ENGINE SERVICE FUNDAMENTALS

CONTENTS

CAUTION: Do not run engines with torque converter drive belt removed unless torque converter drive sheave is also removed from engine output shaft.

TROUBLESHOOTING

Most performance problems such as failure to start, failure to run properly or missing out are caused by malfunction of the ignition system or fuel system. Refer to sequences listed below for assistance in diagnosing and repairing performance problems.

FAILURE TO START

Remove and examine spark plugs. If fuel is reaching the cylinder in proper amount, there should be an odor of gasoline on the plugs if they are cold. Too much fuel or oil can foul the plugs causing engine not to start. Fouled plugs are wet in appearance and easily detected. The presence of fouled plugs is not a sure indication that the trouble has been located, however, the engine might have started before fouling occurred if ignition system had been in good shape.

With spark plug (or plugs) removed, hold wire about 1/8- to 1/4-inch away from an unpainted part of engine and crank engine sharply. Ground one plug wire against engine on two cylinder models. The resulting spark may not be visible in bright daylight but a distinct snap should be heard as the spark jumps the gap.

If carburetor and ignition were both in apparently good condition when checked, examine other elements of engine such as crossed spark plug wires, improper timing, etc. A systematic search will usually pinpoint the cause of trouble with a minimum of delay or confusion.

DIAGNOSIS. If the presence of fuel was not apparent and the spark seemed satisfactory, systematically check the fuel system for the cause of trouble. Possible causes of lack of fuel could be:

1. No fuel in tank
2. Frozen or clogged fuel line or filter
3. Fuel pump impulse line disconnected
4. Damaged or frozen fuel pump diaphragm
5. Carburetor dirty or improperly adjusted
6. Fuel pickup line disconnected or leaking

If no spark occurred during initial check look for the following:

1. Key switch "Off"
2. Emergency kill switch in "Stop" position
3. Shorted stop wire or switch
4. Loose coil connections
5. Open (broken) wire
6. Breaker points improperly adjusted or stuck open
7. Broken or grounded primary wire
8. Faulty coil or condenser

POOR PERFORMANCE

On many two cylinder engines, the ignition system for each cylinder is completely independent, therefore one cylinder can run perfectly while the other will not fire. On some two cylinder engines with Japanese magnetos, a short at one set of points will cause engine not to run. On other models the engine will not fire on either cylinder if one set of points is stuck in the open position.

Complaints of not enough power or speed can usually be traced to improper tuning. Make sure that air filter is clean and in good condition and that exhaust pipe and muffler are open and not clogged or restricted. Ignition timing and carburetor(s) must be correctly adjusted. Both the carburetors and ignition systems must be synchronized on two cylinder models. The proper altitude adjustments must be made for mountain running if the altitude nears or exceeds 5000 ft.

Also check to be sure the engine is actually at fault. Complaints of poor performance can be caused by improper drive sprocket selection, a binding or improperly adjusted track or drive chain, or a torque converter which does not operate properly. Other items to check include:

- Brakes dragging
- Damaged pistons, rings and/or cylinders
- Loose cylinder head nuts or leaking head gasket
- Leaking crankcase seals
- Incorrect fuel/oil mixture
- Incorrect or improperly adjusted spark plugs

ENGINE OVERHEATS. The following lists some possible causes of engine overheating.

1. Dirt, weed seeds or debris accumulation in cooling fins.
2. Incorrect fuel/oil mixture or lean carburetor adjustment.
3. Improper ignition timing.
4. Missing or broken cooling fins or fan blades.
5. Missing or bent shields or fan housing.
6. Cylinder heads improperly installed.

SPARK PLUG DIAGNOSIS

The appearance of the spark plug will change with use and careful examina-

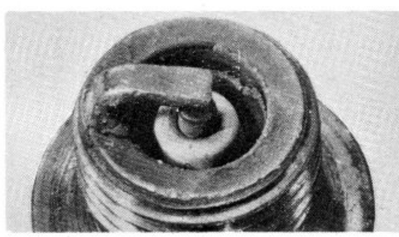


Fig. 1—Normal spark plug. Insulator tip color brown to light tan; electrodes not burned or eroded. Clean, regap and reinstall.

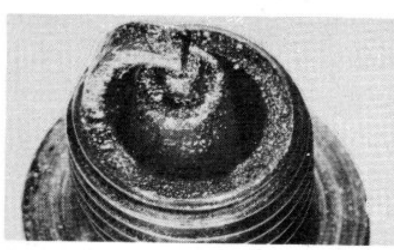


Fig. 2—Wet fouling. Damp oily film over firing end; insulator tip black. Indicates rich fuel mixture, incorrect fuel/oil mix (too much oil); missing (two cylinder engine) or incorrect carburetor mixture setting. If none of the above factors apply, install hotter plug.

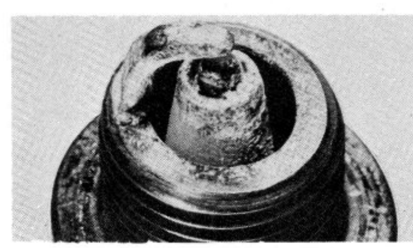


Fig. 3—Too hot. Light tan to white deposits with flaking and blistering. Electrodes eroded and burned. Engine overheating or detonating or plug too hot for operating conditions. Install colder plug and retest. If performance does not improve check for other causes of overheating or detonation.

tion of removed plugs can help in plug selection and in pinpointing other causes of engine malfunction. The accompanying pictures (Fig. 1 through 6) are provided by Champion Spark Plug Company to illustrate typical conditions. Listed also are the probable causes and suggested corrective measures.

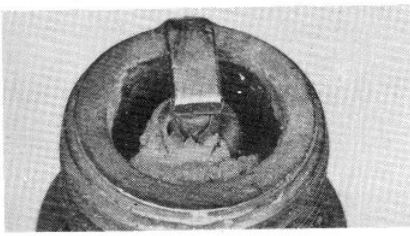


Fig. 4—Core bridging. Caused by excessive carbon deposits in cylinder and/or plugged exhaust system. The deposits break away and fuse on plug during high-speed operation. Check exhaust system, carburetor mixture and fuel/oil mixture. Refer also to Fig. 5.

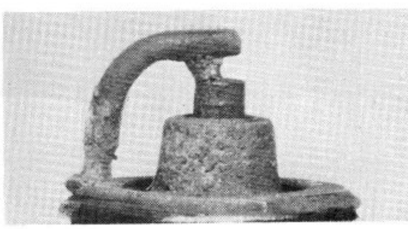


Fig. 5—Gap bridging. Same causes as Fig. 4. Decarbonizing is recommended in both instances as well as correcting other causes.

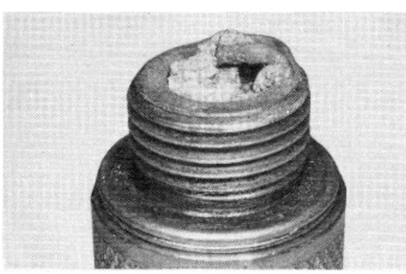


Fig. 6—Plug fouled by aluminum deposits. Caused by severe overheating or detonation. Overhaul engine immediately and correct the cause before more serious trouble develops.

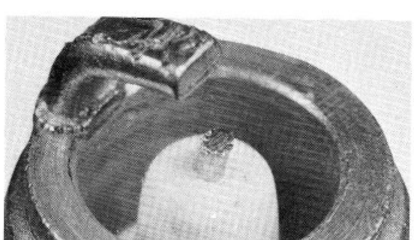


Fig. 7—"Gold Palladium" spark plug with center electrode bent in filing. Electrodes are softer than normal and special care must be exercised in handling.

MAINTENANCE

SPARK PLUG

The recommended electrode gap and standard spark plug is listed in the CONDENSED SERVICE DATA Tables for the appropriate engine section. The suggested spark plug or equivalent is usually most suitable for normal or average use. Engine modification or special conditions may call for the installation of a spark plug of a different heat range.

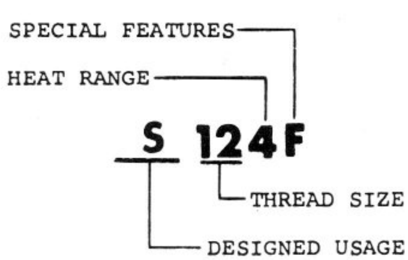
Spark plugs are normally cleaned by abrasive in a compressed air blast. Plugs so cleaned should be thoroughly recleaned and/or flushed to be sure no abrasive material remains in recesses of the plug to later fall and cause engine damage. Rounded or dished electrodes should also be dressed with a point file to return the electrodes as nearly as possible to original shape.

NOTE: Use special caution when filing spark plugs with precious metal electrodes. Fig. 7 shows the center electrode of a CHAMPION "Gold Palladium" spark plug which has been bent in filing. Precious metal electrodes are usually softer than normal and may be easily damaged.

It is often necessary to clean or renew spark plugs shortly after overhaul or after engine has been properly stored. The oil used to coat engine parts may foul plugs quickly.

Each spark plug manufacturer uses a different special code to identify spark plug characteristics. It has been found impossible to provide a plug cross reference chart which is accepted by all manufacturers, however the following code identification for some spark plugs may be helpful in selecting the correct plug. Although not universally true, it can be generally assumed that two plugs of different manufacture falling within similar portions of the heat range scale will interchange. In some cases it may be necessary to move up or down the scale one or two steps for best performance.

AC SPARK PLUGS



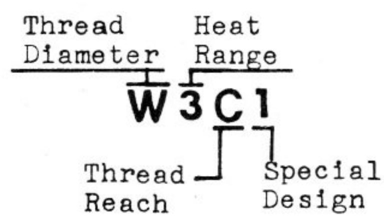
Thread Size—the first digit or digits of the number code indicates thread size. The pictured sample indicates a 12 mm plug.

Heat Range—the last digit of number code indicates heat range. Plugs may be numbered from "0" to "9", the lower number indicating the colder plug. The pictured example "4" falls approximately in mid-range.

Suffix Letters—a letter (or letters) after the number indicates special features. The "F" in pictured example indicates that plug is "Special Reach for Foreign Applications".

Prefix Letters—letter (or letters) before number code indicates designed usage. In the case of snowmobiles, the prefix of S is added only when a special plug or modification is required.

BOSCH SPARK PLUGS



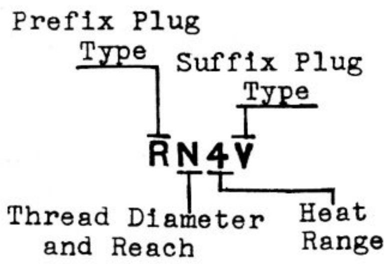
Thread Diameter—the first letter of the identification code indicates thread diameter. The pictured sample indicates a 14 mm plug.

Heat Range—the first digit or digits following the thread diameter indicates heat range. Numbers range from zero to twelve. The middle numbers are medium range, the lower numbers are cold range and the upper numbers are hot range. The pictured sample indicates a cold range plug.

Thread Reach—the letter following the heat range digit or digits indicates thread reach. The pictured sample indicates a ¾-inch thread reach with a regular electrode.

Special Design—the last digit or letter indicates if plug has a special design feature.

CHAMPION SPARK PLUGS



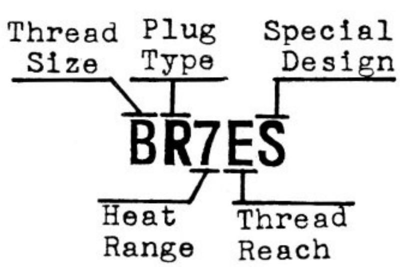
Prefix Plug Type—the first letter of the identification code indicates whether the plug is a resistor or has an auxillary gap. The pictured sample indicates a resistor type plug.

Thread Diameter And Reach—the letter following the prefix plug type indicates thread diameter and reach. The pictured sample indicates a 14 mm plug with a ¾-inch thread reach.

Heat Range—the first digit or digits indicates heat range. The higher number (within type range) indicates hotter plug. The pictured sample indicates a cold range plug.

Suffix Plug Type—the last letter indicates if the plug has a special feature or application. The pictured sample indicates a surface gap type plug.

NGK SPARK PLUGS



Thread Size—the first letter of the identification code indicates thread size. The pictured sample indicates a 14 mm plug.

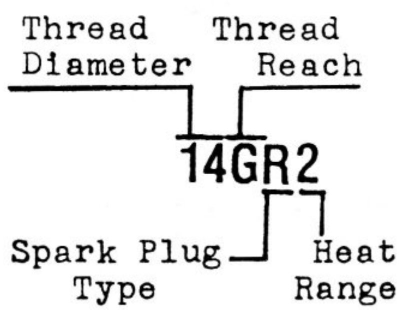
Spark Plug Type—the second letter indicates plug type. The pictured sample indicates a resistor type plug.

Heat Range—the first digit or digits indicates heat range. Numbers range from two to ten. Lower numbers indicate hotter plugs, higher numbers indicate colder plugs. The pictured sample indicates a medium range plug.

Thread Reach—the letter following the heat range digit indicates thread reach. The pictured sample indicates a ¾-inch thread reach.

Special Design—the last letter indicates special design feature or application. The pictured sample indicates having a standard copper core center electrode.

PRESTOLITE SPARK PLUGS



Thread Diameter—the first digit or digits of the number code indicates thread diameter. The pictured sample indicates a 14 mm plug.

Thread Reach—the first letter following the thread diameter indicates thread reach. The pictured sample indicates a ¾-inch thread reach.

Spark Plug Type—the second letter indicates spark plug type. The pictured sample indicates a resistor type plug.

Heat Range—the last digit or digits of the number code indicates heat range. Numbers range from zero to eleven. The middle numbers are medium range, the lower numbers are cold range and the upper numbers are hot range. The pictured sample indicates a cold range plug.

CARBURETOR

Refer to **CARBURETOR REPAIR** section for data on specific carburetor types.

IGNITION AND ELECTRICAL

Flywheel Magneto

Repair is usually limited to renewal of breaker points and/or condenser and adjustment of ignition timing. Refer to CONDENSED SERVICE DATA Tables of the specific engine for recommended point gap and timing recommendations.

BREAKER POINTS. On some units, breaker points can be inspected and adjusted through a flywheel window as shown in Fig. 8 but, although an inspection window is present on most models, accurate adjustment is not always possible. Flywheel must usually be removed for renewal of parts.

NOTE: On some engines, a special puller is required for flywheel removal. Check engine sections for procedure.

On most models with automatic timing advance, the breaker cam can be quickly removed from flywheel and temporarily installed on crankshaft for point adjustment as shown in Fig. 9. Use a clean greaseless feeler gage for checking the gap and be sure points are not pitted. Contact surfaces must seat squarely and properly align when points are closed. Loosen retaining screw (R–Fig. 8) and insert a blade screwdriver in notches (N) to make the adjustment. Recheck gap after retaining screw (R) is tightened.

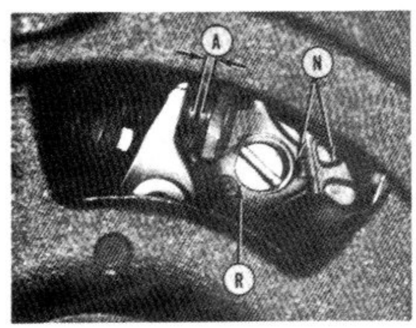


Fig. 8—Ignition points viewed through flywheel opening

A. Point gap
N. Adjusting notches
R. Retaining screw

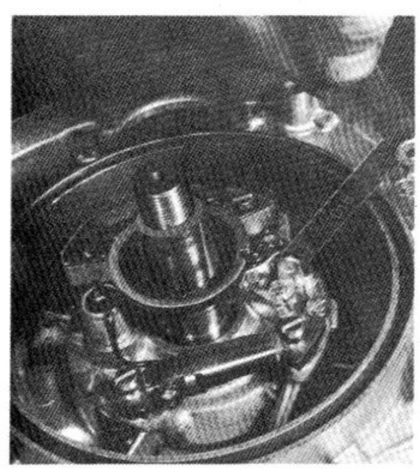


Fig. 9—On some engines, breaker cam can be removed from flywheel and positioned over crankshaft for point adjustment.

CONDENSER. A defective condenser can cause point failure or complete failure of engine to start and run. On many units, condenser is pressed into armature plate and leads are soldered. Use an iron and a minimum amount of heat when making the connections. Condenser should not be removed unless renewal is indicated. If condenser is to be renewed, armature plate must be removed and condenser pressed out from bottom. Condenser is swaged or staked in place (S–Fig. 10) when installed. If burrs remain from previous staking, remove with a scraper or file. Press in new condenser working from top (flywheel) side of plate. If condenser is not tight after installation, stake in three or four places. Use care not to crush the case when condenser is installed.

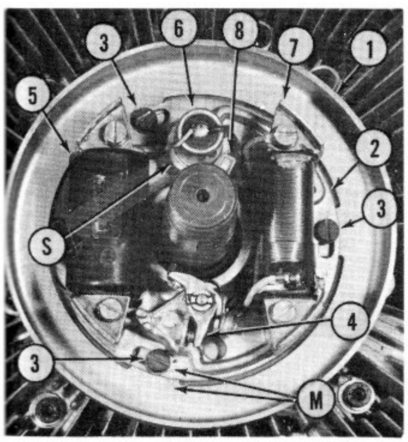


Fig. 10—Assembled view of high tension magneto unit with flywheel removed.

M. Timing marks
S. Swaging
1. Mounting plate
2. Armature plate
3. Mounting screws
4. Breaker points
5. Ignition coil
6. Condenser
7. Lighting coil
8. Oiler wick

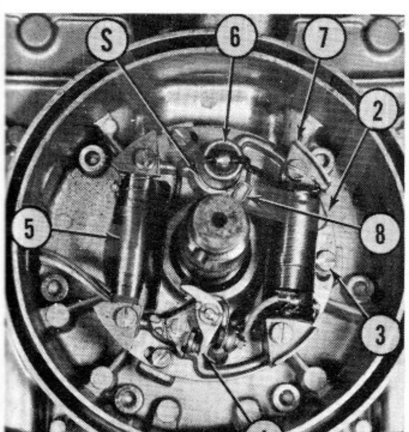


Fig. 11—Installed view of energy transfer magneto plate with flywheel removed, showing component parts. Refer to Fig. 10 for parts identification.

IGNITION COIL. On models with a conventional flywheel magneto system the ignition coil (5–Fig. 10) is mounted on the armature plate. On models with an energy transfer system, the armature plate contains only an ignition generating coil (5–Fig. 11) and the ignition coil (or coils) is externally mounted. Plug-in connectors are used; refer to fundamentals section for typical wiring diagrams. If testing equipment is not available, output can be checked by holding spark plug wire about ¼-inch away from block while turning engine with a starter. If no spark occurs or if spark is weak or yellow, renewal of ignition coil may be indicated.

IGNITION TIMING. Ignition timing is usually specified in degrees of crankshaft rotation before piston reaches Top Dead Center, or by measuring piston travel before TDC with a dial indicator as shown in Fig. 12. If the spark plug hole is angled, special dial indicators are available as shown in Fig. 13.

Timing should be checked using a light or buzzer connected to the blue primary lead or black kill lead. If advance timing is being checked on models with automatic timing advance, cam may be blocked in the fully advanced position as shown in Fig. 15. Manufacturer's timing recommendations are given in the individual ENGINE SERVICE Sections. Increasing the breaker point gap will advance the timing.

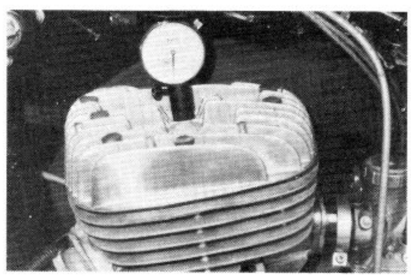


Fig. 12—To measure piston travel, install a dial indicator (such as Central Tool Co. indicator shown) in spark plug hole. Find TDC, then move piston by rotating crankshaft until ignition timing is correct. Refer to Fig. 13 if spark plug hole is not parallel to cylinder bore centerline.

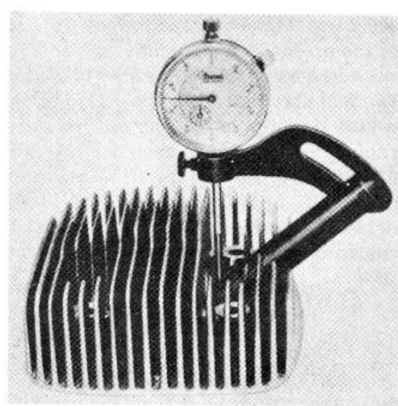


Fig. 13-Special dial indicators are available as shown for measuring piston travel in angled spark plug holes.

MAGNETO EDGE GAP. For maximum strength of the ignition spark, the breaker points should just start to open when the flywheel magnets are at the specified position relative to the ignition coil pole shoe. This distance is variously known as Edge Gap, Break-Away Gap, Pole Shoe Break or Straight Gap. Sometimes the edge-gap is not adjustable and will be maintained at the proper dimension if the breaker points are correctly adjusted and the correct breaker cam installed. Magneto Edge Gap can change (and spark intensity reduced) due to the following.

1. Improper adjustment.
2. Flywheel key sheared.
3. Flywheel key or key seat worn (flywheel loose).
4. Excessive breaker cam wear.

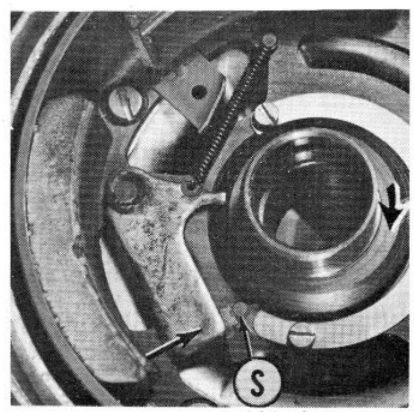


Fig. 14—Breaker cam in retard (starting) position, with advance weight resting against stop pin (S). Refer also to Fig. 15.

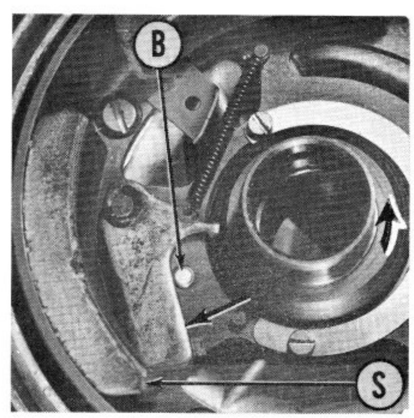


Fig. 15—Breaker cam is fully advanced when advance weight is in contact with flywheel magnet (S). On some engines, a bolt (B) can be dropped in hole provided to block the cam in advanced position for engine timing as shown.

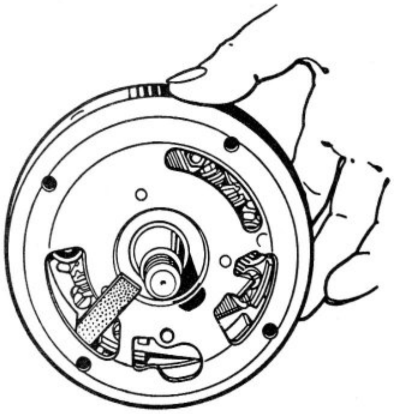


Fig. 16—A cardboard strip of suitable width can be used to measure edge gap.

Magneto Edge Gap can be adjusted on those models where breaker cam can be moved independently of flywheel or breaker pivot can be moved independently of armature plate. Edge gap can be measured using a strip of cardboard the correct width and working through flywheel opening as shown in Fig. 16.

Energy Transfer System

An energy transfer ignition system operates very much like the previously described flywheel magneto system except that the components are not in one area on the engine. Single cylinder models present no particular problems in understanding or in service.

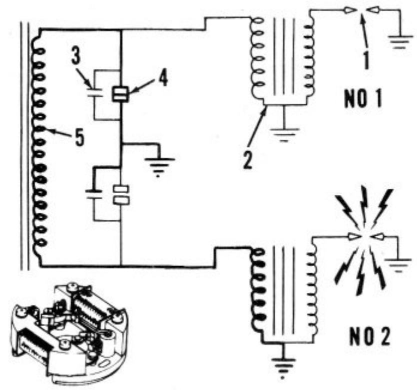


Fig. 18—Schematic wiring diagram of SAWAFUJI two cylinder ET magneto used on CCW 340S engine. Ignition systems for the two cylinders are interconnected through the single ignition generating coil (5). Ignition generating circuit is complete only when both breaker points (4) are closed and pulse of current flows to one ignition coil primary when one set of points open as shown. Refer to Fig. 17 for parts identification.

Basic differences exist in construction and in the service of some twin units, however, and these differences must be understood to avoid confusion. Fig. 17 is wiring diagram of a Kokusan magneto used by Canadian Curtiss Wright on some engines and also typical of Bosch used on European engines. Low Tension generating coils for both cylinders are piggy-backed as shown in inset, and magneto consists essentially of two timed single-cylinder magnetos.

Fig. 18 is a wiring diagram for the Sawafuji magneto used on CCW 340S (manual start) engine. A single low tension coil is used for both cylinders and the closed set of points provides part of the primary circuit as shown. One set of points which fail to make contact will therefore cause engine to stop, rather than miss out. A shorted set of points will permit the opposite cylinder to fire.

It should be mentioned that an ET magneto differs from a conventional magneto in that the secondary current (spark) is induced by a primary voltage rise, rather than by primary circuit interruption in a battery ignition system or conventional magneto. Refer again to Fig. 17. Note that with points closed (Cyl. No. 1) the ignition generating current (heavy lines) flows through the points and generating coil, with no current to ground or ignition coil. When points open (Cyl. No. 2) the normal path of current flow is interrupted and the remaining current path is through ground and ignition coil primary. The resulting voltage rise in ignition primary induces the secondary current which fires the spark plug.

With these differences in mind ET magneto service is identical to that given for Flywheel Magneto.

Capacitor Discharge System

Because of differences in CD ignition construction, it is impractical to outline a general procedure for CD ignition service. Refer to the specific engine section for testing, overhaul notes and timing of capacitor discharge ignition systems.

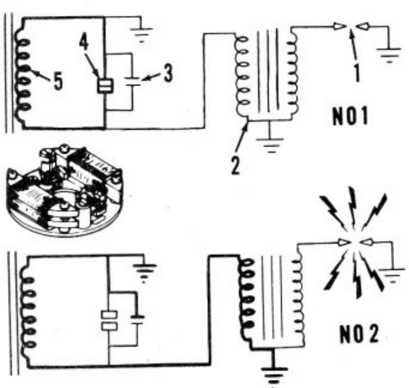


Fig. 17—Schematic wiring diagram of KOKUSAN two cylinder ET magneto used on some CCW engines. Ignition generating coils (5) are "Piggy Backed" and ignition systems for each cylinder are independent. Ignition generating current circuit for No. 1 cylinder is completed through points (4) as indicated by heavy lines. On No. 2 cylinder points have opened breaking the circuit and a rising voltage pulse passes through primary windings of ignition coil (2) initiating the spark at No. 2 plug (1) as shown.

1. Spark plug
2. Ignition coil
3. Condenser
4. Breaker points
5. Generating coil

REPAIRS

Because of the close tolerance of the internal parts, cleanliness is of utmost importance. It is suggested that the exterior of the engine and all nearby areas be absolutely clean before any repair is started. The manufacturer's recommended torque values for tightening screw fasteners should be followed closely. The soft threads in aluminum castings are often damaged by carelessness in overtightening fasteners or in attempting to loosen or remove seized parts.

PISTON, PIN, RINGS AND CYLINDER

Two cycle engines do not have a complex valve mechanism and the piston rings have no oil control function. On the other hand, carbon build-up is more likely to occur, and where oil consumption is the most common service problem on four cycle engines, carbonization is the two-cycle counterpart.

The simple construction of two stroke engines and the benefits to be gained from periodic carbon removal make decarbonization a part of the recommended maintenance procedure of most two cycle experts. Because the piston rings have no oil control function, ring renewal is not required at carbon removal except to correct for wear or other damage.

Excessive carbon build-up can be harmful in two ways. First, it insulates to keep the heat from escaping normally. Second, it raises the compression ratio to create more heat. This places an additional heat load on that portion of the cylinder which is scraped clean of carbon by the piston rings.

The need for carbon removal is often first indicated by inability to properly adjust the carburetor. If performance is erratic and improper carburetion is indicated, but attempts to adjust the carburetor fail, check first for excessive carbon build up. No cleaning or adjustment of the carburetor can materially improve performance if exhaust passages are partially carbon blocked.

No problems will be encountered in removing cylinder head and/or cylinder for carbon removal provided normal standards of care and cleanliness are observed.

Examine the parts as engine is disassembled for clues to engine condition, to correct possible future trouble, or identify the cause of existing trouble. As an example, refer to Fig. 19. On this particular piston, the skirt is not scored and the first glance will show melted aluminum which has covered the ring on one side. The melted spot (D) on top and below piston crown is conclusive proof of detonation damage and the cause must be corrected during overhaul or the same failure can be expected to reoccur.

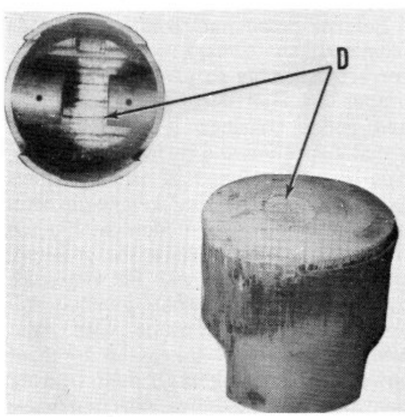


Fig. 19 — Top and bottom view of piston severely damaged by detonation. Spot (D) on top and bottom of crown show where metal has started to melt. Absence of scoring on skirt rules out seizure, over-heating or lack of lubrication as a contributing cause.

If pistons are scuffed or scored, look for metal transfer to cylinder walls. Metal transfer and score marks must be removed from cylinder walls with a hone. Chrome plated cylinder bores should not be honed.

Full strength muriatic acid can be used to remove aluminum deposits from a cast iron cylinder bore. Muriatic acid can be purchased in a drug store. It is also used as a soldering acid, although the supply kept in most radiator shops has usually been cut (diluted) with zinc. Use acid carefully, it can cause painful burns if spilled on the skin and the fumes are toxic. It is most easily used by carefully transferring a small amount to a plastic squeeze bottle, or to another small container and applying with a cotton swab. DO NOT allow the acid to spill or run onto aluminum portions of the cylinder, it will rapidly attack and dissolve the metal. Do not use the acid on a chrome bore. When applied to aluminum deposits, the acid will immediately start to boil and foam. When the action stops the aluminum has been dissolved or the acid is diluted; wipe the area with an old rag or towel which can be discarded. If deposits remain, repeat the process. Flush the area with water when aluminum is removed. Water will dilute the acid and can be used to stop the action if desired, or if acid runs off onto aluminum portion of cylinder, is accidentally spilled, etc. Immediately coat treated portion of cylinder with oil, as the acid makes the cast iron especially susceptible to rust.

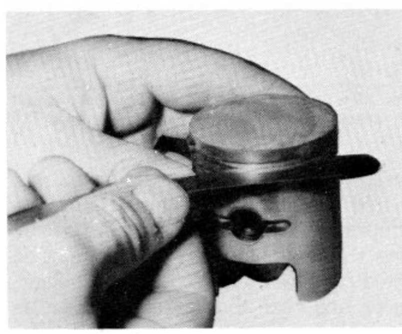


Fig. 21 — Ring side clearance in groove should be measured with feeler gage as shown. Clearance should be within recommended limits and the same all the way around piston.

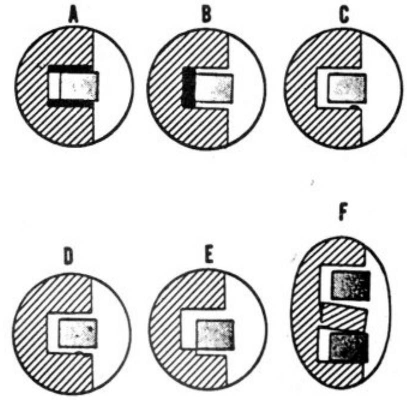


Fig. 22 — Examine piston for damage before removing old rings. Shown are some common faults.

A. Carbon buildup, sides of groove
B. Carbon buildup behind ring
C. Incomplete carbon removal, loose carbon
D. Nicks in groove
E. Stepped wear
F. Broken or bent land

A rule of thumb says scuffing or scoring of piston above the piston pin is due to overheating. Damage below the pin is more likely due to insufficient lubrication or improper fit. Overheating may be caused by a lean mixture, overloading, a damaged cooling fan or fins, air leaks in carburetor mounting gasket or manifold, blow-by (stuck or broken rings) as well as carbon build-up.

The greatest cylinder wear of a two-stroke engine generally occurs in port area of cylinder wall instead of at top of ring travel. Cast iron or aluminum bores should be measured using ring gap as an indicator or an inside micrometer. Check for spots on chromed bores which are different in appearance. Spots may be metal deposits from overheated pistons or may be where the thin chrome plating is worn through. Deposited metal can be scraped or carefully hand sanded from the chrome. If plating is worn through, cylinder must be renewed. Aluminum will be easily scratched by a sharp object but chrome will not.

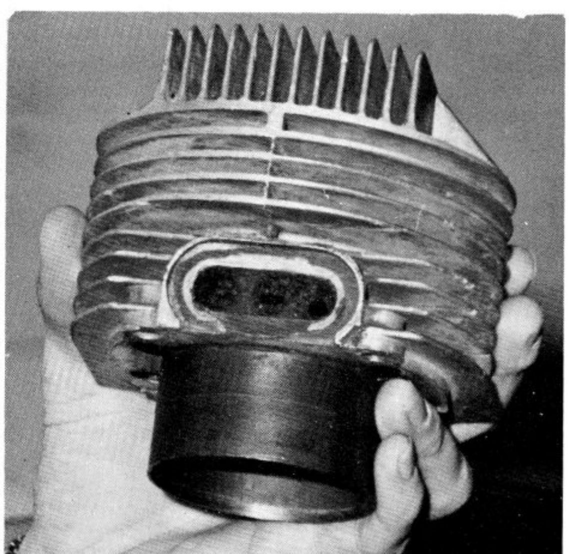


Fig. 20 — Example of severe case of port carbon. Carbon must be removed to restore performance.

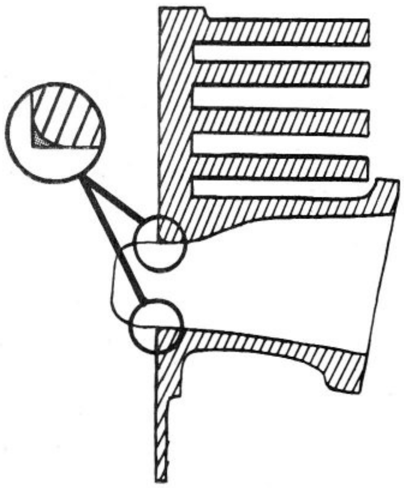


Fig. 23 — Some manufacturers recommend that edges of ports be chamfered as shown in insert, after reboring.

On models with cast iron cylinder, the bore should be honed when engine is overhauled, to true the bore, remove the glaze and remove the ridge at top and bottom of ring travel area. If ridge is not removed, new unworn rings may strike the ridge and bend ring lands in piston as shown at (F – Fig. 22). The finished cylinder should have a light cross-hatch pattern. After honing, wash cylinder assembly with soap and water, then swab with new oil on a clean rag until all tendency of rag to discolor is gone. Washing in solvent will not remove the abrasive from finished cylinder walls.

Some manufacturers have oversize piston and ring sets available. If care and approved procedures are used, installation of oversize units should result in a highly satisfactory overhaul.

The cylinder bore may be over-sized by using either a boring bar or hone; however, if a boring bar is used, finish sizing should be done with a hone. Before attempting to rebore, first check to be sure that new standard units cannot be fitted within the recommended clearances and that the correct oversize is available.

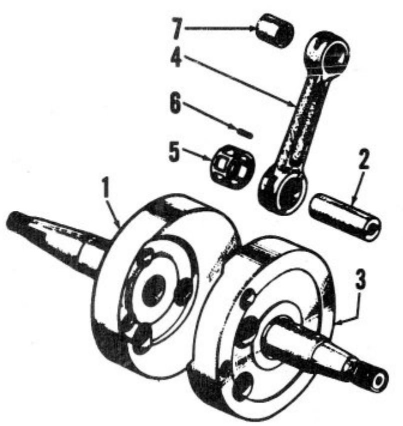


Fig. 24 — Exploded view of typical built-up crankshaft.

1. Counterweight
2. Crankpin
3. Counterweight
4. Connecting rod
5. Bearing cage
6. Needle roller
7. Bushing or bearing

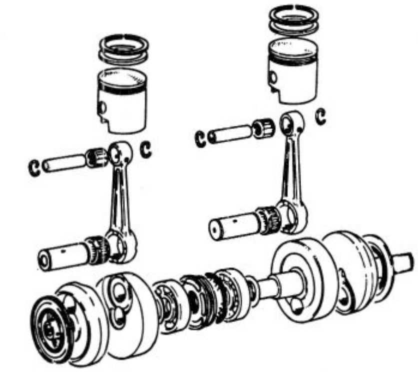


Fig. 25 — Exploded view of built-up crankshaft and associated parts used on some two cylinder engines.

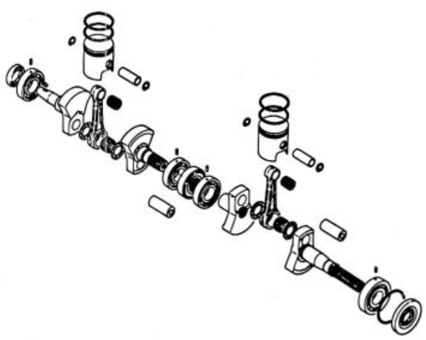


Fig. 26 — Another type of built-up crankshaft assembly used on two cylinder models.

Some manufacturers recommend that after boring a cylinder to an oversize, the top and bottom edges of cylinder wall ports be rounded to prevent rings from catching. Fig. 23 shows typical port cross section with area to be removed indicated in the inset.

When assembling piston to connecting rod, observe special precautions outlined in the individual repair sections. The pistons in some engines may have the pin offset, rings pinned or other design features which prevent piston from being safely installed backward. Check for assembly marks or other indicators on the piston and in the individual repair sections.

Lubricate piston pin bearing (or bushing), piston, rings and cylinder as engine is assembled. Run engine with slightly rich carburetor setting during break-in period and do not overload, to prevent overheating until the parts wear in. It is sometimes advisable to install a hotter heat range spark plug in an attempt to prevent oil fouling in a newly started engine. Plug fouling during this period is not uncommon and it is advisable to have spare plugs along when running in a newly overhauled engine.

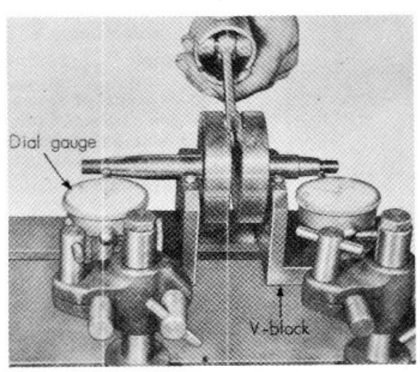


Fig. 27 — View showing mesurement of runout using vee blocks.

CONNECTING ROD, CRANKSHAFT AND BEARINGS

Before detaching connecting rods from crankshaft, mark rods and caps for correct assembly to each other and to proper cylinder. Most damage to ball and roller bearings is evident after visual inspection and turning the assembled bearing by hand. If bearing shows evidence of overheating, renew the complete assembly. On models with plain (bushing) bearings, check the crankpin and main bearing journals for wear with a micrometer. Crankshaft journals will usually wear out-of-round with most wear on side that takes the force of power stroke (strokes). If main bearing clearances are excessive, new crankcase seals may not be able to prevent pressure from blowing fuel and oil around crankshaft. All crankcase seals should be renewed when crankshaft, connecting rods and bearings are serviced.

Built-up crankshafts should be checked for runout when removed. Typical built-up crankshafts are shown in Figs. 24, 25, and 26. Check for runout using either vee blocks (Fig. 27) or lathe centers (Fig. 28). Should the shaft not meet specifications, then it should be taken to a machine shop, motorcycle rebuilder or a shop experienced in straightening built-up shafts.

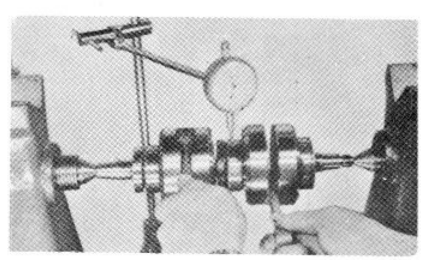


Fig. 28 — View showing measurement of runout using lathe centers.

XENOAH

AIR COOLED MODELS

Tokyo, Japan

CONDENSED SERVICE DATA

ENGINE MODEL	G29B	G34B	G40B	G44B
Bore—mm	59.5	64	65	68
Inches	2.36	2.52	2.56	2.677
Stroke—mm	52.6	52.6	59.5	59.5
Inches	2.071	2.071	2.36	2.36
No. of Cylinders	2	2	2	2
Displacement—cc	292	338	394	432
Cubic Inches	17.8	20.6	24.04	26.4
Cooling Type	Axial Fan			
Carburetor Make	*Keihin			
Model	*CD42	*CD42	CD42	*CD42
Number Used	1	1	1	1
Ignition Type	**Energy Transfer			
Make	.....	....	....	....
Point Gap—mm	**0.3-0.4			
Inch	**0.012-0.016			
Timing Advance?	Yes			
Timing Checked at	**Retard			
Setting	**8° BTDC			
Spark Plug:				
NGK	***B7HS			
Electrode Gap—mm	0.55-0.65			
Inch	0.022-0.026			
Fuel:Oil Ratio	20:1			

*Later models use Mikuni BN042 carburetor.

**Later models are equipped with a breakerless capacitor discharge ignition system.

***Spark plug reach is ¾-inch on later models.

MAINTENANCE

CARBURETOR. Early models are equipped with a Keihin CD42 carburetor. Normal initial adjustment is one turn open for idle mixture adjustment needle and 1¼-turns open for load adjustment screw. Both needles must be readjusted for best performance with engine warm and under actual operating conditions. Refer also to the appropriate CARBURETOR SERVICE section elsewhere in this manual.

Later models are equipped with a Mikuni BN042 carburetor as shown in Fig. 1. Carburetor contains two identical diaphragm type fuel pumps which supply fuel to carburetor and return excess fuel to fuel tank. Fuel pump on adjustment needle side of carburetor returns fuel to tank while opposite fuel pump supplies fuel to carburetor. Crankcase pulsations actuate the fuel pump diaphragms. The pulse line fitting is located on outlet side of carburetor.

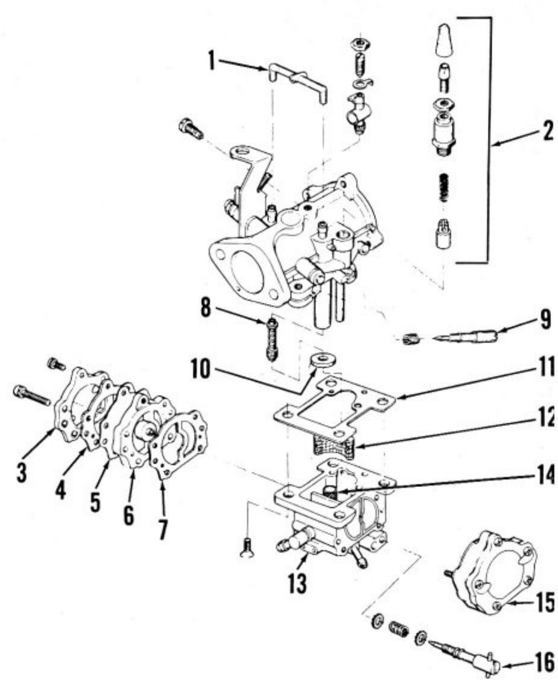


Fig. 1—Exploded view of Mikuni BNO42 carburetor.

1. Air vent tube
2. Starter jet
3. Fuel pump cover
4. Gasket
5. Diaphragm
6. Check valve plate
7. Gasket
8. Main jet & nozzle
9. Idle mixture needle
10. Packing
11. Gasket
12. Filter
13. Fuel bowl
14. Check valve
15. Fuel pump assy.
16. High speed mixture needle

Fuel is pumped past check valve (14—Fig. 1) by fuel pump when engine is running. Check valve prevents fuel from siphoning from carburetor when fuel pump is not operating. Fuel pump fills carburetor fuel bowl with excess fuel overflowing dam around fuel return cavity. Fuel entering fuel return cavity is pumped by fuel return pump to fuel tank. Fuel is drawn from fuel bowl through main jet (8) into carburetor bore. Mixture adjustment is provided by idle (9) and high speed (16) mixture needles.

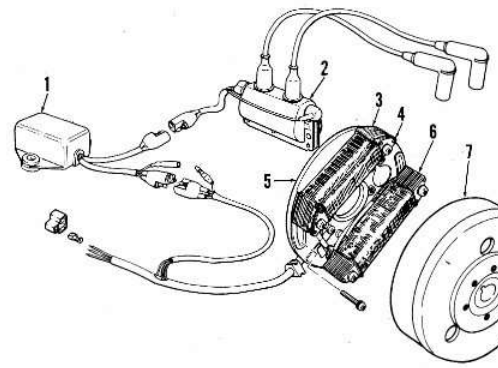


Fig. 4—Exploded view of capacitor discharge ignition system used on later models.

1. Ignition module
2. Ignition coil
3. Exciter coil
4. Pulse coil
5. Stator coil
6. Lighting coil
7. Flywheel

SPARK PLUG. NGK Spark Plugs are standard equipment. The recommendations given in CONDENSED SERVICE DATA tables are for normal operation. A different heat range plug may improve performance under some conditions. Refer to Spark Plug Selection paragraphs of SERVICE FUNDAMENTALS for additional information.

IGNITION AND TIMING. Breaker point gap, on models so equipped should be 0.3-0.4 mm (0.012-0.016 inch). Points can be adjusted after removing recoil starter, fan drive pulley and "V" belt; by working through flywheel windows as shown in Fig. 2. All models with breaker points are equipped with a centrifugal timing advance which provides retarded timing for starting only.

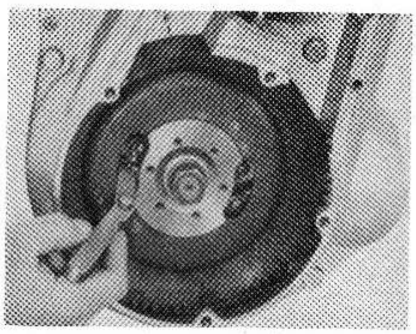


Fig. 2—Breaker points can be adjusted through flywheel timing windows as shown. Timing is correct when timing marks on flywheel align with "F" marks on housing.

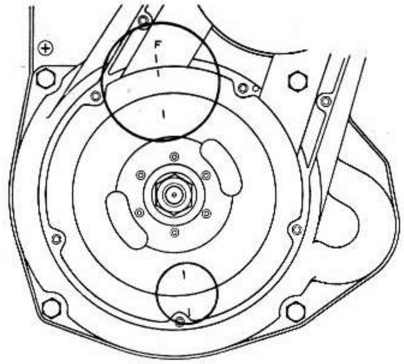


Fig. 3—Timing marks are stamped into flywheel and fan housing to indicate static timing.

On models equipped with breaker point ignition, both cylinders must be timed as nearly as possible alike. It is suggested that point gap and timing be checked on one cylinder; then timing synchronized by varying point gap for the other cylinder if necessary. Static (retarded) timing is correct when points break with flywheel and housing marks aligned as shown in Fig. 3.

Later models are equipped with the breakerless capacitor discharge ignition system shown in Fig. 4. Ignition timing advances electronically to 21 degrees before top dead center at 6000 rpm. Ignition timing should be correct when stator plate timing marks are aligned with crankcase boss as shown in Fig. 5.

If ignition malfunctions and spark plug is not faulty, connect an ohmmeter as follows to check components. Resistance between brown lead and white/red lead of exciter coil should be 250-300 ohms. Resistance between blue lead and white/red lead of pulse coil should be 20-23 ohms. Resistance of primary ignition coil windings should be approximately 0.05 ohms while secondary ignition coil winding resistance should be 640-780 ohms. If module is suspected, replace module with a good module and check ignition operation.

LUBRICATION. The engine is lubricated by oil mixed with the fuel. Good quality regular gasoline and a good two-stroke motor oil should be used. Recommended fuel:oil ratio should be 20:1.

The use of Ethyl, Premium or high octane non-leaded gasolines; or of outboard motor oil is not recommended by the manufacturer.

COOLING FAN AND BELT. The cooling fan drive belt should have ¼-inch free play measured midway between pulleys as shown in Fig. 6. Outer pulley half is notched to accept a holding spanner wrench for removal of shaft nut. To adjust belt tension, remove the nut and outer pulley half; then add or remove adjusting shims located between pulley halves. Be sure not to pinch belt when reinstalling shaft nut. Tighten the nut to a torque of 30 ft.-lbs.

REPAIRS

TIGHTENING TORQUES. Refer to the following table for tightening torques. Measurements are given in ft.-lbs.

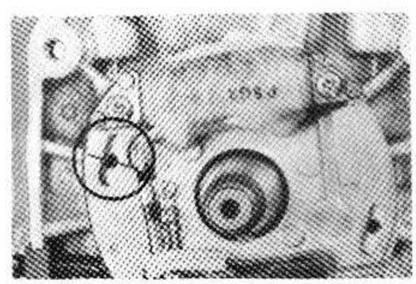


Fig. 5—Align stator plate marks with crankcase boss on models with capacitor discharge ignition system.

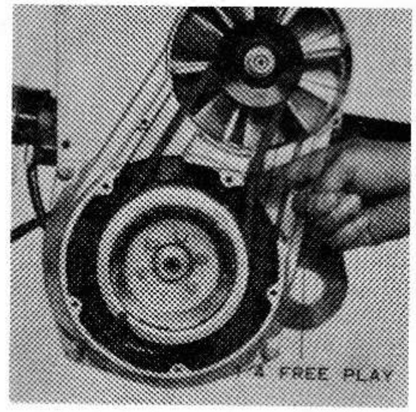


Fig. 6—Cooling fan drive belt should have ¼-inch free play when depressed with finger as shown.

Cylinder	14-16
Cylinder head	14-16
Crankcase	14-16
Flywheel	45-55
Fan shaft nut	28-32

DISASSEMBLY AND REASSEMBLY. To disassemble the removed engine, first remove ignition coil cover and coils, then remove cylinder shrouds. Remove fan guard, recoil starter and starter pulley. Unbolt and remove fan housing, fan and associated parts as a unit. Remove crankshaft nut using flywheel holding tool and suitable wrench as shown in Fig. 7; then remove flywheel using puller as shown in Fig. 8.

Check armature plate for timing (alignment) marks and mark if necessary, then unbolt and remove magneto plate. Remove manifolds, spark plugs and cylinder heads. Unbolt and remove cylinder units, then remove pistons. Remove plate retaining crankshaft drive-end seal; remove crankcase through-bolts and separate crankcase halves by tapping with a soft hammer.

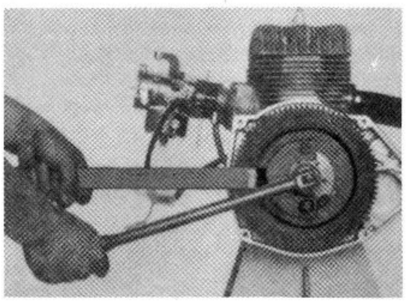


Fig. 7—Using the flywheel holding tool to remove crankshaft nut.

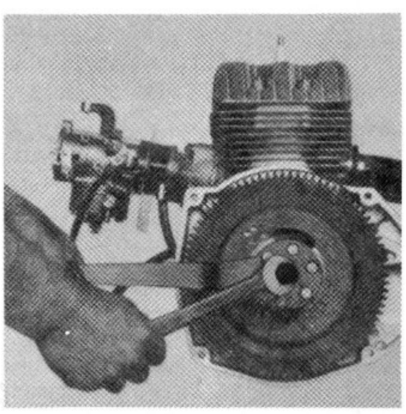


Fig. 8—A suitable puller is required for flywheel removal.

Piston crowns are marked with an arrow which should be installed toward exhaust side of cylinder. Top piston rings are chromed and all rings are positively located by pins in piston grooves. Crankshaft end play should be 0.00-0.1 mm. End play is controlled by shims located beneath end plate at drive end. Shims are available in thicknesses of 0.1 and 0.3 mm. Tighten crankcase through-bolts using the sequence shown in Fig. 9. All tightening torques are given in tabular form at beginning of REPAIR Section.

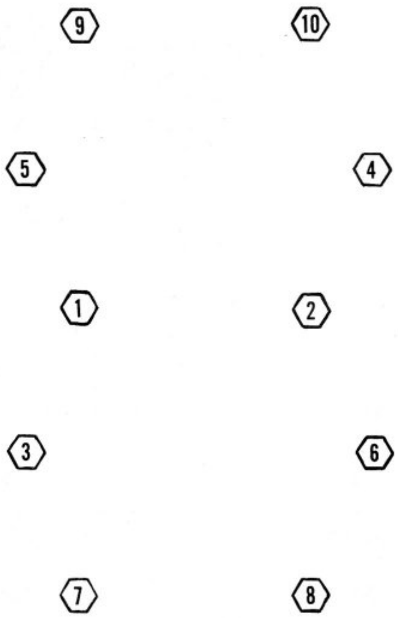


Fig. 9—Tighten the crankcase through-bolts in the sequence shown.

REWIND STARTER. Refer to exploded view of starter in Fig. 10. To disassemble starter, remove starter from engine and pull rope out until it is possible to position rope in notch of rope pulley. Release rope and allow rewind spring to unwind. Remove retaining nut (3) and components (6 through 8). Carefully remove rope pulley so that recoil spring remains in cover. If necessary to remove rewind spring, guard against uncontrolled uncoiling of spring which may cause personal injury.

To assemble starter, install rewind spring in cover so that spring is wound in counter-clockwise direction and outer hook of spring contacts lug of cover. Install rope pulley and rope so that lug of pulley engages with inner hook of recoil spring. Install washer (8), pawls (7), spring (6) and pawl return spring (5). Install retainer cover (4) so that end of return spring (5) protrudes through retainer cover (4) and turn retainer cover one-third turn clockwise to pre-load spring. Install washers and retaining nut. If rope handle was not removed during disassembly, position rope in notch of rope pulley and turn pulley two turns counterclockwise to pre-load recoil spring. If handle was removed, turn rope pulley counterclockwise two or three turns and insert end of rope through rope outlet in cover. Tension on rope should be apparent. Tie a temporary knot to hold rope and install rope handle.

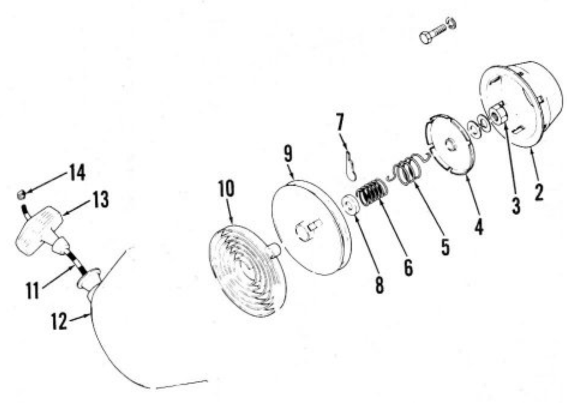


Fig. 10—Exploded view of rewind starter.

2. Starter cup
3. Nut
4. Retainer
5. Return spring
6. Spring
7. Pawls
8. Washer
9. Rope pulley
10. Recoil spring
11. Rope
12. Cover
13. Handle
14. Retainer