1975
Scorpion
Brut

Service Manual

Engine Section

ENGINE SYSTEM

General Description:

The Scorpion Brut engine is especially designed and built for today's high performance snowmobile.

Any internal combustion engine performs best and is most reliable at a constant operating temperature. The Scorpion Brut engine is thermostatically controlled to run at a 180 degree +4 degree F cylinder head temperature whether the outside temperature is -30 degree F or +50 degree F. This close temperature control reduces to a minimal, the necessity of changing spark plugs and the worry of piston seizing.

However, in order to get the best possible use and ensure that it retains its high degree of dependability, performance and endurance, it must receive proper care and maintenance. Therefore, it is necessary to know something about the basic fundamentals of this engine and how it functions.

OPERATION

The Scorpion Brut engine uses a mixture of gasoline, oil and air for combustion, lubrication and cooling. It fires on every stroke of each piston. There are two or three power strokes (depending on the model), for every revolution of the crankshaft.

As the piston moves upward in the cylinder, it draws the fuel/air mixture into the crankcase through the intake manifold while at the same time compressing fuel that has been forced into the combustion chamber (Fig. 1-1A).

As the piston nears top dead center, the spark plug is fired and the compressed fuel/air mixture burns and expands, thereby forcing the piston downward on a power stroke.

As the downward stroke of the piston turns the crankshaft, it also starts to compress the fuel/air mixture in the crankcase and, simultaneously, opens the exhaust port and closes the intake port (Fig. 1-1B & C).

After the exhaust port is fully open and the intake port is fully closed, further piston travel starts to open the transfer ports. The compressed fuel/air mixture from the crankcase then travels up the transfer ports and into the combustion area.

After most of the burned exhaust gases have left the cylinder, an incoming charge of fuel/air mixture scavenges the combustion area giving it a fresh charge and the cycle is then repeated. (Fig. 1-1D).

Because lubrication is dependent on the mixing of oil and fuel, it is extremely important that good quality oil and gasoline are properly mixed. The proper ratio of oil to gasoline will prevent possible engine overheating, piston or cylinder scoring, or eventual engine seizure. Too much oil and not enough gasoline can lead to incomplete combustion, fouled plugs, carbon build-up and muffler clogging.

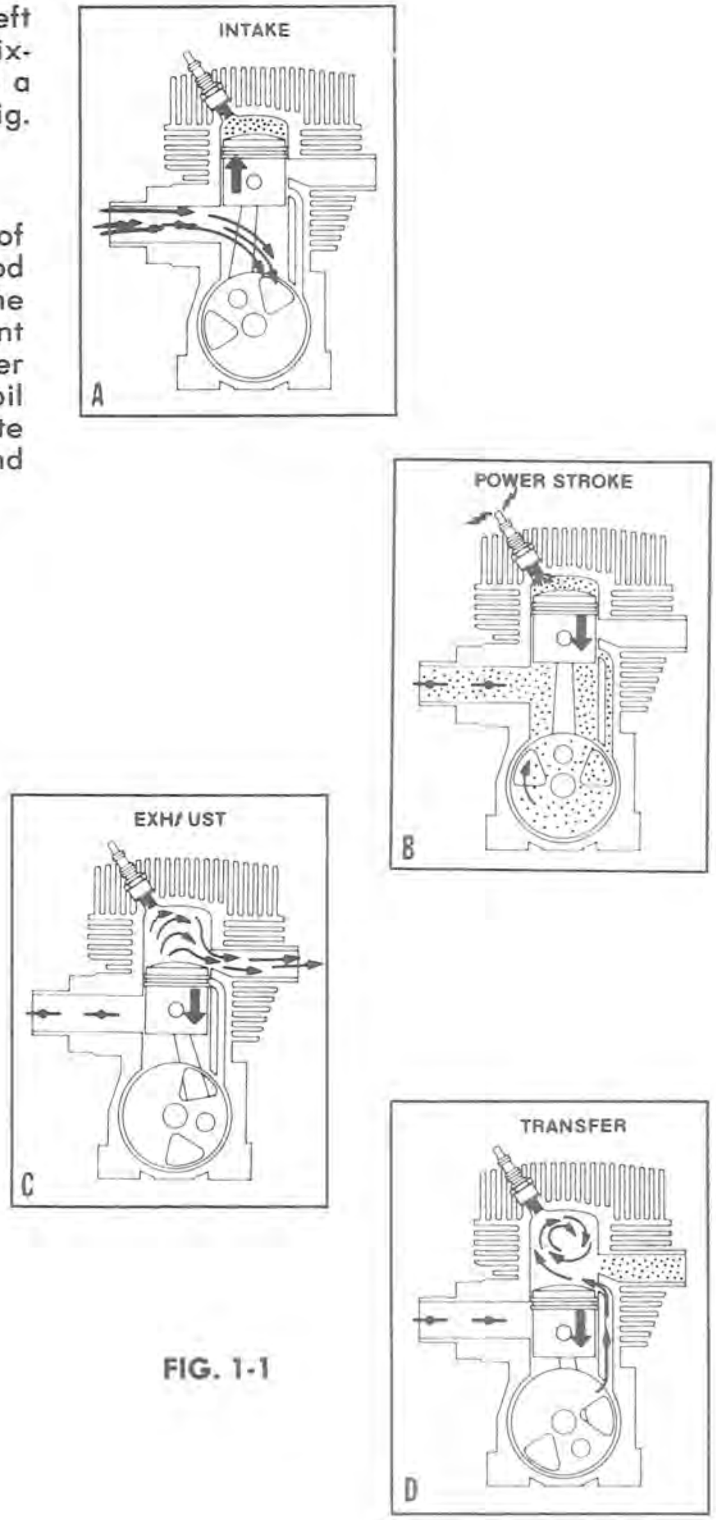
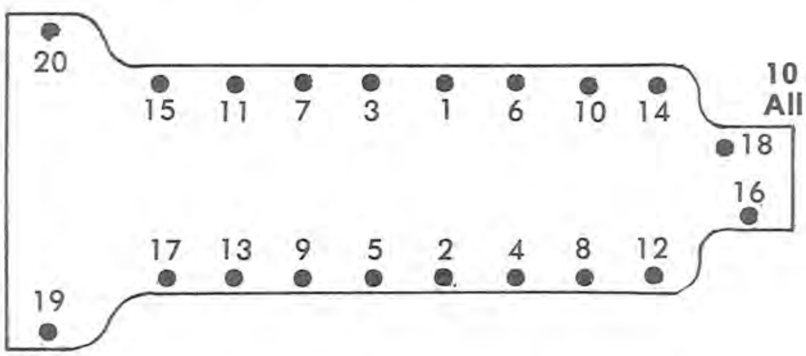


FIG. 1-1

TABLE OF SPECIFICATIONS

IDENTIFICATION	SIZE	TORQUE
Cylinder Head Nuts	8 mm	20 Ft. lbs.
Cylinder Base Nuts	10 mm	25 Ft. lbs.
Flywheel Nut		45-50 Ft. lbs.
Intake Manifold Nuts	8 mm	20 Ft. lbs.
Exhaust Manifold Nuts	8 mm	20 Ft. lbs.
Water Manifold Nuts	6 mm	15 Ft. lbs.
Crankcase Bolts	8 mm	20 Ft. lbs.
	10 mm	25 Ft. lbs.

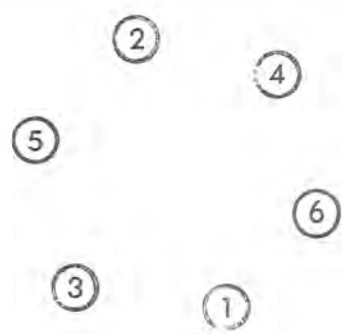
CRANKCASE BOLTS TORQUE SEQUENCE



10 mm Bolts Circled
All others are

440 Brut is shown. Use the same torquing pattern for the 340 Brut which has 12 instead of 18 - 8 mm bolts.

CYLINDER HEAD NUT TORQUING SEQUENCE:
340, 440 Models



ENGINE REMOVAL

1. Separate the carburetors from the engine by removing the clamps which secure the rubber connectors to the carburetor outlet.

2. Remove the 3/8" nuts which fasten the tie rod ends to the steering frog.

Remove the cotter key from the lower end of the steering frog.

Remove the 2¼" bolts which secure the upper steering bracket to the roll bar.

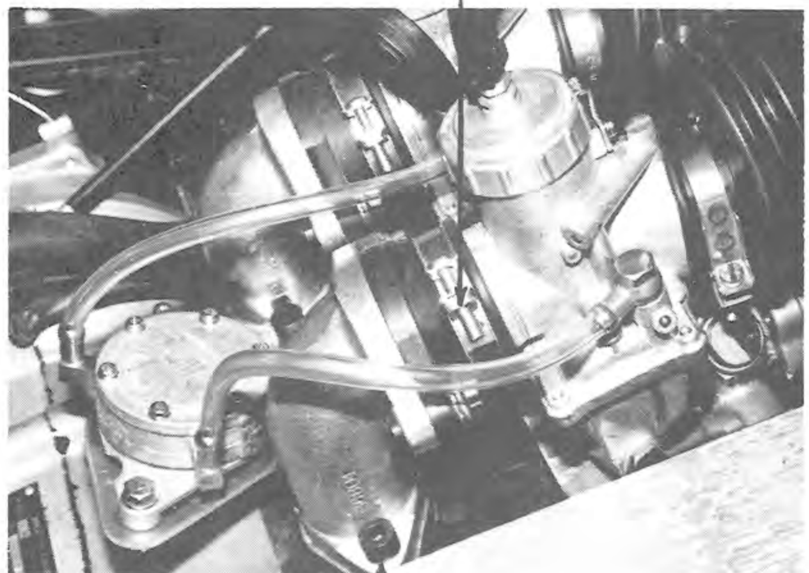


FIG. 1-2

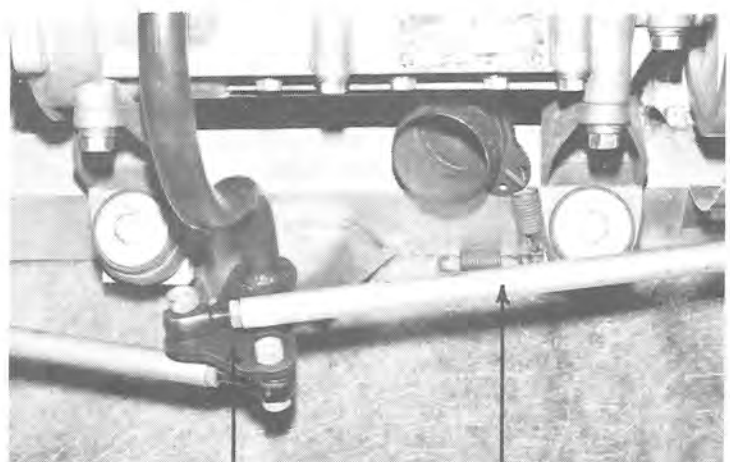


FIG. 1-3

Lift the steering post clear of the engine area.

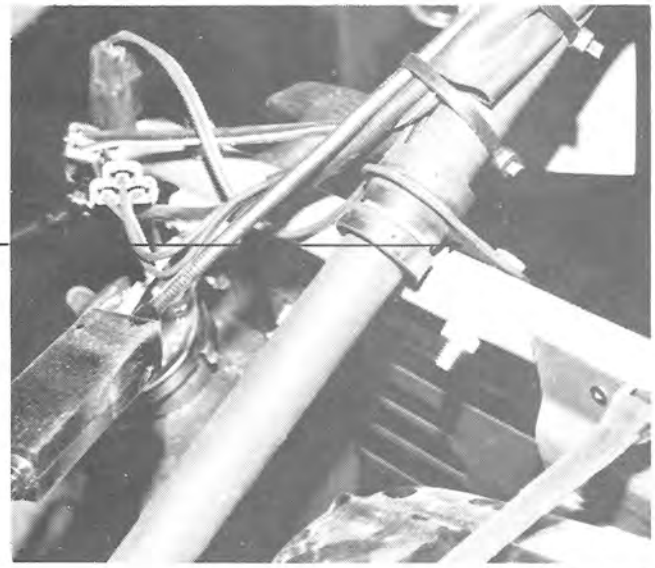


FIG. 1-4

3. Disconnect the engine electrical connectors, spark plug leads and the temperature light wire from th heat sensing element.

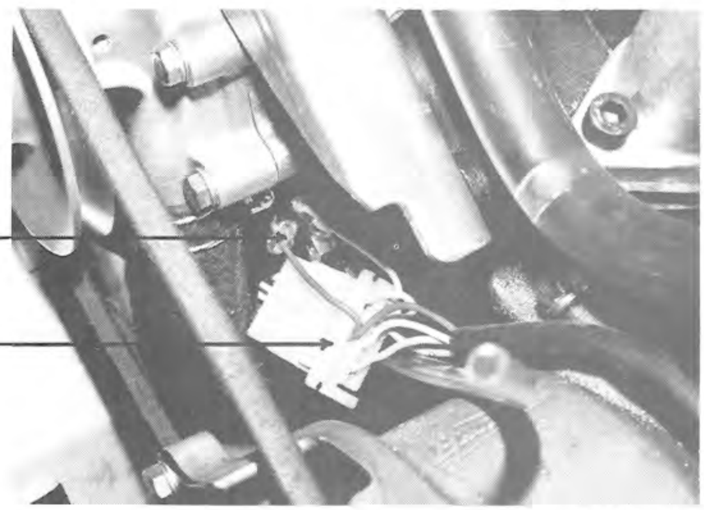


FIG. 1-5

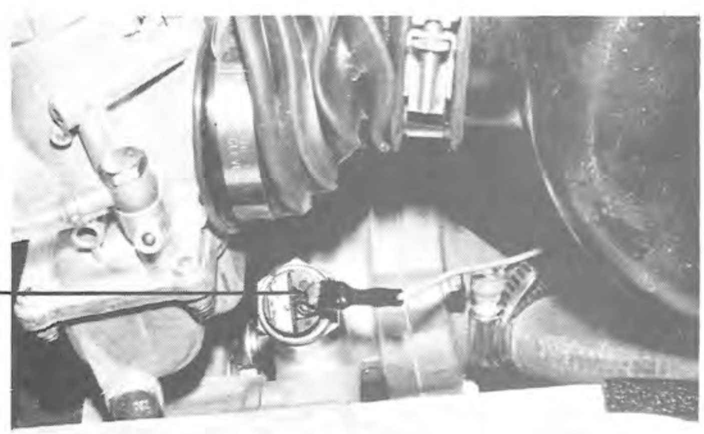


FIG. 1-6

4. Disconnect the coolant hoses from the manifolds and plug both manifolds and hoses to reduce coolant spillage.

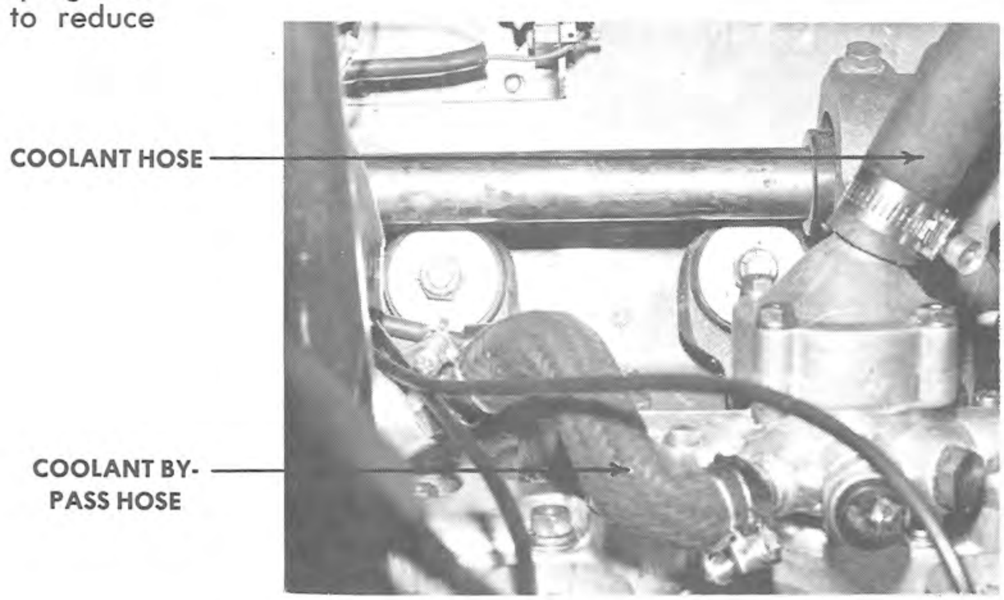


FIG. 1-7

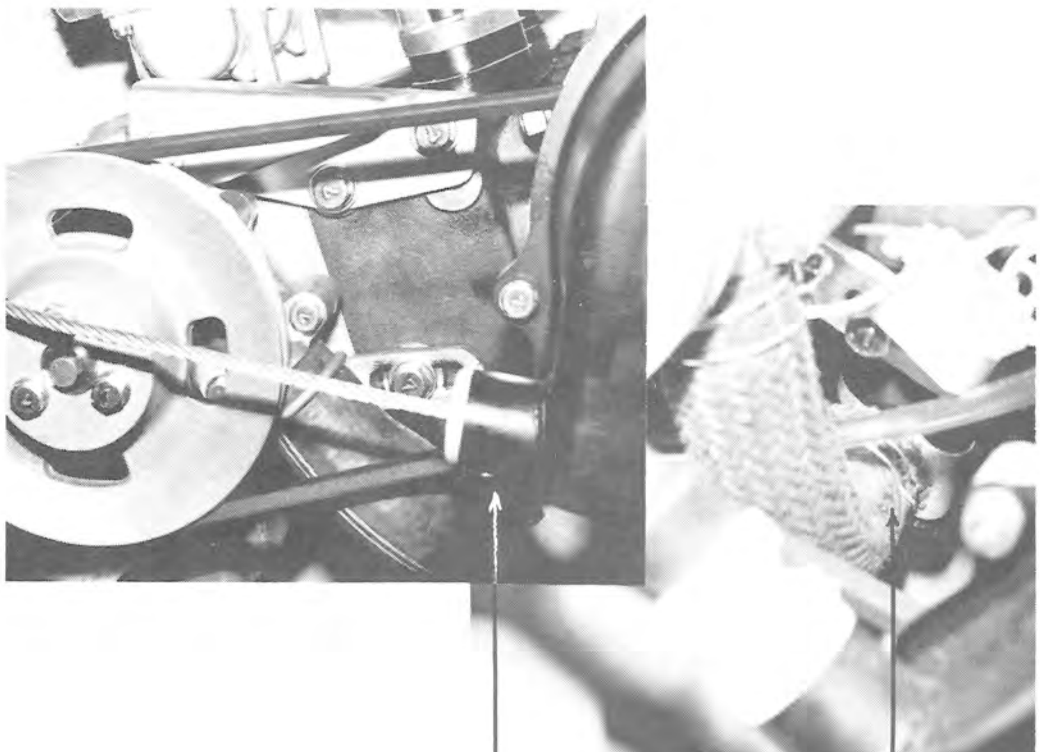


FIG. 1-8

5. Remove 2-7/16" lock nuts which secure the front motor mounts to the chassis.

   Remove the 6 - 8 mm screws which secure the rear motor mounts to the engine.

6. Release the springs which fasten the exhaust wye to the muffler.

7. Lift the engine from the sled and drain the coolant.

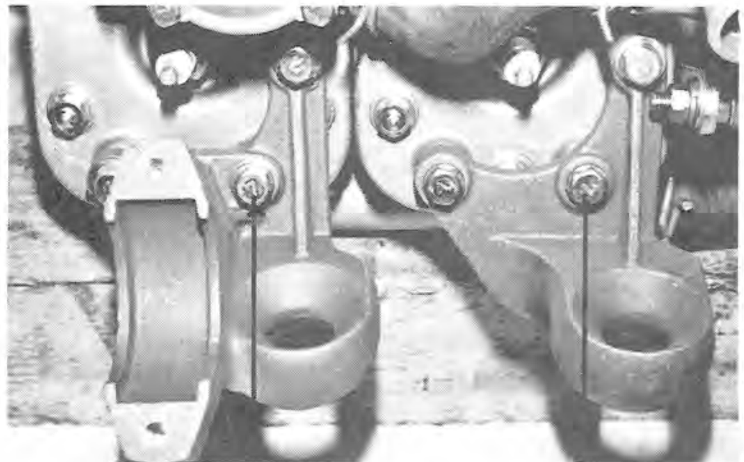


FIG. 1-9

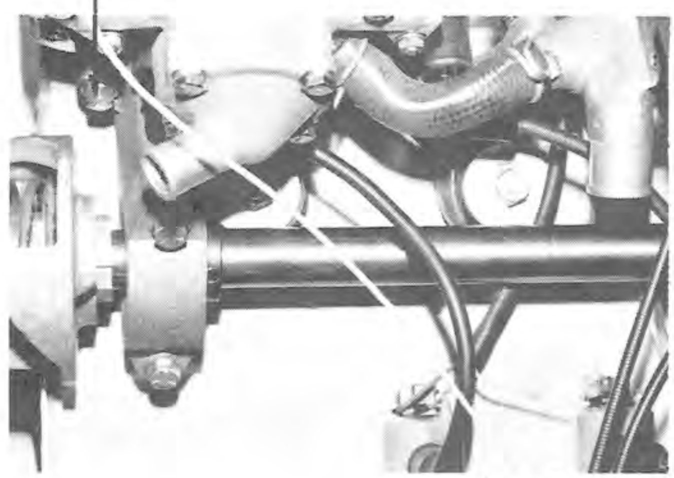


FIG. 1-10

ENGINE DISASSEMBLY/ ASSEMBLY

Disassembly (Peripheral Equipment)

1. Remove the carburetor to engine Elbow connectors. (2 socket head screws/elbow) See Fig. 1-2.

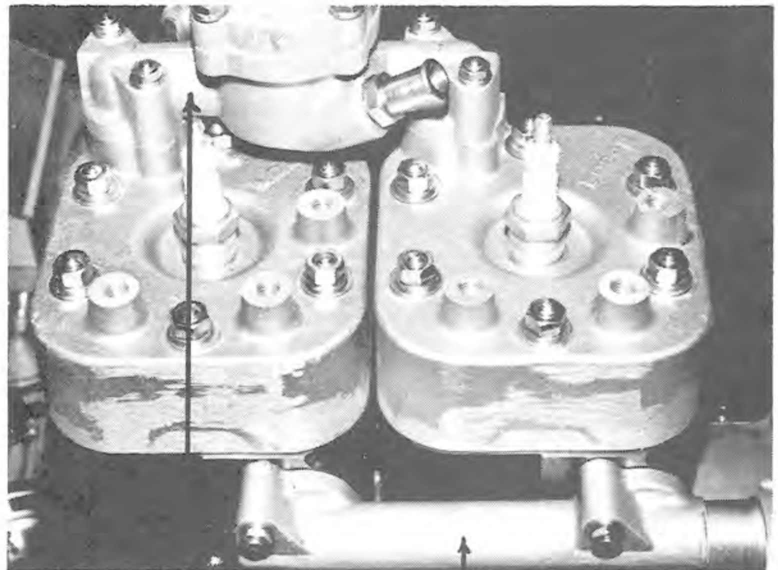
2. Disconnect the exhaust wye (Socket head screws).

3. Disconnect the coolant by-pass hose. (2 clamps). See Fig. 1-7.

4. Remove the coolant inlet and outlet manifolds. (6 mm nuts).

5. Disconnect the water pump mounting brackets. (3 - 8 mm bolts).

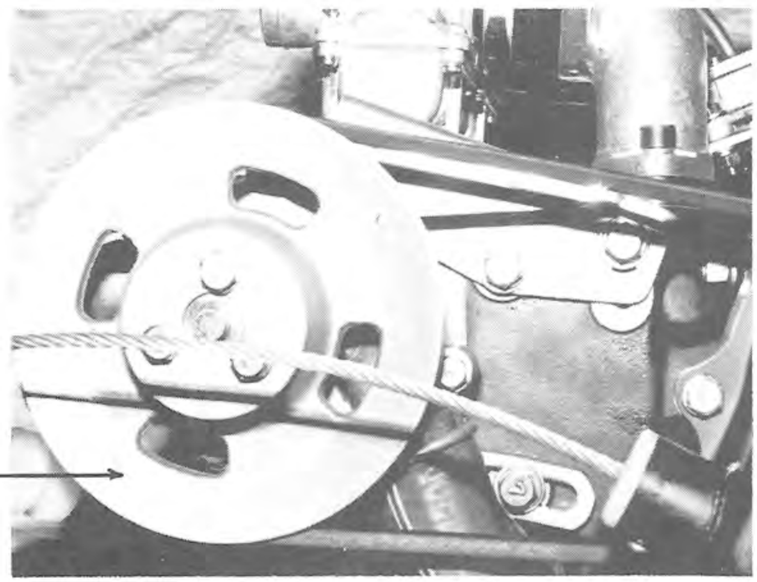
6. Remove the front motor mounts from the engine.



COOLANT OUTLET MANIFOLD

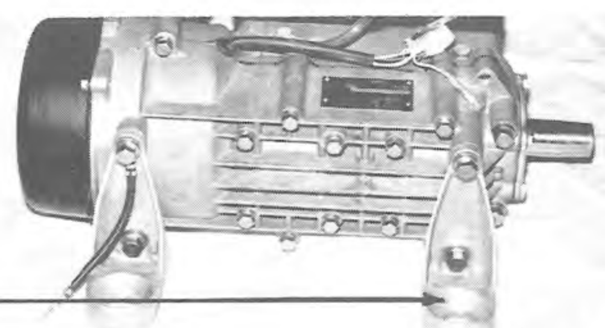
COOLANT INLET MANIFOLD

FIG. 1-11



WATER PUMP/PULLEY

FIG. 1-12



FRONT MOTOR MOUNT

FIG. 1-13

Engine Disassembly

1. Remove heads.

   Remove 8 mm nuts (6 per head).

   Pry up carefully to separate heads from cylinder.

FIG. 1-14

HEAD NUTS

2. Remove cylinders.

   Remove 10 mm cylinder nuts.

   Slide cylinders off pistons.

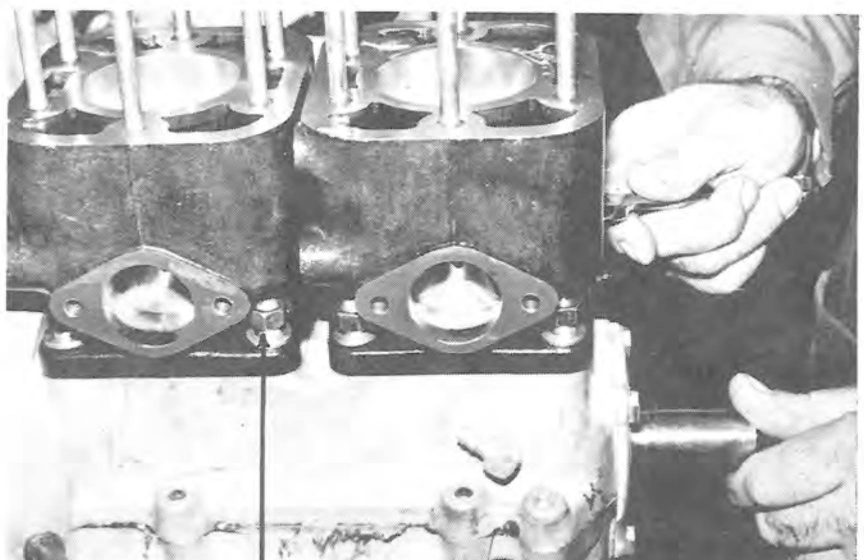


FIG. 1-15

CYLINDER NUTS

3. Remove pistons.

   Extricate snap ring with snap ring pliers.

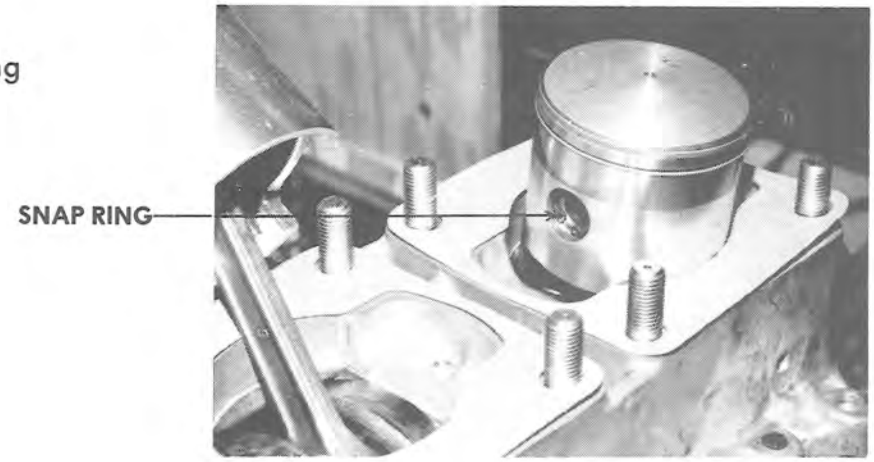


FIG. 1-16

Slide piston pin out of piston. Exercise care that excessive side pressure is NOT applied to the connecting rod.

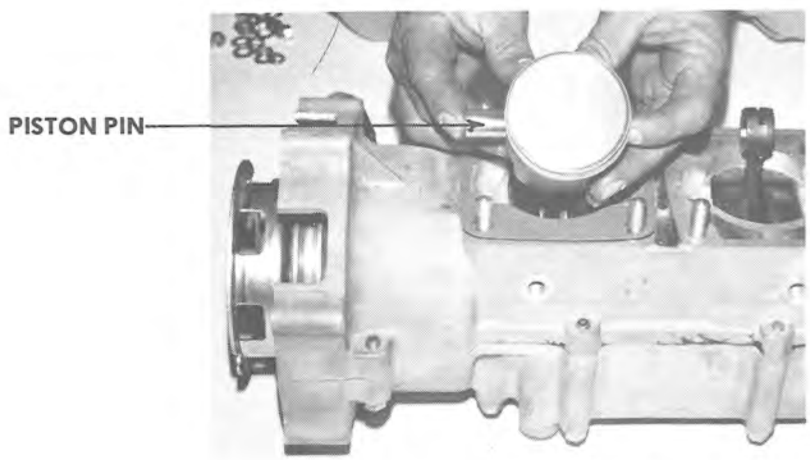


FIG. 1-17

Pull piston from connecting rod.

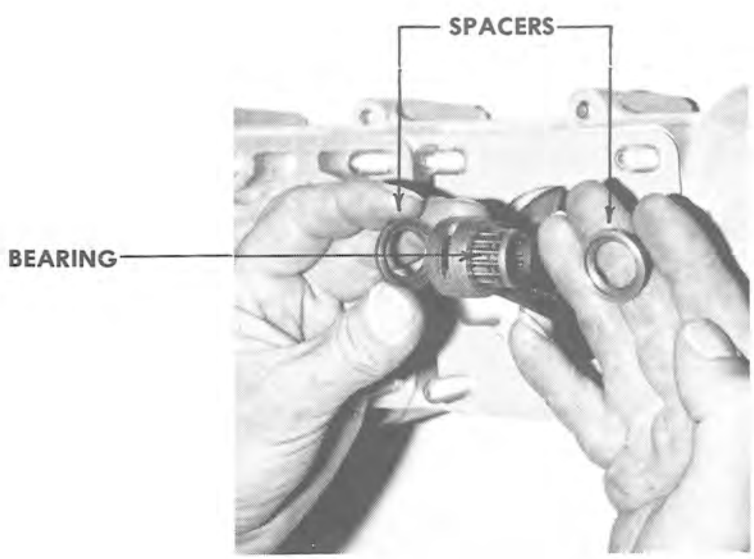


FIG. 1-18

Remove pin bearing and bearing spacers.

PTO END

1. Remove hex head bolts with locking strips.

2. Remove seal.

3. Remove gasket.

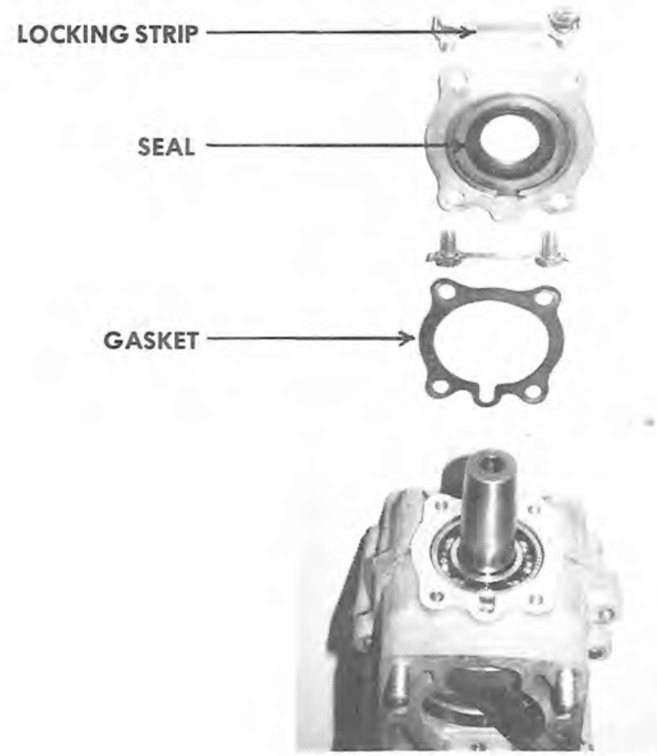


FIG. 1-19

MAGNETO END

1. Remove Recoil Starter. Take hex head screws out. Pull recoil off crankcase.

2. Complete Disassembly.

FIG. 1-20

340 MODEL

a. Remove pump pulley bolts, emergency rope pulley and water pump pulley.

440 MODEL

a. Remove 6 mm pump pulley bolts, emergency rope pulley and water pump pulley.

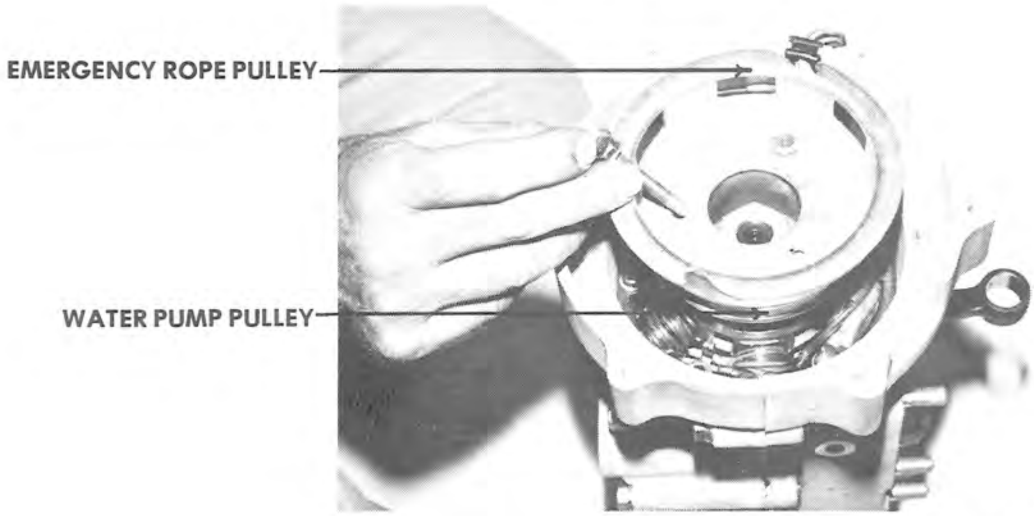


FIG. 1-21

340 MODEL

b. Remove 18 mm nut holding rotor on shaft.

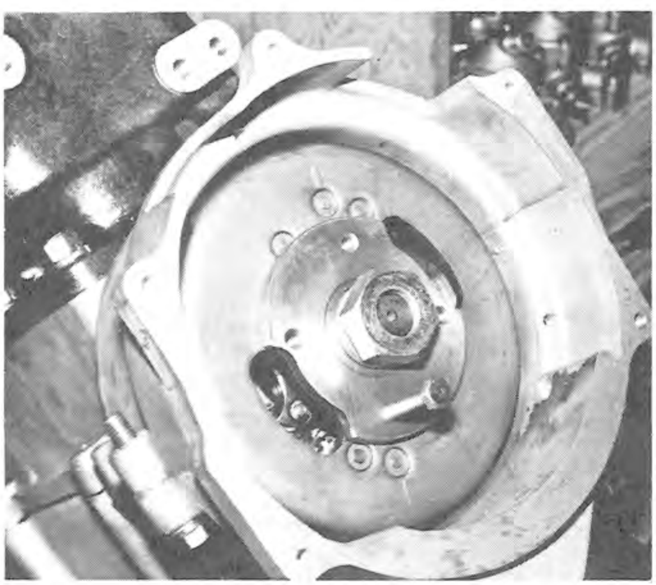


FIG. 1-22

440 MODEL

b. Remove 18 mm nut holding rotor on shaft.

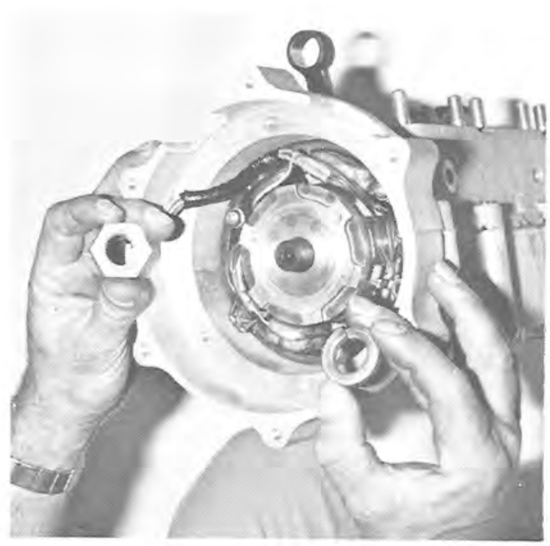


FIG. 1-23

340 MODEL

c. Pull rotor from shaft using puller.

d. Take out pulleys head screws holding magneto to crankcase. Remove magneto.

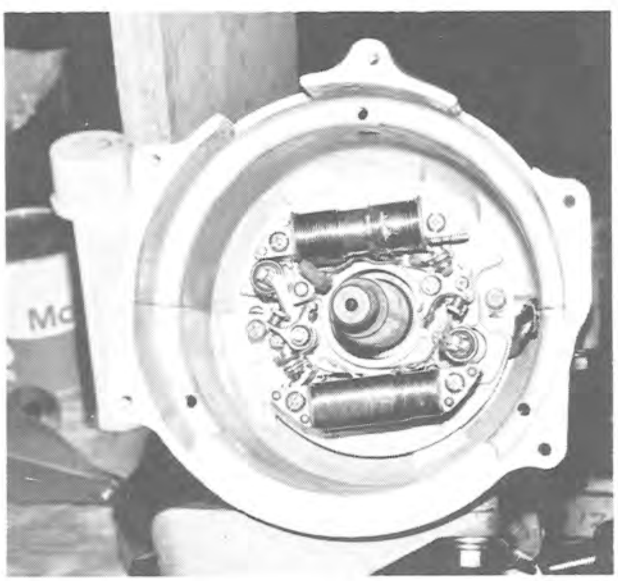


FIG. 1-25

440 MODEL

c. Pull rotor from shaft using puller.

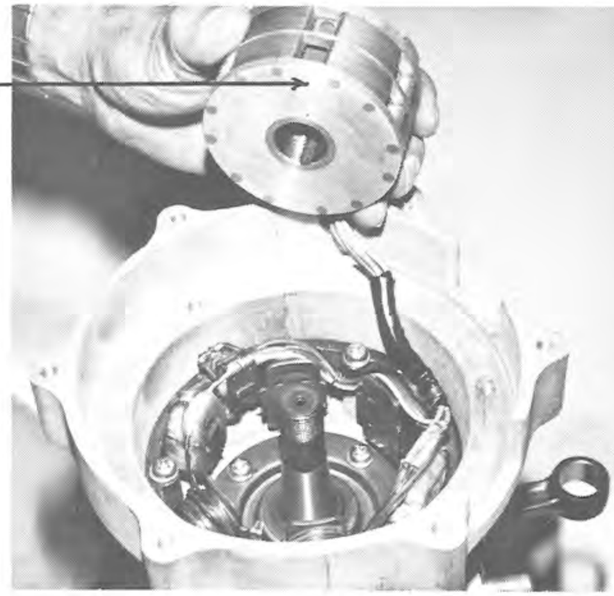


FIG. 1-24

d. Take out Phillips head screws holding magneto to crankcase. Remove magneto.

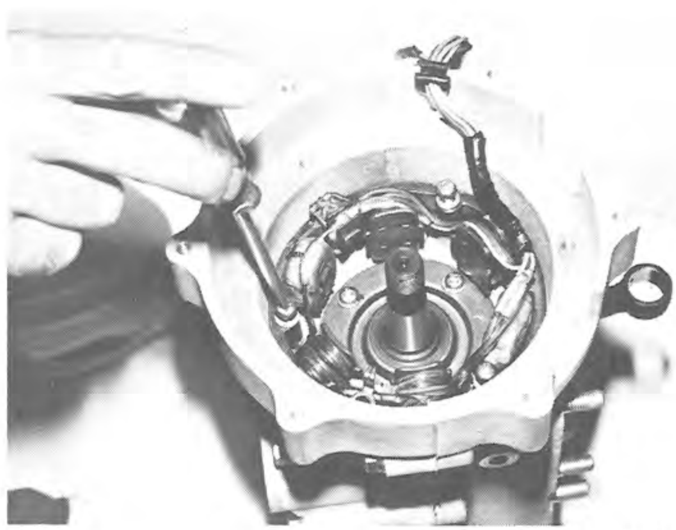


FIG. 1-26

340 MODEL

e. Remove Phillips head screws holding seal to crankcase - Remove seal.

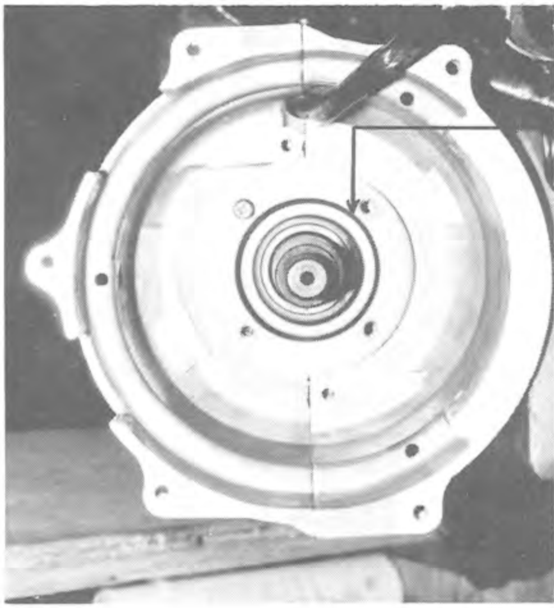


FIG. 1-27

440 MODEL

e. Remove Phillips head screws holding seal to crankcase. Remove seal.

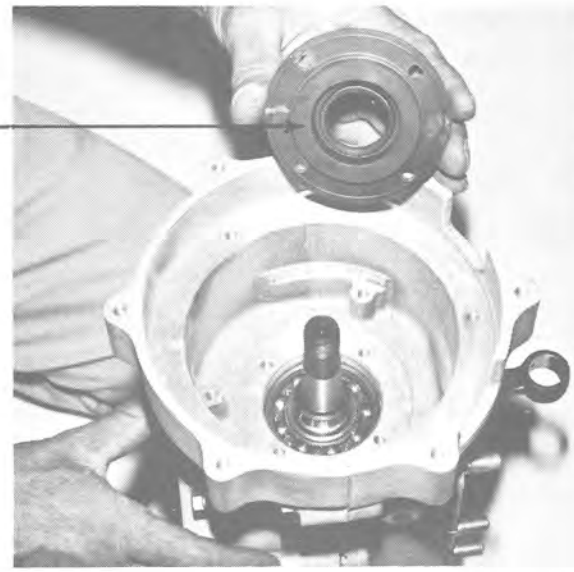


FIG. 1-28

DISASSEMBLY OF CRANKCASE

1. Remove 8 mm bolts (18-440, 12-340) and 2-10 mm bolts.
2. To loosen crankcase, hold bottom half firmly and tap top half with plastic mallet.
3. Lift top half of crankcase off.
4. Lift crankshaft out of lower half of crankcase.

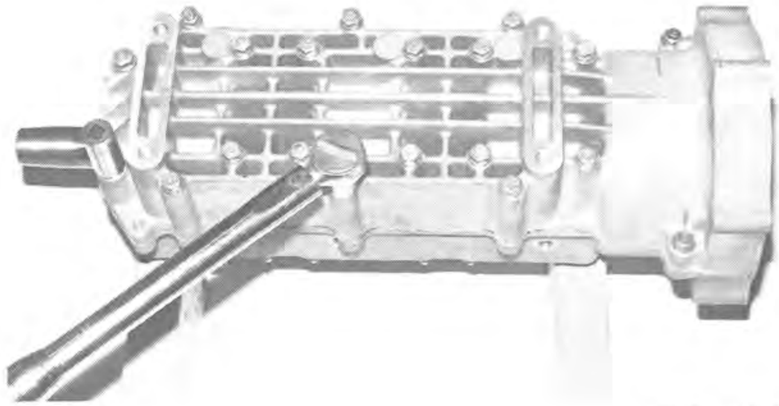


FIG. 1-29

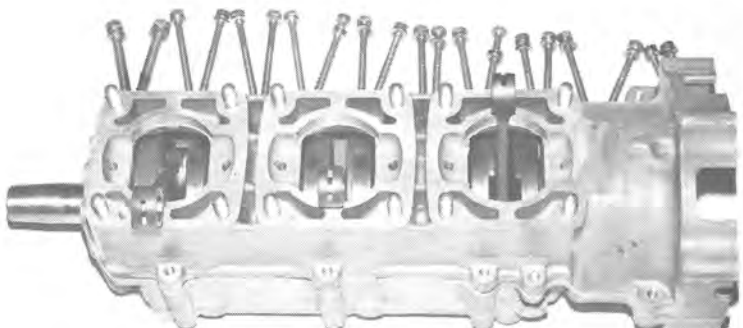


FIG. 1-30

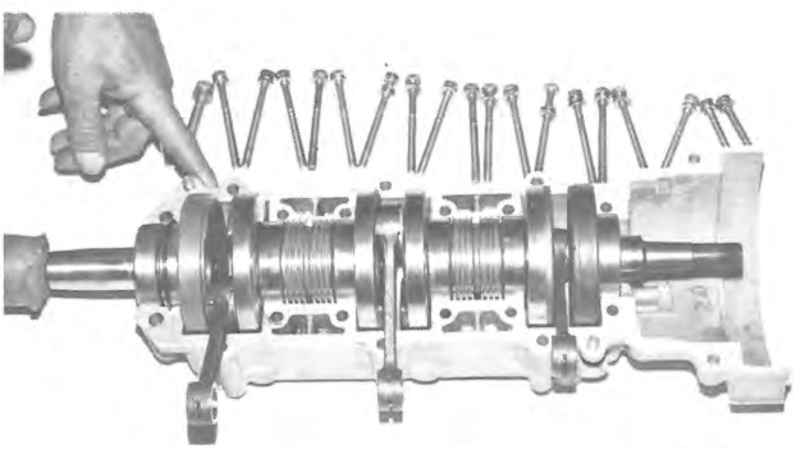


FIG. 1-31

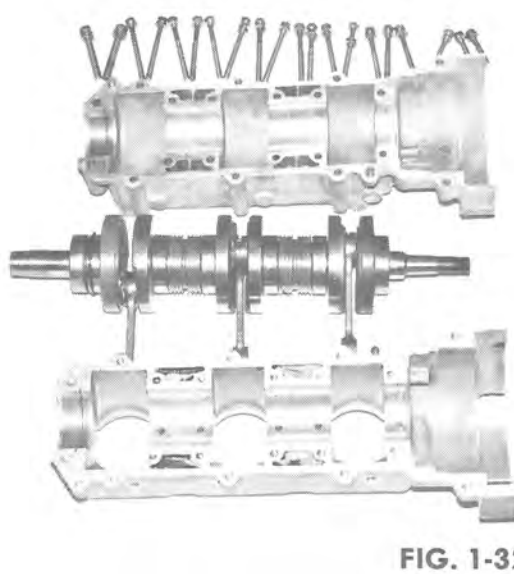


FIG. 1-32

ENGINE ASSEMBLY

Assemble Crankcase/Crankshaft.

1. Lay lower half of crankcase on work bench. Grease.

2. Place crankshaft in crankcase with positioning ring in groove.

   • Install rotor key in crankshaft **carefully.** (440 Model only).

   • Grease labyrinth seal and oil bearings.

3. Apply gasket sealer on lower half of crankcase.

   • Place upper half of crankcase on lower half.

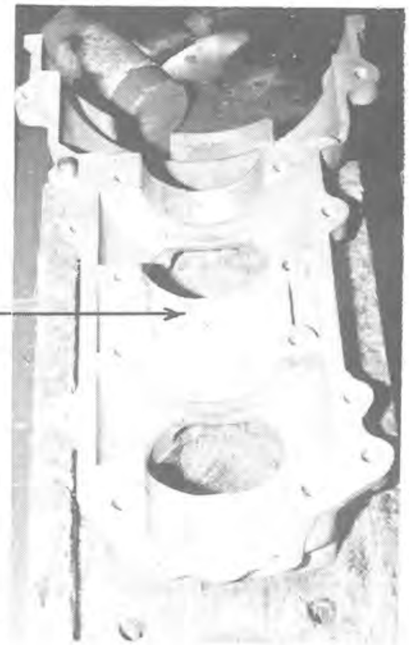


FIG. 1-33

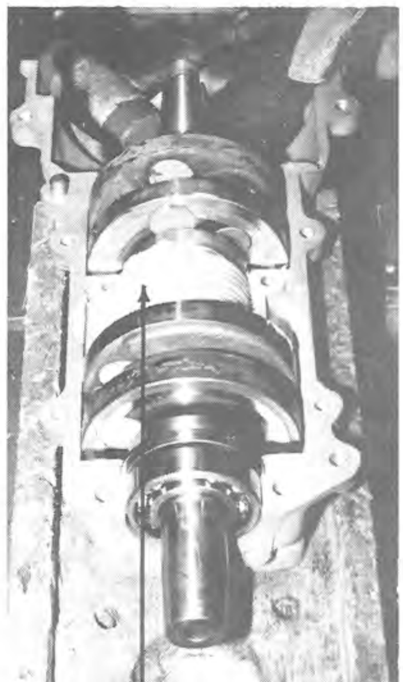


FIG. 1-34

FIG. 1-35

4. Install crankcase bolts and torque (See Specifications: P.1-4).

5. Install cylinder base gaskets.

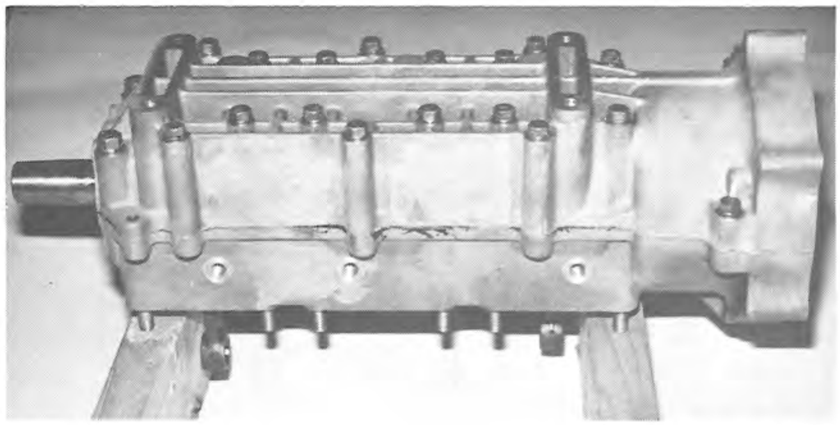


FIG. 1-36

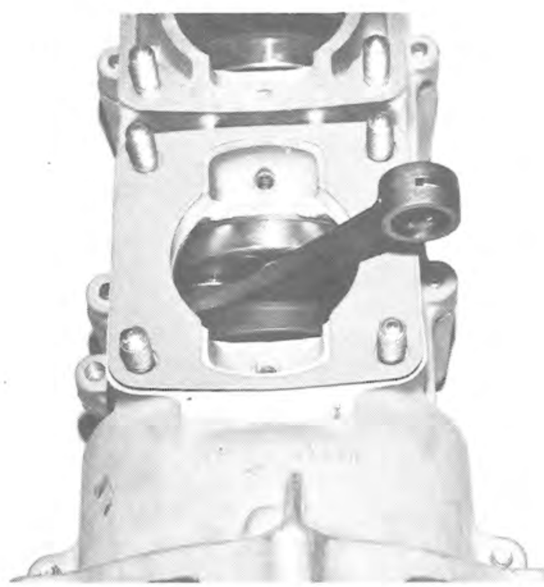


FIG. 1-37

SEAL PLATE INSTALLATION

1. Measure distance from seal mounting plate surface on case to outer race of end bearing on shaft. (Use depth micrometer).

2. Select and install correct end gasket depending upon depth measurement as follows:

Depth Measurement	Gasket Thickness
.091 and over	.2 mm (.003")
.081 to .091	.3 mm (.012")
.080 and less	.5 mm (.020")

3. Bolt seal plate in position.

4. Bend lock tabs to secure plate bolts.

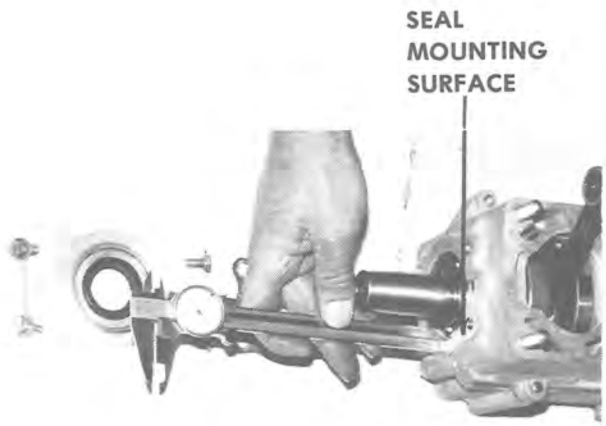


FIG. 1-38

FIG. 1-39

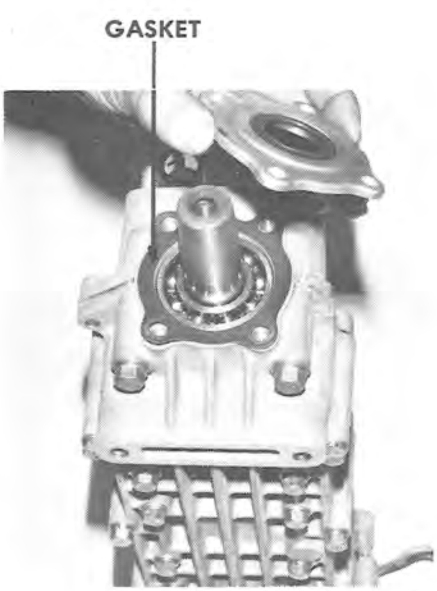


FIG. 1-40

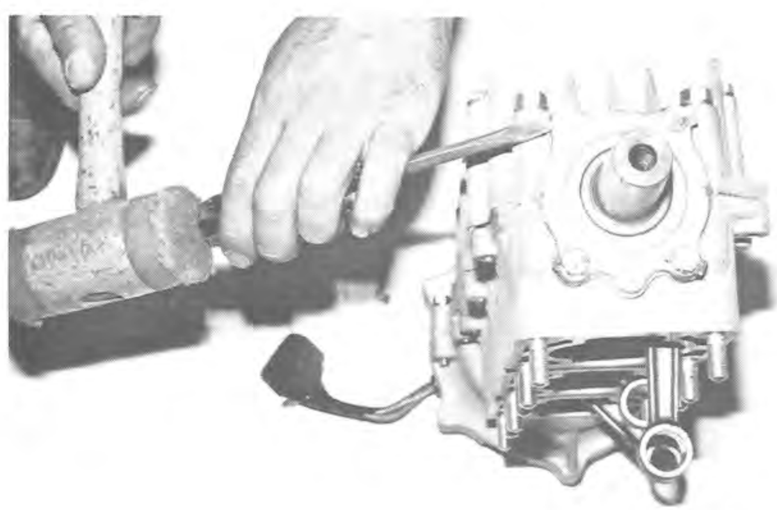


FIG. 1-41

PISTON INSTALLATION

1. Place piston pin bearings in connecting rods.

   • Position spacers at ends of bearings.

   • Lubricate bearings.

   See Fig. 1-18.

2. Install one (1) snap ring in each piston before placing pistons on rods.

3. Slip pistons over connecting rods holding bearings and spacers in position.

4. Insert piston pin through piston, bearing and spacers.

   • Install remaining snap ring.

   See Fig. 1-16, and 1-17.

PISTON RING INSTALLATION

Expand ring until it just slips over piston.

Do not expand any further than necessary.

Position rings so that ring notch slides over ring locating pin.

See Fig. 1-42.

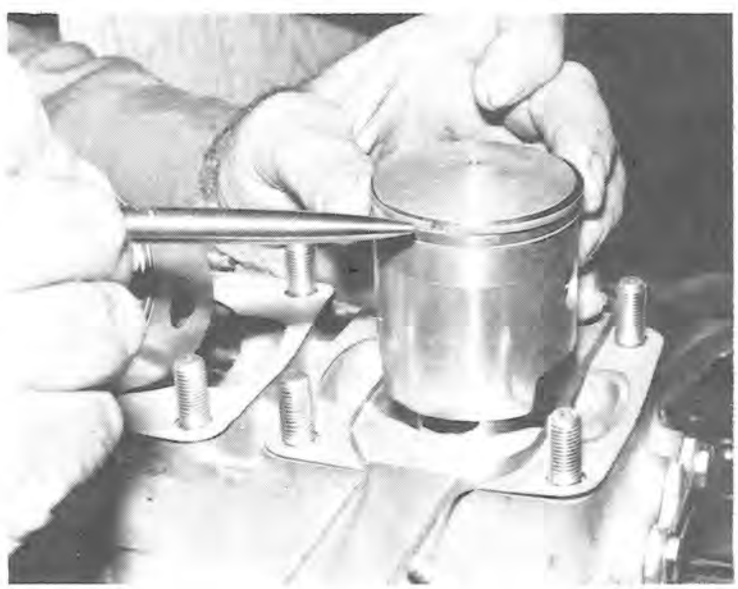


FIG. 1-42

CYLINDER INSTALLATION

1. Position cylinder so that the intake port (carburetor side) is toward side of crankcase with impulse fittings.

2. Place wooden block or other support crankcase to support piston.

3. With ring compressor over rings, slide cylinder onto piston.

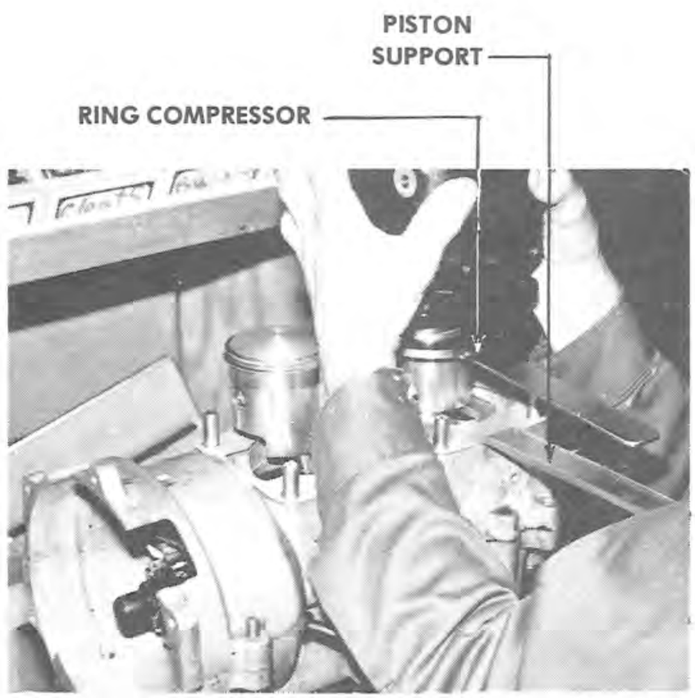


FIG. 1-43

4. With cylinders in place, place inlet coolant manifold on cylinders,

   - Torque 6 mm nuts on manifold to 5 Ft. lbs.

   - THEN

   - Tighten torque 10 mm nuts on cylinder studs securely to 25 Ft. lbs.

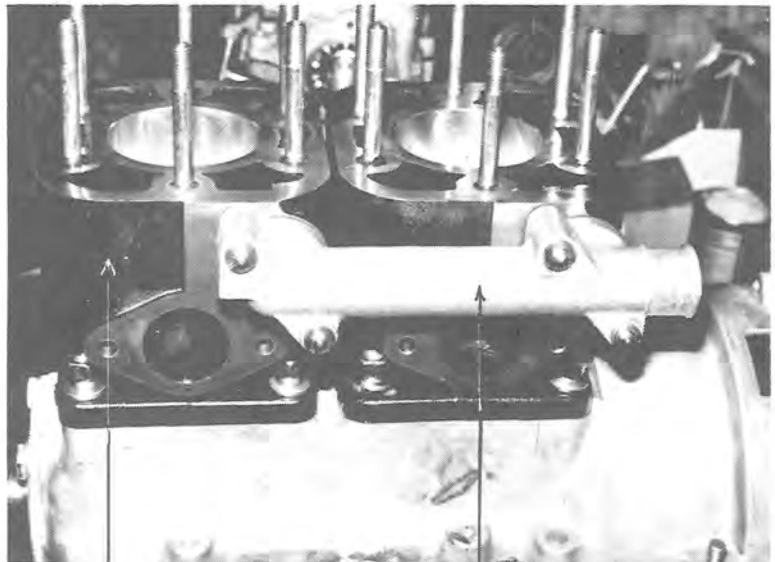


FIG. 1-44

5. Place heads on cylinders.

   - Locate outlet coolant manifold on heads.

   - Torque 6 mm manifold nuts to 5 Ft. lbs.

   - Torque 8 mm head nuts on studs; torque to 20 Ft. lbs. (See Specifications for torquing sequence).

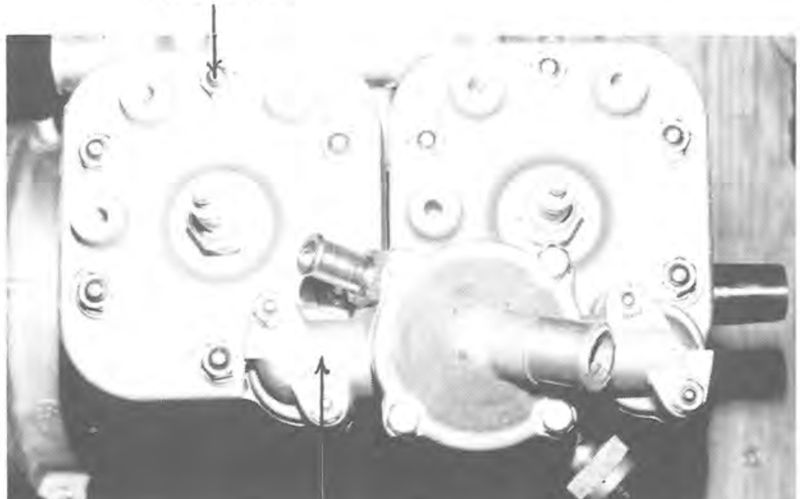


FIG. 1-45

TIMING PROCEDURE (340 ONLY)

1. Set point gap at maximum opening on both sets of points at .015".

   Fig. 1-46, 1-47 illustrations show special cam (without magnetic flywheel) installed so that gap check can be seen. Under normal conditions, the gap will be checked through the windows in the flywheel (rotor). See Fig. 1-49).

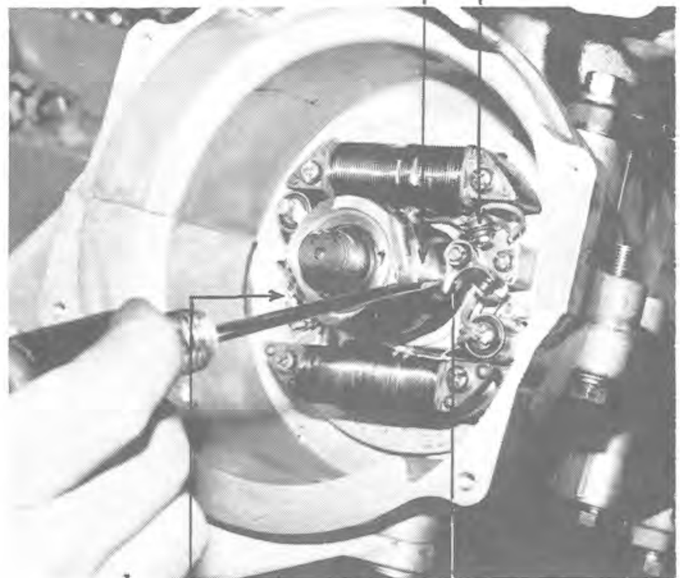


FIG. 1-46

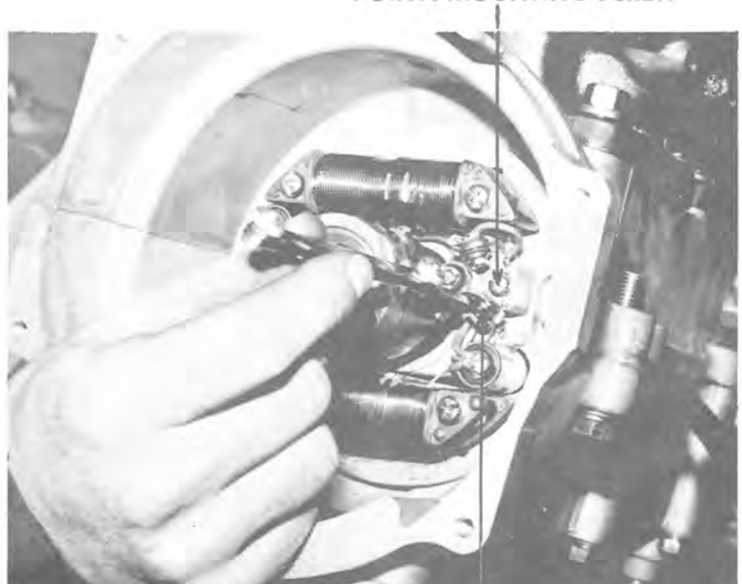


FIG. 1-47

2. Install special bolt in flywheel to hold the weight arms in the "full advance" position.

WEIGHT ARMS

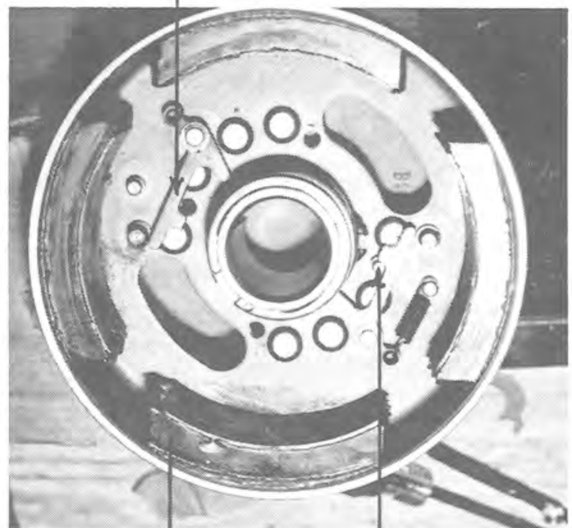


FIG. 1-48

FLYWHEEL

SPECIAL BOLT FOR POSITIONING WEIGHT ARM

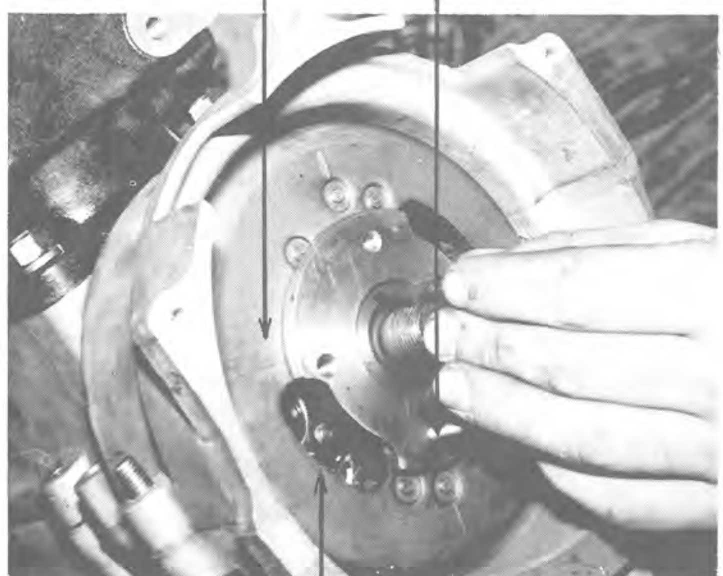


FIG. 1-49

FLYWHEEL WINDOW

3. Insert the dial indicator in the PTO cylinder.

   Fig. 1-50 shows the dial indicator in position with the heads removed for clarity. Under normal circumstances the dial indicator will be inserted through the spark plug hole.

   Connect an ohmmeter with one terminal to the red lead from the magneto, the other terminal grounded to the crankcase.

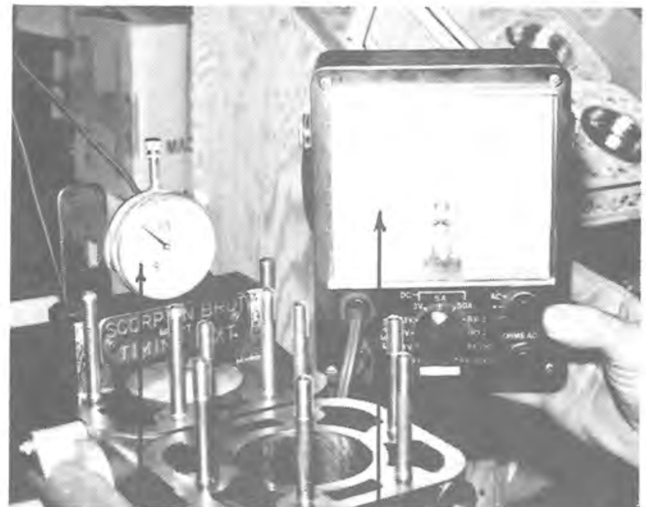


FIG. 1-50

DIAL INDICATOR

OHM METER

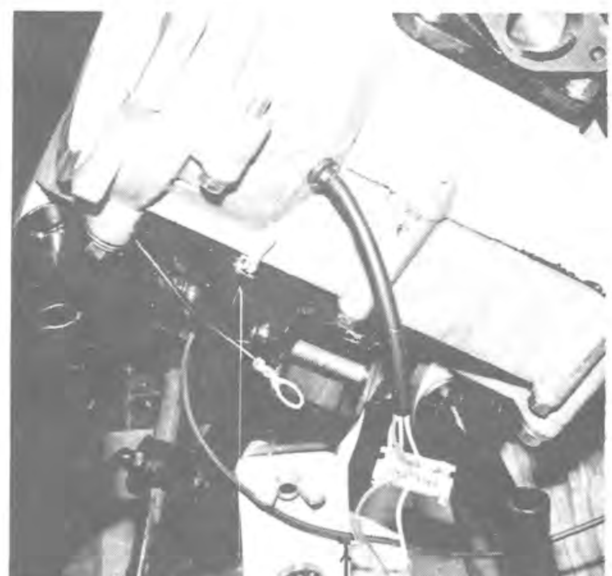


FIG. 1-51

OHMMETER GROUND

OHMMETER
("HOT" LEAD CONNECTED HERE)

4. Locate top dead center of the piston travel.

   Set the dial indicator on zero.

   See Fig. 1-50.

5. Rotate the crankshaft counter-clockwise until the indicator reads .250".

   Set the ohmmeter scale selector at RX1.

   Adjust the needle reading to 4 on the resistance scale.

   See Fig. 1-50.

6. Rotate the crankshaft clockwise until the ohmmeter indicates a sudden decrease in resistance. This means that the points have closed.

   The dial indicator should read .150" to .160". See Note.

   If the dial indicator reads outside this tolerance, adjust to within tolerance by loosening the mounting screws and rotating the magneto (armature plate) in the applicable direction.

   NOTE: Timing is set at .150-.160 full advance (340 Brut) when new points are used to allow for break-in of point rubbing blocks. After approximately 3 hours of operation, the timing should be at .138 full advance (normal).

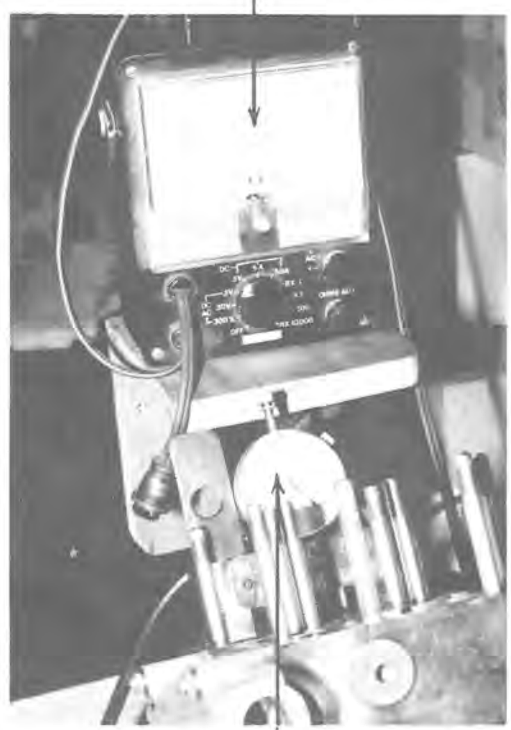


FIG. 1-52

7. Shift the dial indicator to the #2 cylinder (magneto end). Connect the ohmmeter terminal to the white lead from the magneto.

8. Adjust the point closing position to **within .005"** of the position established for the #1 cylinder. This is done by loosening the points mounting screw and adjusting the point gap in the necessary direction. (See Fig. 1-47).

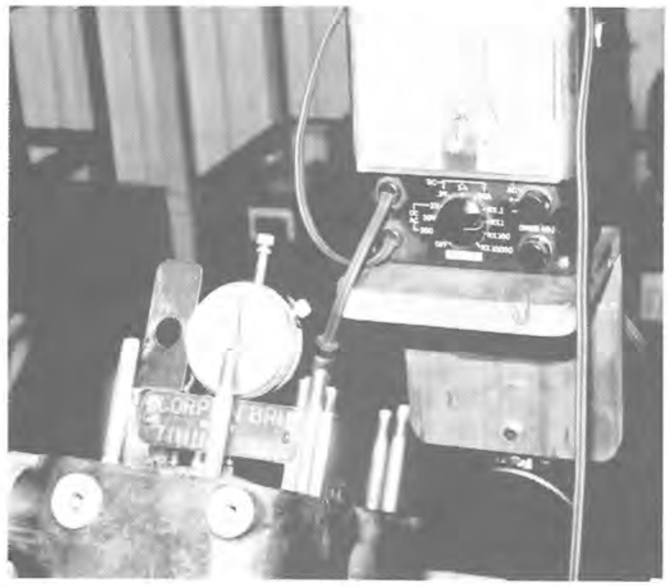


FIG. 1-53

1975 SCORPION BRUT

Service Manual

Carburetor Section

FUNCTIONAL DESCRIPTION:

GENERAL

The purposes of the carburetor are:

(1) to break fuel into tiny particles (vaporize)
(2) to mix the fuel with air in the proper ratio and
(3) to deliver the combustible mixture to the engine.

Pulsations from the crankcase through the impulse tube actuate the fuel pump diaphragm to transport fuel from the tank into the carburetor. As engine fuel demand increases, differential pressure forces fuel from the carburetor float bowl through applicable orifices, jets and passages into the main bore and from the bore into the engine. The floats actuate the carburetor needle valve to maintain an adequate fuel supply in the bowl for all engine demands.

In order for the carburetor to provide the correct air/fuel ratio under all engine loads, four separate fluid circuits are provided:

(1) Starter System
(2) Pilot System
(3) Main System
(4) Float System

The schematics included in the section are functionally correct but do not necessarily represent the actual physical appearance of the carburetor. A significant departure from the physical arrangement occurs in connection with the main jet.

The schematic indicates the main jet to be attached to the lower end of the needle jet. On the Mikuni carburetor used on the Brut, the main jet is located in the main jet holder (See FIG. 2-12), but it still performs the same function.

On this carburetor, the fitting on the lower end of the needle jet serves to hold the needle jet in position. It is bored out larger than the main jet so that it does not restrict the fluid flow.

STARTER (FUEL ENRICHING) SYSTEM (See FIG. 2-1, 2-2)

1. The fuel is metered through the starter jet.
2. The fuel is broken into particles and mixed with air as it travels through the emulsion tube.
3. The mixture flows into the area vacated by the Fuel Enriching Valve and there is mixed with air from the intake port.
4. The final mixture is delivered to the engine intake through the fuel discharge port.
5. The starter system is activated by the Fuel Enriching Valve Control on the instrument panel.

NOTE: It is important that the throttle valve is closed during the Starting Operation.

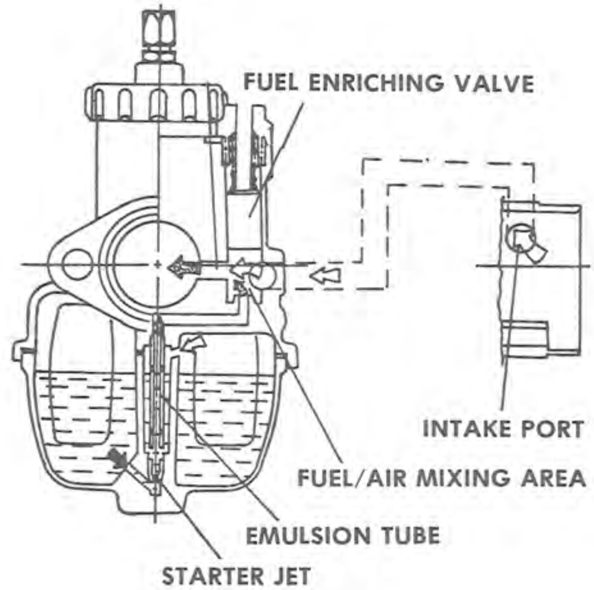


FIG. 2-1

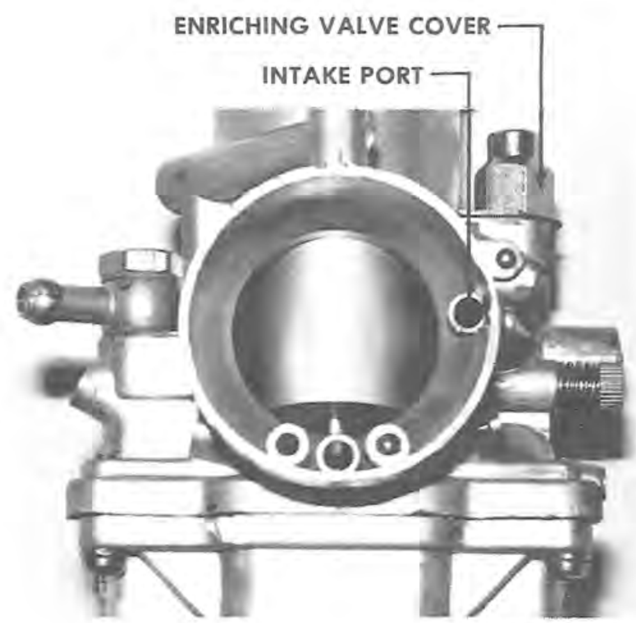


FIG. 2-2

PILOT SYSTEM (LOW SPEED OPERATION)

(See FIGS. 2-3, 2-4, 2-5)

1. Conditions:
   a. The throttle valve is nearly closed.

   b. Air velocity through the needle jet is slow, resulting in insufficient negative pressure to draw fuel from the needle jet in the main fuel system.

2. Fuel is metered through the pilot jet.

3. The fuel is mixed with air adjusted to the proper amount by the air screw.

4. The mixture is mixed with additional air coming in through the by-pass.

5. Finally the mixture is drawn through the pilot outlet to mix with air flowing through the main bore.

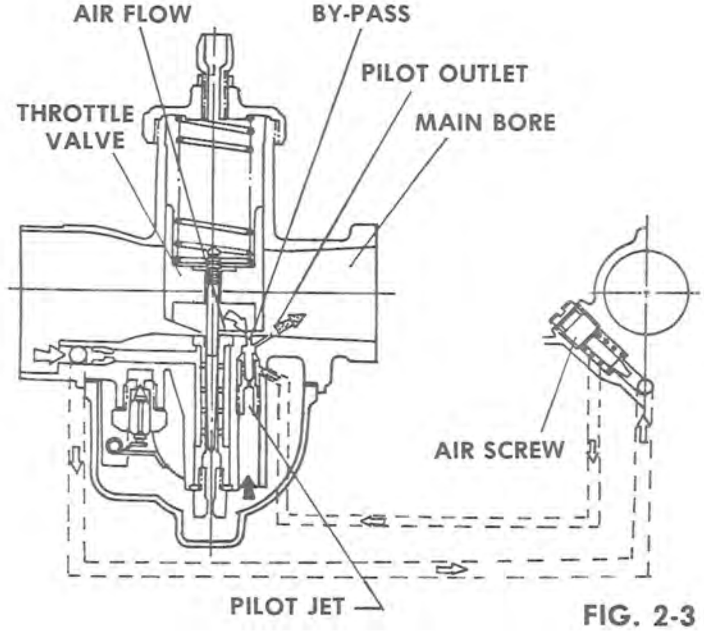


FIG. 2-3

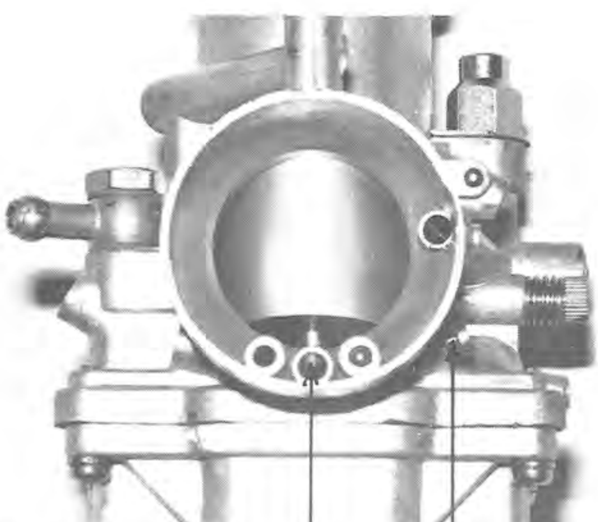


FIG. 2-4

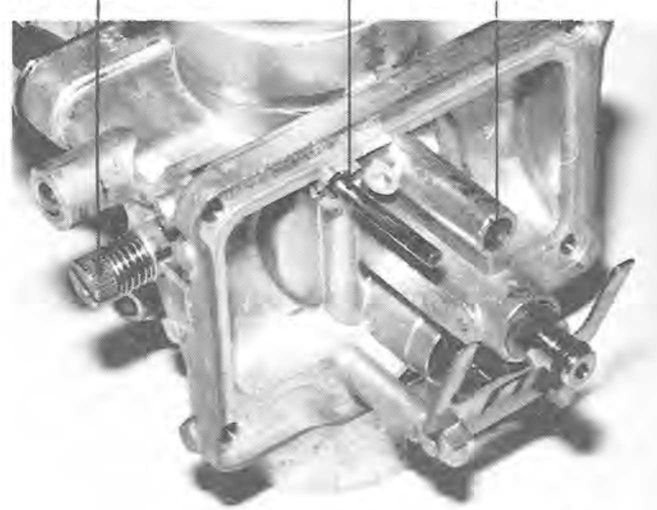


FIG. 2-5

PRIMARY (MAIN FUEL) SYSTEM

(See Fig. 2-6)

(Throttle ¼ Open To Full Open)

1. Velocity of air flowing through needle jet increases. Differential pressure increases to force fuel flow.

2. Throttle Valve ¼ to ¾ open.

   a. Fuel passes through main jet.

   b. Fuel is metered in the clearance between the needle jet and the jet needle.

   c. Fuel is mixed with air in the needle jet.

   d. The mixture is injected into the main bore, and mixed with the main air flow as it is transported to the engine.

3. Throttle valve ¾ to full open.

   a. Fuel is metered by the main jet.

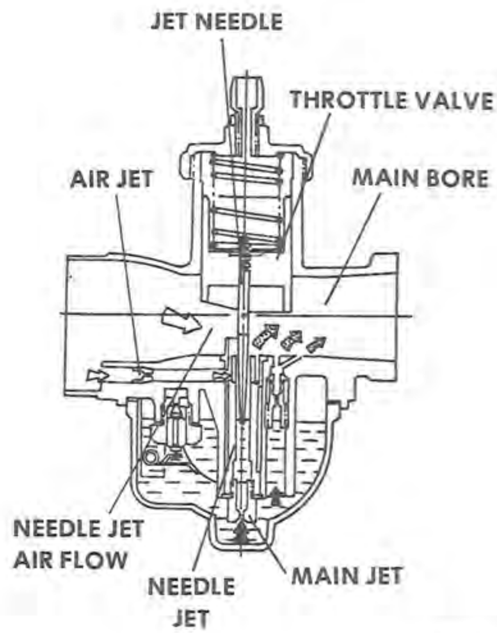


FIG. 2-6

FLOAT SYSTEM (FIG. 2-7)

1. This system operates to maintain a constant fuel level in the bowl.
2. The fuel flows from the fuel pump between the needle valve and valve seat into the float chamber.
3. When the buoyancy of the floats overcomes the fuel pressure, the needle valve closes, shutting off the fuel supply.
4. If the fuel level becomes too high, excessive fuel leaves the nozzle enriching the mixture.
5. Too low fuel level results in a lean mixture.

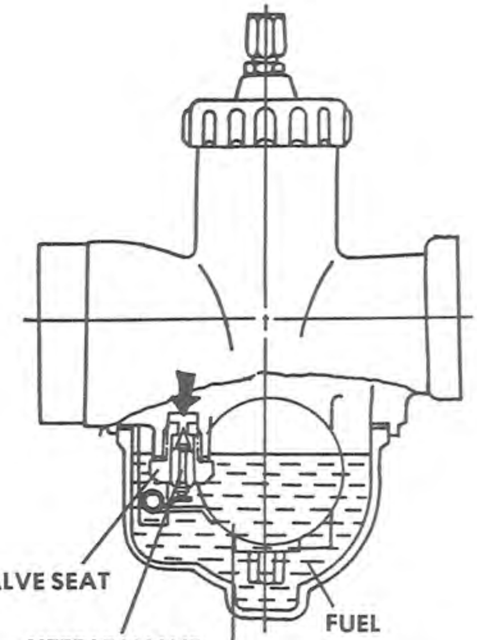


FIG. 2-7

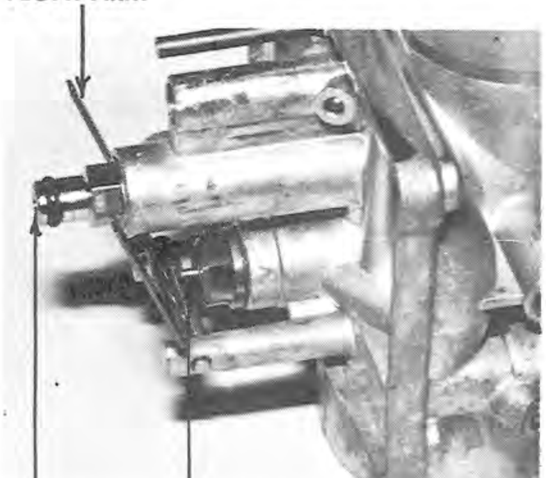


FIG. 2-8

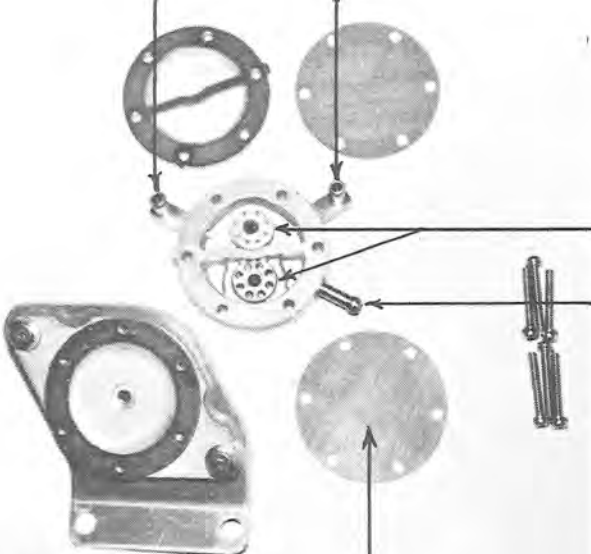


FIG. 2-10

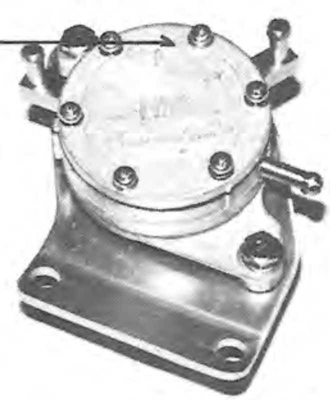


FIG. 2-9

DISASSEMBLY - ASSEMBLY

To perform maintenance, cleaning or repair operation on the Mikuni Carburetor, use the following procedure:

Remove the parts as indicated and place them on a clean surface in the sequence removed.

MISCELLANEOUS

1. To drain the float bowl, remove the main jet holder in the bottom of the bowl (14 mm wrench).
2. Remove the jet from the jet holder (6 mm wrench).
3. Remove Enriching Valve (Starter) Assembly (12 mm wrench).

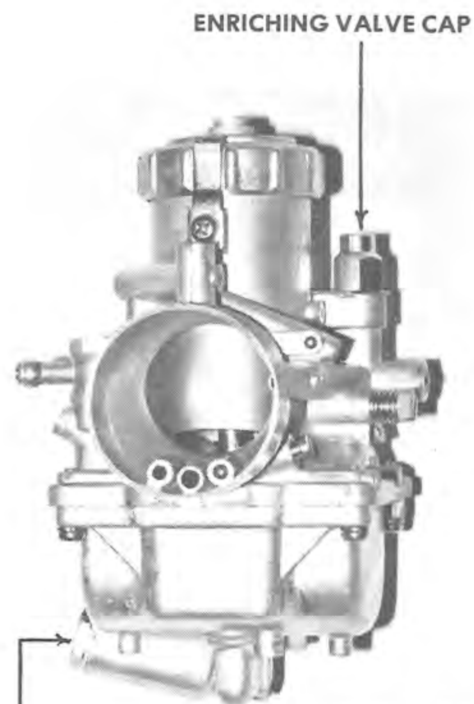


FIG. 2-11

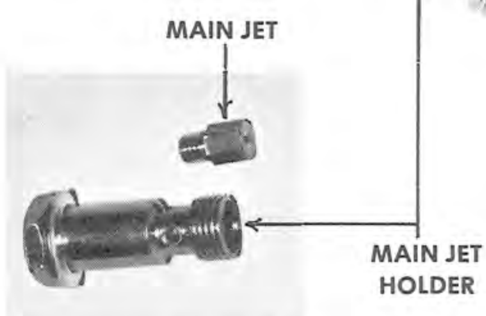


FIG. 2-12

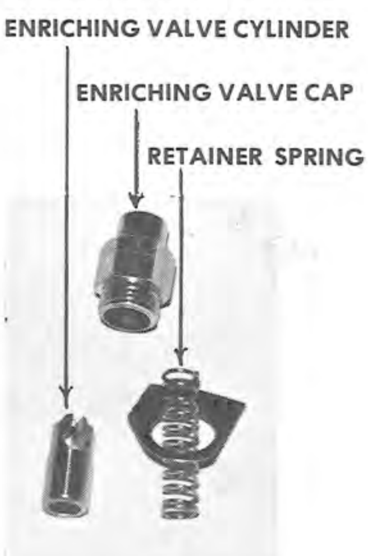


FIG. 2-13

4. Remove Air Screw (flat blade screwdriver). (Fig. 2-14).
5. Remove pilot jet (narrow, flat blade screwdriver.
6. Remove air jet (narrow, flat blade screwdriver).
7. Remove idle speed screw (flat blade screwdriver). (See Fig. 2-15).

AIR SCREW

FIG. 2-14

IDLE SPEED SCREW

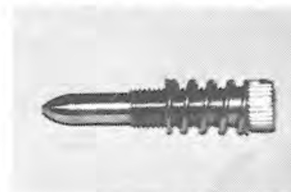


FIG. 2-15

THROTTLE VALVE (Fig. 2-16)

1. Remove the cap lock (Phillips screwdriver).
2. Unscrew the carburetor cap (hand operation).
3. Remove the following parts:
   a. Spring
   b. Valve
   c. Keeper Washer
   d. Jet Needle

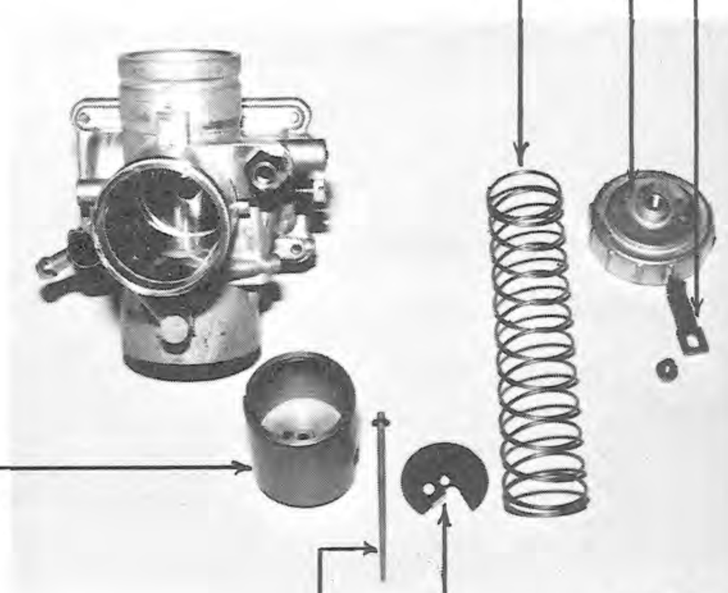


FIG. 2-16

FLOAT BOWL (FIG. 2-17, 2-18)

1. Remove four Phillips head screws (Phillip screwdriver).
2. Remove float bowl.

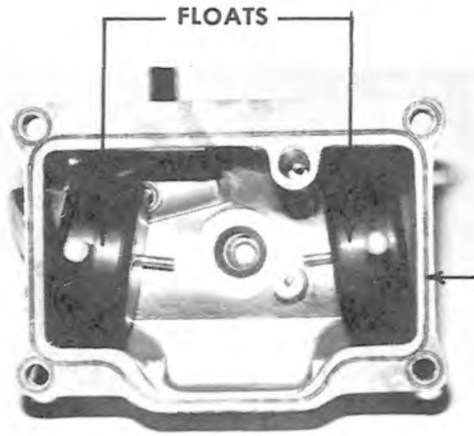


FIG. 2-18

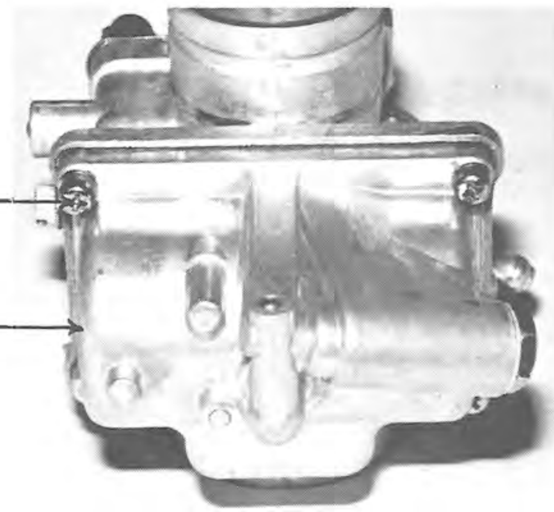


FIG. 2-17

NEEDLE JET (FIG. 2-19)

1. Unscrew retainer fitting (8 mm wrench).
2. Remove needle jet.

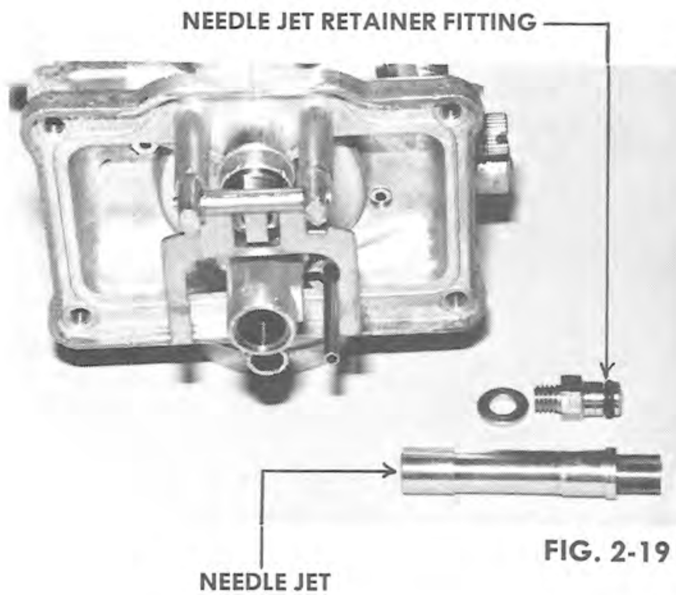


FIG. 2-19

CLEANING

1. Clean entire carburetor with carburetor cleaner or solvent.

2. Blow out all jets and passages with air or clean them with a nylon brush or something equally soft. Do not use metal wire for cleaning. Any nicks, scratches or other damage may cause the carburetor to malfunction.

REASSEMBLY

Reassemble in the reverse order of disassembly.

CARBURETOR ADJUSTMENTS

FLOAT ADJUSTMENT

(See FIG. 2-20)

1. The float arm position determines the fuel level in the float bowl.
2. The float arm is adjusted by bending the lip.
3. The dimension from the flat surface of the carburetor body to the bottom of the float arm is 22-24 mm.

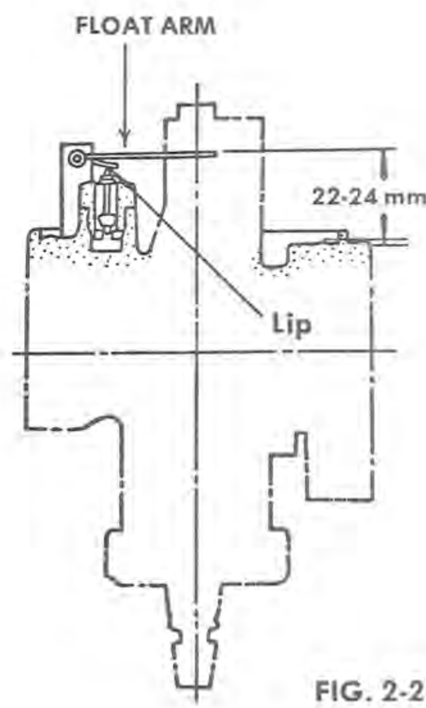


FIG. 2-20

PILOT SYSTEM ADJUSTMENT

1. The pilot outlet and by-pass opening are sized to match the carburetor bore. The pilot jet opening and the air screw position are equally important.

2. Pilot Jet Size Check

   a. Elevate the sled so that the track is clear of the ground and start the engine.

   b. Open the throttle slightly and observe the speed increase characteristics.

   c. If the exhaust smoke is heavy and the exhaust noise dull, the pilot jet is too big.

   d. If the increase of engine speed is slow and irregular or if speed can not be maintained in the 12-25 MPH range with throttle constant, the pilot jet is too small.

3. Air Screw Position.

   a. Warm up the engine.

   b. Set the idle speed screw about 15% higher than the desired idle speed.

   c. Turn the air screw in and out to determine the point at which the engine RPM is maximum.

   d. Adjust the idle speed screw to the desired level.

   e. Check again for the point of maximum engine RPM by turning the air screw in and out, ¼ to ½ turn in each direction.

NOTES:

1. The air screw position should never be more than three (3) turns open. At this point the spring ceases to function as a lock, and the screw could be lost in operation.

2. If there is a range in the air screw adjustment where the maximum engine RPM is essentially constant (i.e., 1½ to 2 turns), better acceleration will be achieved at the lower setting.

MAIN SYSTEM ADJUSTMENT

1. The jet needle and needle jet serve to control the proper air/fuel ratio, and thereby engine performance, at partial loads (¼ to ¾ throttle valve opening). The jet needle tapers and the clearance between the needle and needle jet increases as the throttle valve opening increases.

   The air/fuel ratio is controlled by the position of the "E" ring that is inserted in one of the five (5) slots on the head of the needle. (See Fig. 2-21).

2. The main jets provided with the carburetors from the factory are:

   32 mm (Brut 340) - 220

   34 mm (Brut 440) - 340

   For richer or leaner engine operation under special conditions, additional jet sizes are available.

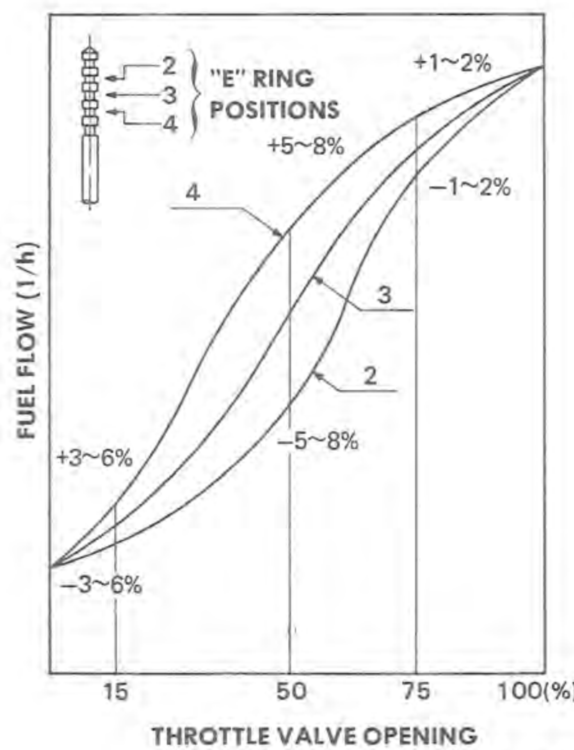


FIG. 2-21

TROUBLE SHOOTING CHART

TROUBLE	PROBABLE CAUSE	REMEDY
FUEL RICH CONDITION		
-Engine noise dull, intermittent - Spark plugs fouled. - Heavy exhaust gases -Malfunctioning gets worse, when enriching valve is opened.	1. Damage to or foreign obstacle under inlet needle valve or valve seat. 2. Float arm bent to allow excess of fuel in float bowl. 3. Air jet blocked.	1. Remove needle valve. Inspect, clean or replace. 2. Adjust float arm. (See ADJUSTMENTS, P. 2-11) 3. Clean as necessary.
FUEL LEAN CONDITION		
-Engine overheats. -Acceleration is poor. -Spark plugs burn. -Engine RPM fluctuates, power is low. -Condition improves, when enriching valve is opened.	1. Ice or water in float bowl. 2. Dirt in jets or fuel passage. 3. Carburetor connections leak air. 4. Needle jet blocked or damaged. 5. Impulse line leaking or pinched. 6. Malfuncting fuel pump. -Damaged diaphragm -Intake check valve leaks. -Exhaust check valve leaks.	1. Drain and clean float bowl, main jet and needle jet. 2. Disassemble carburetor and clean. 3. Repair as necessary. 4. Replace as necessary. 5. Repair as necessary. 6. Replace diaphragm or plastic valve disc(s) as necessary. (See FIG. 2-10).

1975 SCORPION BRUT

Service Manual

Electrical Section

ELECTRICAL SYSTEM

The Scorpion Brut Electrical System is divided into four sections:

A. Power generation
B. Ignition
C. Voltage Regulation
D. Electrical Control and Distribution

POWER GENERATION

Functional Description:

AC power, used for lighting and controls operation, is generated by rotating a permanently magnetized flywheel mounted on the engine crankshaft past a stator which contains lighting coils.

The no load voltage generated, increases with engine R.P.M. To safeguard the system, a regulator limits the voltage level to 13-14 volts maximum. (See Voltage Regulation Section).

Main Elements:

1. Magnetic Rotor
2. Lighting Coils

BRUT 440

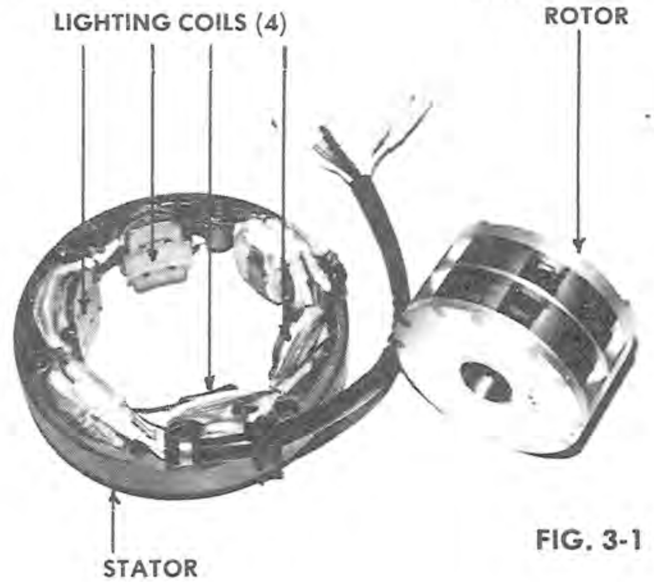


FIG. 3-1

BRUT 340

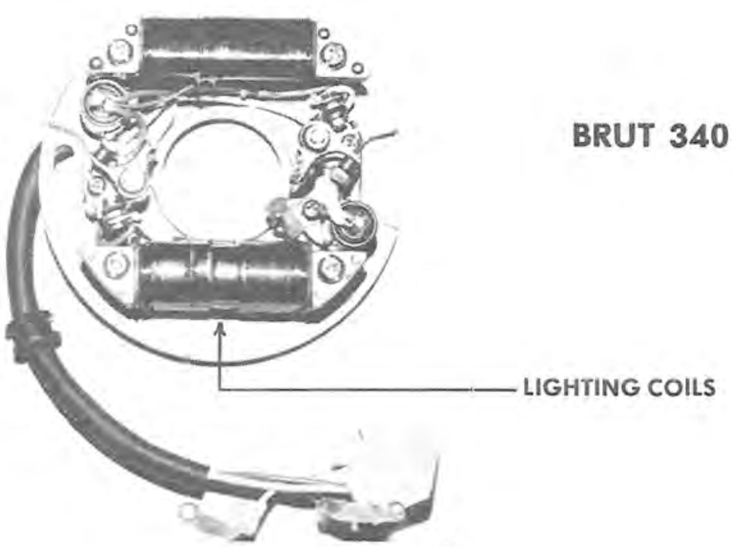


FIG. 3-2

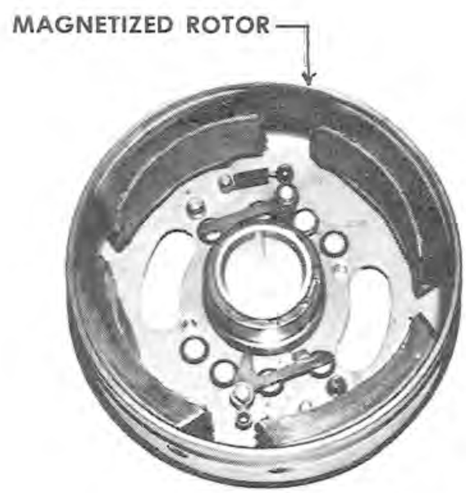
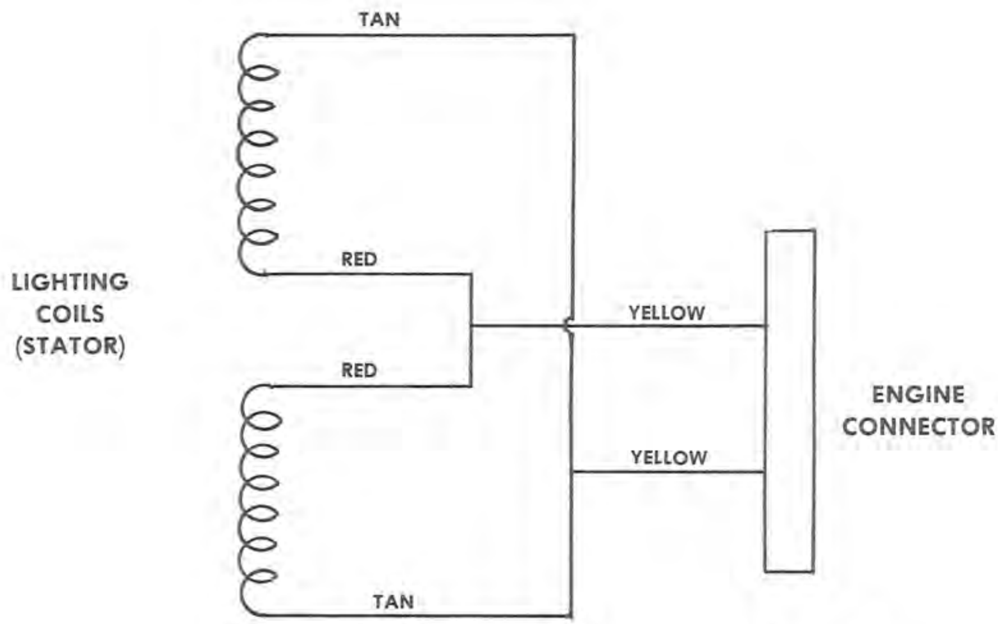
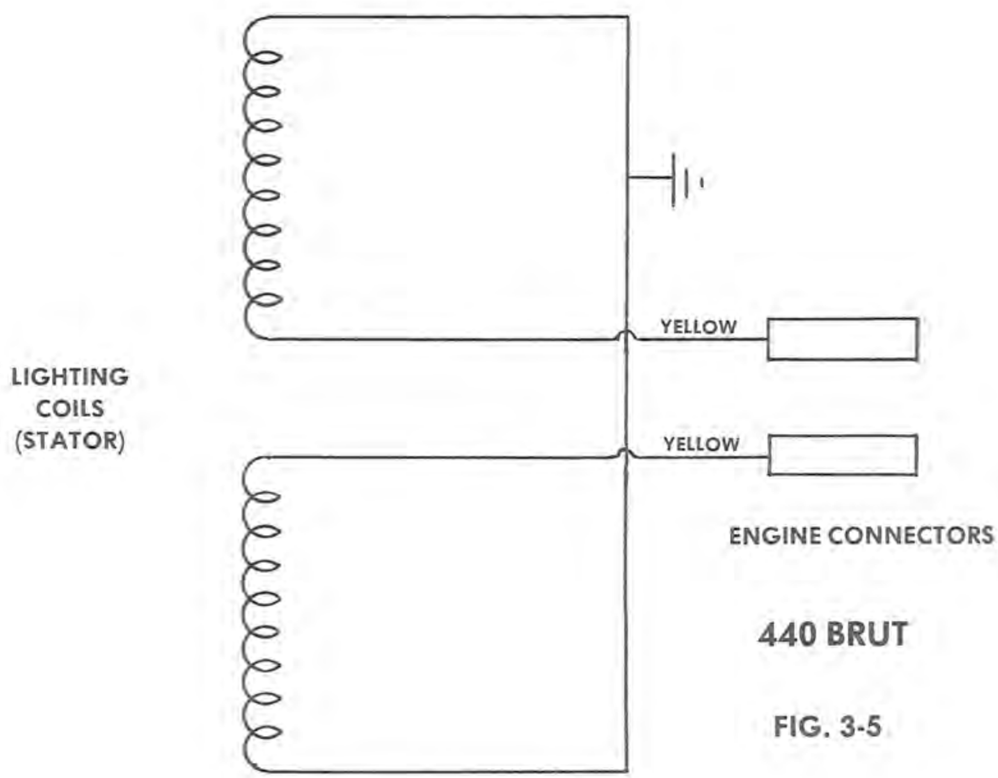


FIG. 3-3



340 BRUT

FIG. 3-4



440 BRUT

FIG. 3-5

IGNITION

Functional Description:

The Brut engines utilize two different type ignition systems. The 340 engine is equipped with a flywheel magneto type ignition. The 440 engine is equipped with an electronic Capacitive Discharge Ignition System.

340 Engine Ignition:

An electrical current is generated by rotating a permanently magnetized flywheel about the ignition coils. The current initiated in the coils in turn energizes the primary coils of the external ignition coils. The secondary coils of the external ignition coils are situated in the force field generated by the primary coils.

When the points close, causing an interruption of the current flow through the primary winding, its force field immediately collapses and generates a very high voltage in the second coil. This voltage in the region of several thousand volts will jump the spark plug gap causing ignition to begin.

The collapsing lines of force cut through the primary windings, raising the voltage in that circuit also. As this occurs, the condenser absorbs the generated current to reduce the tendancy to overload the points. As soon as the voltage level in the primary winding drops below that of the condenser, current again flows in the original direction, energizing the system. This occurrence and the reversal happens several times each cycle creating a powerful, long duration spark for more reliable ignition.

MAIN ELEMENTS:

1. Ignition Coils (Stator)
2. Condensers (2)
3. Breaker Points (2)
4. Ignition Coils (External) (2)
5. Spark Plugs (2)

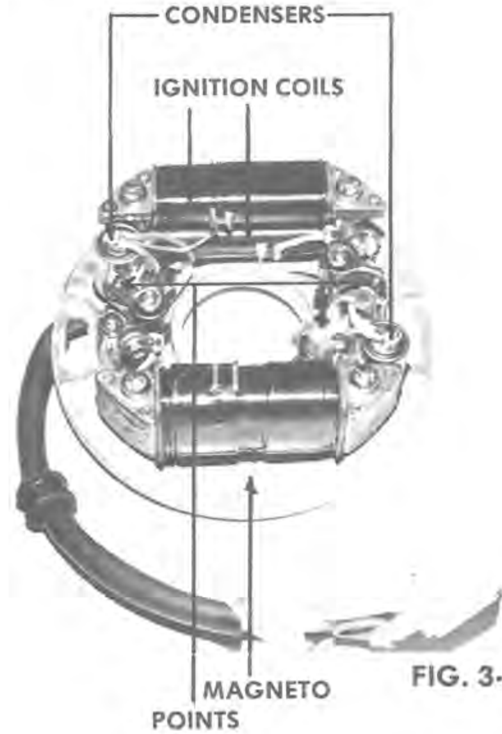


FIG. 3-6

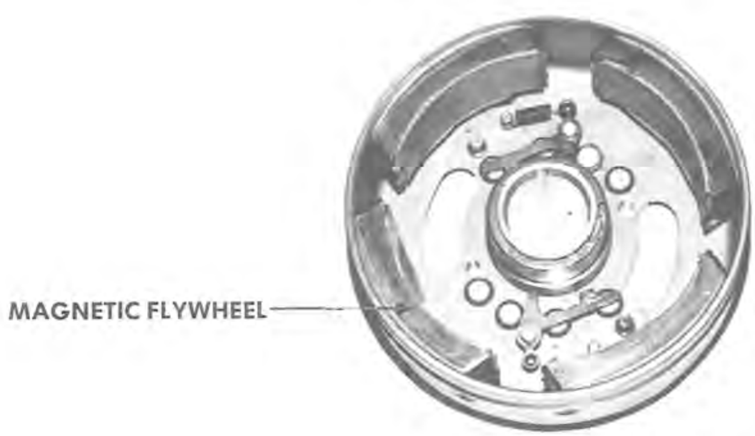


FIG. 3-7

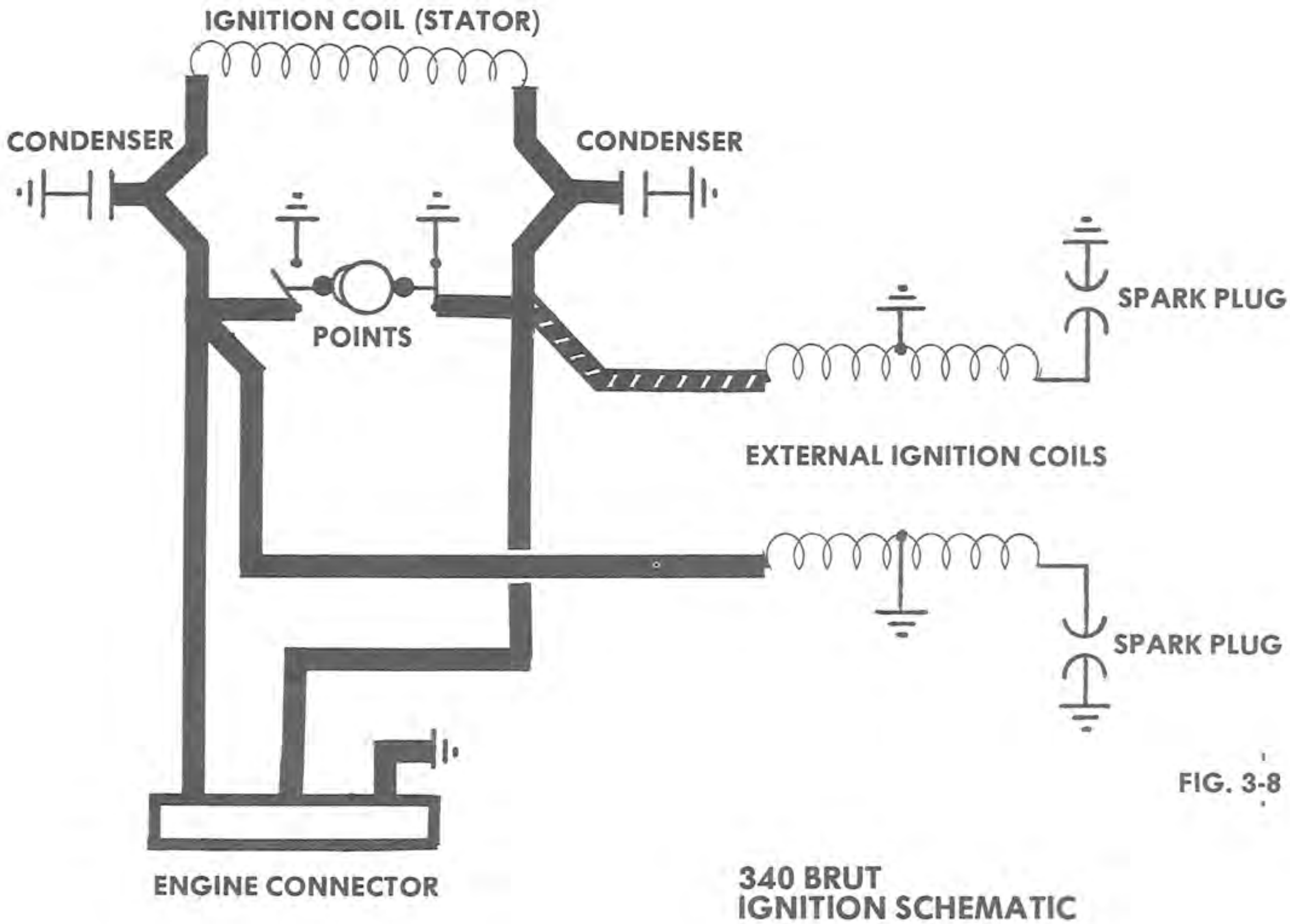


FIG. 3-8

340 BRUT
IGNITION SCHEMATIC

440 Engine Ignition:

Electrical energy (high voltage, low amperage) is generated by rotating a permanent magnet flywheel past a pair of ignition coils. The high voltage ($\approx$200v) thus generated is absorbed by a large condenser.

A special signal is also initiated by the rotating magnet which closes an electronic switch (transistor) every 120 degrees of rotation. When the transistor conducts, current flows from the condenser through the primary windings of the three external coils. The current rises abruptly as the condenser discharges creating the necessary force field in the external coils, and falls just as abruptly.

The voltage induced in the secondaries of the external coils rises so rapidly that it will exceed the voltage necessary to jump the spark plug gap even when the plugs are fouled.

All three plugs "fires" simultaneously every 120 degrees. Timing of cylinder pressure, however, determines which one of the three cylinders supports combustion.

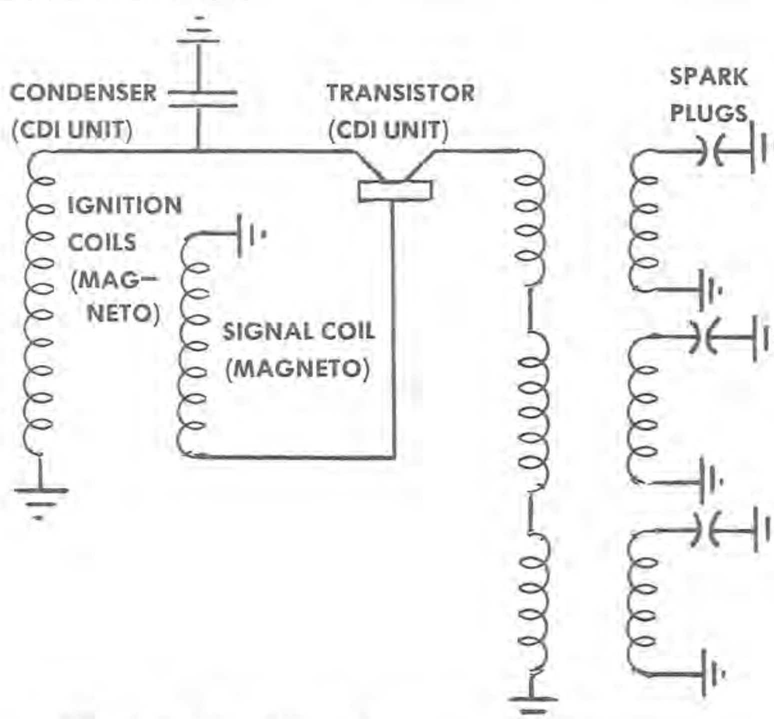
The keyed relationship between the crankshaft and the rotor determines the timing of the engine.

The timing is electronically advanced progressively from start-up to fully advanced at 4500 RPM. At 4500 RPM, the lead is between 3.2 and 3.5 mm. This corresponds to 16 degrees - 20 degree advance.

NOTE: The Brut 440 ignition schematic is not accurate physically, but only intended as a pictoral representation of the ignition principles involved.

MAIN ELEMENTS:

1. Magneto Coils
   a. Ignition Coils
   b. Signal Coil
2. CDI Unit
3. External Coils
4. Spark Plugs



BRUT 440 IGNITION SCHEMATIC

FIG. 3-9

FIG. 3-10

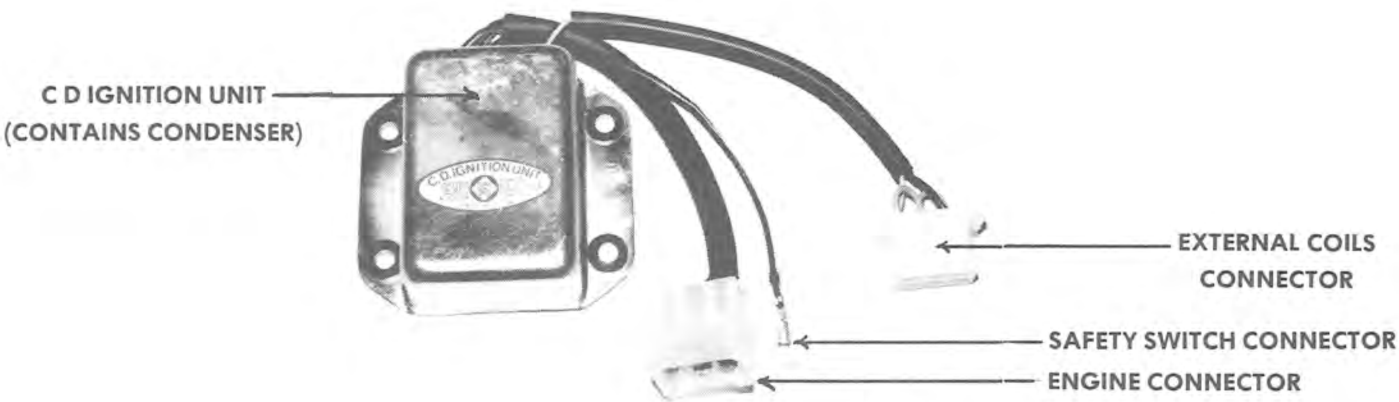


FIG. 3-11

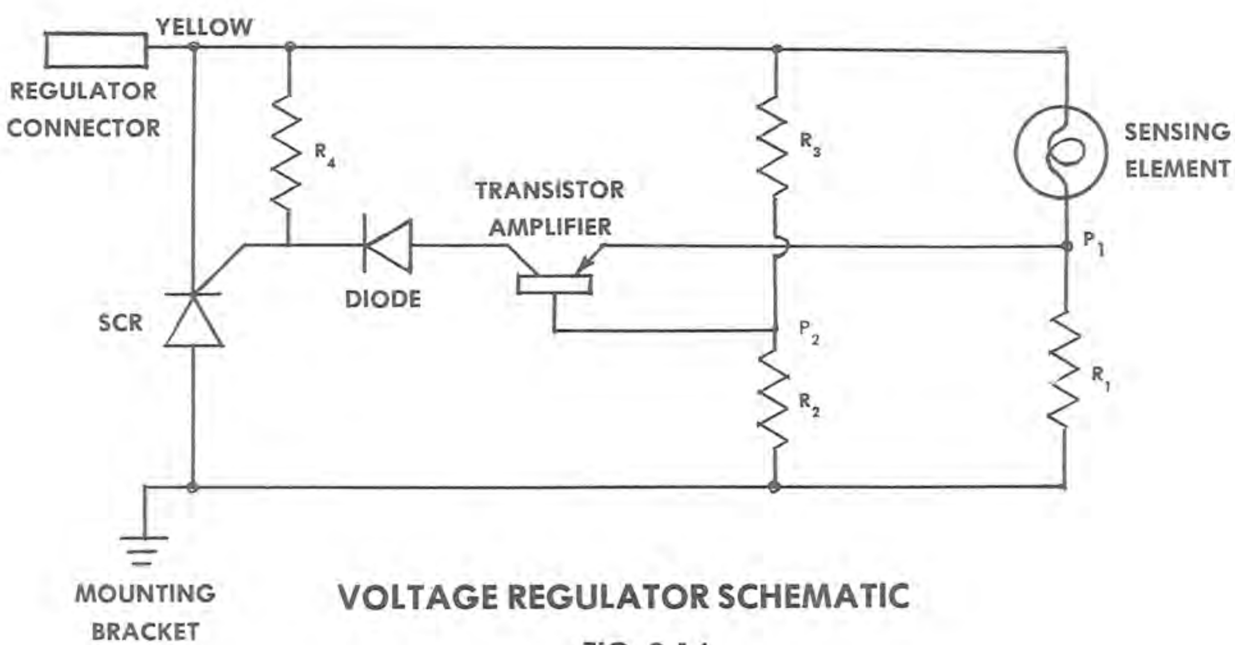
FIG. 3-12

VOLTAGE REGULATION

Functional Description:

The voltage regulator is connected across the lighting coils in parallel with the electrical load of the sled. Under operating conditions, the voltage drop across the regulator is such that 13.8 volts RMS is supplied to the snowmobile lighting circuit.

FIG. 3-13



VOLTAGE REGULATOR SCHEMATIC

FIG. 3-14

VOLTAGE REGULATOR CHECKS

1. Resistance across regulator

   Two most common catastrophic failure modes of the regulator may be identified by simply checking the resistance of the regulator.

   a. Burned out sensing element.

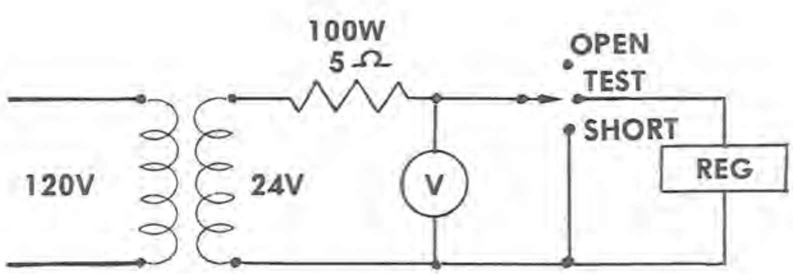
      Normal resistance across the regulator is approximately 155 - 160 . The symptom of a burned out sensing element is a significantly increased resistance reading.

   b. Shorted SCR.

      Shorted SCR is characterized by a significantly reduced resistance reading.

2. Set point check

   Use test circuit as shown below. Read voltage across regulator. Value should be 13.8 ± .5V.



REGULATOR SET POINT TEST CIRCUIT

FIG. 3-15

ELECTRICAL CONTROL & DISTRIBUTION

Functional Description:

Power is supplied continuously to the tachometer movement, brake light switch and temperature indicator so that any time power is being generated, those items will function.

Power to all other items is supplied through the ignition switch in the "lights" mode.

Grounding of the wiring system is accomplished at the roll bar.

Main elements of the system are:

1. Main wiring harness
2. Seat wiring harness
3. Safety switch
4. Brake light switch
5. High-Low switch
6. Ignition switch

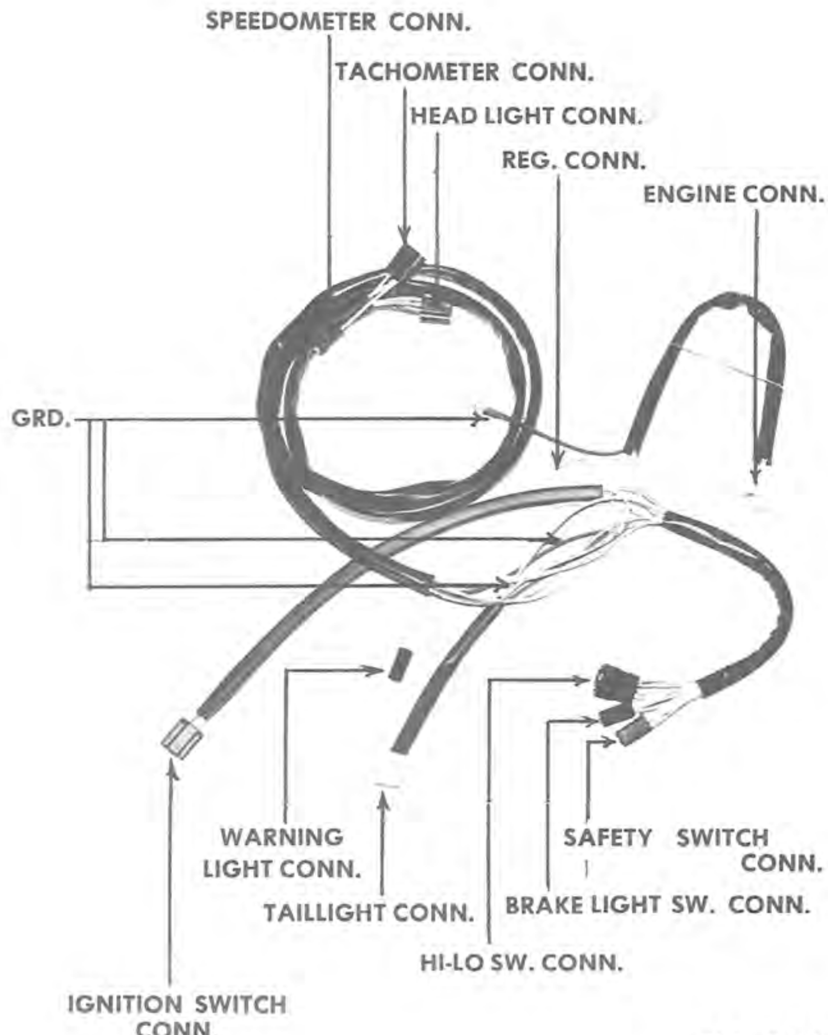
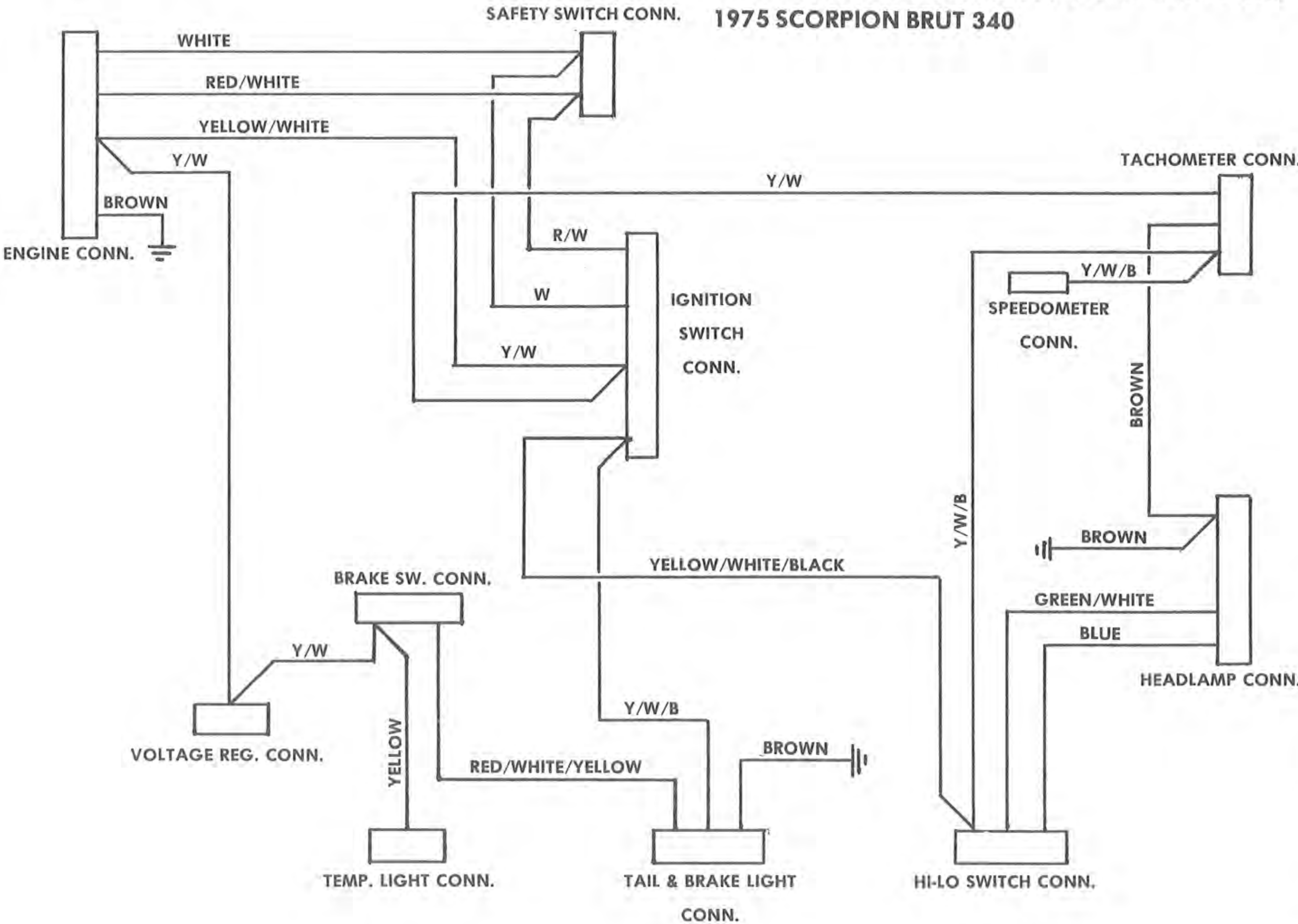


FIG. 3-16

WIRING SCHEMATIC FIG. 3-17

ELECTRICAL DISTRIBUTION & CONTROL

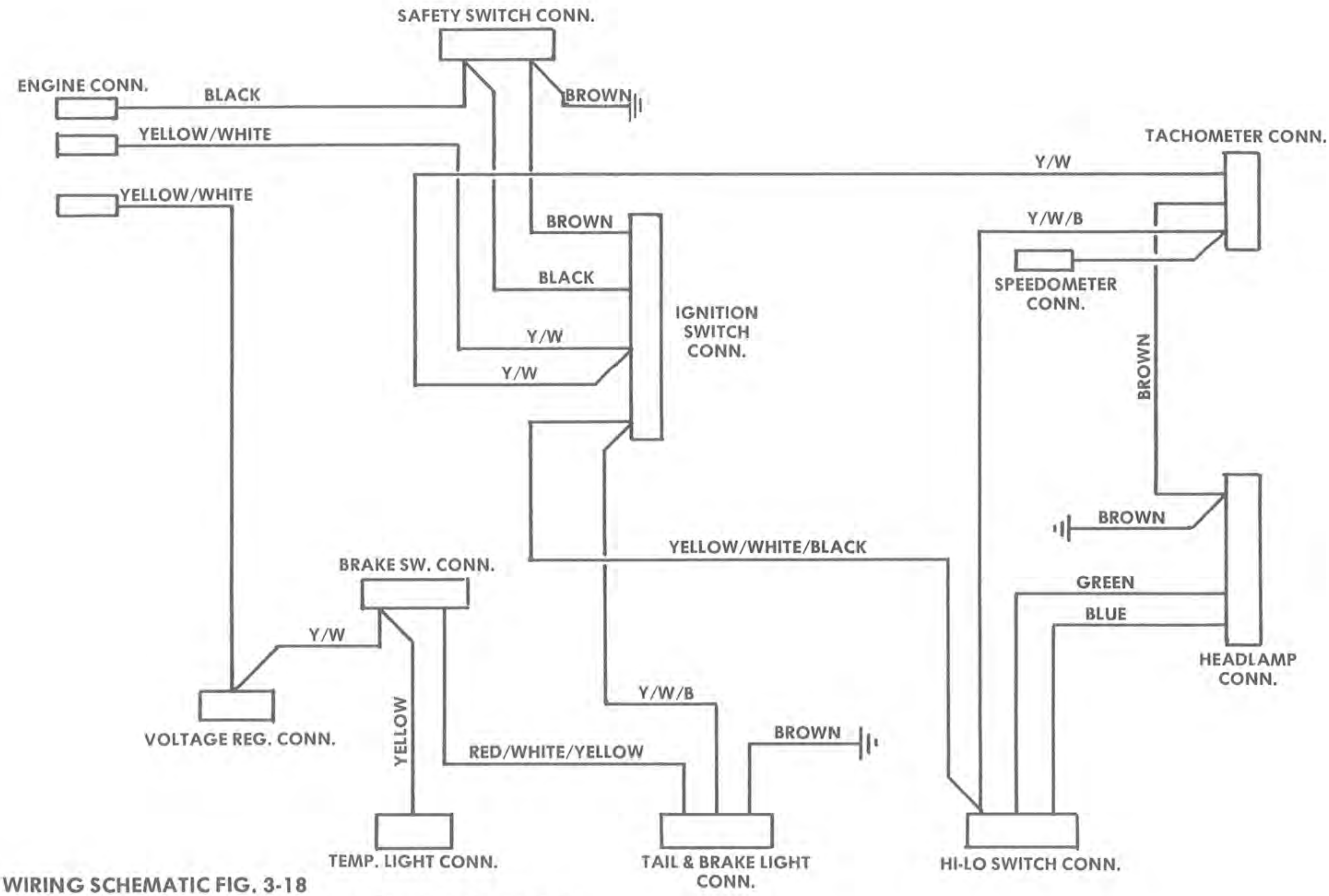
1975 SCORPION BRUT 340



WIRING CODE (ELECTRICAL DISTRIBUTION & CONTROL)

BRUT 340

COLOR	FUNCTION	FROM	TO
Blue	Hot (Hi)	Hi-Lo Switch Connector	Headlight Connector
Brown	Ground Ground Ground Ground	Tachometer Connector Headlight Connector Taillight Connector Engine Connector	Headlight Connector Roll Bar Roll Bar Roll Bar
Green/White	Hot (Lo)	Hi-Lo Switch (Lo)	Headlight (Lo)
Red/White	Hot Hot	Engine Connector Safety Switch Connector	Safety Switch Connector Ignition Switch
Red/White/ Yellow	Hot	Brake Light Switch Connector	Taillight Connector
White	Hot Hot	Engine Connector Safety Switch Connector	Safety Switch Connector Ignition Switch Connector
Yellow	Hot	Brake Light Switch Connector	Heat Warning Indicator
Yellow/White	Hot Hot Hot Hot	Engine Connector Engine Connector Regulator Connector Ignition Switch Connector	Ignition Switch Connector Regulator Connector Brake Light Switch Connector Instrument Connector
Yellow/White Black	Hot Hot Hot Hot	Ignition Switch Connector Ignition Switch Connector Hi-Lo Switch Connector Tachometer Connector	Taillight Connector Hi-Lo Switch Connector Tachometer Connector Speedometer Connector



WIRING SCHEMATIC FIG. 3-18

ELECTRICAL DISTRIBUTION & CONTROL

1975 SCORPION BRUT 440

WIRING CODE (ELECTRICAL DISTRIBUTION & CONTROL)

BRUT 440

COLOR	FUNCTION	FROM	TO
Black		Engine Connector Safety Switch Connector	Safety Switch Connector Ignition Switch Connector
Blue	Hot (Hi)	Hi-Lo Switch Connector (Hi)	Headlamp Connector (Hi)
Brown	Ground Ground Ground Ground Ground	Ignition Switch Connector Safety Switch Connector Instrument Connector Headlamp Connector Taillight Connector	Safety Switch Connector Ground (Roll Bar) Headlamp Connector Ground (Roll Bar) Ground (Roll Bar)
Green	Hot (Lo)	Hi-Lo Switch Connector (Lo)	Headlamp Connector (Lo)
Red/White/ Yellow	Hot	Brake Light Switch Connector	Taillight Connector (Brake Light)
Yellow	Hot	Brake Switch Connector	Temperature Light Connector
Yellow/White	Hot Hot hot Hot	Engine Connector Ignition Switch Connector Engine Connector Regulator Connector	Ignition Switch Connector Instrument Connector Regulator Connector Brake Switch Connector
Yellow/White Black	Hot Hot Hot Hot	Ignition Switch Connector Ignition Switch Connector Hi-Lo Switch Connector Instrument Connector	Taillight Connector (Taillights) Hi-Lo Switch Connector Instrument Connector Speedometer Connector

TROUBLE SHOOTING (ELECTRICAL)

TROUBLE	PROBABLE CAUSE	REMEDY
No lights	Open Circuit: Faulty Switch(s) Separated Connector(s) Cut Wiring	Repair or replace faulty or damaged element.
	Wiring shorted to ground: Damaged Insulation	Repair or replace damaged or faulty element.
	Faulty Regulator (Shorted SCR)	Replace regulator.
Dim lights	Shorted or open lighting coil.	Replace stator plate.
	Faulty regulator - Incorrect regulator set point (too low).	Replace regulator.
Burned out lights (all)	Faulty regulator - burned out regulator sensing element. Incorrect Set Point (too high).	Replace regulator and failed bulbs.
Burned out lights (individual)	Failed bulb.	Replace bulb.
Burned out lights	Intermittent short in wire harness.	Repair or replace wire harness.
Engine won't run Weak or no spark	1. Open or shorted windings in ignition coils (stator). 2. Open or shorted windings. in external ignition coil. 3. Shorted condenser - dirty or worn. 4. Damaged (burned) points.	1. Replace armature plate. 2. Replace external coil. 3. Replace condenser. 4. Replace points.
Engine won't run - Adequate spark.	1. Burned or fouled plugs.	1. Replace plugs. Determine that correct plugs are being used. CHECK ENGINE TROUBLE SHOOTING.
	2. See Engine Trouble Shooting Section	
Unacceptable Engine Performance	See Engine Trouble Shooting Section	

1975 Scorpion Brut

Service Manual

Clutch/Drive Section

DRIVE SYSTEM

Functional Description:

The main elements included in this system are:

1. Drive Clutch
2. Drive Belt
3. Driven Clutch
4. Chain Case with sprockets, chain and chain tensioners.
5. Drive shaft with track drive sprockets.

The power from the engine is transmitted through this system to the track in sequence of elements listed above to propel the machine.

The drive clutch, belt and driven clutch serve as a torque converter. The torque converter on the snowmobile "down shifts" to a lower ratio as the track load increases as readily as it "up shifts" when the track load decreases.

To accomplish the automatic shifting, the movable sheave of the driven clutch is fitted with a helical ramp which is guided by a follower. This sheave is controlled by a spring pre-stressed in torsion and compression to hold the sheaves together at the **maximum** pitch diameter. The drive clutch cover has a set of centrifugal weights and helical ramps. The drive movable contains a mating set of ramps (followers). A spring automatically positions the movable drive clutch at the minimum pitch under zero and idle speed conditions.

Under acceleration, the torque from the engine is greater than the demand from the track. As RPM increases, the weight arms move to force the movable in (away from the cover). At the same time, the belt tension and belt friction on the movable sheave results in a relative rotational motion between the cover and the movable such that the cam action also forces movable away from the cover.

The wedging action of the drive sheaves forces the belt outward in the driven clutch.

Belt tension and wedging action are greater than spring forces of the driven clutch and the sheave faces are wedged open against the helical cam. This action winds up and compresses the spring.

Under steady running, all forces are balanced and the belt chooses a ratio at which this balance exists.

Under deceleration, the driven stationary stalls slightly. The belt tension and friction on the driven movable plus spring torsion, moves the movable along the ramp, closing it and forcing the belt out to a greater pitch diameter. This action increases belt tension. Wedging action opens the drive movable against the weights down the ramps to a new lower pitch diameter for the drive clutch until forces are again equalized.

DRIVE CLUTCH REMOVAL

1. Remove the 7/16" clutch bolt.

2. Remove large nut holding clutch together.

3. Insert a ¾" x 3¼" steel plug in hollow drive clutch hub. Use large nut with plug as puller to remove clutch.

FIG. 4-1

FIG. 4-2

DRIVE CLUTCH DISASSEMBLY

1. With clutch removed from sled, install large nut approximately one-half (½) way, i.e., one-half the threads engaged.

2. Holding movable firmly with cover facing the floor, rap the large nut sharply against the floor (or some other firm object). The cover will separate from the stationary hub.

3. Remove the large nut.

   Remove the movable and cover from the stationary.

4. Completely disassemble clutch. (Reverse of assembly procedure, which see).

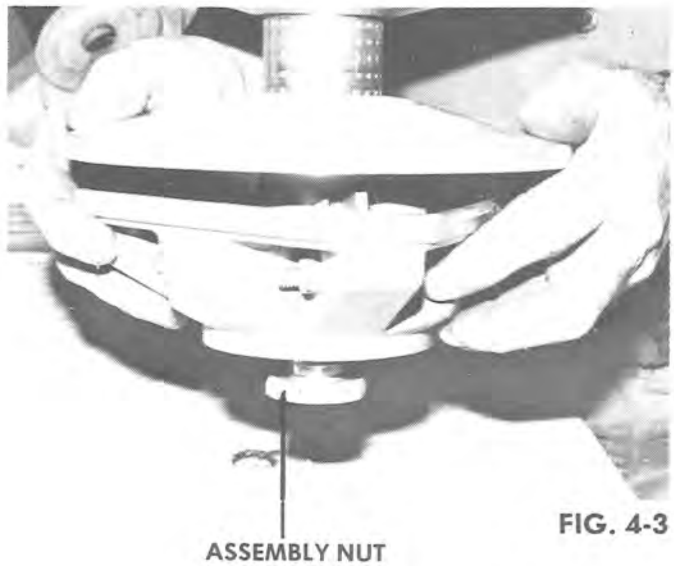


FIG. 4-3

FIG. 4-4

DRIVE CLUTCH ASSEMBLY

MOVABLE

1. Insert the idler spring in the movable bore. Shove it far enough through that the keeper (retainer) can be installed. The spring tang must be in one of the grooves in the movable bore.

2. Position the spring retainer.

3. Push the spring back up against the retainer.

Install the plastic bushing.

FIG. 4-5

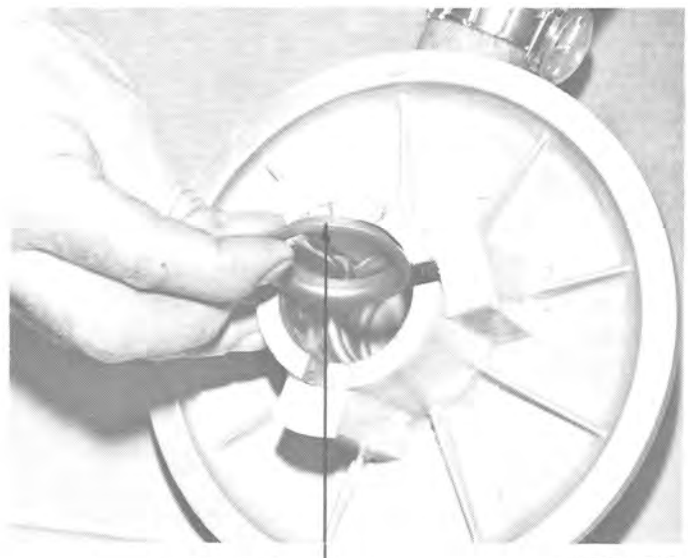


FIG. 4-6

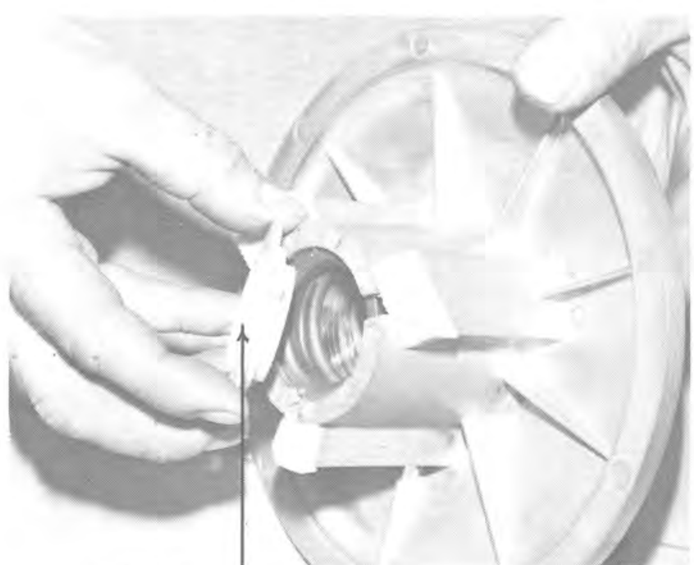


FIG. 4-7

4. Place washer on nylon bushing.

FIG. 4-8

CLUTCH COVER

1. Insert the bushing with washer in weight arm.

   NOTE: The nylon washer **always** goes on the clockwise side of the weight arm when viewed looking into the clutch cover.

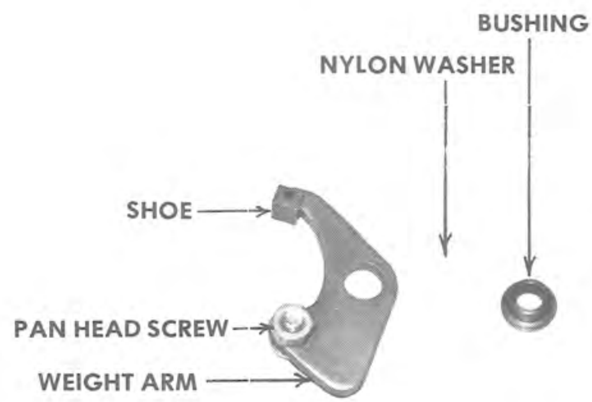


FIG. 4-9

2. Install weight arm in cover, securing it with bolt.

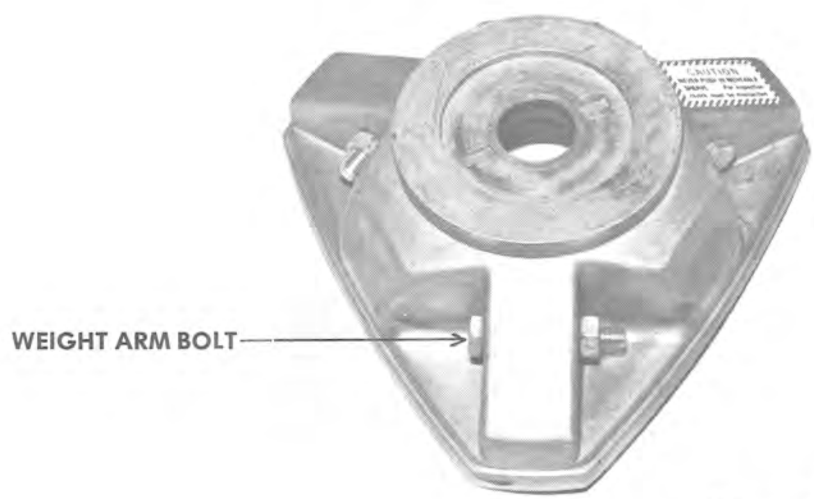


FIG. 4-10

CLUTCH (COMPLETE)

1. Place the movable sheave on the stationary sheave. Engage the inner spring tang in the hole in the stationary hub.

2. Prepare the cover with a rubber band, holding the weight arms correctly. Insure that the shoes on the weight arms are all properly oriented.

Place cover over movable.

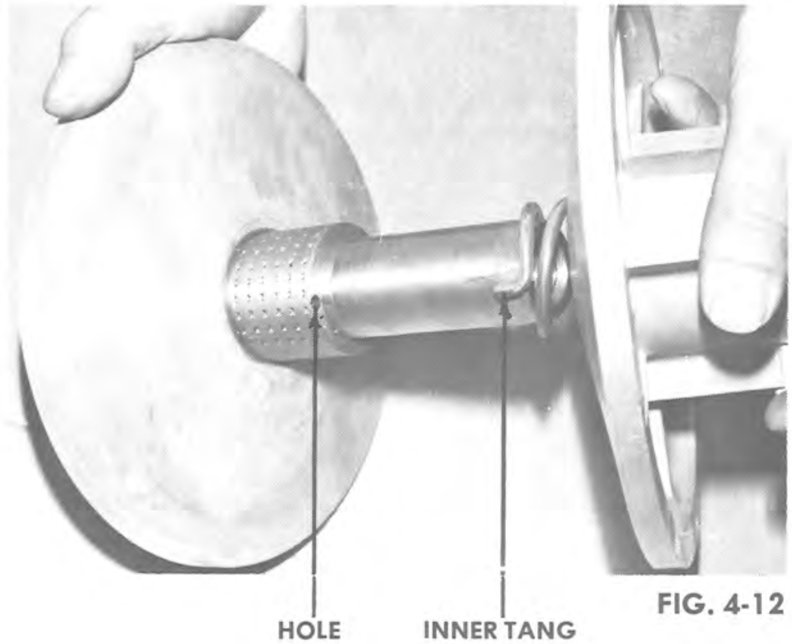


FIG. 4-12

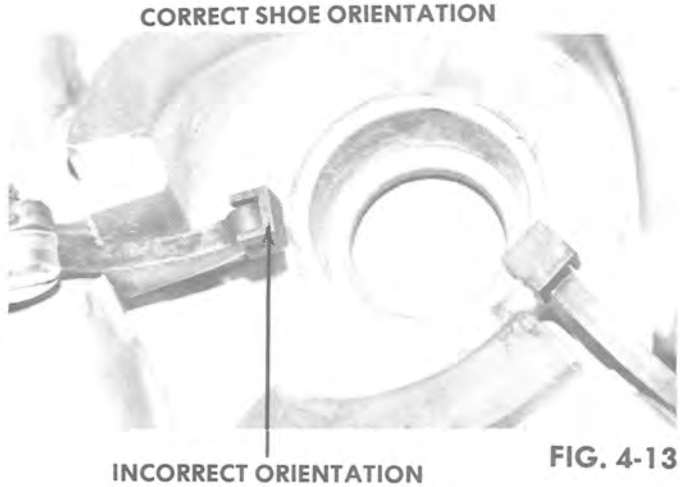


FIG. 4-13

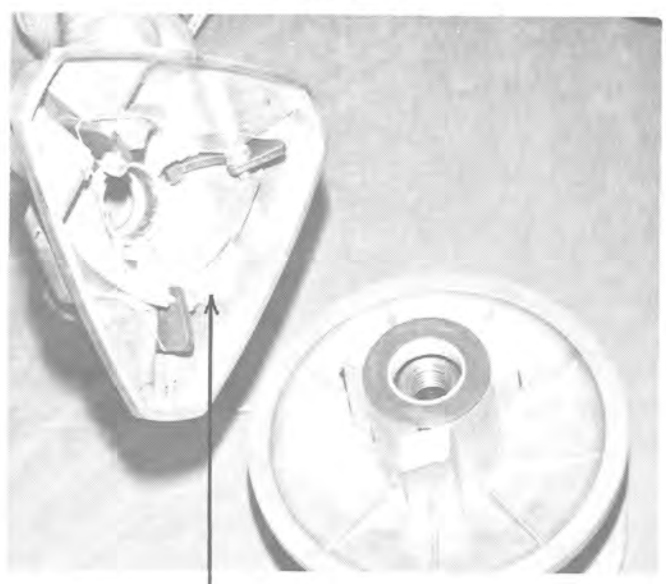
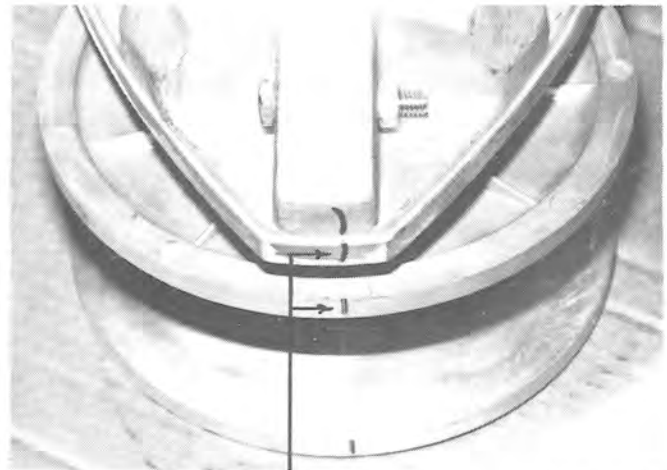


FIG. 4-14

Make sure that the index marks on rim of the movable and cover are aligned.



INDEX MARKS

FIG. 4-15

3. Secure clutch together with large nut.

Remove rubber band.

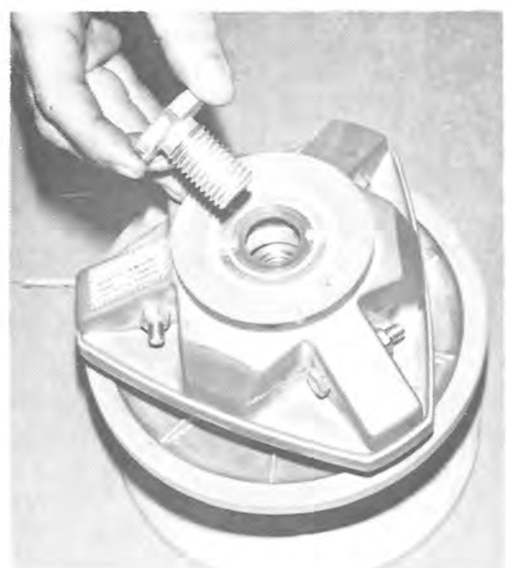


FIG. 4-16

DRIVEN CLUTCH REMOVAL

1. Remove screw and lock washer, securing clutch to Jack Shaft.

2. Pull clutch off shaft.

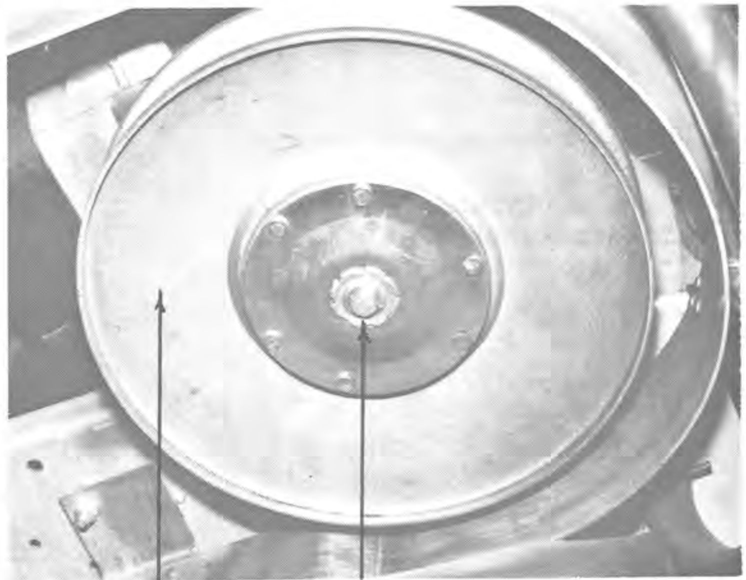


FIG. 4-17

DRIVEN CLUTCH DISASSEMBLY

1. Wind the movable sheave against the spring approximately 1/6 turn, and restrain it. Compress cam top against clutch spring. Slide cam in on stationary splined hub until locking inserts clear the cam top hub.

2. Remove locking inserts.

3. Allow cam top to move off the splined stationary hub slowly.

   Be careful, since the spring is under both compression and wind up, that the cam does not fly off or rotate rapidly from spring wind up.

4. All parts of driven clutch can then be separated.

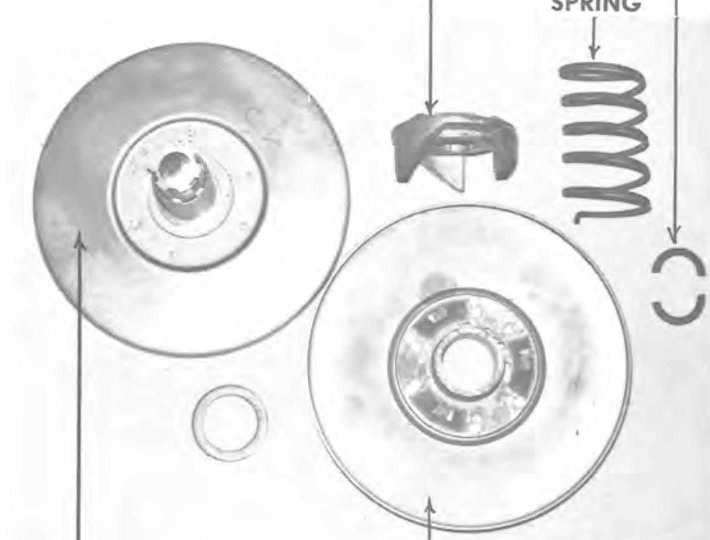


FIG. 4-18

DRIVEN CLUTCH ASSEMBLY

1. Place washer on stationary hub.

   Install movable sheave on stationary sheave.

FIG. 4-18

2. Place clutch spring over hub of movable.

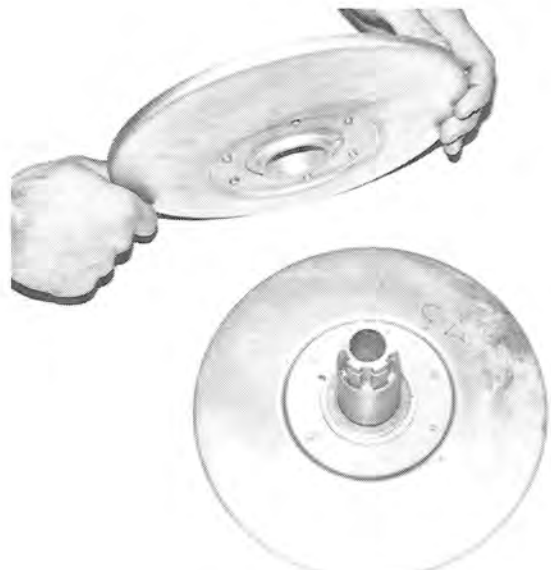


FIG. 4-19

3. Insert the spring tang in the #2 hole (340), or #1 Hole (440).

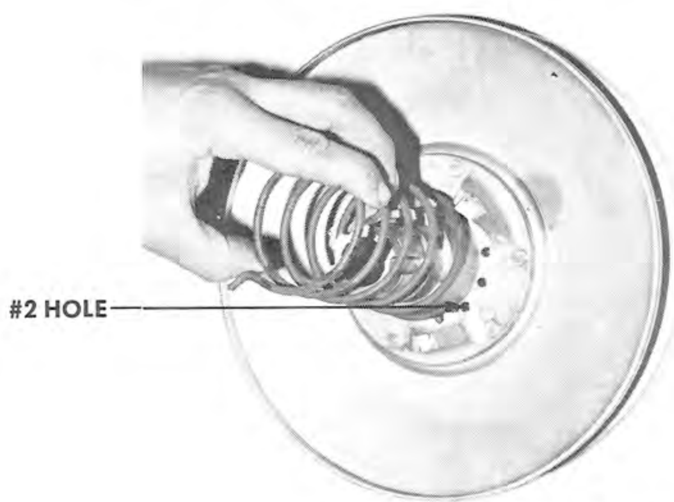


FIG. 4-20

4. Place the cam top over the end of the spring.

5. Engage the spring end behind one of the cam lobes.

6. Rotate to cam top approximately 130 degrees. This will wind up the spring.

   The movable must be restrained during this step.

7. Push the cam top down over the splines to clear the locking insert groove.

8. Install inserts.

   Release the clutch. The cam top will snap back until the cam ramps are engaged.

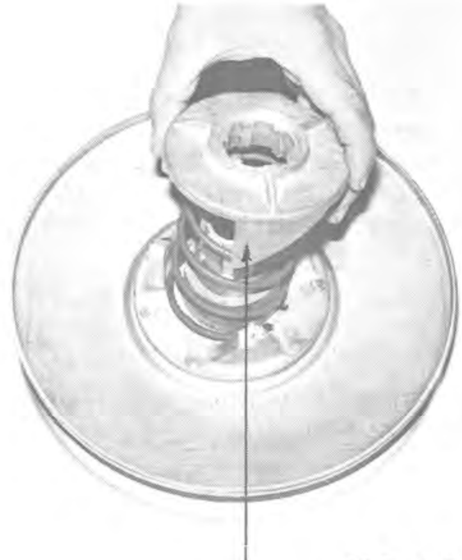


FIG. 4-21

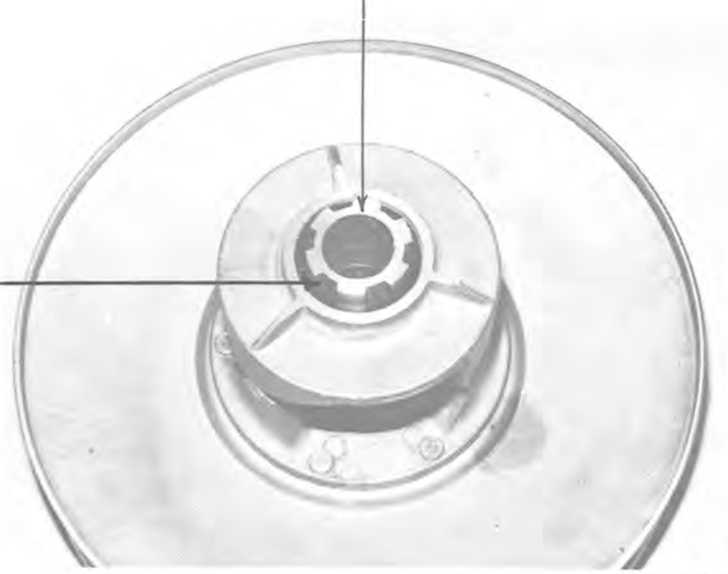


FIG. 4-22

CLUTCH INSTALLATION

DRIVE CLUTCH

1. Place the drive clutch over the engine PTO shaft with .010 shim between clutch bore and shaft. Insure that there is no lubrication on the shaft or in the clutch bore.

2. Insert the clutch attach bolt. (See Fig. 4-1).

   Torque to 75 Ft. lbs.

DRIVEN CLUTCH

1. With the Jack Shaft in position, slide the driven clutch assembly on the end of the shaft.

2. Secure the clutch assembly on the shaft with attaching screw and lock washer. (See Fig. 4-17).

CLUTCH ALIGNMENT

1. With both clutch assemblies installed, measure alignment of the back sides of the stationary sheaves.

   They should be parallel, and off set by ½". (See Fig. 4-23).

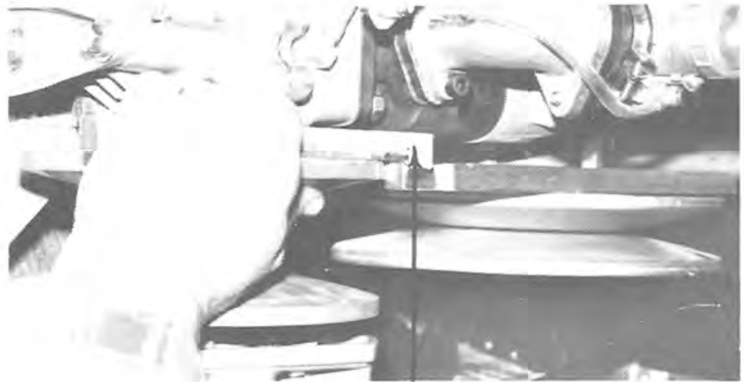


FIG. 4-23

2. If the sheaves are not parallel, loosen the mounting bolts on the chain case and rotate the chain case to bring the sheaves into parallelism.

FIG. 4-24

3. If the off set is not correct, i.e., is not ½", remove the driven clutch and insert or remove spacer washers on end of shaft to provide the correct off set.

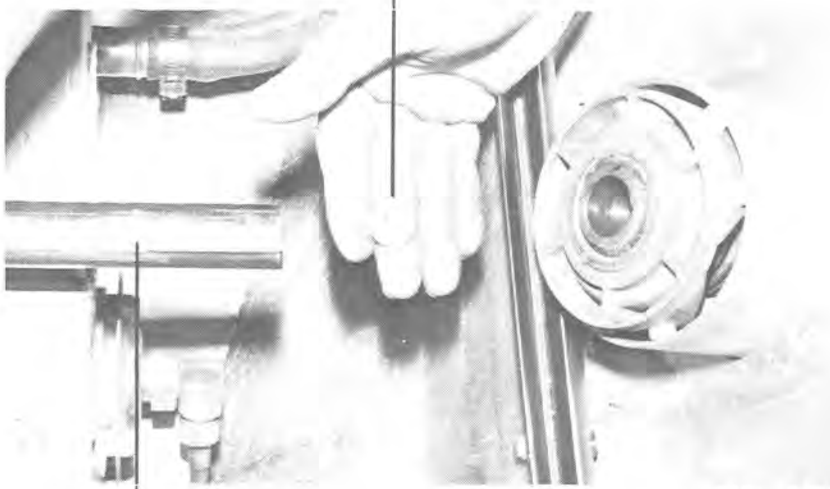


FIG. 4-25

DRIVE CLUTCH ADJUSTMENT

The cut-in speed of the BRUT clutch is 3800 - 4200 rpm. The control speed is 7000 to 7200 rpm.

To vary the shift range of the machine, add or subtract washers on the pan head screws on the weight arms. (See Fig. 4-9).

BRAKE REMOVAL

1. Remove attaching bolts.

2. Separate control cable from clevis and cable bracket.

3. Pull brake disc off jack shaft splines.

DISASSEMBLY

1. Remove cotter pin and castillated nut. Brake assembly can then be separated into component parts.

ASSEMBLY

1. Insert steel plate and wear pad into recessed area in back of castings.

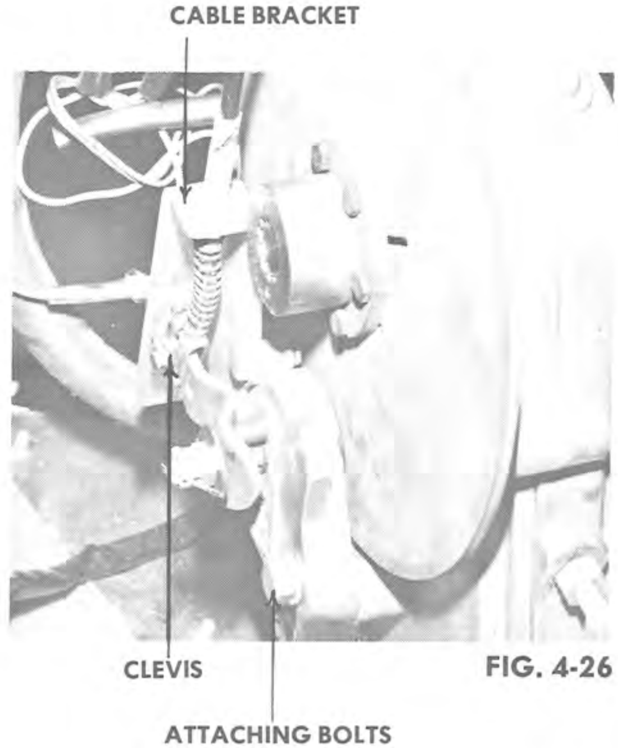


FIG. 4-26

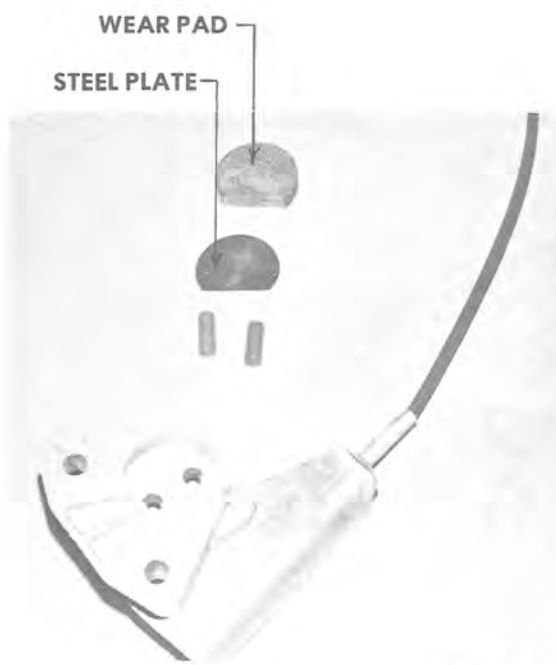


FIG. 4-27

2. Place pins in casting holes, rounded end out.

3. Position lever over threaded stud and washer on top of lever.

4. Install castillated nut and cotter pin.

INSTALLATION

1. Reverse of removal. (See Fig. 4-26).

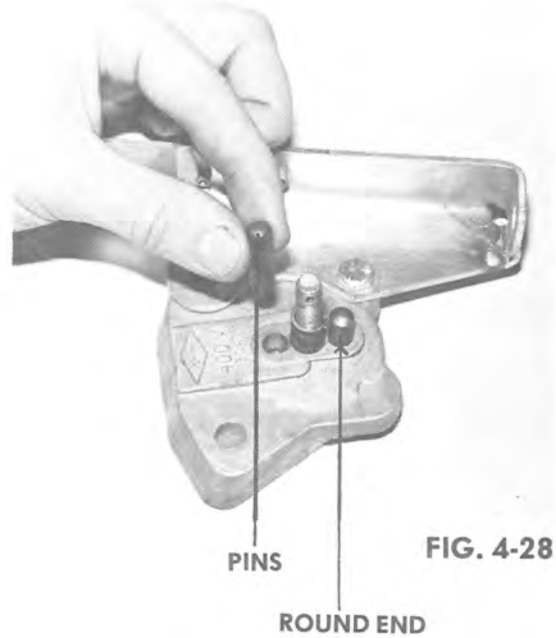


FIG. 4-28

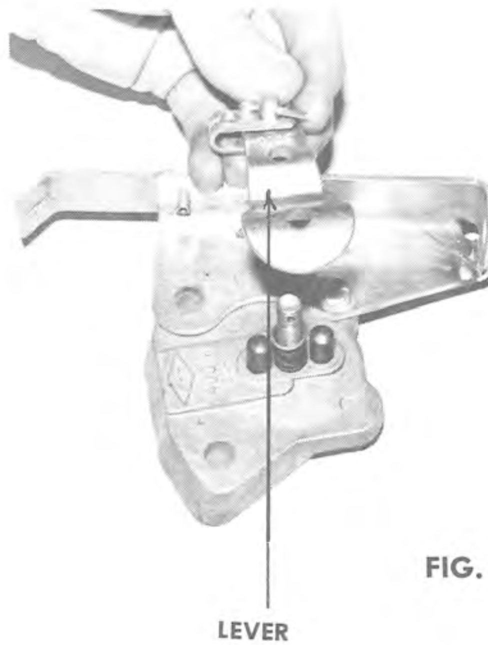


FIG. 4-29

FIG. 4-30

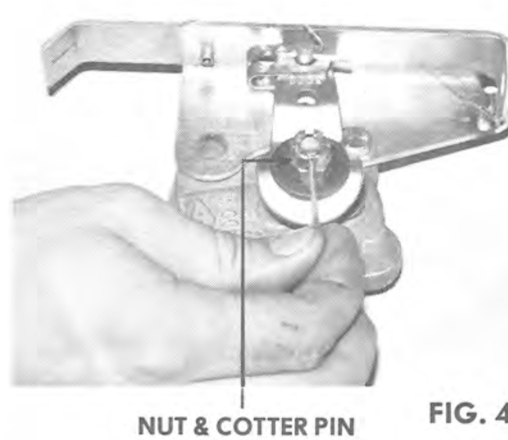


FIG. 4-31

1975 Scorpion Brut

Service Manual

Suspension Section

SUSPENSION SYSTEM

Functional Description:

The four main elements of a snowmobile suspension are:

1. Skis
2. Track Suspension
3. Seat
4. Operator

All elements work together to perform the suspension functions to the optimum degree.
The suspensions are basically designed to:

1. Protect the operator from physical abuse or injury.
2. Keep the operator from being ejected from his operating position and controls.
3. Prevent damage to the machine.
4. Increase ground contact and improve traction.

The track suspension, on the 1975 Scorpion Brut, is a slide (unit type) suspension, especially designed with the following characteristics:

1. Rugged construction for all out performance.
2. Fully adjustable to suit the operator's needs under all conditions.
3. Dampening provided by a cam operated friction disc shock absorber.
4. Attachable road wheel option for marginal snow.

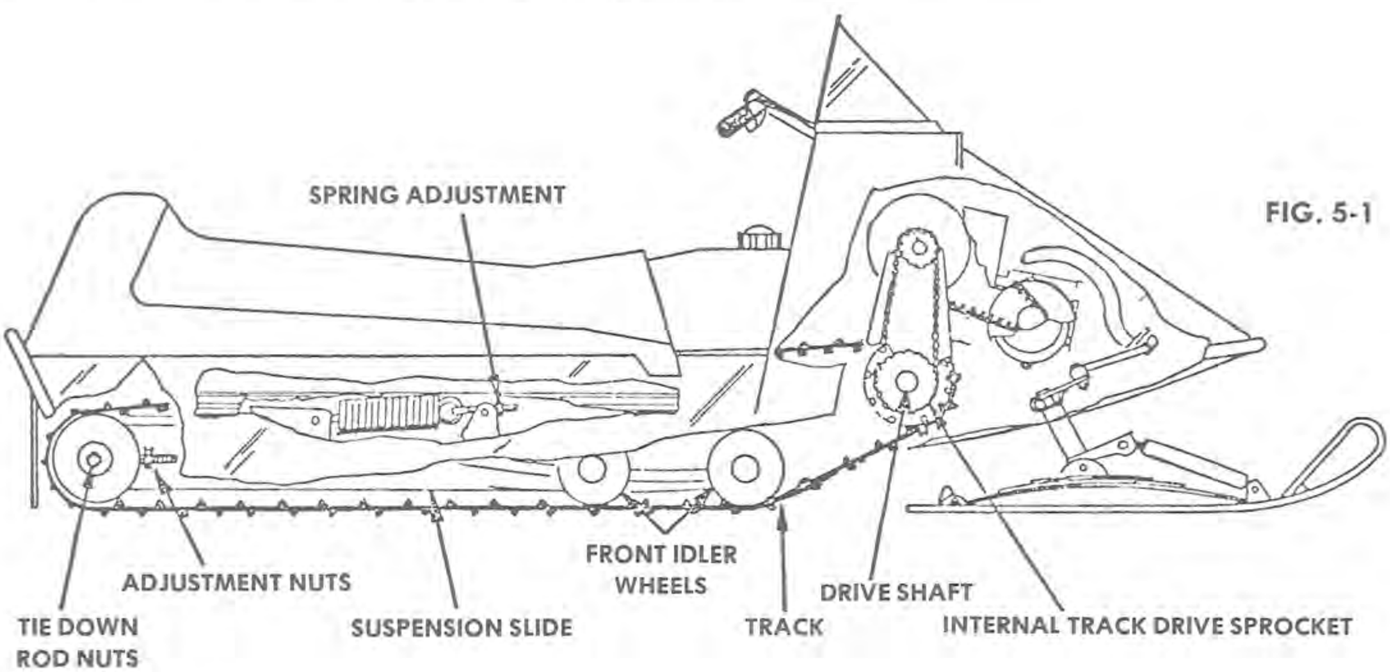


FIG. 5-1

SUSPENSION SYSTEM REMOVAL

The elements of the suspension/drive must be removed in the following sequence:

1. Slide suspension
2. Chain and chain sprockets
3. Drive shaft

SLIDE SUSPENSION REMOVAL

1. Place the sled on the floor with a 2" x 4" underneath the track. Place weight on the sled to extend the cross shaft.

2. Remove the rear mounting screws. Release weight.

3. Remove locking bolts, locks, and front mounting bolts.

4. Plug bleed hole in gas cap. Turn machine on its side. Pull suspension out.

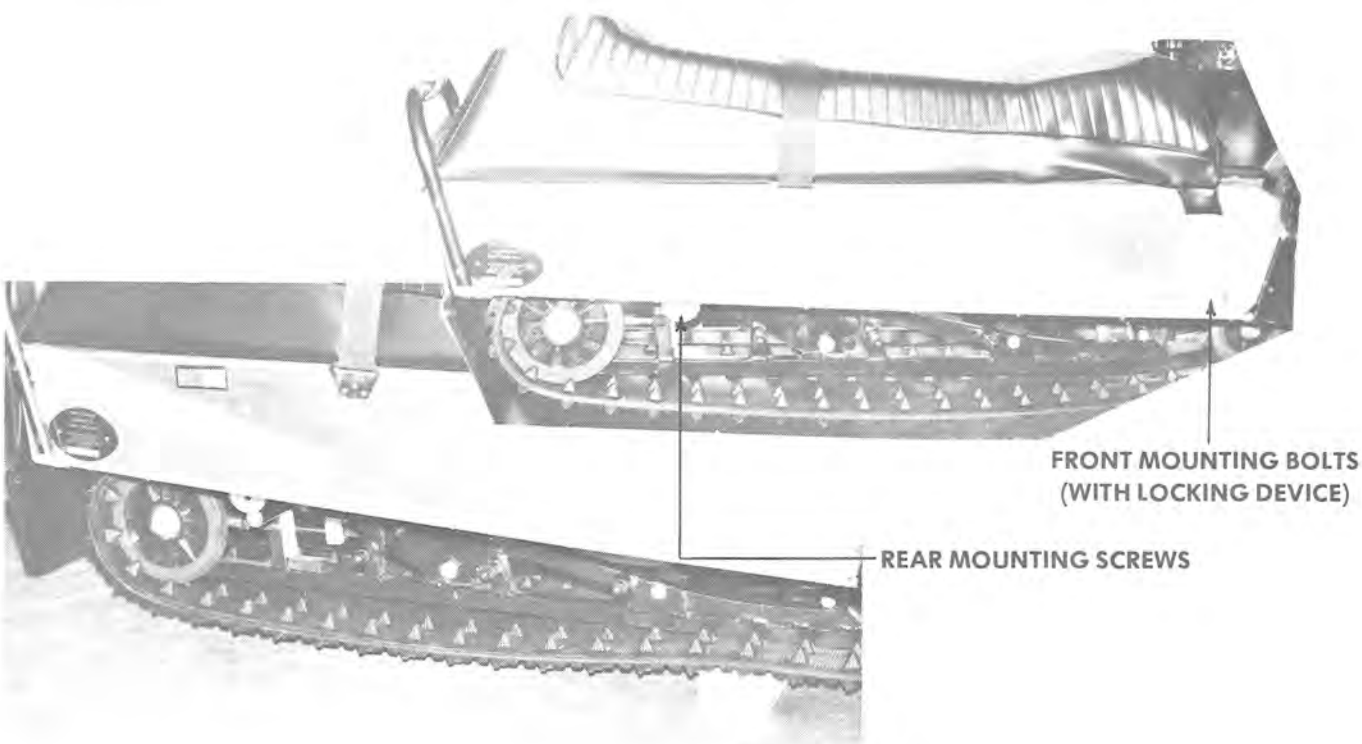


FIG. 5-2

CHAIN DRIVE REMOVAL

1. Remove chaincase cover.

2. Remove chain drive components.

   a. Remove snap ring on upper sprocket.

   b. Remove bolt on lower sprocket.

   c. Back out chain tension tightening bolt.

   d. Slide sprockets and chain out together.

SNAP RING

CHAIN TENSION TIGHTENING BOLT

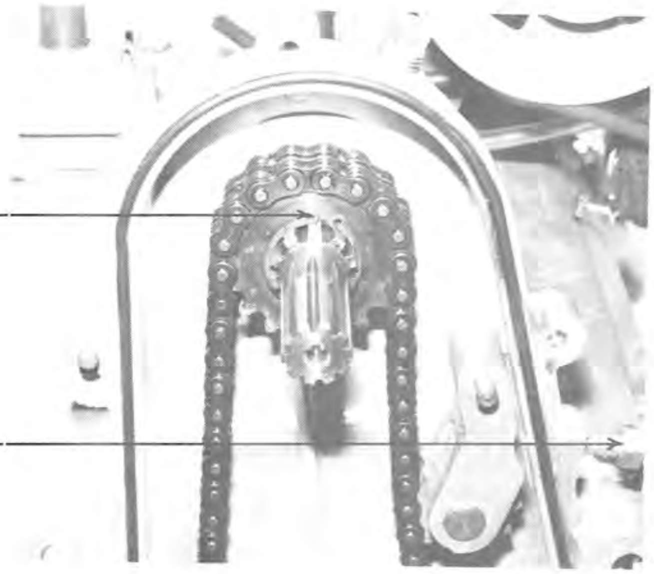


FIG. 5-3A

LOWER SPROCKET BOLT

CHAINCASE MOUNTING BOLTS (4)

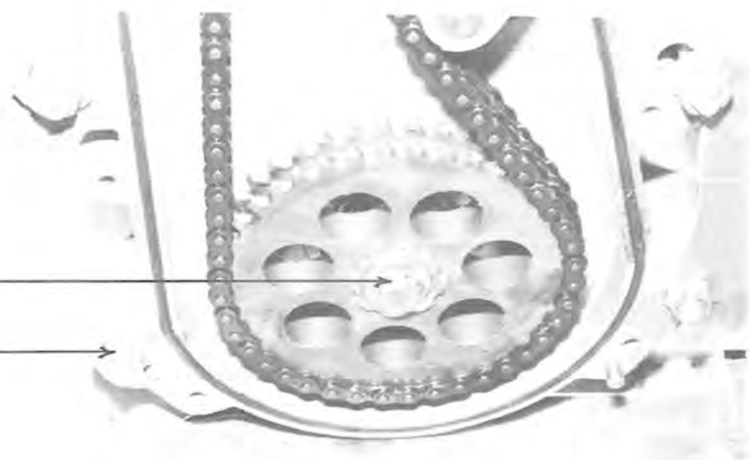


FIG 5-3B

REMOVE FRONT DRIVE

1. Loosen allen screw in collar on left end of shaft just inside chain-case.
2. Rotate collar to loosen.
3. Slide collar over shaft.
4. Loosen chaincase mounting bolts.
5. Push shaft into chaincase hole.
6. Lower opposite end of shaft and pull out of tunnel.

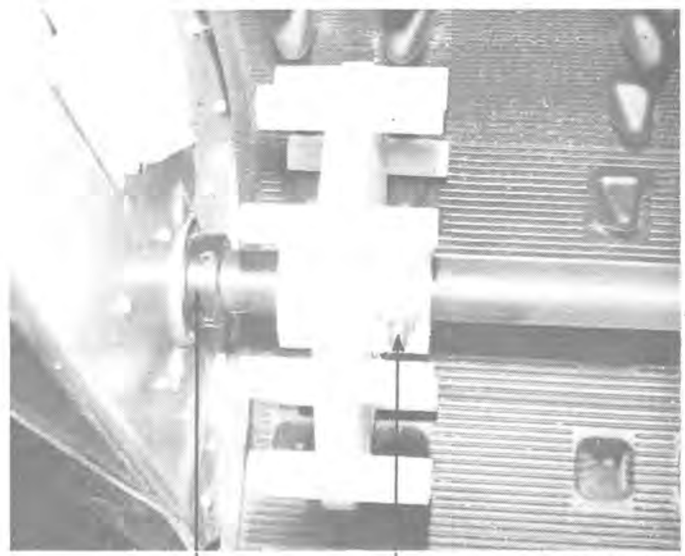


FIG. 5-4

SUSPENSION DISASSEMBLY

1. Remove 5/16" bolts securing sprockets to shaft. (See Fig. 5-4).
2. Slide sprockets off shaft.

SLIDE SUSPENSION

1. Loosen spring adjusting eyebolts. Remove springs.

2. Remove cotter pin, castellated nut and cross bolt. Pull shock assembly out of slide assembly. (See Fig. 5-6).

3. Additional disassembly of the slide suspension may be accomplished by removing shafts which hold the:

    a. front idlers
    b. rear idlers
    c. front mounting weldment (torque arm weldment)

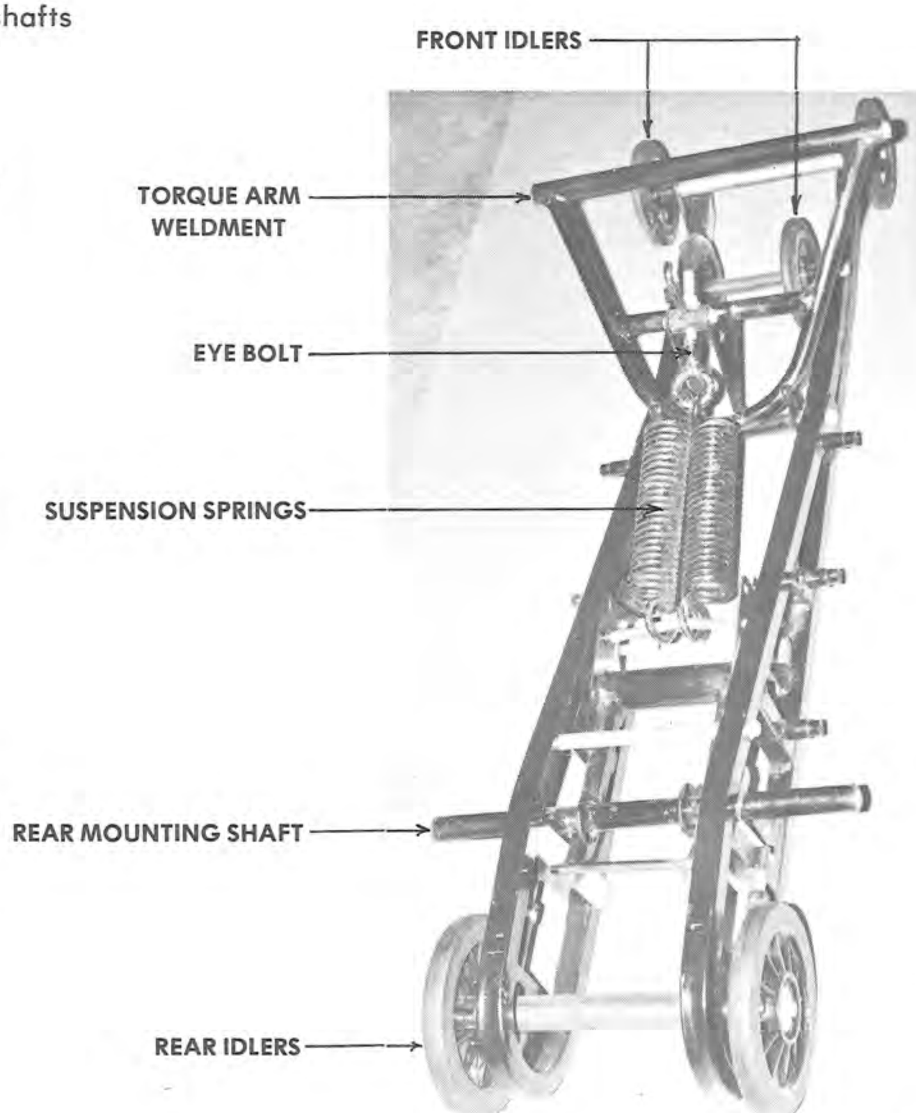


FIG. 5-5

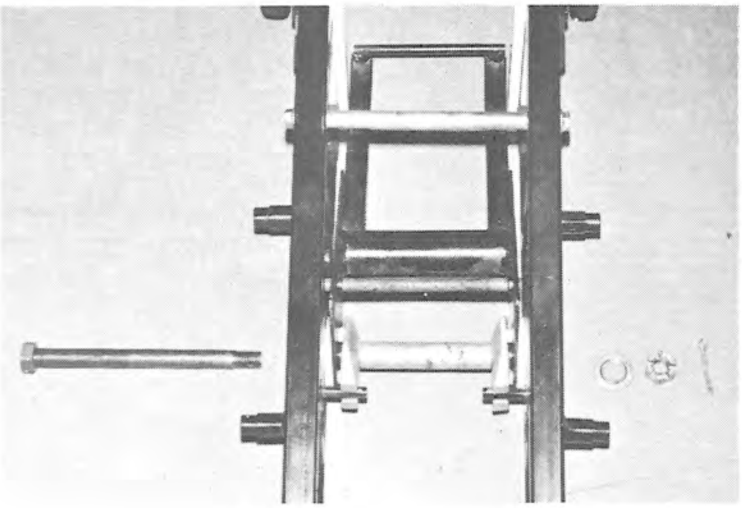


FIG. 5-6

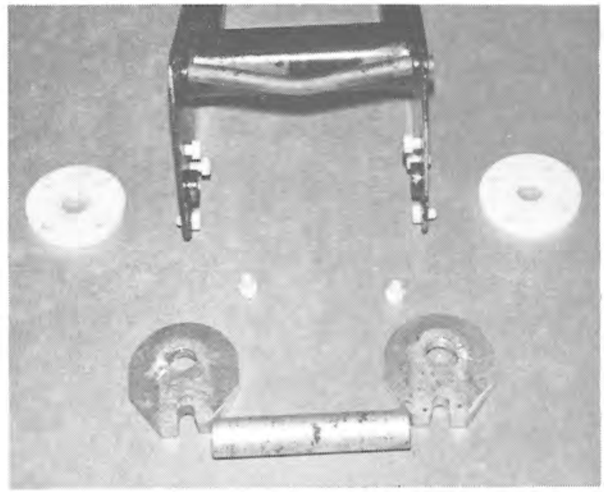


FIG. 5-7

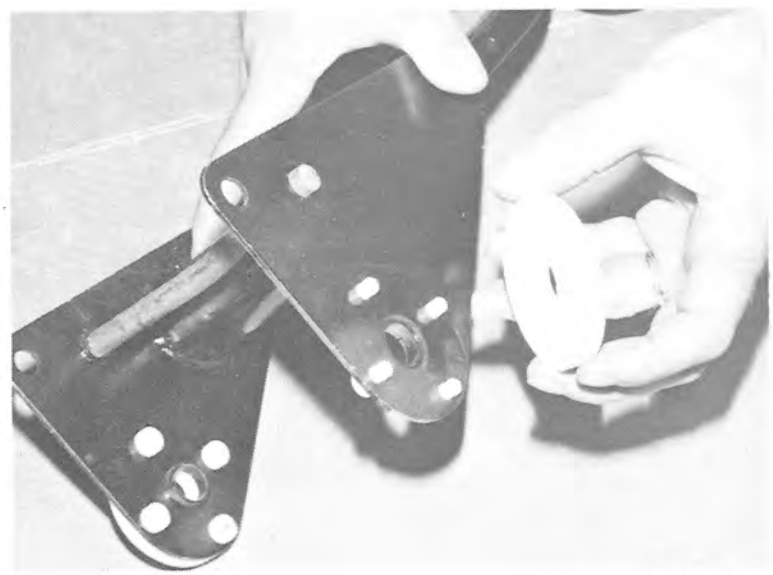


FIG. 5-8

ASSEMBLY/INSTALLATION

Assembly and installation is accomplished in reverse order of removal and disassembly.