BREAKERLESS — ALTERNATOR IGNITION

The Kohler Breakerless-Alternator Ignition system uses solid state devices which eliminate the need for mechanically operated breaker points. With breakerless ignition, timing is permanently set for the lifetime of the engine. Except for the spark plug, the entire system is virtually service-free. The system provides an instantaneous, high energy spark which not only prolongs the service life of the plug but makes spark gap and even condition of the plug less critical.

The breakerless ignition system includes four major components which are: ignition winding (on alternator stator), trigger module, ignition coil assembly and special flywheel with trigger projection. The system also includes the conventional spark plug and lead, plus an ignition switch on blower housing of engine or a remote mounted stop switch as shown in the inset on Figure 6-6. The ignition winding is separate from the other AC windings on the alternator stator--the other windings are used for battery charging and other purposes (discussed in the Electrical System Section).

The trigger module includes three diodes, a resistor, a sensing coil and magnet, plus an electronic switch called an SCR. The trigger module has two clip-on type terminals. The terminal marked A must be connected to the alternator while the I terminal is connected to the ignition coil--improper hook-up will cause damage to the electronic devices.

The ignition coil assembly includes the capacitor and a pulse transformer arrangement similar to the conventional high tension coil with primary and secondary windings. The flywheel has a special projection for triggering the ignition.

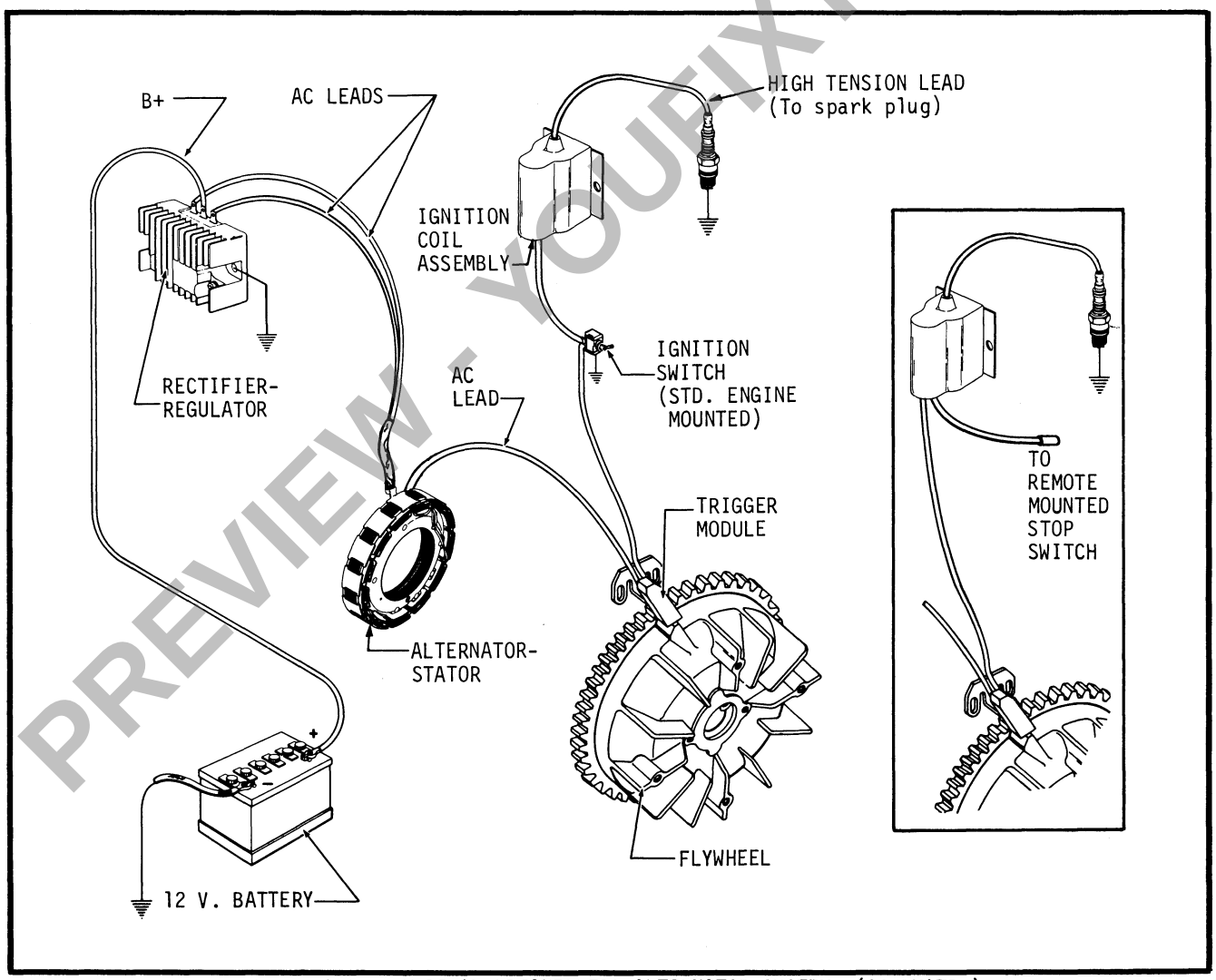


FIGURE 6-6 -- TYPICAL BREAKERLESS-ALTERNATOR SYSTEM (SCHEMATIC)

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SPECIFICATIONS

TORQUE VALUES

TORQUE VALUES -- MAJOR ITEMS	ENGINE MODEL						
	K91	K141	K161	K181	K241	K301	K321
GOVERNOR ARM LOCKING SCREW	35 in. lbs.	35 in. lbs.	35 in. lbs.	35 in. lbs.	----	----	----
CYLINDER HEAD CAPSCREW*	200 in. lbs.	200 in. lbs.	200 in. lbs.	200 in. lbs.	420 in. lbs.	420 in. lbs.	420 in. lbs.
CONNECTING ROD CAPSCREW*	140 in. lbs.	200 in. lbs.	200 in. lbs.	200 in. lbs.	300 in. lbs.	300 in. lbs.	300 in. lbs.
FLYWHEEL RETAINING NUT**	45 ft. lbs.	60 ft. lbs.	60 ft. lbs.	60 ft. lbs.	60 ft. lbs.	60 ft. lbs.	60 ft. lbs.
SPARK PLUG	27 ft. lbs.	27 ft. lbs.	27 ft. lbs.	27 ft. lbs.	27 ft. lbs.	27 ft. lbs.	27 ft. lbs.

* *Lubricate with grease at assembly.*

** *Earlier K241-K301 models with 3/4 - 16 thread -- torque to 100 ft. lbs.*

TORQUE VALUES -- STANDARD HARDWARE ITEMS

SIZE	TORQUE	SIZE	TORQUE
1/4 - 20	70 in. lbs.	1/2 - 13	50 ft. lbs.
1/4 - 28	85 in. lbs.	1/2 - 20	70 ft. lbs.
5/16 - 18	150 in. lbs.	9/16 - 12	75 ft. lbs.
5/16 - 24	165 in. lbs.	9/16 - 18	100 ft. lbs.
3/8 - 16	260 in. lbs.	5/8 - 11	110 ft. lbs.
3/8 - 24	300 in. lbs.	5/8 - 18	140 ft. lbs.
7/16 - 14	35 ft. lbs.	3/4 - 10	150 ft. lbs.
7/16 - 20	45 ft. lbs.	3/4 - 16	200 ft. lbs.

CONVERSION TABLE (INCH LBS. TO FOOT LBS.)										
FOOT LBS.	5	10	15	20	25	30	35	40	45	50
INCH LBS.	60	120	180	240	300	360	420	480	540	600

Divide inch lbs. by 12 for foot pound values. *Multiply foot lbs. by 12 for inch pound values.*

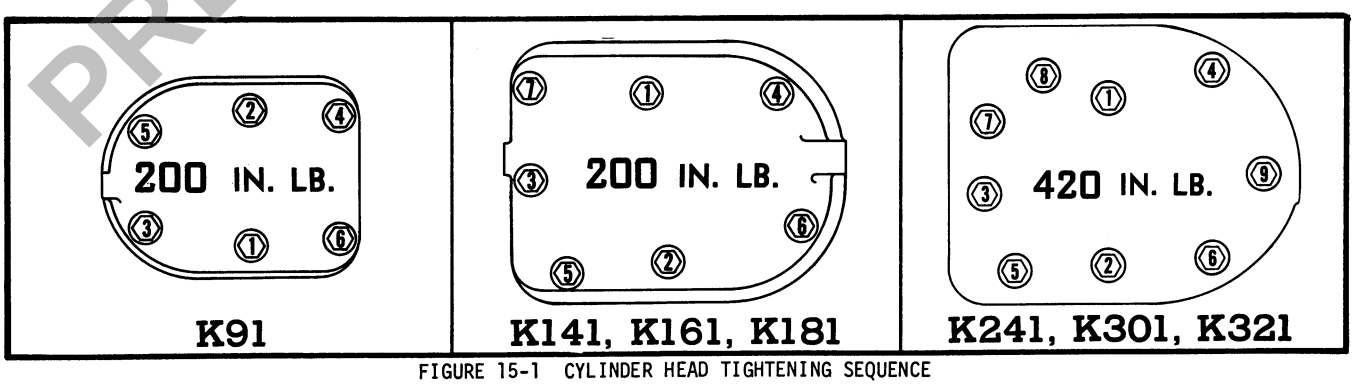


FIGURE 15-1 CYLINDER HEAD TIGHTENING SEQUENCE

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FUEL SYSTEM

CARBURETOR

Carburetors are adjusted in the factory and under normal conditions require no further adjustment. If, however, one of the following conditions exist, readjustment of the carburetor may be needed.

CONDITION	POSSIBLE CAUSE/PROBABLE REMEDY
A. Black, sooty exhaust smoke, engine sluggish.	A. Mixture too rich - readjust main fuel needle.
B. Engine misses and backfires at high speed.	B. Mixture too lean - readjust main fuel needle.
C. Engine starts, sputters and dies under cold weather starting.	C. Mixture too lean - turn main fuel adjustment 1/4 turn counterclockwise.
D. Engine runs rough or stalls at idle speed.	D. Improper idle adjustment - readjust idle fuel needle.

Maximum power and efficiency are possible only with proper carburetion. Improper carburetor adjustment can lead to overheating, fouled spark plug, excessive valve wear and other problems. Do not neglect carburetor if any of the above problems persist. The following adjustment procedure is for the standard side draft and updraft gasoline carburetors -- see Special Fuel System Section for procedure on other types of carburetors.

STEP 1 - Stop engine and carefully turn Main Fuel and Idle Fuel Needle adjusting screws all the way in (clockwise direction) until they bottom -- DO NOT FORCE SCREWS as this will damage needle valves.

STEP 2 - For preliminary adjustment, turn Main Fuel screw 2 turns in counterclockwise direction, turn Idle Fuel screw 1-1/4 turns in counterclockwise direction.

STEP 3 - Start engine and operate at normal speed until normal operating temperatures are reached.

STEP 4 - Main Fuel Adjustment - With engine operating at full throttle and full load, turn Main Fuel Needle in (clockwise) until engine slows down (lean), note position of screw, then turn needle out (counterclockwise) until engine regains speed and then again slows down (overrich). Turn needle back in until it is positioned halfway between lean and overrich settings. If adjusted properly, the engine should accelerate smoothly and operate with steady governor action.

STEP 5 - Idle Fuel Adjustment - Operate engine at idle speed of about 1000 RPM (adjust Idle Speed screw until this speed is attained - check with tachometer). Turn Idle Fuel Needle in (clockwise) until engine slows down and idles rough then turn screw out until engine speeds up and idles smoothly at the desired idle speed.

STEP 6 - Final Adjustment - Since main fuel and idle fuel adjustment have some affect on each other, recheck engine and make final adjustments as necessary to achieve smoothest operation.

NOTE: If the preceding steps do not remedy problems attributed to carburetor, carburetor reconditioning may be necessary.

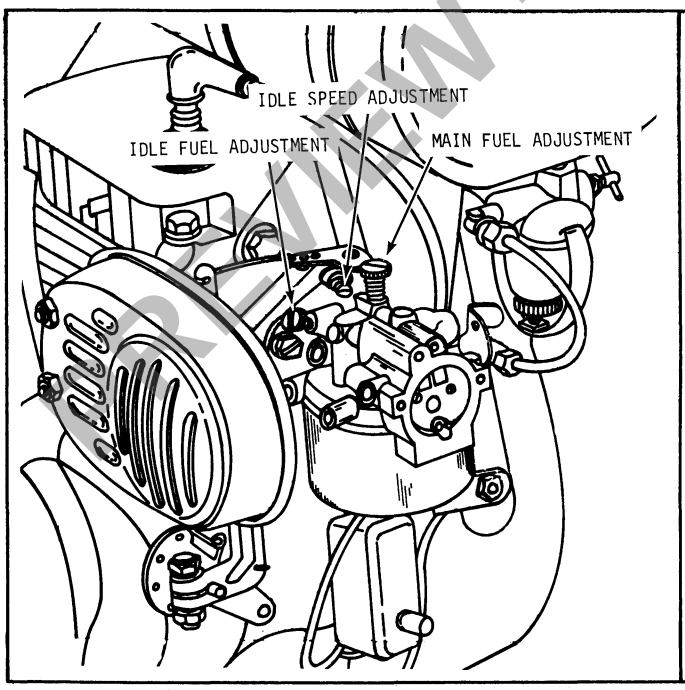


FIGURE 4-1 ADJUSTMENT - SIDE DRAFT CARBURETOR

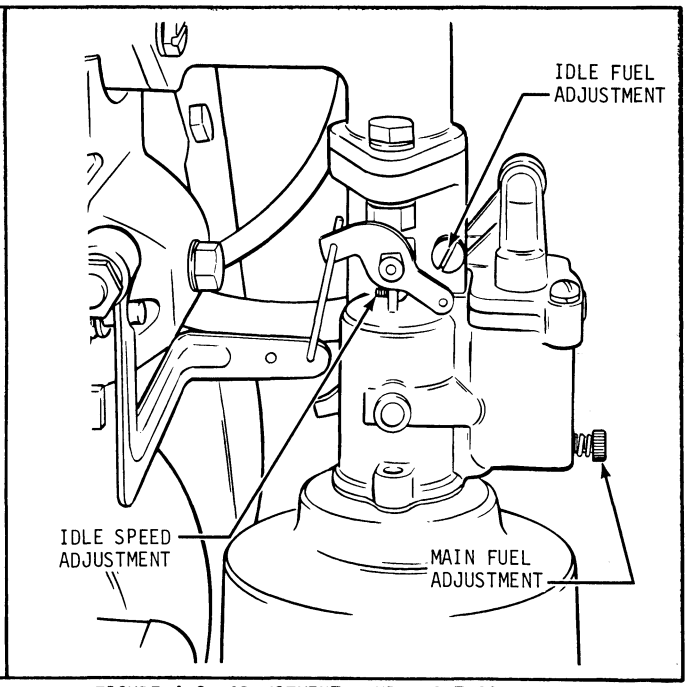


FIGURE 4-2 ADJUSTMENT - UP DRAFT CARBURETOR

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TROUBLE SHOOTING

CONDITION	POSSIBLE CAUSE
A. Hard Starting or Loss of Power	1. Faulty Ignition. a. Loose or grounded high tension or breaker point leads. b. Improper breaker point gap and timing. c. Defective breaker points. d. Faulty spark plug or improper gap. e. Faulty condenser or coil. 2. Faulty Fuel System. a. Gasoline not getting to carburetor. 1. Dirt or gum in fuel line. 2. Fuel pump faulty. b. Dirt in carburetor. c. Carburetor improperly adjusted.
B. Overheating	1. Insufficient available cool air. 2. Dirty air intake screen, shroud or cooling fins. 3. Improper fuel. 4. Fuel mixture too lean. 5. Improper ignition timing. 6. Engine overloaded. 7. Tight tappet clearance.
C. Backfiring	1. Fuel mixture too lean. 2. Improper timing. 3. Valve "sticking".
D. Occasional "Skip" at High Speed	1. Spark plug gap too wide. 2. Improper carburetor setting or lack of fuel. 3. Wrong type spark plug. Use recommended spark plug. 4. Improper timing.
E. Operating Erratically	1. Clogged fuel line. 2. Water in fuel. 3. Faulty choke control. 4. Improper fuel mixture. 5. Loose ignition connections. 6. Air leaks in manifold or carburetor connections. 7. Vent in gas cap plugged. 8. Fuel pump faulty.
F. Engine Will Not Idle	1. Improper carburetor idling adjustment. 2. Carburetor clogged. 3. Spark plug gap set too close. 4. Leaking carburetor or manifold gaskets.

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SERVICE SCHEDULE

SERVICE FUNCTION	PERFORM SERVICE AT INTERVAL INDICATED (X)				
	EACH DAY	EVERY 25 HOURS	EVERY 50 HOURS	EVERY 100 HOURS	EVERY 500 HOURS
LUBRICATION SYSTEM					
OIL LEVEL - Check and add oil as needed.	X				
OIL CHANGE - Thoroughly drain, refill with oil of proper grade and weight.		X			
AIR INTAKE SYSTEM					
DRY TYPE AIR CLEANER - Clean element. (Replace element every 200 hours under normal operating conditions.)			X		
OIL BATH AIR CLEANER - Drain oil, clean bowl, wash element, add new oil to level mark.		X			
FUEL SYSTEM					
FUEL SEDIMENT BOWL - Remove and clean bowl. If filter element used, swish in clean fuel. Reinstall and check for and correct leakage.				X	
IGNITION SYSTEM					
SPARK PLUG - Remove plug, clean and re-gap to .025". (Use new plug if needed.) Reinstall plug and tighten to 324 in. lbs. torque.				X	
BREAKER POINTS - Remove cover, check condition of point contacts, service (or replace) as necessary.				X	
IGNITION TIMING - Check and retime as necessary. Set breaker point gap to .020" fully open or use timing light method.					X
ELECTRICAL (CHARGING - STARTING) SYSTEMS					
MOTOR - GENERATOR - Check and correct belt tension if needed. Check brushes and commutator - service as required.					X
VOLTAGE REGULATOR - Remove cover, check condition and contact point gap. Service as required.					X
MAGNETO - ALTERNATOR - Regular service not required - check condition of leads, tighten loose terminals or connections.					X
COMPACT STARTING MOTOR - Remove end cap, check condition of brushes and commutator, service or replace if needed.					X
ENGINE - GENERAL					
EXTERNAL SURFACES - Clean air intake screen, cooling fins and block especially in oil fill area.	X				
VALVE CLEARANCE - Remove cover, check clearance between valve stems and tappets (See Valve Clearance Adjustment), adjust as needed.					X
CRANKCASE BREATHER - Remove components, check reed valve and gaskets, clean filter. Reinstall in proper sequence.				X	
CYLINDER HEAD - Remove head, scrape out carbon deposits with piece of wood. Install new gasket, reinstall head and tighten bolts in proper sequence and to specified torque value.					X

Note: See appropriate Service Section for specific details on performing the various service functions.

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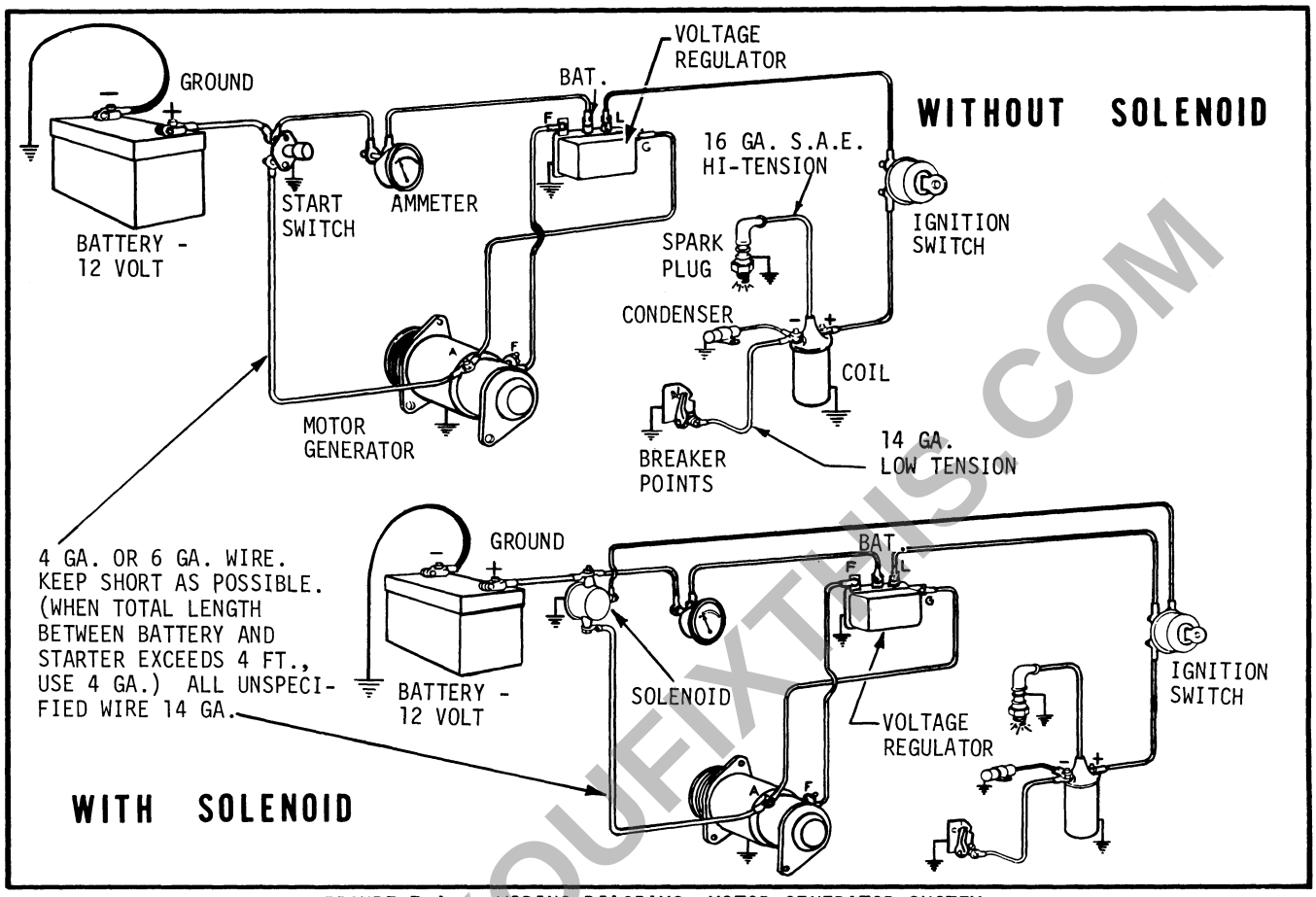


FIGURE 7-4 -- WIRING DIAGRAMS, MOTOR-GENERATOR SYSTEM

MOTOR TESTS: If unit fails to crank properly, inspect entire cranking circuit for loose or badly corroded connections and damaged wiring. Check battery to determine condition. When battery is satisfactory and wiring and connections are in good condition, close starting switch. If unit fails to crank, wire around motor switch with a heavy jumper lead. If motor-generator operates, the switch is defective and should be replaced. If unit fails to operate, the trouble can be attributed to the engine or to the motor-generator. Excessive friction in the engine from tight bearings or pistons or from too heavy oil causes hard cranking. If unit fails to crank properly when engine is known to be in good operating condition and the rest of the cranking circuit is found to be satisfactory, the motor-generator should be removed for further checking. With the motor-generator removed from the engine, the armature should be checked for freedom of operation by turning the shaft. Tight, dirty or worn bearings, a bent armature shaft or loose pole shoe screws may cause the armature to drag and fail to turn freely. If armature does not turn freely, the motor must be disassembled.

GENERATOR TESTS: If generator output is zero, check the commutator, brushes and internal connections. Sticking brushes, a dirty or gummy commutator or poor connections may prevent the generator from producing any output. Solder thrown from the commutator riser bars indicates that the generator has been overheated from excessive output. Often this leads to an open circuit and burned commutator bars and, consequently, no output. If the brushes are satisfactorily seated and making good contact with the commutator and the cause of trouble is not apparent, the unit should be disassembled and tested according to manufacturer's specifications. Special test equipment will usually be needed for further analysis.

DISASSEMBLY: Noise emanating from a generator may be caused by a loose mounting or drive pulley. It can also be caused by worn or dirty bearings or improperly seated brushes. Dirty bearings may sometimes be saved by cleaning and relubrication, but worn bearings should be replaced. Excessive noise may result if the brush holder is bent resulting in improper seating of the brush. Such a brush holder should be replaced. The end frames, bearings and armatures can be removed or replaced without disturbing any electrical connections. The brush holder assemblies are mounted individually on the walls of the field frame. To disassemble motor-generator, use the following procedure:

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FITS & CLEARANCES

SPECIFICATION	ENGINE MODEL						
	K91	K141	K161	K181	K241	K301	K321
Bore and stroke	2-3/8x2	2-7/8x2-1/2	2-7/8x2-1/2	2-15/16x2-3/4	3-1/4x2-7/8	3-3/8x3-1/4	3-1/2x3-1/4
Bore diameter, new	2.375	2.875	2.875	2.9375	3.250	3.375	3.500
Crankshaft end play	.0038/.0228	.002/.023	.002/.023	.002/.023	.003/.020	.003/.020	.003/.020
Crankshaft - conn. rod journal size	.9360/.9355	1.1860/1.1855	1.1860/1.1855	1.1860/1.1855	1.5000/1.4995	1.5000/1.4995	1.5000/1.4995
Crankpin - conn. rod side clearance	.005/.016	.005/.016	.005/.016	.005/.016	.007/.016	.007/.016	.007/.016
Crankpin length	.875	1.125	1.125	1.125	1.187	1.180	1.180
Journal diameter, new	.984	1.181	1.181	1.181	1.575	1.575	1.575
Connecting rod to crankpin running clearance	.001/.0025	.001/.002	.001/.002	.001/.002	.001/.002	.001/.002	.001/.002
Connecting rod to wrist pin clearance	.0005/.0010	.0006/.0011	.0006/.0011	.0006/.0011	.0003/.0008	.0003/.0008	.0003/.0008
Wrist pin to piston boss	.0002 Int. to .0002 Loose	.0001 Int. to .0003 Loose	.0001 Int. to .0003 Loose	.0001 Int. to .0003 Loose	.0000/.0003 Select Fit	One Thumb Push Fit	One Thumb Push Fit
Piston to cylinder bore (thrust face)	.003/.004	.0045/.0065	.0045/.0065	.0045/.0070	.003/.004	.003/.004	.0035/.0045
Piston to cylinder bore (top of skirt)	.0035/.0060	.006/.0075	.0060/.0075	.006/.008	.0075/.0085	.0065/.0095	.007/.010
Piston pin bore size	.51632	.62565	.62565	.62565	.85975	.85975	.85975
Piston pin diameter	.562	.625	.625	.625	.86	.86	.86
Ring side clearance, top ring	.002/.004	.0025/.0040	.0025/.0040	.0025/.0040	.002/.004	.002/.004	.002/.004
Ring side clearance, middle ring	.002/.004	.0025/.0040	.0025/.0040	.0025/.0040	.002/.004	.002/.004	.002/.004
Ring side clearance, oil ring	.0015/.0035	.001/.0025	.001/.0025	.001/.0025	.001/.003	.001/.003	.001/.003
Ring end gap	.007/.017	.007/.017	.007/.017	.007/.017	.010/.020	.010/.020	.010/.020
Ring width, inches, top ring	.093	.093	.093	.093	.093	.093	.093
Ring width, inches, middle ring	.093	.093	.093	.093	.093	.093	.093
Ring width, inches, oil ring	.187	.187	.187	.187	.187	.187	.187
Camshaft pin to camshaft clearance	.0010/.0025	.0010/.0035	.0010/.0035	.0010/.0035	.001/.0035	.001/.0035	.001/.0035
Camshaft pin to block (Bearing plate end)	.0005/.0012	.0005/.0020	.0005/.0020	.0005/.0020	.0005/.002	.0005/.0020	.0005/.0020
Camshaft pin to block (P.T.O.E.) (Int.)	.0055/.002	.0015/.003	.0015/.003	.0015/.003	.0015/.0030	.0015/.0030	.0015/.0030
Camshaft pin to breaker cam	.001/.0025	.0010/.0035	.0010/.0035	.0010/.0035	.0010/.0025	.0010/.0025	.0010/.0025
Camshaft end play	.005/.020	.005/.010	.005/.010	.005/.010	.005/.010	.005/.010	.005/.010
Valve stem clearance in guide, intake	.0005/.0020	.0010/.0025	.0010/.0025	.0010/.0025	.0010/.0025	.0010/.0025	.0010/.0025
Valve stem clearance in guide, exhaust	.0020/.0035	.0025/.0040	.0025/.0040	.0025/.0040	.0025/.0040	.0025/.0040	.0025/.0040
Valve guide in block (Interference)	Not Used	.0005/.0020	.0005/.0020	.0005/.0020	.0005/.0020	.0005/.0020	.0005/.0020
Valve seat in block (exhaust) (Interference)	.002/.005	.002/.004	.002/.004	.002/.004	.003/.005	.003/.005	.003/.005
Valve clearance, intake (cold)	.005/.009	.006/.008	.006/.008	.006/.008	.008/.010	.008/.010	.008/.010
Valve clearance, exhaust (cold)	.011/.015	.015/.017	.015/.017	.015/.017	.017/.020	.017/.020	.017/.019
Valve seat angle	44.5	44.5	44.5	44.5	44.5	44.5	44.5
Valve face angle	45	45	45	45	45	45	45
Valve seat width	.037/.045	.037/.045	.037/.045	.037/.045	.037/.045	.037/.045	.037/.045
Valve tappet clearance in block	.0005/.002	.0005/.002	.0005/.002	.0005/.002	.0008/.0023	.0008/.0023	.0008/.0023
Governor bushing to gov. cross shaft clear.	.0012/.0027	.0005/.002	.0005/.002	.0005/.002	.001/.0025	.0010/.0025	.0010/.0025
Governor gear to governor shaft	--	.0025/.0055	.0025/.0055	.0025/.0055	.0005/.0020	.0005/.0020	.0005/.0020
Ball bearing to cylinder block (Interference)	.007/.0022	.0014/.0029	.0014/.0029	.0014/.0029	.0006/.0022	.0006/.0022	.0006/.0022
Ball bearing to bearing plate (Interference)	.0007/.0022	.0014/.0029	.0014/.0029	.0014/.0029	.0012/.0028	.0012/.0028	.0012/.0028
Ball bearing to crankshaft (Int. to loose)	.0004/.0003	.0005/.0002	.0005/.0002	.0005/.0002	.0004/.0005	.0004/.0005	.0004/.0005
Sleeve bearing to crankshaft (K141 only)	--	.0010/.0025	--	--	--	--	--
Sleeve bearing to bearing plate, K141 (Int.)	--	.0020/.0045	--	--	--	--	--

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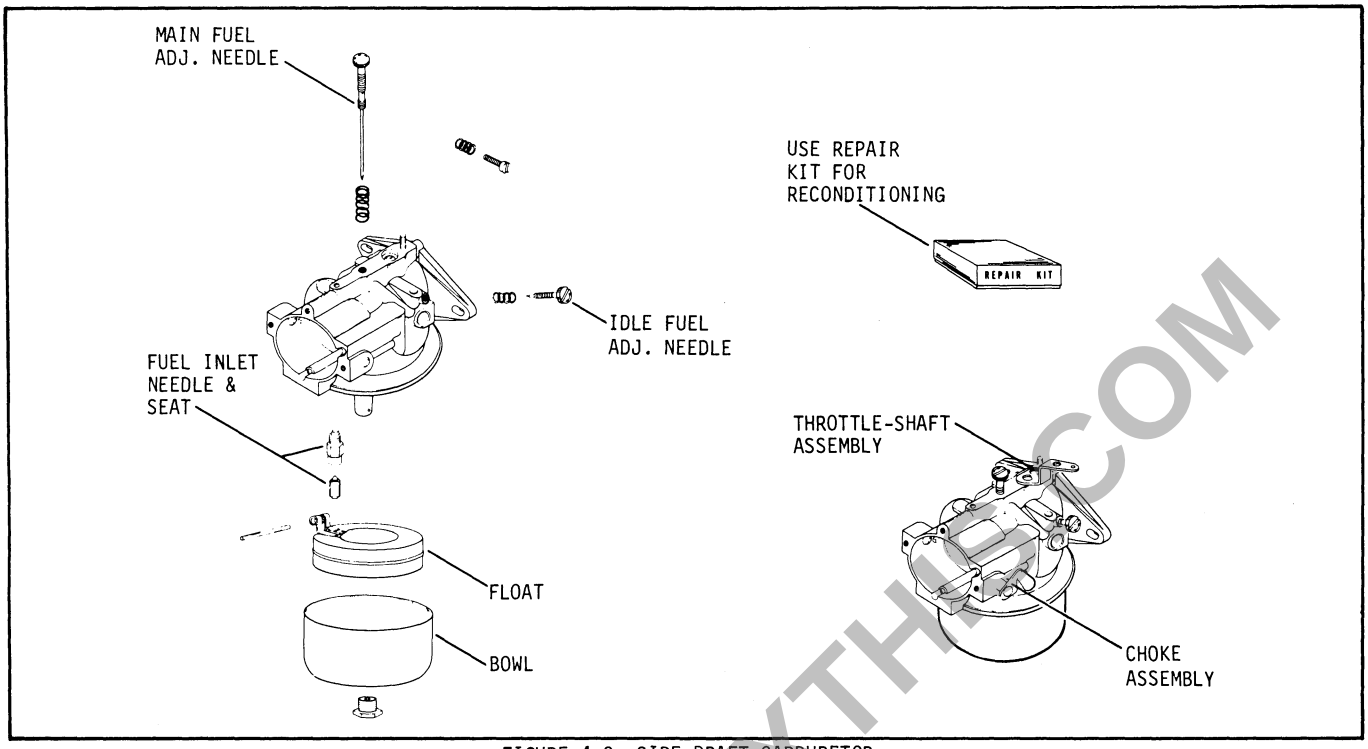


FIGURE 4-3 SIDE DRAFT CARBURETOR

Carburetor Reconditioning

Service difficulties with fuel systems usually originate from improper carburetor adjustments or dirt, gum or varnish in components. It will be necessary to completely disassemble carburetor to clean thoroughly. Normally only pre-season cleaning will be required; however, the frequency of cleaning will depend upon use and operating conditions.

All parts should be cleaned in a solvent. Gum is easily removed with an alcohol or acetone solvent. Be sure any carbon deposits are removed from bore, especially where throttle plate seats in casting. Blow out all passages with compressed air. Replace all worn and damaged parts. Always use new gaskets. Carburetor repair kits are available for most carburetors. They include the bowl nut gasket (if required), bowl ring gasket, float pin, bowl baffle gasket and fuel inlet needle and seat.

Disassembly of Carburetor - Side Draft

1. Remove carburetor from engine.
2. Remove bowl nut, gasket and bowl. When carburetor has bowl drain, remove drain spring, spacer (when used), plug and gasket from inside of bowl.
3. Remove float pin, float, needle and needle seat. Check float for dents, leaks and wear on float lip or in float pin holes.
4. Remove bowl ring gasket.
5. Remove idle fuel adjusting needle, main fuel adjusting needle and springs.
6. Do not remove choke and throttle plates and shafts. If these parts are worn, replace carburetor assembly.

Assembly of Carburetor - Side Draft

1. Install needle seat, needle, float and float pin.
2. Set float level. With carburetor casting inverted and float resting lightly against needle in its seat, there should be 11/64" plus or minus 1/32 of an inch clearance between machined surface of casting and free end of float (side opposite needle seat).
3. Adjust by bending lip of float with small screwdriver.
4. Install new bowl ring gasket, new bowl nut gasket (when required) and bowl nut. Tighten securely after making sure bowl is centered on gasket.
5. Install main fuel adjustment needle. Turn in until needle seats in nozzle and back out two turns.
6. Install idle fuel adjustment needle. Back out approximately 1-1/2 turns after seating lightly against jet. CAUTION: DO NOT USE FORCE ON ADJUSTMENT NEEDLES.

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