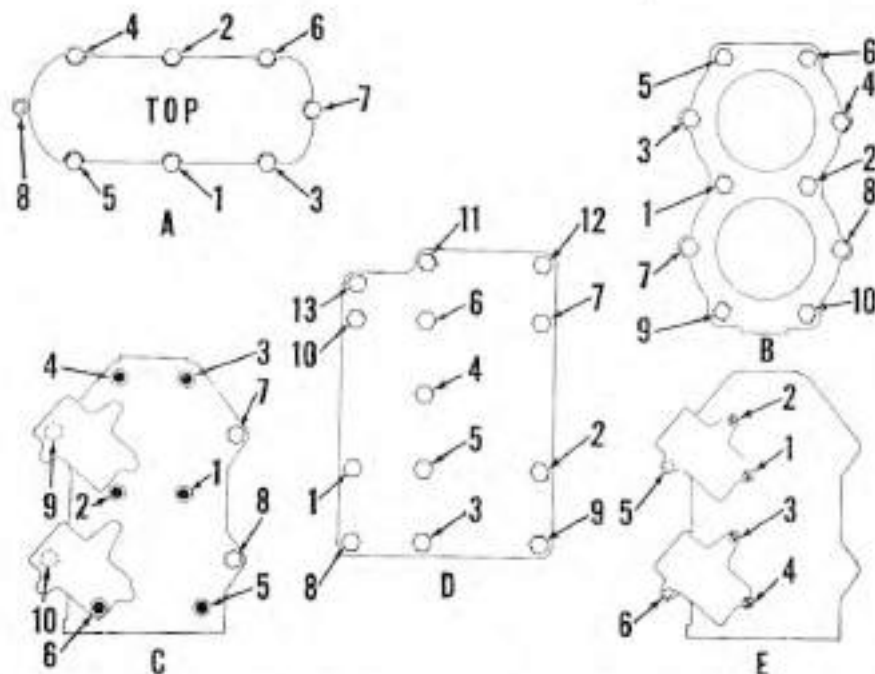


Fig. Mc130 — Recommended tightening sequence for the major powerhead assemblies on two cylinder motors. Refer to CONDENSED SERVICE DATA table for tightening torques.

- A. Powerhead adapter to lower motor housing
- B. Cylinder head to block
- C. Crankcase to cylinder block
- D. Exhaust covers to block
- E. Inlet manifold to crankcase

signed a special tool for removing and installing piston pins and pin bearings. The tool is available from Kent-Moore Organization, Inc., 28635 Mound Road, Warren, Michigan, under part number J7654. Bearings are pressed into piston bosses until inner edge of bearing is almost flush with inner edge of boss. Piston pin must be pressed into rod so that pin is centered, and neither end can protrude beyond outer edge of piston. Connecting rod is marked "TOP" for proper assembly. All bearing and friction surfaces should be lubricated.

CONNECTING ROD, CRANKSHAFT AND BEARINGS. Before detaching connecting rod from crankshaft, make certain that rod and cap are properly marked for correct assembly to each other and in the proper cylinder.

Connecting rod bearing is of the split-cage roller type as shown in Fig. Mc133. Cages and rollers are available as an assembly only, and the parts should be kept together and not intermixed. Matching corners of the bearing cage are marked by grinding as shown by arrow. Parting faces of rod and cap are not machined, but are

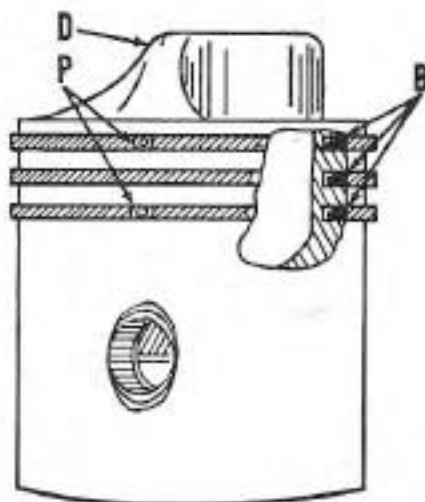


Fig. Mc132—Cross sectional view of piston showing two of the three piston ring locating pins (P). The other pin is on opposite side of piston. Rings are installed with beveled inner edge (B) toward closed end of piston. Deflector (D) directs the flow of incoming fuel charge for proper scavenging.

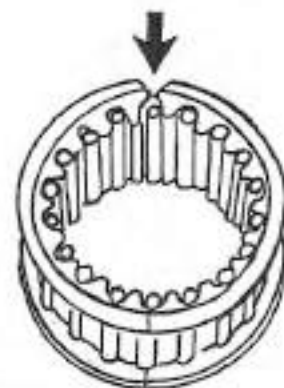


Fig. Mc133—Connecting rod bearing cages have one ground corner as indicated by arrow. Ground corners must be matched during assembly.

fractured during manufacture at point of arrows, Fig. Mc134, to provide a positive location. When installing cap, make sure the correlation marks (C) are aligned, then shift cap back and forth a slight amount while tightening, until fractured sections are in perfect mesh. When tightened completely, the parting line of rod and cap is practically invisible. When installing the connecting rod, the side marked "TOP" should face flywheel end of crankshaft.

The upper and lower main bearings of early two-cylinder motors, and the upper main bearings of late two-cylinder motors are of the caged, needle roller type. Lower main bearing of late two-cylinder motors, and upper and lower main bearings of all three-cylinder motors are of the ball bearing type which are pressed on crankshaft and retained by flanged bearing retainers. The center main bearings of all motors are of the split-cage, needle roller type. The cage is separated during manufacture by fracturing as described for the connecting

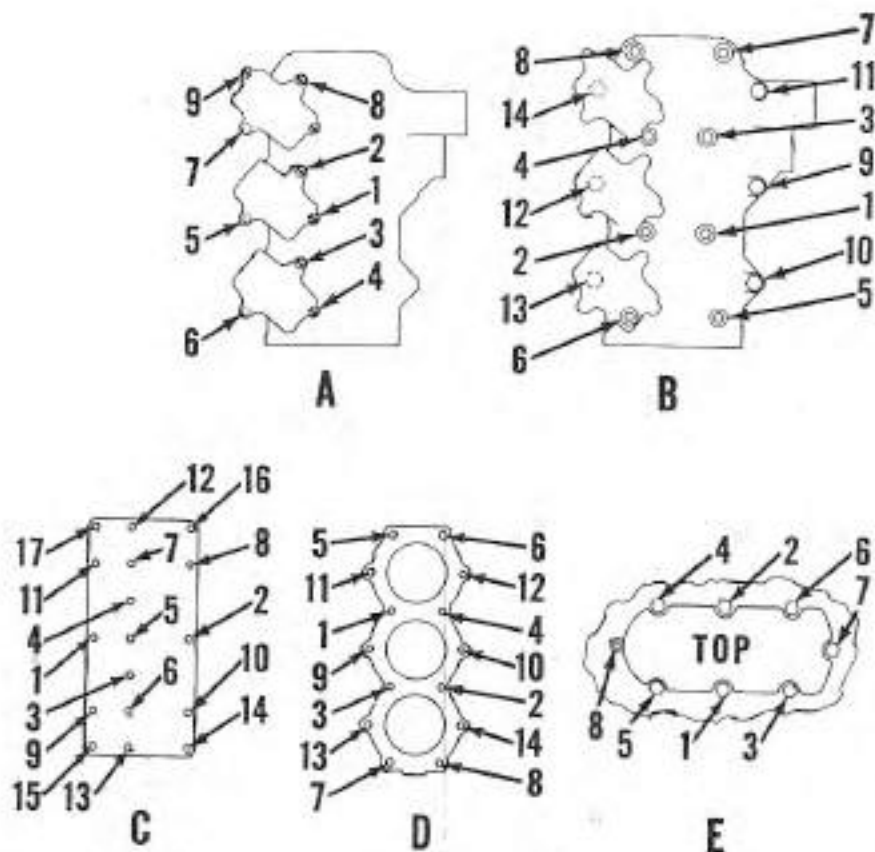


Fig. Mc131 — Recommended tightening sequence for the major power head assemblies on three cylinder motors. Refer to CONDENSED SERVICE DATA table for tightening torques.

- A. Inlet manifold to crankcase
- B. Crankcase to cylinder block
- C. Exhaust covers to block
- D. Cylinder head to block
- E. Powerhead adaptor to lower motor housing

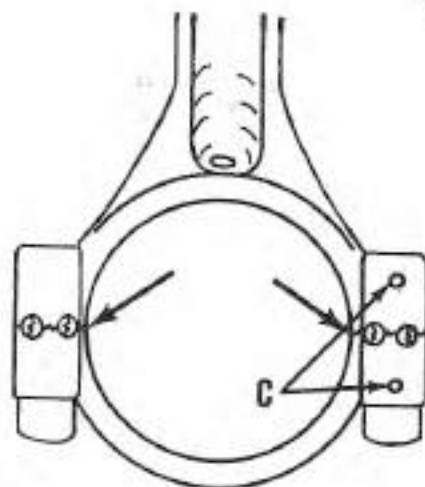


Fig. Mc134 — Uneven fractured parting line of rod and cap (shown by arrows) assures positive fit after assembly. Be sure correlation marks (C) are aligned.

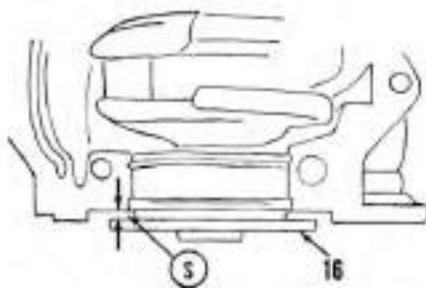


Fig. Mc135 — Suggested method of adjusting crankshaft end play on two cylinder motors with ball bearing mains. Refer to text.

- 16. Lower bearing cap
- B. Measure gap

rod. When assembling the center main bearings around crankshaft journals, work the sections back and forth a slight amount until fracture lines mesh, then install the retaining ring. All main bearings of the needle roller type are prevented from rotation in crankcase by dowels located in crankcase bores. When assembling, make sure the dowels enter the holes provided in bearing races.

On motors equipped with ball bearing mains, crankshaft end play is controlled by shims located underneath the bearing flanges. On two cylinder motors, crankshaft end play is controlled to 0.000-0.002 by means of shims (14—Fig. Mc127). The thickness of shim pack should be determined after crankshaft and bearings are installed in cylinder block, but before crankcase front half is installed, as follows: Temporarily install the lower bearing cap (16), without shims as shown in Fig. Mc135. While holding cap firmly against lower main bearing, measure the gap (B) between bearing flange and crankcase. Record the measurement for future use. Install crankcase front half, then install a shim pack beneath the lower bearing flange equal to the measured thickness. Shims are available in thicknesses of 0.001, 0.002 and 0.005.

On all three-cylinder motors, crankshaft end play is controlled by shims (9—Fig.

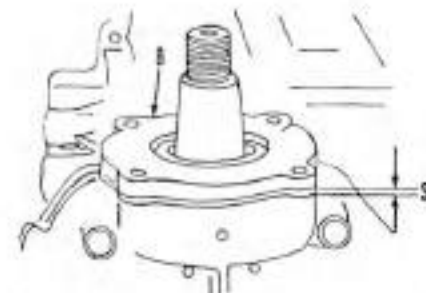
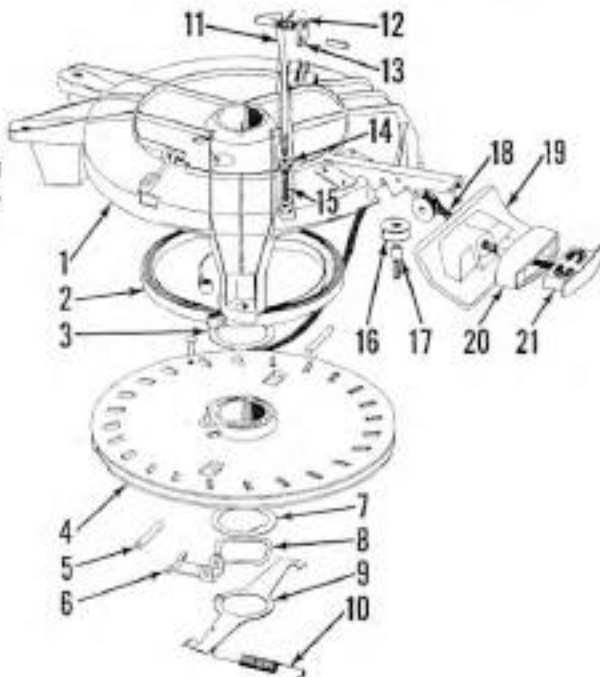


Fig. Mc136 — Suggested method of adjusting crankshaft end play on three cylinder motors. Refer to text.

- 8. Upper bearing cap
- B. Measure gap

Fig. Mc137 — Exploded view of recoil starter assembly of type used.

1. Housing
2. Recoil spring
3. Washer
4. Pulley
5. Pin
6. Pawl
7. Washer
8. Wax washer
9. Friction spring
10. Spring
11. Lock link
12. Spring
13. Lock
14. Adjusting nut
15. Spring
16. Roller
17. Bushing
18. Flange
19. Panel
20. Handle
21. Anchor



Mc129) located under the upper bearing cap flange. The recommended end play is 0.008-0.012. When assembling the motor, install the front crankcase half and install and tighten the lower bearing cap (14). Refer to Fig. Mc126. Position the upper bearing cap (8) without the shims. While holding cap firmly in place, measure the clearance (B) between flange and crankcase, using a feeler gage. Use shims equal to the measured thickness plus 0.010. Shims are available in thicknesses of 0.005, 0.010 and 0.020.

MANUAL STARTER

Fig. Mc137 shows an exploded view of the recoil starter assembly. To renew the starter pawls (6) or friction spring (9), remove and invert the assembled starter on a bench. Remove friction spring (9) with snap ring pliers, drive out the retaining pins and remove the pawls. Pulley (4) can be removed after removing the friction spring. Be careful that recoil spring (2) remains in cavity of housing (1) when pulley is removed. If spring is to be removed, clamp spring with a pair of vise-grip pliers to prevent uncoiling. Replacement spring is coiled and secured with a band clip. Leave clip in place until spring is installed in housing. When reassembling, make sure there is sufficient tension on recoil spring to completely rewind starter rope.

Starter lock (23) must be adjusted so that it enters lugs in starter pulley (4) when shift lever is in "Forward" or "Reverse" positions, but is completely free of lugs in "Neutral" position. To adjust the lock, turn the nut (14) up or down on the link (11) as required.

LOWER UNIT

PROPELLER AND DRIVE PIN. Shear pin protection is carefully engineered for each unit. Protection depends on shear pin material as well as size. Although, in an emergency, the shear pin may be replaced by one of any available material, the correct shear pin should be installed as soon as possible to ensure maximum performance

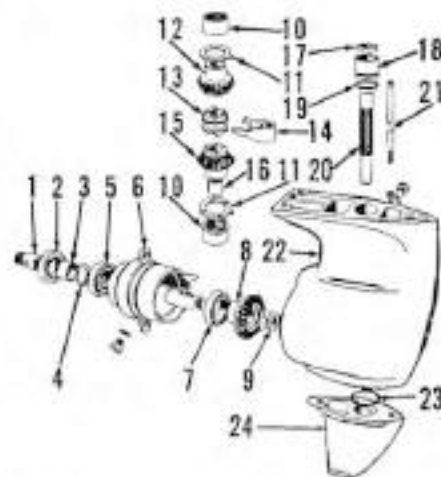


Fig. Mc138 — Exploded view of gearcase housing used on early two cylinder motors.

- | | |
|--------------------|------------------|
| 1. Propeller shaft | 13. Clutch dog |
| 2. Seal | 14. Shift fork |
| 3. Sleeve | 15. Reverse gear |
| 4. Snap ring | 16. Bearing |
| 5. Bearing | 17. Seal |
| 6. Bearing cap | 18. Ring dowel |
| 7. Bearing | 19. Seal |
| 8. Driven gear | 20. Drive shaft |
| 9. Nut | 21. Shift rod |
| 10. Bearing | 22. Gearcase |
| 11. Thrust washer | 23. Seal |
| 12. Forward gear | 24. Skag |

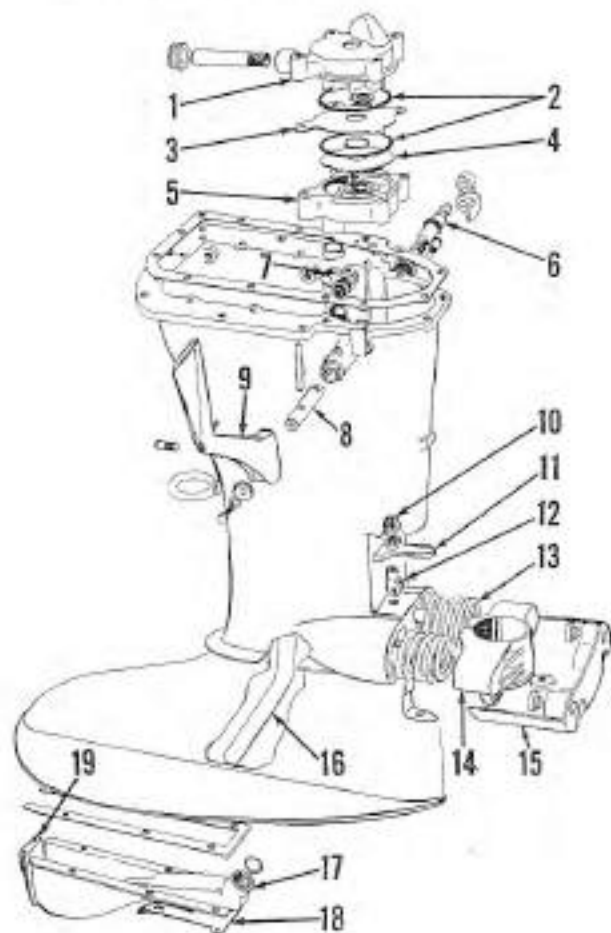


Fig. Mc139 — Lower motor housing and associated parts used on early models.

1. Baler housing
2. Seal
3. Cover plate
4. Cover plate
5. Pump housing
6. Baler inlet
7. Actuator
8. Shaft
9. Shift lever
10. Shift rod
11. Actuator
12. Coupling
13. Spring
14. Mount
15. Bracket
16. Water tube
17. Water inlet
18. Screen
19. Exhaust valve

and protection. All two-cylinder motors use a $\frac{1}{4} \times 1\frac{1}{8}$ -inch brass shear pin, manufacturer's part number 3845-3122. Three-cylinder models use a $\frac{1}{4} \times 1\frac{1}{2}$ -inch brass pin, manufacturer's part number 322-3122. A spare supply of shear pins should be kept on hand. All motors use a rubber cushion hub in the propeller in addition to the shear pin. Propellers are individually selected for the boat application. Two-cylinder motors use a 10-inch diameter propeller, with pitch varying between the ex-

trêmes of 7 to 16 inches. Three-cylinder models use a 11 $\frac{1}{2}$ -inch propeller with pitch varying from 8 to 17 inches.

R&R AND OVERHAUL. Most service on the lower unit can be performed by detaching the gearcase housing from lower motor housing. When servicing the lower unit, pay particular attention to water pump and water tubes with respect to air or water leaks. Leaky connections may interfere with proper cooling and performance of the motor. Use

Figs. Mc138 through Mc150 as a guide when overhauling the lower unit. Refer also to the instructions given in the appropriate following paragraphs.

40 Horsepower Models Before 1960: Refer to Figs. Mc138 and Mc139. To renew or service the propeller shaft, gear or bearings, first drain the lubricant and remove the cap screws retaining the bearing housing (6—Fig. Mc138) to the gearcase housing (22); then, remove the propeller shaft, gear, bearings and bearing housing as a unit. To disassemble the unit, remove the gear nut (9), gear (8) and Woodruff key; then press the shaft rearward out of gear housing. Seal (2) will be removed with shaft. When reassembling, tighten the nut (9) all the way; then back off until shaft turns with only a slight drag. Lock the nut in place by bending up a section of the washer.

To detach the gearcase housing from the lower motor housing, first drain the gearcase and disconnect shift rod coupling (12—Fig. Mc139). Remove the stud nut and two cap screws retaining the gearcase housing to lower motor housing. To make sure the driveshaft is removed with gearcase and gears, install a screw (5—Fig. Mc140) in vent plug hole and tighten screw up against the driveshaft. Carefully withdraw the gearcase housing and driveshaft assembly. The forward gear (12—Fig. Mc138), reverse gear (15), clutch dog (13) and associated parts can be removed after removing the propeller shaft assembly as previously outlined, then withdrawing the driveshaft. Forward and reverse gears are marked "T" and "R" for proper identification and assembly. Shifter fork (14) may be removed by unscrewing the shift rod (21). Assembly can be facilitated by counting the number of turns shift rod is threaded into fork.

Assemble by reversing the disassembly procedure. Lubricate upper end of driveshaft, and install carefully making sure keyway is aligned with pump impellers. Place shift lever in gear and turn driveshaft

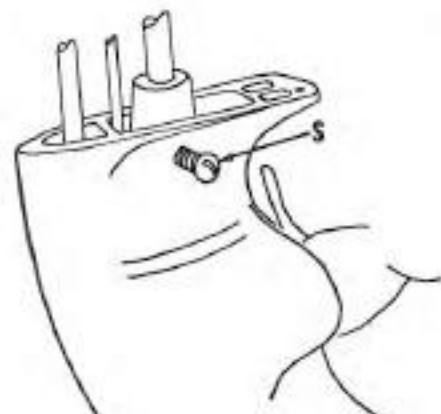


Fig. Mc140 — To retain the driveshaft in gearcase when separating the lower unit, thread a screw (5) in vent plug hole as shown.

1. Shift rod
2. Washer
3. Wave washer
4. Elbow
5. Shift cam
6. Gearcase
7. Drive shaft
8. Bearing cap
9. Bearing cone
10. Pinion
11. Nut
12. Seal
13. Shim
14. Bearing cap
15. Flange
16. Bearing cone
17. Spring
18. Forward gear
19. Clutch dog
20. Pin
21. Propeller shaft
22. Reverse gear
23. Bearing
24. Bearing cone
25. Seal
26. Bearing cap
27. Shim
28. Bearing cap
29. Seal

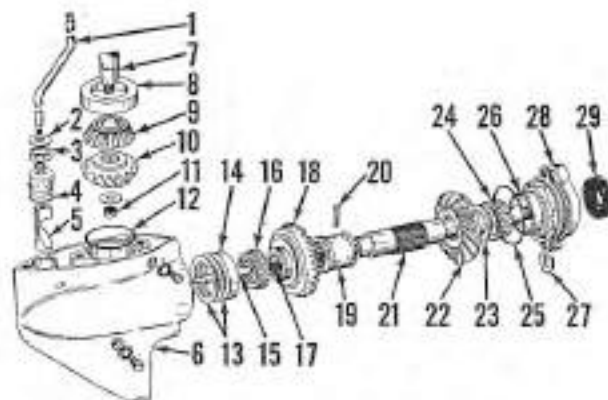


Fig. Mc141—Exploded view of gearcase and associated parts used on late motors except Custom Flying Scott.

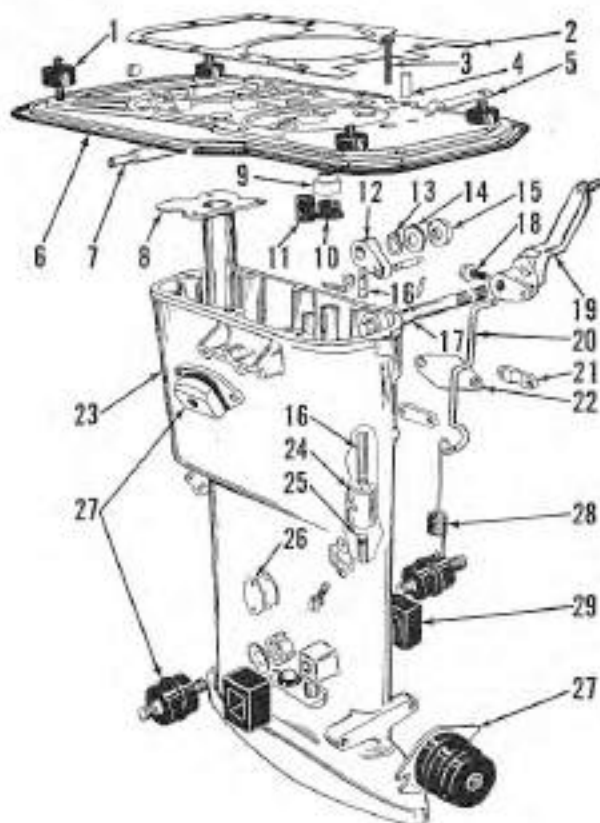


Fig. Mc142 — Lower motor housing and associated parts used on late models.

1. Mount
2. Gasket
3. Screw
4. Pin
5. Clamp
6. Powerhead adapter
7. Bulter inlet
8. Water tube
9. Retainer
10. Seal
11. Seal
12. Actuator
13. Wave washer
14. Washer
15. Seal
16. Shift rod
17. Shaft
18. Screw
19. Shift lever
20. Reverse lock rod
21. Clamp
22. Mount
23. Housing
24. Coupling
25. Shift rod
26. Cover
27. Mount
28. Spring
29. Bumper

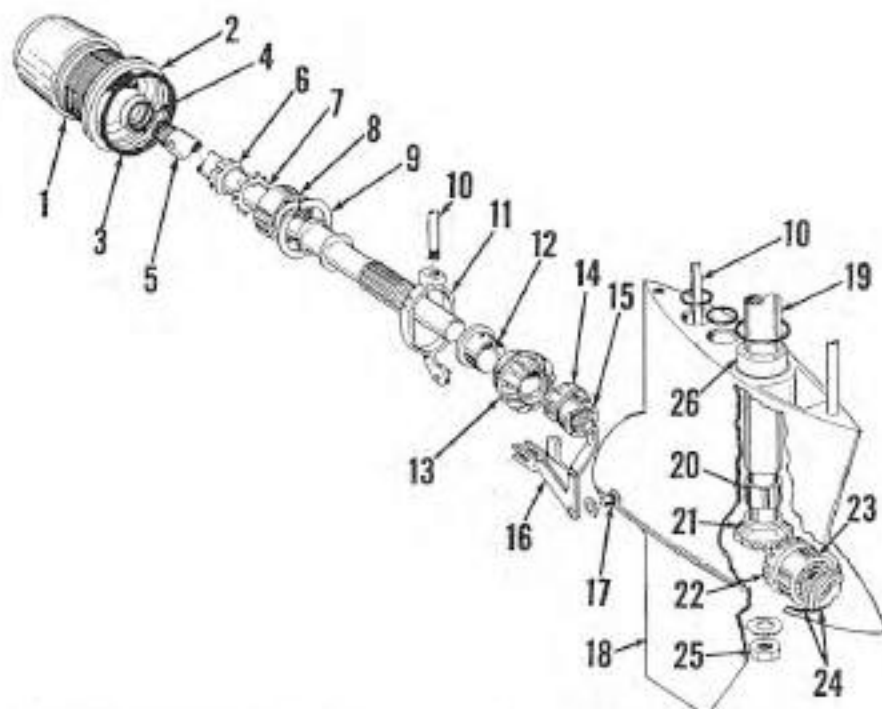


Fig. Mc143 — Exploded view of gearcase housing and associated parts used on Custom Flying Scott Models.

- | | | |
|--------------------|------------------|------------------|
| 1. Bearing cap | 9. Snap ring | 18. Gearcase |
| 2. Shim | 10. Shift rod | 19. Drive shaft |
| 3. Seal | 11. Shift yoke | 20. Bearing |
| 4. Seal | 12. Bearing | 21. Drive pinion |
| 5. Propeller shaft | 13. Reverse gear | 22. Forward gear |
| 6. Nut | 14. Collar | 23. Bearing |
| 7. Lockwasher | 15. Clutch dog | 24. Shim |
| 8. Bearing | 16. Pivot yoke | 25. Nut |
| | 17. Pivot screw | 26. Dowel |

to align upper splines. After motor is assembled, shift linkage must be adjusted as follows:

Move shift lever to "Forward" position, turn the propeller back and forth and note the amount of backlash in gears and shift dog. Move shift lever to "Reverse" position and again note the backlash. Loosen the locknut and clamp screw on shift rod coupling (12—Fig. Mc139) and turn the coupling to shorten or lengthen the shift rod until backlash is exactly equal in forward and reverse gears.

Late Two-Cylinder and Three-Cylinder Motors Except Custom Flying Scott: Refer to Figs. Mc141 and Mc142. To service the propeller shaft, driveshaft and gears, it is first necessary to detach the gearcase housing and pump housing assembly from the lower motor housing. To separate the units, place the shift lever in "Neutral" position, remove inspection cover (26—Fig. Mc142) and remove the lower coupling screw from shift rod coupling (24). Move the shift lever to "Reverse" position to separate the upper and lower shift rods. Remove the screws retaining the pump housing to lower motor housing (23) and slide the pump housing and gearcase unit downward out of lower motor casing. Disassemble the huller and water pumps as outlined in COOLING SYSTEM paragraph, then unbolt and remove the pump housing. Driveshaft and gear assembly (7 through 11—Fig. Mc141) will be removed with pump housing. Pinion gear (10) and bearing (9) can be removed with a suitable press after removing shaft nut (11).

Remove the propeller and reinstall the propeller nut. Remove the capscrews from bearing cap (20) and remove the propeller shaft, gears and bearings assembly by tapping on propeller nut with a soft hammer. Do not use a pry between gearcase (8) and cap (20). Cap (20) may be withdrawn from propeller shaft after unit is removed from gearcase. To remove the forward gear (18), reverse gear (22) or the shaft bearing cones (16 or 24), support the gear nearest the bearing and press out the propeller shaft. Withdraw the shift plunger (15) before removing the forward gear. To remove the clutch dog (19), compress the spring (17) with the forked tool J7534 (available from Kent-Nose Organization, Inc., 28635 Mound Road, Warren, Michigan) or similar tool, and drive out the pin (20). Forward gear (18) and reverse gear (22) are marked with an "F" or "R" stamped on clutch ring. The front bearing cone (16) and cap (14) are only available as an assembly which includes the factory shim pack (13). The complete assembly should be installed, and must not be mixed. Clutch dog (19) must be installed with the square teeth toward propeller end of shaft, facing the reverse gear.

Reassemble by reversing the disassembly procedure. Adjustment of the propeller shaft bearings is controlled by the horseshoe shims (27) which are available in thicknesses of 0.001, 0.002, 0.003 and 0.005. The same

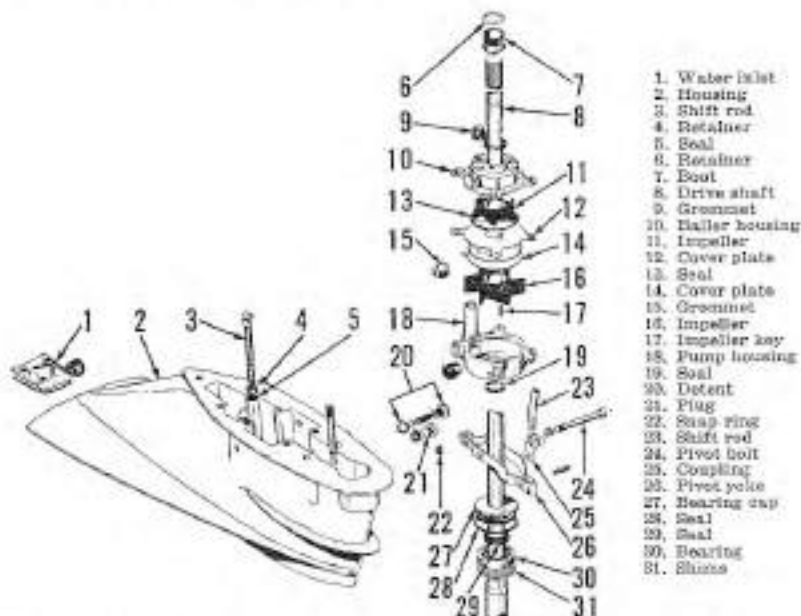


Fig. Mc144 — Exploded view of pump housing, shift linkage and associated parts used on Custom Flying Scott.

thickness of shims must be used under each ear of the bearing cap (28). To adjust the bearings, install the bearing cap without shims and tighten the retaining screws finger tight. Measure the gap between cap flange and gear case housing using a feeler gage. Install shims (27) equal to the measured gap, under each ear of the bearing cap and tighten the retaining screws to a torque of 250 inch-pounds. Place the shift lever in "Neutral," temporarily install the propeller retaining nut, and measure the rolling torque of the propeller shaft using the torque wrench. Add or remove shims as required to obtain a rolling torque of

3-6 inch-pounds for two-cylinder motors; or 7-11 inch-pounds for three-cylinder motors with shaft seal (29) installed. If shaft seal is not installed, rolling torque should be 1-4 inch-pounds for two-cylinder motors; or 5-9 inch-pounds for three-cylinder motors. An equal amount of shims must be installed under each ear of the bearing cap.

Custom Flying Scott Models: NOTE: The Custom Flying Scott drive is a high performance unit introduced to meet the demands of racing enthusiasts. Service on the lower unit requires special care and the use of special tools, most of which can be fabricated by a good, local machine shop. Do not attempt service on the Custom Flying Scott lower unit unless conditions warrant investment in the tools required.

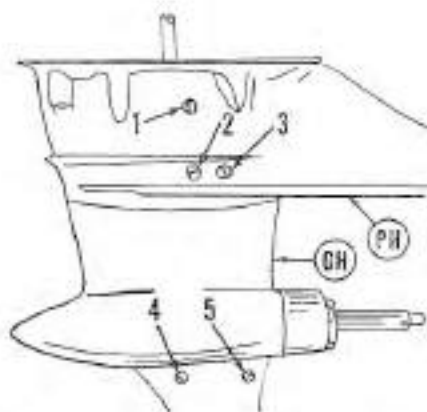


Fig. Mc145 — Custom Flying Scott lower unit showing plug and pivot screw location.

- | | |
|----------------------|--------------------------|
| GH. Gearcase housing | 3. Detent plug |
| PH. Pump housing | 4. Clutch dog yoke screw |
| 1. Pivot yoke bolt | 5. Drain plug |
| 2. Fill plug | |

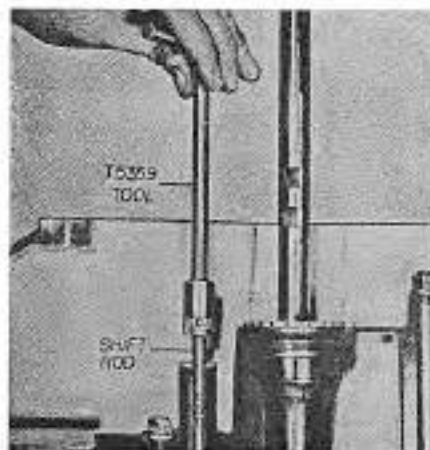


Fig. Mc146 — Using the special tool to remove the shift rod.

Refer to Fig. Mc143 and Fig. Mc144 for an exploded view of the assembly. To service the lower unit components, first remove the unit as outlined previously for the other three-cylinder models. Remove the propeller drive pin, propeller nut and propeller.

Propeller shaft and bearing assembly can be removed with a 1½-inch spanner wrench after the propeller has been removed. To remove the shaft, unscrew the cap (1—Fig. Mc143) being careful not to lose or damage the shims (2). Remove snap ring (8) and tap the shaft and bearing forward out of cap, using a soft hammer. Rear oil seal (4) can be renewed at this time. To renew the bearing (8) or shaft (5), bend down the tabs on lockwasher (7), remove nut (6) and press the shaft out of bearing.

Before removing the driveshaft or gears, the shift linkage must be disassembled using the following sequence. Remove pivot yoke bolt (1—Fig. Mc145) from port side of pump housing, then remove the pivot yoke. Use the special tool T5359 to unscrew and remove the lower shift rod as shown in Fig. Mc146.

Remove the clutch dog yoke screw (4—Fig. Mc145), press forked end of yoke (16—Fig. Mc143) downward and pull lower end of shift rod yoke (11) rearward until pin is disengaged from forked end of yoke (16). Lift yoke (11) up so that pin rests on top edge of fork, then push lower end forward until upper end clears housing as shown in Fig. Mc147. Withdraw the lower shift rod yoke from housing then remove the reverse gear (13—Fig. Mc143) and bearing (12). Remove clutch ring (14), clutch dog (15) and clutch dog yoke (16).

Working through opening in housing, hold the nut (25) and turn the drive shaft until nut (25) and washer can be removed. Remove the retaining lock screw and washer, then unscrew the driveshaft bearing cap (27—Fig. Mc144) using the special tool as shown in Fig. Mc148. Clamp upper end of driveshaft in a soft jawed vise and drift the lower housing and pinion gear off shaft

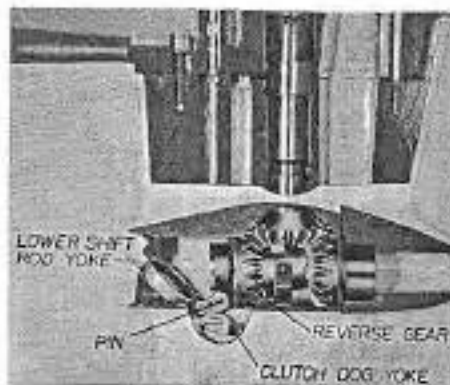


Fig. Mc147—Shift rod yoke must be tipped for removal. Refer to text.

with a heavy hammer and hardwood block. Do not lose or damage the shims located below the shaft bearing. Remove the forward gear (22—Fig. Mc143) and bearing (23) using an internal expanding bearing puller and slide hammer. Bearing (23) and gear (22) are serviced only as an assembly. Remove and save the shims (24). The total thickness of shim pack (24) is stamped on inside bore of gearcase housing. If housing is renewed or if shims are damaged, use shim pack equal in thickness to the stamped figure. Shims are available in thicknesses of 0.001, 0.0015 and 0.002.

Remove the retaining stud nut and cap screw and separate the pump housing from gearcase housing. Ring dowel (26) is factory installed in housing (18) and should not be removed. Needle bearing (20) can be removed using a piloted drift, and should be installed so that upper edge of bearing cage is $2\frac{1}{8}$ inches below FLAT top surface of gearcase housing. NOTE: To obtain this dimension, measure the distance that ring dowel (26) extends above housing surface, add this dimension to the desired $2\frac{1}{8}$ inches, then measure from top surface of ring dowel (26).

When assembling the lower unit, install the required thickness of shim pack (24—Fig. Mc143); then install the forward gear and bearing assembly, using the special installer T-5361 and alignment tool T-5360. Seat the bearing in housing by tapping rear of tool with a soft faced hammer. Install pump housing on gearcase housing using new seals.

Shims (31—Fig. Mc144) control the backlash of the lower unit drive gears. Shims are available in thicknesses of 0.002, 0.003 and 0.010. Backlash should be 0.003-0.005 when measured at the pitch diameter of the drive pinion. To check and adjust the backlash, install the driveshaft and bearing assembly without shims. Mark one tooth of the pinion gear, then install and tighten the pinion gear, retaining washer and shaft nut. Turn the marked pinion tooth to a point where it is visible, note location in housing, and, without moving shaft, indicate shaft position by marking top of pump housing in line with impeller flat on driveshaft. NOTE: Variations in splines on shaft and pinion may make a slight difference in re-

quired shim pack thickness. The indicated procedure permits reinstallation of pinion in same relative position on shaft.

Install driveshaft bearing cap (27—Fig. Mc144) and tighten cap until drive pinion makes contact with forward gear. Insert the gear installer (T-5361) in forward gear and install propeller shaft bearing cap (1—Fig. Mc143), less seal (4) and shims (2). Tighten the bearing cap by hand to lock forward gear to housing. See Fig. Mc149. Thread one pump mounting screw in housing as shown. Attach a dial indicator to driveshaft with indicator plunger bearing against the screw. Measure the distance from center of pump mounting screw to center of driveshaft, and multiply this distance by 0.003 to obtain the gauge reading which will give the correct backlash. Measure the backlash with the dial indicator while pulling upward on driveshaft, and adjust the backlash to the indicated reading by tightening or loosening the driveshaft bearing cap. When the correct measurement has been obtained, remove the dial indicator and mark the bearing cap tooth that is nearest the lock screw hole. Remove the driveshaft bearing cap while counting the number of turns, so that cap can be reinstalled in the same position. Remove the propeller shaft bearing cap and special tool, then remove the drive pinion nut and gear.

Reinstall the driveshaft bearing cap to the identical position required to obtain the correct backlash; then, while counting the turns, continue tightening the bearing cap until bearing is seated. Remove the driveshaft and add 0.050 shims for each complete turn of nut beyond the marked position, and 0.005 shims for each two cap teeth beyond the last complete turn. Reinstall the driveshaft and components, using the correct shim pack and making certain pinion is installed on same shaft splines used when backlash was measured. Reinstall the assembly tool, propeller shaft bearing cap and dial indicator, and recheck the backlash with driveshaft tightened in place before proceeding with the assembly.

Reassemble the propeller shaft, bearing cap and seal, using the seal protector T-5393, then check and adjust the backlash of the reverse gear as shown in Fig. Mc150. To check the adjustment, use the special tool T-5403 to lock the reverse gear to the propeller. Tighten the three cone point screws behind the machined shaft collar and the two dog point screws into the gear oil holes. Install the propeller shaft and reverse gear assembly without the shims (2—Fig. Mc143). Tighten the propeller shaft bearing cap lightly by hand and clamp the lower unit driveshaft in a soft jawed vise with propeller shaft down. Attach a bar to the gearcase skeg with a "C" clamp as shown in Fig. Mc150, and attach dial indicator to propeller shaft with plunger bearing against the bar. Measure the distance from dial indicator plunger to center of pro-

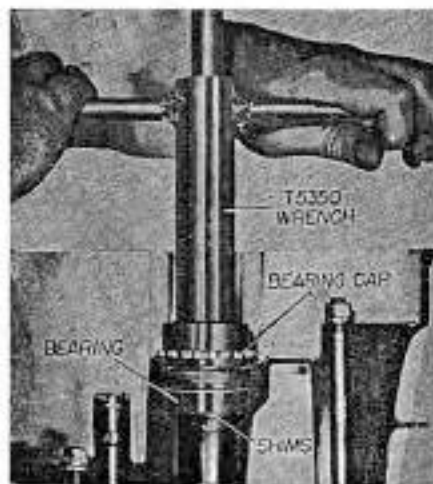


Fig. Mc148—Remove the drive shaft bearing cap by using the special wrench.

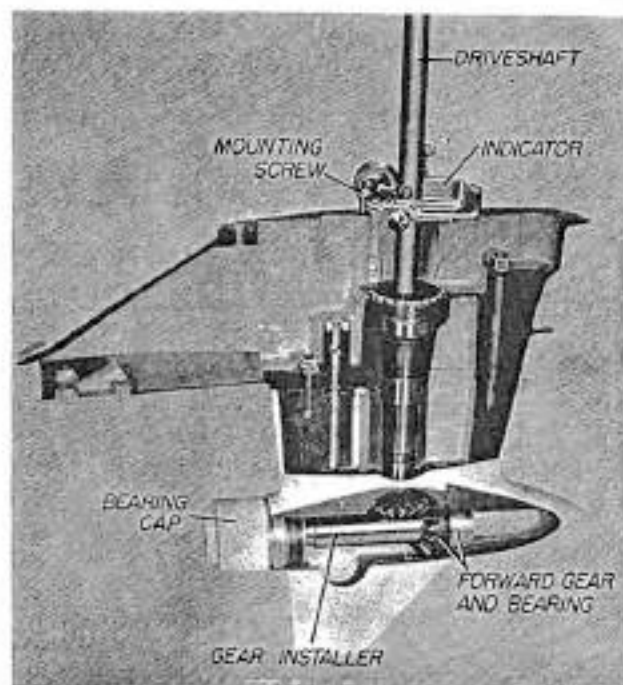


Fig. Mc149—Drive shaft bearing shim pack thickness is determined by measuring backlash with dial indicator as shown. Refer to text.

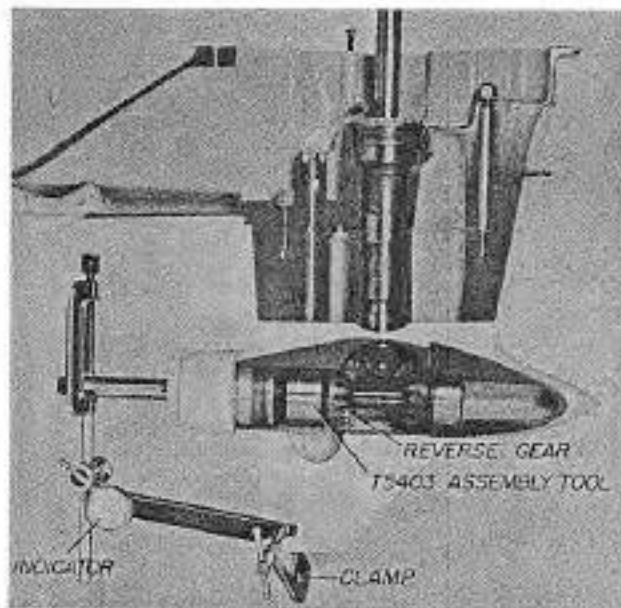


Fig. Mcl50 — Use the dial indicator as shown to measure thickness of propeller shaft bearing cap shim pack. Refer to text.

propeller shaft and multiply this figure by 0.003 to obtain the gage reading which will give the correct backlash. Check the backlash and adjust to the indicated reading by tightening or loosening the propeller shaft bearing cap. When proper adjustment has been obtained, measure the clearance between bearing cap and gearcase housing using a feeler gage, remove the propeller

shaft assembly, install shims equal to the measured gap, then recheck the adjustment with bearing cap fully tightened.

Reassemble the gearcase unit, including the shift mechanism. Lock the propeller shaft bearing cup (1—Fig. Mcl43) in place with a pin punch by bending a section of shims (2) into the notches located in cup

(1) and gearcase housing (18). After unit is assembled, adjust the shift mechanism for equal travel into either gear by threading the shift rod (10) in or out of yoke (11). Adjustment is correct when detent notches travel an equal distance beyond the detent hole (3—Fig. Mcl45). Remove the detent assembly to view the movement when making the adjustment, and turn the propeller shaft to make certain that gears are fully engaged.

SPECIAL TOOLS. The illustrations on pages 310 & 311 show dimensions for local fabrication of the special tools required. Tool usage table is as follows:

- T-4480 & T-4481, Seal Protector, Bearing Cap
- T-5350.....Driveshaft Bearing Cap Wrench
- T-5351.....Shift Rod Dowel Installer
- T-5358.....Seal Installer, Bearing Caps
- T-5359.....Shift Rod Tool
- T-5360.....Forward Gear Alignment Tool
- T-5361.....Forward Gear Installing Tool
- T-5366.....Driveshaft Bearing Installer
- T-5383.....Seal Protector, Prop Shaft
- T-5403.....Reverse Gear Assembly Tool

In addition to the above listed special tools, the following will be required:

- Spanner Wrench, 1½-inch
- Spanner Wrench, Adjustable
- Internal Expanding Bearing Puller w/Slide Hammer Attachment
- Tru-Arc Pliers
- Dial Indicator and Attachments.

CENTRAL PARTS DISTRIBUTORS

Joe Brady & Associates
3029 3rd Avenue South
Birmingham, Alabama

McCulloch Distributors
1205 E. Grand
El Segundo, California

Marine Parts
221 Main Street
Avon, Connecticut

Power Equipment Company
645 S. Route 83
Elmhurst, Illinois

Ryan Auto Parts
602 E. Washington
Indianapolis, Indiana

Kindig Brothers
1122 Mishawauksee Ave.
South Bend, Indiana

Minnesota Marine
1790 University Ave.
St. Paul, Minnesota

Masek Auto Supply
1310 Broadway
Gering, Nebraska

Nassau Shores Home & Garden Shop
E. Shore Road & Merrick Blvd.
Massapequa, L. I., New York

Walt Mfg. & Sales Co.
415 N. Elwood
Tulsa, Oklahoma

Oregon Marine Supply Co.
235 S. W. First Ave.
Portland, Oregon

Maack Auto Supply
135 Sherman
Deadwood, South Dakota

Gateway Sporting Goods
3413 Chapman Highway
Knoxville, Tennessee

Southern Electric & Marine
934 S. Gallatin Road
Madison, Tennessee

Wilson Walz Sporting Goods
502 San Francisco Street
El Paso, Texas

Straus Frank Company
4000 Leeland Avenue
Houston, Texas

Wilson's Transport
655 S. State Street
Salt Lake City, Utah

Richmond Battery & Ignition
1319 W. Broad
Richmond, Virginia

Masek Auto Supply
235 S. David
Casper, Wyoming