TECHNICAL
SERVICE MANUAL

OPERATION, SERVICE AND REPAIR

of

C. C. W.
ENGINES

Model

CCW 290

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SECTIONS PAGE

SECTIONS **PAGE**

LIST OF ILLUSTRATIONS

LIST OF TABLES

SECTION I

INTRODUCTION AND TECHNICAL DATA

1.1 INTRODUCTION

1.2 This manual contains instructions for the operation, service, and repair of Canadian Curtiss-Wright CCW 290 two cycle engine.

1.3 The model CCW290 engine is shown in Figure 1-1. This engine is designed for use in various snowmobile configurations and is suitable for use in All Terrain Vehicles or similar applications.

1.4 The instructions detail the procedures and tools required to ensure efficient operation, servicing and repair of the engine and component parts. Refer to Parts Catalogue for tool cross-reference.
Engine nuts, bolts and threads are metric except for the engine mounting bolts, which are 7/16" SAE coarse, and the power take off (P.T.O.) end of the crankshaft which is 1/2" SAE fine (20TPI).

1.5 Carburetion data for the engine models covered in this manual is detailed under separate instructions. For carburetor technical requirements refer to applicable manufacturer's specifications.

1.6 MODEL DESIGNATION

1.7 The letters and numbers in the subject engine models designate the following:–

CCW – Manufacturer's type designation.
290 – Cubic centimeter displacement
– S Manual Start
– E Electric Starter
– G Geared flywheel (for subsequent electric starter installation.

SERIAL NOS. COMMENCING	MODEL	YEAR
30	CCW 290/1	
40	CCW 290/2	

1.8 TECHNICAL DATA

Table 1-1 details specifications applicabie to the models CCW 290 engine. (see page 1-2).

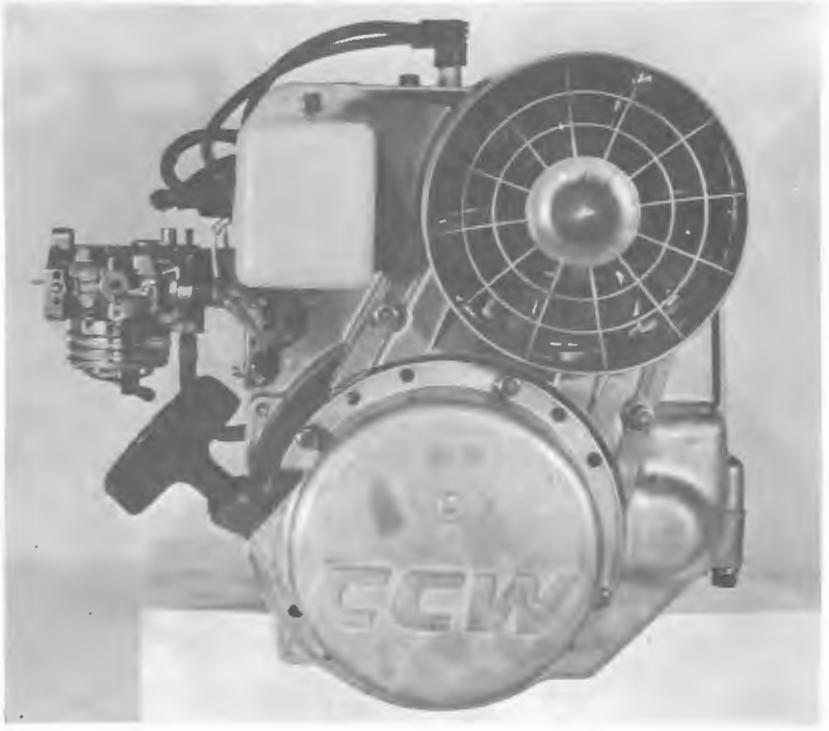


FIGURE 1-1 CCW MODEL 290 ENGINE

SPECIFICATION	CCW 290 SER 3000000 – 3999999	CCW 290 SER 4000000 – 4999999
Cycle:	Two stroke	Two stroke
Number of cylinders:	Two	Two
Displacement	290 cc (17.7 cu.in.)	290 cc (17.7 cu.in.)
Stroke:	54 mm (2.125 in.)	54 mm (2.125 in.)
Bore:	58.5 mm (2.305 in.)	58.5 mm (2.305 in.)
Compression ratio:	6.8 (145 PSI @ 450 RPM)	7.5 (160 PSI @ 450 RPM)
Rating:	20 BHP at 6,000 rpm	23 BHP at 6,500 rpm
Maximum torque:	(17.2 lbs. ft. at 6,000 rpm)	(18.2 lbs. ft. at 6,000 rpm)
Specific fuel consumption under full load:	440 gr/ps.h (0.96 lb/ps.h)	440 gr/ps.h (0.96 lb/ps.h)
Ignition system:	Auto-advanced flywheel ignition with lighting coil 12V - 75W	Auto-advanced flywheel ignition with lighting coil 12V - 75W
Contact breaker gap:	0.3 to 0.4 mm (.012 to .016 in.)	0.3 to 0.4 mm (.012 to .016 in.)
Ignition timing setting when fully advanced:	25^0 BTDC	25^0 BTDC
(Static timing setting): BTDC	10^0 (.020" BTDC on Piston)	10^0 (.020" BTDC on Piston)
Spark Plug:		
Spark plug gap:	0.6 to 0.7 mm (0.024 to 0.028 in.)	0.6 to 0.7 mm (0.024 to 0.028 in.)
Starter system:	Rewind starter with emergency starting pulley or electric starter (output 0.5 kw)	Rewind starter with emergency starting pulley or electric starter (output 0.5 kw)
Carburetor:	Tillotson HR or equivalent	Tillotson HR or equivalent
Fuel:	Mixture, gasoline of known brand and special air cooled two stroke engine oil. (See Table 2-2)	Mixture, gasoline of known brand and special air cooled two stroke engine oil. (See Table 2-2)
Mixture ratio:	20:1 (at normal operating conditions)	20:1 (at normal operating conditions)
Rotation direction of engine:	Left hand (standard configuration) see toward the power take off end of the engine.	Left hand (standard configuration) see toward the power take off end of the engine.
Weight:	54 lbs.	54 lbs.
Inlet port, timing	134^0	
height	19.5 mm	20.5 mm
width	42 mm	45 mm
Exhaust port, timing	165^0	170^0
height	21 mm	22 mm
width	28 mm	35 mm
Piston height:	67 mm	67 mm
Piston ring, chromium plate, top	1	1
Piston ring, gray cast-iron, bottom	1	1
Cylinder head, volume	16 cc	14 cc
Cooling fan, blades	8	8
ratio	1.81:1	2.03:1
MAGNETO	DENSO	DENSO
IGNITION COILS	DENSO	DENSO
Resistance, primary	.37Ω ± 10%	.37Ω ± 10%
Resistance, secondary	8.35KΩ ± 15%	8.35KΩ ± 15%
Current rating	1.5/1.75 amps	1.5/1.75 amps
Spark in free air (three needle gap)	8 mm @ 500 RPM 15 mm @ 5,500 RPM	8 mm @ 500 RPM 15 mm @ 5,500 RPM

SECTION II

OPERATION AND SERVICE INSTRUCTIONS

2.1 PRINCIPLES OF OPERATION

a. The CCW two stroke engine is designed to complete in one revolution, or two strokes of the piston, the complete cycle of (a) fuel/air induction, (b) compression of the fuel mixture, (c) combustion, (d) exhaust of the burned gases.
b. The construction of the engine requires a sealed crankcase and a cylinder having four carefully positioned ports as follows:
   1. Carburetor inlet for induction of the fuel/air mixture.
   2. Two transfer ducts leading to transfer ports for transferring the mixture from the crankcase to the combustion chamber.
   3. Exhaust port for exhausting the burned gases.
c. The first stroke of the piston, from bottom dead center (B.D.C.) to the top dead center (T.D.C.), has two functions:
   1. To induce a mixture of fuel and air into the crankcase via the carburetor.
   2. To compress the charge in the combustion chamber.
d. The second stroke of the piston, from T.D.C. to B.D.C., also has two functions:
   1. To uncover the exhaust ports and allow the burned gases to escape.
   2. To compress the fuel mixture in the crankcase and transfer it through the two transfer ducts to the combustion chamber.

2.2 SEQUENCE OF OPERATION (see Figure 2-1)

a. As the crankshaft rotates, the piston moves from the B.D.C. position, thus creating a depression (or partial vacuum) in the crankcase. When the piston uncovers the

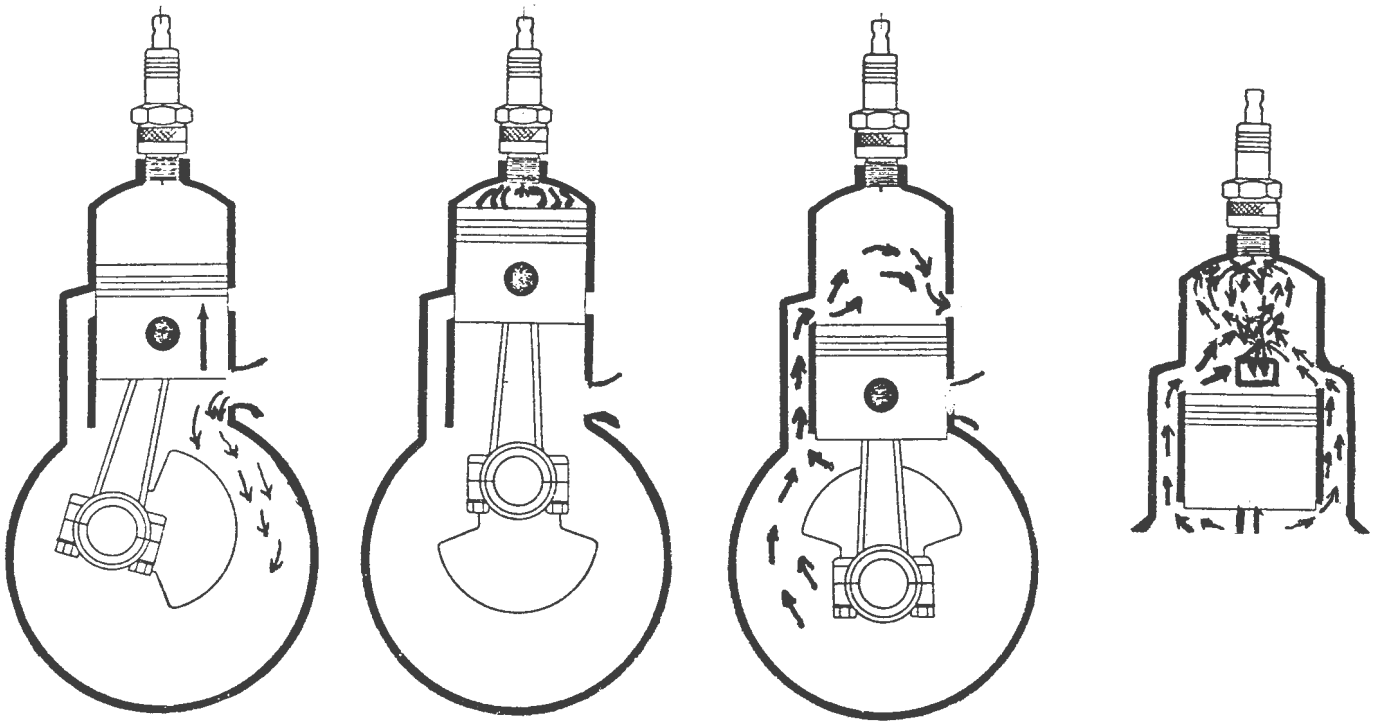


FIGURE 2-1 TWO STROKE ENGINE: OPERATING PRINCIPLES

carburetor inlet port, fuel/air mixture, metered by the carburetor, is admitted to the crankcase.

b. Continued upward movement of the piston will compress the charge in the combustion chamber until, at a point near T.D.C., the spark from the spark plug will ignite the mixture.
c. Resultant expansion of the ignited fuel will push the piston toward B.D.C. Moving downward, the piston first uncovers the exhaust port and allows the hot gases, still under considerable pressure, to escape to atmosphere through the exhaust system.
d. Continuing downward, the piston will now uncover the two transfer ports and close the carburetor inlet port. The mixture in the crankcase and lower part of the cylinder is displaced by the piston and conducted through the transfer ducts to the combustion chamber above the piston. The fresh charge, entering through the two transfer ports will form a loop (see Figure 2-1), thus scavenging the cylinder of burned gases.
e. The cycle will repeat continuously as from paragraph (a) until the engine ignition is switched off.

2.3 IGNITION SYSTEM

2.3.1 General

The ignition system used with model CCW 290 engine is basically the same as systems used with most conventional two stroke engines. It consists of a low tension magneto, two high tension ignition coils, two ignition spark plugs, spark plug (high tension) lead wires, an ignition switch and the required electrical wiring.

2.3.2 Description

The magneto assembly is mounted to the engine crankcase at the flywheel end. It functions to generate low tension impulses in the primaries of the ignition coils. Two sets of contact breaker points, one set for each cylinder, are installed in the magneto. During engine operation, a cam, mounted on the flywheel, opens and closes the breaker points in sequence. A condenser, wired in parallel across each set of breaker points, protects the points from damage caused by self-induced electrical surges in the primary coil. Lighting and battery charging coils (see paragraph 2.6) are mounted on the magneto coil plate. The coils produce the electrical power required to operate a 12-volt lighting system and to charge the battery used with electric started engines.

Low tension (primary wires) leading from the magneto are encased in a protective cover and routed through a grommet, located in the fan cover case, to the ignition coupler on the fan cover.

2.3.2.2 DENSO Ignition (See Figure 2-3)

The magneto used with model 290 ignition systems has two low tension generating coils. One end of each coil is grounded to the magneto frame. The other end of the coil connects in parallel to the breaker point set and the primary of one ignition coil.

2.3.3 Operation (See Figure 2-2)

The ignition switch is connected in parallel with the primary windings of the ignition coils. Operation of the ignition switch to the "RUN" position, opens a circuit between the windings and allows the contact breaker points to control the ignition circuit.

The flywheel incorporates four permanent magnets and a breaker point cam and auto advance mechanism. In operation, as the flywheel rotates, an electrical current is generated in the low tension generating coil. The rotating breaker point cam activates the breaker points, opening and closing them in accordance with a timed ignition sequence. (Refer to Section V, paragraph 5.4.4). Closing the points causes the buildup of a magnetic field in the ignition coils. Opening the points causes a very rapid collapse of the field, thus inducing a high voltage current in the secondary windings of the coil. High tension spark plug wires conduct the high voltage current to the spark plugs.

Self induced high voltage current in the primaries is momentarily stored in the condensers to prevent arcing across the point contacts. When the contacts next close, the condensers will discharge back to the ignition coils, thus assisting in the buildup of the magnetic field in the coils.

The ignition circuit will continue to function until the ignition switch is turned to the "OFF" position which will maintain a circuit and prevent ignition.

2.4 DETONATION:–

The internal combustion engine is designed to induce a combustable mixture of gasoline and air into the cylinder which is subsequently ignited by a spark plug, and the resultant gas expansion utilized to produce the power stroke. Some considerable care is taken in the design to ensure that the combustion takes place at a controlled rate, but under certain conditions the charge will burn at a highly excessive rate, producing abnormal gas temperatures and pressures in the cylinder. This condition is called detonation and may, therefore, be defined as the rapid and uncontrolled burning of the charge which commences at the point of ignition by the spark plug and is completed prematurely over a very short movement of the piston.

2.4.1 The causes of detonation are many and varied, but all have the common effect of overheating the charge towards the spontaneous combustion temperature of the fuel. Consequently, when the charge is further heated by compression and ignited by the spark, the flame spread rate is very rapid indeed, resulting in the formation of the high pressure wave which impinges on the combustion chamber surfaces to create the sound of detonation of "pinging" which is so familiar to many people.

2.4.2 It cannot be emphasized too strongly that if detonation is allowed to persist, serious damage may result to the engine. Overheating of the engine can cause distortion of the cylinder and cylinder head, seizing and burning of pistons, breaking of cylinder flanges and studs etc.,

In addition, prolonged detonation may lead into pre-ignition of the charge and even more serious consequences to the engine. It is essential, therefore, that detonation should be recognized and the cause eliminated as soon as possible.

2.4.3 Most of the common causes of detonation can be easily rectified:–

1. High compression pressures. (CCW 290 = 175-180 PSI. cold at 500 RPM.) see Tech. Data.
2. Incandescent points in the combustion chamber due to ash deposits.
3. Wrong type of spark plugs. (See Table 1-1)
4. Spark plug overheated due to seat washer being worn or missing.
5. Incorrect ignition timing. (See section 5.4.4)
6. Weak carburetor settings.
7. High ambient temperatures. (Over 95° F.)
8. Partially choked exhaust system causing high back pressure.

2.5 PRE-IGNITION may be defined as the premature burning of the charge due to spontaneous combustion, and before the specified timed ignition point by the spark plug. The resultant gas expansion, acting on the rising piston, generates extreme temperatures and pressures in the combustion chamber and frequently results in broken pistons, bent connecting rods, twisted or bent crankshaft and damaged bearings.

Pre-ignition is usually caused by overheating and can be readily identified by the very heavy knocking which is due to gas expansion on the rising piston. It is usually preceded by detonation, but certain conditions such as an under-sized or choked exhaust system, will cause the engine to go straight into pre-ignition without detonation. It is imperative that the engine should be stopped at once by closing off the air supply to the carburetor. It will be apparent that the engine cannot be stopped by switching off the ignition.

2.6 LIGHTING SYSTEM

2.6.1 Vehicle lighting is provided by lighting and battery charging coils in the magneto, and the necessary wiring and light switches required to operate the system.

2.6.2 Operation

2.6.2.1. Engines **Model 290**

The engines are equipped with a six pole terminal coupling for the ignition and lighting circuits. The lighting and battery charging sources are a single centre tapped coil with the ends terminated by yellow wires at the coupler and the centre tap ground extended to the coupler by a brown wire.

N.B.

This brown wire may be disconnected provided a satisfactory ground is maintained between the lighting circuits and the engine.

The coil is rated at a nominal 12 volt 75 watt maximum and can be connected to meet the various electrical configurations.

1. ONE HEADLAMP 12V35W - ONE TAIL LAMP 12V3W
See Figure 2-3

A ballast resistor rated at 5.3 ohms 40 watts must be connected in parallel with the headlamp to prevent lamp burn out. It will be noted from Figure 2-3 that an alternative resistor at 7 ohms 40 watts will raise the operating voltage across the lamp to give a better light at the cost of reduced lamp life.

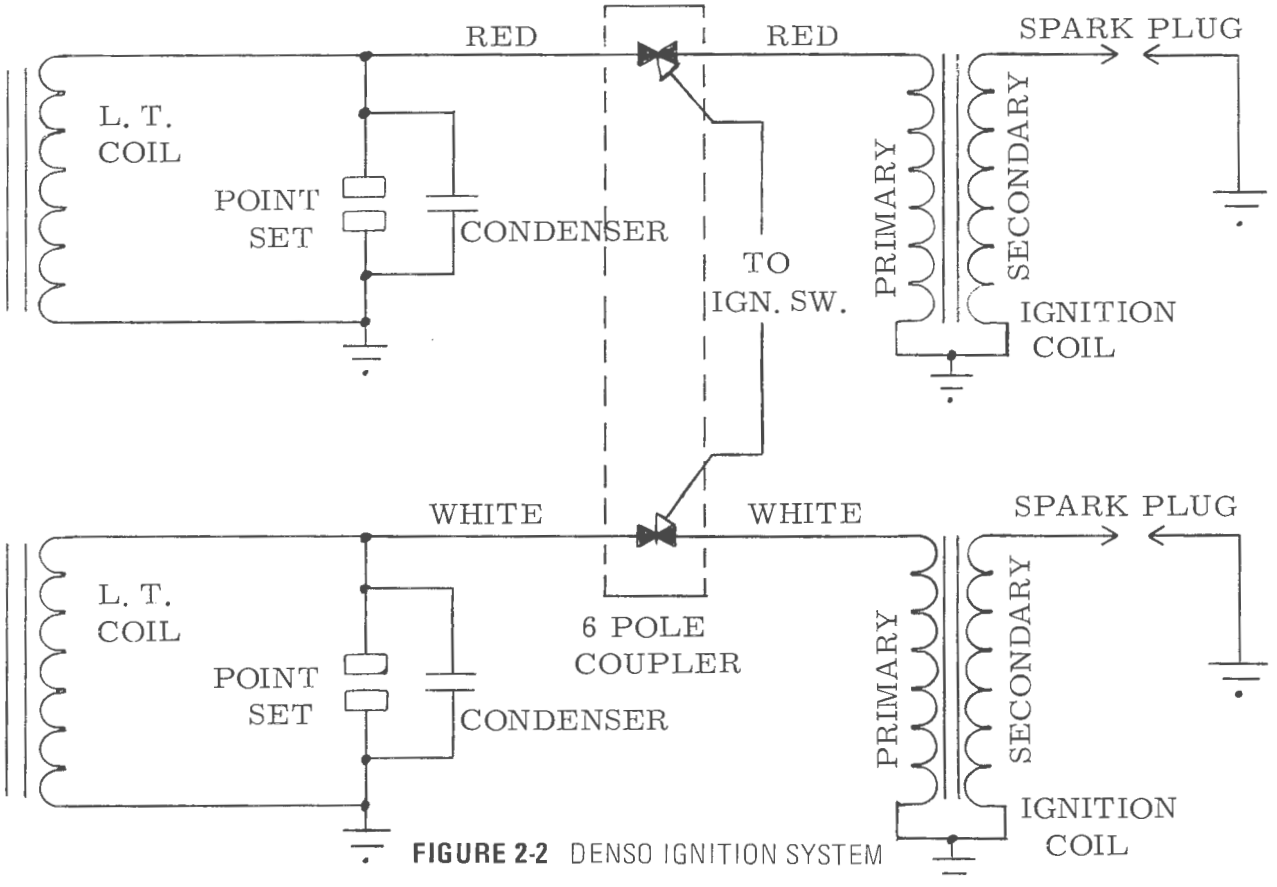


FIGURE 2-2 DENSO IGNITION SYSTEM

2. Two Headlamps 12V35W - Two Tail Lamps 12V3W
(See Figure 2-4)
The head and tail lamps are connected in parallel across one yellow wire and ground through the lighting switch, and the ballast resistor is, of course, unnecessary.

3. Electrical Start Engines (See Figure 2-5)
On engines equipped with an electric starter motor, a full wave rectifier, CCW Part No. 43-0715-10, is connected to the two yellow wires at the terminal coupler and the A.C. output is converted to D.C.A. 7.5 amp fuse is connected to the D.C: output red wire and the circuit is completed via the lighting switch to charge the battery. Head and tail lamps are connected across the battery terminals as shown in Figure 2-5.

2.7 PERIODIC SERVICING

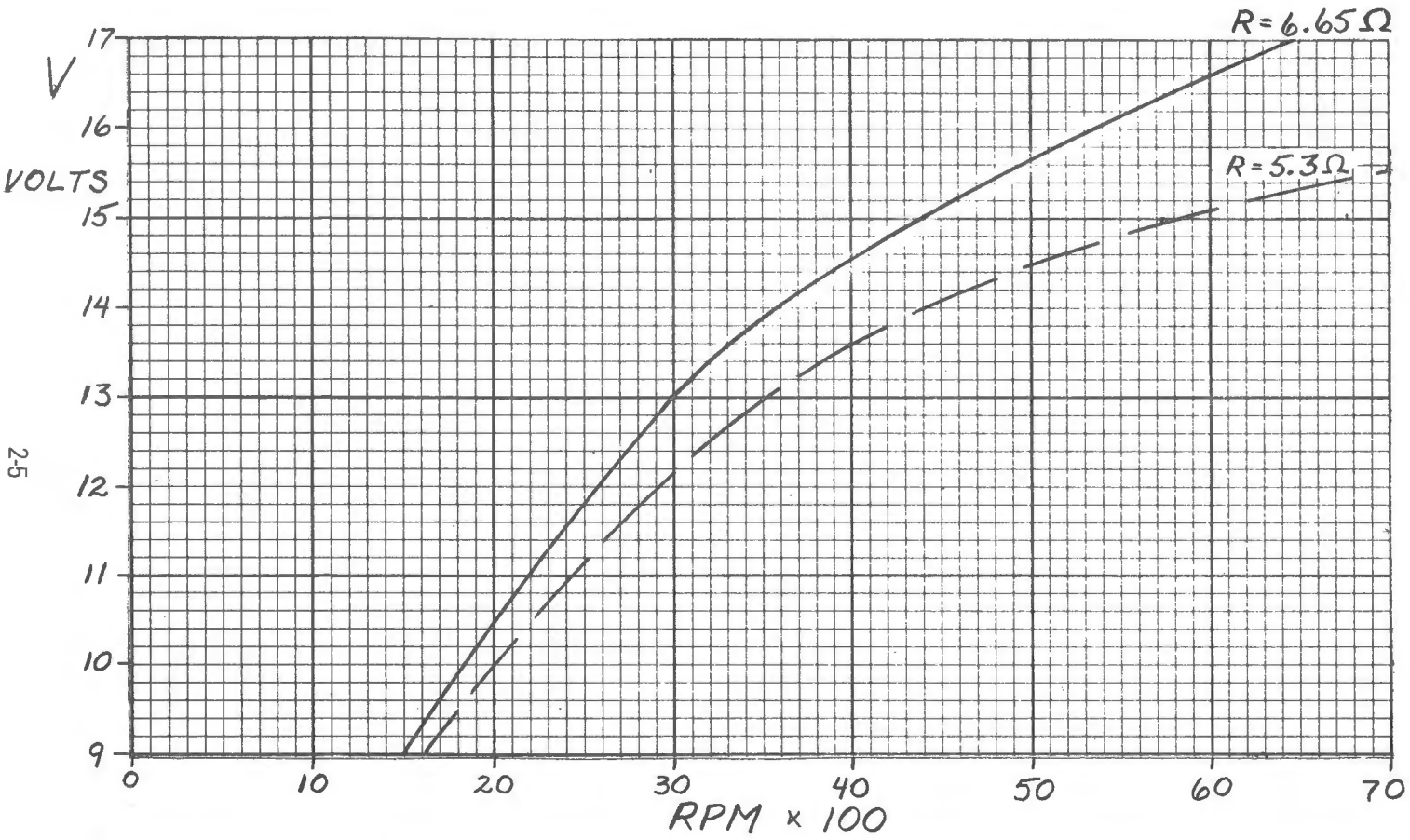
2.7.1 Spark Plugs
Remove, inspect, clean and/or adjust spark plugs at regular intervals as necessary. (See Section III, para. 3.3.4). Discard excessively burnt or damaged plugs. Install only specified spark plugs after adjusting to proper gap. (Table 1-1).

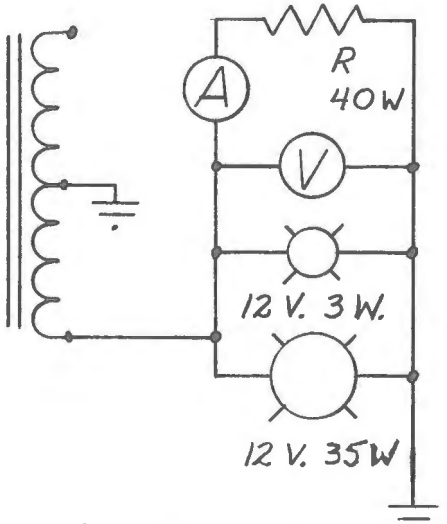
2.7.2 Fan Belt
Periodically check fan belt for wear, fraying and proper tension. A properly adjusted fan belt should leave approximately 1/4 inch side play when flexed by hand at a point near center of belt length.
Adjust fan belt tension as follows:
a. Remove 19 mm nut, lockwasher and plain washer from threaded end of fan shaft, using locking tool Part No. 43-0792-50.
b. Remove outer pulley. Remove spacer(s), as required, to achieve proper tension.
c. Install outer pulley, plain washer, lockwasher and nut. Ensure belt is properly engaged between pulley halves. Tighten nut securely.

NOTE: Retain surplus spacer(s) for use when a new belt is to be installed.

2.7.3 Troubleshooting
Table 2-1 lists probable causes of engine malfunction and remedial action required to correct faults. For spark plug, breaker points and engine timing specifications, refer to Technical Information, Table 1-1.

CENTRE TAP LIGHTING COIL
CCW 290 DENSO IGNITION





NOTE: SWITCH IS OMITTED TO SIMPLIFY CIRCUIT.

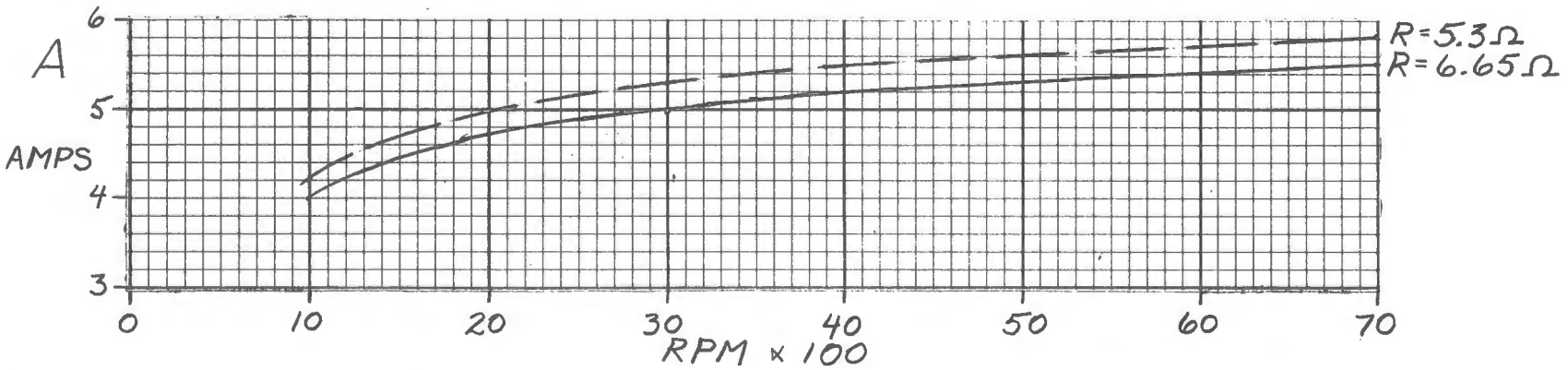
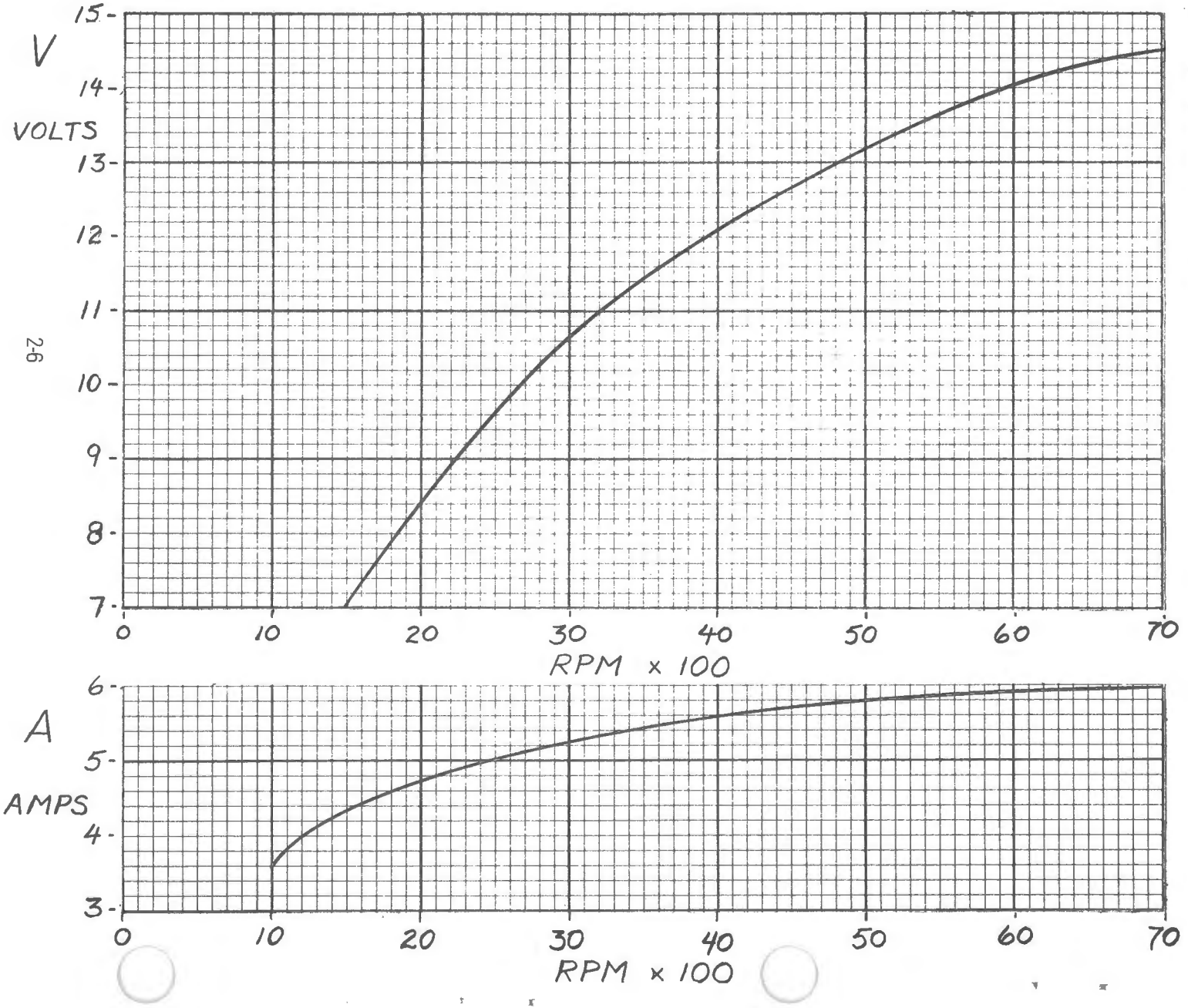
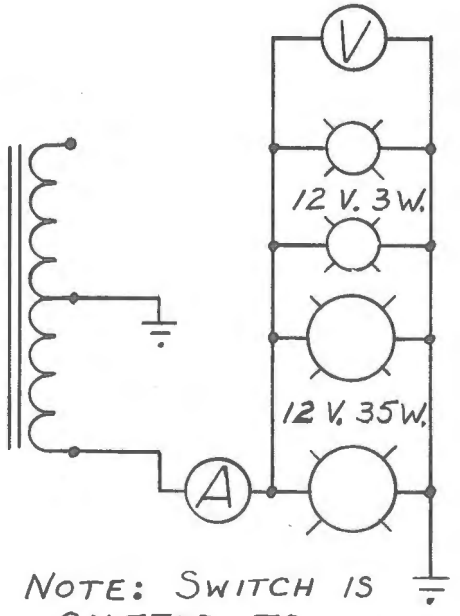


FIGURE 2-3

CENTRE TAP LIGHTING COIL
DENSO IGNITION

CCW 290



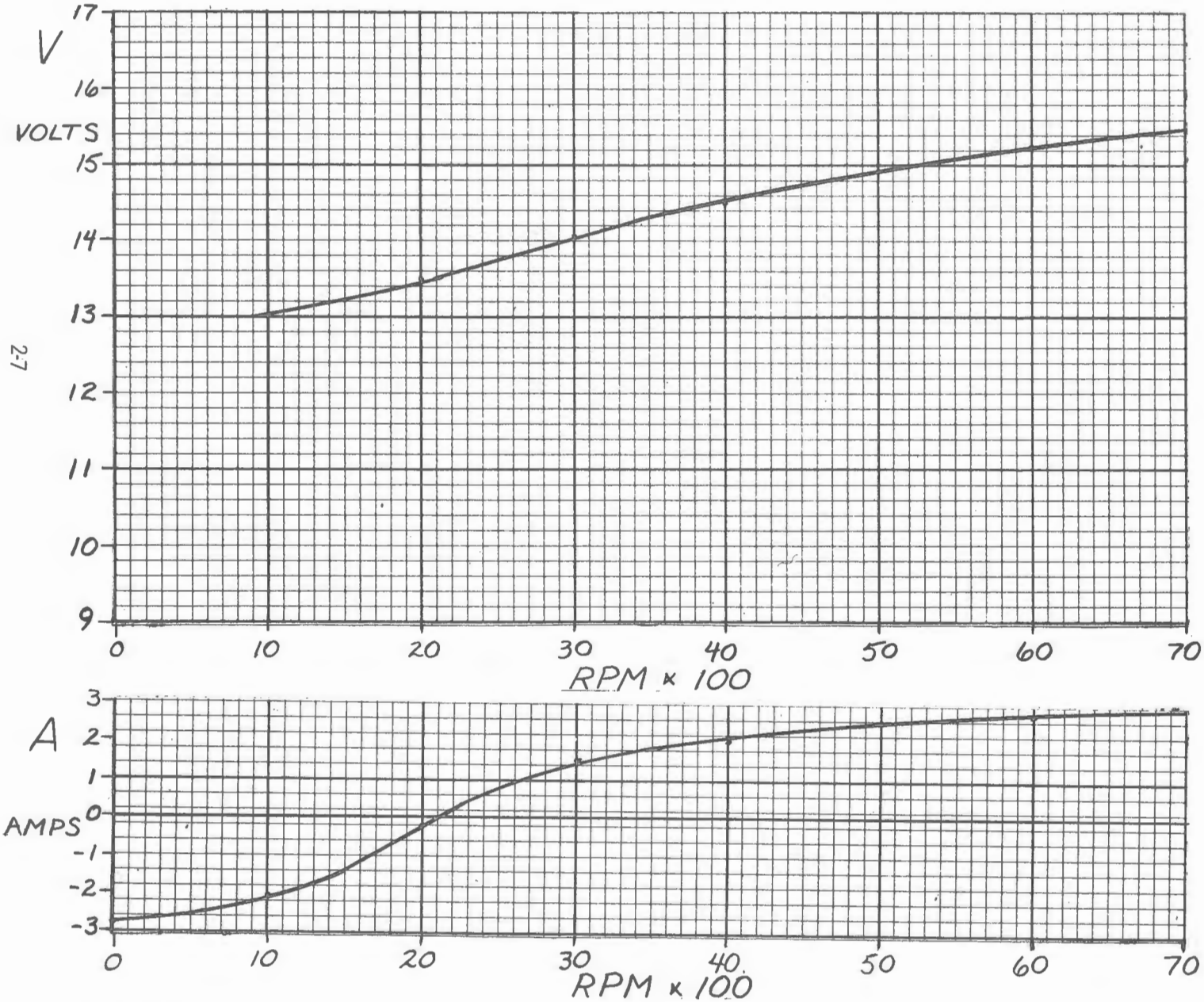


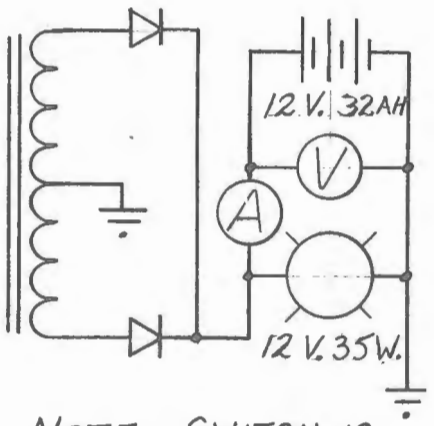
NOTE: SWITCH IS OMITTED TO SIMPLIFY CIRCUIT.

FIGURE 2-4

CENTRE TAP LIGHTING COIL

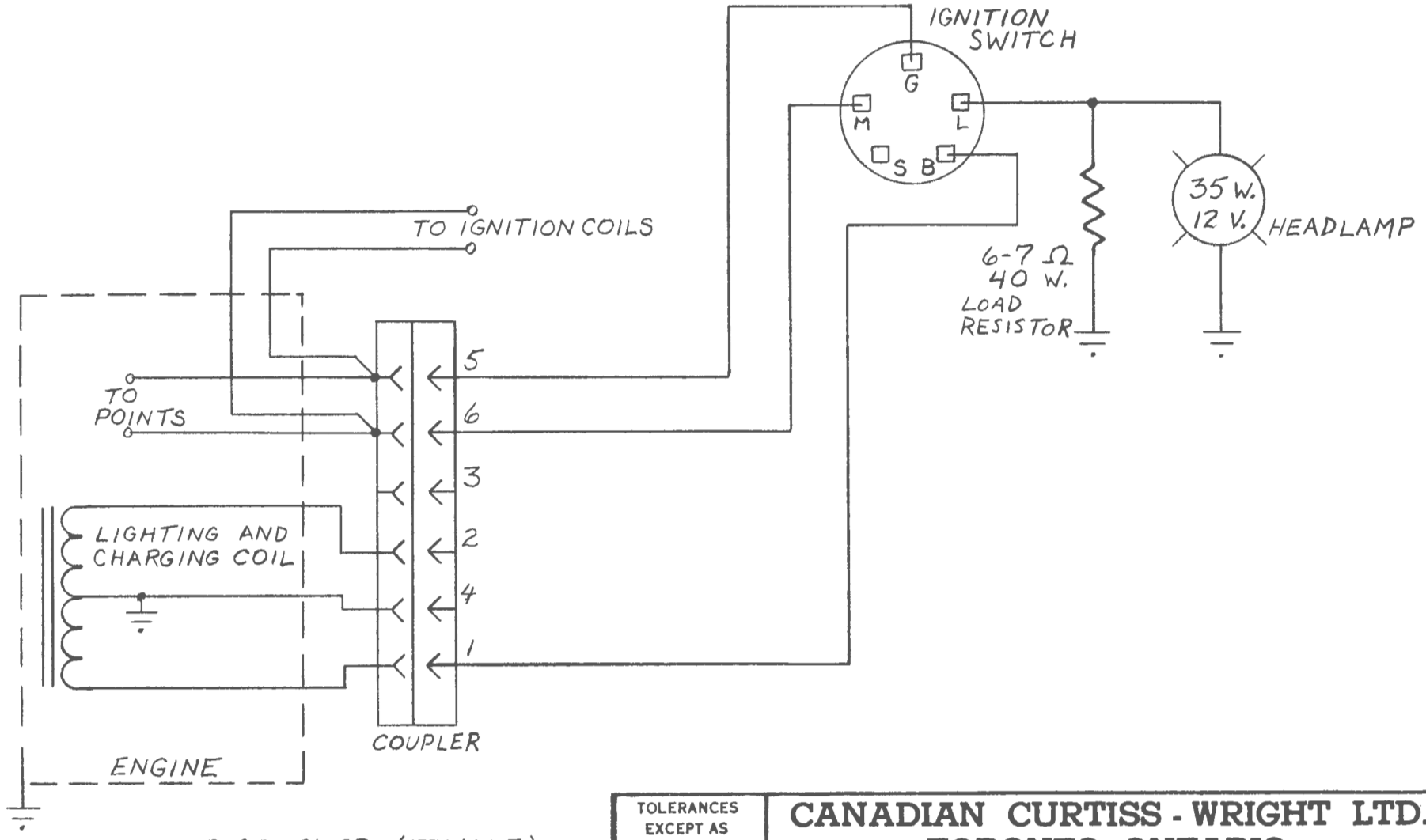
CCW 290 DENSO IGNITION

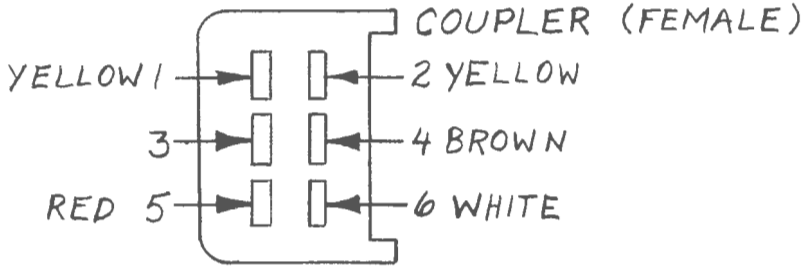




NOTE: SWITCH IS OMITTED TO SIMPLIFY CIRCUIT.

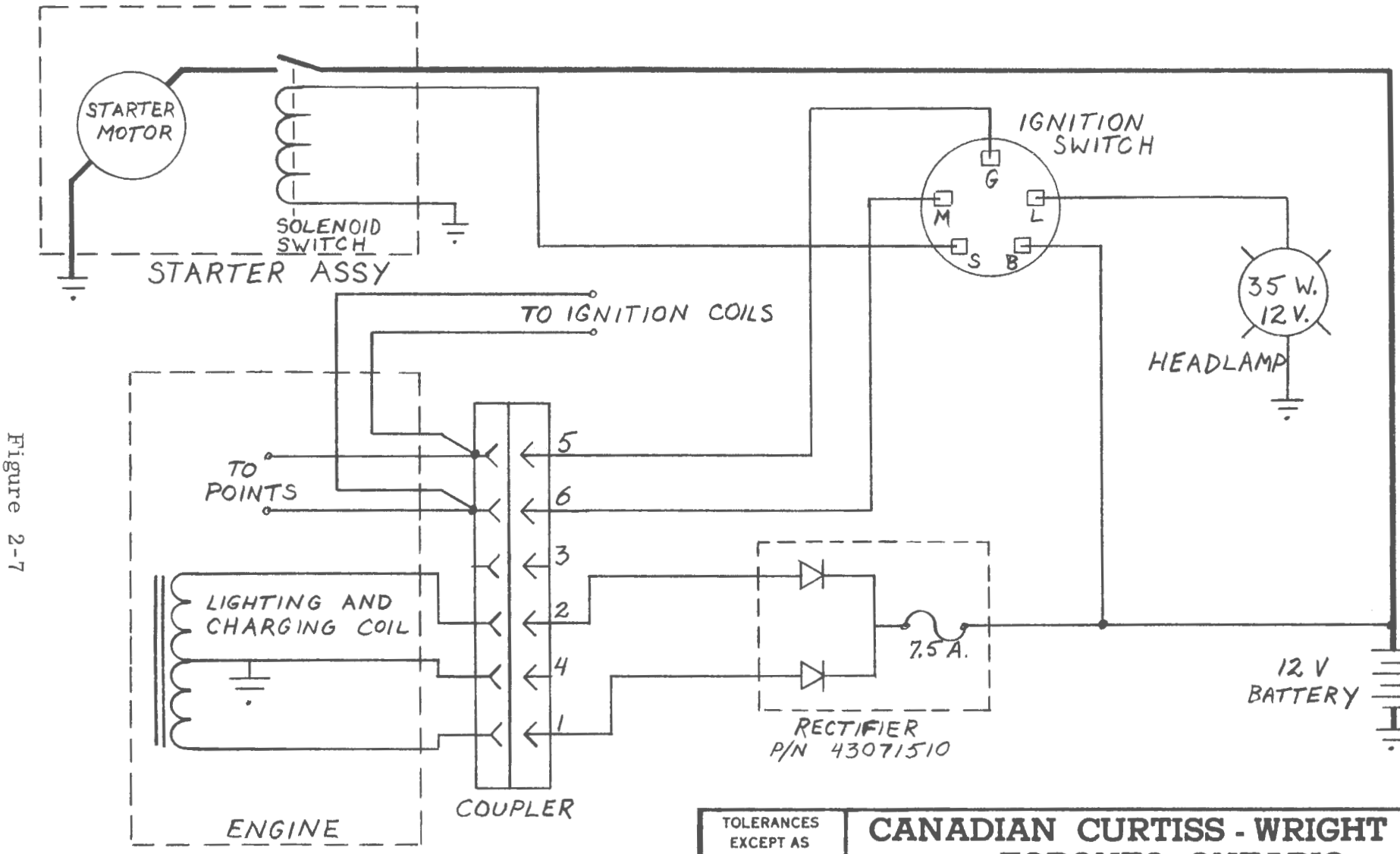
FIGURE 2-5





TOLERANCES EXCEPT AS NOTED	CANADIAN CURTISS - WRIGHT LTD. TORONTO ONTARIO		
DECIMAL ± —	CCW 290	SCALE —	DRAWN BY A Pope / APPROVED BY
FRACTIONAL ± —	TITLE TYPICAL WIRING DIAGRAM MANUAL START ENGINES		
ANGULAR ± —	DATE	DRAWING NUMBER FIGURE 2-6	

Figure 2-6
2-8



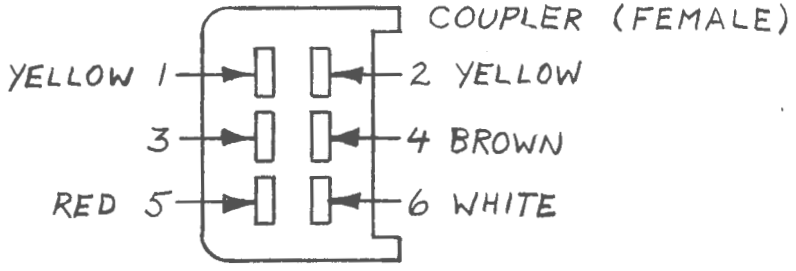


Figure 2-7

TOLERANCES EXCEPT AS NOTED	CANADIAN CURTISS-WRIGHT LTD. TORONTO ONTARIO		
DECIMAL ± —	CCW 290	SCALE —	DRAWN BY APoss / APPROVED BY
FRACTIONAL ± —	TITLE TYPICAL WIRING DIAGRAM ELECTRIC START ENGINES		
ANGULAR ± —	DATE	DRAWING NUMBER FIGURE 2-7	

TABLE 2-1 **TROUBLE SHOOTING CHART**

Trouble	Probable Cause	Remedy
Manual starter rope comes out but pawls don't engage.	1. Lack of friction plate return spring action. 2. Defective pawls.	1. Check friction plate returnspring. Replace spring as required. 2. Check for broken or bent pawls. Replace pawls as required.
Manual starter rope doesn't return.	1. Recoil spring broken or bent. 2. Pulley housing warped or bent. 3. Starting pulley worn.	1. Replace spring. 2. Replace housing. 3. Replace pulley.
Electric starter inoperative	1. Loose electrical connections. 2. Poor ground 3. Faulty battery or circuits. 4. Faulty electric starter	1. Retighten connections. 2. Secure ground connection. 3. Check, recharge or replace battery. 4. Check starter solenoid. Repair or replace. 5. Inspect starter motor for evidence of moisture and broken or worn brushes. Dry out as necessary. Replace brushes as required. 6. Check starter switch. Replace if required. 7. Check harness or connector for broken wire. Repair or replace.
Hard to start or won't start	1. Carburetor adjustments too lean (not allowing enough gas to engine). 2. Inoperative diaphragm or flapper valve. 3. Engine not being choked to start. 4. Spark plugs improperly gapped, dirty or broken. 5. Magneto breaker points improperly gapped or dirty. 6. Head gasket blown or leaking 7. Empty gas tank or improper fuel mixture. 8. Water in fuel system 9. Weak coil or condenser 10. Obstructed fuel system 11. Air leak in crankcase or inlet system. 12. Primary wire broken. 13. Engine not timed properly. 14. Secondary wire not connected or spark plug protector not installed properly.	1. Adjust carburetor. Refer to Manufacturer's Specifications. 2. Refer to Manufacturer's Specifications. 3. Ensure choke is fully closed. 4. Remove plugs. Clean, adjust or install new plugs. 5. Clean, adjust or replace points. 6. Replace gasket 7. Refill tank with specified fuel/oil mixture (See Table 1-1). 8. Drain fuel from carburetor. Add carburetor de-icer as required to fuel. 9. Replace faulty coil or condenser 10. Disconnect fuel lines—clear obstruction. Flush system. Connect fuel lines. 11. Check crankcase pressure (3 - 6 PSIG) 12. Repair or replace primary wire. 13. Re-time engine to proper specifications. 14. Secure secondary wire or spark plug protector.
Impossible to adjust idle	1. Spark retarding mechanism not working properly. 2. Pistons or rings worn. 3. Faulty carburetor	1. Repair retard mechanism 2. Replace as necessary. 3. Check carburetor, check valve. Refer to Manufacturer's Specifications.

TABLE 2.1 **TROUBLE SHOOTING CHART**

Missing at low speed or won't idle smoothly or slowly	1. Incorrect carburetor idle adjustment.	1. Adjust idle – Refer to Manufacturer's Specifications.
	2. Spark plugs improperly gapped or dirty.	2. Clean, adjust or install new plugs.
	3. Head gasket blown or leaking	3. Replace gasket.
	4. Loose or broken magneto wires	4. Repair or replace wires.
	5 Magneto breaker points improperly gapped or dirty.	5. Adjust, clean or install new points.
	6 Weak coil or condenser	6. Replace coil or condenser
	7. Improper fuel mixture (1) Too much oil (2) Too little oil	7. Refuel, using specified fuel/oil mixture (See Table 1-1).
	8. Leaking crankshaft seal	8. Replace seal.
Missing at high speed or intermittent spark.	1. Spark plugs improperly gapped or dirty.	1. Clean, adjust or install new plugs.
	2. Loose or broken magneto wires.	2. Repair or replace wires.
	3. Magneto breaker points improperly gapped or dirty.	3. Clean, adjust or install new points.
	4. Weak coil or condenser	4. Replace coil or condenser
	5. Heat range of spark plug incorrect.	5. Install specified spark plugs.
	6. Leaking head gasket.	6. Replace head gasket.
	7. Engine improperly timed.	7. Re-time engine.
Coughs, spits, slows down, surges	1. Idle or high speed jets too lean.	1 to 5. Adjust carburetor or fuel pump. Refer to Manufacturer's Specifications.
	2. Leaking gasket flange.	
	3. Inlet control lever set too low	
	4. Pulsation line obstructed	
	5. Fuel pump not supplying enough fuel due to: (1) Punctured diaphragm (2) Inoperative flapper valve.	
	6. Crankcase not properly sealed.	6. Reseal crankcase.
	7. Idle or main carburetor nozzle obstructed.	7. Refer to Manufacturer's Specifications.
	8. Fuel line obstructed.	8. Remove fuel line. Clear obstruction. Replace line.
	9. Carburetor inlet needle and seat obstructed.	9. Refer to Manufacturer's Specifications.
	10. Welch plug leaking.	10. Refer to Manufacturer's Specifications.
Overheating	1. Carburetor too lean	1. & 2. Adjust carburetor. Refer to Manufacturer's Specifications.
	2. Carburetor too rich	
	3. Incorrect timing	3. Retime engine to Specifications.
	4. Too much carbon	4. Remove cylinder heads. Clean top of pistons and inside compression chamber. Clean out exhaust port.
	5. Spark plug too hot	5. Install specified spark plugs.
	6. Air deflector not installed	6. Install air deflector.
	7. Air leak in manifold	7. Tighten nuts or change gaskets.
	8. Crankcase seal leaking	8. Fit new seal.
Vibrates excessively or runs rough and smokes.	1. Idle or high speed carburetor adjustment too rich.	1. to 5. Adjust carburetor. Refer to Manufacturer's Specifications.
	2. Choke not opening properly (bent linkage).	

TABLE 2.1 **TROUBLE SHOOTING CHART**

	3. Inlet control lever too high (carburetor floods).	
	4. Idle air bleed plugged.	
	5. Welch plug loose.	
	6. Muffler obstructed	6. Check and clear muffler.
	7. Engine not secured tightly to engine support.	7. Tighten engine mounting bolts.
	8. Water in gas.	8. Add carburetor de-icer fluid as required.
	9. Water in the ignition switch.	9. Dry out switch, using suitable de-icer spray or heat.
Won't start, kicks back and backfires.	1. Spark plug wires reversed	1. Install wire correctly.
	2. Flywheel key missing or sheared	2. Replace key.
	3. Faulty condenser	3. Replace condenser
	4. Improper timing	4. Re-time engine
	5. Faulty breaker points	5. Adjust or replace points.
	6. Unhooked spark retarding mechanism-or spring broken	6. Reconnect mechanism or replace spring
No acceleration, low top R.P.M., hard to start	1. Spark plugs improperly gapped or dirty.	1. Clean, adjust or install new plugs.
	2. Magneto breaker points improperly gapped or dirty.	2. Clean, adjust or install new points.
	3. Faulty coil or condenser.	3. Replace coil or condenser.
	4. Loose or broken magneto wires.	4. Repair or replace magneto wires.
	5. Blown head gasket.	5. Replace head gasket.
	6. Inlet lever adjustment too low	6. Refer to carburetor manufacturer Specifications.
	7. Crankcase leaking	7. Install new seal.
Good spark but engine runs on one cylinder.	1. Leaking cylinder head	1. Check head for warps, cracks. Install new gasket and cylinder head
	2. Magneto wires broken inside (coil ground broken).	2 Repair or replace wires.
	3. Cracked cylinder wall	3. Replace faulty cylinder.
	4. Defective spark plug.	4. Clean, adjust or install new plug
	5. Breaker points improperly gapped	5. Re-adjust points.
	6. Crankcase seal leaking.	6. Install new seal
No acceleration. Idles well but dies down when put to full throttle.	1. High speed needle set too lean.	1. to 7. Adjust carburetor. Refer to Manufacturer's Specifications
	2. Dirt behind needle and seat.	
	3. High speed jet obstructed.	
	4. Inlet lever set too low.	
	5. Choke partly closed.	
	6. Silencer obstructed.	
	7. Fuel pump not supplying enough fuel due to: (1) Punctured diaphragm (2) Flapper valves distorted.	
	8. Fuel line obstructed.	8. Remove fuel line. Clear obstruction. Replace line.
	9. Not enough oil in gas.	9. Refuel, using specified fuel/oil mixture.
	10. Breaker points improperly gapped or dirty.	10. Adjust, clean or install new points.
	11. Engine improperly timed.	11. Re-time engine to specifications
Engine runs by using choke at high speed.	1. High speed needle set too lean.	1. & 2. Adjust carburetor. Refer to Manufacturer's Specifications.
	2. Dirt behind needle and seat.	

TABLE 2.1 TROUBLE SHOOTING CHART

	3. Fuel line obstructed	3. Remove line, clear obstruction, replace line.
	4. Inoperative fuel pump	4. Refer to Manufacturer's Specifications
No power under heavy load	1. Magneto breaker points improperly gapped or dirty.	1. Clean, adjust or install new points.
	2. Ignition timing too far advanced	2. Adjust timing
	3. Magneto coil plate loose	3. Check magneto and secure coil plate.
	4. Faulty carburetion	4. Refer to Manufacturer's Specifications.
Cranks over extremely easy on one or both cylinders. Loss of compression.	1. Scored piston due to: (1) Not enough oil in gas. (2) Lack of cooling	1. Replace faulty piston.
	2. Blown head gasket.	2. Replace head gasket.
	3. Loose spark plug	3. Check plug for security.
	4. Head bolts not tight enough	4. Torque head bolts to proper specifications.
Engine won't crank over. Unable to rotate flywheel.	1. Piston rusted to cylinder wall	1. Remove piston and cylinder. Replace defective parts.
	2. Crankshaft seized to bearing (main or rod).	2 & 3. Disassemble engine. Replace defective parts.
	3. Broken connecting rod.	
	4. Flywheel seized to coil plate.	4. Remove flywheel. Replace defective parts.
	5. Engine improperly assembled after repair.	5. Recheck re-assembly procedure.

2.8 OPERATING INSTRUCTIONS

2.8.1 Preparation For Operation:

Ensure that the fuel tank is filled with the correct mixture of recommended gasoline and special air-cooled two stroke engine oil. See Table 1-1 and Table 2-2.

CAUTION: When filling or topping up the fuel tank, use a fuel strainer to prevent possible contamination of engine and fuel system components.

2.8.2 Starting

2.8.2.1 Starting the engine using recoil starter.

a. Adjust throttle lever to approximately one-half full open position.
b. Close carburetor choke lever. When starting a warm engine it may not be necessary to close the choke.
c. Switch the ignition to the RUN position.
d. Pull lightly on the handle of the rope until a click is heard when the pulley engaged with the flywheel and then pull strongly on the rope. Let the handle return quickly to the original position. Do not let go of the handle until the rope has fully retracted.
e. If engine does not start, repeat step (d) and adjust throttle lever as required until the engine starts.
f. After the engine has started, gradually open the choke lever and close throttle lever until the engine runs smoothly at idling speed (1000-1200 rpm). When the engine is running at normal operating temperature the choke should remain in the fully open position.

NOTE: If the engine fails to start after repeated attempts, refer to Trouble Shooting Chart, Table 2-1.

2.8.2.2 Starting the engine using electric starter.

a. Adjust throttle lever to approximately one-half full open position.
b. Close carburetor choke lever. When starting a warm engine it may not be necessary to close the choke.
c. Engage the applicable ignition switch. If engine does not start within 5 seconds, disengage the ignition switch. Adjust throttle lever as required; wait approximately 30 seconds and repeat the starting procedure.
d. After the engine has started, gradually open the choke lever and close the throttle lever until the engine runs smoothly at idling speed (1000-1200 rpm). When the engine is running at normal operating temperature the choke should remain in the fully open position.

NOTE: If the engine fails to start after repeated attempts, refer to Trouble Shooting Chart, Table 2-1.

2.8.3 Stopping the Engine

To stop the engine, close throttle; switch off the ignition. Do not stop engine by grounding the spark plugs or disconnecting spark plug wires.

2.9 LUBRICATION

Lubrication chart, Table 2-2, details periodic lubrication requirements. Further periodic lubrication of these engines is not required.

TABLE 2-2 **LUBRICATION CHART**

Component	Frequency	Type/Method	Access
Recoil Starter Center hub. Main spring. Pawls.	Once yearly or during overhaul	Grease, low temperature, Lubriplate or equivalent (by hand)	Remove recoil starter cover. Remove friction plate. (See Section III, Para. 3.2.1d and Section IV, para. 4-3).
Electric Starter drive shaft and spring (if installed).	Once yearly or during overhaul	Grease, low temperature, Lubriplate or equivalent (by hand)	Remove starter (See Section III, Para. 3.2.1g).
Contact Breaker Points (oil-felt pads)	Once yearly or during overhaul	1 or 2 drops good quality light machine oil (oil can).	Remove recoil starter and starter pulley. (See Section III, Para. 3.2.1d and 3.2.1h). Lubricate through breakerpoint access hole.
Contact Breaker Point Cam	Once yearly or during overhaul	Grease, low temperture, Lubriplate or equivalent. Lightly coat governor assembly and flywheel collar (by hand)	Remove flywheel (See Para. 3.2.1j) Remove snap-ring. Lift out cam. Replace cam and snap ring. (See Section IV, Para. 4.4).
Two-Stroke Engine Oil	The following is a list of recommended brands of two stroke engine oil: Esso Snowtrac Veedol Snowmobile Shell Two Cycle Snowmobile Mercury 50 New Formula "Quicksilver" "Bardahl" Snowmobile VBA		

SECTION III

DISASSEMBLY, CLEANING AND INSPECTION

3.1 PREPARATION FOR DISASSEMBLY

a. Remove muffler and exhaust pipe as applicable. Disconnect electrical wiring and controls. Remove engine mounting bolts; place engine on a suitable workbench.

b. Thoroughly clean exterior surfaces of engine, using suitable cleaning solvent.

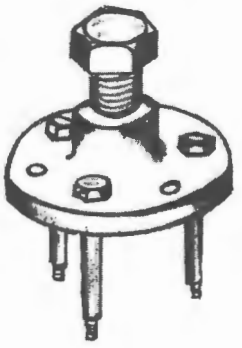
3.1.1 TOOL REQUIREMENT

The following is a list of tools required for the overhaul and adjustment of model CCW 290 engine:

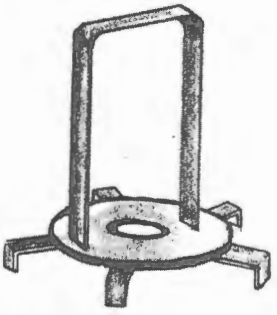
a. Special Tools	**Reference**
Tool, Flywheel puller Part 43-0790-90	Para. 3.2.1
Tool, Main Spring, Starter Rewind. 43-0797-60	Para. 4.3
Tool, Bearing puller (crankshaft). Part 43-0791-70	Para. 4.6.1
Tool, Flywheel Locking. Part 43-0798-40	Para. 3.2.1
Tool, Fan Pulley Locking. 43-0792-50	Para. 4.2.1

b. Standard Tools

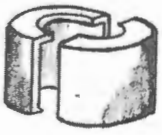
Allen wrench 6 mm
10/13 mm spanner
13/21 mm Box spanner and handle
22 mm spanner
22 mm socket wrench and ratchet
Piston ring removal tool
Piston ring compressor
Piston ring groove cleaning tool
Circlip removal tool
Torque wrench (pounds feet)
Dial indicator
Degree wheel
Feeler Gauge
Spark plug tap
Spark plug wire gauge
Thread Cleaning tools
Wire brush (spark plugs)
Soft metal (non ferrous) scraper
Phillips screw driver set
Common screw drivers
Soft hammer



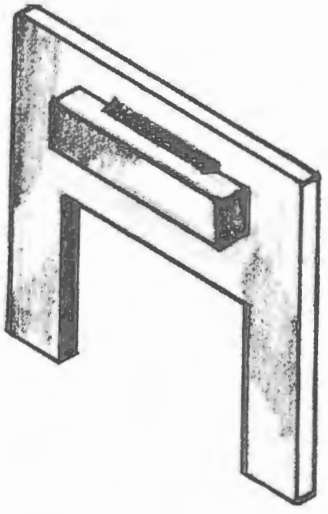
43-0790-90
FLYWHEEL PULLER



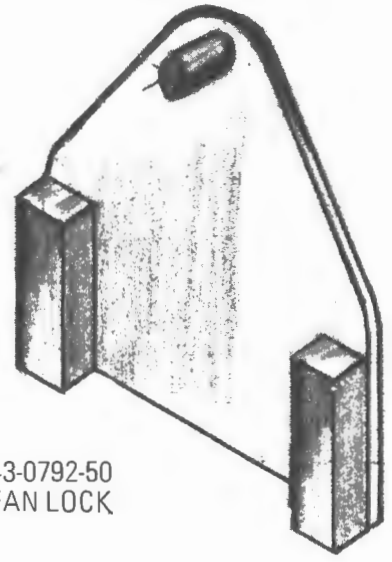
43-0797-60
REWIND SPRING TOOL



43-0791-70
BEARING PULLER



43-0798-40
FLYWHEEL LOCK



43-0792-50
FAN LOCK

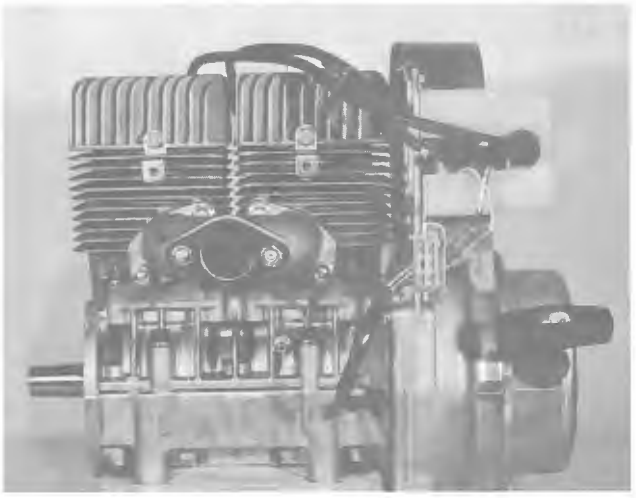


FIGURE 3-1 CYLINDER COVER REMOVED

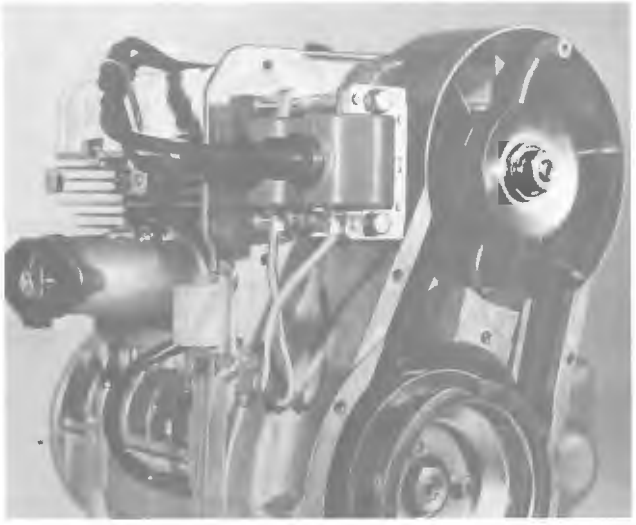


FIGURE 3-2 HIGH TENSION COILS AND IGNITION WIRING

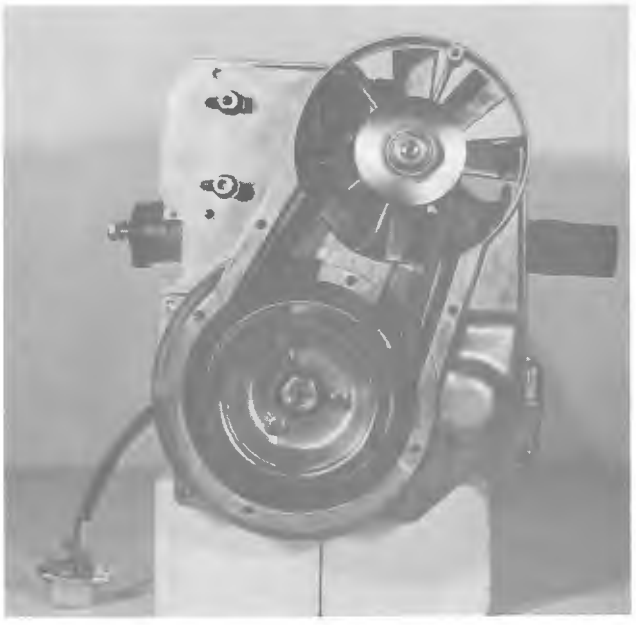


FIGURE 3-3 RECOIL STARTER AND IGNITION REMOVED

3.2 DISASSEMBLY

NOTE: To prevent loss and expedite reassembly procedures, keep attaching hardware with each part as it is removed.

3.2.1 Disassemble the engine as follows:

a. Disconnect spark plug wires at spark plugs. Remove plugs.
b. Remove the bolts securing cylinder cover to engine body. Remove cover. See Figure 3-1
c. Remove the four hold-down nuts, washers and lockwashers securing intake and exhaust manifolds to cylinders.
   Remove manifolds. Remove intake manifold with carburetor attached. Remove carburetor only if it requires servicing.

NOTE: Cover all ports of carburetor with tape or caps to prevent any foreign bodies from entering during repair of the engine.

   For carburetor servicing refer to applicable carburetor manufacturer's specifications. Remove insulator from intake side. Discard gaskets.

d. Remove the four bolts securing recoil starter to fan cover. Remove starter to expose starter cup and fan belt pulley.
e. Disconnect coupler attached to fan cover. Remove two bolts securing coil cover to fan cover. Remove cover to expose high tension coils. Figure 3-2
f. Remove the two bolts and spacers securing high tension coils to fan cover. Remove coils with spark plug wires attached. Figure 3-3
g. Remove the two hold-down nuts, two attaching bolts and lockwashers securing electric starter to engine body (if so equipped). Remove starter.
h. Remove the three bolts securing starter cup, fan belt pulley and window plate to flywheel. Pull outward and up on pulley to remove from flywheel. Remove fan belt. Figure 3-4
i. Remove the two Phillips screws securing ignition terminal coupler and bracket to fan cover,
j. Lock the flywheel using CCW Tool Part #43-0798-40 remove the nut, lockwasher and flat washer securing flywheel to crankshaft. Remove the flywheel as follows:
   1. Install flywheel puller to the three tapped holes in flywheel.

NOTE: Bolts will not go into tapped holes right up to shoulder so do not force. In most cases mounting bolts need only be finger tight but must be of uniform length so that puller plate sits level and each bolt takes its share of the load.

NOTE: If flywheel has gear ring installed, it will be impossible to remove flywheel without removing fan cover. Be sure to loosen flywheel before removing fan cover, however, since flywheel lock #43-0798-40 braces against fan cover to lock flywheel.

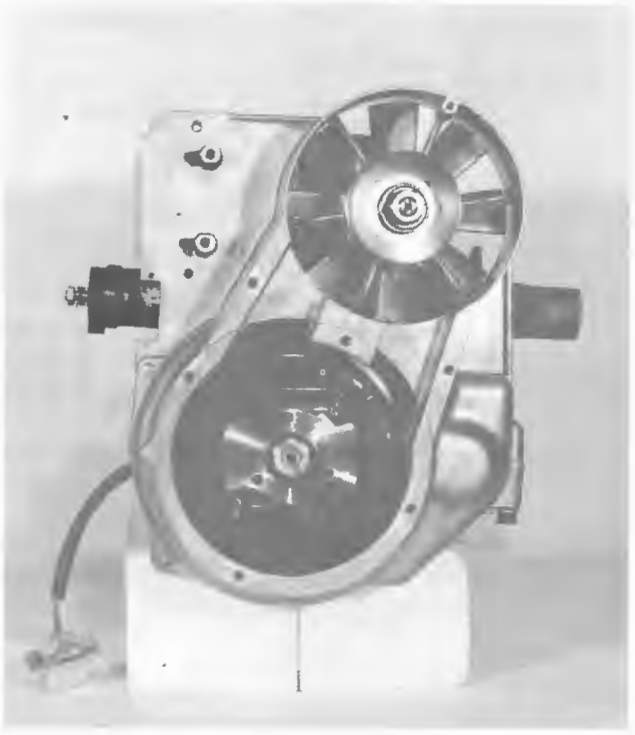


FIGURE 3-4 STARTER CAP AND FAN BELT REMOVED

FIGURE 3-5 FLYWHEEL PULLER INSTALLED

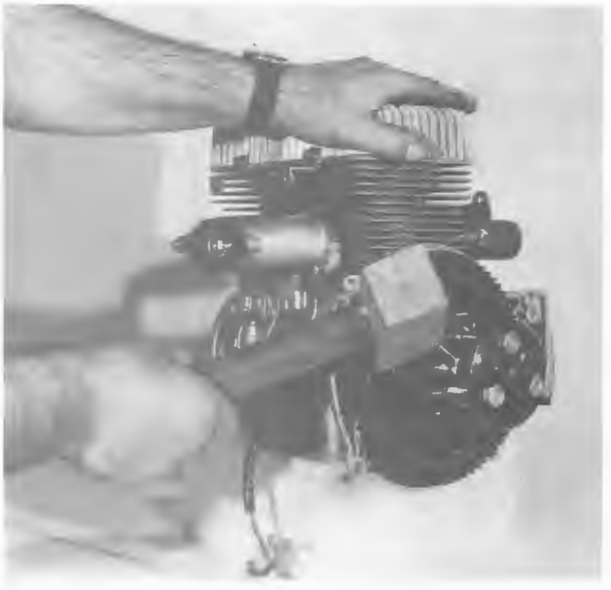


FIGURE 3-5A REMOVING FLYWHEEL

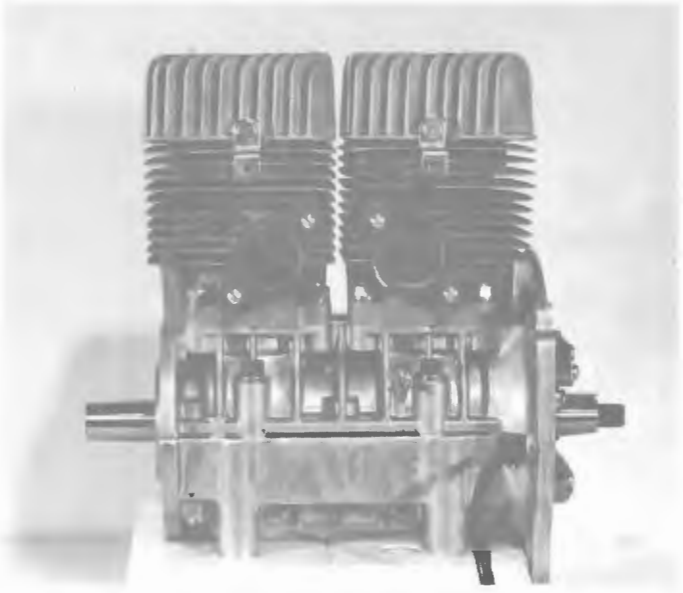


FIGURE 3-6 FAN COVER REMOVED

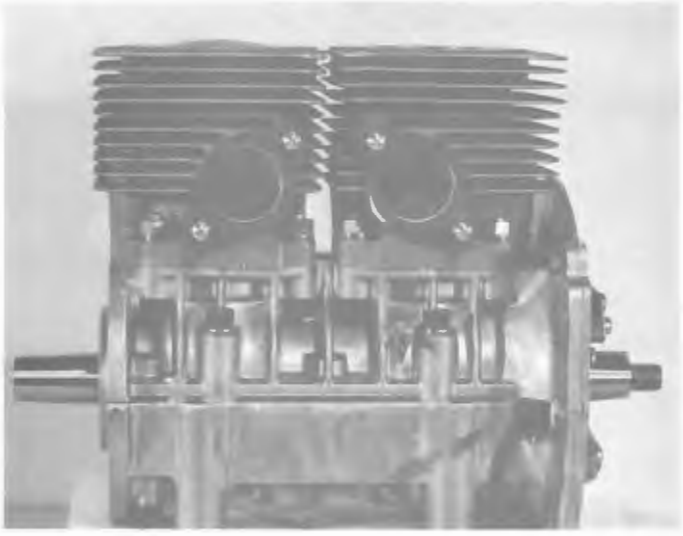


FIGURE 3-7 CYLINDER HEADS REMOVED

2. Tighten the center bolt of puller to 40 pounds-feet maximum. Figure 3-5
3. Using a wooden mallet or block and hammer, tap each side of the flywheel alternately while maintaining the torque setting on center bolt until the flywheel is removed. Figure 3-5A

CAUTION: 1. Do not over torque center bolt on flywheel puller. Excessive torque may result in breaking the puller attachment bolts.
2. Do not hammer on end of crankshaft to remove flywheel. Damage to the shaft or bearings may result.

k. Remove four bolts securing fan cover then remove fan cover. Figure 3-6

l. Remove the six hold-down nuts securing each cylinder head to cylinder. Remove cylinder heads. Figure 3-7 Discard cylinder head gaskets.

NOTE: Before proceeding any further check crankshaft for bend and twist as follows:

1. Check for twist:
   (a) Rotate engine to T.D.C. on No. 1 cylinder using a dial indicator mounted on the cylinder.
   (b) Install and zero a degree wheel on the crankshaft.
   (c) Rotate crankshaft 180°. The piston on No. 2 cylinder should be at T.D.C. Permissable tolerance is 2°.
2. Check for bend on either end:
   (a) Mount a dial indicator at the junction of the parallel and tapered sections of the shaft.
   (b) Zero the indicator. Rotate the crankshaft one full turn. Permissable runout is 0.003 inch on one rotation.

m. Remove the four hold-down nuts securing each cylinder to crankcase. Remove cylinders to expose piston and connecting rod assemblies. Discard cylinder base gaskets. Figure 3-8).

CAUTION: If disassembly is discontinued after cylinder or piston removal, ensure that crankcase is kept covered to prevent ingress of dirt or foreign objects to crankcase.

n. Before removing pistons, ensure that the piston crown is marked with an arrow directed toward the exhaust port. If no arrow is legible, inscribe the piston crown accordingly. It is also important to makr each piston according to its cylinder (left or right) as they are not interchangeable.

o. Using a suitable circlip removal tool, remove one of the two circlips securing each piston pin in position. Use a propane torch or cloth soaked in hot water and heat the pistons until warm to the touch (120^0 - 140^0F). Use a soft drift to push the pins out from the opposite side. Remove needle bearings from connecting rods small end. (Figure 3-9)

CAUTION: Exercise care when removing piston pins to prevent damage to needle bearings. Keep bearings adequately protected until time of reassembly.

p. Remove piston rings from piston ring groove, using a suitable ring removal tool.

q. Remove the two screws securing stator assembly to crankcase.

r. Remove the 11 bolts, plain washers and lockwashers joining the two halves of crankcase. Separate crankcase by pulling the two halves apart. Remove the crankshaft. Remove the four seal retaining circlips from crankcase lower half. (Refer to Section V, figure 5-1). Figure 3-10

CAUTION: Do not use a screw driver to pry the crankcase apart. If necessary, use a soft hammer and tap the case lightly on either end.

NOTE: Unless being serviced, stator assembly should be stored inside flywheel to ensure retention of magnetic properties.

3.3 CLEANING AND INSPECTION

3.3.1 Cleaning

Prior to inspection clean all parts, except the magneto assembly, by immersing and soaking in a suitable cleaning solvent or using specified methods. Clean the crankshaft before cleaning other components, to protect bearings from possible damage due to dirty cleaning solvent. Thoroughly dry all parts after cleaning.

Pay particular attention to the following special instructions:

a. Spark plugs:
Remove light carbon deposits by brushing lightly with a wire brush. If plug is excessively dirty and proper cleaning equipment is not available, install a new spark plug.

b. Piston ring grooves, piston crowns, cylinder heads:
Use the proper groove cleaning tool for cleaning piston ring grooves. Normal cleaning methods should be sufficient for cleaning piston crowns and cylinder heads.

c. Spark plug holes and exhaust ports:
Carefully remove heavy carbon deposits from these areas, using a soft metal (non-ferrous) scraper. Use a spark plug tap to clean threads.

FIGURE 3-8 CYLINDERS REMOVED

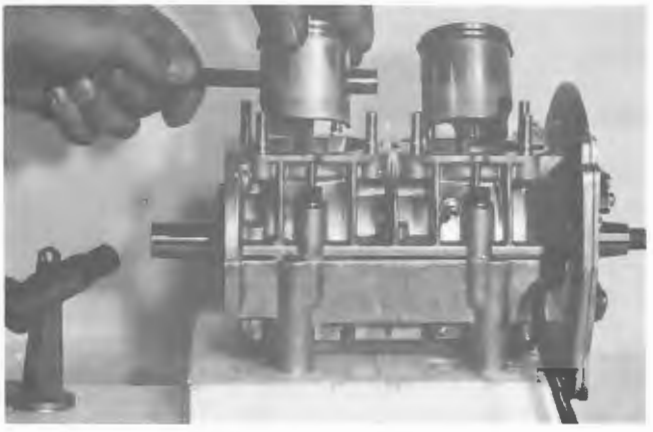


FIGURE 3-9 REMOVING PISTONS

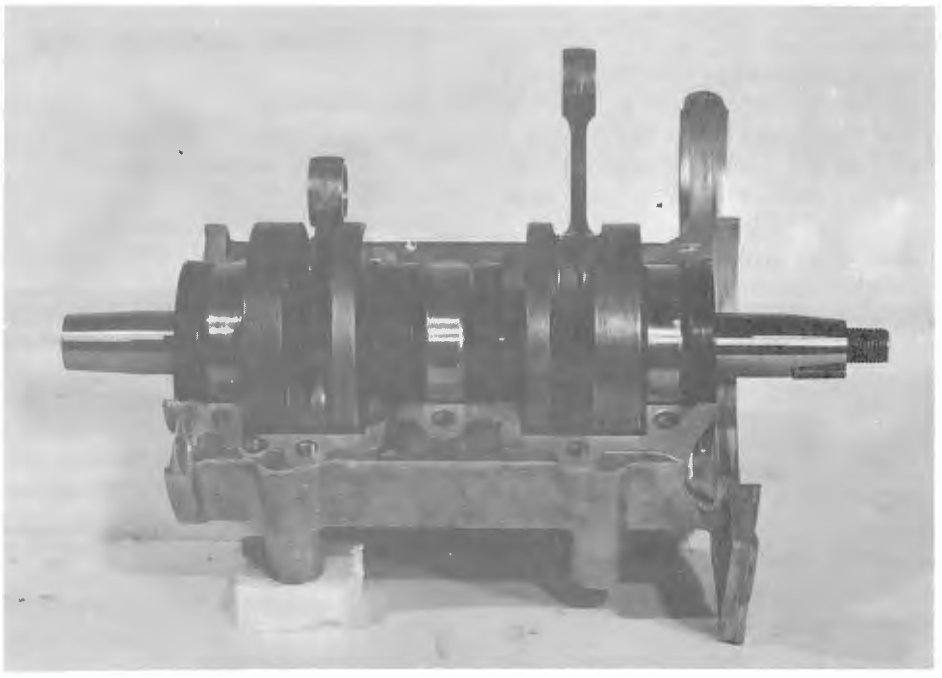


FIGURE 3-10 CRANKSHAFT IN LOWER CRANKCASE

CAUTION: Do not scrape down to base metal surfaces when removing heavy carbon deposits. Exercise care while cleaning spark plug holes, to prevent damage to the threaded area.

d. Magneto:
Thoroughly dryclean the magneto using compressed air or suitable cleaning materials. Ensure no moisture or oily film remains after cleaning.

3.3.2 Inspection

3.3.3 General

a. After disassembly, clean all parts in accordance with paragraph 3.3.1. Inspect all parts for obvious damage, wear, cracks, and evidence of corrosion; attaching hardware and attachment holes for wear and condition of threads. If it is necessary to dress the threads, use suitable thread cleaning tools. Repair or replace damaged parts and any parts that fail to meet applicable specifications. Refer to Section IV, Repair and Replacement.
b. Perform additional inspections as detailed in paragraphs 3.3.4 to 3.3.13.

3.3.4 Spark Plug Inspection and Adjustment

a. Inspect spark plugs for general condition, cracked or broken insulators and burned electrodes.
Guide to spark plug serviceability:
1. Center electrode burned brown indicates plug is functioning normally.
2. Center electrode burned white indicates the plug is too low in thermal value. Discard plug and install new plug of specified type.
3. Center electrode burned black indicates the plug is too high in thermal value. Discard plug and install new plug of specified type.

b. Adjust spark plug gap to 0.6 to 0.7 mm. (0.023 to 0.025) in). Bend the outside (ground) electrode only. Use a spark plug wire gauge to measure the gap. Discard plug if electrode is burned excessively or if specified gap cannot be maintained.
c. Inspect spark plug wires for condition of insulation; rubber bushings for splitting or deterioration; tips for security. Replace defective wires.

3.3.5 Fan Cover

a. Inspect fins for cracks; fan for blade damage, freedom of movement and evidence of binding. Dress out nicks or dents. Replace fan if a blade is cracked or broken since the balance will be affected.
b. Inspect fan belt for stretch, fraying and deterioration.

3.3.6 Recoil Starter

a. Pull starter rope out and permit it to recoil. Do not let rope snap back on recoil. Rope should pull out smoothly and recoil without hesitation. A weak or incomplete recoil indicates a defective or maladjusted main spring.
b. Check for smooth operation of pawls. When the rope is pulled out, pawls should move outward; when the rope recoils, pawls should move inward.
c. Inspect handle and rope guide for general condition and security of attachment.

3.3.7 Electric Starter (if installed)

a. Inspect drive shaft and spring for condition, smooth operation and security. Lubricate in accordance with Lubrication Chart, Table 2-2.

NOTE: Disassembly or repair of electric starters should be performed by authorized dealers only. Replace defective starters if overhaul facilities are not available.

3.3.8 Magneto Assembly

a. Inspect coil plate for damage and security.
b. Inspect low tension generation coil(s) and lighting coils for general condition and security.
c. Inspect contact breaker points and condensers for condition; breaker points for wear, burning or pitting. Serviceable points appear a greyish frosty color. If points are in

serviceable condition, the condenser can be considered serviceable. Inspect oil felt pads for condition and security; lubricate in accordance with Lubrication Chart, Table 2-2.

d. Inspect all electrical connections for security; insulation for chafing and deterioration.

3.3.9 Flywheel Assembly

a. Inspect cam, governor weight and spring for general condition and security; cam for wear, particularly at point of contact with governor weight.
b. Check flywheel taper for snug fit. When placed on crankshaft hand tight, the flywheel should not wobble.
c. Inspect magnets for nicks, scores or burrs. Use a suitable stone to smooth off high spots.
d. Inspect ring gear and teeth (if installed) for wear, general condition and security.
e. Lubricate cam, governor weight and spring in accordance with Lubrication Chart, Table 2-2.

3.3.10 Cylinder Heads and Cylinders

a. Inspect cylinder heads and cylinders for pitting, scoring and evidence of corrosion.
b. Check cylinder heads for warp or distortion as follows:
   1. Place cylinder head, flat side down, on a surface plate or suitable measuring device.
   2. Using a feeler gauge, measure amount of distortion at point of contact between cylinder head and surface plate.
      Take a reading at each of the five locations between cylinder head hold down studs.
      Maximum allowable distortion at any one location is 0.002 inch.
c. Check cylinders for distortion as follows:
   1. Install a serviceable head on cylinder to be checked. Do not install hold down nuts or head gasket.
   2. Using a feeler gauge, measure amount of distortion at point of contact between cylinder head and cylinder. Take a reading at each of the five locations between cylinder head hold down studs.
      Maximum allowable distortion at any one location is 0.002 inch.
d. Using a dial indicator or suitable measuring device, check inside diameter of cylinders. Cylinders, worn beyond standard tolerances, may be rebored to accomodate the installation of oversize pistons. Refer to Table 3-1 for standard and oversize fits and tolerances. The oversizes listed in the table are the maximum allowable. Discard cylinders that require boring in excess of tolerance shown. Replace with serviceable cylinders.

NOTE: Rebored cylinders should be honed with a fine finishing stone.

3.3.11 Pistons, Pins and Rings

a. Inspect pistons, pins and rings for scoring and wear; piston crowns for pitting, evidence of corrosion and distortion.
b. Check diameter of pistons, pins and pin bore; piston ring end and side clearances. Refer to Table 3-1 for method of inspection and tolerances.
c. Discard any parts that fail to meet applicable specifications and note the following:
   1. If cylinder has been inspected and found serviceable, replace defective piston with new standard size piston.
   2. If cylinder has been rebored and honed, replace defective piston with oversize piston as listed in Table 3-1.

3.3.12 Crankshaft and Connecting Rods

a. Inspect threads on each end of shaft. The mating nut on the flywheel end of the shaft should turn on all the way by hand without excessive looseness.
   Use a suitable thread cleaning tool to remove burrs from the threads. Replace worn nuts.
b. Inspect keyway and Woodruff key for damage and wear. Replace worn keys.
c. Check tapered surface of flywheel end of shaft for scoring and wear. When placed on the shaft hand tight, the flywheel should not wobble.
d. Inspect ball bearings for wear, free movement and security.
e. Using Vee blocks (2) on a flat surface, support the crankshaft on the center main bearings. Mount dial indicators at junction of tapered and parallel sections of the shaft and rotate crankshaft by the connecting rods. Refer to Table 3-1 for tolerances.
f. Check crankshaft for bend or twist on the crankshaft journals. Use a dial indicator placed on the main bearing journals. Zero the indicator. Rotate crankshaft one full turn. Refer to Table 3-1 for tolerances.
g. Check connecting rod diameter at small end; side and vertical clearance at large end. Refer to Table 3-1 for method of inspection and tolerance.
h. Check connecting rod twist as follows:
   1. Insert a bar, 100 mm long or any other convenient length, into the connecting rod small end. Centralize the rod using a depth gauge and lock in position.
   2. Support connecting rod horizontally. Using a dial indicator measure the maximum height at opposite ends of the bar when the rod is twisted to the right and to the left. Any variation indicates connecting rod twist. Refer to Table 3-1 for tolerance.
i. Check connecting rod tilt as follows:
   1. Repeat step h(1).
   2. Support connecting rod vertically. Using a dial test indicator, measure the amount of movement at ends of bar when bar is tilted to the right and to the left. The difference between the two readings indicates the amount of tilt. Refer to Table 3-1 for tolerance.

3.3.13 Crankcase

a. Inspect crankcase mating surfaces for deep scratches, scoring and pitting.
b. Inspect bearing and oil seal retaining inserts for wear, scoring or conditions which could cause leaks.
c. Inspect attaching dowel pins for wear and security.
d. Discard crankcase if normal repair procedures are not sufficient to correct defects.

3.3.14 Fits and Tolerances

Table 3-1 lists standard fits and tolerances to be checked during inspection of pistons, piston pins, cylinders and crankshaft. It also lists allowable oversizes of pistons and rings. If suggested method of inspection is not available, use suitable measuring devices.

FITS AND TOLERANCES TABLE 3-1

CCW Model 290

Component	Std. Size In.	Std. Size Mm	Tolerances Inches Minus	Tolerances Inches Plus	Remarks	Method of Inspection
Cylinder	2.305	58.5	N/A	.0007		Dial Indicator
Connecting Rod, small end	.867	22	N/A	.0003 .0008		Dial Indicator
big end	1.261	32	N/A .001	.0004		
side clearance			.014 .016	N/A		
vertical clearance			N/A	.0004 .0015		Dial Indicator
twist				.003	Measured at ends of bar 3.94" centred in small end (See Manual)	Dial Indicator
bend			N/A	.001		
Crankshaft permissable misalignment due to bend or twist.			N/A	.0035	Measured at junction of taper and parallel sections (see manual).	Dial Indicator
Crankshaft, end float			N/A	.003		Feeler gauge.
Piston, at	2.305	58.5		N/A		Micrometer
Top land	–	–	.011 .012			
Piston Pin, c/l	–	–	007 .008	N/A		
Bottom of skirt	–	–	.004 .0047	N/A		
Piston Pin Bore	.709	18	.0004	N/A		Dial Indicator
Piston Pin	.709	18	.0003	N/A		Micrometer
Piston Ring, No. 1	.083		.0025	N/A		Feeler Gauges
groove clearance			.004			
end clearance	–	–	.004 .012	N/A		
Piston Ring, No. 2	.083		.0014 .003	N/A		
groove clearance						
end clearance			.004 .012	N/A		

SECTION IV

REPAIR AND REPLACEMENT

4.1 GENERAL

4.1.1 The repair and replacement instructions detailed in this section are included to assist in the disassembly, replacement of defective parts and assembly of major sub-assemblies. It is not necessary to completely disassemble the sub-assemblies unless inspection procedures reveal defects. Perform only those steps necessary to gain access to the defective part(s) and to effect the necessary repairs.

4.2 FAN COVER (See figure 4-1)

4.2.1 Disassembly

a. Remove nut (2), lockwasher (3), and plain washer (4) from threaded end of fan shaft. Spacer (5) is permanently secured to outer pulley (6).
Tool: 19 mm box spanner, Locking tool, Part No. 43-0792-50.

NOTE: Drill one 1/4" hole in pulley to take pin of locking tool

b. Remove outer half (6) of fan belt pulley, spacers (7, 8, 9) inner half (10) of pulley, and spacer (11) from shaft.

c. Tap lightly on end of fan shaft to remove fan (16) from fan cover.

d. Inner bearing (15) should remain on fan shaft assembly and can be removed by sliding it off the shaft. To remove outer bearing (12), turn the case over; use a suitable soft drift to tap bearing out of retainer. Remove spacer (13). It is not necessary to remove snap ring (14) unless it is found defective. Use suitable removal tool to remove snap ring.

e. Clean all parts, except bearings, using suitable cleaning solvent. Wipe bearings clean, using a clean cloth moistened with cleaning solvent. Thoroughly dry all parts after cleaning.

4.2.2 Assembly

a Replace defective parts.

b. Install snap ring (14) if it has been removed.

c. Install outer bearing (12). Turn case over; install spacer (13) and inner bearing (15). Ensure bearings are properly seated with no evidence of binding. If necessary, use a soft steel drift to tap bearings into position. Ensure that no dirt or foreign material enters bearings.

d. Reverse disassembly steps (a) to (c). Tighten retaining nut securely, using lock tool No 43-0792-50.

e. Check fan for proper operation

1. Fan cover
2. Retaining nut
3. Lockwasher
4. Plain washer
5. Spacer
6. Outer pulley
7. Spacer
8. Spacer
9. Spacer
10. Inner pulley
11. Spacer
12. Outer bearing
13. Spacer
14. Snap ring
15. Inner bearing
16. Fan

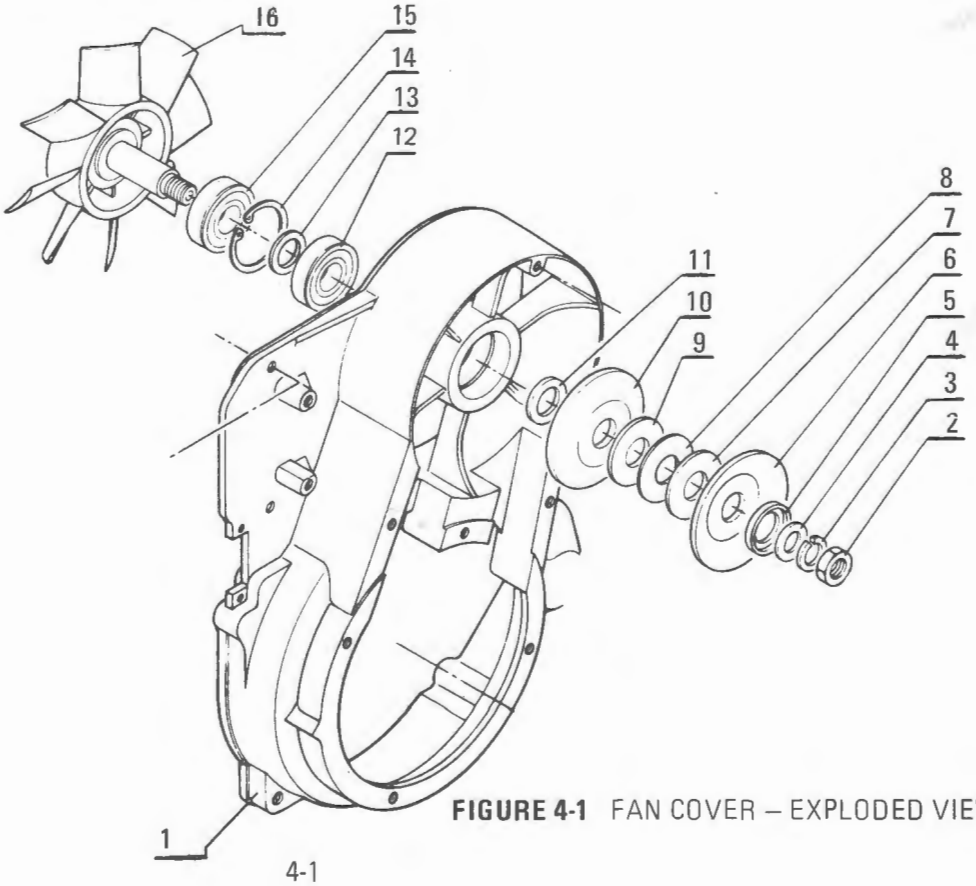


FIGURE 4-1 FAN COVER – EXPLODED VIEW

4.3 RECOIL STARTER (See Figure 4-2)

4.3.1 Disassembly

a. Untie the knot in the rope at rope handle (15). Remove handle and allow the rope to recoil slowly into the case (12). Unscrew and remove rope guide (13).
b. Remove retaining nut (2), lockwasher (3) and flatwasher (4) from threaded shaft of reel hub (10)
c. Manipulate friction plate (5) on reel hub until eye end of return spring (7) aligns with retaining slot (22). Remove friction plate.
d. Remove the three pawls (6).
e. Remove return spring (7), spring (8) and cup washer (9). Note position of plain end of return spring in the spring retaining hole in reel hub.
f. Remove reel (10). Unwind the rope; lift and untie the knotted end from center hub of reel.
g. Lift long rolled end of main spring (11) from the fixed spring retaining pin in the case and carefully remove the spring.
h. Clean all parts, except rope, using a suitable cleaning solvent. If rope requires cleaning, wash it in a solution of soap and water. Thoroughly dry all parts after cleaning.
i. Inspect all parts for obvious damage and wear.

4.3.2 Assembly

a. Replace defective parts.
b. Install main spring as follows:
   1. Secure main spring winding tool, part number 43-0797-60, or equivalent tool, circular end up, in a suitable bench vise.
   2. Start with the long rolled end of main spring (11) and wind spring into circular end of tool in a clockwise direction.
   3. Remove tool from vise. Grasp the tool by its handle and lower the tool, with spring installed, into case (12).
   4. Secure the long rolled end of spring over the fixed spring retaining pin. Remove winding tool Apply a light film of Lubriplate, or equivalent, to spring.
c. Secure case, open side up, in bench vise.
d. Tie a knot at one end of the rope. Secure knotted end around center hub of reel (10). Pull rope taut and wind entire rope around reel in an anti-clockwise direction until the free end protrudes through the notched section of the reel.
e. Apply a light film of Lubriplate, or equivalent, to center hub of case and install the reel Push down and rotate reel in an anti-clockwise direction until the hook (23) engages with the free end of main spring. Tension will be felt when reel and spring are properly engaged.
f. Rotate reel a maximum of three complete turns in an anti-clockwise direction. Do not exceed three turns; hold reel in this position and feed free end of rope through case at the rope guide hole. Install rope guide. Loosely knot the rope to prevent recoil.
g. Apply a light film of Lubriplate or equivalent to pawls (6) and install them on the reel in the pawl retainers.
h. Install cup washer (9) flat side down, spring (8) and return spring (7). Ensure that plain end of return spring is properly engaged in the retaining hole in reel hub.
i. Install friction plate (5) over reel hub. Manipulate plate until eye end of return spring engages and locks crosswise in retaining slot (22).
j. Rotate friction plate until the three notches are aligned with pawls when pawls are at the recoil position.
k. Install flatwasher (4), lockwasher (3), and nut (2). Tighten nut securely.
l. Untie the temporary knot in free end of rope and install the rope handle. Tie a permanent knot and fit handle securely.
m. Check starter for proper operation. When handle is pulled outward, pawls should move outward.

NOTE: If main spring is to be installed without the use of a spring winding tool, wind main spring into case in an anti-clockwise direction. Clockwise installation on the winding tool is necessary to ensure correct anti-clockwise installation of the spring when tool is placed upside down in the case.

1. Starter pulley
2. Retaining nut
3. Lockwasher
4. Flatwasher
5. Friction plate
6. Pawl (each 3)
7. Friction plate return spring
8. Spring
9. Cup washer
10. Reel
11. Main spring
12. Case
13. Rope guide
14. Rope
15. Handle
16. End piece
17. Bolt, starter to fan cover attaching
18. Lockwasher
19. Flatwasher
20. Bolt, starter pulley to fly-wheel attaching
21. Lockwasher
22. Slot, return spring retaining
23. Hook, main spring retaining

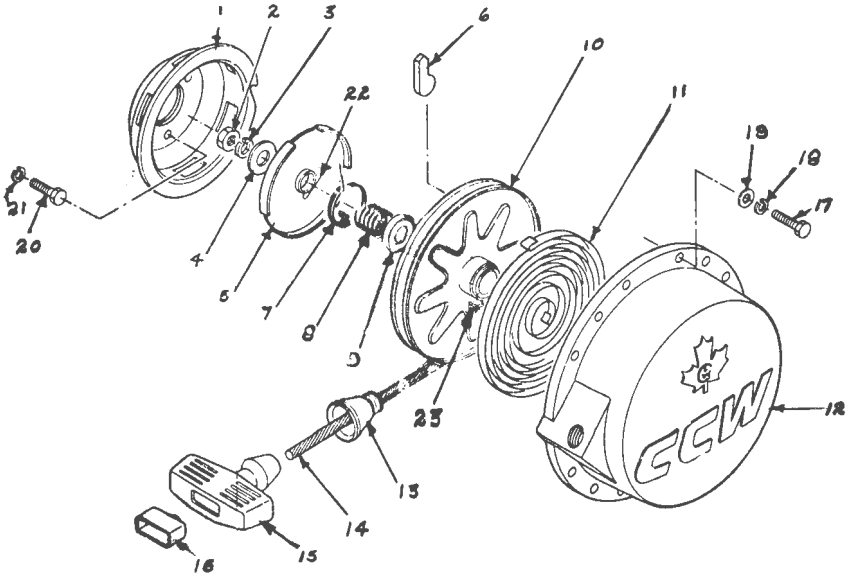


FIGURE 4-2 RECOIL STARTER – EXPLODED VIEW

4.4 FLYWHEEL ASSEMBLY (See Figure 4-3)

4.4.1 Disassembly

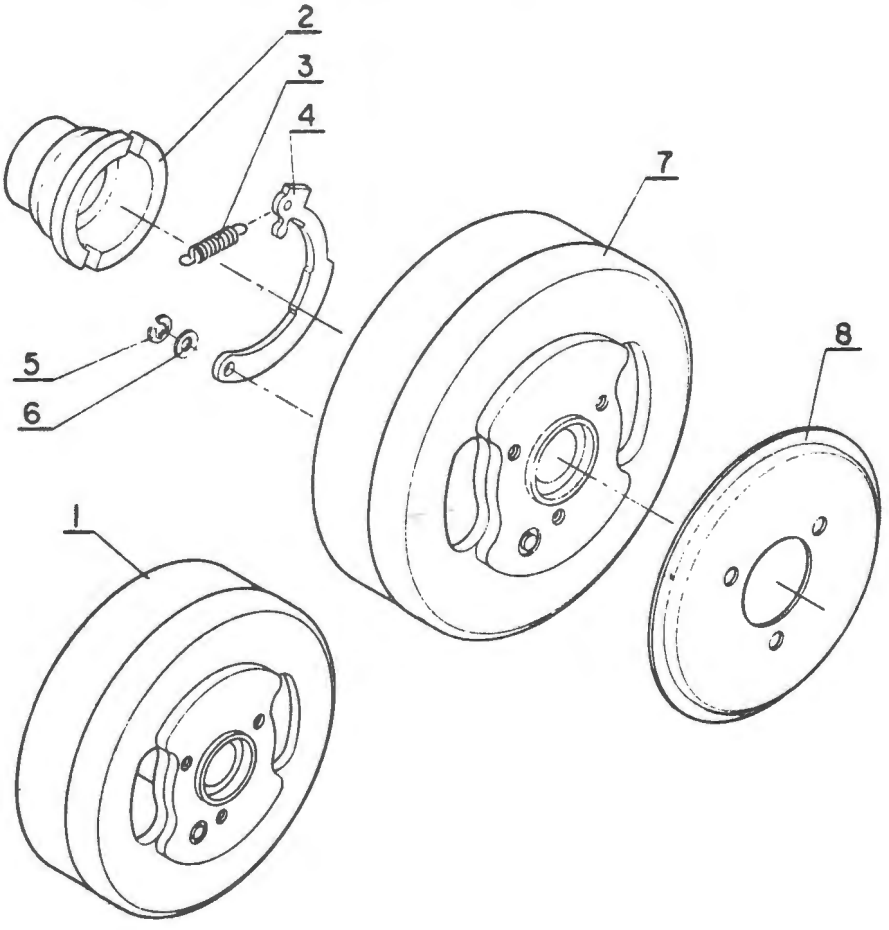
NOTE: Complete disassembly of flywheel assemblies should be performed by authorized dealers only. The auto advance mechanism is pre-set during manufacture and should require no further adjustment. If inspection reveals faulty governor parts or defective magnets, install a new flywheel assembly or return flywheel to overhaul facility.

Remove snap ring (5) and governor weight (4) to release the breaker point cam.

Lift cam off collar. Check cam and collar for scoring and wear; governor weight stops for wear and security. Replace defective parts.

4.4.2 Assembly

a. Apply a light film of Lubriplate or equivalent to outer surface of flywheel collar.
b. Reverse removal procedure.
c. Lubricate in accordance with Lubrication Chart, Table 2-2.
d. Check mechanism for proper operation.



1. Flywheel assembly
2. Cam
3. Governor spring
4. Governor weight
5. Snap ring
6. Washer
7. Flywheel
8. Window plate

FIGURE 4-3 FLYWHEEL – EXPLODED VIEW

4.5 STATOR ASSEMBLY (See Figure 4-4)

NOTE: Complete disassembly of flywheel assemblies should be performed by authorized dealers only. The auto-advance mechanism is pre-set during manufacture and should require no further adjustment. If inspection reveals faulty governor parts or defective magnets, install a new flywheel assembly or return flywheel to overhaul facility.

4.5.1 Contact Breaker Point Sets

NOTE: Removal and installation procedure is applicable to both point sets.

4.5.1.1 Removal

a. Loosen electrical terminal connector securing ignition wiring at contact breaker point set (7). Disconnect the wires.
b. Remove retaining screw (22), lockwasher (21), and washer (20) securing breaker point set to coil plate (2). Remove breaker point set.

4.5.1.2 Installation

a. Apply a light film of Lubriplate or equivalent to pivot shaft.
b. Reverse removal procedure.

CAUTION: Ensure no lubricant gets on breaker points during installation. Contaminated points will burn during engine operation.

c. Adjust points to specified gap. Refer to Section V, Paragraph 5.4.3.

4.5.2 Condensers and Oil Felt Pads

NOTE: Removal and installation procedure is applicable to both condensers.

4.5.2.1 Removal

a. Loosen electrical terminal connector at contact breaker point set (7). Disconnect the condenser lead wire.
b. Remove retaining screw (23), and washer (21) securing condenser to coil plate (2). Remove condenser and oil felt pad. Check pad for condition and replace if lubricating capacity is questionable.

4.5.2.2 Installation

a. Reverse removal procedure.
b. Lubricate oil felt pad. Refer to Lubrication Chart, Table 2-2.

1. Stator assembly
2. Coil plate
3. Low tension generating coils
4. Lighting coil
5. Condenser (red)
6. Oil felt
7. Point set
8. Condenser (white)
9. Clamp
10. Rubber bushing
11. Screw
12. Spring washer
13. Bracket coupler
14. Coupler
15. Washer
16. Spring washer
17. Bolt, coil plate attaching
18. Bolt, ignition coil attaching
19. Bolt, lighting coil attaching
20. Washer
21. Spring washer
22. Screw
23. Screw
24. Screw
25. Washer

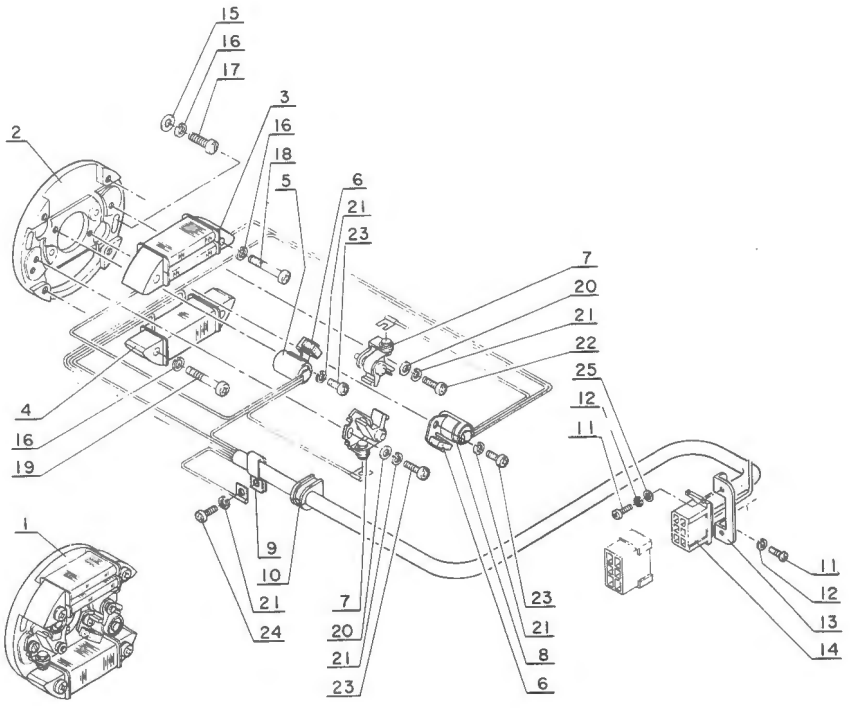


FIGURE 4-4 COIL PLATE ASSY. – EXPLODED VIEW

4.6 CRANKSHAFT (See Figure 4-5)

NOTE: If inspection reveals maintenance requirements beyond outer ball bearing or outer oil seal removal and installation, install a new crankshaft.

4.6.1 Oil Seal and Outer Bearing

4.6.1.1 Removal

a. Remove Woodruff key (14) from tapered end of crankshaft assembly, using suitable pliers or removal tool.
b. Remove oil seals (3). Seals are a snug fit, and can be removed by sliding them along the shaft. Discard seals.
c. Remove outer bearings (2), one from each end of crankshaft, using bearing puller or suitable removal tool.

4.6.1.2 Installation

NOTE: Keep bearings in the packaged condition or adequately protected from dust, dirt and other contaminants until ready for use.

Reverse removal procedure and note the following:

a. Bearings are a press fit on the crankshaft.
Install new bearings as follows:
1. Apply a light film of lubricating oil to crankshaft and ball bearing inner race.
2. Preferred Method
The preferred method of installation is with the use of an arbor press. Lay the new bearing on a face block having a slot or hole slightly larger than the bearing inner bore; press shaft down until bearing is firmly seated.
3. Alternate Method
An alternate method of installation is with the use of a soft tube. Use a suitable length of mild steel tubing, accurately squared at the ends, with large enough inside diameter to slip loosely over the crankshaft. Start bearing on end of crankshaft. Using the tube, gently tap the bearing down the shaft until bearing is firmly seated.

CAUTION: Prevent damage to the shaft and bearings until installation. Ensure that bearing is started true and not cocked on the shaft and that no loose metal chips are allowed to fall into bearings.

b. Use new oil seals.
Ensure seal is installed with cup facing inward and arrow directed as shown in the illustration. Exercise care when installing seals, to prevent seal damage and leaks during engine operation.

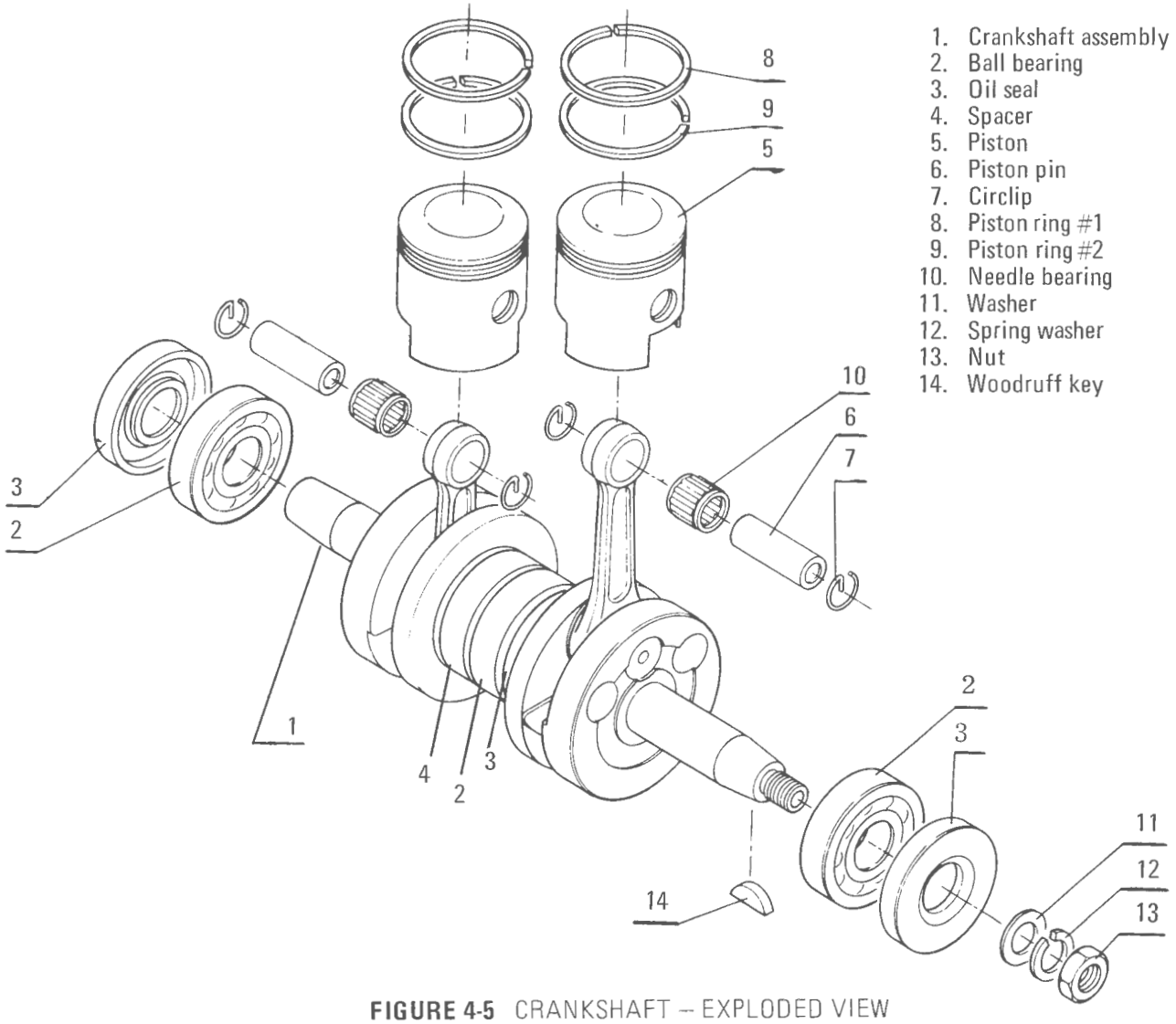


FIGURE 4-5 CRANKSHAFT – EXPLODED VIEW

REASSEMBLY, TESTING AND ADJUSTMENTS

5.1 GENERAL

5.1.1 Prior to reassembly, check all parts for cleanliness and serviceability in accordance with Section 3.3.

During assembly, tighten all screws, bolts and nuts securely. Ensure that correct torque values are applied where specified. Do not overtorque.

Use only new gaskets and seals during assembly procedure.

During assembly, lubricate all bearings and friction surfaces with new, clean two stroke engine oil.

If procedures are discontinued during assembly, ensure that intake and exhaust ports, spark plug holes and all other openings are covered to prevent ingress of dirt or foreign objects to cylinders and crankcase.

5.2 REASSEMBLY

5.2.1 Crankcase and Crankshaft (See Figure 5-1)

a. Place crankcase lower half on work bench with flanged fan cover end to right hand side; insert the four seal retaining circlips.
   Install the crankshaft into lower half of crankcase with externally threaded (flywheel) end of shaft toward right hand side. (See Section III, figure 3-10). Ensure that seal retaining circlips do not become dislodged.
b. Rotate spacer in chamber #2 such that the drain groove at the bottom centre of the crankcase. See Figure 5-1A.
c. Apply a liberal amount of two-stroke engine oil to crankshaft and bearings.
d. Apply a good quality, non hardening sealing compound evenly to sealing surfaces of both crankcase halves.
e. Reseat the crankcase halves; ensure that the two dowel pins are properly engaged with mating holes in crankcase upper half.

NOTE: If stator cable has coupler on the end it will be desirable to place cable in hole between crankcase halves at this time. This will save having to remove coupler to install cable later in assembly.

f. Insert eleven attaching bolts, washers and lockwashers with longer bolts at positions 4, 5, 6, 7, & 8. Loosely tighten the bolts, then torque all bolts down evenly to 15 - 18 foot-pounds maximum in accordance with sequence shown in the illustration. Figure 5-2
g. Install and secure stator to engine crankcase using two Phillips head screws. Position ignition wire bundle in the recess provided.

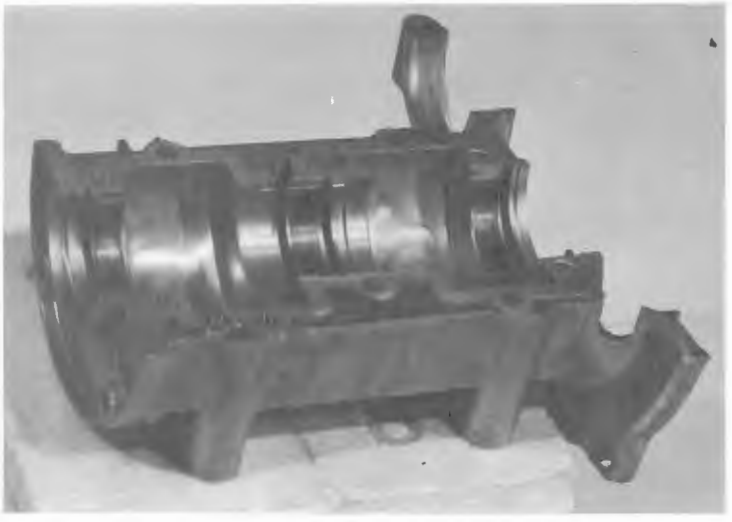


FIGURE 5-1 CRANKCASE LOWER HALF (WITH CIRCLIPS)

FIGURE 5-1A
CRANKSHAFT DETAIL SHOWING SPACER

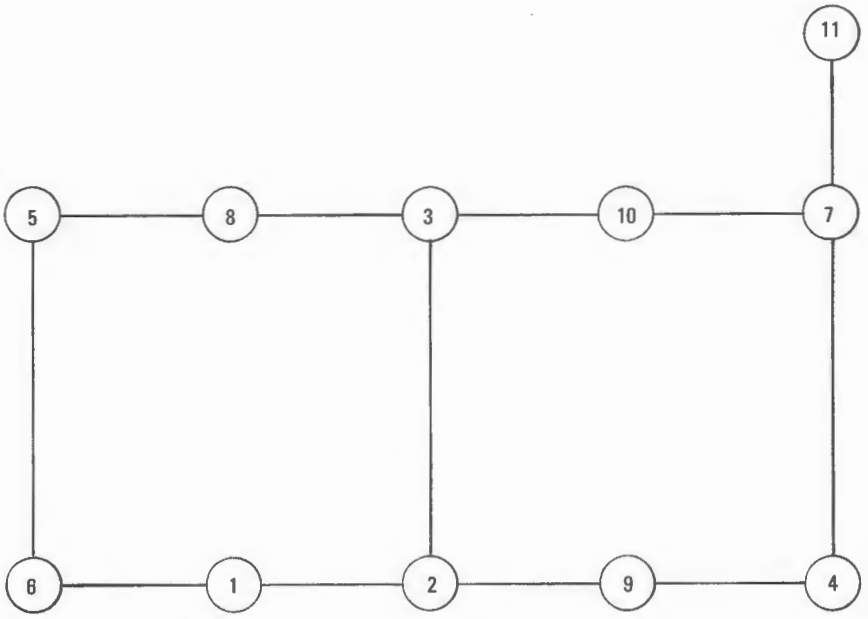


FIGURE 5-2 CRANKCASE BOLT TORQUING SEQUENCE

5.2.2 Pistons, Piston Rings and Pins (See Figure 5-3)

a. Lubricate piston pin needle bearing with two-stroke engine oil and install bearing into connecting rod small end.
b. If both piston pin retaining circlips have been removed from piston, use a suitable tool and install a circlip at one piston pin bore.
c. Use a propane torch or cloth soaked in hot water and heat piston until warm to the touch (120 to 140°F). Ensure that the arrow on piston crown is directed toward the exhaust port and align piston pin bore with center bore of connecting rod. Lubricate piston pin and, using a soft drift, push pin into piston until it bottoms on the installed circlip. Exercise care to prevent damage to needle bearing. Install remaining circlip.
d. Install piston rings in ring grooves, using a suitable ring installing tool. Ensure that piston ring gap is correctly positioned at the ring groove locating pin.
e. Repeat steps (a) to (d) for second piston.

NOTE: Chrome piston ring is installed in top groove

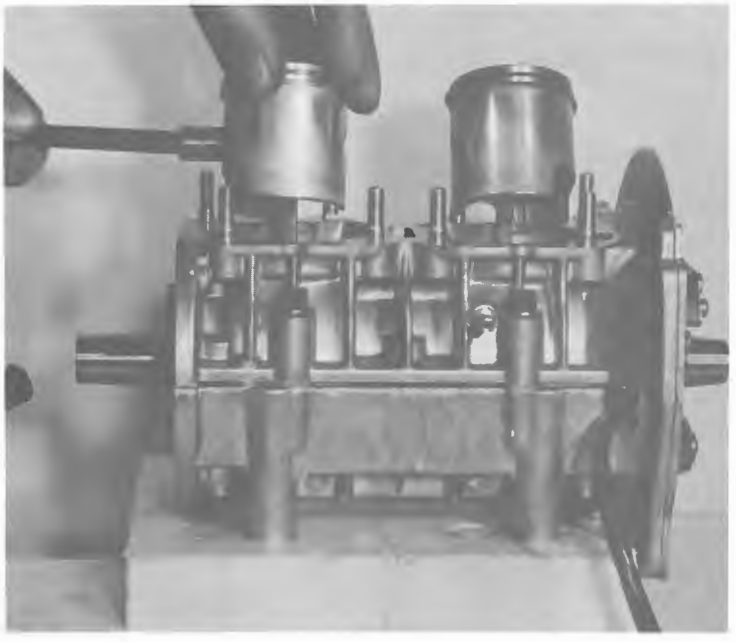


FIGURE 5-3 INSTALLING PISTONS

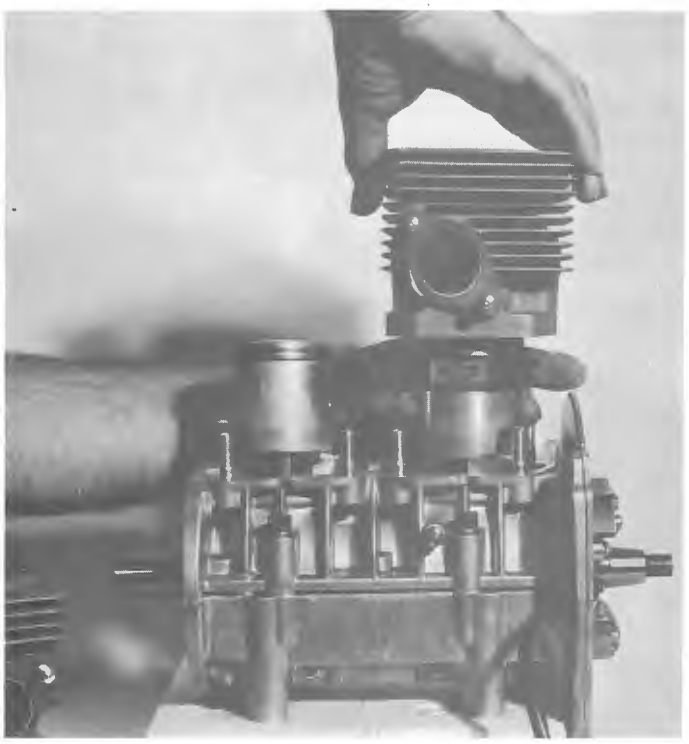


FIGURE 5-4 INSTALLING CYLINDERS

5.2.3 Cylinders (See Figure 5-4)

a. Install new base gaskets over cylinder hold down studs.
b. Cylinders are identified by the letters "L" (left hand) and "R" (right hand) stamped on the cylinder flange. Locate right hand (No. 1) cylinder at flywheel end of crankcase.
c. Lubricate pistons, rings and cylinders with two-stroke engine oil.
d. Place a suitable wooden block between piston and crankcase to steady the piston. Using a piston ring compressing tool, compress rings flush with piston.
e. Slide cylinder over piston and ring assembly. Remove ring compressing tool.
f. Repeat steps (c), (d) and (e) for No. 2 cylinder.
g. Install cylinders over hold down studs and secure with eight washers, lockwashers and hold-down nuts. Torque nuts down evenly, in accordance with the sequence shown in Figure 5-5, using the wrench provided. Recommended torque is 15-18 foot-pounds maximum.

NOTE: Install intake and exhaust manifolds prior to torquing down cylinder to prevent misalignment of mounting surfaces and possible fracture of manifolds.
For instructions see 5.2.11.

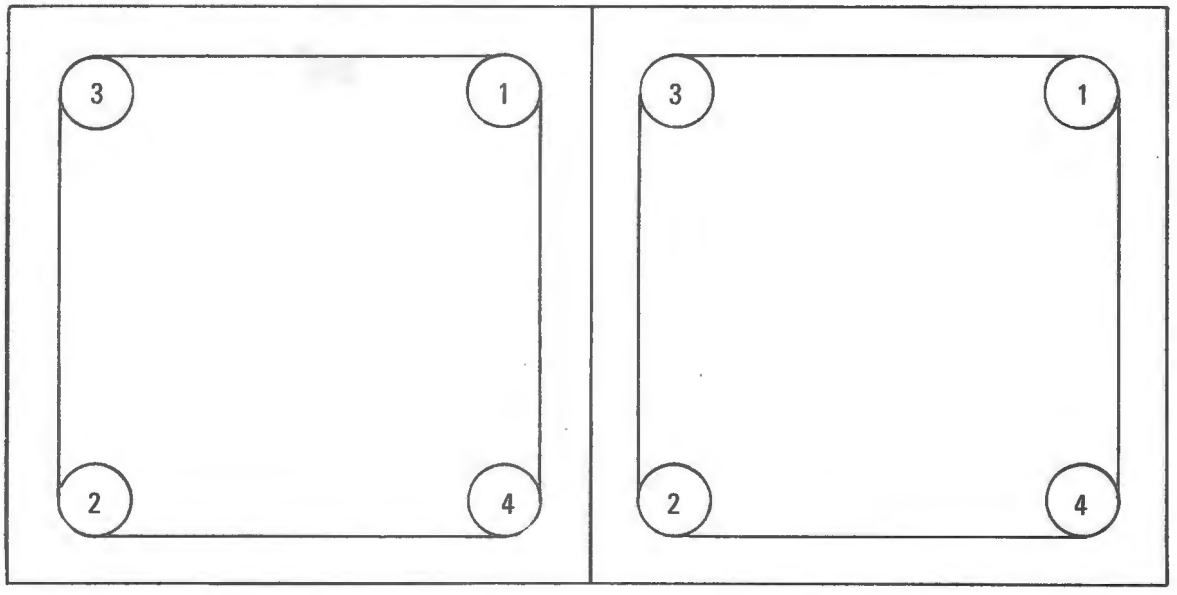


FIGURE 5-5 CYLINDER NUT TORQUING SEQUENCE

5.2.4 CYLINDER HEADS (See Figure 5-6)

a. Install new cylinder head gaskets over cylinder head hold-down studs.
b. Install heads with machined side facing inward and cover brackets facing toward intake ports.
c. Using twelve washers, lockwashers, and bolts provided. Torque the heads down according to sequence shown in Figure 5-7. The internally threaded standoff bolts are to be positioned at location 3 on each cylinder head.

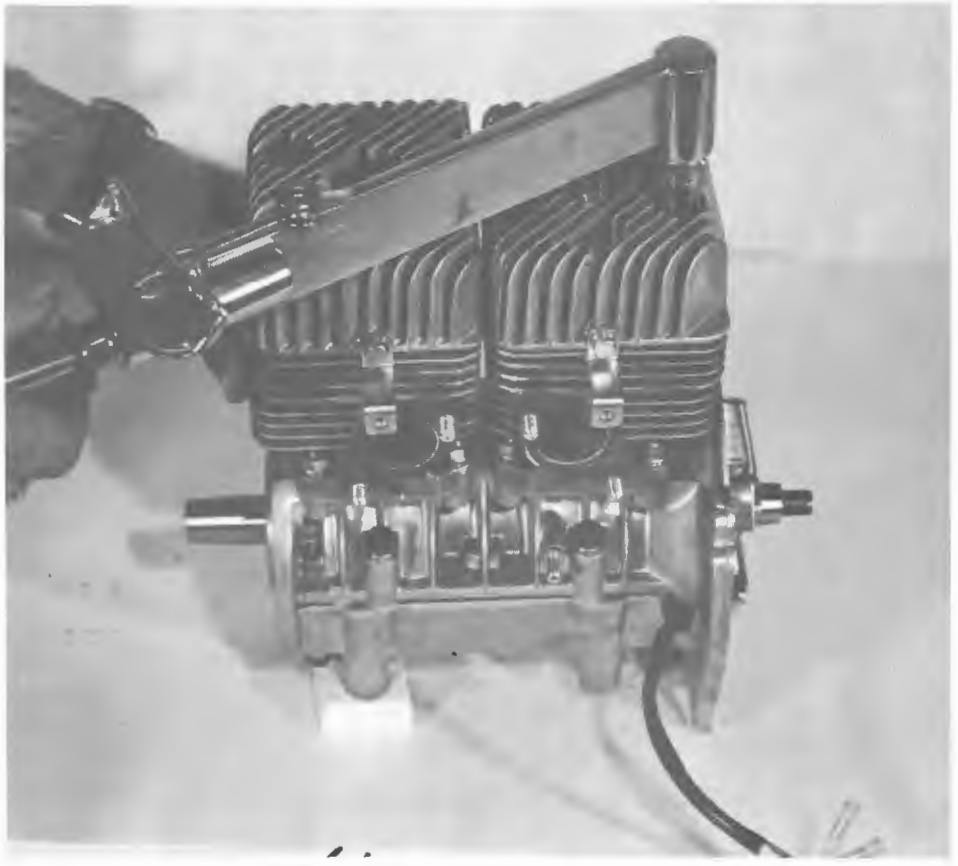


FIGURE 5-6 CYLINDER HEAD INSTALLATION

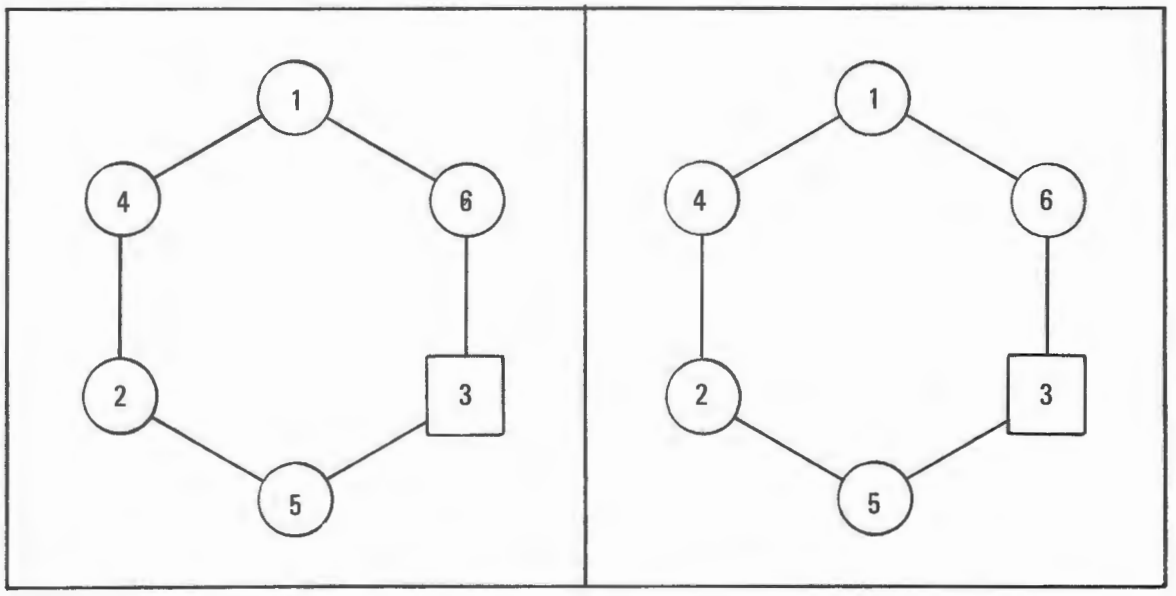


FIGURE 5-7 CYLINDER HEAD BOLT TORQUING SEQUENCE

5.2.5 Stator Assembly (See Figure 5-8)

If not installed during crankcase assembly:

a. Install and secure stator to engine crankcase using two Phillips head screws.
b. Remove the coupler and feed the wire bundle through aperture in crankcase.
c. Re-install coupler.

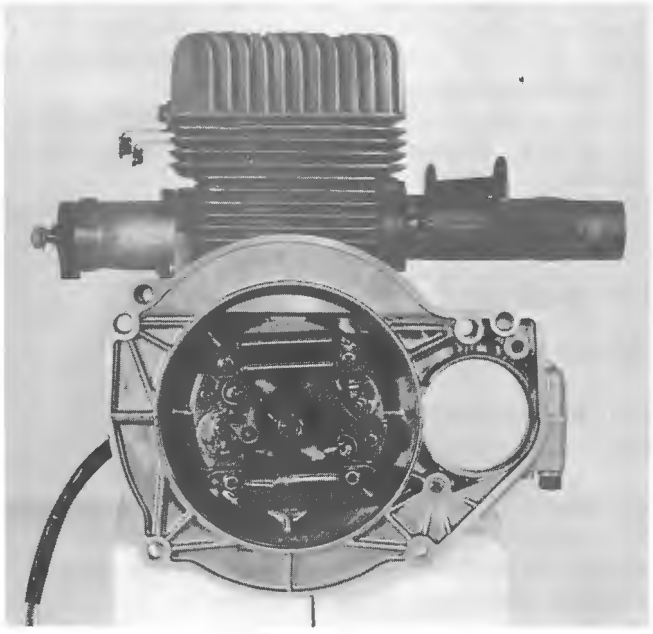


FIGURE 5-8 STATOR INSTALLED

5.2.6 Fan Cover Case and Flywheel (See Figure 5-9)

a. Install and secure fan cover case to crankcase using four bolts, plain washers and lockwashers. Longer bolt is placed in position above electric starter port.

NOTE: If gear ring is installed on flywheel it will be necessary to position flywheel prior to installing fan cover case.

b. Place a Woodruff key in the slot on the crankshaft. Ensure flywheel center bore and tapered end of crankshaft are free of oil or grease. Align keyway and key; slide flywheel on to shaft as far as it will go. Rotate flywheel to ensure freedom of movement with no evidence of binding. Lock the flywheel using CCW Tool #43-0798-40; install flat washer, lockwasher and nut. Tighten nut to 40-50 pounds feet maximum torque. Set timing to proper specifications. Refer to paragraph 5.4.4.

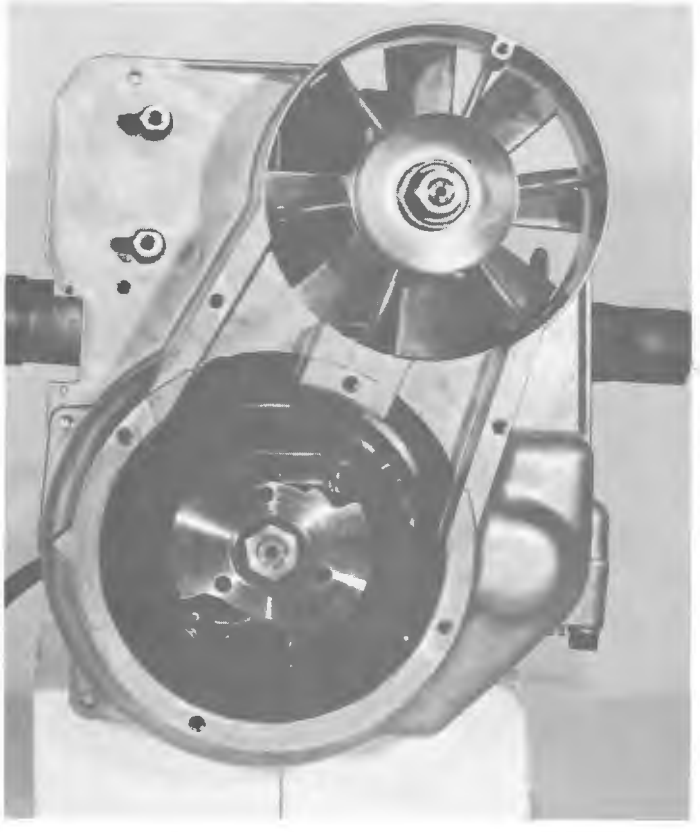


FIGURE 5-9 FAN COVER AND FLYWHEEL INSTALLED

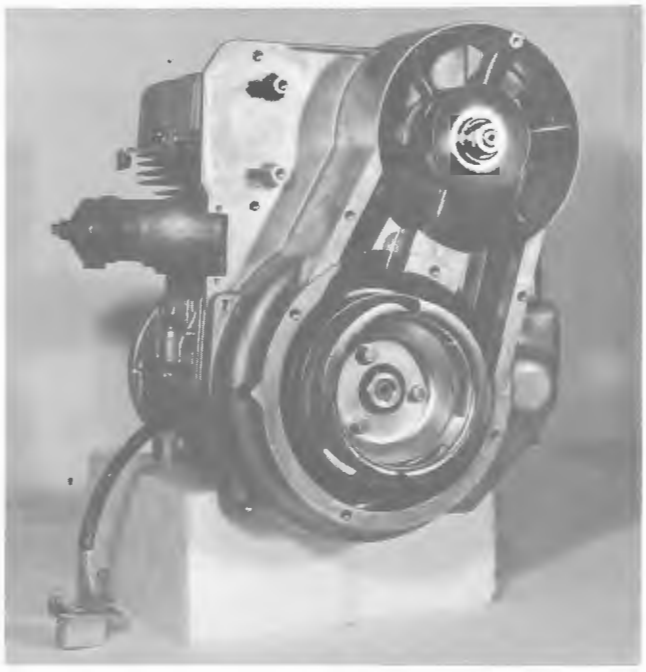


FIGURE 5-10
STARTER CUP AND FAN BELT INSTALLED

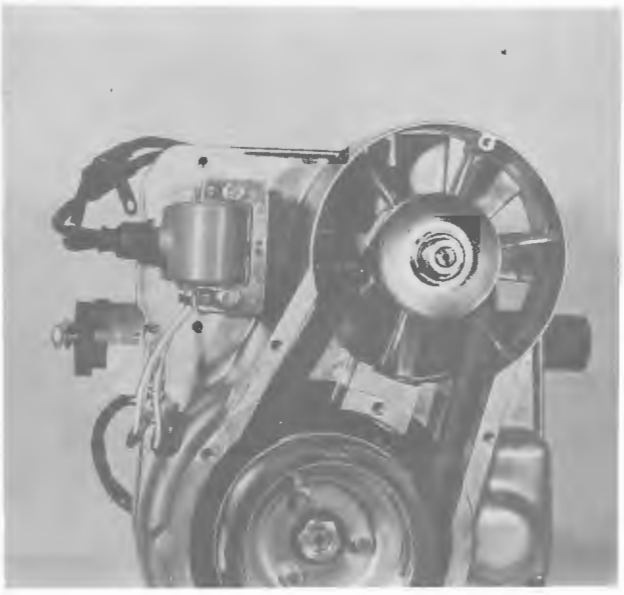


FIGURE 5-11 HIGH TENSION COILS INSTALLED

5.2.7 Starter Cup and Fan Belt Pulley (See Figure 5-10)

a. Secure ignition terminal coupler and bracket using two Phillips head screws.

b. Replace window plate behind fan belt pulley. Install and secure fan belt pulley and starter cup to flywheel using three 6 x 22 bolts and lockwashers. Install fan belt and adjust to proper tension. (Refer to Section II, Paragraph 2.6.2.)

5.2.8 Electric Starter (if so equipped)

a. Install and secure electric starter to hold down studs at covercase. Secure to crankcase using two 8 x 20 bolts, washers and lockwashers.

5.2.9 Ignition Coils—Testing and Installation

a. Coil output can be tested on a Merc-O-Tronic or other comparable analyzer. See Table 1-1 for specifications. A three needle air gap tester may also be used. See Table 1-1. Note:—A 12 volt battery will be required on the older model of Merc-O-Tronic analyzers.

b. Install and secure high tension ignition coils to fan cover using two 6 x 65 attaching bolts and spacers. Connect low tension wires to ignition coupler. Figure 5-11

c. Install and secure coil cover using two 6 x 10 bolts, plain washers and lockwashers.

5.2.10 Recoil Starter

a. Install and secure recoil starter to fan cover using four 6 x 22 bolts, flat washers and lockwashers.

5.2.11 Intake and Exhaust Manifolds

NOTE: In accordance with our recommendation (5.2.3) it is probable that the manifolds have already been installed. If so, check to assure that the following has been accomplished.

a. Install two new intake manifold gaskets and the two insulators over intake manifold hold down studs.

b. Install two additional new gaskets over insulators and mount intake manifold to hold-down studs. Secure with four flatwashers, lockwashers and hold-down nuts. Do not overtorque the nuts.

c. Install two new exhaust manifold gaskets and mount exhaust manifold to hold-down studs. Secure with four flatwashers, lockwashers and hold-down nuts. Do not overtorque the nuts.

5.2.12 Covers

a. Install and secure cylinder cover and adapter to engine using eleven attachment bolts and lockwashers. Start each attachment bolt before tightening any bolts; then tighten all bolts securely. Ensure spark plug wires are properly secured.

5.2.13 Engine Installation

a. Install engine to applicable mounting location; attach muffler and tailpipe; connect electrical wiring and controls.
b. Check engine for proper operation. Refer to paragraph 5.3.

5.3 TESTING AFTER OVERHAUL

5.3.1 General

A five to ten percent power loss may be expected on a newly overhauled engine until it has been subjected to a suitable run-in period. Carefully run the engine at varying engine speeds for the first twenty-five hours of operation.

5.4 ADJUSTMENTS

5.4.1 Carburetor (Refer to applicable manufacturer's specifications)

5.4.2 Spark Plugs (Refer to Section III, Paragraph 3.3.4)

5.4.3 Contact Breaker Points (See Figure 5-12)

a. Remove recoil starter, starter cup and fan belt pulley.
b. Remove window plate.
c. Loosen applicable breaker point retaining screw.
d. Adjust breaker points gap to 0.014±.002 inch. Use a feeler gauge to measure the gap with points in fully open position.
e. Tighten breaker point retaining screw.
f. Check engine ignition timing. See Paragraph 5.4.4.
g. Replace window plate, starter cup, fanbelt pulley and recoil starter.

5.4.4 Engine Ignition Timing (See Figure 5-13)

After engine overhaul or whenever contact breaker points have been replaced or adjusted, check and/or adjust ignition timing to ensure continued engine operating efficiency.

5.4.4.1 Preferred Method

The recommended method of engine ignition timing is with a dial indicator and a timing light having a self contained battery. This method is considered the most convenient means of determining piston position in respect to true top dead center.

Time the engine as follows:

a. Remove recoil starter, starter cup and fan belt pulley; remove window plate (if installed).
b. Remove spark plugs; disconnect ignition at coupler.
c. Install a suitable dial indicator into No. 1 cylinder spark plug hole.
d. Rotate flywheel to locate No. 1 piston position at true top dead center. True top dead center is that point on the indicator scale where the pointer begins to reverse direction of motion. Zero the dial indicator at true T.D.C.
e. Refer to figure 5-13. Adjust No. 1 cylinder breaker point gap to 0.014 inch. This point set has red ignition wiring. Connect one lead of a timing light to the red wire at ignition coupler and the other lead to ground.
f. Rotate flywheel until pointer of dial indicator reaches 0.020 inch before true top dead center. At this instant the timing light should go out to indicate breaker points just starting to open.
   If necessary, adjust ignition coil plate to the right or to the left until the light goes out. Secure ignition coil plate in this position; recheck piston travel to verify timing accuracy.

NOTE: If coil plate cannot be adjusted enough to accurately set No. 1 cylinder timing, recheck breaker point gap. Gap may be re-adjusted to 0.014±.002 inch to obtain desired timing sequence. Breaker point gap must remain within specified tolerance.

g. Remove dial indicator and install it into No. 2 cylinder spark plug hole. Disconnect timing light from ignition coupler.
h. Adjust No. 2 cylinder breaker point gap to 0.014 inch. This point set has red ignition wiring. Connect one lead of timing light to the red wire at coupler and the other lead to ground.
i. Locate No. 2 piston position at true T.D.C. Refer to procedural step (d).
j. Rotate flywheel until pointer of dial indicator reaches 0.020 inch before true T.D.C. At this instant the timing light should go out to indicate breaker points just starting to open. If necessary, point gap may be re-adjusted to 0.014±.002 inch to obtain the desired timing sequences. Breaker point gap must remain within specified tolerance. Recheck piston travel to verify timing accuracy.
k. Replace window plate, starter cup, fan belt pulley and recoil starter.
l. Replace spark plugs; check engine for proper operation.
m. Using a Stroboscope, check ignition timing setting, auto advance mechanism, when fully advanced in accordance with specifications, Table 1-1.

5.4.4.2 Alternate Method (See Figure 5-14)

As an alternate method of engine ignition timing, use the two sets of reference marks on the flywheel and the top dead center (zero) reference line marked on the fan cover. The reference marks on the flywheel include a "T" which indicates piston position at top dead center when aligned with the zero reference line on fan cover, and 5^0, 8^0 and 10^0 reference lines in advance of top dead center. One set of reference lines is 180^0 opposed to the other set. If using the alternate method, time the engine as follows:

a. Remove spark plugs; disconnect ignition at coupler.
b. Remove recoil starter, starter cup and fan belt pulley. Remove window plate (if installed).
c. Refer to Figure 5-12.
   Adjust No. 1 cylinder contact breaker point gap to 0.014 inch. This point set has white ignition wiring. Connect one lead of a timing light having a self contained battery, or suitable instrument to the white wire at coupler and the other lead to ground.
d. Rotate flywheel until No. 1 piston is approaching top dead center and the nearest 10^0 reference line is aligned with the zero reference line on the fan cover. At this

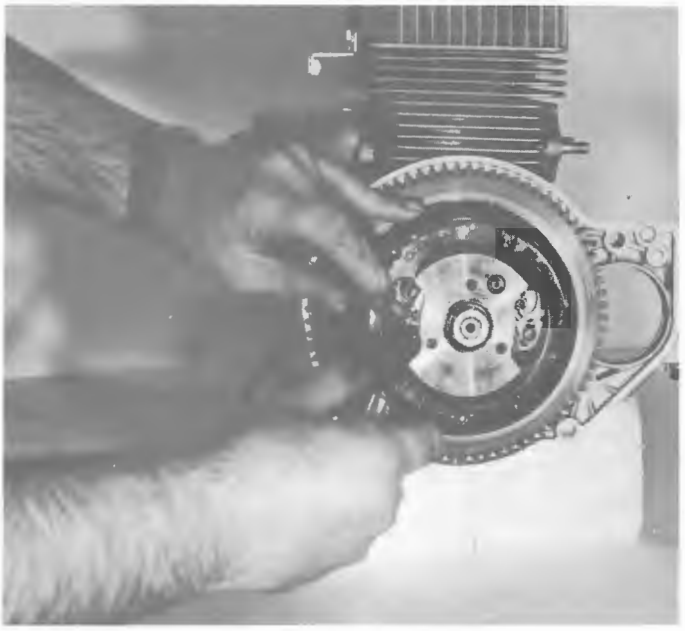


FIGURE 5-12 SETTING CONTACT BREAKER POINT GAP

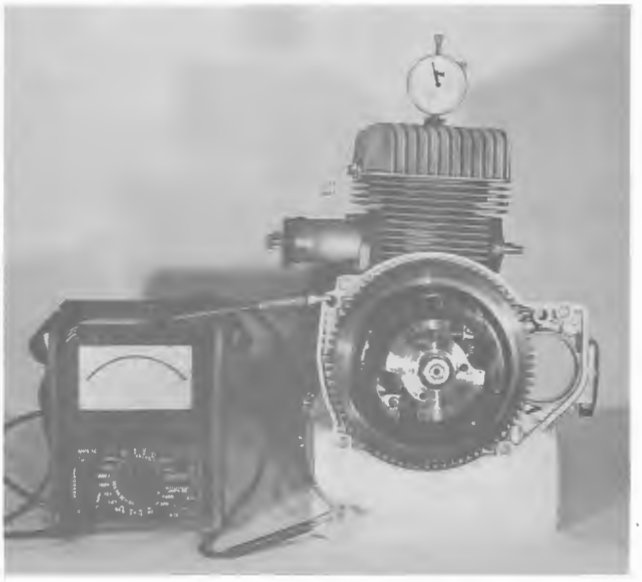


FIGURE 5-13 SETTING ENGINE TIMING

instant, the timing light should go out or suitable instrument should activate to indicate No. 1 cylinder breaker points just starting to open. If necessary, adjust ignition coil plate to the right or to the left until the correct indication is given. Secure ignition coil plate in this position. Recheck timing to verify accuracy.

NOTE: If coil plate cannot be adjusted enough to accurately set No. 1 cylinder timing, recheck breaker point gap. Gap may be re-adjusted to 0.014±.002 inch to obtain desired timing sequence.

e. Refer to Figure 5-12.
Adjust No. 2 cylinder contact breaker point gap to 0.014 inch. This point set has red ignition wiring. Connect one lead of timing light or suitable instrument to the red wire at coupler and the other lead to ground.

f. Rotate flywheel 180^0 to the opposite set of reference marks. Adjust flywheel until No. 2 piston is approaching top dead center and the nearest 10^0 reference line is aligned with the zero reference line on fan cover.
At this instant the timing light should go out or suitable instrument should activate to indicate No. 2 cylinder breaker points just starting to open. If necessary, breaker points may be re-adjusted to 0.014±.002 inch to obtain desired timing sequence. Recheck timing to verify accuracy.

g. Replace window plate, starter cup, fan belt pulley and recoil starter.

h. Replace spark plugs; check engine for proper operation.

i. Using a stroboscope, check ignition timing setting, auto advance mechanism when fully advanced, in accordance with Specifications, Table 1-1.

5.4.4.3 Crankshaft Angle Versus Piston Travel
Table 5-1 lists piston position relative to crank angle.

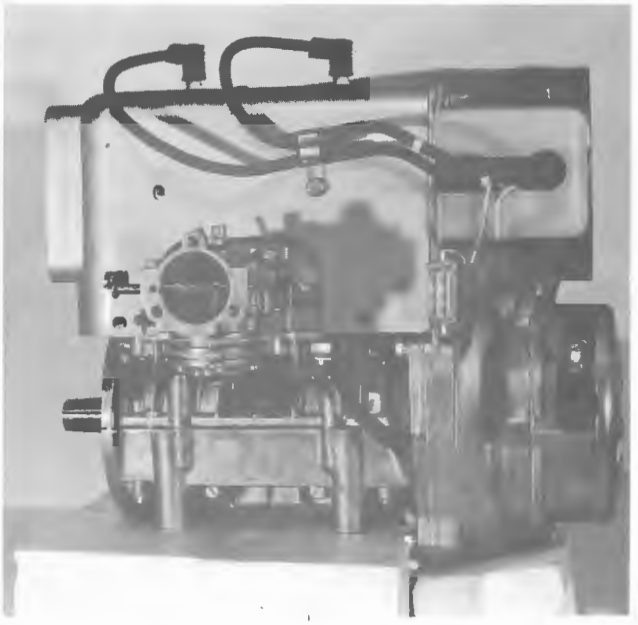


FIGURE 5-14 CCW MODEL 290

TABLE 5-1

CRANK ANGLE VS. PISTON TRAVEL

Angle	Dist. BTDC in In.	Angle	Dist. BTDC in In.
0	0	14	.039
1	.0002	15	.045
2	.0008	16	.050
3	.002	17	.056
4	.003	18	.062
5	.005	19	.068
6	.007	20	.074
7	.010	21	.080
8	.013	22	.087
9	.017	23	.093
10	.020	24	.100
11	.025	25	.107
12	.030		
13	.034		

TABLE 5-2

TORQUE SPECIFICATIONS

Location	Type	Size	Lbs. Ft.
Crankcase	Screws	8 mm.	12-15
Cylinder Head	Nuts	8 mm.	15-18
Cylinder to Crankcase	Nuts	8 mm.	12-15
Flywheel to Crankshaft	Nut	14 mm.	45-50
Fan Pulley	Nut	12 mm.	28-31

TABLE 5-3

METRIC/LINEAR CONVERSION TABLE

Multiply (Known)	by	to Obtain (Unknown)
Millimeters (mm)	0.03937	Inches
Inches (in.)	25.4	Millimeters
Centimeters (cm)	.3937	Inches
Inches (in.)	2.54	Centimeters
Kilometers (km)	.6214	Miles
Miles (mi)	1.609	Kilometers
Meters (m.)	3.281	Feet
Feet (ft.)	.3048	Meters
Cubic Centimeters (cc.)	.061	Cubic Inches
Cubic Inches (cu.in.)	16.387	Cubic Centimeters
Liters (l.)	.264	Gallons
Gallons (qal.)	3.785	Liters
Liters (l)	1.057	Quarts
Quarts (qt.)	.946	Liters
Cubic Centimeters (cc.)	.0339	Fluid Ounces
Fluid ounces (fl.oz.)	29.57	Cubic Centimeters
Kilograms (kg.)	2.205	Pounds
Pounds	.4536	Kilograms
Grams (g.)	.03527	Ounces
Ounces (oz.)	28.35	Grams
Metric Horsepower (ps)	1.014	bhp.
Brake horsepower (bhp.)	.9859	ps.
Kilogram-meter (kg.-m.)	7.235	Foot-pounds
Foot-pounds (ft.-lbs.)	.1383	kg.-m.
Square millimeters (sq.mm)	0.00155	sq. in.
Square inches	645.2	sq. mm.