Buccaneer

OUTBOARD MOTORS

SERVICE MANUAL

GALE PRODUCTS

Galesburg, Illinois

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OUTBOARD MOTORS

SERVICE MANUAL

Prepared by

SERVICE DEPARTMENT

GALE PRODUCTS

GALESBURG, ILLINOIS

First Edition

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CHAPTER ONE - INTRODUCTION

FOREWORD

This service manual has been prepared to help you profitably service Gale outboard motors and maintain customer satisfaction. The manual specifically covers motors manufactured since 1951, but it will also prove useful in servicing older motors, since much of the information can be universally applied to all outboard motors. Cutaway views of all Gale motors manufactured since 1951 are included in this chapter, on pages 1-2 to 1-7.

Where essential, step-by-step procedures have been given. However, since different service men have different ways of doing things, in most cases the necessary information for accomplishing the work is given with essential details high-lighted.

ARRANGEMENT OF MANUAL

This manual is arranged in chapters for each of the main components of the outboard motor as indicated in the index. Exploded views of these main components and some specific service instructions for each model are included at the end of each chapter. Whenever new model motors are added, exploded views covering these new models will be issued for insertion in the manual. In addition, there are chapters for general service information and trouble shooting, and other useful information such as sizes of parts.

SERVICING PROBLEMS

Always feel free to write regarding service problems which are troubling you. However, be sure to thoroughly check the service manual for information. Often we receive inquiries for information already fully covered in the service manual. Write to Service Division, Gale Products, Galesburg, Illinois giving complete information including motor model and serial number.

KEEPING SERVICE MANUAL UP TO DATE

From time to time you will be receiving pages containing new information for your manual. File these immediately in the manual. The page number indicates just where the page should go. For example, all pages with 2- before the page number belong in Chapter Two. This same plan is also used for illustrations.

FACTORY WARRANTY

Your obligation to the customer should not end with the sale of a new motor. He has a right to expect the motor to be in perfect condition, and, if not, to have defective parts replaced. For this purpose, Gale Products offers the following warranty:

> We warrant each new outboard motor to be free from defects in material and workmanship under normal use and when operated according to these instructions. Within 90 days from date of sale to the original purchaser we will exchange free of charge any part which our examination shall disclose to our satisfaction to be defective.
>
> This warranty shall not apply to any motor which has been subject to misuse, alteration, or accident; or which has been used for racing or equipped with a racing propeller. All transportation charges on motors or parts returned to the factory must be prepaid.

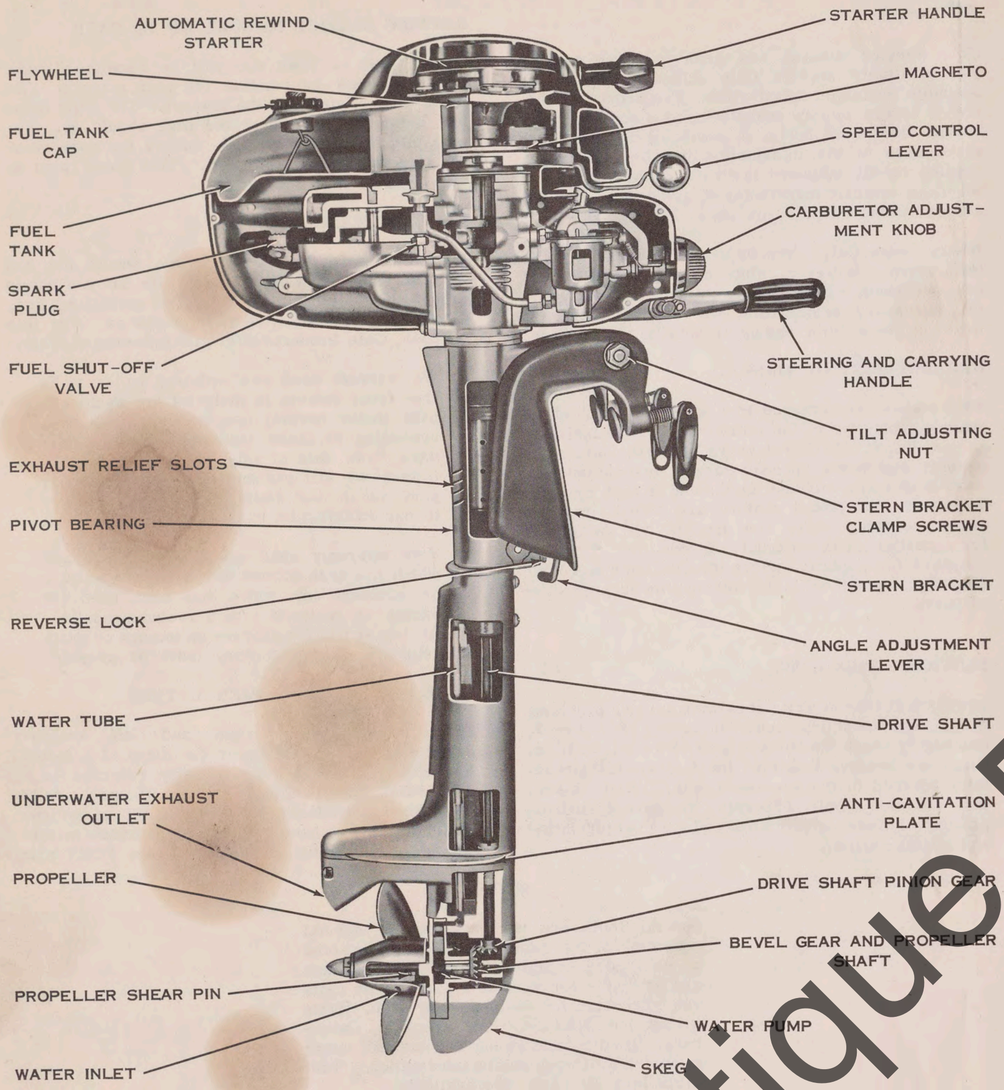
OUTBOARD MOTOR NOMENCLATURE

Sometimes the words "right" and "left" are very confusing when referring to the sides of a motor. Therefore, the sides are usually referred to as STARBOARD or PORT. STARBOARD means on the right hand while facing the bow (FRONT) of the boat, PORT means left hand. On all Gale Products motors, the steering handle is located on the PORT side.

NOTE

Special tools are not required for normal servicing of the outboard motors. For some of the more complex operations, drawings are available for special tools. These tools can be constructed easily in your shop. Write to Service Division, Gale Products, Galesburg, Illinois, mentioning the specific operation for which you desire information. Test propellers etc. are also available.

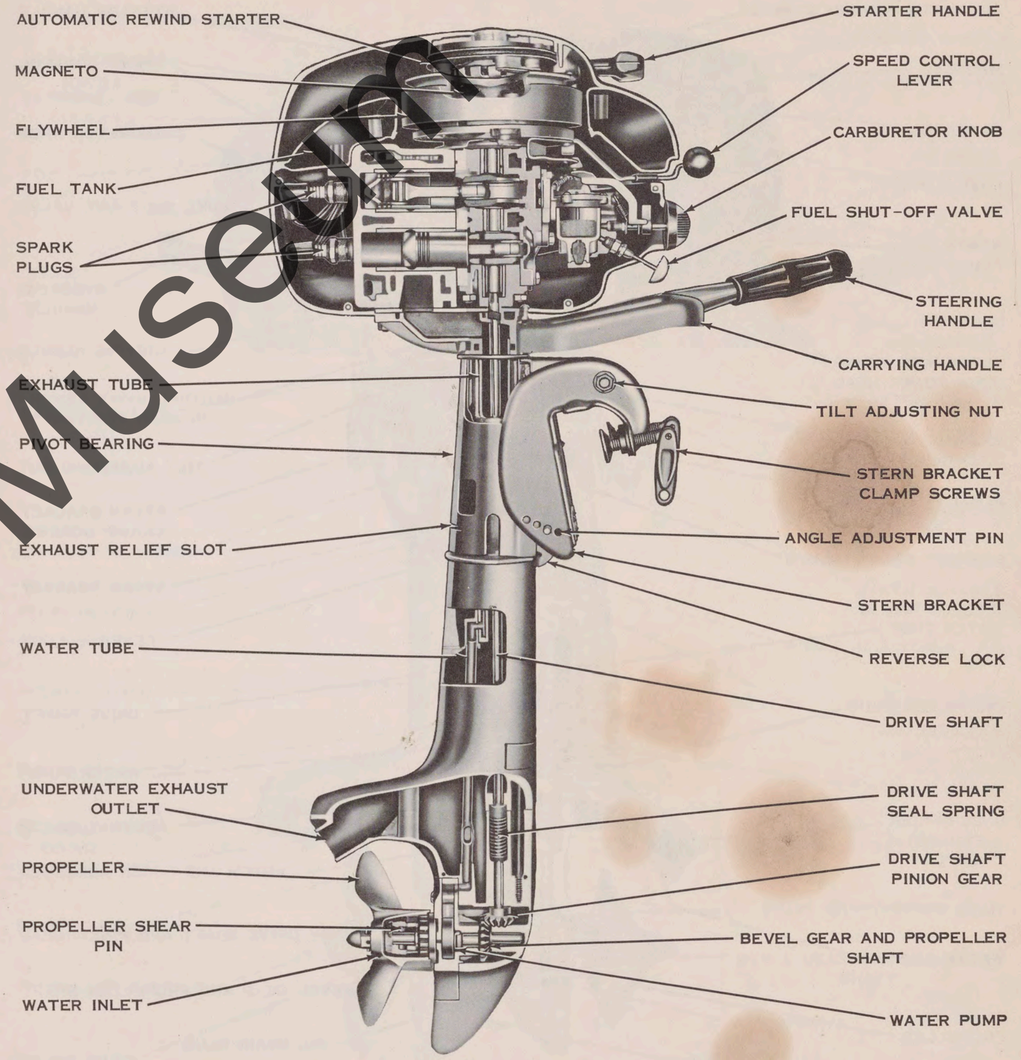
CUTAWAY VIEW OF MODEL 3D10 & 3D11 MOTOR



SPECIFICATIONS

HORSEPOWER	3.0 AT 4000 R.P.M. - O.B.C. CERTIFIED
NUMBER OF CYLINDERS	1
BORE AND STROKE	2-1/8" BORE X 1-1/2" STROKE
PISTON DISPLACEMENT	5.32 CUBIC INCHES
TYPE OF POWER HEAD	2 CYCLE, 2 PORT
GEAR RATIO	13:22
PROPELLER	2 BLADE, 6-1/2" DIAMETER X 6" PITCH
COOLING	POSITIVE DISPLACEMENT SYNTHETIC RUBBER ROTOR
IGNITION	BUILT IN FLYWHEEL MAGNETO
CARBURETOR	SINGLE JET - VARIABLE VENTURI
SPEED CONTROL	SINGLE LEVER SYNCHRONIZED THROTTLE AND SPARK
FUEL TANK CAPACITY	0.5 GALLONS
RUNNING TIME (FULL THROTTLE)	APPROX. 1-1/2 HOUR
STARTER	AUTOMATIC REWIND
STEERING	360° FULL REVERSING
WEIGHT	29 POUNDS
RECOMMENDED TRANSOM HEIGHT	15"

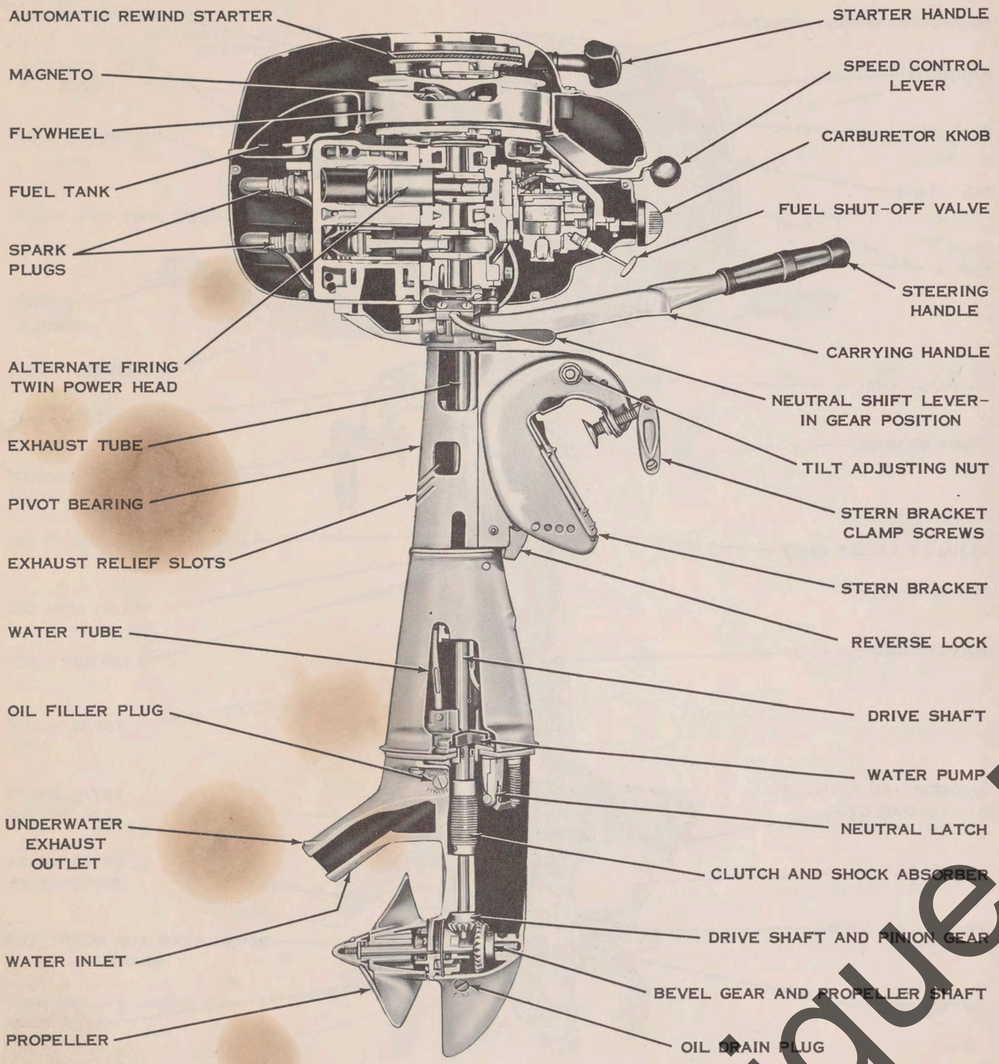
CUTAWAY VIEW OF MODEL 5S10 MOTOR



SPECIFICATIONS

HORSEPOWER	5.0 AT 4000 R.P.M. - O.B.C. CERTIFIED
NUMBER OF CYLINDERS	2
BORE AND STROKE	1-15/16" BORE X 1-1/2" STROKE
PISTON DISPLACEMENT	8.84 CUBIC INCHES
TYPE OF POWER HEAD	2 CYCLE, 2 PORT, ALTERNATE FIRING
GEAR RATIO	13:20
PROPELLER	2 BLADE, 7-1/2" DIAMETER X 7-1/4" PITCH
COOLING	POSITIVE DISPLACEMENT SYNTHETIC RUBBER ROTOR
IGNITION	BUILT IN FLYWHEEL MAGNETO
CARBURETOR	VARIABLE VENTURI
SPEED CONTROL	SINGLE LEVER SYNCHRONIZED THROTTLE AND SPARK
FUEL TANK CAPACITY	0.8 GALLONS
RUNNING TIME (FULL THROTTLE)	APPROX. 1 HOUR
STARTER	AUTOMATIC REWIND
STEERING	360° FULL REVERSING
WEIGHT	45 POUNDS
RECOMMENDED TRANSOM HEIGHT	15"

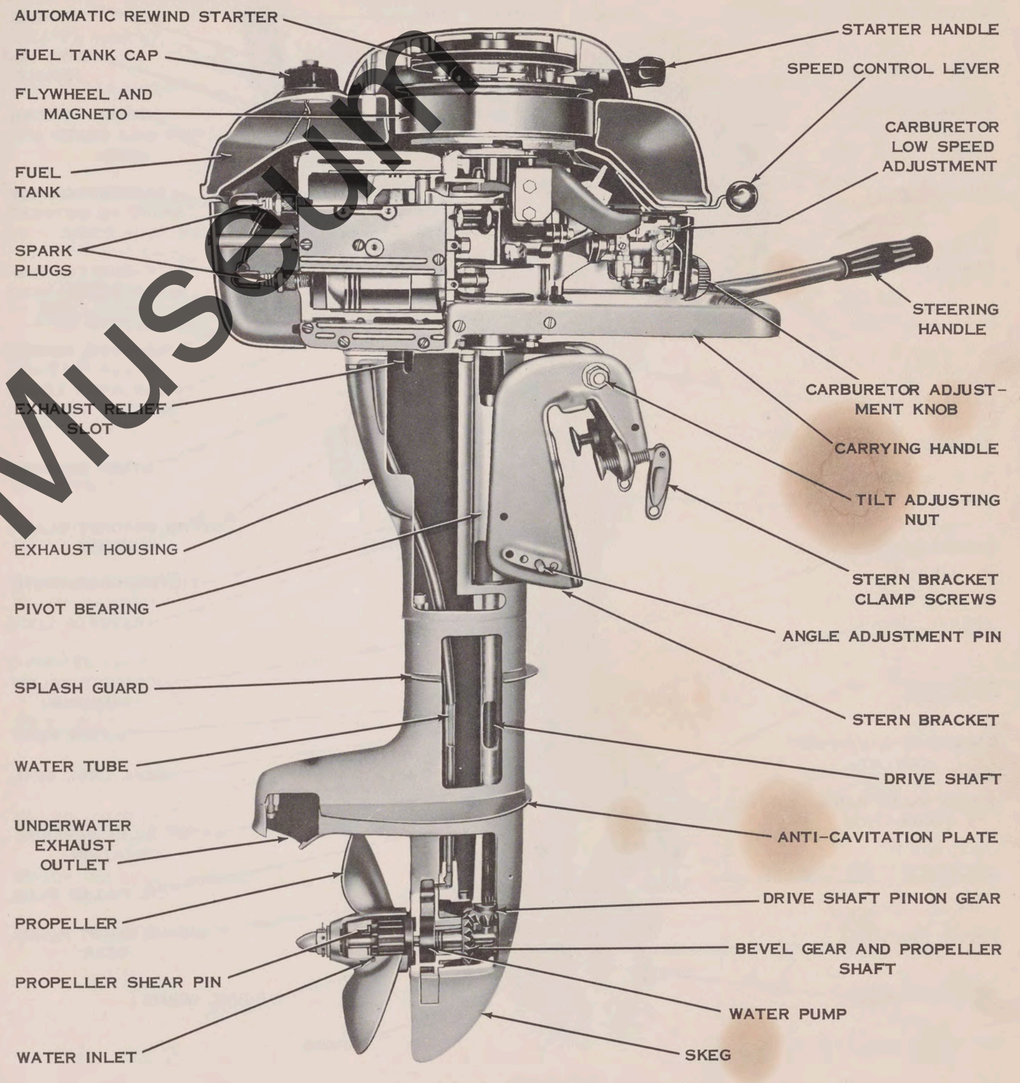
CUTAWAY VIEW OF MODEL 5D10 MOTOR



SPECIFICATIONS

HORSEPOWER	5.0 AT 4000 R.P.M. – O.B.C. CERTIFIED
NUMBER OF CYLINDERS	2
BORE AND STROKE	1-15/16" BORE X 1-1/2" STROKE
PISTON DISPLACEMENT	8.84 CUBIC INCHES
TYPE OF POWER HEAD	2 CYCLE, 2 PORT, ALTERNATE FIRING
GEAR RATIO	14:25
PROPELLER	2 BLADE, 8" DIAMETER X 7-1/4" PITCH
COOLING	RUBBER BLADE COMBINATION DISPLACEMENT AND CENTRIFUGAL WATER PUMP
IGNITION	BUILT IN FLYWHEEL MAGNETO
CARBURETOR	VARIABLE VENTURI
SPEED CONTROL	SINGLE LEVER SYNCHRONIZED THROTTLE AND SPARK
FUEL TANK CAPACITY	0.8 GALLONS
RUNNING TIME (FULL THROTTLE)	APPROX. 1 HOUR
STARTER	AUTOMATIC REWIND
STEERING	360° FULL REVERSING
CLUTCH CONTROL	NEUTRAL AND IN GEAR
WEIGHT	46-1/2 POUNDS
RECOMMENDED TRANSOM HEIGHT	15"

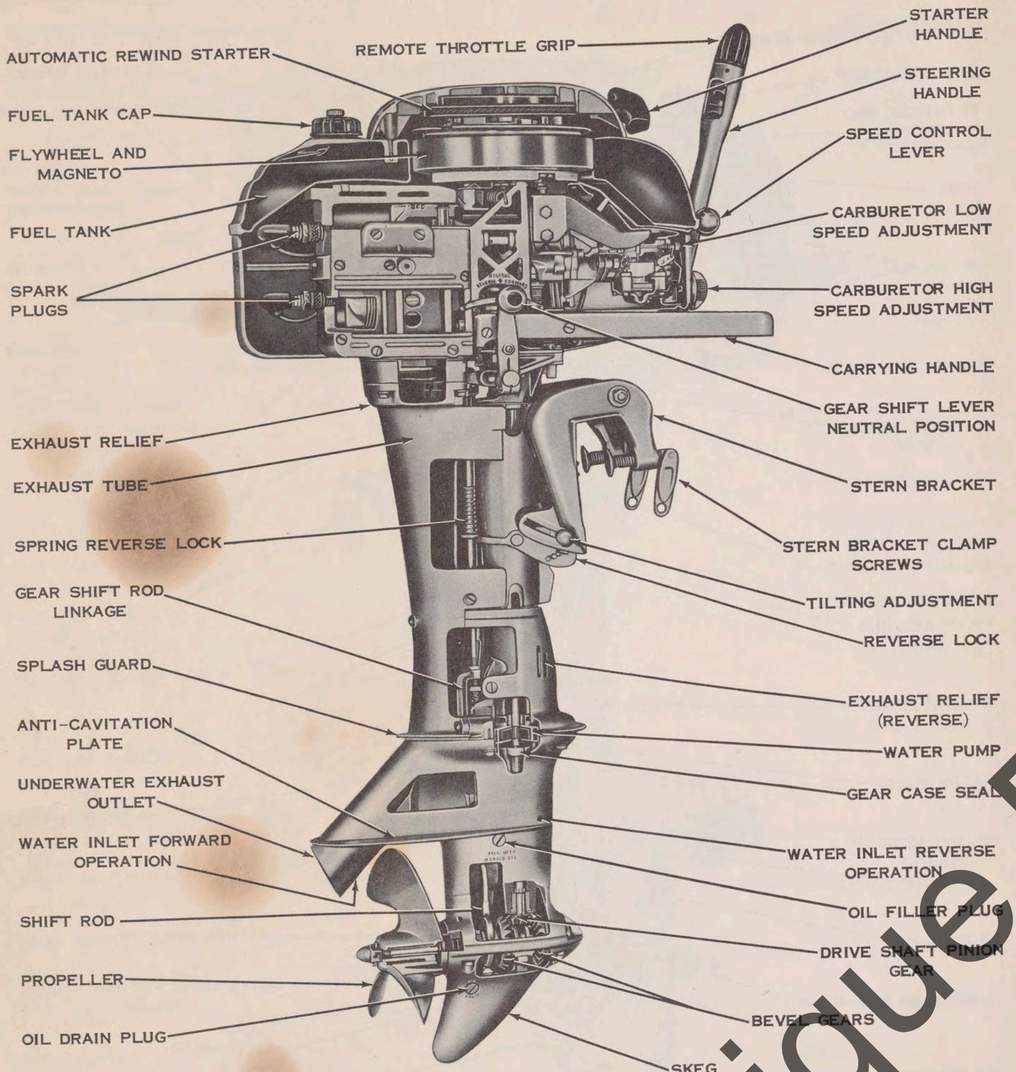
CUTAWAY VIEW OF MODEL 12S10 MOTOR



SPECIFICATIONS

HORSEPOWER	12.0 AT 4000 RPM – O.B.C. CERTIFIED
NUMBER OF CYLINDERS	2
BORE AND STROKE	2-3/8" BORE X 2-1/4" STROKE
PISTON DISPLACEMENT	19.94 CUBIC INCHES
TYPE OF POWER HEAD	2 CYCLE, 2 PORT, ALTERNATE FIRING
GEAR RATIO	13:19
PROPELLER	2 BLADE – 9-1/4 DIAMETER X 8-3/4 PITCH
COOLING	POSITIVE DISPLACEMENT SYNTHETIC RUBBER ROTOR
IGNITION	BUILT-IN FLYWHEEL MAGNETO
CARBURETOR	CONCENTRIC TYPE FLOAT
SPEED CONTROL	SINGLE LEVER SYNCHRONIZED THROTTLE AND SPARK
FUEL TANK CAPACITY	1.5 GALLONS
RUNNING TIME (FULL THROTTLE)	45 MINUTES
STARTER	AUTOMATIC REWIND
WEIGHT	66 POUNDS
RECOMMENDED TRANSOM HEIGHT	15 INCHES

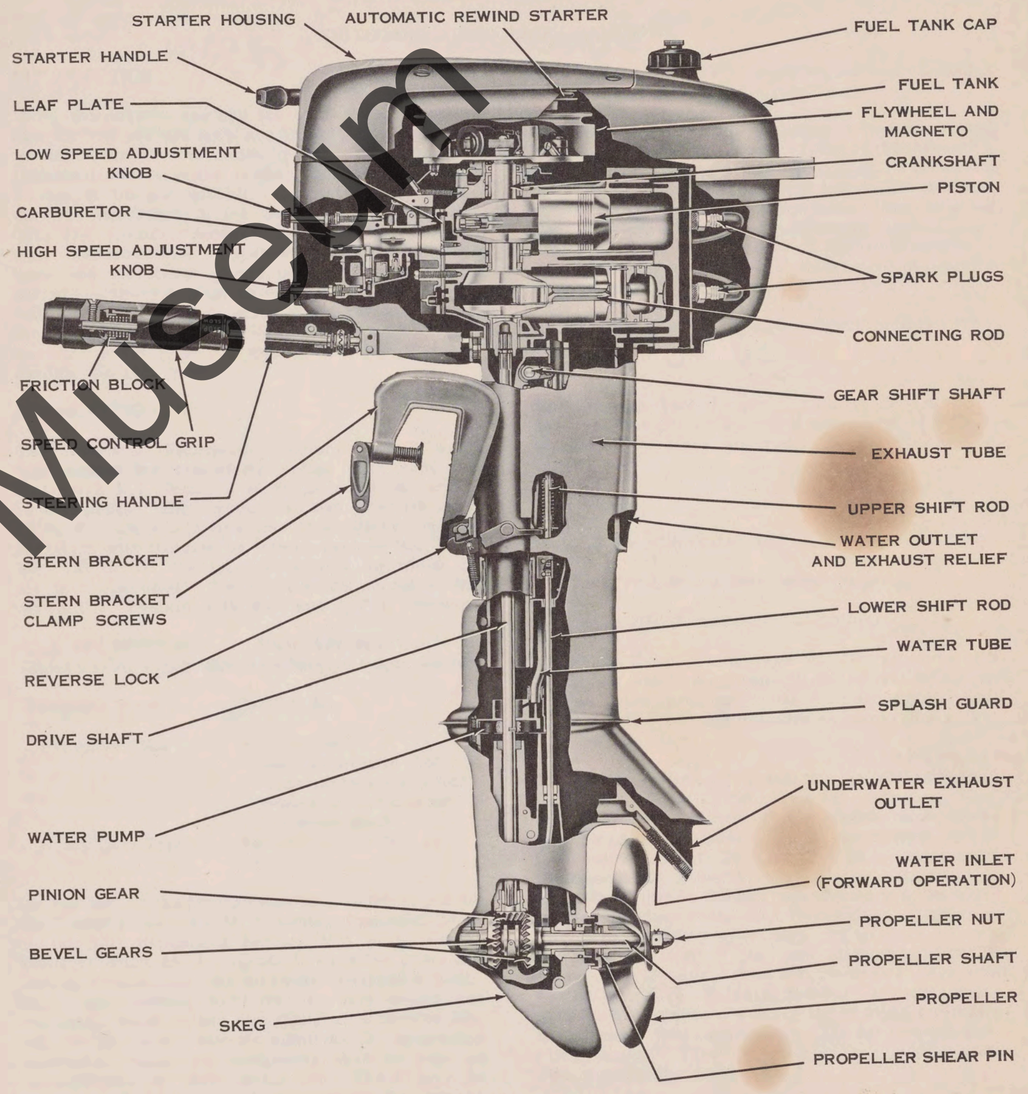
CUTAWAY VIEW OF MODEL 12D10 MOTOR



SPECIFICATIONS

HORSEPOWER	12.0 AT 4000 RPM – O.B.C. CERTIFIED
NUMBER OF CYLINDERS	2
BORE AND STROKE	2-3/8" BORE X 2-1/4" STROKE
PISTON DISPLACEMENT	19.94 CUBIC INCHES
TYPE OF POWER HEAD	2 CYCLE, 2 PORT, ALTERNATE FIRING
GEAR RATIO	12:21
PROPELLER	3 BLADE, 9" DIAMETER X 10" PITCH
COOLING	RUBBER BLADE, COMBINATION DISPLACEMENT AND CENTRIFUGAL WATER PUMP
IGNITION	BUILT-IN FLYWHEEL MAGNETO
CARBURETOR	CONCENTRIC TYPE FLOAT
SPEED CONTROL	SINGLE LEVER SYNCHRONIZED THROTTLE AND SPARK
FUEL TANK CAPACITY	1.5 GALLONS
RUNNING TIME (FULL THROTTLE)	45 MINUTES
STARTER	AUTOMATIC REWIND
GEAR SHIFT CONTROL	FORWARD – NEUTRAL – REVERSE
WEIGHT	64.5 POUNDS
RECOMMENDED TRANSOM HEIGHT	15 INCHES

CUTAWAY VIEW OF MODEL 12D11 MOTOR



SPECIFICATIONS

HORSEPOWER	12.0 AT 4000 RPM – O.B.C. CERTIFIED
NUMBER OF CYLINDERS	2
BORE AND STROKE	2-1/4" BORE X 2-1/4" STROKE
PISTON DISPLACEMENT	17.89 CUBIC INCHES
TYPE OF POWERHEAD	2 CYCLE 2 PORT ALTERNATE FIRING
GEAR RATIO	12:21
PROPELLER	3 BLADE 9" DIAMETER X 11" PITCH
COOLING	POSITIVE AND CENTRIFUGAL SYNTHETIC RUBBER ROTOR
IGNITION	BUILT-IN FLYWHEEL MAGNETO
CARBURETOR	FAST AND SLOW SPEED NEEDLE VALVES, CONCENTRIC TYPE FLOAT, AUTOMOTIVE TYPE CHOKE
SPEED CONTROL	SYNCHRONIZED SPARK AND THROTTLE, TWIST GRIP CONTROL
FUEL TANK CAPACITY	2 GALLONS
RUNNING TIME (FULL THROTTLE)	APPROXIMATELY 1 HOUR
STARTER	AUTOMATIC REWIND
GEARSHIFT CONTROL	FORWARD – NEUTRAL – REVERSE
WEIGHT	66 POUNDS
RECOMMENDED TRANSOM HEIGHT	15 INCHES

OUTBOARD FUELS AND LUBRICANTS

INTRODUCTION

Using the correct gas and the correct oil is important for top performance and trouble free operation in any internal combustion motor. This is very important for outboard motors, along with correct mixing of the gas and oil. Correct mixing procedure is described in the Owner's Guide included with the motor. Because there has not been a clear understanding concerning just what type of fuels and lubricants should be used, we have had our engineers run tests on a large number of fuels and oils to determine which would be satisfactory for outboard use. The following discussion on gas and oil should clear up most of the questions regarding the fuel mixture.

LUBRICATING OIL

The American Petroleum Institute has set up a new system for classifying engine oils, known as the new A.P.I. System, which is based on service requirements. This system has been effective since 1952; all companies now use this system and the container will indicate by letters such as ML, MM, MS, DG or DS the type of service for which the oil is to be used. The chart below compares the old A.P.I. System with the new A.P.I. System.

OLD API SYSTEM Based on Oil Types	NEW API SYSTEM Based on Service Requirements
Regular Type	Service ML
Premium Type	Service MM (Some especially good Premium type oils could be used for Service MS conditions also)
Heavy Duty Type	Service MS, or DG, or DS

Do not use oil marked Service ML, which is usually the lowest price oil sold, in outboard motors. Most of the oils designated Service MM contain some additives such as detergents to dissolve gums and carbon formations, anti-oxidents, corrosion inhibitors, anti-foaming additives and acid neutralizer additives. Most of the oils designated Service MS, DG, or DS contain similar additives but in greater quantities. Some oil companies have as high as 30 additives in their motor oil. These may be changed both in type and quantity by the various companies from time to time without notice to the public as the companies find new material for additives or find that some of the additives or quantities of additives then used are undesirable. In general it may be found that among oils containing additives of different companies some oils may tend to cause eventual bridging of the spark plug gap (fouled spark plugs) with consequent irregular running of the motor or, as is usually the case, that the cylinder will not fire at all. In this case, of course, the spark plugs will have to be cleaned. The frequency of bridging the spark plug gap varies with the motor and the speed at which it is running.

On the other hand, the additives in these oils will reduce gum formation, reduce some carbon deposits, and prevent rings sticking in the piston. This should definitely make the engine last longer and perform better than with non-detergent oils. Thus weighing the advantages of the detergent oil against non-detergent oil it would appear that the advantages of detergent oils outweigh the disadvantages of possible premature gap bridging of the spark plugs.

Use Service MM or "outboard" oil obtained from a reputable company.

The oil in the fuel mixture of your outboard motor is used only once - not over and over again as in automobiles. Therefore heavy duty oil is unnecessary.

GASOLINE

Some of the differences in gasoline are--

1. The octane rating (anti-knock rating).
2. The volatility (ease of evaporation).
3. Gums (These are deposits of a gummy or varnish nature which may deposit out in fuel tank, gas line, strainers, and carburetors from either heat or from being left standing in motor for a long period of time).

The octane rating of a gasoline is not important when used in an outboard motor. However, Ethyl or top price gasolines usually contain more tetra-ethyl lead than regular gasoline which may tend to form more deposits on the spark plugs under some conditions. In general there is no advantage to using the Ethyl or Premium gasolines in an outboard motor. Marine White Gasoline which is harder to find, will probably give very satisfactory service and may be tried if the user is having excessive spark plug fouling. However, switching to a different brand of Regular gasoline or even trying several may eventually solve the problem by finding the cleanest burning gasoline. Do not use any gasoline "dopes." There is no advantage in adding extra oils, top cylinder lubes, etc.

It is the practice of the manufacturers of gasoline to vary the volatility of the gasoline with the season. In general gasoline bought during the spring and fall will be more volatile than those purchased during the hot summer months, and gasoline bought during the cold winter months will be even more volatile than those bought during the spring and fall. Therefore, you may have difficulty starting and idling a motor in very cold weather using gasoline purchased the previous summer. For this

reason it is a good idea to use recently purchased fuel at all times. The formation of gum in the fuel tank, strainer, gas line, carburetor, and motor should not be a problem if you use gasoline purchased from a reputable company, not more than a few weeks prior to using. There have been instances where inexpensive, off-brand gasolines have deposited unbelievably large quantities of gum, causing failure of the carburetor or motor in just a few hours of operation. Here again we want to caution against leaving gasoline in the outboard motor tank for a long period of time although it is commonly done with only few cases of resulting trouble.

GENERAL REMARKS

If you use oil classified as Service MM, or "outboard" and a good grade of regular gasoline you should not have any trouble. If a customer has trouble with spark plug fouling he should try changing to another reputable oil in the classification mentioned. If that does not work, try another reputable brand of regular gasoline. Again the importance of properly mixing the fuels prior to putting in the motor tank cannot be over emphasized. You do not have to worry about oil settling out of the gasoline once it has been properly mixed.

To avoid gasoline and oil trouble both gasoline and oil containers should be kept clean and the gasoline should be strained through a 100 mesh screen to prevent passage of water and dirt. Dirty gasoline or oil must never be used.

LUBRICATING LOWER UNIT

The lower units require either grease or oil in the gear case. Proper lubricating procedure is given in the Owner's Guide for each motor.

In general, we recommend a good grade SAE 90 automotive (hypoid) gear lubricant for motors requiring oil. If hypoid lubricant is not available, in an emergency use a good grade SAE 30 engine oil until recommended lubricant can be obtained. Any good outboard motor grease is suitable for motors using grease in the gear case. Do not use automotive differential or cup grease.

The 12 H.P. deluxe motors also have zerk fittings on the gear shift lever and the swivel bracket. A good grade of waterproof grease such as Lubriplate No. 630AA is recommended for these fittings.

HOW TO PUT A NEW MOTOR INTO OPERATION

NEW MOTOR DELIVERY

Complete instructions for putting new motors in operation are included in the "Owner's Guide" manual packed with each motor. Be sure your customer receives this manual if you unpack and set up his motor for him and suggest that he study it before running his motor.

The following check list is a reminder of the important things to do when putting a new motor into operation.

a. Be sure spark plugs are tightened securely with gaskets in place. Refer to Chapter Nine for torque.

b. Be sure spark plug wires are securely attached to the spark plugs and the lead marked "UP" attached to the upper plug.

c. Be sure the correct gasoline-oil mixture is used. Pour fuel into motor tank through a fine mesh strainer. See Owner's Manual.

d. Be sure the motor is properly installed on the boat or that your customer knows how to install it. See MOTOR INSTALLATION, page 2-3.

e. Caution your customer not to operate his new motor at continuous full power until at least one hour of operation has been completed. During the first hour, short periods of full power may be used for progressively longer periods of time.

CORRECT MOTOR MOUNTING ON THE BOAT

It is important that the motor be properly mounted on the stern of the boat. For best results, the propeller should operate at the correct depth below the surface of the water, and the propeller line-of-drive should be horizontal, or parallel to the line of boat travel.

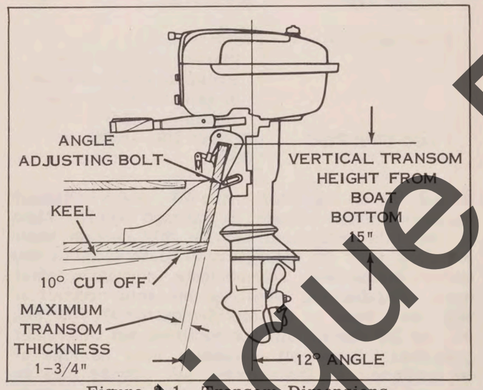


Figure 2-1. Transom Dimensions

TRANSOM HEIGHT (See figure 2-1)

The correct recommended transom height in most cases is 15 inches.

Should the transom be too low, an excessively large section of the lower unit is submerged below the surface of the water. The additional drag created will slow the boat. Should the transom be too high, the propeller will operate near the surface in highly

disturbed water, resulting in cavitation, causing reduced boat speed and inefficient cooling due to air entering the water circulating system.

If the transom is too low, it may be possible to build it up to the proper height. If it is too high, it may be desirable to notch in the top of the transom the depth necessary to accommodate the motor.

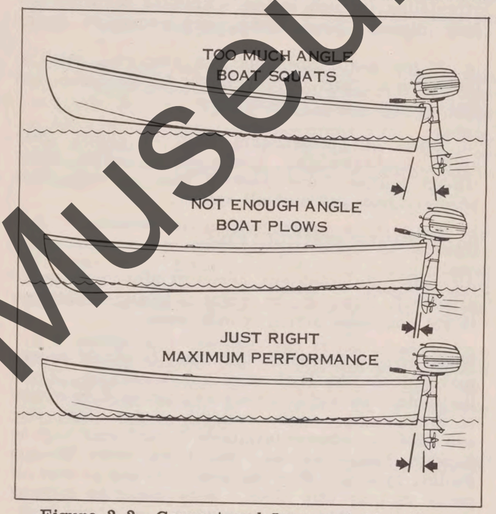


Figure 2-2. Correct and Incorrect Mounting

TRANSOM ANGLE (see figure 2-2)

To obtain maximum efficiency, motor lower unit should be perpendicular to, or at right angles to the line of boat travel at top speed. This puts the line of propeller thrust parallel to the boat line of travel. Outboard motors are provided with adjustable stern brackets to permit adjusting the angle of the lower unit in relation to the boat transom.

The average boat transom angle is approximately 12°. Greater transom angle can be compensated for by adjusting the stern bracket. A boat with a straight transom or a motor mounted with angle between stern and motor too great will result in a downward thrust of the propeller causing the stern of the boat to dig in and the bow to rear up. This will result in the boat "squatting" and pushing water before it, or "galloping" (bow bobbing up and down) if a larger motor is involved, rather than gliding over the surface.

A boat made with the bottom higher at the transom than in the middle will probably require less angle between the transom and motor. The resulting slight angle of the propeller thrust line will result in a lifting or raising effect on the stern, thus permitting the boat to operate at a fairly even keel when under way. When loading a boat of this type, it is advisable to load forward to overcome the rocking effect. The boat should ride exactly on an even keel with the bow slightly higher than the stern.

If the motor is mounted with the propeller tilted too far away from the stern, thrust will be directed downward, causing the boat to "squat" with the stern low and the bow high. Under certain conditions, the boat will "gallop" with the bow pounding up and down on the water at frequent intervals. At the opposite extreme, if the propeller is tilted toward the stern, thrust will be directed upward with a tendency toward raising the stern causing the bow to "plow" into the water with the stern high and the bow low. The result is a zig-zag course and tricky handling, especially at higher speed with larger motors.

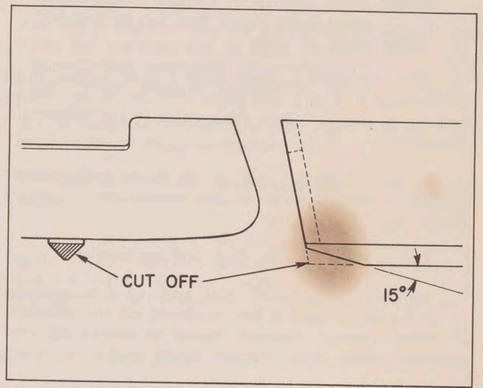


Figure 2-3. Trimming Boat Keel

BOAT KEEL (See figure 2-3)

For maximum performance, the boat keel should be tapered bringing each side back to a feather edge, starting approximately 12 to 18 inches from the stern. This keel construction avoids possible turbulence. Also, to eliminate undesirable rooster tails, the stern of the keel should be cut off at an angle. (See figure 2-3.) On some 360° motors (full reverse) the lower unit will strike the keel if it is not cut off in this manner.

MOTOR INSTALLATION

Check transom thickness. All our motors are built to conform to the SAE standard of 1-3/4 inches. In some cases, the transom may be too thick to accommodate the motor clamp. This condition will require notching out to accommodate the motor.

Now install the motor on the transom. Tighten clamp screws securely. (Do not use a wrench.) It is good insurance to fasten one end of a piece of sturdy rope or chain to the boat and the other end to the motor. In case the motor does get away for any reason, it will not be lost. Most of the motors have a safety link for this purpose. Refer to Owner's Guide for location.

Set the motor at the proper angle in relation to the transom by means of the tilt adjustment until the lower unit of the motor is in a vertical position, as explained in the paragraph "Transom Angle."

CARE OF OUTBOARD MOTORS

STORING MOTORS

Motors which are to be stored must be serviced to prevent damage from moisture and dust. If the motor is prepared according to the following procedure, and then stored in a dry place, it can be quickly reserviced and readied for use again at any time.

CAUTION

Do not store motors in a cellar, boat house or any other place where they will be exposed to dampness or dust.

a. If the motor has been used in salt water, flush it thoroughly with fresh water and let it dry before putting it away. (See paragraph "Salt Water Instructions.")

b. Drain the water out of the tubes and cylinder jackets as instructed in the paragraph "Care of Motor in Cold Weather."

c. Drain all fuel from tank and carburetor.

d. Remove each spark plug and put a teaspoonful of oil (same as used in fuel mixture) into the cylinder. Revolve flywheel several times to spread oil over cylinder walls; then replace spark plug.

e. Drain the gear housing and refill. Wipe the entire exterior of the motor with a cloth saturated with oil to form an exterior film of oil.

f. Completely wrap the motor in a piece of canvas, an old blanket, or heavy waterproof paper, and store in a dry place. The preferable way of storing motors is to set them on racks with the hand clamps tightened sufficiently to prevent the motors from moving.

REMOVING MOTORS FROM STORAGE

When removing a motor from storage, clean all oil and dirt film from the outside, remove the covers, and inspect carefully.

a. Check the gear housing for lubricant. Always be sure to keep the gear housing properly lubricated. It is preferable to leave a small air space rather than completely filling with lubricant.

b. Clean and adjust the magneto contact points. (Refer to Chapter Three.)

c. Clean the fuel filter. Clean out the fuel tank, the fuel feed line, and the carburetor. (Refer to Chapters Four and Eight.)

d. Remove and clean the spark plugs. If the plugs are cracked, broken or badly burned, replace them with new ones.

e. Carefully check over all parts of the motor for damage or loose parts. Replace or tighten as required.

f. Put motor in test tank, using a test propeller. Fill with correct fuel mixture, and check operation of motor. Check for fuel leaks, adjust carburetor until motor runs smoothly. Be sure that water is circulating through motor. Examine propeller for bent blades, large nicks, and excessive wear.

g. If the motor does not run properly, refer to the Trouble Chart in this chapter for the cause, and make the necessary corrections.

h. Check all adjustments such as clutch, gear shift, steering friction, handle tilt-up friction, motor tilt-up friction, and packing nuts on carburetor needle valves and shut-off valves.

SALT WATER INSTRUCTIONS

All materials used are commercially "salt water proofed." However, no motor is totally impervious to the corrosive action of salt water.

When using a motor in salt water it should be removed from the boat when not in service. Flush the motor thoroughly either by running it in a tank of fresh water or by removing water flush plug and using an adapter (available through your regular Service Parts Source), run fresh water through cooling system. Wipe the motor dry and go over all parts with an oily cloth. This should be done as soon as possible after removing motor from boat.

CARE OF MOTOR IN COLD WEATHER

Extra precautions are necessary when using the motor in freezing weather. If the motor is not given proper attention, and water freezes in the motor, it may result in cracked tubes and water jackets. There is no danger of the motor freezing while operating. But when the motor is idle, or when being stored away in cold weather, all water must be removed from it by setting the motor in an upright position and removing the water flush plug. Put speed control at stop and pull starter cord several times to pump out remaining water. This allows water to run out of the cylinder jacket and passages, thereby preventing freezing and damaging motor.

Drain and refill the gear housing if there is any indication of water in gear case.

MOTORS THAT HAVE BEEN SUBMERGED

A motor which has been completely submerged should usually not be operated until it has been thoroughly serviced. Use the following procedure in reservicing a motor which has been submerged.

a. Drain fuel tank by removing fuel tank filler cap and turning motor upside down.

b. Remove plug at very bottom of carburetor thereby draining water and fuel from carburetor. Pour

enough fresh fuel into gas tank to remove any water from fuel line, by permitting fuel to run out of carburetor drain plug hole (fuel tank shut-off valve must be open). When all traces of water are removed, replace plug.

c. Remove and dry spark plugs. Lay motor down on side and crank motor. Turn motor so that spark plug holes are down and again crank motor until no further water is expelled.

d. Check spark by inserting screw or other small metal object into rubber spark plug hood to make contact with terminal spring in hood and holding screw about 1/4 inch from cylinder crank motor rapidly. Check spark from both lead wires. If there is no spark, service magneto according to instructions in Chapter Three.

e. Reassemble all parts removed, fill tank with new fuel mixture, and start motor. It may be necessary to clean water from points of spark plugs several times as there is a possibility of small drops of water remaining in cylinder which may short plugs.

f. If motor does not start and is not to be run in a short time, remove spark plugs and pour about a tablespoonful of clean oil through each opening. Rotate flywheel slowly to distribute oil on cylinder walls and replace plugs.

NOTE

If the motor is dropped in a foot or two of fresh water for a very short period of time, with the gas tank vent and fuel shut-off valve closed, it may not be necessary to follow the above procedure. It may be possible to start the motor by merely draining the carburetor to make sure no water is present, removing the spark plugs, and tipping the motor in such a way that if there is any water in the cylinders it will quickly run out.

The above instructions are primarily for motors that have been submerged in fresh water. For motors submerged in salt water a few additional precautions, listed below, may be necessary.

a. Remove carburetor and fuel tank, and wash with fresh water. Dry thoroughly.

b. Remove flywheel, and wash magneto with fresh water.

c. It is advisable to wash external working parts, such as the starter mechanism, with fresh water and lubricate. Internal working parts of powerhead are lubricated by the fuel mixture.

OUTBOARD MOTOR OPERATING PROBLEMS

WHAT TO LOOK FOR

Most operating problems are due to incorrect mounting of the motor on the boat, poor quality or wrong mixture of fuel, or wrong operating procedure. When looking for the cause of troubles, always be sure the motor is filled with good fuel of the correct mixture; then check the operating instruction book to be sure the instructions are being followed properly. Check the mounting of the motor on the boat as previously described. Also, check the propeller drive or shear pin. If trouble still persists, check the Trouble Charts in this chapter for help in locating the cause.

CAVITATION

Cavitation should not be confused with a sheared propeller pin. Cavitation is a condition where the propeller is forced to operate in turbulent or greatly disturbed water. Consequently, air drawn from the water's surface into the propeller stream lessens the load on the propeller, which then turns at a higher rate of speed. However, since the propeller is acting largely on air and turbulent water, its effectiveness is reduced considerably in that the propeller is merely churning the water rather than propelling the boat. In most instances, cavitation is brought about by the propeller operating too near the surface of the water, through interferences created by the stern being too high or possibly by turning too sharply at high speed. A wide keel, extending to the stern of the boat, is often responsible for such interference and can be corrected by tapering to a feather edge (see page 2-3).

Collection of grass and weeds on the gear case also causes cavitation. Bent or damaged propeller blades frequently result in excessive vibration and loss in propeller efficiency, and may contribute toward causing cavitation.

PROPELLERS

Propellers are designed to give the best possible service for average use. Some motors use 3-blade propellers; others use 2-blade propellers. The number of blades is no indication of efficiency, speed, etc.

Some propellers are equipped with an integral shock absorber (rubber cushion built into propeller). NEVER SUBSTITUTE PROPELLERS WITHOUT THIS SHOCK ABSORBER, AS RAPID WEAR OF REVERSE MECHANISM MAY RESULT. The size of the propeller is given in two dimensions, diameter and pitch.

DIAMETER is the diameter of the circle scribed by the tips of the blades (see figure 2-4).

PITCH is the distance the propellers would advance in one revolution if operating in a semi-solid substance, with no slippage (see figure 2-4).

FOR EXAMPLE - a 10-inch by 12-inch propeller will have a 10-inch diameter and a 12-inch pitch, theoretically advancing 12 inches per revolution. No propeller is 100 per cent efficient; certain losses prevail under all circumstances. The percentage of loss from slippage frequently runs as low as 10 per cent on extremely light racing hulls and upwards from 40 to 60 per cent on heavier hulls.

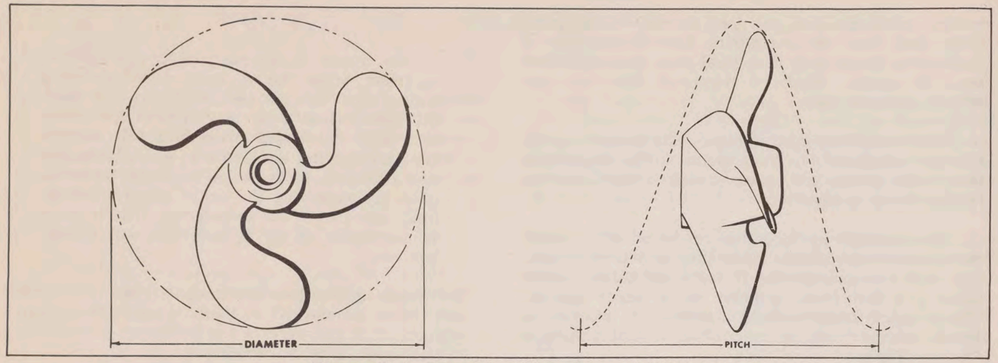


Figure 2-4. Propeller Diameter and Pitch

EFFICIENCY of the propeller depends to a great extent upon the shape and weight of the hull. The light-weight hydroplane type of hull offers the least resistance to forward motion, therefore, high propeller efficiency. The heavier boat offers a greater resistance, especially if the power applied is insufficient and incapable of planing the boat, resulting in low propeller efficiency.

Keel interference, angle of propeller thrust with relation to the line of forward motion, depth at which the propeller operates, marine growth below the water line, and of course, the load carried are all factors affecting propeller efficiency. In determining whether a motor should have a flatter pitch propeller on a very heavy boat, check the maximum rpm. If it is below rated speed, usually 4000 rpm, a propeller with less pitch will increase boat speed. However, too flat a pitch propeller on a light hull may result in overspeeding and possible damage.

MOTOR TROUBLES AND REMEDIES

Fuel and ignition systems are the most common sources of motor troubles. Before attempting any repairs on a motor that is not operating properly, be sure it is filled with fresh, clean fuel of the proper mixture, that it has a good spark, and all operating adjustments are properly made. Put the motor on the test tank using a test propeller, and make a systematic check of the motor's performance. The following procedures provide an outline to follow in finding trouble. When the trouble is localized to the magneto, for example, a detailed magneto trouble chart will be found in this chapter.

TESTING MOTOR IN TANK

When testing a motor in a test tank the test propeller should be used to enable the motor to come up to normal operating R.P.M., approximately 4000 R.P.M. on most motors. Although it will not hurt a motor to run it for a few minutes, especially at reduced speeds, in a test tank with a regular propeller the turbulence created by the regular propeller often beats so much air into the water that the water pump may not function properly resulting in an overheated motor. High speed adjustments of the carburetor cannot be made properly in a test tank unless the motor is equipped with a test propeller. No harm will be done to the motor if it is run at reduced or idle speeds in a test tank even with a regular propeller. At no time should a motor be run out of the water for more than a few seconds as serious damage can be done by overheating the motor and the propeller spinning in the open is very dangerous. Whenever a motor is being operated in the test tank it is very important to make sure that adequate cooling water is circulating through the motor.

MOTOR IS HARD TO START OR WILL NOT START

a. CHECK FUEL SUPPLY. Be sure tank is filled with fresh, clean mixture of oil and gasoline.

b. CHECK STARTING CONTROLS. Be sure shut-off valve is open, vent screw is open, and mixture setting is correct. The motor may be flooded if it is warm, or mixture may be lean if motor is cold.

IF MOTOR IS FLOODED shut off the high speed needle valve, set speed control at START, and pull starter until motor starts. Allow motor to run until it stops. Reset high speed valve in running position and restart motor.

IF MOTOR IS COLD be sure it is properly primed or choked before starting.

c. CHECK SPARK PLUGS. Remove spark plugs and examine them carefully. Should the point and inner porcelain appear wet from either oil or water, center electrode loose, or the points burned, replace the plugs. If plug is badly carboned, clean or replace. Check the spark gap and adjust if necessary to .030 inch. If spark plugs consistently give trouble refer to Chapter Three. Before replacing spark plug, check strength of spark (item d). It is not necessary to replace spark plug if gap has just been bridged by a small particle of carbon and the plug is in good condition. Clean and re-gap plug.

d. CHECK STRENGTH OF SPARK. With spark plugs out of the cylinder, hold one lead terminal 1/4 inch away from the motor, and pull on starter handle. A good spark should jump this gap. On motors equipped with rubber spark plug covers, insert 1/4 inch screw to make contact. Repeat this procedure on the other spark plug wire. If there is any evidence of spark failure it will then be necessary to check breaker point adjustment (item e). Be sure to replace lead marked "UP" on upper plug.

e. CHECK BREAKER POINT ADJUSTMENT. Check breaker point gap and readjust if necessary. Inspect the points carefully, and if they are burned, or dirty it will be necessary to clean or replace breaker points. (See Chapter Three.)

If the breaker points are properly adjusted and cleaned, and in good order, but there is still no spark, remove and service the magneto.

f. CHECK FUEL FLOW. Loosen fuel line connections at carburetor and open tank vent screw and shut-off valve and check to see that fuel flows freely to the carburetor. If not, remove and clean fuel filter. Also blow out fuel line to be sure there is no obstruction in it. If fuel flows freely through line, remove and clean carburetor. (See Chapter Four.) Occasionally a carburetor float may stick or a fuel line become airlocked. This can often be corrected by shaking the motor from side to side.

g. CHECK FOR MECHANICAL DEFECTS. If it is hard to pull the starter cord, check for binding in the power head or lower unit. There may be corrosion on the inside of the cylinders or in the drive or propeller shaft. Separate the power head from lower unit to facilitate determining cause of trouble.

h. CHECK COMPRESSION. Remove plugs and turn motor over to see if it turns freely. Then replace plugs and slowly turn the flywheel against compression. If compression is good, flywheel will turn hard and "snap" over after point of highest compression is reached. If compression is low, the flywheel will turn over with very little perceptible "snap."

i. If motor will still not start when above items have been checked and corrected, check carburetor reed valves for proper seating.

MOTOR SKIPS OR MISSES

a. CHECK CARBURETOR MIXTURE SETTING. If carburetor mixture is too rich, motor will run rough or sluggish. If the mixture is too lean, motor will spit or backfire, and slow down or stop.

b. CHECK SPARK PLUG WIRES. Wipe the spark plug wires clean, and inspect for broken or worn insulation or broken wires, especially under clamps. Be sure wires are tight at the magneto end and on the spark plugs.

c. CHECK UNDER "MOTOR IS HARD TO START OR WILL NOT START." A check of all the items will determine whether the trouble lies with the ignition or the fuel system.

MOTOR SURGES OR RUNS UNEVENLY

a. CHECK FOR CAVITATION. If cavitation is present, motor will race and vibrate excessively at intervals. This is caused by the transom of the boat being too high, by interference of the boat keel, or weeds gathered on gear housing. Improper loading of the boat may also cause cavitation.

b. CHECK AIR VENT SCREW. Lack of air entering the fuel tank, as fuel is used, may cause surging and uneven motor operation. Be sure the air vent is open when operating the motor, and that the small hole in the vent is not plugged.

c. CHECK SPARK PLUGS. If the spark plug insulator becomes heavily oxide coated, and the electrodes are worn, replace the plug with the next cooler type. Refer to the spark plug information in Chapter Three. This should rarely be necessary, unless original plugs have been replaced with the wrong type.

d. CHECK FOR FREE OPERATION OF MOTOR. Be sure there is no binding in the gears or bearings in the motor.

MOTOR OVERHEATS

a. CHECK WATER CIRCULATION. Be sure motor is pumping sufficient cooling water and that the intake is not obstructed. If water is not circulating, be sure the motor is deep enough in the water so that the intake is well under the surface. If there is no obstruction, and water does not flow, disassemble the cooling system and clean or repair it. Check pump first. (See Chapter Six.)

b. CHECK GASOLINE-OIL MIXTURE. Fill the fuel tank with the correct gasoline-oil mixture.

c. CHECK FOR FREE OPERATION OF MOTOR. Binding due to tight fit in the bearings, piston rings or gears, may cause overheating. Also, if the shaft, gears, and cylinders are corroded, overheating may result. However, these conditions would be very unusual.

MOTOR KNOCKS

a. CHECK FOR OVERHEATING. Overheating may cause motor knocks, so check all items under the heading "MOTOR OVERHEATS."

b. CHECK FOR LOOSE FLYWHEEL NUT. Be sure that the flywheel nut is securely tight (see torques, Chapter Nine). A loose nut will cause a motor knock and may damage the motor. Make sure flywheel is not hitting coil laminations in magneto. Be sure crankshaft taper and flywheel hub are dry.

c. CHECK FOR CORRECT GASOLINE-OIL MIXTURE. Carbon in the cylinder may cause a knock. Insufficient oil in the gasoline-oil mixture may also cause overheating and knocking.

d. CHECK FOR FOREIGN MATERIAL IN CYLINDER.

MOTOR IS NOISY

a. CHECK FOR MOTOR KNOCK. Motor knock may be caused by any of the items under the heading "Motor Knock." Check these four items before making any further investigations.

b. CHECK FOR MECHANICAL KNOCKS. Knocking noise can be caused by several things. The primary ones to check are in the power head. Check the flywheel to be sure that it is not loose, striking the armature or part of the recoil starter assembly. Check for loose rods or wrist pins. Check for loose or out-of-line bearings, a sprung or twisted crank-shaft or bent or sprung connecting rods. Excessive end play will also cause a knocking noise.

c. CHECK EXHAUST NOISE. Exhaust noise may be due to its escape through loose connections, blown or leaking gaskets, or loose spark plugs. Also check to be sure the motor is not too high on the boat.

d. CHECK GEAR HOWL. Gear howl can be caused either by insufficient lubricant in the gear housing, gears meshing too tightly, gears worn or damaged, and worn bearings.

MOTOR VIBRATES

a. CHECK IGNITION. No spark in one cylinder, due to a faulty spark plug, wire or breaker point, will cause motor vibration.

b. CHECK FUEL MIXTURE. Be sure to use the correct gasoline-oil mixture, and mix well before filling tank.

c. CHECK MOTOR MOUNTING. Be sure the motor is tight on the boat.

d. CHECK PROPELLER. Inspect the propeller to see that it has not been bent, damaged, or chipped as this will cause vibration.

e. CHECK FLYWHEEL. Flywheel nut should be tightened to torque given in Chapter Nine. Taper and hub must be dry. Play in flywheel causes vibration.

f. Check motor alignment. A bad fall may bend entire lower unit.

MOTOR RUNS BUT BOAT MAKES LITTLE OR NO PROGRESS

a. CHECK PROPELLER DRIVE PIN. If pin has been sheared, the motor normally runs at excessive speed, which is an indication of the trouble.

b. CHECK PROPELLER SHOCK ABSORBER. If the rubber shock absorber is slipping, the motor speed will probably be greater than normal, but the boat will make little or no progress.

c. CHECK FOR OBSTRUCTION. Be sure there are no obstructions, such as anchor, or heavy ropes, hanging in the water to impede the boat's progress.

MOTOR TUNE-UP AND OVERHAUL PROCEDURES

When motors are brought to you for check-up, probably not for any specific trouble, but because the owner wants to be sure that the motor is in good order; or if the motor is brought in because of some minor difficulties, the following tune-up procedures can be used as a guide in putting the motor in good shape for the owner. In connection with the following procedures, consult the Trouble Charts in finding any troubles which might appear.

This tune-up may vary with some motors, but here is the complete procedure to follow as a guide.

a. If motor runs, but with some fault, operate it in test tank. Consult Trouble Charts if necessary. See whether pump is supplying cooling water.

b. Examine fuel mixture in tank. Remove fuel screen, clean tank thoroughly. Check connections. Clean fuel line.

c. Check to be sure spark plugs are correct type. Clean plugs and adjust points with gauge.

d. Check magneto breaker points. Clean and adjust if necessary.

NOTE

If the breaker points have not been damaged by salt water corrosion or contamination by oil, cleaning and resetting should not be necessary except after a long period of operation. Unnecessary point cleaning can cause considerable damage. The magneto is very trouble-free and ignition trouble can usually be traced to plug fouling or plug lead failure.

e. If motor runs sluggishly or keeps running with the speed control at STOP, it may indicate that the spark plugs are too "hot" for the particular type of service, or that excessive carbon may have accumulated in cylinders and ports, necessitating cylinder removal and cleaning. Check for compression by slowly turning flywheel against compression. A motor with good compression will be hard to turn, will "snap" over after point of highest compression is reached. If compression is low, recommend overhaul with cleaning of piston ring grooves and replacement of piston rings.

f. If motor starts hard, knocks, and lacks pep, check for loose flywheel and connecting rod bearings by bouncing flywheel back and forth, listening for knocks. Excessive wear in crankshaft journal bearings can usually be detected by seizing flywheel firmly in hands and moving it slowly toward and away from you. Motors with such faults cannot be run without danger of further costly damage. If play appears excessive, check sizes (see Chapter Nine).

g. After removing propeller, turn propeller shaft back and forth to determine wear in gears, and wiggle it back and forth to detect propeller shaft bearing wear. Repairs should be made if excessive wear in gears or bearings has occurred.

CAUTION

Never turn motor over by the propeller or "crank" it while making these checks as the motor may suddenly start, causing serious injury to the person or persons checking the motor. Remove and ground plug wires.

h. If cooling water supply is feeble or absent, pump may need overhauling.

i. If gear case is without lubricant, check for wear. Fill housing with lubricant. (Fill approximately 3/4 full - leave air space.)

j. Check propeller shear pin for breakage or damage.

k. When testing motor after check-up, use proper fuel mixture.

l. Test for adequate spark.

m. After motor has run sufficiently long to indicate a satisfactory condition, stop and restart it several times. Operate it on high and lowest speeds. Stall motor by flooding or choking. Then turn high speed needle to normal position or release choke and start in normal manner.

n. Tighten all external nuts, bolts, and screws. Replace any damaged screws. See Chapter Nine for recommended torques.

o. Old motors may not come up to speed because of carbon in exhaust ports. This is very common on motors run a considerable length of time.

p. Clean and dry motor thoroughly, before returning it to the customer.

TROUBLE CHECK CHARTS

SPARK PLUGS

CONDITION	CAUSE	RECOMMENDATION
Black carbon or sooty deposit.	a. Long periods of slow speed operation.	a. Use hotter plug.
	b. Excessive oil in fuel.	b. Check for correct mixture.
	c. Breaker points dirty or out of adjustment.	c. Clean and adjust gap.
	d. Weak condenser.	d. Check and replace if weak.
Pitted or burned points. White, light tan or blistered deposits. Rapid wear of points.	a. Long periods of high speed operation.	a. Use cooler plug.
Cracked or broken plug upper end.	a. Careless installation of plug.	a. Replace plug.
Cracked or broken insulator on lower end of plug.	a. Center electrode strained when regapping plug.	a. Replace plug.
Widening of gap.	a. Normal wear.	a. Clean and regap.

MAGNETO

TROUBLES	CAUSES	REMEDIES
Weak spark	a. Points pitted, dirty, oily, or out of adjustment.	a. Clean and adjust. If too oily, check oil return, slinger, etc.
	b. Breaker arm binding. Weak spring.	b. Clean and lubricate. Replace spring if weak.

MAGNETO (CONT'D.)

TROUBLES	CAUSES	REMEDIES
Weak spark (cont'd.)	c. Weak condenser.	c. Check and replace if weak.
	d. Permanent magnet weak.	d. Re-magnetize the permanent magnet.
	e. Coil heel to magnet pole shoe gap incorrect.	e. Check gap and re-adjust if necessary.
	f. Loose or broken connection. Worn insulation on wire.	f. Clean and check all connections and wires.
Intermittent spark.	a. Broken wire or loose connection. Bare wire shorting on motor.	a. Clean and check all wire and connections. Check all ground connections.
	b. Check all causes for "Weak Spark."	
No spark.	a. Check all causes under "Weak Spark" and "Intermittent Spark."	
	b. Broken down, damp or shorted coil or condenser.	b. Test coil and condenser and replace if defective.

CARBURETOR

TROUBLES	CAUSES	REMEDIES
Motor floods.	a. Choke improperly adjusted.	a. Adjust choke.
	b. Float damaged.	b. Replace or repair float.
	c. Dirt between float needle and seat.	c. Clean carburetor.
	d. Float level set too high.	d. Adjust float level.
	e. Float valve stem bent so valve does not close.	e. Replace valve.
	f. Damaged needle valve or valve seat.	f. Replace valve and seat.
	g. Dirt prevents leaf or reed valve seating.	g. Clean leaf or reed valve.
	h. Damaged leaf or reed in valve.	h. Replace leaf or reed.
Motor starves.	a. Water or foreign matter clogging passages, jets and screens.	a. Clean carburetor and strainer.
	b. Float valve corroded or gummed so that valve does not open properly.	b. Clean or replace valve.

CARBURETOR (CONT'D.)

TROUBLES	CAUSES	REMEDIES
Motor starves (cont'd.)	c. Float level set too low.	c. Adjust float level.
	d. Float valve stem bent and does not open properly.	d. Replace valve stem.
	e. Float hinge dirty or corroded.	e. Clean float hinge and valve.
	f. Vapor lock.	f. Check for overheating of fuel line or kink in line.
Poor carburetion.	a. Jets, needle valves, fuel lines, and screens dirty.	a. Clean carburetor, strainer, and fuel lines.
	b. Loose connection or defective gasket between carburetor and crankcase.	b. Tighten bolts and replace gasket if necessary.
	c. Faulty butterfly valve or choke.	c. Check and repair.
	d. Dirt prevents leaf or reed valve from closing.	d. Clean leaf or reed valve.
	e. Broken or damaged leaf or reed valve.	e. Replace leaf or reed.

POWER HEAD

TROUBLES	CAUSES	REMEDIES
Motor overheats or is hard to start due to stiff power head.	a. Corroded cylinder leaking water.	a. Replace cylinder.
	b. Piston rings carboned, worn, broken or fitted too tight.	b. Remove, clean or replace and fit rings properly.
	c. Warped, scored or burned piston.	c. Replace piston.
	d. Piston fitted too tight.	d. Replace piston.
	e. Bearings out of line or too tight.	e. Replace.
	f. Bearings not properly lubricated.	f. Use correct fuel-oil mixture.
	g. Bent, twisted or broken connecting rod.	g. Replace rod.
	h. Connecting rod too tight.	h. Replace rod.
	i. Crankshaft sprung or twisted.	i. Repair or replace crankshaft.
	j. Crankcase sprung.	j. Replace sprung crankcase.
Motor is hard to start due to poor compression	a. Piston rings carboned, worn, broken, or stuck in groove resulting in blow-by.	a. Replace piston rings. Clean grooves carefully.

POWER HEAD (CONT'D.)

TROUBLES	CAUSES	REMEDIES
Motor is hard to start due to poor compression (cont'd.).	b. Worn piston ring grooves resulting in blow-by.	b. Replace piston and rings.
	c. Worn cylinder.	c. Replace cylinder.
	d. Loose cylinder or head bolts - loose or defective gasket.	d. Replace gasket and tighten bolts.
	e. Poor lubrication.	e. Use correct gasoline - oil mixture.
	f. Cylinder ports clogged with carbon.	f. Clean carbon from cylinder ports.
Knock in power head (not due to spark advance or defect in magneto).	a. Excessive carbon in cylinders causing detonation.	a. Clean out carbon.
	b. Worn piston slapping against cylinder.	b. Replace piston.
	c. Twisted or worn connecting rod.	c. Check rods and replace as required.
	d. Worn piston pin.	d. Replace pin.
	e. Worn or loose bearings. Excessive end play in crankshaft.	e. Replace bearings.
	f. Bearings misaligned.	f. Replace.
	g. Crankshaft sprung, twisted or worn.	g. Replace or repair crankshaft.
Squeak in power head.	a. Corrosion in cylinders.	a. Clean cylinders.
	b. Insufficient lubrication.	b. Use correct gasoline - oil mixture.
	c. Leaky gasket.	c. Replace gasket.

LOWER UNIT

TROUBLES	CAUSES	REMEDIES
Motor overheats or is hard to start due to stiff lower unit.	a. Dry-no lubricant.	a. Flush and relubricate.
	b. Bent or corroded propeller or driveshaft.	b. Replace.
	c. Gears broken or out of mesh.	c. Replace gears.
Motor overheats due to lack of cooling.	a. Clogged inlet or water tubes.	a. Clean all water lines.
	b. Faulty water connections.	b. Tighten or replace parts.
	c. Worn or broken pump impeller or impeller drive pin.	c. Replace impeller or pin.
	d. Pump housing loose on gear case.	d. Replace gasket and tighten screws.
	e. Worn pump rotor, eccentric, gear housing cap or cover.	e. Replace parts.

LOWER UNIT (CONT'D.)

TROUBLES	CAUSES	REMEDIES
Water in gear case.	a. Housing cap loose or defective gasket.	a. Replace gasket and tighten cap bolts.
	b. Worn grease seals where used.	b. Replace seals.
	c. Propeller shaft bearing worn.	c. Replace bearing.
	d. Grease plugs loose.	d. Tighten plugs.
Noise and vibration due to lower unit.	a. Bent propeller.	a. Straighten or replace propeller.
	b. Gears set up too tight or too loose.	b. Replace gears or check bearings.
	c. Dry or corroded gears and bearings.	c. Clean and lubricate gear housing.

MOTOR OVERHAUL INFORMATION

Detailed overhaul information for the various parts of the motor are given in Chapters Three through Eight of this manual. The following general information may be of value as reference when overhauling a motor.

When dismantling a motor for overhaul, keep the small parts and the hardware in small pans, such as bread pans, so that all parts for each motor can be kept segregated until ready for reassembly.

When it is difficult to remove or separate parts, because of corrosion or "freezing," there are two remedies which sometimes prove effective. For aluminum parts, expand the larger or surrounding member by heating with a torch or other means. This sometimes breaks the parts loose. Be careful of fire due to fuel mixture or grease. In the case of steel or iron parts, which have rusted together, soak thoroughly with penetrating oil. This sometimes loosens the parts to a point where they can be separated without damage.

When a motor is to be completely overhauled, disassemble it into the main subassemblies outlined in this manual, then proceed with disassembly and overhaul of each of the subassemblies.

When the motor has been completely disassembled, clean all parts with a good grease solvent and be sure to remove all carbon from the pistons and cylinders. Coat with oil after cleaning. When cleaning, pay particular attention to gasket surfaces to be sure there are no particles of gasket adhering to the metal. During the cleaning procedure, a close inspection can be made of all parts to see that there are no obvious worn or damaged parts which may cause trouble after the motor has been reassembled.

After the complete motor has been reassembled, test it in a tank before putting it on a boat, so that the proper adjustments can be made.

If the overhauled motor is to be stored, be sure to prepare it for storage as outlined before.

REFINISHING

The careful refinishing of a repaired motor creates the visual satisfaction that the customer receives from your repair service. It is this satisfaction that will bring your customer's future patronage.

As refinishing is very important, each phase will be dealt with individually to be certain it is fully covered. Complete refinishing consists of going over the motor completely, removing all old paint and applying a new coat of paint. This phase is done only when the motor is in your shop for a complete overhaul. The other type of refinishing consists of touch-up work, such as scratches and blemishes, done primarily when a relatively new motor is in your shop for testing and adjusting.

a. CLEANING PARTS. When the motor is disassembled for a major repair job, wash off each part in a good solvent. Apply a coat of paint remover and allow the remover action to loosen the paint; brush off the old paint until the part is absolutely clean. It may be necessary to apply more than one coat of paint remover to remove paint; if so, apply as many coats as are necessary. After parts are free from any trace of old paint, the motor can be reassembled using old and new parts as needed and is ready for the next operation. Assemble motor up to and including the power head with the exception of the gas tank, starter housing, and motor covers. These items should be refinished separately.

b. PRIMER. Using a heat resistant primer that is adaptable for use on die-cast aluminum (see paint supplier for recommended primer), spray primer on all exposed surfaces, pivoting motor from side to side to be sure to cover all exposed parts. Permit primer to dry according to paint manufacturer's specifications. Protect carburetor passages and magneto from primer and paint.

c. PAINTING. When the primer coat is completely dry, spray the motor with the applicable lacquer or enamel. The starter housing, gas tank and motor covers are sprayed individually. Instructions for installing decals, where needed, are available in Chapter Eight.

d. TOUCH-UP. Touch-up work is a simple process of sanding scratched areas with fine sandpaper and spraying with a fresh coat of paint. Be sure that before attempting any touch-up work the complete motor or area around the scratched surface, is sprayed clean with clean solvent. If a spray gun is not available for this purpose, solvent can be applied by means of a clean cloth. Be sure to allow ample time for proper drying.

RETURNING MOTOR TO CUSTOMER

After a motor has been overhauled and before it is delivered to the customer, check the following:

a. Lubricant in gear case.

b. Carburetor properly adjusted.

c. Spark plugs in good condition.

d. Magneto produces good spark.

e. Motor runs properly at both high and low speeds.

f. No fuel leaks.

g. No water leaks.

h. No rattles.

i. Motor is clean.

j. Be sure customer understands the proper care and operation of the motor.

k. All screws and nuts are tight.

l. Cotter pin in propeller nut.

m. Water pump operating efficiently.

CHAPTER THREE - IGNITION

DESCRIPTION

IGNITION SYSTEM

The ignition system used in these motors consists of a flywheel type magneto connected to one or more spark plugs through high tension spark plug wires. The magneto is a self contained electrical generating unit consisting of an armature plate with ignition coil and lamination assembly, condenser, and breaker mounted on it. A permanent magnet built into the flywheel completes the assembly. In operation, as the permanent magnet poles pass over the pole shoes of the coil laminations, a magnetic field causes a current to flow through the primary winding of the coil. This current is normally grounded through closed breaker points.

When the breaker points open, actuated by a cam on the crankshaft, the flow of the primary current is broken and the magnetic field about the coil breaks down instantly. As the current tends to continue flowing, the condenser, which is connected across the breaker points, momentarily absorbs this current and hastens the collapse of the magnetic field by creating a high frequency oscillation in the current. The condenser also reduces pitting of breaker points by absorbing any sparking across them. In the secondary winding of the coil, this collapsing magnetic field induces a very high voltage which is carried by the high tension spark plug wire to the spark plug where it jumps the plug gap and ignites the fuel charge in the cylinder. This cycle is repeated for each revolution of the crankshaft. There is one complete coil, condenser and breaker point circuit for each cylinder.

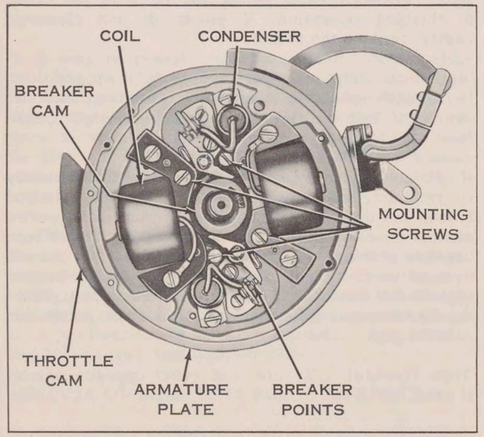


Figure 3-1. Typical Magneto Armature Plate

SPARK PLUG INFORMATION

A very important factor for peak operation of the outboard motor is the proper selection (heat range) of the spark plug. Spark plugs are classified into various types, in accordance with the temperatures at which they are designed to operate - generally speaking, HOT and COLD.

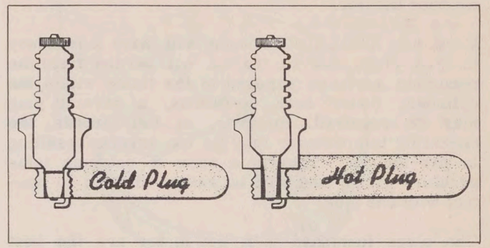


Figure 3-2. HOT and COLD Spark Plugs

HOT PLUG - designed to operate under normal conditions having a long core section (porcelain) exposed to the flame within the cylinder; for use where operating temperatures and speeds are low.

COLD PLUG - designed to operate under extreme high temperature, having a short core section exposed to the flame within the cylinder, for use where operating temperatures and speeds are high.

There are no sharp lines of distinction between the HOT and COLD spark plugs. Each group has several classifications, with relation to the temperatures at which they are designed to operate.

The installation of a COLD plug in a low speed engine will result in consistent fouling, while the installation of a HOT plug in a high speed engine will result in pre-ignition, causing the engine to "ping" or to "surge," that is to run at full rpm for short periods then at a noticeable drop in revolutions. In extreme cases, the plug may be hot enough to result in the motor stopping entirely, or burning a hole in the piston head.

If there are reasons to suspect the spark plug installed in a certain engine of being too HOT or too COLD - remove it. Should the core section be found to be BLACK, SOOTY or MOIST, the plug is too COLD. If found to be PITTED, BURNED, WHITE, or a LIGHT TAN it is too HOT. If a LIGHT BROWN, you can be reasonably assured that it will operate efficiently. Should the spark plugs run exceptionally HOT, the motor will continue to fire occasionally after the magneto handle or speed control grip has been moved to STOP position.

NOTE

Plugs vary so in appearance after several hours operation that no exact rule can be made. Before condemning plug as being too COLD, make certain fuel mixture is correct, and that the carburetor is properly adjusted.

The correct spark plug to be installed in any motor depends upon the type of service to which it is

subjected. Unless the spark plug is properly suited to the motor, trouble may arise, which might be interpreted as carburetor difficulty by the inexperienced operator. Spark plugs furnished with the motor, as standard equipment, are installed for average service.

Very low TROLLING speeds will have a tendency to foul plugs due to the oil not burning from the porcelain surfaces exposed to the flame within the cylinder. Under such conditions, a warmer plug may be required. However, at full throttle, the operating temperature may be too severe, resulting in pre-ignition. This is a case of extreme temperature range and will be rather difficult to control with one plug.

The plugs furnished with the motor are the best for average motor operation. If the plugs consistently give trouble refer to the IGNITION TROUBLE CHART in Chapter Two.

CLEANING AND REGAPPING SPARK PLUGS
(See figure 3-3.)
Inspect for cracked porcelain and excessively worn electrodes.

Clean the electrodes with fine sandpaper or emery cloth. Adjust the electrode to the specified gap, .030 inch. In re-gapping, adjust only the outer (ground) electrode. Attempting to bend the center electrode will crack the insulator. A round wire feeler gage is the preferred type for checking spark plug gap. Always check gap of new plugs before installing them.

Before installing the plug, be sure the plug seat in the cylinder head is clean and free from obstructions. Install a new spark plug gasket if the old one is damaged. Screw the plug in by hand. Tighten to torque given in Chapter Nine. If an old gasket is re-used, just snug plug down. Blow-by, a result of loose plugs, is indicated by black carbon streaks on the upper insulator of the plug.

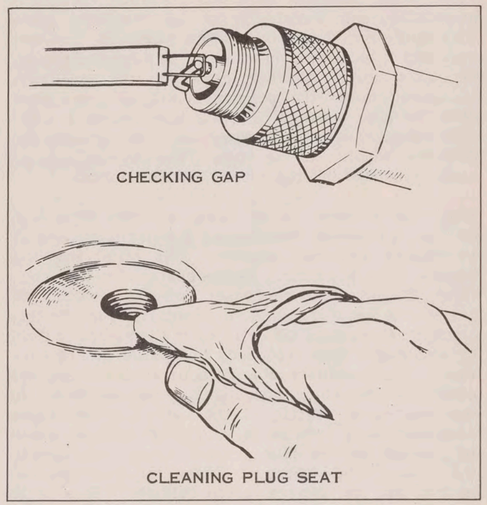


Figure 3-3. Spark Plug Service

HOW TO CLEAN AND ADJUST BREAKER POINTS

Over an extended period of service the breaker points may become pitted, dirty, oily, or out of adjustment. The following procedure will cover cleaning and adjustment of breaker points. The actual procedure is basically the same for all models. See figure 3-4.

a. Remove starter assembly. If flywheel cover plate is used, also remove starter ratchet and cover plate.

b. Turn the flywheel to a position where the inspection hole comes to rest above the breaker points. On 3 H.P. motors, with two inspection holes on top of flywheel, use opening farthest from starting rope notch.

c. Before adjusting the breaker, check it over carefully to be sure it is not corroded or otherwise defective. Check action of the spring and free movement of breaker arm. If the breaker does not operate correctly, disconnect fuel line, remove gas tank and flywheel, and clean and service the breaker.

d. Carefully spread the points with a blunt instrument (a small screwdriver may be used) then insert a point dresser. Release points and work point dresser up and down until assured that point surfaces are clean and smooth. Replace excessively rough or burnt surface points. This is only a cleaning operation. If points do not clean up easily, replace the points.

e. Insert strip of paper and work it up and down to remove possible traces of dressing material which, if left on the point surfaces, might interfere.

f. Points should check 0.020 inch. If necessary to readjust, insert screw driver through hole and loosen breaker point lock screw (round head screw closest to crankshaft). Now with screw driver turn breaker point adjusting screw (outer slotted screw) to open or close points as necessary. After proper adjustment has been made, lock breaker by tightening breaker point lock screw. Re-check points for correct gap.

Turn flywheel 1/2 turn and reset opposite points, if used.

When adjusting points with flywheel removed, turn crankshaft until flywheel key is in line with fibre cam follower on breaker arm. This is the high point of the cam and breaker points should check 0.020 inch. The starboard breaker points fire the lower cylinder through the rear coil and the port breaker points fire the upper cylinder through the front coil.

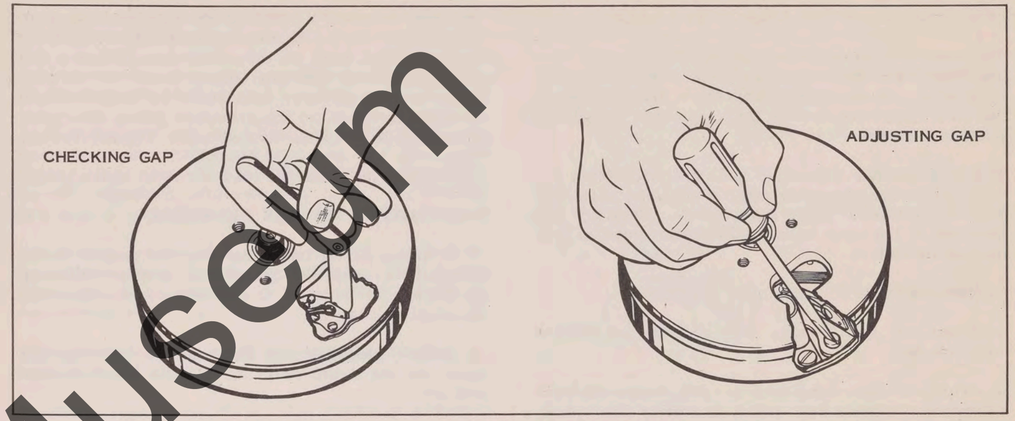


Figure 3-4. Adjusting Breaker Points

MAGNETO OVERHAUL INFORMATION

DISASSEMBLY FOR ACCESS TO MAGNETO

Remove motor covers, if any. Disconnect fuel line. Remove gas tank and starter housing.

Remove the flywheel as follows: (See figure 3-5.)

a. If using a puller, fasten the puller to the flywheel, using the cap screws supplied with puller. Hold the puller to prevent turning by inserting a bar in the hole at the edge. With a wrench, turn down the stud on the puller until flywheel snaps loose.

b. It may be possible to remove the flywheel without using a flywheel puller. Hold flywheel rigid and unscrew the flywheel nut about two full turns. Have someone lift up on the flywheel and then place a piece of bar solder or a block of lead over the flywheel nut and tap a sharp blow with a hammer. If flywheel does not come off, loosen nut a trifle more and repeat procedure.

e. When flywheel comes off, use care not to lose the key by which the flywheel is held in engagement with the shaft. When again replacing flywheel, be sure key is in place and fits snugly, then draw up the nut tightly, using a torque wrench or a hammer on a regular wrench. For recommended torque, see Chapter Nine.

REMOVAL OF ARMATURE PLATE ASSEMBLY

Disconnect high tension lead wires from spark plugs. On the 12D10 models, the magneto handle will have to be loosened from the magneto handle support bracket. On 12D11 models, snap the spring clip off the top of the armature plate control lever on the port side of the power head. Remove high tension lead bracket mounted on cylinder head. Loosen the armature plate mounting screws and lift armature plate off motor. (See figure 3-1 for location of screws).

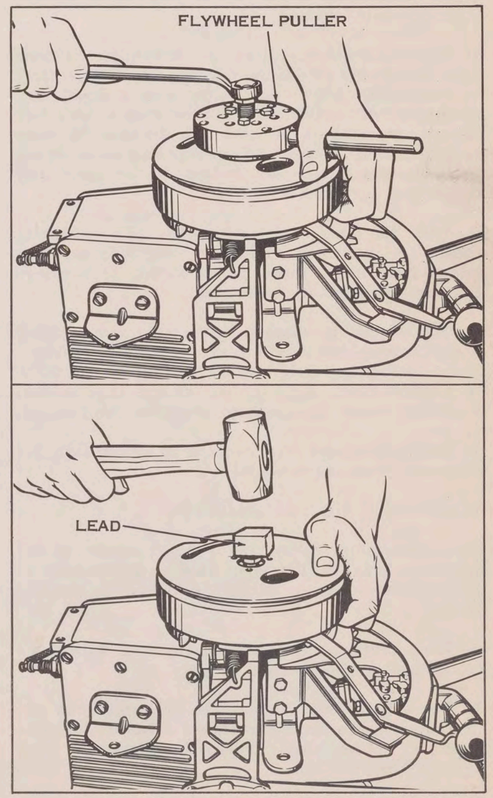


Figure 3-5. Removing Flywheel With and Without Flywheel Puller

DISASSEMBLY OF THE ARMATURE PLATE

The armature plate can be disassembled easily. The exploded views at the end of this chapter are indexed in order of disassembly. Therefore disassemble in the same sequence as the index numbers in the applicable exploded view.

The high tension lead wires pull out easily from the coil lamination assembly after clamp has been removed. Normally, these high tension wires are left attached to the base, unless examination reveals that they are defective.

CLEANING, INSPECTION, AND TESTING

a. Clean all metal parts with a good oil solvent and wipe dry.

b. Wipe off the wires with a cloth dampened with a solvent. Inspect all wires carefully for worn, cracked, or broken insulation, or breaks in the wire. Check all connections carefully to be sure they are tight. It is recommended that old wires be replaced when overhauling an armature plate. Old wires, insulation leakages, or broken wires can cause irksome troubles.

c. Inspect breaker points to determine whether they are dirty, pitted or burned. If slightly dirty or corroded, dress the points with a hone, fine sandpaper, or a point file. Take only a very fine cut, do not attempt to clean up excessively worn or pitted points. Replace them with new ones. Check breaker spring and mechanism to be sure they are in good operating condition.

d. Test the coil and condensers. On replacing either the coil or condenser, test the new part before installing. These parts cannot be repaired and must be replaced if defective.

e. The magnet is charged to its maximum capacity at the factory and should retain this charge indefinitely. However, under some circumstances, such as a hard blow, some of the charge may be lost. In these cases the magnet must be re-charged.

f. Inspect magneto cam located on crankshaft, for excessive wear or breakage.

REASSEMBLY OF THE MAGNETO

For reassembly, follow the reverse order of the index numbers on the applicable exploded view in this chapter. Pay particular attention to the following:

a. When replacing the condensers, make sure there are insulating sleeves on each wire.

b. Correct locating of the coil and lamination assemblies is governed by machined mounting surfaces on the armature plate. Lamination should be flush with machined surface.

c. Make all wiring connections on the magneto, making sure that there is good contact.

d. Apply a coat of good grade lubricant, such as "lubriplate," to the crankcase neck before replacing the armature base on the crankcase. Place a few drops of oil on the felt oiler. Move the throttle lever or cam follower (whichever is used) forward to clear the cam on the armature plate; then place armature, base down, on crankcase. Tighten screws.

e. Connect high tension lead wires to spark plugs.

INSTALLATION OF THE FLYWHEEL

a. If there is an indication that the magnet in the flywheel is weak, re-charge the magnet following the procedure outlined in instructions accompanying the magneto charger.

b. Before mounting the flywheel, be sure that the taper on the crankshaft and in the hub are clean and dry.

c. Place flywheel over tapered end of crankshaft and at the same time align key and keyway in flywheel hub. See figure 3-6 for correct key position.

d. When parts are properly aligned, carefully push the flywheel down over the crankshaft taper. Attach nut. Use a torque wrench, if available. Otherwise tap wrench with hammer to tighten securely.

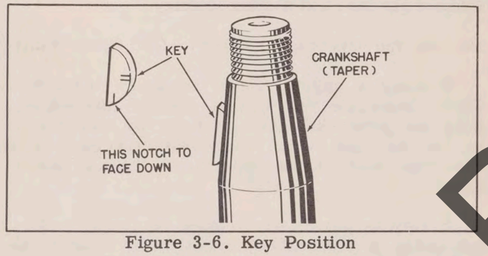


Figure 3-6. Key Position

e. Watch the flywheel - be sure it is tight on the crankshaft before a repaired motor leaves the shop. Also, every time the flywheel is removed, be sure to check the taper on the crankshaft and the taper in the flywheel to see that they are not damaged. Clean and dry flywheel and crankshaft tapers before reassembling the flywheel to the crankshaft.

f. Whenever possible, use a torque-meter wrench to tighten flywheel nut following the torque reading chart in Chapter Nine.

WAVE WASHER TYPE ARMATURE MOUNTING.

The wave washer type armature mounting, though actually considered part of the power head, is usually serviced in conjunction with the magneto. This type of mounting is used on all motors except the 12D11 models and serves to hold the speed control lever in position, regardless of where it is set. The 12D11 models use a friction block in the steering handle grip for this purpose.

Four screws through the armature plate into the retaining ring attach the armature plate. To remove the magneto and service the mounting, disassemble it as follows:

a. Remove the magneto mounting screws, and lift off the armature assembly.

b. Remove four screws holding the armature plate support to the crankcase and remove the wave washer and ring. Notice the position of the lug on the armature plate support. This lug serves as a stop on some motors. Replace in same position.

c. Clean all parts in a grease solvent and inspect for broken wave washer or defective parts. Replace the wave washer if it is broken, weak or excessively worn.

d. Reassemble the ring, washer, and bracket in position on the crankcase.

e. Attach armature plate with mounting screws.

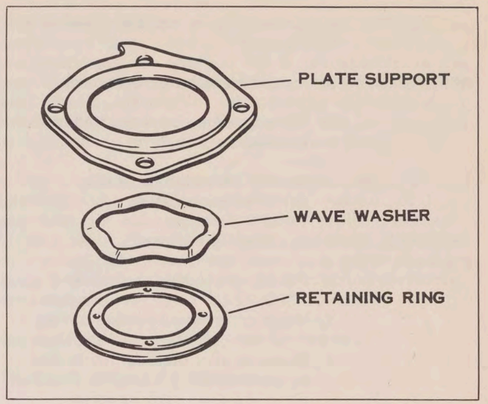


Figure 3-7. Wave Washer Type Magneto Mounting

MAGNETO SERVICING AND TESTING

MAGNETO CHECK CHART

Normally magnetos are not difficult to service nor magneto troubles difficult to diagnose. With test equipment, the coils, condensers and magnets are easy to check. However, before disassembly to correct trouble which is suspected in the magneto carefully check the ignition system over according to the following check chart:

SPARK PLUG
a. Wrong heat range
b. Broken or cracked porcelain
c. Fouled electrodes or residue formed on porcelain (particularly in salt water area)
d. Loose terminal

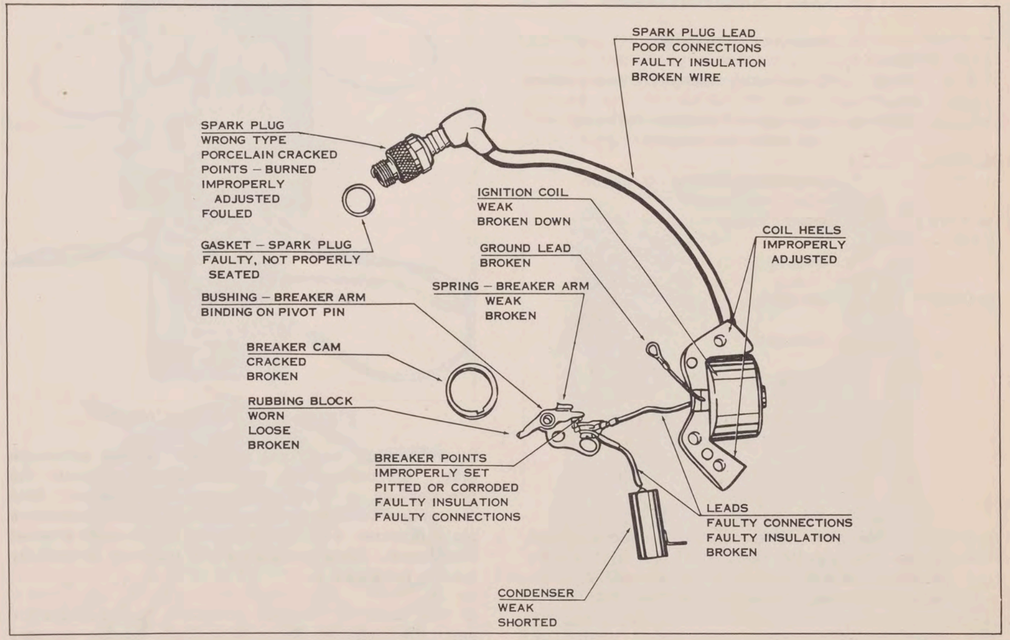


Figure 3-8. Ignition Trouble Spots

	e. Loose plug or defective gasket - blow-by
WIRING	a. Insulation worn or oil soaked
	b. Wire broken - perhaps under insulation
	c. Loose, corroded or poorly soldered connections
BREAKER POINTS	a. Incorrectly adjusted
	b. Pitted, corroded, or fouled
	c. Weak or broken breaker spring
	d. Breaker arm binding due to dirt or corrosion
	e. Breaker point loose in mounting
	f. Loose or broken wire connection
CONDENSER	a. Weak
	b. Shorted
	c. Improperly mounted
	d. Loose wire connection
IGNITION COIL	a. Weak - partially shorted
	b. Dead - completely shorted
	c. Improperly mounted
	d. Loose or broken wire connection
	e. Excessive clearance between coil heels and magnet
	f. Coil heels rubbing on magnet
MAGNETO CAM	a. Worn
	b. Broken or cracked
MAGNET	a. Weak
	b. Cracked
	c. Broken
	e. Incorrect clearance with ignition coil heels

If it is not the coil; if it is not the condenser; and if it is not the points, then check the wiring system carefully. Look for grounds caused by oily wires and insulating washers, broken insulation, broken or cracked insulation washer. Do not overlook possibility of broken wires under insulation, loose connections or open circuits because of corroded connections. Check every wire on the armature plate if necessary.

TEST EQUIPMENT

Literature and procurement information on ignition testing equipment can be obtained from the factory. Address all inquiries to the Service Department. Complete operating instructions for testing magnetos and components are included with each piece of test equipment; therefore the instructions in this chapter are brief and general only.

The ignition coil primary current values (in amperes) are furnished with the testing equipment. Capacity is the same for all the condensers, 0.2 mfd.

COIL TESTING

Fundamentally, the coil tester provides a source of primary current, interrupted by a built-in breaker to induce high voltage current in the secondary winding of the coil on test - intensity of which is in proportion to amount of current (amperage) flowing through the primary circuit.

Primary current is controlled manually by a rheostat in the test unit - a definite amperage (indicated on ammeter) having been established for each coil to be tested.

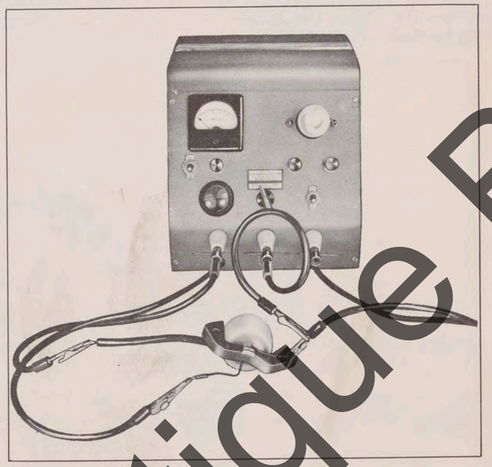


Figure 3-9. Testing Coil

When testing any coil mounted on the armature plate, disconnect the condenser and separate the breaker by a strip of paper. One primary lead from the test unit is connected to the armature plate (ground) with the other to the breaker bracket (insulated). This completes the primary circuit for testing purposes.

If the coil is in good condition and suitable for use, the induced secondary (high tension current to spark plugs) should be of sufficient strength

to consistently spark across the gap on the test unit, with primary current adjusted to amperage specified for the particular coil.

An irregular, seemingly weak or hesitating spark across the gap indicates a weak coil (damp or partially broken down secondary). No attempt should be made to improve this spark by increasing primary current - the coil is inoperative if it cannot be made to spark properly on the specified amperage.

A completely "dead" coil is indicated by no spark - definitely shorted out. See instructions provided with testing unit.

CONDENSER TESTING

To check or test the condenser, detach the insulated lead from the breaker bracket and attach to one of the leads from the test unit as shown in the illustration, the grounded end being attached to the second lead. Thus, when checking or testing, the condenser is charged by a mechanism in the test unit - if in good condition, the condenser will hold the charge until intentionally discharged by operation of the unit. Discharge will be observed by momentary or flash flow of the neon tube.

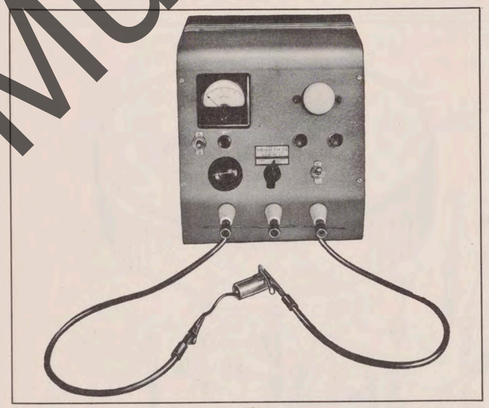


Figure 3-10. Testing Condenser

If the condenser is weak, the neon tube will flash intermittently when attempting to charge. It does not hold its charge, and therefore, is not satisfactory for further use. If the condenser is shorted out completely, the neon tube will glow continuously when charging - there is no charge; therefore, the condenser is "dead" and not fit for use.

See instructions provided with testing unit.

TESTING BREAKER POINTS

Connecting the breaker point tester to the magneto breaker points makes it possible to quickly check the condition of the points electrically. The indicator will show BAD or GOOD depending on point condition.

Complete operating instructions are furnished with the unit.

MAGNET CHARGING

Flywheel magnets are designed to hold their charge (magnetism) indefinitely. It is, however, good policy to recharge the magnet when the magneto is overhauled.

Operating on a d-c current (battery or rectified a-c current) the charger sets up a strong magnetic field in its poles. Opposite poles of the flywheel on the charger are recharged by this field in the tester. Complete instructions for charging magnets are included with the charging unit.

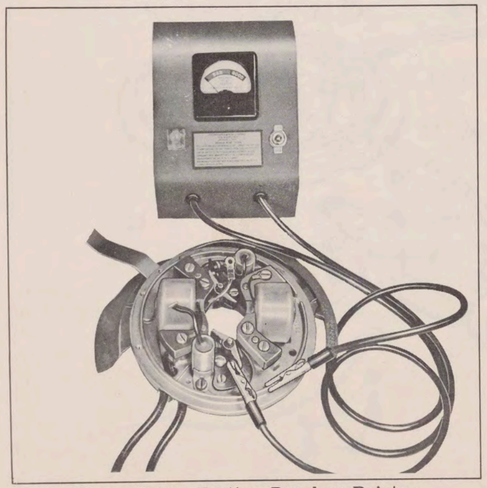


Figure 3-11. Testing Breaker Points

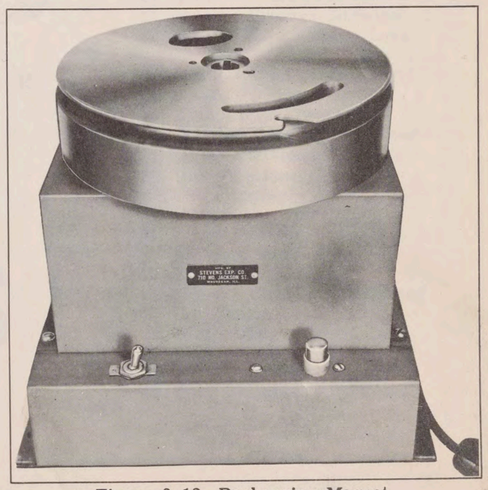
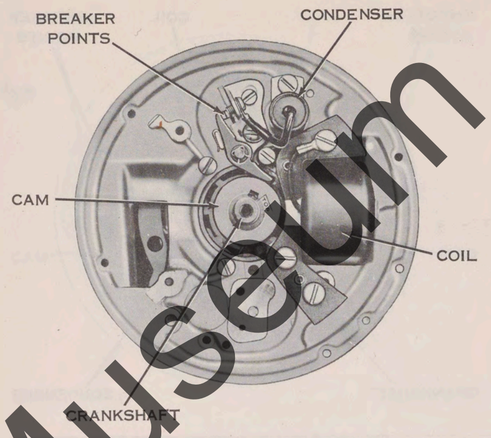


Figure 3-12. Recharging Magnet



MAGNETO

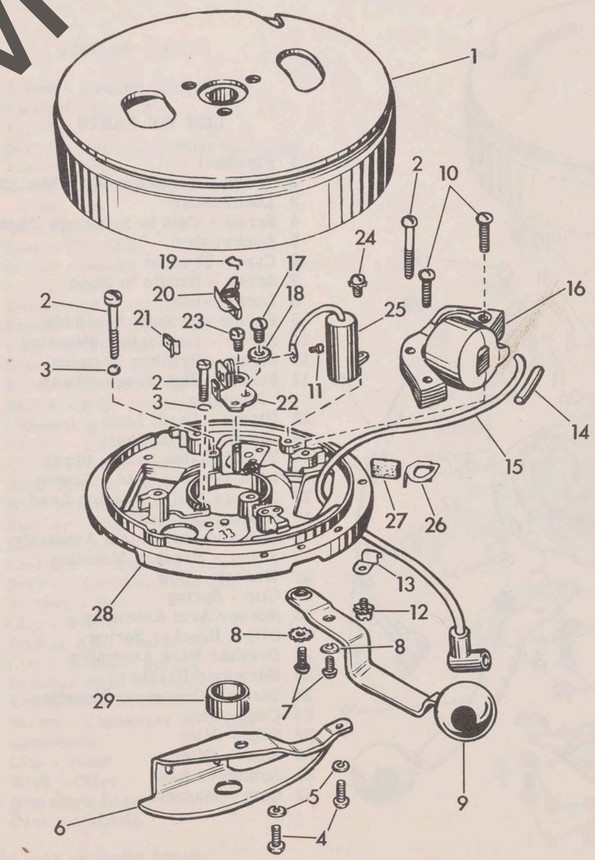
Models 3D10, 3D11

SPECIFICATIONS

Breaker Point Gap	.020 in.
Spark Plug Gap	.030 in.
Spark Plug	Ch. J6J or Auto - Lite A3X
Breaker Assembly Part No.	580148
Coil-Lamination Assembly Part No.	580118
Condenser Part No.	510173

OVERHAUL INFORMATION

The exploded view is indexed in order of disassembly. Therefore to disassemble, remove parts in sequence of index numbers. To reassemble, put together in reverse sequence of index numbers. Special instructions for disassembly and assembly are given previously in this chapter. Be sure this chapter is read thoroughly before working on magneto.



LIST OF PARTS

1 Flywheel
2 Screw - Armature Plate Mounting
3 Lockwasher
4 Screw - Cam to Armature Plate
5 Lockwasher
6 Cam - Throttle
7 Screw - Handle to Plate
8 Lockwasher
9 Handle and Knob Assembly
10 Screw - Lamination Mounting
11 Screw - Breaker Terminal
12 Screw - High Tension Lead Mounting
13 Clamp - High Tension Lead
14 Sleeve - Insulating
15 Lead - High Tension
16 Coil and Lamination Assembly
17 Screw - Breaker Mounting
18 Washer - Bow
19 Clip - Spring
20 Rocker Arm Assembly
21 Clip - Breaker Spring
22 Breaker Base Assembly
23 Eccentric - Breaker
24 Screw - Condenser Mounting
25 Condenser
26 Clip - Oiler
27 Wick - Oiler
28 Armature Base
29 Cam - Magneto

MAGNETO

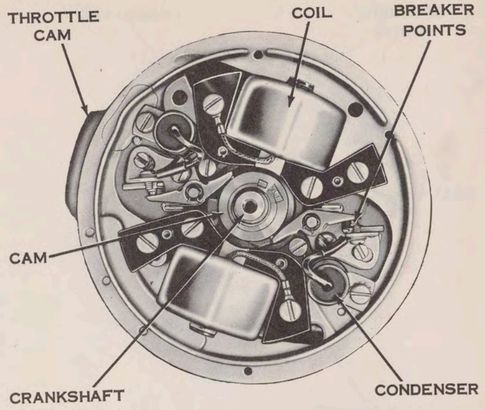
Models 5S10, 5D10

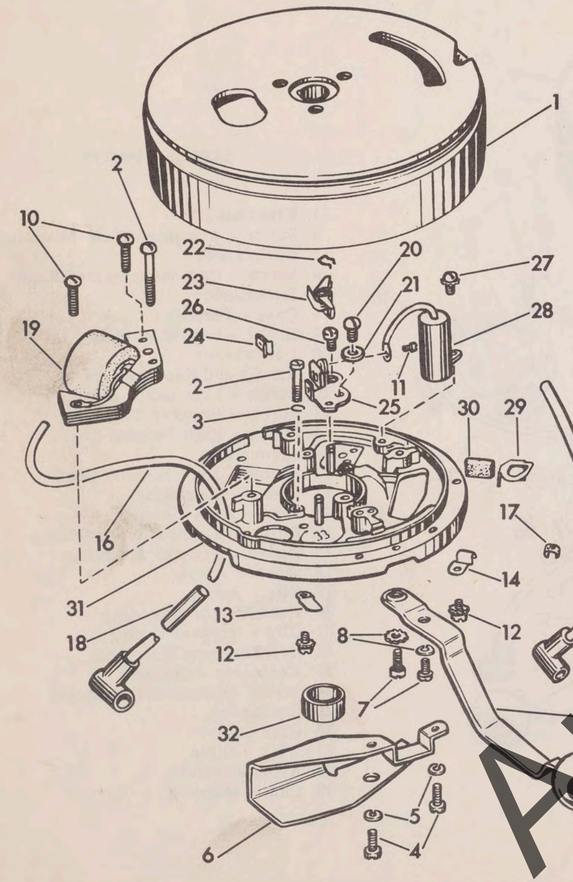
SPECIFICATIONS

Breaker Point Gap	.020 in.
Spark Plug Gap	.030 in.
Spark Plug	Ch. J6J or Auto - Lite A3X
Breaker Assembly Part No.	580148
Coil-Lamination Assembly Part No.	580118
Condenser Part No.	510173

OVERHAUL INFORMATION

The exploded view is indexed in order of disassembly. Therefore to disassemble, remove parts in sequence of index numbers. To reassemble, put together in reverse sequence of index numbers. Special instructions for disassembly and assembly are given previously in this chapter. Be sure this chapter is read thoroughly before working on magneto.





LIST OF PARTS

1 Flywheel
2 Screw - Armature Plate Mounting
3 Lockwasher
4 Screw - Cam to Armature Plate
5 Lockwasher
6 Cam - Throttle
7 Screw - Handle to Plate
8 Lockwasher
9 Handle and Knob Assembly
10 Screw - Lamination Mounting
11 Screw - Breaker Terminal
12 Screw - High Tension Lead Mounting
13 Clamp - Lead, Long
14 Clamp - Lead, Short
15 High Tension Lead - Upper
16 High Tension Lead - Lower
17 Marker - High Tension Lead
18 Sleeve - Insulating
19 Coil and Lamination Assembly
20 Screw - Breaker Mounting
21 Washer - Bow
22 Clip - Spring
23 Rocker Arm Assembly
24 Clip - Breaker Spring
25 Breaker Base Assembly
26 Eccentric Breaker
27 Screw - Condenser Mounting
28 Condenser
29 Clip - Oiler
30 Wick - Oiler
31 Armature Base
32 Cam - Magneto

MAGNETO

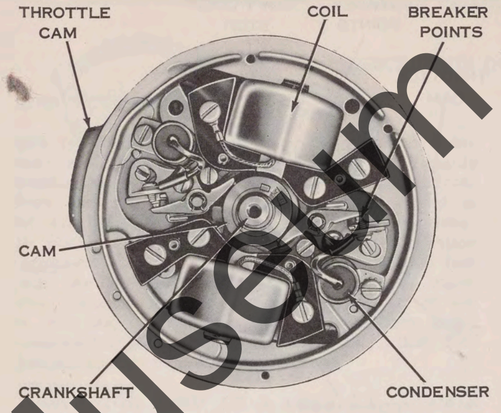
Models 12S10, 12D10

SPECIFICATIONS

Breaker Point Gap	.020 in.
Spark Plug Gap	.030 in.
Spark Plug	Ch. J6J or Auto - Lite A3X
Breaker Assembly Part No.	580148
Coil-Lamination Assembly Part No.	580118
Condenser Part No.	510173

OVERHAUL INFORMATION

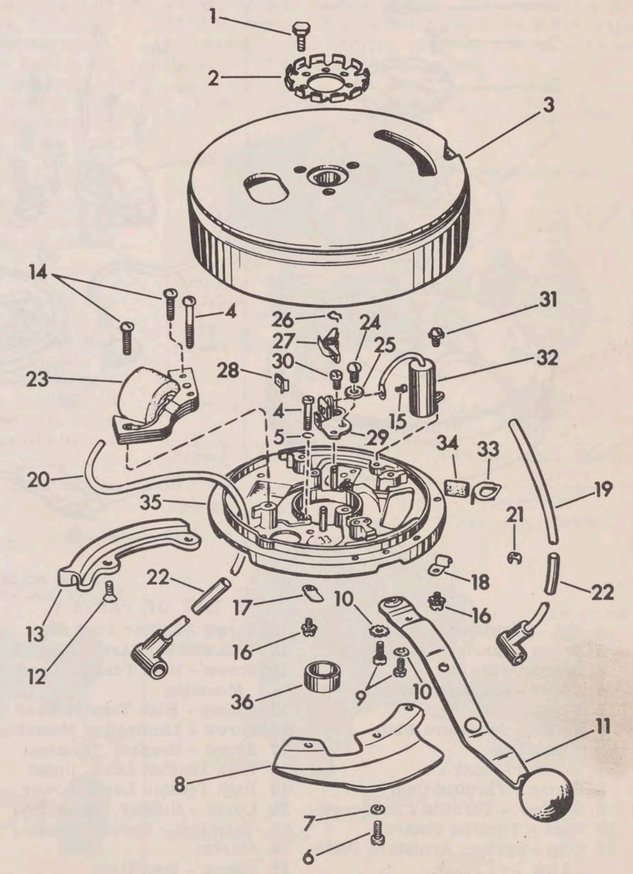
The exploded view is indexed in order of disassembly. Therefore to disassemble, remove parts in sequence of index numbers. To reassemble, put together in reverse sequence of index numbers. Special instructions for disassembly and assembly are given previously in this chapter. Be sure this chapter is read thoroughly before working on magneto.



LIST OF PARTS

1 Screw - Ratchet to Flywheel
2 Ratchet - Starter
3 Flywheel
4 Screw - Armature Plate Mounting
5 Lockwasher
6 Screw - Cam to Armature Plate
7 Lockwasher
8 Cam - Throttle
9 Screw - Handle to Plate
10 Lockwasher
11 Handle and Knob Assembly
*12 Screw - Shift Lock Cam
*13 Cam - Shift Lock
14 Screw - Lamination Mounting
15 Screw - Breaker Terminal
16 Screw - High Tension Lead Mounting
17 Clamp - Lead, Long
18 Clamp - Lead, Short
19 High Tension Lead, Upper
20 High Tension Lead, Lower
21 Marker - High Tension Lead
22 Sleeve - Insulating
23 Coil and Lamination Assembly
24 Screw - Breaker Mounting
25 Washer - Bow
26 Clip - Spring
27 Rocker Arm Assembly
28 Clip - Breaker Spring
29 Breaker Base Assembly
30 Eccentric - Breaker
31 Screw - Condenser Mounting
32 Condenser
33 Clip - Oiler
34 Wick - Oiler
35 Armature Base
36 Cam - Magneto

*Not used on Model 12S10



MAGNETO

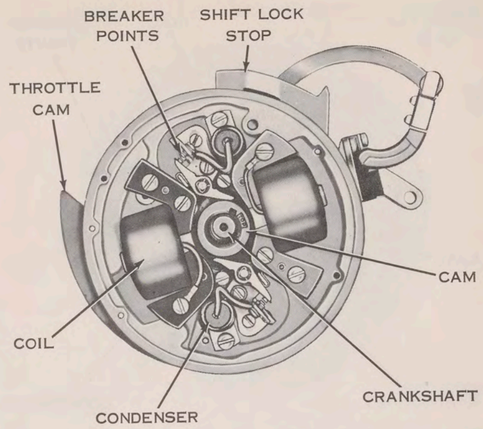
Model 12D11

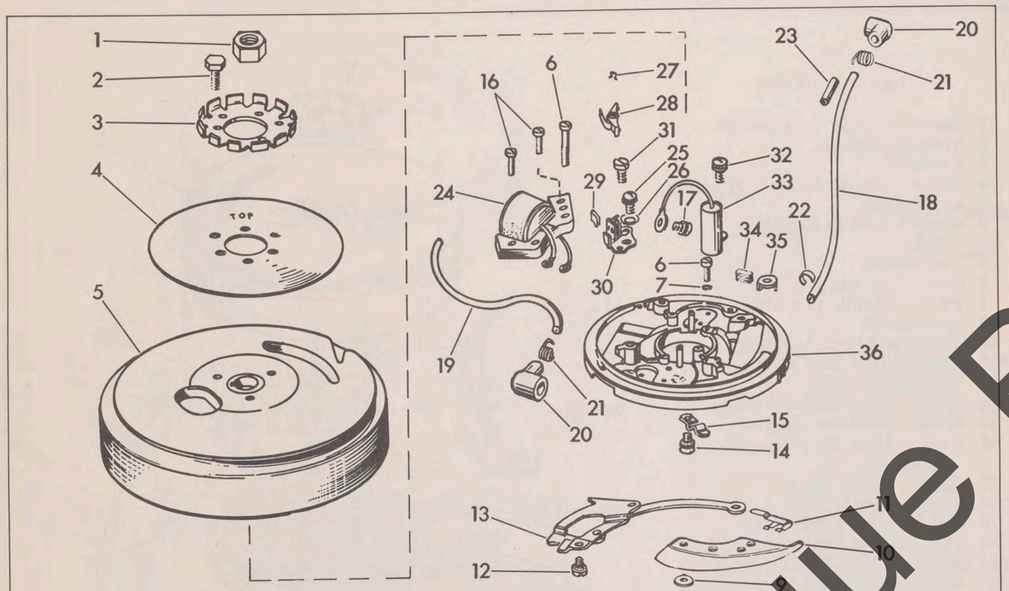
SPECIFICATIONS

Breaker Point Gap . . . . . .020 in.
Spark Plug Gap . . . . . .030 in.
Spark Plug . . . . . Ch. J6J or Auto - Lite A3X
Breaker Assembly Part No. 580148
Coil-Lamination Assembly Part No. 580118
Condenser Part No. 510173

OVERHAUL INFORMATION

The exploded view is indexed in order of disassembly. Therefore to disassemble, remove parts in sequence of index numbers. To reassemble, put together in reverse sequence of index numbers. Special instructions for disassembly and assembly are given previously in this chapter. Be sure this chapter is read thoroughly before working on magneto.





LIST OF PARTS

1 Nut - Flywheel
2 Screw - Starter Ratchet
3 Ratchet - Starter
4 Cover - Inspection Hole
5 Flywheel
6 Screw - Armature Plate Mounting
7 Washer - Lock
8 Screw - Throttle Cam
9 Washer - Throttle Cam Screw
10 Cam - Throttle Control
11 Clip - Spring, Armature Plate Link
12 Screw - Shifter Lock Stop
13 Link and Stop Assembly
14 Screw - High Tension Lead Mounting
15 Clamp - High Tension Lead
16 Screw - Lamination Mounting
17 Screw - Breaker Terminal
18 High Tension Lead, Upper
19 High Tension Lead, Lower
20 Cover - Rubber, Spark Plug
21 Terminal - Spring, Lead
22 Marker
23 Sleeve - Insulating
24 Coil and Lamination Assembly
25 Screw - Breaker Mounting
26 Washer - Bow
27 Clip - Spring
28 Rocker Arm Assembly
29 Clip - Spring, Breaker
30 Breaker Base Assembly
31 Screw - Breaker Eccentric
32 Screw - Condenser Mounting
33 Condenser
34 Wick - Oiler
35 Clip - Oiler
36 Armature Base

CHAPTER FOUR - CARBURETION

DESCRIPTION OF CARBURETION

CARBURETOR PRINCIPLE

Both types of carburetors used on the motors deliver a controlled mixture and quantity of highly combustible vapor to the induction passage; from there the mixture goes to the crankcase and to the combustion chamber. In the outboard motor, the piston chamber is, of course, the combustion chamber. The carburetor controls the flow of fuel from the tank, breaks the liquid fuel into vapor form, mixing it with the correct amount of air so that the resulting combination will burn under compression so rapidly, and forcefully, that mechanical energy or power is produced.

CARBURETOR USED ON 3 and 5 H.P. MODELS

The flow of fuel is by gravity from the tank to the carburetor float bowl. This flow can be shut-off by the shut-off valve in the carburetor or tank. Strainers remove foreign particles which might impair operation. The float in the bowl keeps the fuel in the bowl at a fairly constant level. As the fuel level in the bowl goes down, the float follows the level of fuel. The inlet needle mounted in the float cork is moved downward by the downward movement of the float which in turn moves the inlet valve on the inlet needle away from the seat. This allows fuel to enter into the bowl until the correct level is reached, at which time the carburetor float in the elevated position moves the inlet needle valve to the closed position, stopping the flow of fuel.

The fuel is drawn in liquid form from the bowl into the carburetor passages where air is introduced to form a combustible mixture. The quantity of fuel reaching the jet orifice in the induction passage is determined by the carburetor adjusting needle setting. The quantity of air introduced in the mixture is determined by the throttle valve. The throttle valve setting depends on the position of the magneto handle acting through the throttle lever cam against the throttle valve lever.

CARBURETORS USED ON 12 H.P. MOTORS

The operation of these carburetors is essentially the same as on the smaller motors. The construction is quite different, however. Where the other type carburetor has the inlet needle mounted on the free-floating float, the 12 H.P. carburetors have a hinged float and the needle inlet assembly mounted separately. The 12D10 and 12S10 needle inlet assemblies are mounted in the float bowl; the 12D11 in the upper carburetor body.

The choking or priming procedure is also different. On the smaller motors, priming is accomplished by holding the inlet needle valve open, increasing the amount of fuel flowing into the carburetor. On the 12 H.P. motors, a butterfly valve in the air passage is closed in the choking process, cutting down on the supply of air mixed with the fuel.

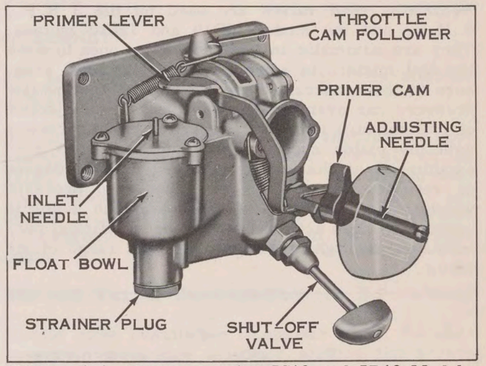


Figure 4-1. Carburetor for 5S10 and 5D10 Models

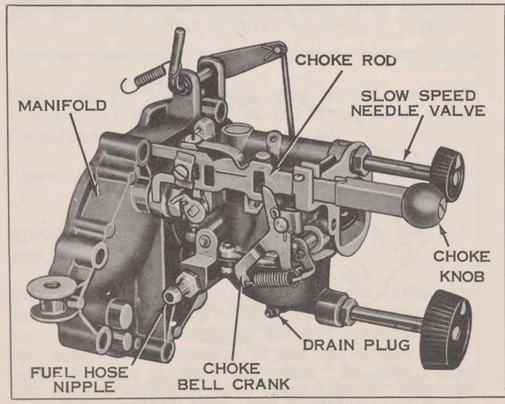


Figure 4-2. Carburetor for Model 12D11 Motors

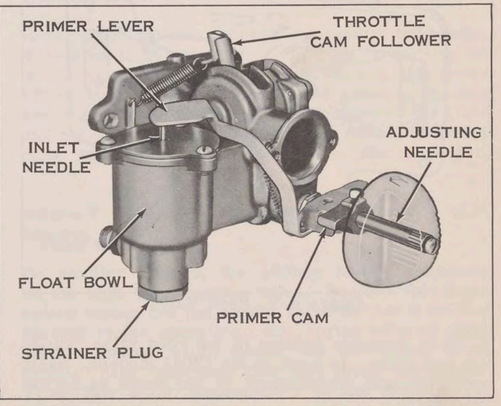


Figure 4-3. Carburetor for 3D10 and 3D11 Motors

Throttle valves in both cases operate off cams on the armature plate. The smaller motors use rotary throttle valves, the larger, butterfly valves.

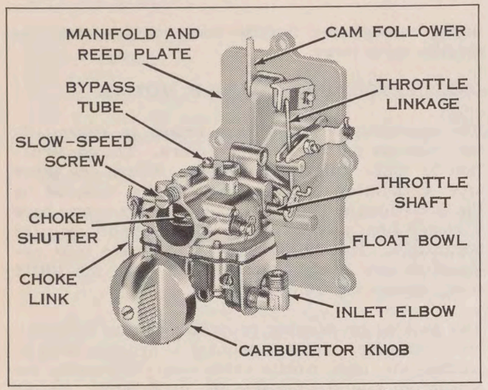


Figure 4-4. Carburetor Used on 12D10 Motors

REED (LEAF) VALVES (See figures 4-5 and 4-6).

Automatic reed valves are used on the 3 H.P., 5 H.P. and the model 12D10 and 12S10 motors. They are automatic in that they do not open to allow the fuel mixture to enter the crankcase until pressure in the crankcase is low enough so that outside pressure can overcome leaf tension. Thus injection of fuel mixture into the cylinders is timed correctly with the piston cycle. The reed tension is preestablished at the factory with gages. The degree of reed opening depends on crankcase pressure which varies with rate of speed at which motor is operating. Such action results in more efficient performance throughout the entire speed range of the motor.

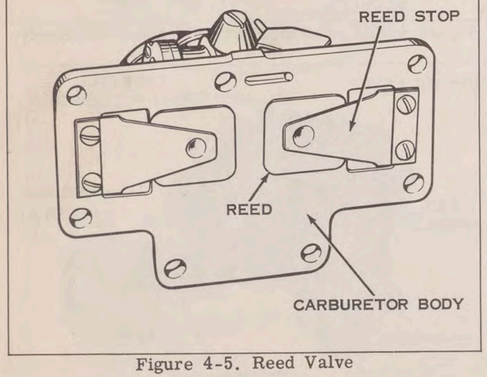


Figure 4-5. Reed Valve

A more complex version of the reed valve, called the leaf valve, is used on the 12D11 models. Basic operation and maintenance is the same as for the reed valve.

FLOAT AND FLOAT VALVE

The float and float valve, which control the flow of fuel into the carburetor, are contained in the float bowl section. Two types of float arrangements are in use - integral and hinged type float. In both types, the float valve consists of the inlet needle and inlet needle seat.

INTEGRAL TYPE (3 and 5 H.P. Motors)

The inlet needle is inserted directly through the center of a cork float. Usually a groove in the needle locates a float lock on top of float for correct float level. On all others, set locks so that the top of the float will be 1/2 inch below the top of the float bowl when the needle valve is in the closed position. A lock, located in needle below float prevents needle and float from dropping too low in bowl. The inlet needle seat is integral with the float bowl and cannot be replaced separately.

HINGED TYPE FLOAT (12 H.P. Motors)

A hollow metal or cork float is hinged at the edge and has a lip (float arm) which bears against the needle to hold it in the inlet needle seat. Although the seat is replaceable, the needle and seat are matched units and must be replaced together. Adjustment of the float lever is made by bending the float arm as required. See data with exploded views at end of chapter.

CARBURETOR CHOKE (12 H.P. Motors)

The carburetors are fitted with a choke to cut down the proportion of air to fuel for cold starts. The choke is a butterfly shutter installed in the air inlet. On 12D11 carburetor (figure 4-2) a choke knob is pulled out to choke. On 12S10 and 12D10 carburetor (figure 4-4) the carburetor knob is turned to extreme counterclockwise position to choke.

PRIMER (3 and 5 H.P. Motors)

The primer consists of a cam operated lever mounted on the adjusting needle which, when depressed, holds the inlet valve open to provide an extra rich starting mixture. (Increased ratio of fuel to air.)

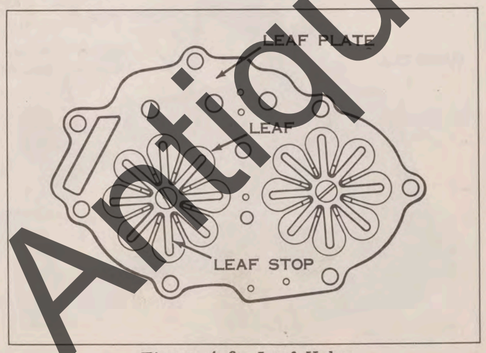


Figure 4-6. Leaf Valve

CARBURETOR OVERHAUL

GENERAL INSTRUCTIONS

When trouble has been traced to a carburetor that has been in service, the best procedure is to dismantle the complete carburetor, clean and inspect it thoroughly; then reassemble it, replacing defective parts. On new carburetors, try to determine the cause of trouble from the Trouble Chart, Chapter Two, then refer to the part of these instructions which apply to the part causing the trouble. Dirt and incorrect adjustments are the most frequent causes of trouble.

The following overhaul instructions are given for the various parts found in carburetors. In overhauling a carburetor, completely disassemble the carburetor first, then proceed with cleaning, repair, and reassembly.

By using compartmentalized plastic cases, such as larger size bait boxes or bread pans, to keep the parts for each group such as the high speed needle valve, separate, it will be easier to reassemble the carburetor, and the possibility of losing or damaging parts will be minimized.

REMOVAL OF CARBURETOR FROM MOTOR

Removal of the carburetor from the power head varies on different motors but the following procedure will be a guide in removing the carburetor. Start by removing all the control knobs. Remove the motor cover assemblies. Disconnect the fuel line at the carburetor. Disconnect all throttle and choke linkage, and any other connections to the carburetor. Remove the stud nuts and screws, where used, to take off the carburetor. Discard the carburetor gasket and install a new one when reassembling on the motor.

On larger motors a manifold and the leaf or reed valve assembly are mounted between the carburetor and the crankcase.

Remove the manifold screws next and take off the manifold. Remove the leaf or reed plate assembly and gaskets. On 12D11 motors, remove screw in center of leaf plate. Use care in handling the leaf or reed valve so that none of the leaves or reeds are damaged.

CARBURETOR DISASSEMBLY

GENERAL INSTRUCTIONS

Disassemble the carburetor according to the applicable exploded view at end of this chapter; or in logical sequence paying particular attention to the following parts.

INTEGRAL TYPE FLOAT DISASSEMBLY (3 and 5 H.P. Motors)

Remove the drain plug, gasket, and strainer (if used) from the bottom of the float bowl.

Remove the float bowl cover.

To remove the inlet needle, tap it lightly down to the top of the float with a plastic hammer. Then pull the needle out through the bottom of the bowl.

Lift the float and float locks out of the float bowl.

Check the condition of the inlet needle seat with a magnifying glass. If it is nicked or out of round the carburetor body must be replaced.

Check the needle for condition and straightness.

HINGED TYPE FLOAT DISASSEMBLY (12 H.P. Motors)

Disassembly of the float bowl from the carburetor can be made according to exploded view in this chapter. In these carburetors, the float chamber forms the entire lower section of the carburetor. Remove the float chamber assembly. Be sure to back out needle valve in float bowl several turns on 12S10 and 12D10 carburetors. Otherwise the needle and seat may be damaged. The float is attached by a pinion. Remove the float.

Lift out the inlet needle valve and unscrew the inlet needle valve seat. For access to the seat on the 12D10 model, it is necessary to remove an inlet plug screw. The high speed needle valve is installed in the float chamber. Remove and service it according to the NEEDLE VALVE instructions below.

NEEDLE VALVE DISASSEMBLY (12 H.P. Motors)

Needle valve installation is similar on all the carburetors. A packing gland or stuffing box serves both to prevent leaking and to hold the needle valve in its set position.

Remove the nut; then unscrew and remove the needle. If packing is damaged or worn, pick the packing out of the gland (stuffing box) and discard it. On model 12D10 motors, also take out the gland or stuffing box and gasket. On model 12D11 motors, the gland and nut are integral. Disassemble the 12D11 model slow speed needle valves in the same manner.

NEEDLE VALVE DISASSEMBLY (3 and 5 H.P. Motors)

On smaller motors, the primer lever is mounted on the high speed needle valve. Remove this lever before taking out the needle valve so that it will not be bent in the operation. Slip spring off lever, take off the control knob, loosen the set screw in the primer cam, and slip cam and lever off needle. From this point, disassembly is the same as for 12 H.P. motors.

CHOKE AND THROTTLE DISASSEMBLY (12 H.P. Motors)

Remove all linkage, connected to shaft and lever assemblies. Remove shutter screws, then turn the shaft so that the shutter is horizontal in the carburetor, and remove the shutter. Withdraw the shaft and lever.

NOTE: Disassemble on 12D11 motors only if absolutely necessary, since screws are staked.

REED (LEAF) VALVE DISASSEMBLY

Exploded views of the reed valve assembly are included with the carburetors in this chapter. Special precaution is necessary in disassembling these reed valves so that the reed will not be damaged. Because the reed must be absolutely flat to maintain a tight seal with the reed plate, do not under any circumstances bend or flex reeds of the valve by hand. It is advisable to clean and immediately reassemble the reed valve rather than leave it apart for reassembly later. These same instructions apply to leaf valves on model 12D11 motors. When reeds or leaf valves do not lay flat against surface, try turning them over.

THROTTLE VALVE DISASSEMBLY (3 and 5 H.P. Motors)

The exploded views of the carburetors in this chapter will serve as a guide in disassembling the valve.

On 3 H.P. motors, the throttle valve and lever are integral, and slip out through a notch in the carburetor body after the cover is removed. On 5 H.P. motors, a cotter key must be removed and the throttle lever must be screwed out of the throttle valve before it can be removed.

CLEANING AND INSPECTION

GENERAL INSTRUCTIONS

Clean all parts, except cork float, in grease solvent and blow dry. Do not dry parts with a cloth because lint may stick to the parts and cause trouble in the reassembled carburetor. Be sure all particles of gaskets are removed from gasketed surfaces. If there is a gummy deposit on any of the parts, dissolve with alcohol. Grease solvent will not remove this gum which accumulates particularly in the float bowl, strainer bowl and on needle valves. Flush out all ports in the carburetor body with solvent and clean gum out with alcohol if necessary.

CORK FLOAT

If a cork float has become damaged, discard it and install a new one. If the float appears to be in good condition, dry it out thoroughly and recoat with shellac.

HOLLOW METAL FLOAT

If a hollow metal float is leaking or bent, do not attempt to repair it. The metal is so thin that it is practically impossible to make solder repairs. Repairs may also change the characteristics of the float. Always replace defective metal floats. Never blow air through carburetor vents: float may collapse.

VALVE NEEDLES (Figure 4-7)

Inspect the tapered ends of the high and low speed mixture valves and the inlet needle for grooves which may have been caused by tightening the needles in the seats too hard. If the needles are grooved or otherwise defective, replace them. Do not attempt to straighten a bent needle; replace it. Gum on the needle must be removed with alcohol. After cleaning, check again for damage to the taper on the needle.

NEEDLE VALVE SEATS (Figure 4-8)

Check the mixture needle valve seats, and the inlet needle valve seats with a magnifying glass. If the hole is nicked, deeply scratched, or worn out of round it will not give satisfactory service. If the valve seats are replaceable, they are usually matched with the needle, so both parts must be replaced. This is true of the inlet (float) valves. In smaller carubretors, where the inlet needle valve seat is integral with the float bowl, the entire carburetor casting must be replaced.

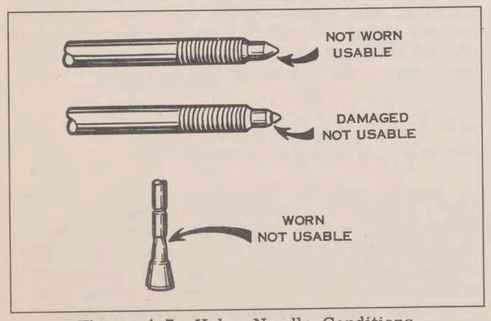


Figure 4-7. Valve Needle Conditions

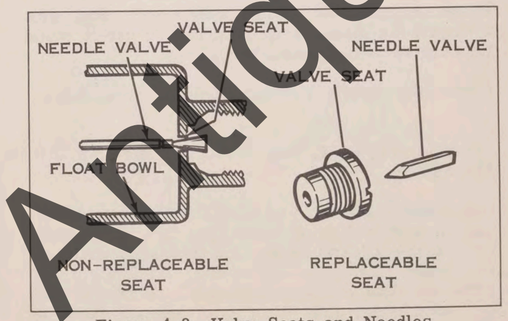


Figure 4-8. Valve Seats and Needles

(REED) LEAF VALVES

The only requirement for the reed valves is that they must be cleaned of all dirt and gum, and the reeds must be perfectly flat without distortion so that when they lay against the reed plate, they form a perfect seal with the plate. Replace broken or damaged reed units. Do not attempt to bend or repair a damaged reed. Also check condition of reed stop for bent elements and replace if damaged.

These same instructions apply to leaf valves as used in model 12D11 motors.

CARBURETOR BODY

Clean out all the jets and the venturi making sure no gum deposits remain. Pay particular attention to the inside of the float bowl and to the needle valve seats. Dry after cleaning with compressed air. Keep clean until reassembled.

CARBURETOR REASSEMBLY

GENERAL INSTRUCTIONS

Reassemble the carburetor paying particular attention to the following procedure. Keep all dust, dirt and lint out of the carburetor during reassembly, and be sure the parts are clean and free from gum or corrosion when reassembling them.

Replace all gaskets. Do not attempt to reuse old gaskets because leaks may develop after the carburetor is in use.

INTEGRAL TYPE FLOAT REASSEMBLY

a. Insert the inlet needle through the bottom of the float bowl and support it in place by setting it on the handle end of a punch held in a vise.

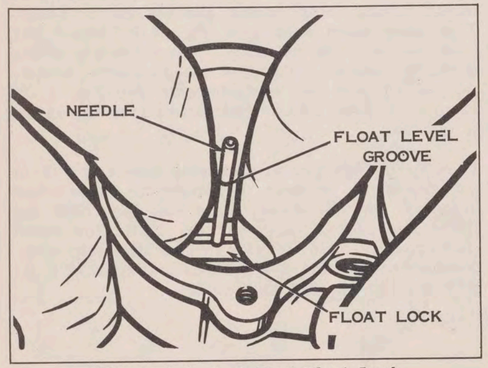


Figure 4-9. Installing Float Lock

b. Slide the bottom float lock down the needle until it snaps into position in the groove nearest bottom of bowl. (See figure 4-9.)

c. Push the float down over the inlet needle until lock on top of float engages groove in needle. On carburetors with no upper groove in needle, install float with two locks so top of float is 1/2 inch below top of bowl with needle in closed position. Install float bowl cover.

d. Install the strainer screen (where used) and plug, using a new strainer plug gasket.

HINGED TYPE FLOAT REASSEMBLY

a. Using a new gasket, install the inlet needle valve seat. Screw it in as tight as possible.

b. Set the inlet needle in place, and install the float with its pinion.

c. Adjust the float height, if necessary, by bending the float arm until the float is at proper height (for data, see exploded views at end of chapter).

NEEDLE VALVE REASSEMBLY

When reassembling needle valves, it is always good practice to install new packing. Proceed as follows:

a. Screw the needle in with the fingers until it comes lightly against the seat. Then back off needle slightly.

b. Slide new packing (and washers, spacers as used) over the needle and press packing into the gland. Screw the packing nut on the gland just tight enough to hold the needle in position.

c. Adjust the needle valve after the carburetor has been completely assembled and installed on the motor. Adjustment instructions are given with the exploded views at end of chapter.

CHOKE AND THROTTLE REASSEMBLY (12 H.P. Motors)

Insert the throttle or choke shaft and lever assembly in the carburetor. Check for excessive wear and replace the shaft if play is excessive. Install the shutter on the shaft with the attaching screws. Check operation of the throttle or choke to be sure the shutter correctly shuts off air flow. If the shutter is out of shape and does not conform reasonably to the edges of the carburetor body, replace it. Excessive air leakage around the edges of the shutter makes it difficult to regulate low speed operation.

Check the choke and throttle both for free operation. Both must move freely enough to be fully operated by the return spring. Complete the reassembly of the choke and throttle by installing the connecting linkage and springs.

REED (LEAF) VALVE REASSEMBLY

The importance of keeping the reed in these valves free from distortion cannot be over-emphasized. If there is any indication of distortion or damage to the reed or reed stop replace it.

The reed is so designed that it maintains constant contact with the reed plate. The heat treated metal segments will spring away from the plate when predetermined pressure is exerted against them. Their travel away from the plate is limited by the reed stop. When pressure is removed, the inherent spring action of the segments return and hold them against the plate.

Attach the reed and reed stop to the reed plate with spacers, if used; then examine each reed carefully. It must lay flat against the plate with no edges turned up or away from the plate.

On 12 H.P. models, install the reed valve plate assembly on the crankcase first. Then install the manifold and carburetor. Always use new gaskets.

NOTE

Do not lift or bend reed segments by hand.

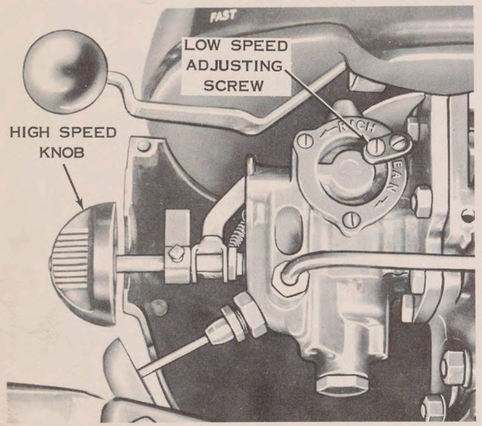


Figure 4-10. Low Speed Adjusting Screw for 3 and 5 H.P. Models

This may damage them so that the reed would have to be replaced.

The same instructions apply to the leaf valve used in 12D11 models.

THROTTLE VALVE REASSEMBLY (3 and 5 H.P. Models)

Reassembly of the throttle valve is the reverse of disassembly as shown in the exploded views, at the end of this chapter.

REASSEMBLY OF CARBURETOR TO MOTOR

In all motors, install the carburetor on the manifold or crankcase with a new gasket and the nuts or screws as required. Follow the reverse order of the removal steps as given on page 4-3. On 12 H.P. motors be sure that all the linkage is free and not binding.

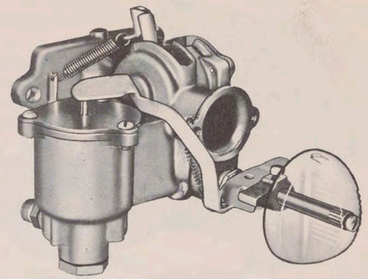
CARBURETOR OPERATING ADJUSTMENTS

Some operating difficulties can be traced to improper carburetor adjustments after the motor has been started. Be sure that your customer understands these adjustments before the motor leaves your shop.

To adjust 3 and 5 H.P. carburetors, remove port motor cover. Start motor and operate at FAST. Turn high speed knob (see Fig. 4-10) either way until motor runs smoothly. Then operate motor at SLOW position. Turn low speed adjusting screw, located on port side of carburetor (see Fig. 4-10) toward RICH or LEAN until satisfactory low speed is obtained.

12 H.P. carburetors are adjusted similarly. It is not necessary, however, to remove the motor cover to adjust for low speed, since both the 12D10 and 12S10 low speed needle and the 12D11 low speed knob are accessible from the front of the carburetor. See figures 4-1 and 4-4 for location of the 12 H.P. high and low speed adjustments.

MODELS 3D10, 3D11



OVERHAUL INFORMATION

The exploded view is indexed in order of disassembly. Therefore to disassemble, remove parts in sequence of index numbers. To reassemble, put together in reverse sequence of index numbers. Special instructions for disassembly and assembly are given previously in this chapter. Be sure this chapter is read thoroughly before working on carburetor.

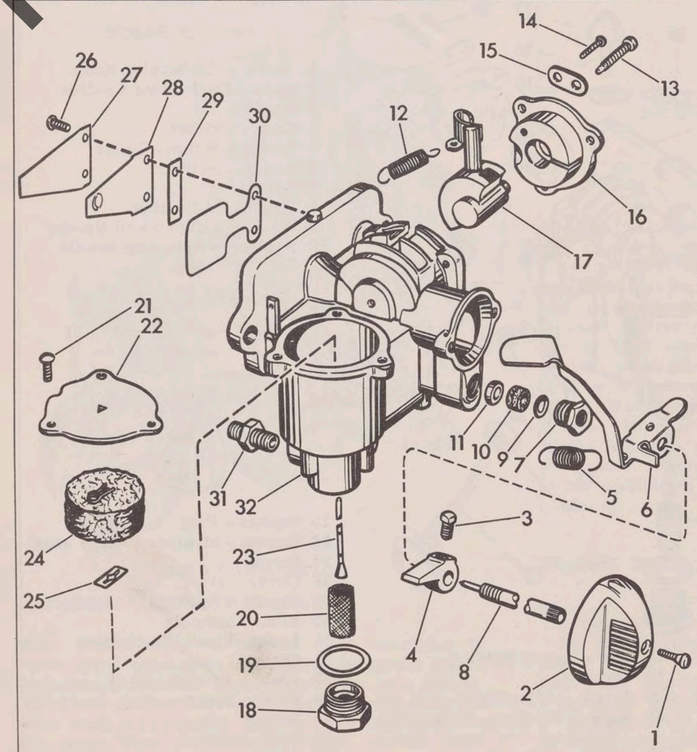
ADJUSTING CARBURETOR KNOB

After reassembling carburetor with exception of carburetor knob and primer cam and attaching to motor, it is necessary to make initial adjustment of the adjusting needle before installing carburetor knob or fastening primer cam to adjusting needle. Turn adjusting needle in (clockwise) with screwdriver until seated (DO NOT FORCE). Then back out (counterclockwise) one-half turn. Slip primer cam on adjusting needle leaving 1/16" clearance between it and primer lever. Point primer cam up and tighten set screw. Replace motor covers and fasten carburetor knob to adjusting needle with arrow pointing straight up.

FLOAT LEVEL

Float level is properly set by sliding inlet needle through float until lock on top of float catches in top groove in needle.

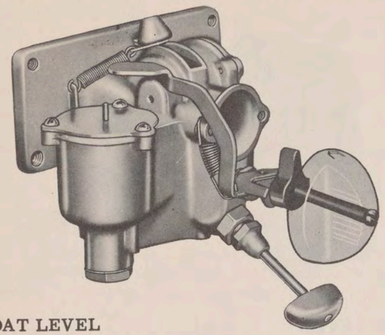
Set two upper float locks above and below float so that top of float is 1/2 inch below top of float bowl when inlet needle is in closed position.



LIST OF PARTS

1 Screw - Carburetor Knob
2 Knob - Carburetor Mixture Control
3 Screw - Set
4 Cam - Primer
5 Spring - Primer
6 Lever - Primer
7 Gland - Adjusting Needle
8 Needle - Carburetor Adjusting
9 Washer - High Speed Needle
10 Packing
11 Spacer - High Speed Needle
12 Spring - Carburetor Throttle
13 Screw - Throttle Adjusting
14 Screw - Throttle Cover
15 Plate - Friction
16 Cover - Throttle Valve
17 Throttle Valve and Lever Assembly
18 Plug - Strainer
19 Gasket - Strainer Plug
20 Screen - Strainer (where used)
21 Screw - Float Cover
22 Cover - Carburetor Bowl
23 Needle - Inlet
24 Float Assembly
25 Lock - Float
26 Screw - Reed
27 Stop - Reed
28 Reed - Upper
29 Spacer
30 Reed - Lower
31 Connection - Straight
32 Carburetor Body and Nozzle Assembly

MODELS 5S10, 5D10



FLOAT LEVEL

Float level is properly set by sliding inlet needle through float until lock on top of float catches in top groove in needle.

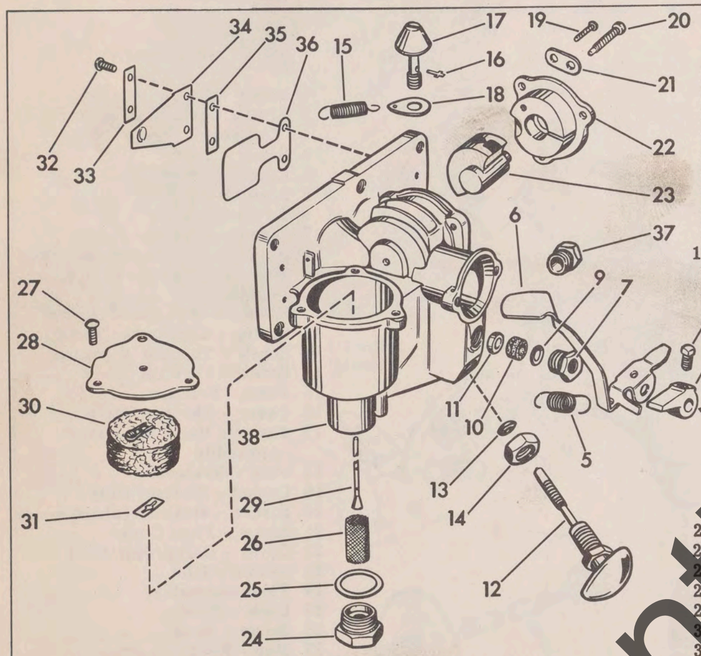
Set two upper float locks above and below float so that top of float is 1/2 inch below top of float bowl when inlet needle is in closed position.

OVERHAUL INFORMATION

The exploded view is indexed in order of disassembly. Therefore to disassemble, remove parts in sequence of index numbers. To reassemble, put together in reverse sequence of index numbers. Special instructions for disassembly and assembly are given previously in this chapter. Be sure this chapter is read thoroughly before working on carburetor.

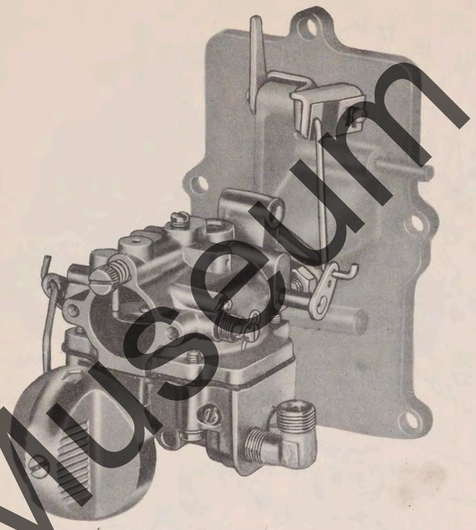
ADJUSTING CARBURETOR KNOB

After reassembling carburetor with exception of carburetor knob and primer cam and attaching to motor, it is necessary to make initial adjustment of the adjusting needle before installing carburetor knob or fastening primer cam to adjusting needle. Turn adjusting needle in (clockwise) with screwdriver until seated (DO NOT FORCE). Then back out (counterclockwise) one-half turn. Slip primer cam on adjusting needle leaving 1/16" clearance between it and primer lever. Point primer cam up and tighten set screw. Replace motor covers and fasten carburetor knob to adjusting needle with arrow pointing straight up.

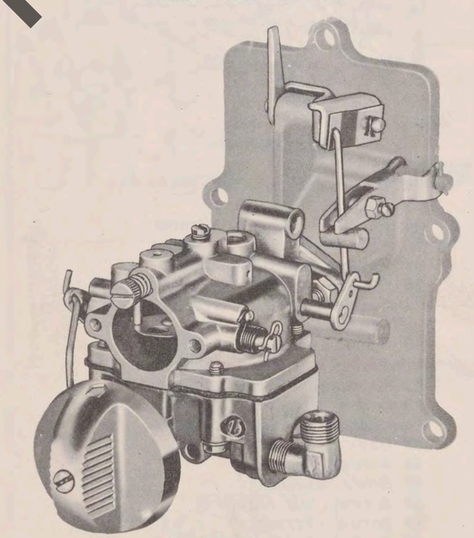


LIST OF PARTS

1 Screw - Carburetor Knob
2 Knob - Carburetor Control
3 Screw - Set
4 Cam - Primer
5 Spring - Primer Lever
6 Lever - Primer
7 Gland
8 Needle - Adjusting
9 Washer - High Speed Needle
10 Packing - Adjusting Needle
11 Spacer - High Speed Needle
12 Carburetor Shut-Off Needle Assembly
13 Packing - Shut-Off Needle
14 Nut - Jam
15 Spring
16 Pin - Cotter
17 Lever - Throttle
18 Lug - Spring Holding
19 Screw
20 Screw - Adjusting
21 Plate - Friction, Carburetor Adjusting
22 Cover - Valve
23 Valve - Throttle
24 Plug - Strainer
25 Gasket - Plug
26 Screen - Strainer (Where used)
27 Screw
28 Cover - Bowl
29 Needle - Inlet
30 Float Assembly
31 Lock - Float, Carburetor
32 Screw
33 Plate - Binding, Reed
34 Reed - Upper
35 Spacer
36 Reed - Lower
37 Gland
38 Carburetor Body and Screw Assembly



12S10 CARBURETOR



12D10 CARBURETOR

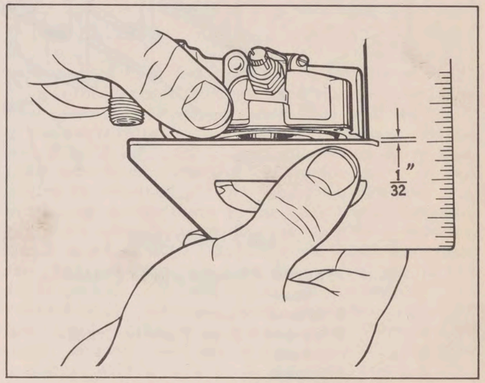
ADJUSTING CARBURETOR KNOB

After reassembling carburetor it is necessary to make initial adjustment of the adjusting needle before installing carburetor knob. Turn needle in (clockwise) with screwdriver until seated (DO NOT FORCE). Then back out (counterclockwise) one half turn. Do the same with slow speed screw. Install parts such as carburetor covers, etc, and install carburetor knob with arrow pointing straight up.

MODELS 12S10, 12D10

OVERHAUL INFORMATION

The exploded view (page 4-10) is indexed in order of disassembly. Therefore to disassemble, remove parts in sequence of index numbers. To reassemble, put together in reverse sequence of index numbers. Special instructions for disassembly and assembly are given previously in this chapter. Be sure this chapter is read thoroughly before working on carburetor.



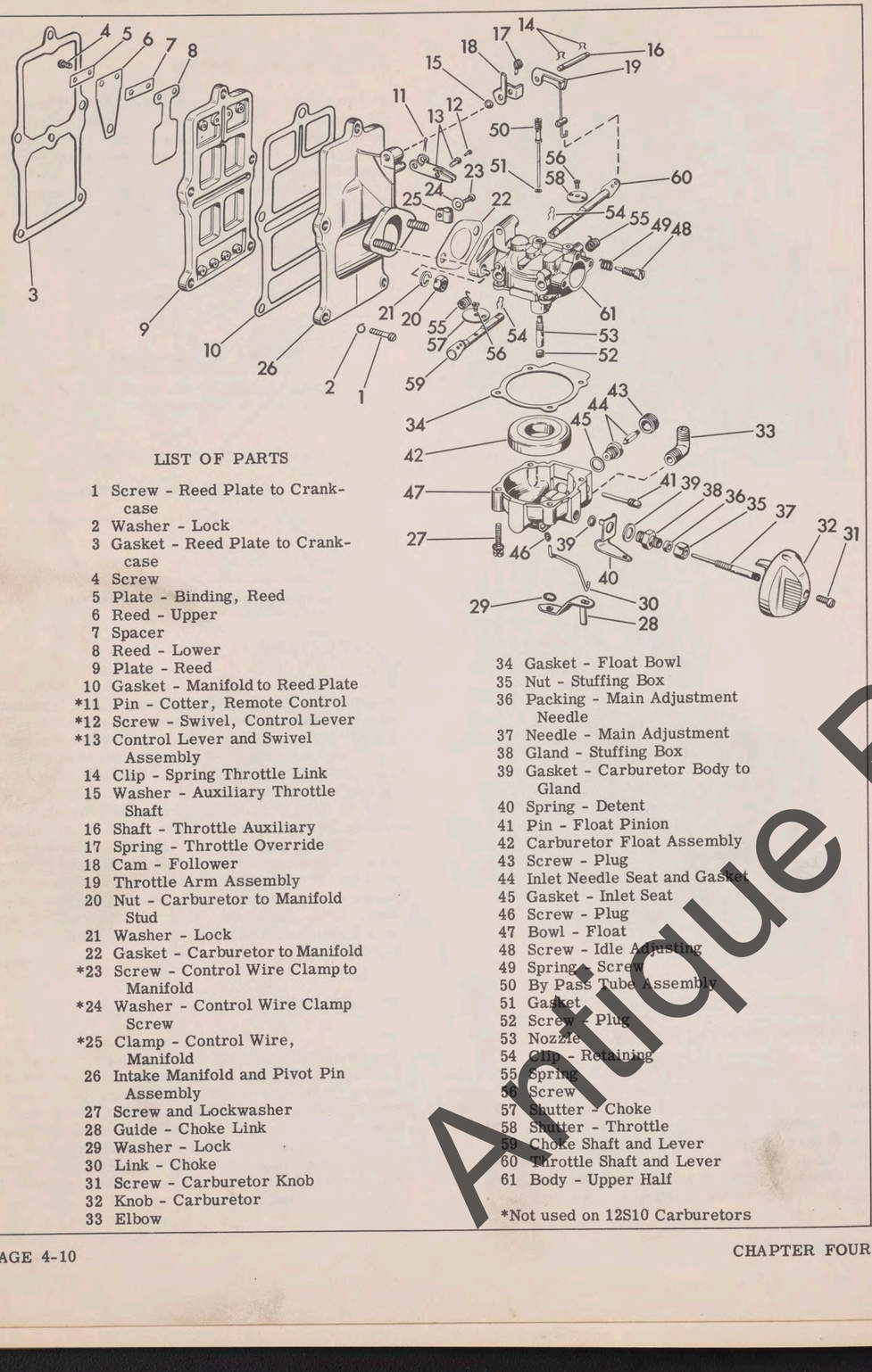
MEASURING FLOAT SETTING

FLOAT SETTING

Remove float bowl assembly and gasket from upper body assembly. Be sure to back out adjusting needles a few turns to clear by-pass tube before removing float bowl assembly. Then with float bowl assembly held in upside down position, the then lowest point of float, at free end, should project 1/32 inch below rim of float bowl (see illustration above). If resetting is required, remove float and carefully bend vertical float lever to obtain proper measurement. When inspection indicates fuel level continues to rise beyond float setting point, remove inlet needle and seat and clean seating surface with a soft cloth. Reinstall, then if proper fuel level is not maintained, install new inlet needle and seat assembly.

BY-PASS TUBE

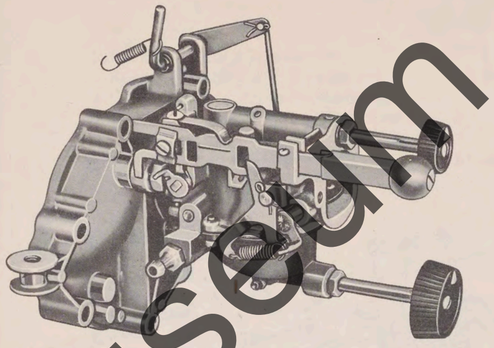
The by-pass tube (item 50 of exploded view on page 4-10) permits some of the fuel to by-pass the inlet needle valve for better high speed performance. This tube has fine openings which may become clogged or gummed up. Whenever the carburetor is disassembled for repairs or cleaning, be sure to check this tube and clean out openings. Replace the gasket (item 51 of exploded view) if it is not in good condition.

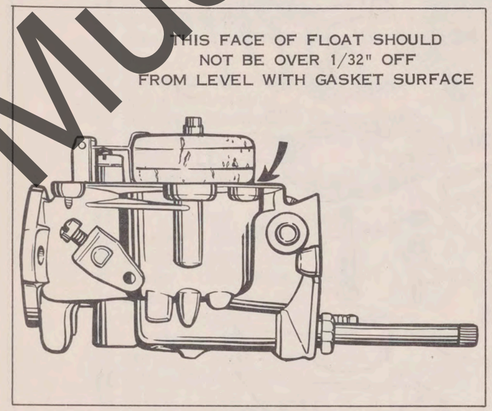


LIST OF PARTS

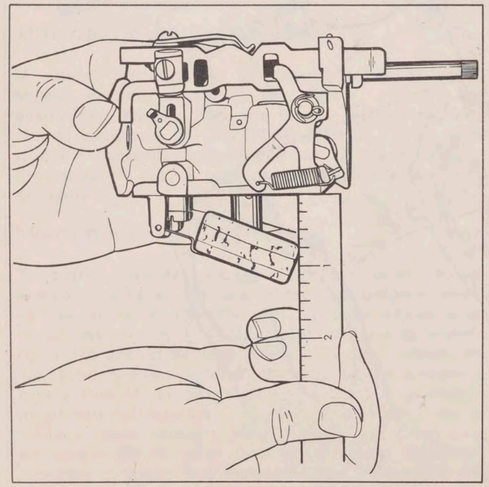
1 Screw - Reed Plate to Crankcase
2 Washer - Lock
3 Gasket - Reed Plate to Crankcase
4 Screw
5 Plate - Binding, Reed
6 Reed - Upper
7 Spacer
8 Reed - Lower
9 Plate - Reed
10 Gasket - Manifold to Reed Plate
*11 Pin - Cotter, Remote Control
*12 Screw - Swivel, Control Lever
*13 Control Lever and Swivel Assembly
14 Clip - Spring Throttle Link
15 Washer - Auxiliary Throttle Shaft
16 Shaft - Throttle Auxiliary
17 Spring - Throttle Override
18 Cam - Follower
19 Throttle Arm Assembly
20 Nut - Carburetor to Manifold Stud
21 Washer - Lock
22 Gasket - Carburetor to Manifold
*23 Screw - Control Wire Clamp to Manifold
*24 Washer - Control Wire Clamp Screw
*25 Clamp - Control Wire, Manifold
26 Intake Manifold and Pivot Pin Assembly
27 Screw and Lockwasher
28 Guide - Choke Link
29 Washer - Lock
30 Link - Choke
31 Screw - Carburetor Knob
32 Knob - Carburetor
33 Elbow
34 Gasket - Float Bowl
35 Nut - Stuffing Box
36 Packing - Main Adjustment Needle
37 Needle - Main Adjustment
38 Gland - Stuffing Box
39 Gasket - Carburetor Body to Gland
40 Spring - Detent
41 Pin - Float Pinion
42 Carburetor Float Assembly
43 Screw - Plug
44 Inlet Needle Seat and Gasket
45 Gasket - Inlet Seat
46 Screw - Plug
47 Bowl - Float
48 Screw - Idle Adjusting
49 Spring - Screw
50 By Pass Tube Assembly
51 Gasket
52 Screw - Plug
53 Nozzle
54 Clip - Retaining
55 Spring
56 Screw
57 Shutter - Choke
58 Shutter - Throttle
59 Choke Shaft and Lever
60 Throttle Shaft and Lever
61 Body - Upper Half

*Not used on 12S10 Carburetors





FLOAT LEVEL



FLOAT DROP

CARBURETOR

MODEL 12D11

OVERHAUL INFORMATION

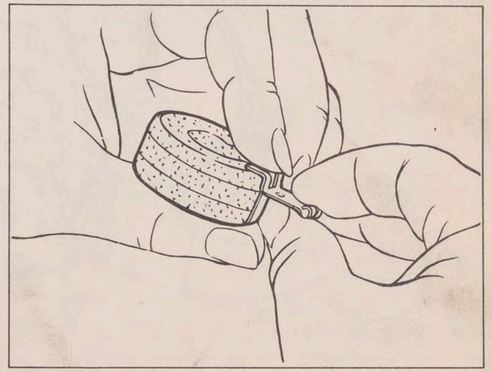
The exploded view (page 4-12) is indexed in order of disassembly. Therefore to disassemble, remove parts in sequence of index numbers. To reassemble, put together in reverse sequence of index numbers. Special instructions for disassembly and assembly are given previously in this chapter. Be sure this chapter is read thoroughly before working on carburetor.

FLOAT SETTING

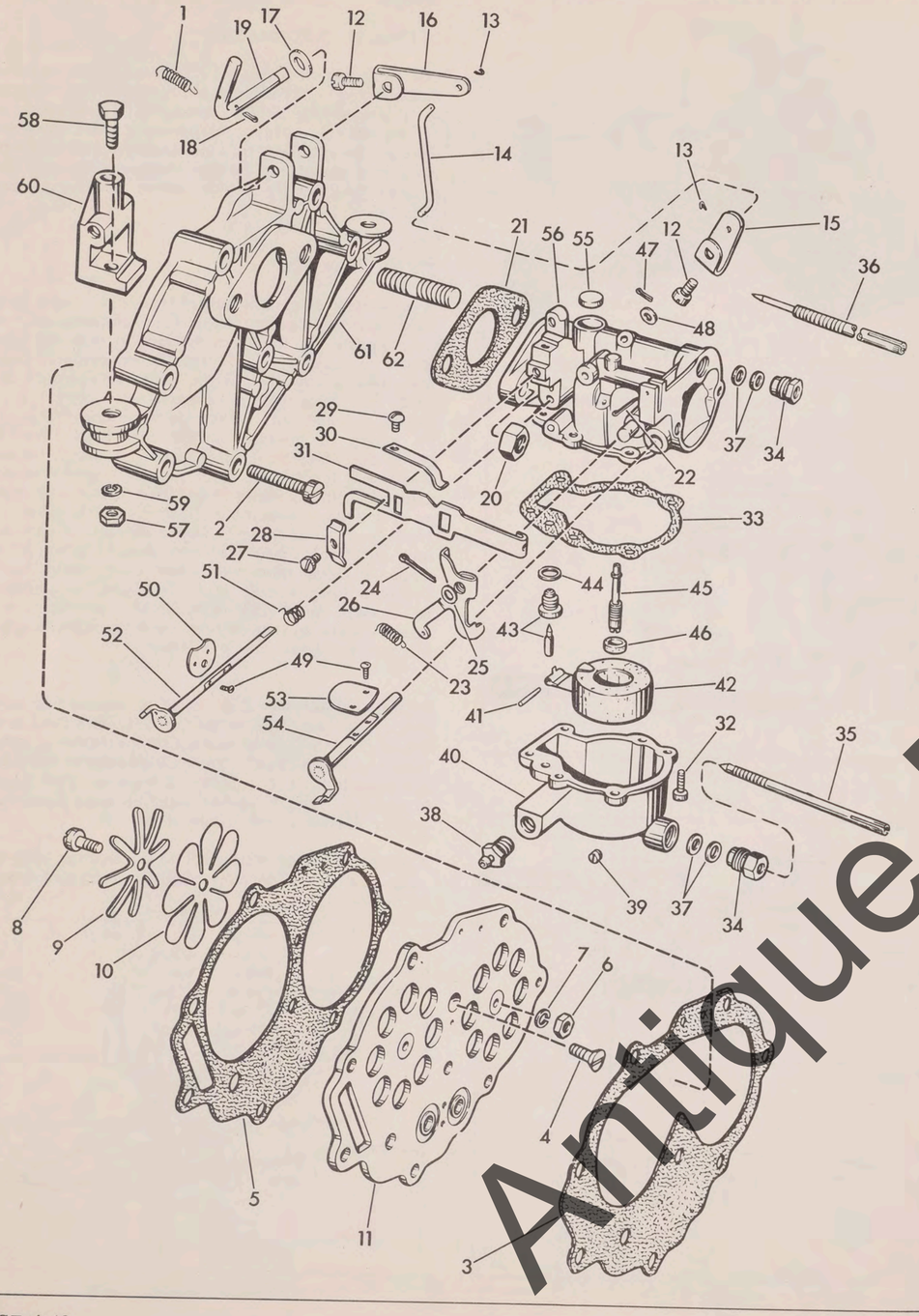
Remove fuel bowl and gasket from carburetor body. Then with carburetor body held upside-down, the float should be level, or horizontal with the plane of the carburetor body. This is important. Readjust float if any part of the float varies more than 1/32 inch from bottom of carburetor body. If resetting is required, do not bend the brass float arm by pulling or pressing on the cork float. Instead, grasp the brass tabs holding the cork float, between thumb and forefinger, placing other thumb over float arm and pin (directly over float valve) and adjust as required. Assemble float to carburetor and recheck float setting. When inspection indicates fuel level continues to rise beyond float setting point, remove inlet needle and seat, clean seating surfaces with a soft cloth. Before reassembling be certain that hole in float is centered around speed nozzle so that there is no restriction to movement of the float during operation.

Before assembling float bowl to carburetor body, check the float drop by holding body with float down. Measure from gasket surface of carburetor body to lowest point of float. This measurement should be approximately 1-1/4 inch. If necessary to adjust, bend small metal tab at back of float hinge until proper measurement is obtained.

Always assemble float bowl to carburetor body with body held in upside-down position to prevent damage to float hinge.



BENDING FLOAT ARM



LIST OF PARTS

1 Spring - Cam Follower
2 Screw - Manifold to Crankcase
3 Gasket - Leaf Plate to Manifold
4 Screw - Leaf Plate to Crankcase
5 Gasket - Leaf Plate to Crankcase
6 Nut - Leaf to Leaf Plate Screw
7 Washer - Lock
8 Screw - Leaf Attaching
9 Stop - Leaf
10 Leaf - Carburetor
11 Plate - Leaf
12 Screw - Throttle Shaft and Cam Follower Arms
13 Pin - Retaining
14 Link - Throttle Shaft Arm to Cam Follower Arm
15 Arm - Throttle Shaft
16 Arm - Cam Follower
17 Washer - Cam Follower
18 Pin - Cotter
19 Follower - Throttle Cam
20 Nut - Carburetor
21 Gasket - Manifold to Carburetor
22 Pin - Cotter, Choke Control Rod
23 Spring - Bell Crank Choke Lever
24 Pin - Cotter, Bell Crank
25 Washer - Bell Crank
26 Crank - Choke Bell
27 Screw - Choke Rod Bracket
28 Bracket - Choke Rod
29 Screw - Spring to Carburetor Body
30 Spring - Choke Control Rod
31 Rod - Choke Control
32 Screw - Float Chamber to Carburetor Body
33 Gasket - Float Chamber to Carburetor Body
34 Nut - High and Low Speed Valves
35 Valve - Needle, High Speed
36 Valve - Needle, Low Speed
37 Packing - High and Low Speed Valves
38 Nipple - Float Chamber
39 Screw - Float Drain
40 Chamber - Float
41 Pin - Hinge, Float Arm
42 Float and Float Arm
43 Float Valve and Seat Assembly
44 Washer - Float Valve Seat
45 Nozzle - High Speed
46 Gasket - Float Chamber to Carburetor Body Boss
47 Pin - Cotter, Throttle Shaft
48 Washer - Throttle Shaft
49 Screw - Throttle and Choke Valves
50 Valve - Throttle
51 Spring - Throttle Shaft
52 Throttle Shaft and Lever Assembly
53 Valve - Choke
54 Choke Shaft and Lever Assembly
55 Plug - Expansion
56 Carburetor Body and Bell Crank Shaft Assembly
57 Nut - Tank Bracket
58 Screw - Gas Tank Support to Manifold
59 Washer - Lock
60 Bracket - Gas Tank Support
61 Manifold
62 Stud - Manifold to Carburetor

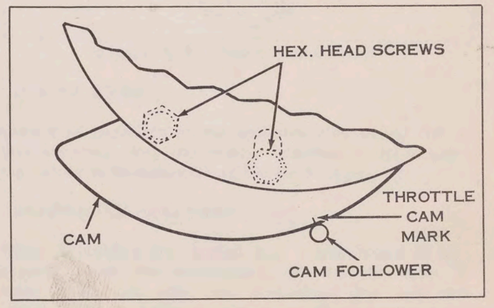
ADJUSTING CARBURETOR KNOBS

If either the high or low speed adjusting knobs should become loose on the needle, remove the screw and knob. Turn the needle (clockwise) into closed position. **DO NOT USE FORCE.** Then back it out (counterclockwise) 3/4 turn. Place knob on the needle in No. 3 position and tighten knob screw securely.

THROTTLE CAM ADJUSTMENT

To adjust throttle cam on armature base, rotate armature base to position where cam follower rests on the mark on throttle cam. (Choke button must be all the way in.) At this point the throttle butterfly valve should be just closed. If not, loosen the hex head screws holding the cam to the armature base. One of the screw holes in the cam is slotted to permit adjustment. Pivot cam towards rear of motor. Hold throttle lever closed and pivot cam forward until it just contacts the cam follower. Continue to pivot cam forward until it takes up the looseness in the linkage and begins to open butterfly valve. Tighten the two hex head screws and recheck position.

If throttle butterfly valve does not close when throttle control grip is turned to STOP, either the throttle return spring is weak and should be replaced or the throttle or linkage is binding.



DESCRIPTION

The power head consists of the cylinder, pistons, rods, crankshaft and crankcase. The outboard motors are either single cylinder or alternate twin cylinder. In the latter, the cylinders are located one above the other, and fire alternately.

Figure 5-1 illustrates a typical alternate twin powerhead with fuel tank, carburetor and magneto in place. Sizes and tolerances for various components of the powerhead are tabulated in Chapter Nine. When servicing and reassembling the powerhead, always check these sizes.

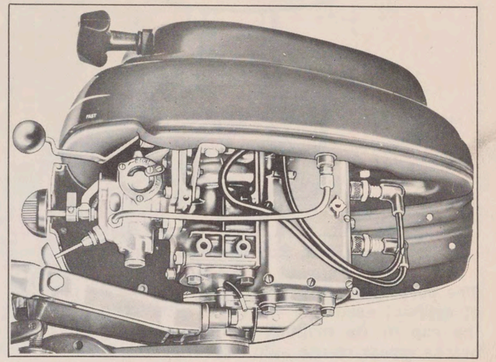


Figure 5-1. Alternate Twin Power Head

HOW TO OVERHAUL THE POWER HEAD

Detail of disassembly and final reassembly (with necessary repairs or replacement parts installed) must be carefully thought out prior to actual procedure if the job is to be well done and with a minimum of effort. First observe construction and assembly of the unit, then establish order of disassembly. Exploded views included in this chapter are indexed in order of disassembly. These exploded views may also be used as a guide in order of disassembly of similar motors.

DISASSEMBLING POWER HEAD FROM MOTOR

a. Remove motor covers and rewind starter. Refer to Chapter Seven for rewind starter instructions.

b. Remove the fuel tank. Refer to Chapter Eight for fuel tank information.

c. Remove the flywheel and magneto. Refer to Chapter Three for magneto instructions.

d. Remove the carburetor, manifold and reed or leaf valve. Refer to Chapter Four for carburetor information.

e. Remove the lower unit. For working on power head, we recommend that you construct a bench stand as illustrated in Figure 5-2. By using appropriate upper portions of old driveshafts, all but the 3 H.P. power head can be mounted. The splined end of the driveshaft will fit into the bottom end of the power head crankshaft. For 3 H.P. power heads, just slip driveshaft casing over the pipe.

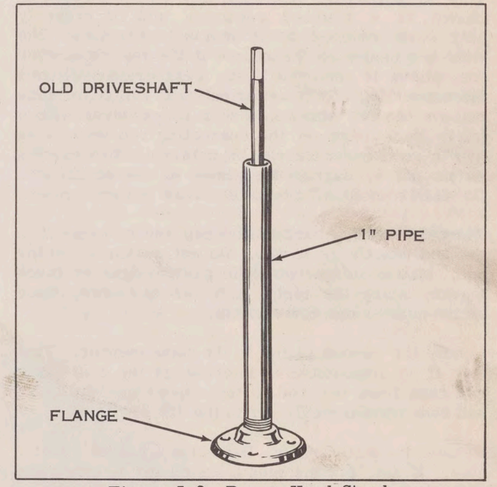


Figure 5-2. Power Head Stand

DISASSEMBLING THE POWER HEAD

For practical purposes, the types of power heads can be listed in three classes, as follows:

1. 3 H.P. (Models 3D10 and 3D11).

2. 5 and 12 H.P. (Models 5S10, 5D10, 12S10, and 12D10).

3. 12 H.P. (Model 12D11).

In disassembly of the power heads, follow the sequence of numbers on the exploded view at the end of this chapter. Pay particular attention to the following points in disassembling the three types.

GENERAL (All three types)

When detaching the piston and connecting rod assembly from the crankshaft, it will be seen in many instances that the connecting rod and cap are marked or indexed with a small elongated boss (see figure 5-3).

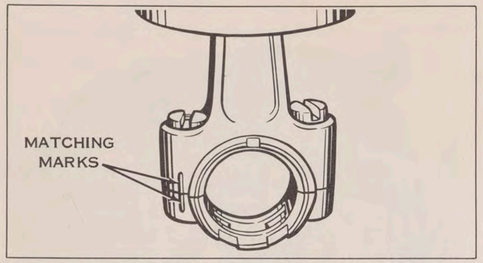


Figure 5-3. Rod and Cap Markings

The purpose of this marking is to indicate position of original assembly and to guide the replacement of the cap in its original position on the rod. Index marks appear on one side only.

In the event no index marks appear on the rod or cap, make it a point to provide the indexes before removing the cap. Index mark either a new rod or a rod prior to disassembly from the motor. Do not use punch, use a file.

This is important since the rod and cap are machined as a matched assembly and fit properly only when matched as to original assembly. The rods are easier to disconnect if the top, or number one, piston is removed first. Turn crankshaft until the connecting rod is as far out as it will come; then remove the two screws. Use a screwdriver with a fairly thick edge on the connecting rod screws so that a good purchase can be obtained. Use caution so as not to damage the piston or connecting rod. On 12D11 models, use a hex head socket wrench.

Take out the connecting rod cap and refasten it to the rod exactly as it was. Do not switch it end for end. Match up the two little guide ridges or index marks. Mark the piston and rod to identify them as the number one combination.

Handle the second piston in the same manner. That way it is impossible to interchange the connecting rod caps from one rod to the other - or the pistons and rods from one cylinder to the other.

Remove the piston rings. Use a ring expander if available. If not, pry the ends loose enough to grip them with pliers. Then break them away from the piston.

With long nose pliers, pull out the spring rings at both ends of each piston pin.

Observe wrist pin bosses inside of piston. On some note that a small "L" or dot is embossed on one wrist pin support (boss), to indicate slip fit (figure 5-4).

NOTE

12D11 models are bored for slip fit on both sides.

To prevent distortion of the piston as it expands on reaching normal running temperature of the motor, on some models, one of the bosses is bored for a slip-fit on wrist pin while the other is for a press-fit. The marked boss contains the slip-fit bore. Consequently when driving the wrist pin out, drive from the side opposite the marked side to guard against distortion or damage during the operation.

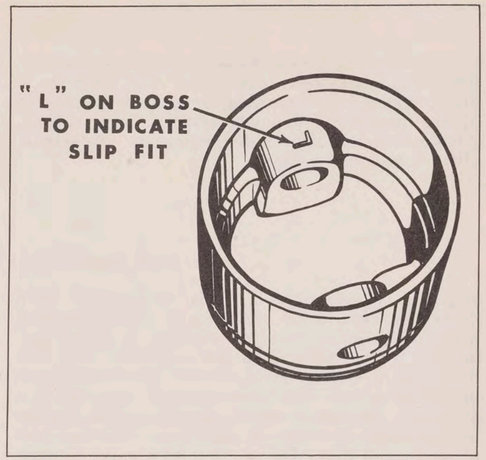


Figure 5-4. Piston Pin Slip-Fit

TYPE 1 DISASSEMBLY (Models 3D10 and 3D11) (Figure 5-5)

On the 3 H.P. models, the drive shaft tube assembly and crankcase are in one piece and should not be separated. To remove the power head assembly, loosen the shock absorber clamp screw at the front of the pivot bearing and the driveshaft tube clamping screws in the upper front of the driveshaft housing. Then pull up on the power head assembly to remove from lower unit.

The carrying and steering handle assembly is attached directly to the crankcase and should be removed for handling convenience.

Do not remove the cylinder end cover. It is almost impossible to re-establish a correct seal between the cylinder cover and cylinder. If a repair of this nature is necessary, it should be done at the factory.

Remove the cylinder screws and separate the cylinder from the crankcase, leaving the piston and connecting rod assembly attached to the crankshaft.

Remove the piston and connecting rod from the crankshaft.

Remove the upper bearing from the crankcase. This may have to be pried up. If so, work around the bearing slowly, so as not to damage the bearing or crankcase. The crankshaft can then be removed through the top of the crankcase.

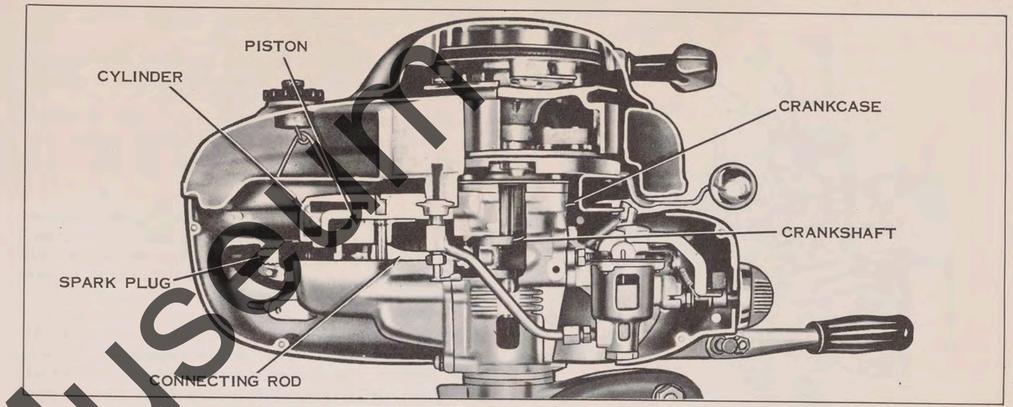


Figure 5-5. Type 1 Power Head

TYPE 2 DISASSEMBLY (Models 5S10, 5D10, 12S10, and 12D10) (Figure 5-6)

On 12S10 and 12D10 models, the carrying handle and steering handle are attached to the power head and should be removed from the power head for ease of handling. Be sure that the control wire in the steering handle has been detached from the throttle control lever and swivel assembly on the model 12D10 carburetor. The carrying handle and steering handle are attached to the lower unit on 5 H.P. models.

Remove the nuts on the studs attaching the cylinder to the crankcase, and separate the cylinder from the crankcase, leaving the piston and connecting rod assemblies attached to the crankshaft.

Do not attempt to remove the cylinder side covers. It is almost impossible to re-establish a perfect seal in the field. If leaks have developed, or work of this type is necessary for any other reason, the repairs should be made at the factory.

There are two removable bearings in the crankcase; the center bearing and the bottom bearing. Take off the screws holding the bottom bearing in place and remove it from the crankcase and crankshaft.

It may be necessary to pry it off. If so, work slowly around bearing, so as not to damage.

The center bearing is fastened to the crankcase with either screws or screws and dowel pins. These must be removed before crankshaft can be driven out of crankcase. The dowel pins will require a special dowel pin puller, illustrated in figure 5-7.

Separate the crankshaft and center bearing from the crankcase by having someone hold the crankcase while you tap the crankshaft and center bearing out through the bottom of the crankcase. Use a block of wood on the crankshaft to prevent damage.

Remove the screws holding the two halves of the center bearing together. Also remove bearing seal on 12S10 and 12D10 models and throw away, if damaged.

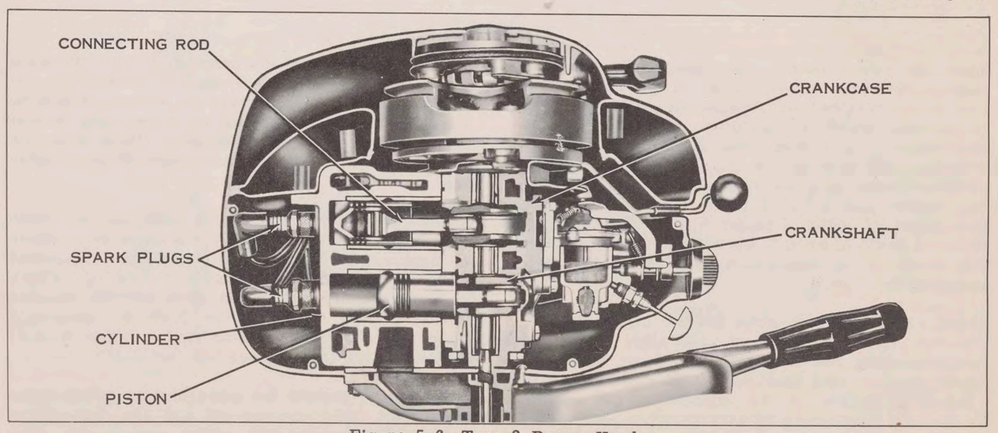


Figure 5-6. Type 2 Power Head

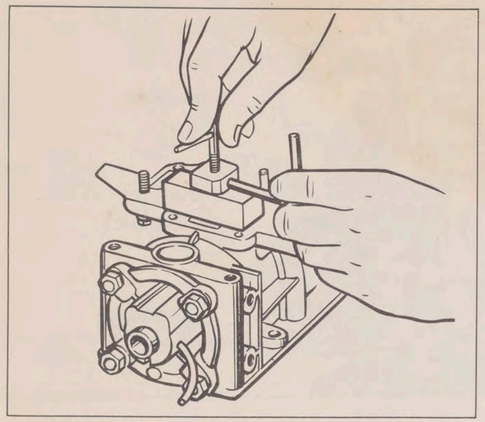


Figure 5-7. Dowel Puller (Center Bearing)

TYPE 3 DISASSEMBLY (Model 12D11) (Figure 5-8)

The model 12D11 motor is the only style using a split crankcase and a removable cylinder head.

Remove the cylinder head screws and separate the cylinder head from the cylinder body. The gasket must be in very good condition to form a perfect seal. If not, discard it.

Before separating the two crankcase halves, remove the oil line tubing. Then remove the cap screws, dowel pins (see figure 5-12) and the two allen head screws in the center holding the crankcase halves together and split crankcase.

The piston and connecting rod assemblies must be removed through the rear of the cylinders. Therefore remove the connecting rod screws, lockplates and caps. The crankshaft will then be free to remove. Slide the piston and connecting rod assemblies out through the cylinder.

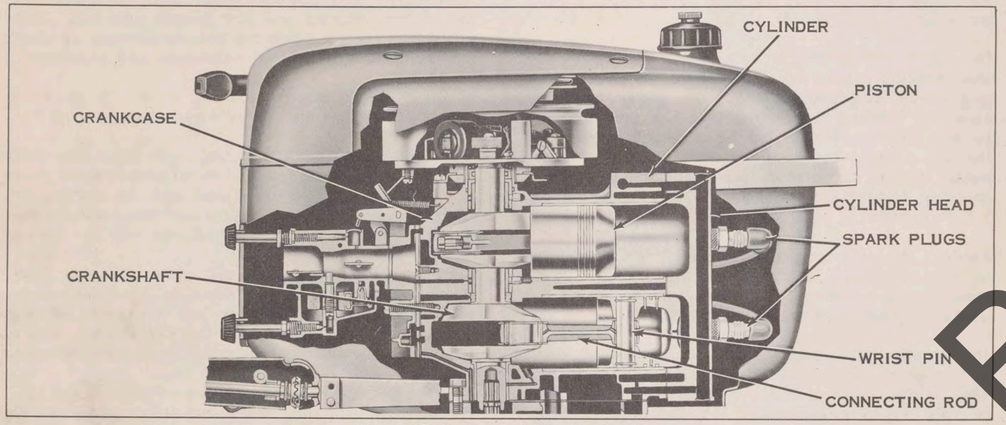


Figure 5-8. Type 3 Power Head

CLEANING AND INSPECTION

When the power head is completely disassembled, inspect the various parts to determine which parts are to be replaced or repaired to restore motor to normal operating condition. Clean all parts thoroughly in a grease solvent. Check the piston rings as to "freeness" in the ring grooves and for excessive wear (ring seats and ring grooves). Check the pistons and cylinder walls for excessive wear (see chart of sizes, Chapter Nine). Observe condition of walls of ports in the cylinders to make certain there is no obstruction as a result of carbon accumulation.

Check connecting rod, wrist pin and crank pin fits. Observe general condition of wrist pins, crank pins, and connecting rod bearings - if badly scored or worn, replace with new parts. To check for excessive looseness of the connecting rod on the crank pin, first check to ascertain freeness of the rod on the pin by exerting up and down motion on the rod at right angle to the crank pin. This operation should indicate normal clearance; however, if excessive clearance (or wear) is evident, it will be found possible to rock the rod from side to side on the pin in a "cocking" motion. Check wrist pin fit the same way. Check connecting rod for straightness.

Check for piston roundness by inserting the piston into its respective cylinder - if there is evidence of tightness or binding, the piston can be assumed to be out of round and should be "trued" up. Check with micrometer. If piston slips into the cylinder freely, further check can be made by inserting a feeler gage between piston and cylinder wall at several points (see figures 5-9 and 5-11).

Provide new gaskets but make certain gasket faces have first been cleaned off and are flat with no indication of warp. Use gasket cement (see page

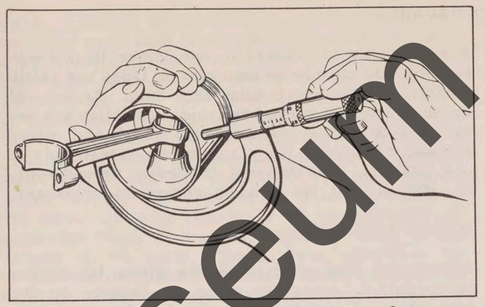


Figure 5-9. Checking Piston for Roundness

5-11) on gasket faces.

Check the crankshaft keyways for chipped edges and other signs of wear - and the upper end for stripped or battered threads.

In the lower end, the hole which engages the drive shaft should not be battered, worn or distorted.

Check the journals. If burned or undersized (see sizes in Chapter Nine), replace. Otherwise clean up.

Excessively worn cylinder walls, pistons, and piston rings contribute to loss of compression and subsequently, proportionate loss of power, hard starting and faulty operation. Carbon clogged ring grooves cause the piston rings to become partially inactive

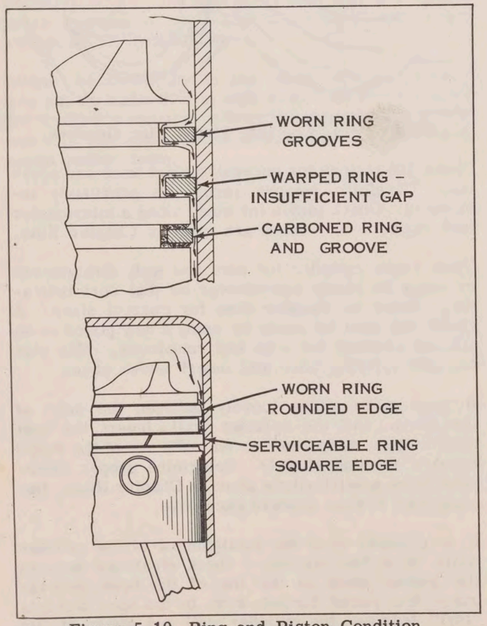


Figure 5-10. Ring and Piston Condition

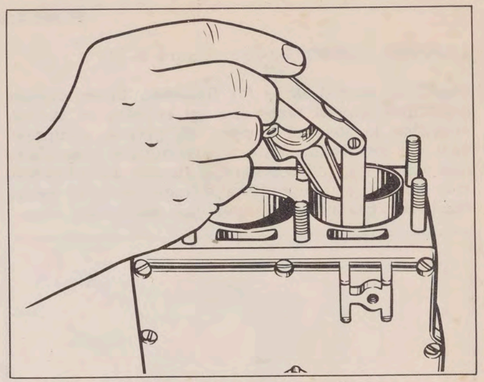


Figure 5-11. Checking Piston Clearance

resulting in "blowby," loss of compression and power. The rings must be free in their respective ring grooves. (See figure 5-10.) Cylinder walls wear in various degrees depending on lubrication and general conditions under which the motors are operated. Major portion of wear is the port area and area covered by ring travel in the cylinder to make the walls "barrel" shaped - hard starting and inefficient performance result.

Carbon accumulation on walls of the exhaust ports restricts the flow of exhaust gases and has considerable effect on performance of the motor - restricted flow of exhaust gases limits the fresh fuel vapor charge to the cylinder to result in partial efficiency, hard starting, overheating and otherwise sluggish performance. All exhaust passages must be made free of carbon deposits to obtain maximum performance.

Carefully scrape carbon accumulation from head and exhaust ports with scraper or other blunt instrument. Walls of exhaust ports must be free of carbon to insure maximum performance.

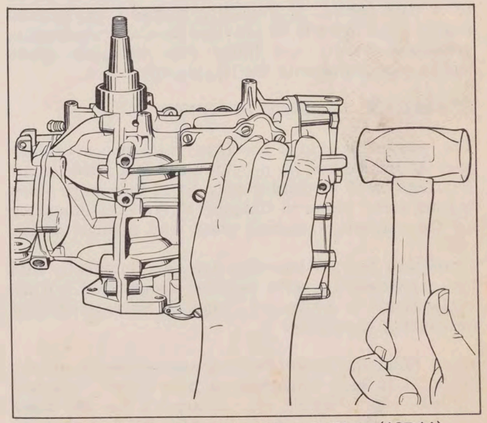


Figure 5-12. Removing Dowel Pins (12D11)

POWER HEAD REPAIR

LAPPING GASKET FACES (Figure 5-13)

Check all gasket faces for flatness. Under certain conditions, gasket faces are apt to warp or spring, resulting in loss of liquids, oil, grease, compression, or air leaks. This is particularly true where comparatively thin sections or flanges are employed and subject to temperature changes such as cylinder heads, carburetor flanges, and manifolds.

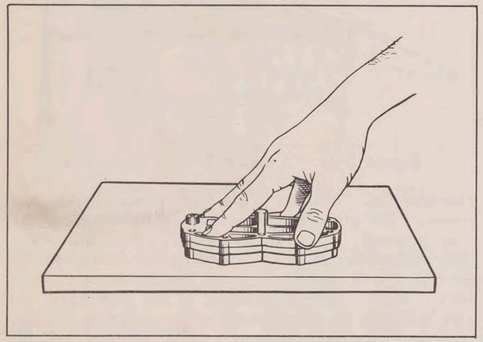


Figure 5-13. Lapping Gasket Surface

When checking for flatness, the operation should be performed on a lapping block or piece of plate glass. Lay a sheet of No. 0 or 00 emery cloth on the lapping block or plate glass. Place the surface to be lapped on the emery cloth and move slowly back and forth several times in a figure 8 motion, simultaneously exerting evenly distributed light pressure. Lift part from lapping surface to observe results. In the event the surface is actually warped or sprung, high spots making contact with the lapping surface will take on a dull polish, while the low areas will have retained their original state.

To insure flatness over the entire surface, continue lapping until the gasket surface has been polished to a dull luster. If resulting surface appears too rough, finer lap can be provided by smearing lapping compound evenly and thinly over the plate glass and by proceeding with the lapping operation.

CRANKCASE JOURNAL BEARINGS

The journal bearings are fitted with proper clearance at the factory to provide sufficient lubrication. Bearings need replacing only when they have worn beyond sizes given in Chapter Nine. Oil smearing on the magneto armature plate may indicate wear.

Crankcase journal bearings are cast integrally with the crankcase or with bearing assemblies. When replacement is necessary, replace entire crankcase or bearing assembly.

When replacing center bearing assemblies on crankshaft, it is very important to have "TOP," marked on both sides, facing up. Assemble the two sides on the crankshaft with the bearing holding screws.

For assembly to crankcase, see Power Head Reassembly. Be sure to replace seal on 12S10 and 12D10 models. Lip on seal must face down. Lower and upper crankcase journal bearing assemblies are assembled on crankshaft and center bearing assembly. They can be assembled only in one position. Tap bearing in lightly around edge, so that it will not become cocked in crankcase.

PISTON AND RINGS

Inspect the ring grooves in the piston for carbon accumulation, excessive wear or damage to the ring seats. Carefully scrape carbon from the ring grooves, if necessary, (see figure 5-14) making certain that carbon clinging to the bottom and sides of the grooves has been thoroughly removed without scratching or otherwise damaging the grooves. Scratches or other damage to the ring seats of the grooves results in lack of compression and power. Rings are worn and should be replaced if the face of the ring is glass smooth, has a highly polished appearance, or if the edge of the ring is "rounded" off. The edges of the ring should be square with a face, not too smooth and rather dull in appearance, if serviceable. If in doubt, install new rings.

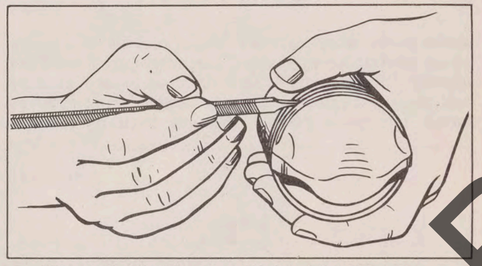


Figure 5-14. Cleaning Piston Ring Grooves

Check the pistons for excessive skirt wear and scoring. Carefully remove carbon as previously instructed. Check piston for size, using a micrometer (see figure 5-9). Sizes are given in Chapter Nine.

Then check cylinder for size and wall straightness by using an inside micrometer or dial bore indicator. Refer to Chapter Nine for correct sizes. A check can also be made by using a new piston or an old one checked for size and roundness. Slip piston into cylinder bore and insert feeler gage.

If gage strip slides loosely between the skirt of the piston and the cylinder wall, insert the next thicker gage strip, and so on, until one of the strips appears to bind slightly. Determine proper clearance from specifications given in Chapter Nine. Replace part if wear appears excessive.

It is possible to check straightness of the cylinder walls in a like manner - check clearance between the piston skirt at the top of the bore, then advance the piston farther down in the bore and note "feel" between the cylinder wall and piston at this

point. If free or loose, attempt inserting next thicker strip and so on until slight binding is noted. In event it is possible to insert a thicker strip of the feeler gage near the center of the bore than at the top, the cylinder wall can be assumed to be "barrel or bottle" shaped. However, if the reverse is true and the thicker strip is required to take up the clearance between the piston and the top of the bore, the cylinder can be considered "wedge" shaped, larger at the top than at or near the bottom of the bore. Greatest cylinder wear, nevertheless, is generally found in area of the ring travel and in vicinity of the ports. The cylinder otherwise can be checked for wear and size by taking micrometer readings from a snap gage adjusted to various positions in the cylinder bore.

The piston rings should be checked for serviceability - discard if any face or wall seat is worn to a high polish and if there are evidences of side wall wear or other irregularities to interfere with efficient ring performance. Place ring squarely in its respective cylinder bore - this can be done by first inserting the ring, then by using the bottom of the piston "square" it up in the bore; push the ring down in the bore slightly with the bottom of the piston. Check gap between ends of the ring (figure 5-16) - if greater than indicated on gap in Chapter Nine, discard and replace with new ring. Check each ring in its respective piston ring groove for evidence of tightness or binding by rolling the ring around the piston ring groove (figure 5-17).

Don't waste time with doubtful rings - install new rings when in doubt but make certain they are properly fitted. Bear in mind too, that it requires more running of the motor to properly seat a new ring in an old cylinder bore.

Minor discrepancies in the rings or ring grooves are not as noticeable at high speeds as at low speeds for trolling purposes - unless the rings seat properly there is sufficient loss of compression to affect slow speed performance.

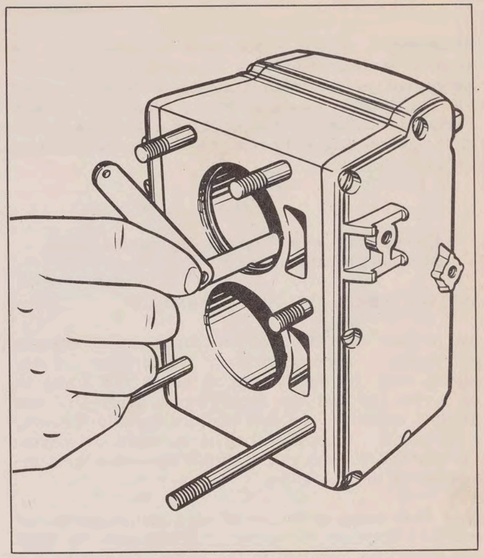


Figure 5-16. Checking Ring Gap

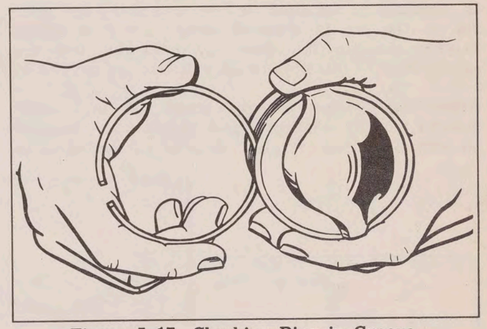


Figure 5-17. Checking Ring in Groove

POWER HEAD REASSEMBLY

Reassembly of the power head is essentially the reverse of disassembly as indicated by the exploded views and the special disassembly instructions given for the various types of power heads previously. Particular attention is required for the installation of the assemblies and parts indicated in the following paragraphs.

NOTE

Always use new gaskets throughout when reassembling the motor.

PISTON, RINGS AND ROD ASSEMBLY

To prevent distortion of the piston as it expands on reaching normal running temperature of the motor, one of the bosses is bored for a slip-fit on wrist pin and the other for a press-fit. The marked boss ("L" or dot) contains the slip-fit bore, consequently, when installing the wrist pin, drive from the marked side to guard against distortion or damage during the operation.

Note that many of the wrist pins are closed at one end and open on the other. In this case the wrist pin should be installed in the piston-connecting rod assembly in such a manner that when the assembly is ultimately installed in the cylinder, the open end of the pin is directed down. Prior to finally driving the pin into position, determine how the piston is to be installed in the cylinder (figure 5-21).

Attach new piston to connecting rod in similar manner. Apply coat of oil to wrist pin - be sure surface is clean - also, a drop or two of oil in each pin hole in the piston. Insert wrist pin through slip-fit side. Oil wrist pin bearing in connecting rod.

Place connecting rod in position, then proceed to drive the pin "home." Replace retaining clips, making certain they come to rest securely in the groove provided for this purpose. The piston may have been distorted during assembly procedure. Check with micrometer to determine "roundness." If slightly out of round, place in rounded-out block and tap high side with light mallet (do not use hammer) to restore original roundness. Proceed carefully in this respect and caliper frequently until the piston is "rounded" out.

Install the piston rings on each piston. Spread each ring with a ring expander just enough to slip it over the head of the piston and down into place. Be sure the rings fit freely in the piston ring grooves.

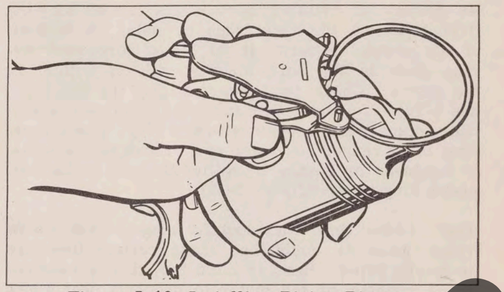


Figure 5-18. Installing Piston Rings

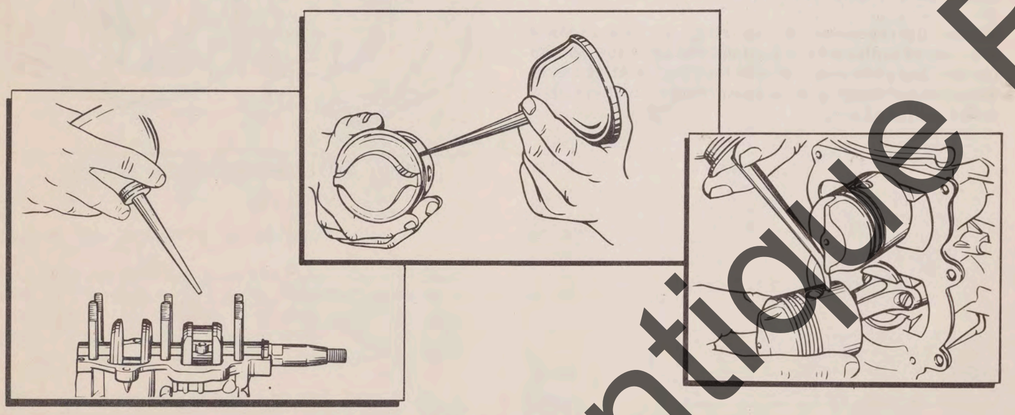


Figure 5-19. Lubricating Power Head

When installing piston rings, the ring gaps should be staggered to retard compression loss as much as possible. The ring grooves in most pistons are pinned to secure position of the ring in the ring groove, not so much in view of staggering the ring gaps as to prevent ends of the ring "catching" on the edges of the ports in the cylinders.

Note the shape of the piston tops - the smaller, steep side is the intake side - the wider, tapered side is the exhaust side. (See figure 5-20.)

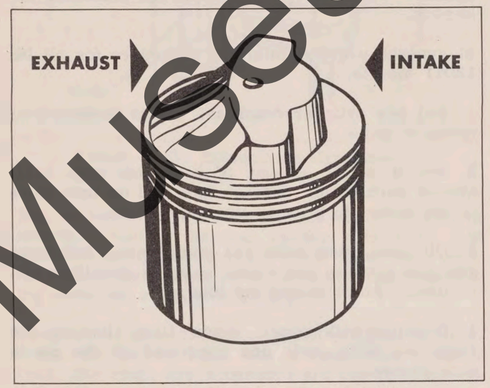


Figure 5-20. Exhaust and Intake Sides

These pistons can be installed "backwards" which interferes considerably with starting and operation of the motor. The straight side of the piston baffle is placed adjacent to the intake port in the cylinder. The purpose of this arrangement is to direct the incoming fresh fuel charge from the crankcase, upward along one side of the cylinder and in doing so, crowd the burned exhaust gases out through the exhaust port.

On 3 H.P. motors, the exhaust port is at the bottom of the cylinder. On all 5 and 12 H.P. motors the exhaust ports are on the starboard side of the cylinders with the exception of the 12D11, which has the exhaust ports on the port side.

INSTALLING CENTER BEARING AND CRANKSHAFT IN CRANKCASE

Lay the crankcase on a bench for the assembly operation.

Smear a coat of oil on the center bearing's outer surface - that way there is less chance to damage bearing or crankcase.

Gently tap the center bearing and crankshaft assembly into the crankcase, line up the screw holes in the bearing with the ones in the crankcase.

If the bearing is lined up correctly, the center bearing screws will turn through easily.

Tighten the screws to torque given in Chapter Nine - no tighter, or the crankcase may be distorted.

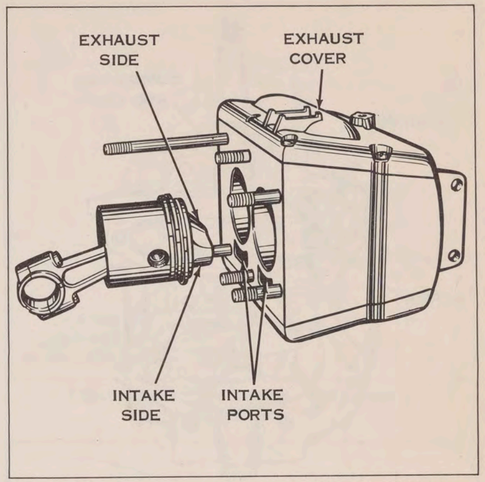


Figure 5-21. Correct Piston Position in Cylinder

Where dowels pin the center bearing in place, tap the dowels into place.

INSTALLING CONNECTING ROD AND PISTON ASSEMBLY

Make certain that all parts involved in the assembly are clean. Coat bearing surfaces, piston ring grooves and cylinder walls with oil to guard against abrasion or scuffing until normal lubrication takes place during the operation of the motor.

See that the piston is arranged with relation to position of the exhaust port - tapered side of baffle adjacent to it.

Be careful to see that the rings are properly seated in the ring grooves, to avoid breakage.

Note marks, file marks, or other matching marks on the connecting rod and cap.

Observe condition of connecting rod bolts or screws. Replace if necessary. Place connecting rod carefully in position on the crank pin - install the cap, with match or index mark to match like marking on the rod. This is important to insure proper bearing surface. 12 H.P. Models have aligning dowel pins. Bolt rod and cap together. Draw down snugly, being careful not to over do it. It may result in stripping of the threads. Rod openings should be the correct size and clean; otherwise they may bind on the shaft. It is recommended that a torquemeter wrench be used.

Draw up connecting rod screws to torques listed in Chapter Nine. Make certain that the rod is "free" on the crankshaft. If not, tap the rod lightly with a soft metal hammer where the rod and cap join. Stake screws and again check for freeness. To stake the screws, the metal opposite the slot should be upset so it will project into the screw

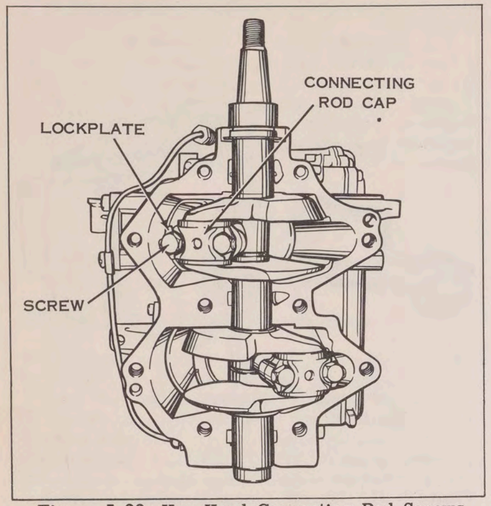


Figure 5-22. Hex Head Connecting Rod Screws with Lockplates

driver slot of the connecting rod screw and in this way create a lock to prevent the screw from turning (see figure 5-23). This, of course, will not apply where hex head screws are used. In this case, be sure to replace the lockplates when reassembling connecting rod. The ears on the lockplates will break off after bending a few times (figure 5-22).

If care is not taken when staking these connecting rod screws, the caps may be sprung out of shape very easily which will cause the connecting rod to bind.

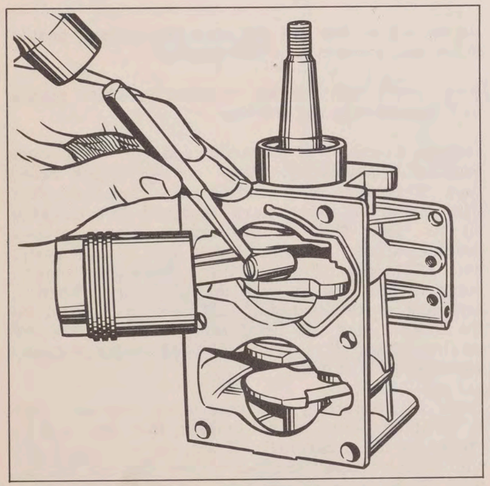


Figure 5-23. Staking Screws

ASSEMBLING CYLINDERS AND CRANKCASE

Proceed slowly. Make no forced assemblies and make no "dry" assemblies. Be sure all parts to be assembled are clean and free of grit - severe damage and expense result from making "dirty" assemblies. Perfectly good cylinder walls, pistons and rings can be ruined in a few minutes of operation unless all forms of grit are removed before assembly. Work in clean surroundings and with reasonably clean hands. Coat all bearing surfaces, cylinder walls, etc., with clean oil preceding assembly.

In general use the following procedure for all but 12D11 models:

1. Put new cylinder-crankcase gasket in place over cylinder studs.

2. Put a small amount of seal (see page 5-11) around each water passage hole and on both sides of the gasket to prevent any water leaks.

3. Oil connecting rods and piston pins. Oil rings and ring grooves and rotate rings to distribute lubrication. Rings should not bind.

4. Working with upper piston first, line up the rings so their ends are separated by the pin in each groove.

5. Install ring compressors over rings (see figure 5-24). Chamfer on outer edge of ring compressor must be toward deflector (top) end of piston.

6. Place a piece of thin (1/32 - 1/16) shim stock on top bolt hole of crankcase so that cylinder stud does not enter in crankcase hole. (See figure 5-25). (This enables crankshaft to be rotated with an adjustable end wrench on the crankshaft nut after rings have entered cylinder, in order to remove the ring compressors. Unnecessary on 3 H.P. Models.)

7. Top ring compressor can be removed through left side, between cylinder and crankcase and bottom compressor from the bottom.

8. Remove shim stock. Press cylinder assembly into place and fasten with nuts and washers.

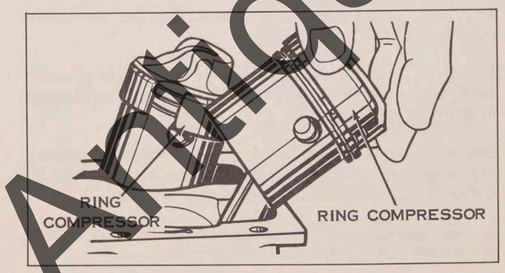


Figure 5-24. Ring Compressing Tools on Pistons

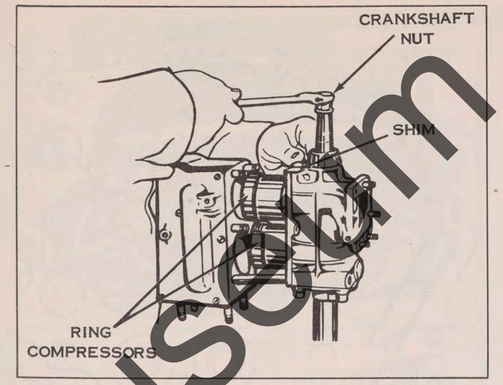


Figure 5-25. Assembling Crankcase to Cylinder (Step 1)

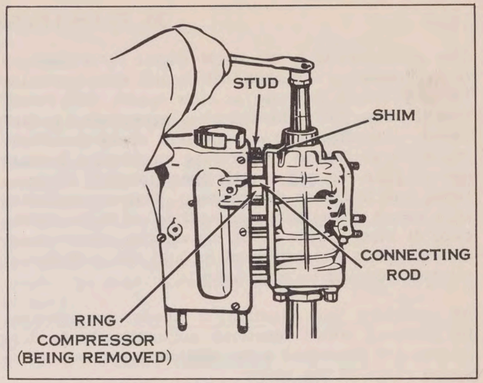


Figure 5-26. Assembling Crankcase to Cylinder (Step 2)

Put on the cylinder-to-crankcase washers, nuts or screws. Install the four corner ones first, and tighten them lightly for alignement. After that, put in the others and fasten all of them securely, tightening each one a little at a time.

Compressor tools are not required on 12D11 Models. Since the power head has a detachable cylinder head, the rings are accessible and can be compressed with the fingers in assembly. Piston and connecting rod assemblies must be slid into the cylinder head end of the cylinder, then attached to the crankshaft. (See figure 5-27.) After installing crankshaft and mounting connecting rod caps, apply a thin coat of cement (see below for recommended cements) to the split crankcase faces and assemble. Do not over - cement, as excess cement may squeeze into oil channels etc. Replace tapered dowel pins and tap in. Then replace cap screws and washers, drawing up evenly.

Since the cylinder head gasket is cemented in place, it was probably destroyed in disassembly. Replace, using cement recommended below.

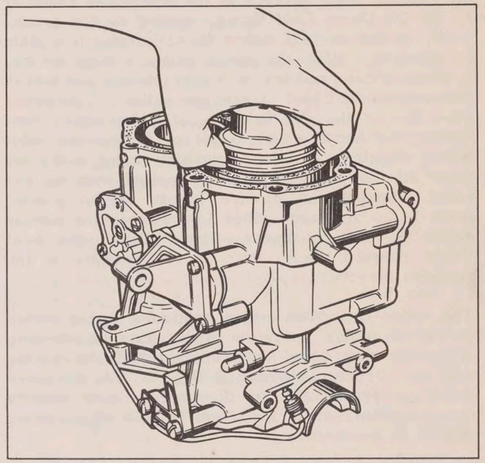


Figure 5-27. Installing 12D11 Pistons

RECOMMENDED CEMENTS

In using cement on gasket faces and between crankcase halves and cylinder, do not over-cement. The excess will just squeeze out and perhaps foul oil channels, etc.

There are several seals on the market which are satisfactory for use on the power head. We recommend the following (or their equivalent) seals:

GASKETS:

Use Perfect Seal No. 4, or any good gasket cement.

CRANKCASE HALVES AND CYLINDER:

Use Sealer 1000, available from Marine Products, 166 No. Main St., Oshkosh, Wisconsin.

WATER TUBE FITTINGS:

Use Aviation Form-A-Gasket No. 3. available from any Local Automotive Supply House.

LOWER UNIT SCREWS:

Use Perfect Seal No. 4.

OIL DRAIN LEAF VALVE (12D11 MODELS)

The crankcase of a two cycle engine has a tendency of accumulating unburned fuel (liquid) when operating for any length of time at slow speed, with result that it is partially flooded when accelerated to high speed. Flooding also affects slow speed operation, which is evidenced by profuse smoking of exhaust gases, faltering and erratic operation until accumulated fuel has been discharged. This accumulation is a result of fuel particles settling out in the crankcase at slow speeds since the velocity or movement of the fuel is not sufficient to hold the particles of oil and gasoline in suspension.

To overcome this situation, a bleeder arrangement is provided which functions automatically to discharge any crankcase accumulation throughout entire speed range of the motor.

This arrangement consists of a small hole or channel leading from pockets in the crankcase chamber to the Oil Drain Leaf Valve, located on the crankcase, on the surface where the carburetor leaf plate is mounted. When the piston makes a down stroke, it creates compression in the crankcase and forces the accumulated fuel to seek an outlet. This pressure forces the Oil Drain Leaf Valve open, permitting the surplus fuel to escape through an outlet which empties into the driveshaft casing and from there to the exhaust housing expelled with the exhaust. During the upward stroke of the piston, there is no discharge since low pressure or suction exists in the crankcase --- the Oil Drain Leaf Valve reseats itself, thus preventing flow in the opposite direction.

The above described action continues during entire period of motor operation with maximum bleeding of fuel at slow speed and proportionately decreasing with an increase in motor R.P.M.'s. At top speed there is practically no discharge since velocity through crankcase is sufficient to hold all particles of fuel in suspension.

When assembled, the leaf valve seats against the oil drain holes in the same manner as the leaf valves on the carburetor leaf plate. The oil drain leaf plate should be aligned with the leaf valve, with particular attention paid to the correct alignment with the opening in the carburetor leaf plate assembly and gasket. No part of this assembly should touch, or interfere with the operation of the oil drain leaf valve.

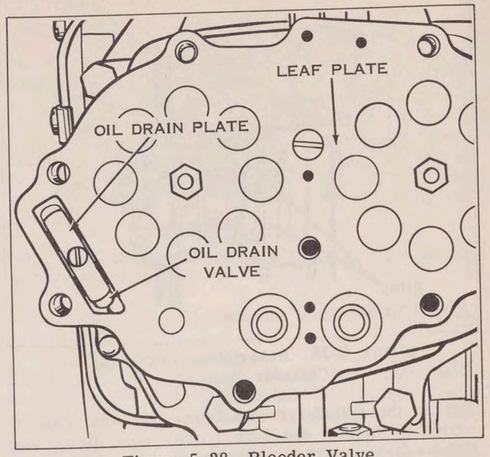
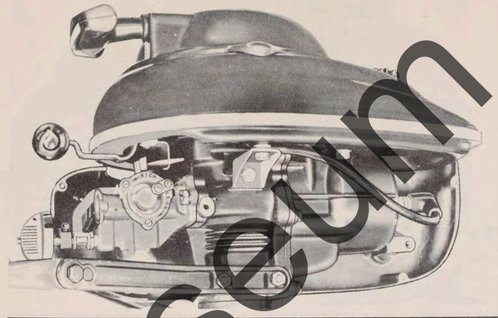


Figure 5-28. Bleeder Valve

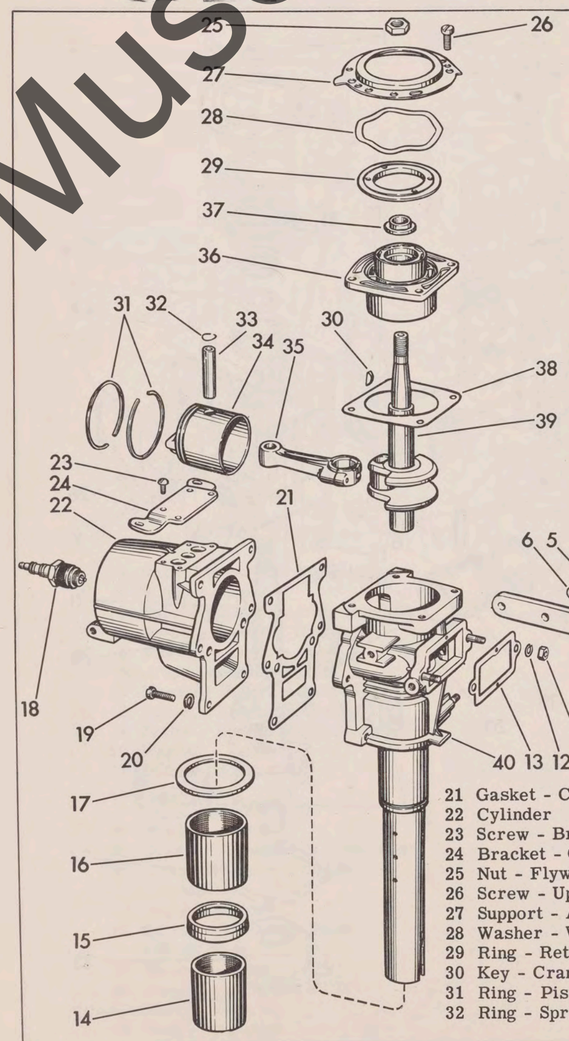
The leaf valve plate is curved slightly at each end, 1/32 of an inch. The center of the plate should be perfectly flat for 3/16 of an inch on each side from the center of the screw hole. When attaching to crankcase, do not draw screw down too tightly as this may result in a bowing of the oil drain leaf valve, and will seriously affect motor performance at slow speeds and when accelerating. If the oil drain leaf valve or plate is warped, burred, bent or does not seem to function properly, remove, and then check for any defect in the crankcase where parts are mounted which might hold valve open or cause leak. Remove burrs or foreign matter from crankcase and replace with new oil drain leaf valve and plate. DO NOT ATTEMPT TO STRAIGHTEN THE LEAF VALVE OR PLATE AS THIS MAY RESULT IN MOTOR MALFUNCTIONING. Replace with new parts if in doubt. If motor is loaded when accelerating from idle check this valve.

MODELS 3D10, 3D11



OVERHAUL INFORMATION

The exploded view is indexed in order of disassembly. Therefore to disassemble, remove parts in sequence of index numbers. To reassemble, put together in reverse sequence of index numbers. Special instructions for disassembly and assembly are given previously in this chapter. Be sure this chapter is read thoroughly before working on power head.

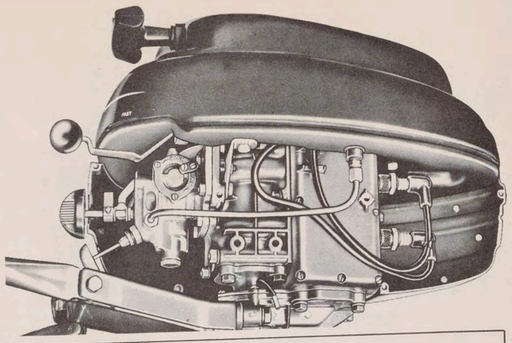


LIST OF PARTS

1 Nut - Elastic Stop
2 Screw - Steering to Tilting Handle
3 Grip - Tilting Handle
4 Handle - Tilting
5 Nut - Handle to Crankcase Stud
6 Washer - Lock
7 Knob - Steering Handle
8 Spring - Steering Handle Lock
9 Pin - Steering Handle Lock
10 Handle - Steering
11 Nut - Carburetor to Crankcase Stud
12 Washer - Lock
13 Gasket - Carburetor to Crankcase
14 Absorber - Shock, Lower
15 Seal - Exhaust
16 Absorber - Shock, Upper
17 Washer - Thrust
18 Spark Plug
19 Screw - Cylinder to Crankcase
20 Washer - Lock
21 Gasket - Cylinder to Crankcase
22 Cylinder
23 Screw - Bracket to Cylinder
24 Bracket - Gas Tank, Rear
25 Nut - Flywheel
26 Screw - Upper Bearing
27 Support - Armature Plate
28 Washer - Wave
29 Ring - Retaining
30 Key - Crankshaft
31 Ring - Piston
32 Ring - Spring, Piston Pin
33 Pin - Piston
34 Piston and Dowel Pin Assembly
35 Connecting Rod Assembly
36 Bearing - Upper
37 Slinger - Oil
38 Gasket - Upper Bearing
39 Crankshaft
40 Crankcase and Drive Shaft Tube Assembly

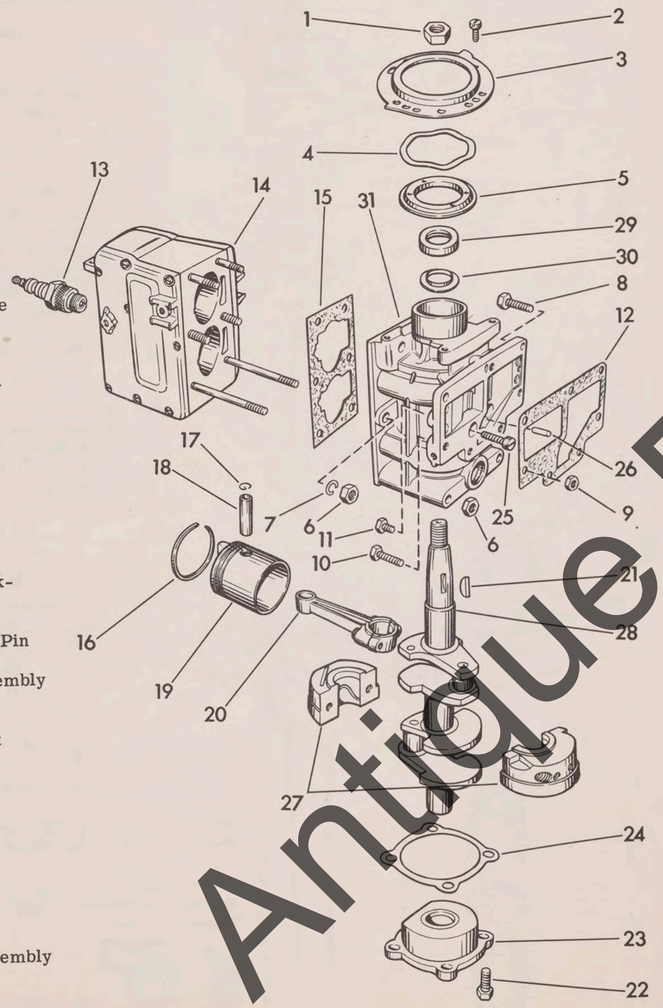
POWER HEAD

MODELS 5S10, 5D10



OVERHAUL INFORMATION

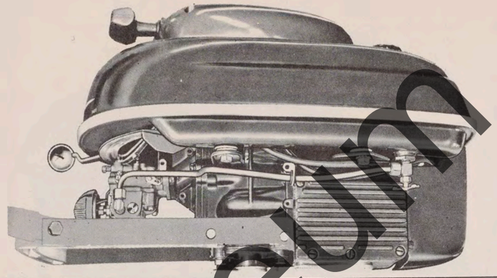
The exploded view is indexed in order of disassembly. Therefore to disassemble, remove parts in sequence of index numbers. To reassemble, put together in reverse sequence of index numbers. Special instructions for disassembly and assembly are given previously in this chapter. Be sure this chapter is read thoroughly before working on power head.



LIST OF PARTS

1 Nut - Flywheel
2 Screw - Support Plate
3 Support - Armature Plate
4 Washer - Wave
5 Ring - Retaining
6 Nut - Cylinder to Crankcase
7 Washer - Lock
8 Screw - Carburetor to Crankcase
9 Nut - Carburetor to Crankcase
10 Screw - Caruburetor and Bracket to Crankcase
11 Screw - Tank Bracket to Crankcase
12 Gasket - Carburetor
13 Spark Plug
14 Cylinder and Covers Assembly
15 Gasket - Cylinder to Crankcase
16 Ring - Piston
17 Clip - Ring, Piston Wrist Pin
18 Pin - Piston Wrist
19 Piston and Dowel Pin Assembly
20 Connecting Rod Assembly
21 Key - Crankshaft
22 Screw - Lower Crankshaft Bearing
23 Lower Bearing and Drain Tube Assembly
24 Gasket - Crankcase
25 Screw - Center Bearing
26 Dowel - Locating
27 Center Bearing Assembly
28 Crankshaft
29 Retainer - Oil
30 Slinger - Oil
31 Crankcase and Screw Assembly

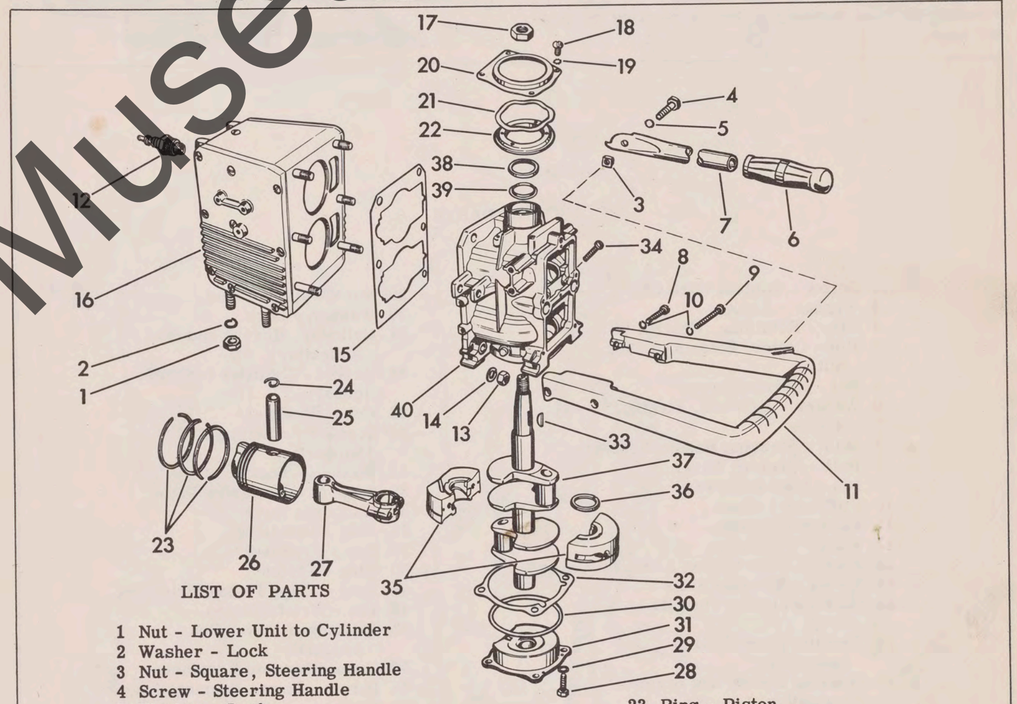
POWER HEAD



MODEL 12S10

OVERHAUL INFORMATION

The exploded view is indexed in order of disassembly. Therefore to disassemble, remove parts in sequence of index numbers. To reassemble, put together in reverse sequence of index numbers. Special instructions for disassembly and assembly are given previously in this chapter. Be sure this chapter is read thoroughly before working on power head.

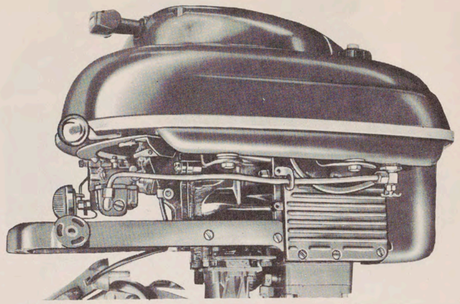


LIST OF PARTS

1 Nut - Lower Unit to Cylinder
2 Washer - Lock
3 Nut - Square, Steering Handle
4 Screw - Steering Handle
5 Washer - Lock
6 Grip - Steering Handle
7 Steering Handle Assembly
8 Screw - Handle to Crankcase
9 Screw - Handle to Crankcase
10 Washer - Lock
11 Handle - Carrying
12 Sparkplug
13 Nut - Cylinder Stud
14 Washer - Lock
15 Gasket - Cylinder to Crankcase
16 Cylinder, Covers and Stud Assembly
17 Nut - Flywheel
18 Screw - Armature Plate Support
19 Washer - Lock
20 Support - Armature Plate
21 Washer - Wave
22 Ring - Retaining
23 Ring - Piston
24 Ring - Clip, Piston Wrist Pin
25 Pin - Wrist, Piston
26 Piston and Dowel Pin Assembly
27 Connecting Rod Assembly
28 Screw - Lower Bearing
29 Washer - Lock, Lower Bearing
30 "O" Ring - Seal
31 Lower Bearing Assembly
32 Gasket - Lower Bearing
33 Key - Flywheel
34 Screw - Center Bearing
35 Center Bearing Assembly
36 Seal - Crankshaft, Lower
37 Crankshaft
38 Retainer - Oil
39 Slinger - Oil
40 Crankcase Assembly

POWER HEAD

MODEL 12D10

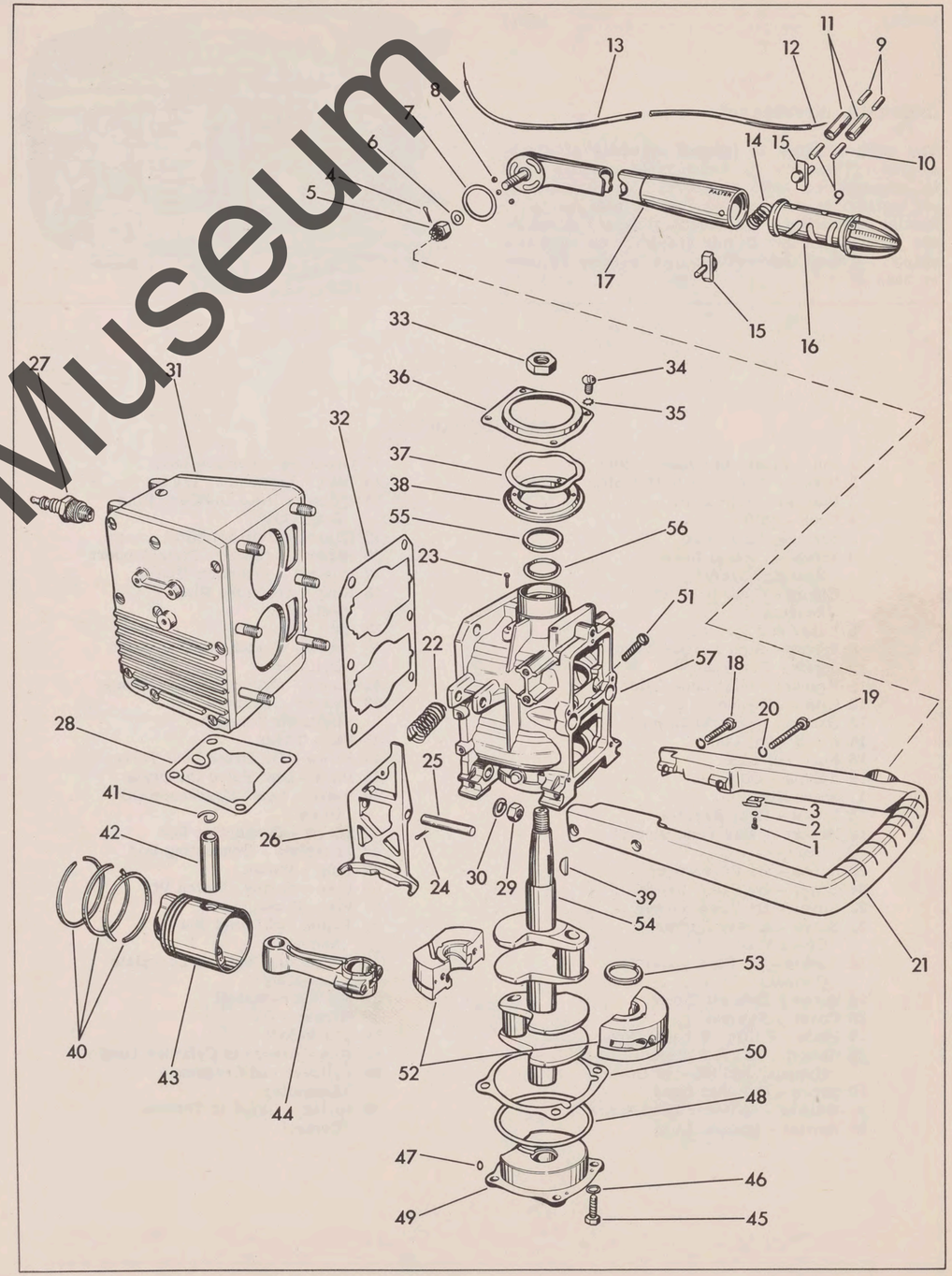


OVERHAUL INFORMATION

The exploded view is indexed in order of disassembly. Therefore to disassemble, remove parts in sequence of index numbers. To reassemble, put together in reverse sequence of index numbers. Special instructions for disassembly and assembly are given previously in this chapter. Be sure this chapter is read thoroughly before working on power head.

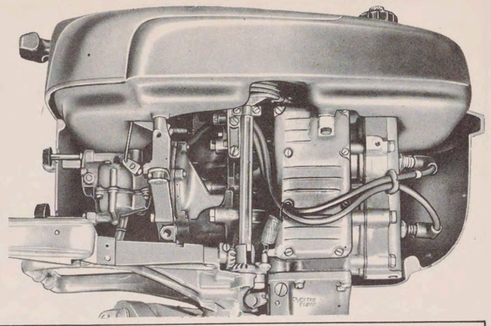
LIST OF PARTS

1 Screw - Control Wire Clip
2 Washer - Lock
3 Clip - Retaining, Control Wire
4 Pin - Cotter, Steering Lever Nut
5 Nut - Steering Lever
6 Washer - Friction, Steering Handle
7 Shim - Steering Handle Bracket
8 Ball - Steering Lever
9 Pin - Cam Follower
10 Follower - Cam
11 Follower - Cam
12 Wire - Control
13 Control Wire Casing Assembly
14 Spring - Friction Shoe
15 Shoe - Friction Throttle Grip
16 Throttle Control Grip Assembly
17 Steering Handle and Screw Assembly
18 Screw - Handle to Crankcase
19 Screw - Handle to Crankcase
20 Washer - Lock
21 Handle - Carrying
22 Spring - Shift Lock Lever
23 Pin - Anchor
24 Pin - Cotter, Shift Lock Lever
25 Shaft - Shift Lock Lever
26 Lever - Shift Locking
27 Spark Plug
28 Gasket - Exhaust Tube Adapter
29 Nut - Cylinder Stud
30 Washer - Lock
31 Cylinder, Covers and Stud Assembly
32 Gasket - Cylinder to Crankcase
33 Nut - Flywheel
34 Screw - Armature Plate Support
35 Washer - Lock
36 Support - Armature Plate
37 Washer - Wave
38 Ring - Retaining
39 Key - Flywheel
40 Ring - Piston
41 Ring - Clip, Piston Wrist Pin
42 Pin - Wrist, Piston
43 Piston and Dowel Pin Assembly
44 Connecting Rod Assembly
45 Screw - Lower Bearing
46 Washer - Lock, Lower Bearing
47 "O" Ring - Lower Bearing
48 "O" Ring - Seal
49 Lower Bearing Assembly
50 Gasket - Lower Bearing
51 Screw - Center Bearing
52 Center Bearing Assembly
53 Seal - Crankshaft, Lower
54 Crankshaft
55 Retainer - Oil
56 Slinger - Oil
57 Crankcase Assembly



POWER HEAD

MODEL 12D11

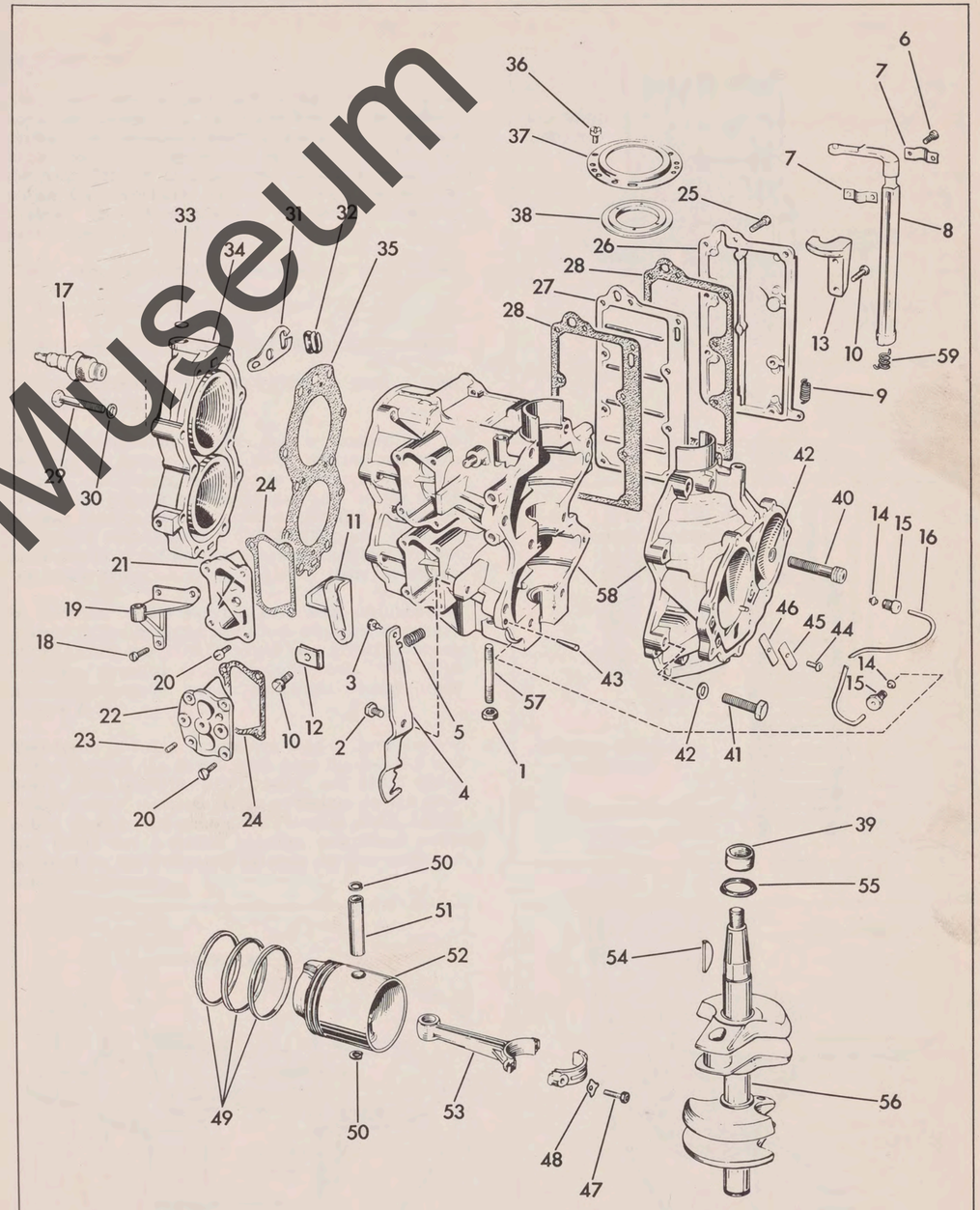


OVERHAUL INFORMATION

The exploded view is indexed in order of disassembly. Therefore to disassemble, remove parts in sequence of index numbers. To reassemble, put together in reverse sequence of index numbers. Special instructions for disassembly and assembly are given previously in this chapter. Be sure this chapter is read thoroughly before working on power head.

LIST OF PARTS

1 Nut - Flange to Cylinder Stud
2 Screw - Shift Lock to Cylinder
3 Bumper - Shift Lock
4 Lock - Shift
5 Spring - Shift Lock
6 Screw - Control Lever Bearing Clamp
7 Clamp - Control Lever Bearing
8 Lever and Spring
9 Spring - High Tension Lead
10 Screw - Bracket
11 Bracket - Shift Lock Guide
12 Clip - Oil Line
13 Bracket - Control Lever
14 Gland - Oil Line
15 Nut - Oil Line
16 Tubing - Oil Line
17 Spark Plug
18 Screw - Rear Bracket
19 Bracket - Gas Tank Support Rear
20 Screw - By Pass Cover
21 Cover - By Pass, Upper
22 Cover - By Pass, Lower
23 Screw - Lower By Pass Cover Plug
24 Gasket - By Pass Cover to Cylinder
25 Screw - Exhaust Cover
26 Cover - Exhaust
27 Plate - Baffle, Exhaust Cover
28 Gasket - Baffle Plate to Cylinder and Exhaust Cover
29 Screw - Cylinder Head
30 Washer - Cylinder Head Screw
31 Anchor - Ignition Lead
32 Grommet - Ignition Lead
33 Plug - Expansion, 1/2 in.
34 Cylinder Head and Core Plug Assembly
35 Gasket - Cylinder Head
36 Screw - Armature Plate Support
37 Support - Armature Plate
38 Ring - Armature Plate Retaining
39 Cam - Magneto
40 Screw - Center, Crankcase to Cylinder
41 Screw - Cylinder to Crankcase
42 Washer - Crankcase to Cylinder Screw
43 Pin - Taper
44 Screw - Oil Drain Leaf Valve
45 Plate -Leaf Valve Oil Drain
46 Valve - Leaf, Crankcase Oil Drain
47 Screw - Connecting Rod
48 Lockplate - Connecting Rod
49 Ring - Piston
50 Ring - Spring, Piston Pin
51 Pin - Piston
52 Piston and Dowel Pin Assembly
53 Connecting Rod and Lockplate Assembly
54 Key - Crankshaft
55 Slinger - Oil
56 Crankshaft
57 Stud - Flange to Cylinder Long
58 Cylinder and Crankcase Assembly
59 Spring - Lever to Throttle Control



DESCRIPTION

The lower unit is that part of the outboard motor assembly comprising the stern bracket, driveshaft casing, and necessary shafting and gearing required to deliver power generated by the power head to the propeller. It also contains the water pump and piping for circulation of water through the cooling system. On deluxe motors, it also includes the gear shifting and clutch mechanism.

There are, in general, three types of lower units:

1. Non-reversible (12S10 models)

2. Full-reversible (3D10, 3D11, 5S10, 5D10 models)

3. FORWARD-NEUTRAL-REVERSE Gear Shift (12D10, 12D11 models)

The non-reversible model has a limited arc in pivoting the motor in the pivot bearing and stern bracket and cannot be used in reverse. The full-reversible models can be pivoted 360° in the pivot bearing, thus permitting reverse operation, while the gear shift models have a REVERSE gear. Reverse locks are provided for the reversing models to prevent the motor from tilting up and away from the stern.

In addition to the varying reversing features the models differ in clutch and shock absorber features. 5S10, 12D10 and 12D11 models use a rubber shock absorber mounted in the propeller hub. The 5D10 model incorporates a neutral clutch and shock absorber (figure 6-3).

Two types of water pumps are used to force cooling water through the power head (see figures 6-5 and 6-6). Models 3D10, 3D11, 5S10, and 12S10 use a rubber rotor mounted on an eccentric on the propeller shaft in the gear case. Models 5D10, 12D10 and 12D11 use a rubber impeller centrifugal pump mounted on the driveshaft between the gear case and driveshaft housing.

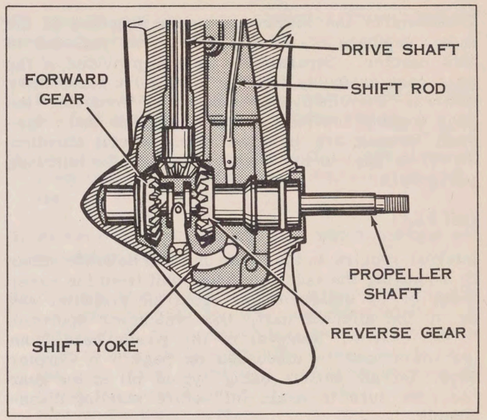


Figure 6-2. Full Gear Shift (12D10, 12D11)

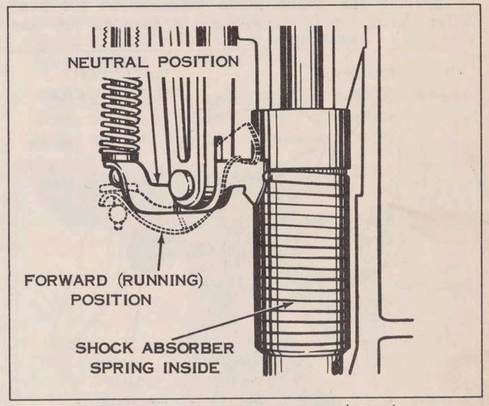


Figure 6-3. Neutral Clutch (5D10)

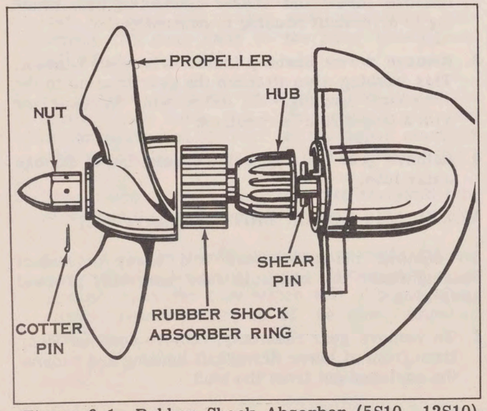


Figure 6-1. Rubber Shock Absorber (5S10, 12S10)

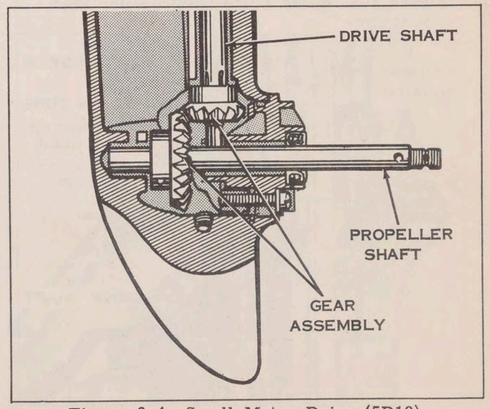


Figure 6-4. Small Motor Drive (5D10)

LOWER UNIT DISASSEMBLY

Disassemble the lower unit in the sequence of the index numbers of the exploded views included in this chapter. Separate views are provided of the gear case assembly for five and twelve horsepower motors. Therefore instructions on removing the gear housing assembly from the exhaust and driveshaft housing are included here. Special attention should be paid to the steps outlined in the following paragraphs.

GENERAL

Internal repairs in the lower unit can be made either by removing the complete lower unit from the power head, or by disassembling from the propeller end up to the affected part. Use whichever approach is the easiest. Removal of the power head from the lower unit is discussed on page 5-1, Chapter Five. On all models using hypoid oil in the gear case, be sure to drain oil before starting disassembly.

To service the water pump mounted on the propeller shaft, it is necessary to remove just the propeller, rubber clutch (if used) and gear housing cap and cap cover. Where the pump is mounted on the driveshaft, the gear case assembly can be removed from the driveshaft housing assembly without further disassembly. For removing gear case assemblies, see following detailed discussions. The water pump assembly is then accessible for repairs.

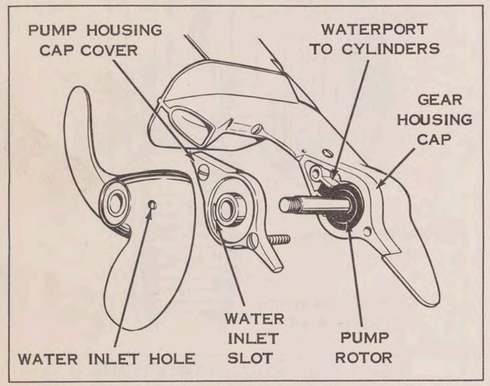


Figure 6-5. Water Pump on Propeller Shaft

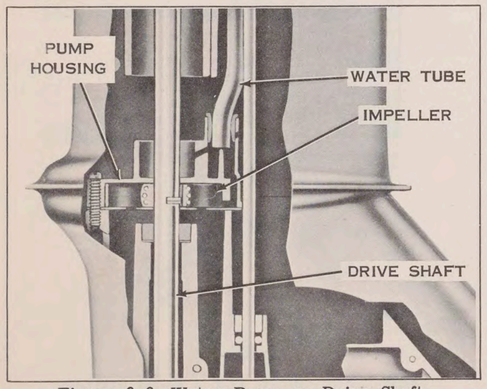


Figure 6-6. Water Pump on Drive Shaft

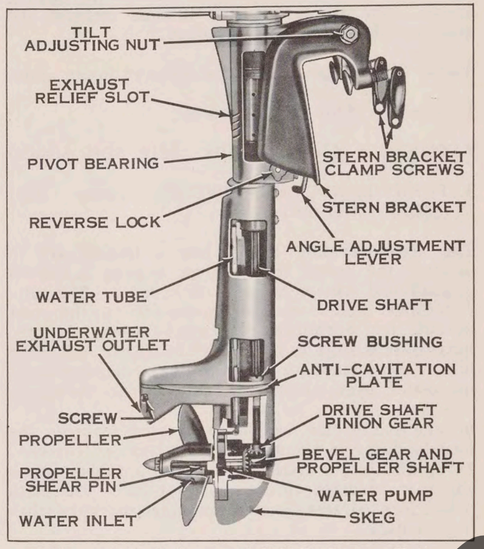


Figure 6-7. Cutaway of 3 H.P. Lower Unit

MODELS 3D10 AND 3D11 LOWER UNITS (See figure 6-7)

To remove gear housing assembly from exhaust and driveshaft housing assembly proceed as follows:

1. Remove driveshaft
2. Remove screw and washer connecting gear housing to driveshaft housing in exhaust outlet.
3. Remove screw bushing inside driveshaft housing. This bushing also attaches the gear housing to the driveshaft housing. An extra wide screwdriver with a long shank is required.
4. Remove gear housing, being careful not to damage water tube.

MODEL 5S10 LOWER UNIT (See figure 6-8)

To remove the gear case and lower driveshaft housing from the manifold tube assembly proceed as follows:

1. To remove gear case only, remove snap-on cover from front of lower driveshaft housing and remove the enclosed nut from the stud.
2. Remove the single screw inside the exhaust outlet attaching the gear housing to the lower driveshaft housing.
3. Then slip the gear case off, being careful not to damage the water tube.
4. To remove the lower driveshaft housing, remove the screw in the upper port side of the housing and loosen the screw in the front of the housing. The housing will then slip off the driveshaft tube.

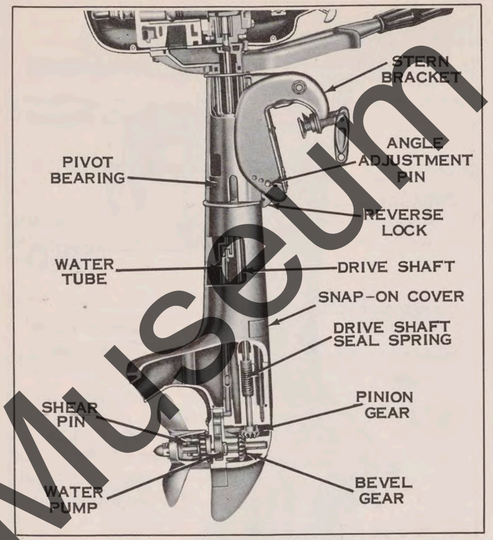


Figure 6-8. Cutaway of Model 5S10 Lower Unit

MODEL 5D10 LOWER UNIT (See figure 6-9.)

To remove gear case and pump housing from manifold tube assembly proceed as follows:

1. To remove gear case only, simply remove the four hex head cap screws and lockwashers connecting the gear case to the pump housing and pull off.
2. To remove the pump assembly, first loosen the screw which holds the clutch control wire taut in the neutral shift lever on the upper manifold tube assembly, and pull out from pump housing.
3. Then remove the pump housing to manifold tube screw and the clamp screw.
4. Then work the pump housing assembly off the manifold tube assembly slowly, taking care not to damage the water tube which will slip out of the rubber grommet on top of the pump impeller housing.

MODEL 12S10 LOWER UNIT (See figure 6-10.)

To remove gear housing assembly from manifold assembly proceed as follows:

1. Remove lower housing to gear housing screw and lockwasher (located in exhaust outlet).
2. Loosen co-pilot screw located in slot at top of pivot bearing. Remove stern bracket pivot bearing.
3. Remove driveshaft tube lock which clamps nut on tube in place.
4. Remove threaded driveshaft tube by turning the nut integral with the shaft counterclockwise. If the shaft is screwed into the gear case too tightly to turn loose with a wrench, it may help to twist the gear case slightly in a soft-jawed vise to break the threads loose. Use caution so as not to damage the water tube.
5. Remove allen head screw and lockwasher connecting the upper and lower housings. This screw is down inside the upper housing and will require an extra long allen head wrench.
6. The gear housing assembly can now be removed from the manifold assembly. The water tube will come out with the gear housing assembly.

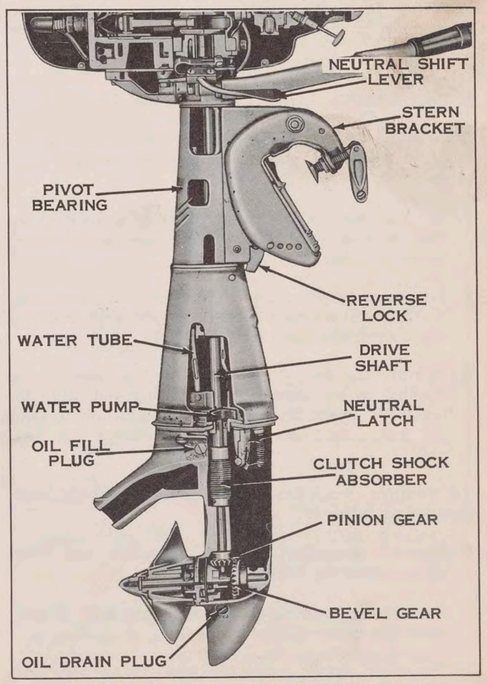


Figure 6-9. Cutaway of 5D10 Lower Unit

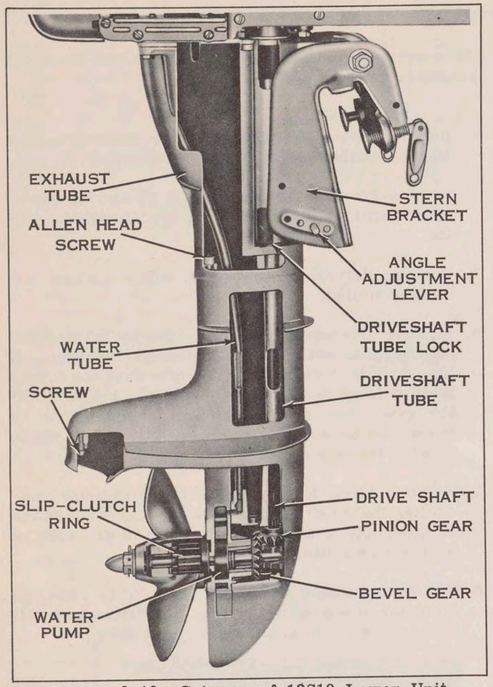


Figure 6-10. Cutaway of 12S10 Lower Unit

MODEL 12D10 LOWER UNIT (See figure 6-11)

To remove gear case and lower pump housing assembly from driveshaft casing and exhaust tube, proceed as follows:

1. Remove the exhaust tube first by removing the five screws which fasten the tube to the upper pump housing.

2. Loosen lock nut on upper shift rod just above link. Then remove cotter pin and upper shift rod pin. Unscrew upper shift rod from link.

3. Remove the four screws holding the lower pump housing to the upper pump housing and slide the complete assembly off. Be careful not to bend the water tube or shifting rod during this process.

To remove propeller shaft gear assembly only, proceed as follows:

1. Remove propeller nut and propeller and drain oil by removing drain screw.

2. Remove six screws attaching lower half of gear case and remove lower half.

3. Propeller shaft assembly and pinion gear can now be removed.

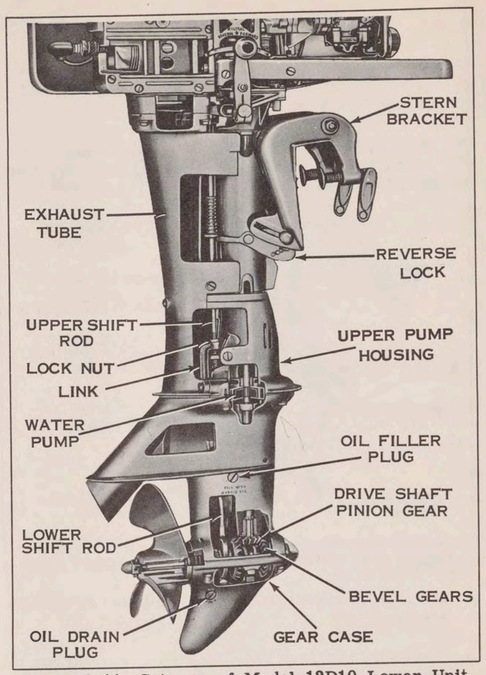


Figure 6-11. Cutaway of Model 12D10 Lower Unit

MODEL 12D11 LOWER UNIT (See figure 6-12)

To remove gear case and lower pump housing assembly from the exhaust housing, proceed as follows:

1. Remove exhaust housing cover plate on lower starboard side of exhaust housing.

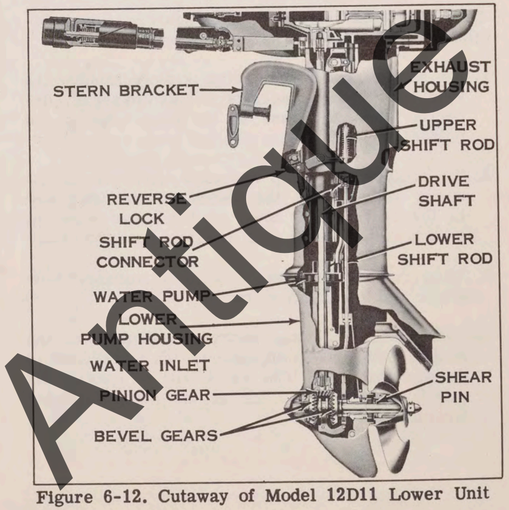


Figure 6-12. Cutaway of Model 12D11 Lower Unit

2. Reach into opening and unscrew lower shift rod connector screw enough so that lower shift rod will slip out of the connector.

3. Remove the four screws attaching the lower pump housing to the exhaust housing.

4. The gear case and lower pump housing can now be separated from the exhaust housing.

To remove the propeller shaft gear assembly only, proceed in the same manner as for the model 12D10 lower unit.

CLEANING, INSPECTION AND REPAIR

With gear case completely disassembled, check the following parts as listed for damage, wear, or scoring.

First wash all parts with solvent and blow dry with compressed air.

Check driveshaft bushing in gear case for scoring.

Check driveshaft, propeller shaft, and shift rod seals; if worn or damaged, replace. To check shift rod seal insert shift rod in position in gear case and check tension of seal on rod. A worn seal will exert very little tension while a good seal will hold the rod in any position that it is placed in.

Remove lower to upper gear case seal and oil retainer housing "O" ring.

Always replace such seals with new ones when reassembling.

Check propeller shaft gears for wear. Also check gears for wear where shifter clutch dog engages into gear. Also check shifter clutch dog for wear at point where it engages the propeller shaft gears.

Check reverse gear thrust washers for wear.

WATER PUMP

If the motor heats up excessively on the motors with the rubber rotor type pump (mounted on the propeller shaft), disassemble as described on pages 6-2, 6-3, and 6-4, and check for the following:

1. Clogged inlet.

2. Excessively worn rotor or housing, or eccentric.

3. Faulty water tube connections.

4. Excessive clearance or wear between side wall of the rotor and pump housing.

5. Pump housing loose on gearcase.

6. Broken pin on propeller shaft.

Replace worn or broken parts and reassemble.

On 5D10, 12D10 and 12D11 motors, disassemble the gear case assembly as described on pages 6-4 and 6-5 to gain access to the pump. Inspect and replace all parts indicating excessive wear.

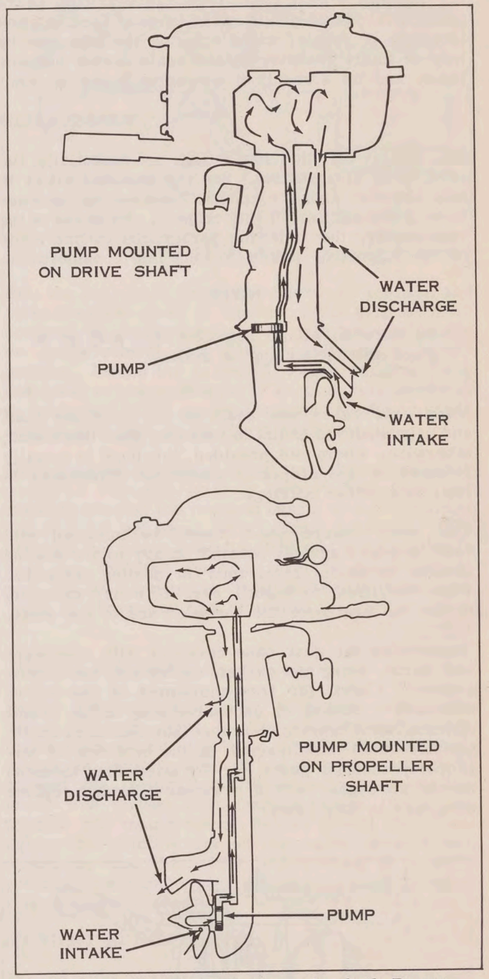


Figure 6-13. Flow Diagrams for both Pumps

IMPORTANT

When installing the water by-pass plate make sure that it is replaced in the correct position, that is, with the water inlet holes in the plate opposite the water discharge in the housing, toward front of motor.

BEARING REPLACEMENT

Bearings, shaft, and gears wear normally as result of normal operation, excessively as result of insufficient or improper lubrication. In either case, replacement is necessary at various intervals, dependent on the amount of service, and lubrication. Lubrication, to be efficient, must be of proper quality and consistency to permit circulation throughout the entire gear case, including bearings, gears and shaft. This depends on the lapse of time between intervals of repair, water entering the gear case by way of faulty gaskets, grease seals, water connections, and as a result of excessive propeller shaft bearing wear because of faulty lubrication, hastening necessity of expensive repairs.

If the bearings or bushings are of the removable type, they can be removed and preparations made for installation of new bearings; otherwise, if cast-in, new castings will be required.

All bearings in the lower units are the friction, cast-in type, with the exception of the propeller shaft bearings on 12D10 and 12D11 models.

Bearings in the 12 H.P. model gear cases are pinned to insure correct location.

REASSEMBLING THE LOWER UNIT

Reassembly of the lower unit is essentially the reverse of disassembly. See the exploded views in this chapter; also the special disassembly instructions given earlier in this chapter. To assist in the reassembly, the following paragraphs outline some of the important points to take into consideration.

NOTE

Be sure to oil all seals so they may go in place without tearing or rolling.

Many gear cases use seals on the propeller shaft and driveshafts to assist in retaining gear lubricants; otherwise, where not provided, lubricant is actually retained by the propeller shafts and driveshafts in their respective bearings.

The seals (where used) should be installed with care to guard against possible injury to the sealing surface to render them unfit for sealing purposes. When required to install over threads, carefully screw the seal over the threaded end of the shaft.

Reassemble the gear case carefully with necessary new parts, using new gaskets coated with non-drying cement. Check for free movement of the entire assembly - binding or excessive drag is the result of insufficient bearing clearance (see clearance chart, Chapter Nine) misalignment of the bearings or improperly meshed gears (or by attempting to mesh an old worn gear with a new gear - always replace all gears in this case).

Check for "feel" of mesh, turn propeller shaft to make sure no binding occurs at any point. Tightly meshed gears cause them to "growl" in operation and in extreme cases affect performance of the motor.

Fill the gear housing with the proper lubricant. See page 2-2.

Before installing the gear housing on the motor try the housing to be sure that the shafts are free and there is no excessive binding. There will be a slight binding if new seals have been used because the seals should fit snugly on the shafts to prevent any leakage of the lubricant.

ADJUSTING SHIFT RODS ON 12D10 MODELS
(See figure 6-14)
It is very important that the shift rods be adjusted properly. If they are not adjusted properly, considerable damage can be done to the propeller gears and shifting mechanism. First screw upper shift rod into link connecting upper and lower shift rods. Then pull up to top position. Screw upper shift rod in or out of link until center of hole in top of rod is 1-1/4 inch below top of flange. After adjusting, tighten lock nut on upper shift rod against link.

ADJUSTING CLUTCH CABLE ON 5D10 MODELS
(See figure 6-15)
Place clutch handle in horizontal (FORWARD) position so that cable spring lies flat. Then pull wire taut through clamp and tighten clamp screw and nut. Handle should go into neutral 1/3 of way up.

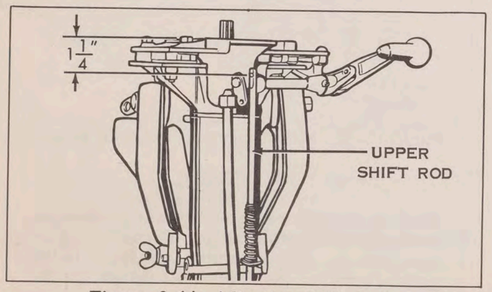


Figure 6-14. Adjusting Shift Rod

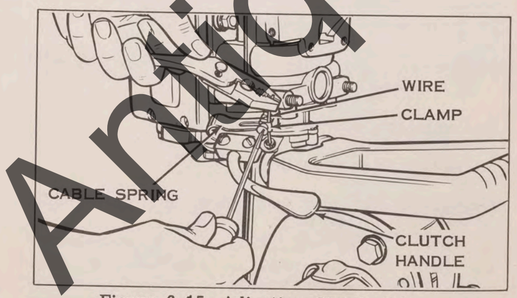


Figure 6-15. Adjusting Clutch Cable

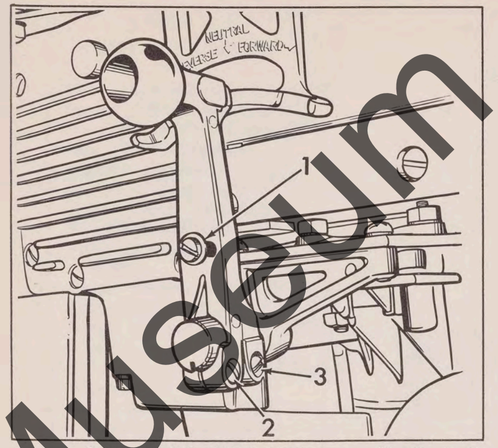


Figure 6-16. Model 12D10 Shift Lever (In Neutral)

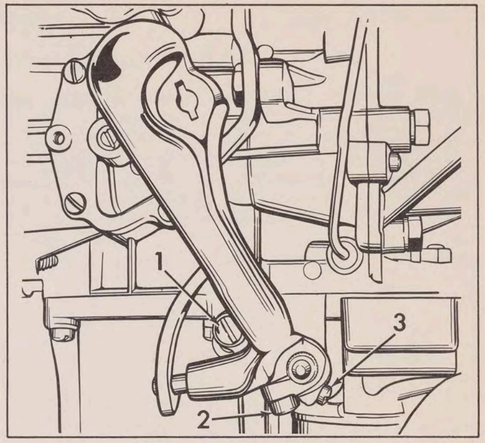


Figure 6-17. Model 12D11 Shift Lever (In Reverse)

ADJUSTMENT OF SHIFT LEVER
(Models 12D10 and 12D11 - see figures 6-16 and 6-17)

Set shift lever in "Neutral" and magneto handle or speed control grip in "slow" position. Loosen adjusting screw (1) and other screw (2) which clamps the bottom of the shift lever.

NOTE

This procedure allows the clamping lever to be moved in either direction.

With shift lever in "Neutral" move the clamping lever until the propeller turns and tighten the adjusting screw (1) on the shift lever.

NOTE

The above is to make sure the gears are not in forward or reverse and to lock the shift lever to the clamping lever.

Turn the propeller so that shift cannot be made into "Forward" position. Check the length of travel the shift lever makes. Repeat the same process for "Reverse."

NOTE

The shift lever should travel the same distance on each side of neutral so as to make sure the clutch dog is centered between the forward and reverse gears.

If the travel of the shift lever is not the same on each side of "Neutral" proceed as follows: With shift lever in "Neutral", loosen the adjusting screw (1) and move clamping lever in either direction until correct setting is obtained. Tighten adjusting screw (1).

Put the gear shift lever in "Forward" position and move magneto lever or speed control grip to "fast" position to check for lock out. If magneto handle or speed control grip will not advance to "fast" position, loosen the screw (3) on the clamping lever and lower screw in shift lever enabling this assembly to be moved in or out until magneto handle or speed control grip will go to "fast" position.

Move magneto handle or speed control grip to "slow" position. Put shift lever in "Neutral" position, and check to see that the magneto handle or speed control grip cannot be advanced to "fast" position. This prevents the motor from "racing" while in "Neutral." Also see that the magneto lever or speed control grip can be advanced to "fast" position with the shift lever in "Forward" and "Reverse."

TILTING FRICTION

Before returning motor to customer, check the tilting friction. This friction must be just enough to maintain motor in a tilted position for beaching, rowing in shallow waters, etc., but not enough to prevent the motor from tilting up in the event the lower unit strikes a submerged object. To adjust friction tilt motor up as far as it will go. Then tighten the friction nut on the stern bracket just enough so that the motor will remain in a tilted position, but can be returned to an upright position with very little pressure.

CO-PILOT ADJUSTMENT

The co-pilot permits the motor to maintain a set course without holding steering handle. It can be adjusted by tightening the screw, located in the front of the pivot bearing under the stern bracket to the desired tension. It may be necessary to tilt motor slightly to reach screw.

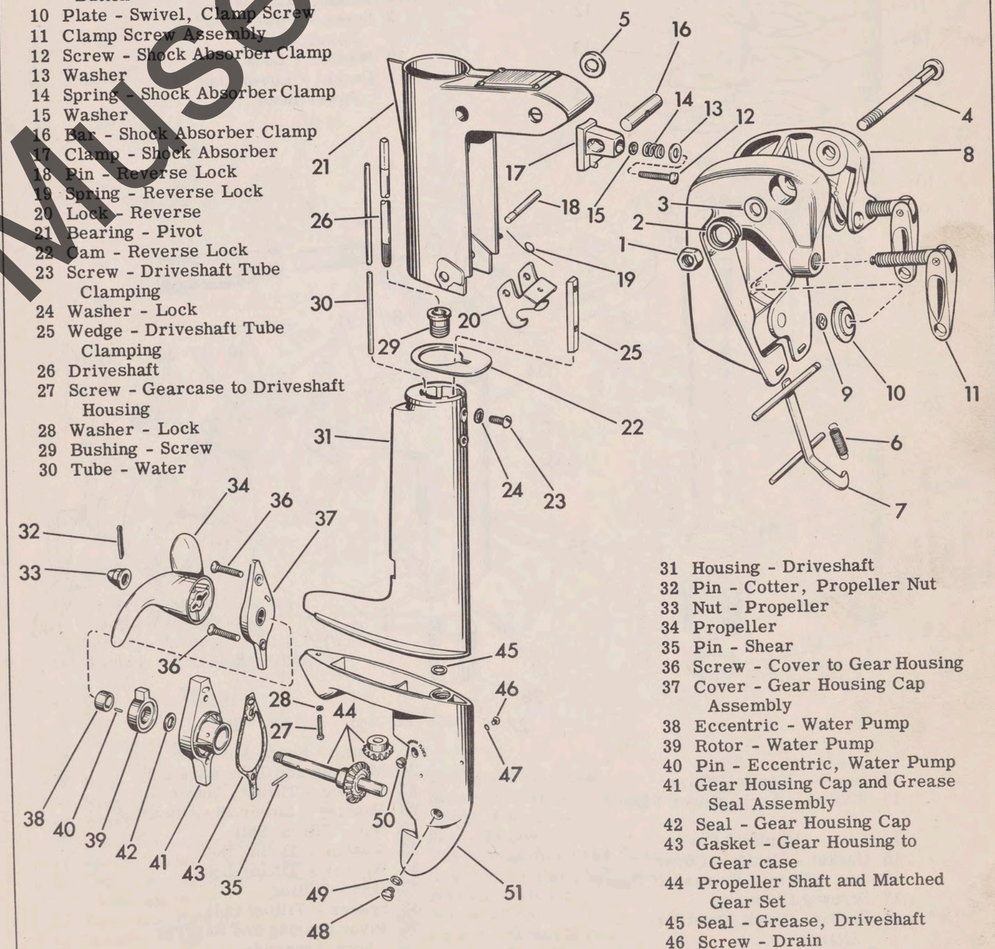
MODELS 3D10, 3D11

OVERHAUL INFORMATION

The exploded view is indexed in order of disassembly. Therefore to disassemble, remove parts in sequence of index numbers. To reassemble, put together in reverse sequence of index numbers. Special instructions for disassembly and assembly are given previously in this chapter. Be sure this chapter is read thoroughly before working on lower unit.

LIST OF PARTS

1 Nut - Lock, Stern Bracket Bolt
2 Spring - Stern Bracket Bolt
3 Washer - Stern Bracket Bolt
4 Bolt - Stern Bracket
5 Washer - Friction
6 Spring - Tilting Lever
7 Tilting Lever Assembly
8 Stern Bracket Assembly
9 Retainer - Clamp Screw Button
10 Plate - Swivel, Clamp Screw
11 Clamp Screw Assembly
12 Screw - Shock Absorber Clamp
13 Washer
14 Spring - Shock Absorber Clamp
15 Washer
16 Bar - Shock Absorber Clamp
17 Clamp - Shock Absorber
18 Pin - Reverse Lock
19 Spring - Reverse Lock
20 Lock - Reverse
21 Bearing - Pivot
22 Cam - Reverse Lock
23 Screw - Driveshaft Tube Clamping
24 Washer - Lock
25 Wedge - Driveshaft Tube Clamping
26 Driveshaft
27 Screw - Gearcase to Driveshaft Housing
28 Washer - Lock
29 Bushing - Screw
30 Tube - Water



31 Housing - Driveshaft
32 Pin - Cotter, Propeller Nut
33 Nut - Propeller
34 Propeller
35 Pin - Shear
36 Screw - Cover to Gear Housing
37 Cover - Gear Housing Cap Assembly
38 Eccentric - Water Pump
39 Rotor - Water Pump
40 Pin - Eccentric, Water Pump
41 Gear Housing Cap and Grease Seal Assembly
42 Seal - Gear Housing Cap
43 Gasket - Gear Housing to Gear case
44 Propeller Shaft and Matched Gear Set
45 Seal - Grease, Driveshaft
46 Screw - Drain
47 Gasket - Drain Screw
48 Plug - Grease
49 Gasket - Grease Plug
50 Plug - Water Flushing
51 Gear Housing and Bushing Assembly

LOWER UNIT

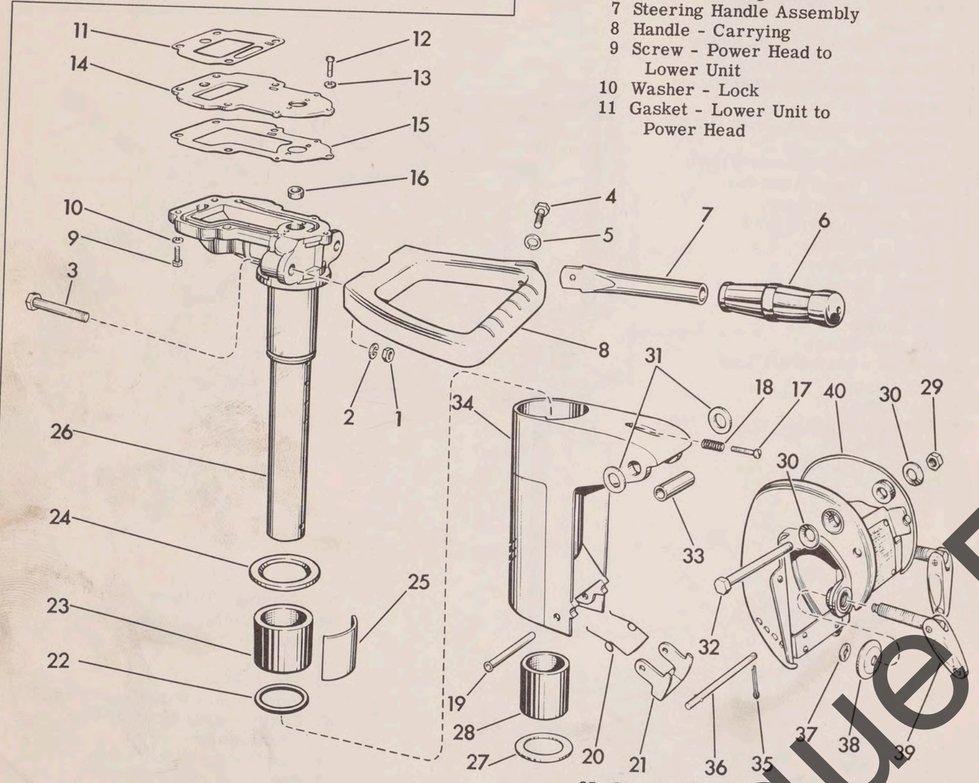
MODEL 5S10

OVERHAUL INFORMATION

The exploded view is indexed in order of disassembly. Therefore to disassemble, remove parts in sequence of index numbers. To reassemble, put together in reverse sequence of index numbers. Special instructions for disassembly and assembly are given previously in this chapter. Be sure this chapter is read thoroughly before working on lower unit.

LIST OF PARTS

1 Nut - Carrying Handle to Lower Unit
2 Washer - Lock, Carrying Handle
3 Screw - Carrying Handle to Lower Unit
4 Screw - Steering Handle
5 Washer - Lock
6 Grip - Steering Handle
7 Steering Handle Assembly
8 Handle - Carrying
9 Screw - Power Head to Lower Unit
10 Washer - Lock
11 Gasket - Lower Unit to Power Head



12 Screw - Manifold Cover
13 Washer - Lock, Cover Plate Screw
14 Plate - Manifold Cover
15 Gasket - Manifold Cover
16 Seal - Water, Driveshaft Upper
17 Screw - Clamping
18 Spring - Shock Absorber Clamp
19 Pin - Reverse Lock
20 Spring - Reverse Lock
21 Lock - Reverse
22 Ring - Seal
23 Bushing - Upper Pivot Bearing
24 Washer - Thrust, Upper
25 Clamp - Shock Absorber
26 Manifold and Tube Assembly
27 Washer - Thrust, Lower
28 Bushing - Lower Pivot Bearing
29 Nut - Tilting Bolt
30 Washer - Tilting Bolt
31 Washer - Tilting Bolt
32 Bolt - Tilting
33 Spacer - Tilting Bolt
34 Pivot Bearing and Reverse Lock Assembly
35 Pin - Cotter, Adjusting
36 Pin - Bracket, Adjusting
37 Retainer - Swivel Plate
38 Plate - Swivel, Clamp Screw
39 Clamp Screw Assembly
40 Stern Bracket Assembly

LIST OF PARTS

1 Screw - Gear Housing to Driveshaft Casing
2 Screw - Lower Housing
3 Driveshaft
4 Screw - Lower to Upper Gear Housing
5 Cover - Snap On
6 Nut - Driveshaft Housing
7 Washer - Lock
8 Tube - Water
9 Housing - Lower, Driveshaft

10 Pilot - Gear Housing to Driveshaft Housing
11 Spring - Driveshaft Seal
12 Washer - Driveshaft Water Seal
13 Seal - Driveshaft
14 Pin - Cotter, Propeller Nut
15 Nut - Propeller
16 Propeller
17 Hub - Clutch, Propeller
18 Ring - Clutch
19 Washer - Clutch
20 Pin - Shear, Propeller
21 Screw - Gear Housing Cap
22 Cap Cover Assembly - Gear Housing
23 Eccentric - Pump
24 Rotor - Pump
25 Pin - Pump Eccentric
26 Cap Assembly - Gear Housing
27 Gasket - Gear Housing
28 Disc - Water Seal
29 Cup - Packing, Water Seal
30 Packing - Water Seal
31 Spring - Water Seal
32 Matched Gear and Propeller Shaft Assembly
33 Key - Pinion
34 Pin - Propeller Shaft Gear
35 Key - Propeller Shaft Gear
36 Washer - Thrust
37 Screw - Drain
38 Gasket - Drain Screw
39 Plug - Water Flushing
40 Plug - Grease
41 Washer - Grease Plug
42 Stud - Gear Housing
43 Gear Housing and Bushing Assembly

LOWER UNIT

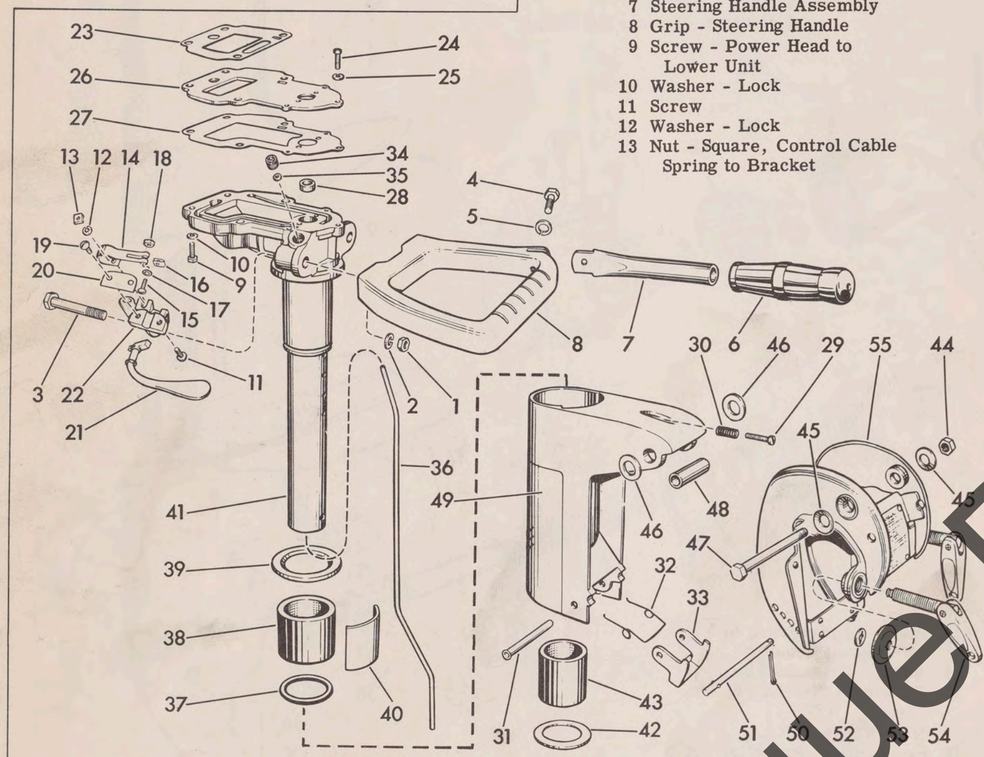
MODEL 5D10

OVERHAUL INFORMATION

The exploded view is indexed in order of disassembly. Therefore to disassemble, remove parts in sequence of index numbers. To reassemble, put together in reverse sequence of index numbers. Special instructions for disassembly and assembly are given previously in this chapter. Be sure this chapter is read thoroughly before working on lower unit.

LIST OF PARTS

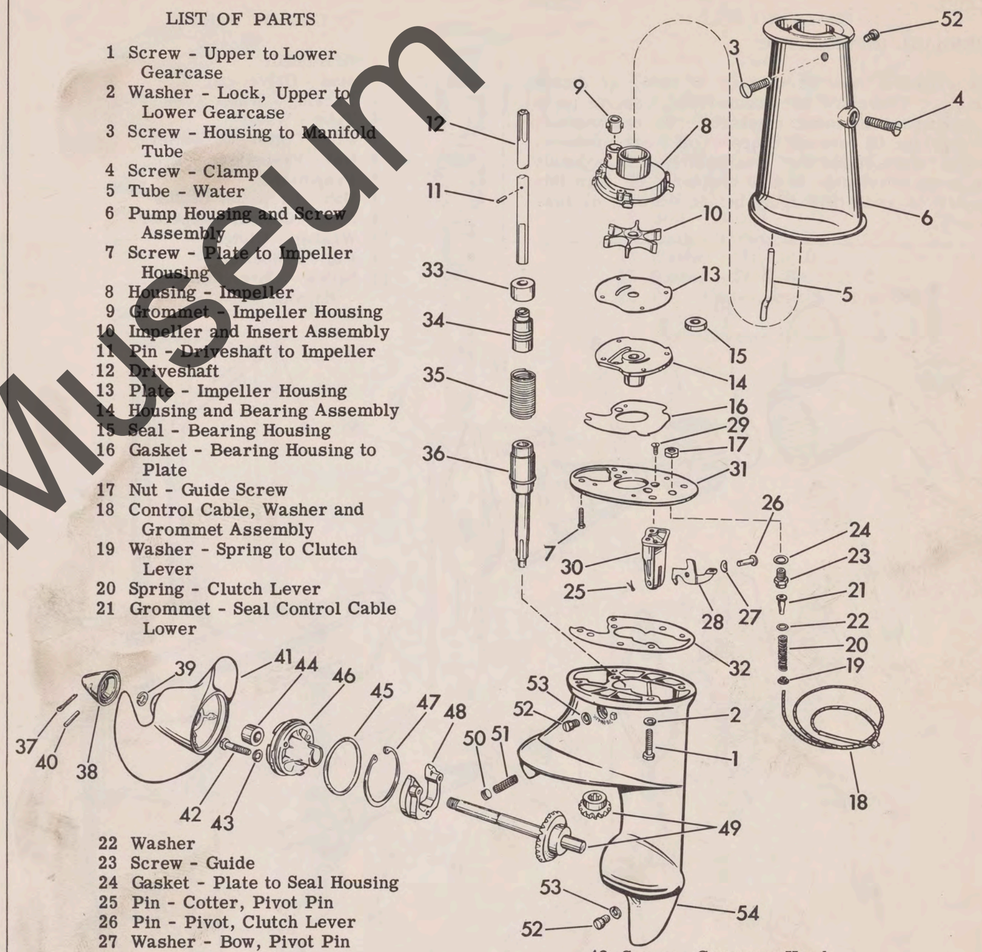
1 Nut - Carrying Handle to Lower Unit
2 Washer - Lock, Carrying Handle
3 Screw - Carrying Handle to Lower Unit
4 Handle - Carrying
5 Screw - Steering Handle
6 Washer - Lock
7 Steering Handle Assembly
8 Grip - Steering Handle
9 Screw - Power Head to Lower Unit
10 Washer - Lock
11 Screw
12 Washer - Lock
13 Nut - Square, Control Cable Spring to Bracket



14 Spring - Control Cable
15 Screw - Control Cable Spring
16 Clamp - Control Cable
17 Washer - Lock
18 Nut - Control Cable Spring
19 Screw - Spring Control Lever Bracket
20 Spring - Control Lever
21 Lever - Control
22 Bracket - Control Lever
23 Gasket - Lower Unit to Power Head
24 Screw
25 Washer - Lock, Cover Plate Screw
26 Plate - Manifold Cover
27 Gasket - Manifold Cover
28 Seal - Water, Driveshaft Upper
29 Screw - Clamping
30 Spring - Shock Absorber Clamp
31 Pin - Reverse Lock
32 Spring - Reverse Lock
33 Lock - Reverse
34 Nut - Control Cable Tube
35 Gland - Control Cable Tube
36 Tube - Control Cable
37 Ring - Seal
38 Bushing - Upper Pivot Bearing
39 Washer - Thrust Upper
40 Clamp - Shock Absorber
41 Manifold Tube Assembly
42 Washer - Thrust, Lower
43 Bushing - Lower Pivot Bearing
44 Nut - Tilting Bolt
45 Washer - Tilting Bolt
46 Washer - Tilting Bolt
47 Bolt - Tilting
48 Spacer - Tilting Bolt
49 Pivot Bearing and Reverse Lock Assembly
50 Pin - Cotter, Adjusting
51 Pin - Bracket, Adjusting
52 Retainer - Swivel Plate
53 Plate - Swivel, Clamp Screw
54 Clamp Screw Assembly
55 Stern Bracket Assembly

LIST OF PARTS

1 Screw - Upper to Lower Gearcase
2 Washer - Lock, Upper to Lower Gearcase
3 Screw - Housing to Manifold Tube
4 Screw - Clamp
5 Tube - Water
6 Pump Housing and Screw Assembly
7 Screw - Plate to Impeller Housing
8 Housing - Impeller
9 Grommet - Impeller Housing
10 Impeller and Insert Assembly
11 Pin - Driveshaft to Impeller
12 Driveshaft
13 Plate - Impeller Housing
14 Housing and Bearing Assembly
15 Seal - Bearing Housing
16 Gasket - Bearing Housing to Plate
17 Nut - Guide Screw
18 Control Cable, Washer and Grommet Assembly
19 Washer - Spring to Clutch Lever
20 Spring - Clutch Lever
21 Grommet - Seal Control Cable Lower



22 Washer
23 Screw - Guide
24 Gasket - Plate to Seal Housing
25 Pin - Cotter, Pivot Pin
26 Pin - Pivot, Clutch Lever
27 Washer - Bow, Pivot Pin
28 Lever - Clutch
29 Screw - Plate to Clutch Lever Bracket and Retainer
30 Bracket - Clutch Lever
31 Plate - Lower to Upper Gearcase
32 Gasket - Lower Gearcase to Plate
33 Retainer - Clutch
34 Spring and Sleeve Assembly
35 Spring - Clutch
36 Pinion Shaft and Clutch Pilot Assembly
37 Pin - Cotter, Propeller Nut
38 Propeller Nut Assembly
39 Washer - Lock, Propeller Nut
40 Pin - Propeller Drive
41 Propeller and Bushing Assembly
42 Screw - Gearcase Head
43 Washer - Gearcase Head Screw
44 Seal - Gearcase Head to Propeller Shaft
45 "O" Ring - Gearcase Head
46 Gearcase Head and Bearing Assembly
47 Ring - Retaining, Lower Gearcase
48 Plate - Nut, Gearcase Head
49 Propeller Shaft - Gear and Pinion Assembly
50 Plug - Gearcase
51 Screen - Water Intake
52 Screw - Grease and Water Plugs
53 Washer - Grease Plug
54 Lower Gearcase and Plug Assembly

LOWER UNIT

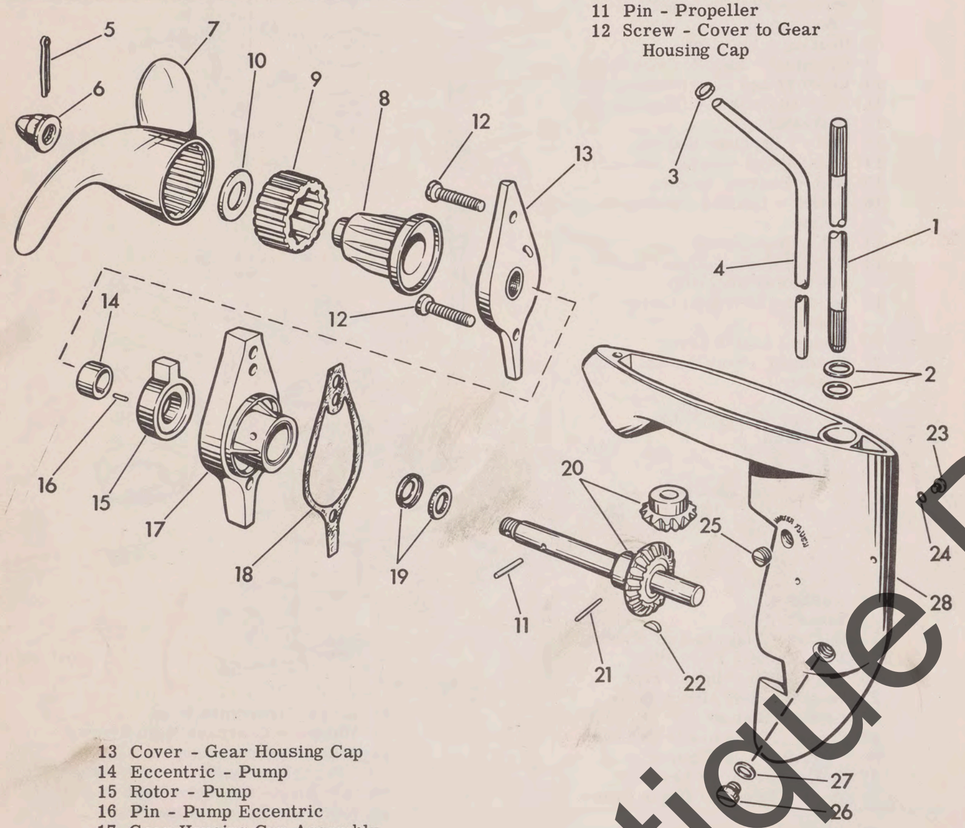
MODEL 12S10

OVERHAUL INFORMATION

The exploded view is indexed in order of disassembly. Therefore to disassemble, remove parts in sequence of index numbers. To reassemble, put together in reverse sequence of index numbers. Special instructions for disassembly and assembly are given previously in this chapter. Be sure this chapter is read thoroughly before working on lower unit.

LIST OF PARTS

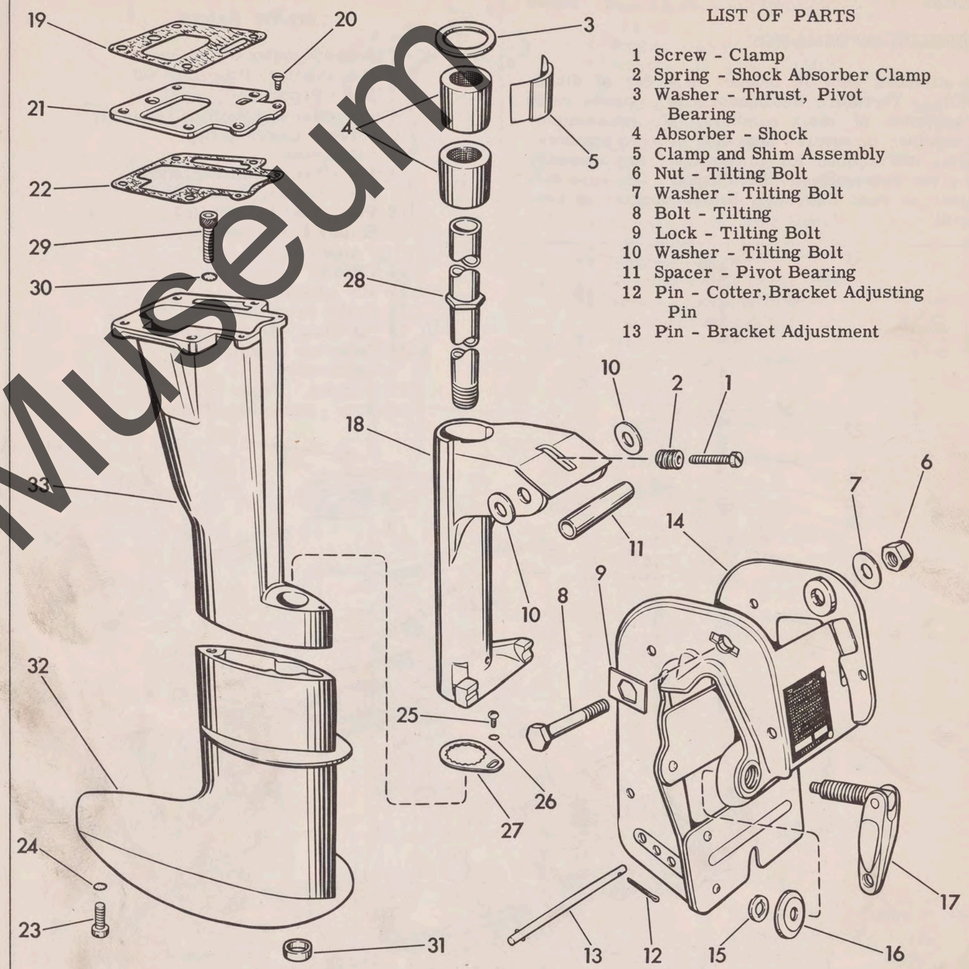
1 Driveshaft
2 Seal - Driveshaft
3 Packing - Water Tube
4 Tube - Water
5 Pin - Cotter, Propeller
6 Nut - Propeller
7 Propeller
8 Hub - Propeller Clutch
9 Ring - Clutch, Propeller
10 Washer - Clutch
11 Pin - Propeller
12 Screw - Cover to Gear Housing Cap



13 Cover - Gear Housing Cap
14 Eccentric - Pump
15 Rotor - Pump
16 Pin - Pump Eccentric
17 Gear Housing Cap Assembly
18 Gasket - Gear Housing Cap
19 Seal - Propeller Shaft
20 Matched Gear and Propeller Shaft Assembly
21 Pin - Gear to Propeller Shaft
22 Key - Gear to Propeller Shaft
23 Screw - Drain
24 Gasket - Drain Screw
25 Plug - Water Flushing
26 Plug - Grease
27 Washer - Lower Unit Plug
28 Gear Housing Assembly

LIST OF PARTS

1 Screw - Clamp
2 Spring - Shock Absorber Clamp
3 Washer - Thrust, Pivot Bearing
4 Absorber - Shock
5 Clamp and Shim Assembly
6 Nut - Tilting Bolt
7 Washer - Tilting Bolt
8 Bolt - Tilting
9 Lock - Tilting Bolt
10 Washer - Tilting Bolt
11 Spacer - Pivot Bearing
12 Pin - Cotter, Bracket Adjusting Pin
13 Pin - Bracket Adjustment



14 Stern Bracket Assembly
15 Retainer - Swivel Plate
16 Plate - Swivel, Clamp Screw
17 Clamp Screw Assembly
18 Bearing - Pivot
19 Gasket - Lower Unit
20 Screw - Plate to Upper Housing
21 Plate - Upper Housing
22 Gasket - Plate to Upper Housing
23 Screw - Lower Housing to Gear Housing
24 Washer - Lock
25 Screw
26 Washer - Lock
27 Lock - Driveshaft Tube
28 Drive Shaft Tube and Stop Assembly
29 Screw - Upper to Lower Housing
30 Washer - Lock
31 Spacer - Lower Housing to Gear Housing
32 Housing - Lower
33 Housing - Upper

LOWER UNIT

MODEL 12D10

OVERHAUL INFORMATION

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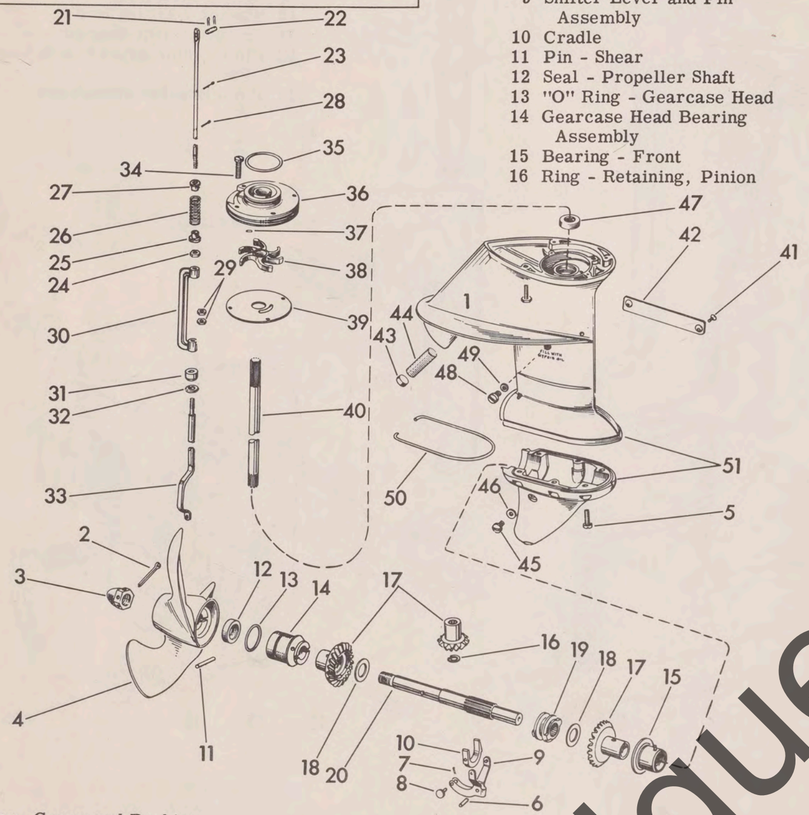
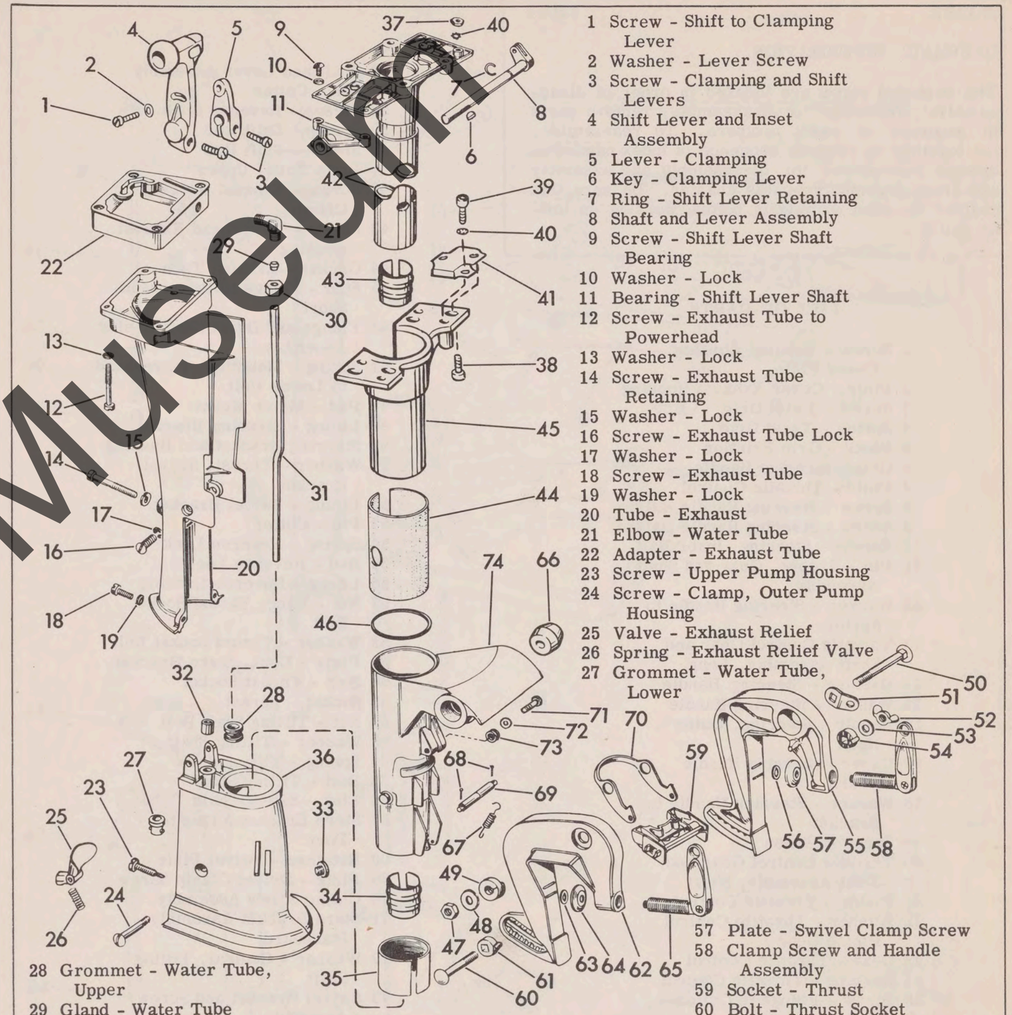


LIST OF PARTS

1 Screw - Upper Gearcase
2 Pin - Cotter, Propeller Nut
3 Nut - Propeller
4 Propeller and Bushing Assembly
5 Screw - Lower to Upper Gearcase
6 Pin - Pivot, Shifting Lever
7 Pin - Cotter, Yoke to Pin
8 Pin - Yoke to Shift Rod
9 Shifter Lever and Pin Assembly
10 Cradle
11 Pin - Shear
12 Seal - Propeller Shaft
13 "O" Ring - Gearcase Head
14 Gearcase Head Bearing Assembly
15 Bearing - Front
16 Ring - Retaining, Pinion
17 Pinion, Gears and Bushing Assembly
18 Washer - Thrust, Propeller Shaft
19 Shifter Assembly - Clutch Dog
20 Shaft - Propeller
21 Pin - Cotter, Shift Rod Pin
22 Pin - Shift Rod, Upper
23 Pin - Cotter, Shift Rod
24 Nut - Shift Rod to Link
25 Sleeve - Reverse Lock
26 Spring - Shift Rod
27 Sleeve - Shift Rod
28 Rod - Shift, Upper
29 Nut - Link to Lower Shift Rod
30 Link - Shift Rod
31 Bushing - Shift Rod, Lower
32 "O" Ring - Lower Shift Rod
33 Rod - Shift, Lower
34 Screw - Impeller Housing
35 "O" Ring - Impeller Housing
36 Housing - Impeller
37 Pin - Driveshaft to Impeller
38 Impeller Assembly
39 Plate - Impeller Housing
40 Driveshaft
41 Screw - Water Bypass Cover
42 Cover - Water Bypass
43 Plug - Water Intake Screen
44 Screen - Water Intake
45 Plug - Oil Drain
46 Washer - Oil Plug
47 Seal - Driveshaft
48 Plug - Oil Filling
49 Washer - Oil Plug
50 Seal - Upper to Lower Gearcase
51 Gear Housing, Bearing and Pin Assembly



1 Screw - Shift to Clamping Lever
2 Washer - Lever Screw
3 Screw - Clamping and Shift Levers
4 Shift Lever and Inset Assembly
5 Lever - Clamping
6 Key - Clamping Lever
7 Ring - Shift Lever Retaining
8 Shaft and Lever Assembly
9 Screw - Shift Lever Shaft Bearing
10 Washer - Lock
11 Bearing - Shift Lever Shaft
12 Screw - Exhaust Tube to Powerhead
13 Washer - Lock
14 Screw - Exhaust Tube Retaining
15 Washer - Lock
16 Screw - Exhaust Tube Lock
17 Washer - Lock
18 Screw - Exhaust Tube
19 Washer - Lock
20 Tube - Exhaust
21 Elbow - Water Tube
22 Adapter - Exhaust Tube
23 Screw - Upper Pump Housing
24 Screw - Clamp, Outer Pump Housing
25 Valve - Exhaust Relief
26 Spring - Exhaust Relief Valve
27 Grommet - Water Tube, Lower
28 Grommet - Water Tube, Upper
29 Gland - Water Tube
30 Nut - Water Tube
31 Tube - Water
32 Bushing - Shift Rod, Upper
33 Plug - Water Flushing
34 Bushing - Rubber
35 Spacer - Rubber Bushing
36 Housing - Pump
37 Nut - Shock Mount Retaining
38 Screw - Shock Mount Retaining
39 Screw - Shock Mount Retaining
40 Washer - Lock
41 Shock Mount Assembly
42 Flange and Driveshaft Casing Assembly
43 Bushing - Rubber
44 Lining - Swivel Bracket
45 Support - Shock Mount, Powerhead
46 Washer - Thrust, Swivel Bracket
47 Nut - Tilting Shaft Bolt
48 Washer - Tilting Shaft
49 Spring - Tilting Shaft
50 Bolt - Tilting Shaft
51 Link - Safety Chain
52 Nut - Wing, Thrust Socket Bolt
53 Washer - Thrust Socket Bolt
54 Plate - Lock, Stern Bracket
55 Stern Bracket and Screw Assembly Port
56 Retainer - Swivel Plate
57 Plate - Swivel Clamp Screw
58 Clamp Screw and Handle Assembly
59 Socket - Thrust
60 Bolt - Thrust Socket
61 Plate - Lock, Stern Bracket
62 Stern Bracket and Screw Assembly Starboard
63 Retainer - Swivel Plate
64 Plate - Swivel, Clamp Screw
65 Clamp Screw and Handle Assembly
66 Washer - Conical, Tilting Shaft
67 Spring - Reverse Lock
68 Pin - Cotter
69 Rod - Reverse Lock
70 Lever - Locking, Reverse
71 Screw - Swivel Bracket
72 Washer - Swivel Bracket
73 Spring - Swivel Bracket
74 Swivel Bracket and Screw

LOWER UNIT

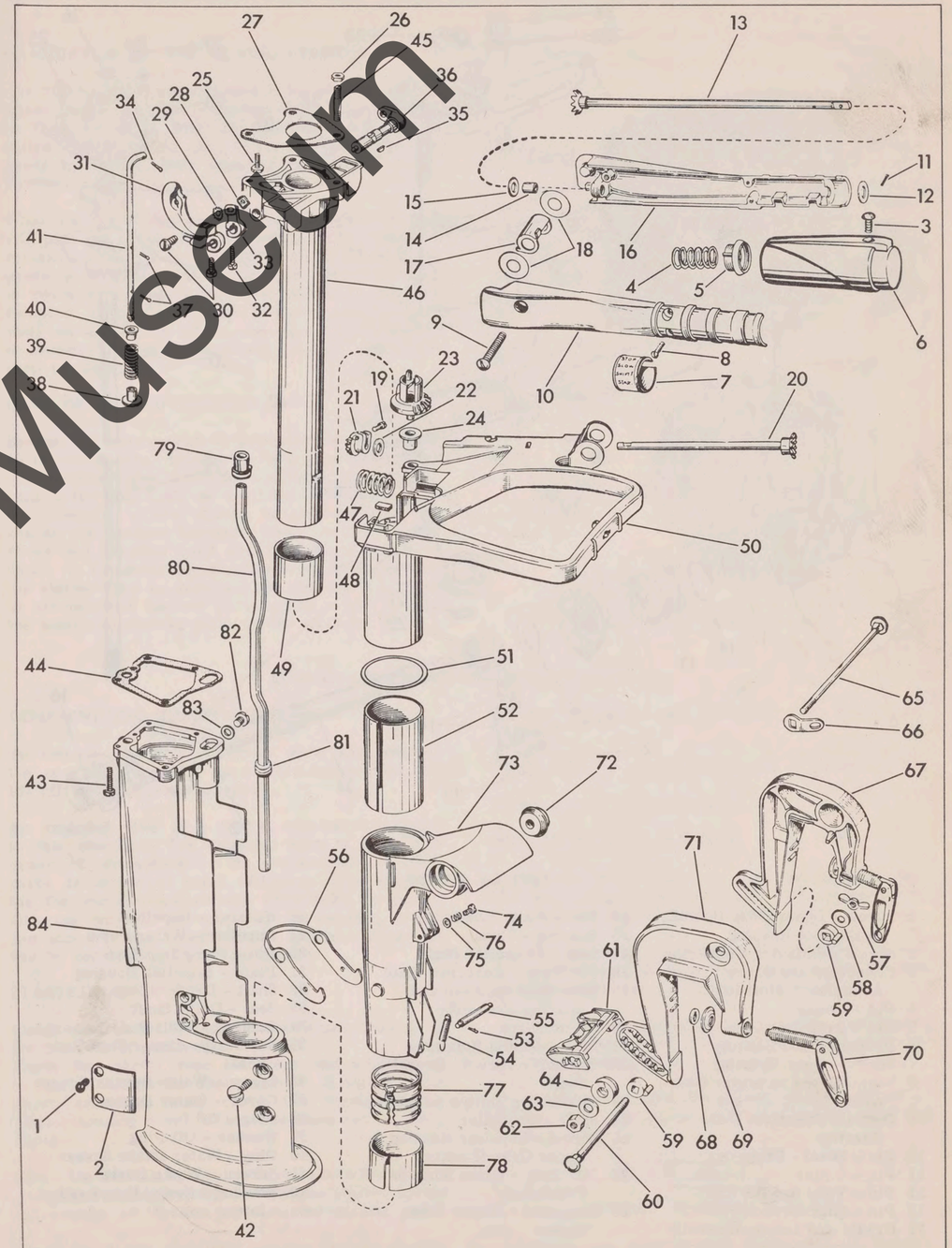
MODEL 12D11

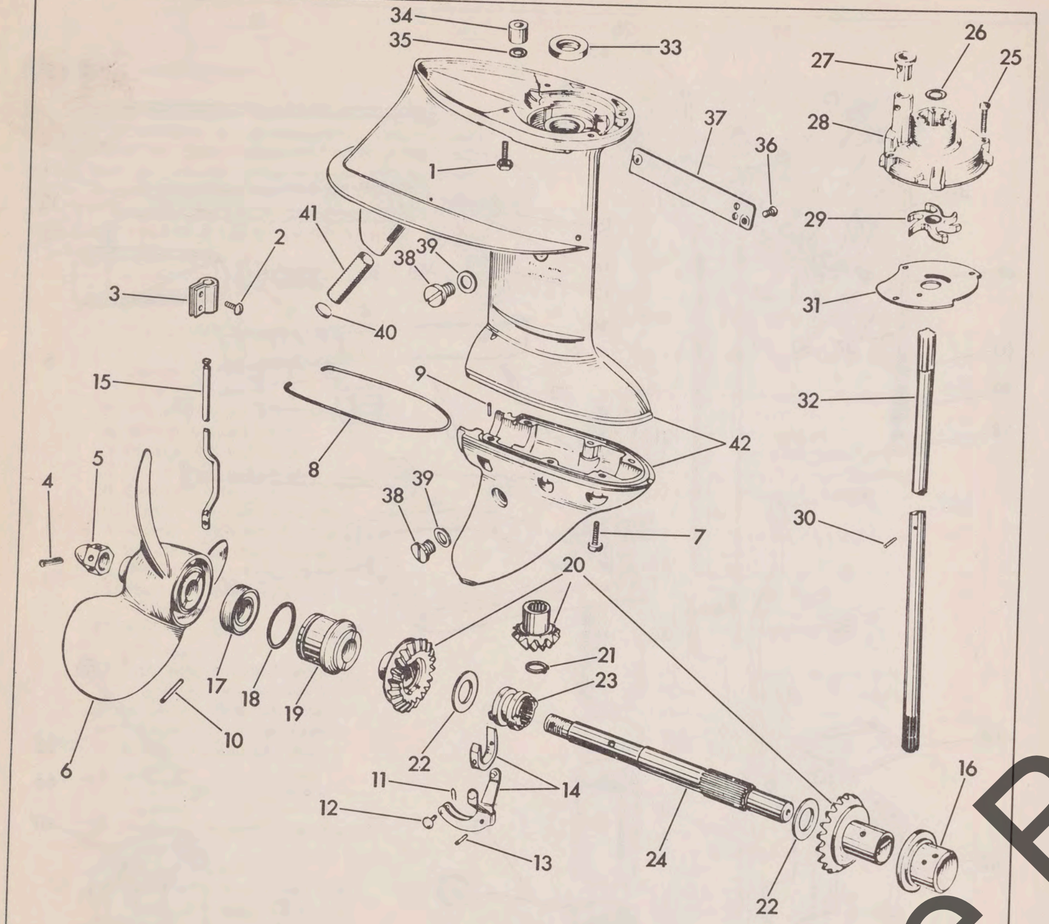
OVERHAUL INFORMATION

The exploded views are indexed in order of disassembly. Therefore to disassemble, remove parts in sequence of index numbers. To reassemble, put together in reverse sequence of index numbers. Special instructions for disassembly and assembly are given previously in this chapter. Be sure this chapter is read thoroughly before working on lower unit.

LIST OF PARTS

1 Screw - Exhaust Housing Cover Plate
2 Plate - Cover Exhaust Housing
3 Screw - Twist Grip
4 Spring - Twist Grip
5 Block - Grip Friction
6 Grip - Steering Handle
7 Plate - Throttle Control
8 Screw - Steering Handle Halves
9 Screw - Steering Handle Halves
10 Handle - Steering, Inner Half
11 Pin - Groove, Gear and Shaft Assembly
12 Washer - Steering Handle to Spring
13 Throttle Control Gear and Shaft Assembly, Long
14 Bushing - Steering Handle
15 Washer - Steering Handle
16 Handle - Steering, Outer Half
17 Cover - Steering Handle Gears
18 Washer - Steering Handle to Bracket
19 Screw - Pinion
20 Throttle Control Gear and Shaft Assembly, Short
21 Pinion - Throttle Control
22 Washer - Throttle Control Pinion Gear
23 Gear - Throttle Control
24 Bushing - Throttle Control
25 Screw - Flange to Cylinder, Short
26 Nut - Flange to Powerhead
27 Gasket - Flange to Powerhead
28 Nut - Shift Handle Adjusting Screw
29 Washer - Lock
30 Screw - Gear Shift Handle Adjusting and Clamp
31 Gear Shift Handle and Pin Assembly
32 Screw - Shift Handle Adjusting Lever Clamp
33 Lever - Shift Handle Adjusting
34 Pin - Cotter
35 Key - Adjusting Lever to Shaft
36 Shaft and Lever Assembly
37 Pin - Cotter
38 Sleeve - Reverse Lock
39 Spring - Shift Rod
40 Sleeve - Shift Rod
41 Rod - Shift, Upper
42 Screw - Exhaust Housing Clamp
43 Screw - Powerhead Exhaust Housing
44 Gasket - Exhaust Tube
45 Stud - Flange to Powerhead, Short
46 Flange and Drive Shaft Casing Assembly
47 Spring - Mounting, Powerhead to Lower Unit
48 Pad - Motor Mount
49 Lining - Steering Bracket
50 Steering Bracket and Bushing
51 Washer - Thrust, Swivel Bracket
52 Lining - Swivel Bracket
53 Pin - Cotter
54 Spring - Reverse Lock
55 Rod - Reverse Lock
56 Lever - Reverse Locking
57 Nut - Wing, Thrust Socket Bolt
58 Washer - Thrust Socket Bolt
59 Plate - Lock, Stern Bracket
60 Bolt - Thrust Socket
61 Socket - Thrust
62 Nut - Tilting Shaft Bolt
63 Washer - Tilting Shaft
64 Spring - Tilting Shaft
65 Bolt - Tilting Shaft
66 Link - Safety Chain
67 Stern Bracket Assembly - Port
68 Retainer - Swivel Plate
69 Plate - Swivel Clamp Screw
70 Clamp Screw Assembly
71 Stern Bracket Assembly - Starboard
72 Washer - Conical, Tilting Shaft
73 Swivel Bracket and Screw Assembly
74 Screw - Swivel Bracket
75 Washer - Swivel Bracket
76 Spring - Swivel Bracket
77 Bushing - Rubber, Drive Shaft Casing
78 Spacer - Rubber Bushing
79 Grommet - Water Tube, Upper
80 Tube - Water
81 Grommet - Water Tube, Center
82 Plug
83 Washer - Plug
84 Exhaust Housing and Screw Assembly





LIST OF PARTS

1 Screw - Upper Gear Housing to Exhaust Housing
2 Screw - Shift Rod Connector
3 Connector and Screw Assembly - Shift Rod
4 Pin - Cotter
5 Nut - Propeller
6 Propeller and Bushing
7 Screw - Gear Housing
8 Seal - Upper to Lower Gearcase
9 Dowel - Front and Rear Bearing
10 Pin - Shear, Propeller
11 Pin - Cotter
12 Pin - Yoke to Shift Rod
13 Pin - Shift Lever Pivot
14 Cradle and Lever Assembly
15 Rod - Shift, Lower
16 Bearing - Front
17 Seal - Propeller Shaft
18 "O" Ring - Gearcase Head
19 Gear Housing Head and Bearing Assembly
20 Set of Gears
21 Ring - Pinion Retaining
22 Washer - Thrust, Propeller Shaft
23 Clutch Dog Shifter Assembly
24 Shaft - Propeller
25 Screw - Impeller Housing to Upper Gear Housing
26 "O" Ring - Drive Shaft to Crankshaft
27 Grommet - Water Tube, Lower
28 Housing - Impeller
29 Impeller - Water Pump
30 Pin - Pump Impeller
31 Plate - Impeller Housing
32 Shaft - Drive
33 Seal - Drive Shaft
34 Bushing - Shift Rod, Lower
35 "O" Ring - Lower Shift Rod Seal
36 Screw - Water Bypass Cover
37 Cover - Water Bypass
38 Plug - Oil
39 Washer - Oil Plug
40 Plug - Water Intake Screen
41 Screen - Water Intake
42 Housing - Gear, Upper and Lower

CHAPTER SEVEN - REWIND STARTER

DESCRIPTION OF THE REWIND STARTER

The starter pawls are mounted on the starter pulley. These pawls are also connected to the equalizer cup by light springs. When the starting cord grip is pulled, the frictional drag of the cup will cause the pawls to extend, thus engaging the ratchet on the flywheel.

When the motor has started, the ratchet teeth will slip past the spring loaded pawls until the operator releases pressure on the starter cord, allowing the pawls to withdraw from the ratchet. When the cord is rewound on the pulley, the starter mechanism remains idle. Consequently, there can be little wear on any of the parts, and very little attention is needed. Action is automatic, simply pull on the cord to crank.

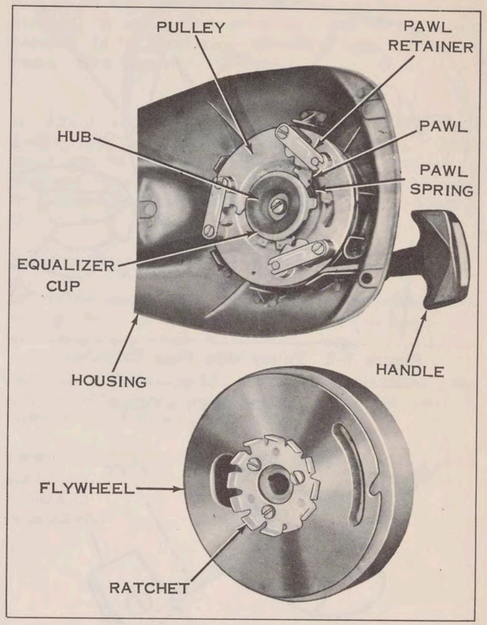


Figure 7-1. Rewind Starter

CARE OF REWIND STARTER

Instruct all owners and all mechanics also to, under no circumstances, let the starting grip "snap" back into position after cranking and letting go. Retain hold of the grip until the cord has returned to normal position. Care should be exercised in this respect to prevent possible injury to the starter cover and starting cord and also the gas tank or hood. In the event the starting cord should break, the starter may be removed and the motor cranked in conventional manner by wrapping a cord around the auxiliary starting plate on the flywheel.

HOW TO OVERHAUL THE REWIND STARTER

DISASSEMBLING THE STARTER

To remove starter for service or repair, remove the screws which hold the starter to fuel tank and lift off entire starter assembly.

An exploded view of a typical starter is included in this chapter. The exploded view is indexed in order of disassembly. To disassemble, remove parts in order of index numbers. The starters for the various motors are essentially the same, differing only in the shape of the housing, length and size of rope, and starter spring. Hence all can be serviced in the same manner.

STARTER INSPECTION

Check the ratchet for wear, and be sure that it is not bent out of position or broken.
Check the starter rope for wear and any breaks in fabric. Check the rope anchor. If starter rope shows excessive wear check the opening in the starter housing cover to be sure there are no sharp edges.

Check the starter spring anchors in both the starter pulley and starter housing. Check the starter spring for cracks or broken or distorted anchor ends.

Check the three equalizer springs and the starter friction spring to see that they have the proper tension.

Check the rope handle for cracks or wear.

Check starter pawls for wear.

REPLACING STARTER ROPE

If the rope shows signs of wear, but is still intact and the spring tension has not been released, the rope may be replaced as follows:

a. Pull rope so that it is fully extended. Insert a pin through the hole in starter pulley to hold pulley securely in place. (See figure 7-2.)

b. Pry clamp assembly from handle and disassemble. (See figure 7-3.) This allows handle to be removed from rope.

c. Remove old rope by pulling anchor end out of pulley slot (see figure 7-2) and pulling rope out through slot.

CAUTION

DO NOT RELEASE PULLEY.

d. Insert new rope through pulley slot and through

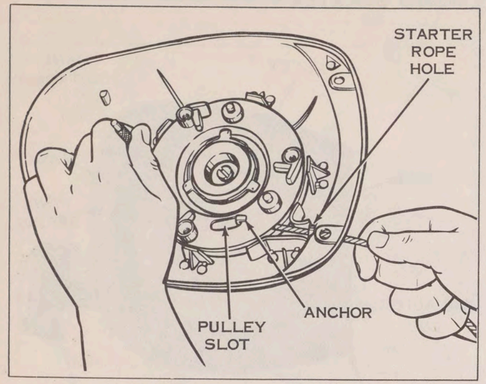


Figure 7-2. Pulley with Rope Extended

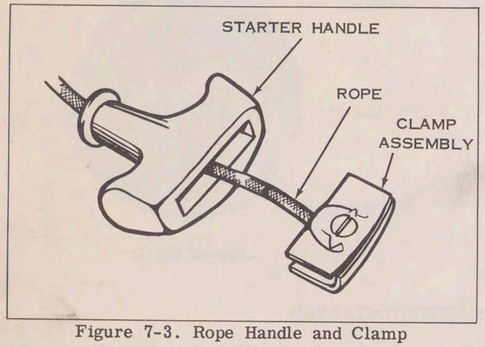


Figure 7-3. Rope Handle and Clamp

starter rope hole in starter housing so that anchor end is engaged in pulley slot.

NOTE

As an added precaution, it may be wise to tie a knot in the rope a couple inches from starter rope hole while replacing handle and clamps. This will prevent spring from unwinding in the event that the pin should accidentally be knocked out of the pulley.

e. Replace starter handle and clamp assembly (see figure 7-3).

f. Remove pin from hole in starter pulley and allow rope to rewind slowly around starter pulley.

If rope has broken and starter spring tension has been released it will be necessary to disassemble starter as explained under REPLACING STARTER SPRING.

REPLACING STARTER SPRING

To replace starter spring, it is necessary to completely disassemble the starter assembly. Refer to figure 7-1 and exploded view for location of parts.

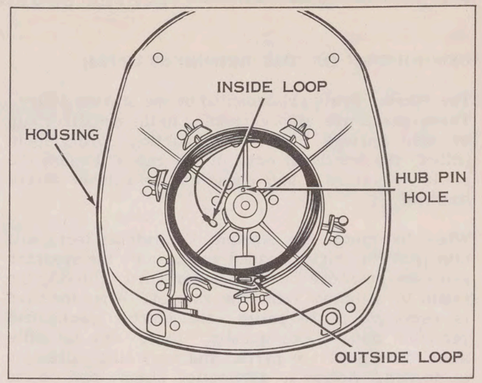


Figure 7-4. Installing Starter Spring

a. Pry clamp assembly from handle and disassemble. (See figure 7-3). Allow rope to wind slowly around pulley until spring tension has been completely released.

b. Unhook the three pawl springs and remove.

c. Remove screw and washers from center of hub.

d. Remove hub and pin assembly, equalizer cup, friction spring, starter pulley, rope and starter spring.

When starter is completely disassembled, install new starter spring as follows:

a. Place outer loop of starter spring over post in housing and wind spring in a counterclockwise direction until it fits down into housing. (See figure 7-4.)

b. Place starter pulley in starter housing so that pin on starter pulley fits into the inside loop of the starter spring.

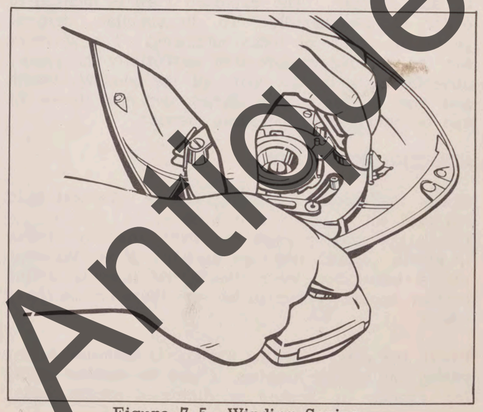


Figure 7-5. Winding Spring

c. Insert starter hub into equalizer cup and friction spring. Make sure that spring is in correct position and is over step on hub as shown in figure 7-6.

d. Install assembled hub, equalizer cup and friction spring in starter pulley, making certain that the pin on starter hub is engaged in the hole in the starter housing.

e. Install washer, lockwasher and screw in center of hub. Equalizer cup must turn against friction spring tension. If not check for binding.

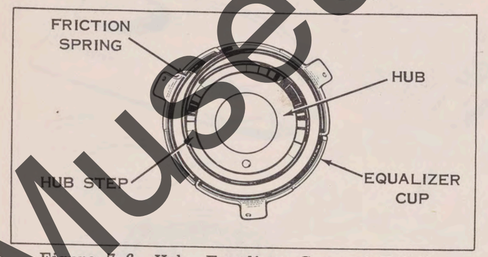


Figure 7-6. Hub, Equalizer Cup and Friction Spring Assembled

f. Wind up starter spring until tight. The simplest way to do this is to invert starter housing on a flat surface, grasp pulley securely, and turn starter housing in a clockwise direction until spring is tight. (See figure 7-5.)

g. Allow starter spring to release slowly until pulley slot is opposite starter rope hole. Then place pin in hole in starter pulley to hold pulley securely in position. Then install rope as described in paragraphs d, e and f of REPLACING STARTER ROPE.

Reassemble remainder of starter as follows:

a. Install starter pawls, pawl retainers, lockwashers and screws, making sure that pawls move freely and are engaged in slots in equalizer cup.

b. Hook starter pawl springs in equalizer cup and attach other ends of springs to the nearest pawl in a counterclockwise direction.

Replace starter assembly on fuel tank and check operation.

STARTER

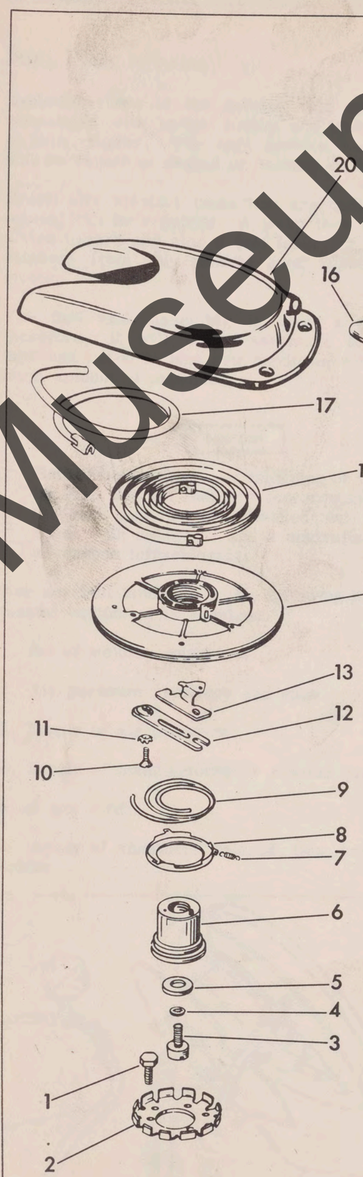
MODELS . . . . . All Models

OVERHAUL INFORMATION

The exploded view is indexed in order of disassembly. Therefore to disassemble, remove parts in sequence of index numbers. To reassemble, put together in reverse sequence of index numbers. Special instructions for disassembly and assembly are given previously in this chapter. Be sure this chapter is read thoroughly before working on starter.

NOTE

Just one exploded view of the rewind starters is shown as all models are essentially the same - the only differences being in the starter rope, rewind spring, and the size and shape of the housings.



LIST OF PARTS

1 Screw - Ratchet to Flywheel
2 Ratchet - Starter
3 Screw - Hub to Housing
4 Washer - Lock
5 Washer - Starter Spindle
6 Spindle and Pin Assembly
7 Spring - Pawl
8 Cup - Equalizer
9 Spring - Friction
10 Screw - Retainer
11 Washer - Lock
12 Retainer - Starter Pawl
13 Pawl - Starter
14 Clamp and Screw - Rope
15 Clamp - Starter Rope
16 Handle - Starter
17 Starter Rope and Anchor Assembly
18 Pulley Assembly - Starter
19 Spring - Starter
20 Starter Housing Assembly

FUEL TANK REPAIRS

Exploded views of the various fuel tanks are incorporated with motor covers and trim at the end of this chapter. The only service work on tanks will be repair of dented or leaking tanks.

Practically all fuel tanks that are badly dented or leaking can be repaired. A leaky tank is definitely a fire hazard and also a fuel loser. A dented tank detracts from the general good appearance of a motor.

The fuel tank assembly is quite a costly item: therefore, it will be of advantage to repair the tank and put it in like new condition with the minimum amount of expense.

CAUTION

Before undertaking any repairing or welding, be sure that all fuel has been removed from the tank and the tank flushed out several times with hot water and a neutralizer such as carbon tetrachloride.

For any fuel tank repair, the following list of fundamental equipment is required.

1. Set of welding equipment.
2. Air pressure regulator and gage.
3. Supply of air pressure.
4. Supply of manufactured or natural gas.
5. A gas torch.
6. Supply of aluminum weldrod, flux, and aluminum solder.
7. Tank repair bench.
8. Holding fixture and stands.

The following procedures are those used in the factory repair shop to repair a damaged tank:

a. Drain dented tank thoroughly, flush with hot water. Mount on fixture. Attach air pressure hose from regulator to tank outlet.

b. With filler cap removed from tank, apply torch directly into filler neck of tank for a few moments then play torch all around tank for a few seconds and again apply torch to open filler neck. Repeat this process several times to be sure THAT ALL GAS FUMES HAVE BEEN REMOVED FROM THE PORES OF THE METAL. When it becomes positive that there are no more gas fumes left that might ignite, then the filler cap can be replaced and air pressure applied.

c. Apply approximately eight to ten pounds (never any more) air pressure on tanks. Play flame around outside outline of dent, working toward its center but keeping most of the heat directed toward outside of dent. It will necessitate time and experience for one to apply just the right amount of heat so as not to cause metal to melt at which time air pressure would blow out the overheated area.

d. With the affected area properly heated it is relatively easy to remove all but the sharpest dents by tapping around the outer rim of the dent with a small wooden or rawhide mallet. This slight jarring effect helps the air pressure to push the dent back into its original position. Care must be used in tapping the tank so as not to put in additional dents. With experience it will be found that by using a torch with one hand and mallet with the other, the constant application of heat and tapping will remove the dents quite easily.

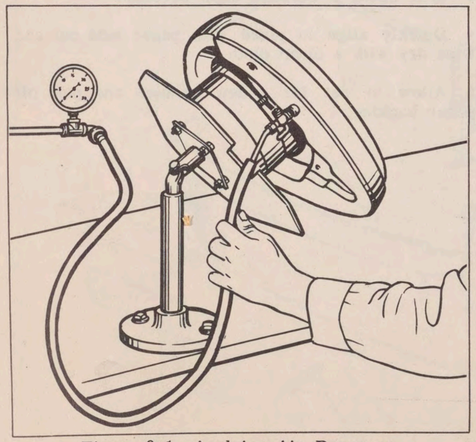


Figure 8-1. Applying Air Pressure

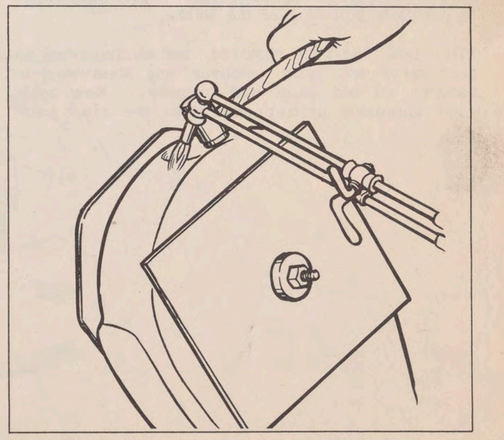


Figure 8-2. Applying Heat to Tank Dent

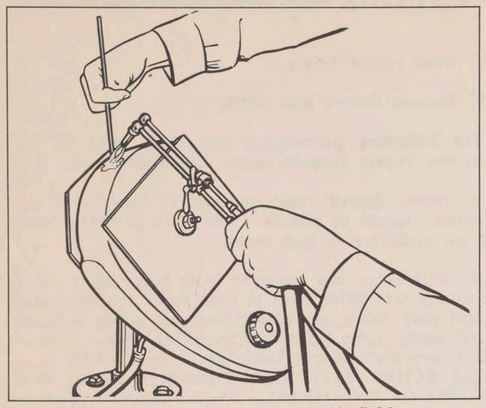


Figure 8-3. Filling Dent with Solder

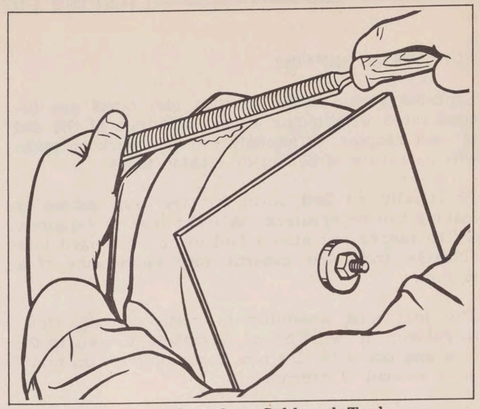


Figure 8-4. Filing Soldered Tank

e. Sharp dents that cannot be removed by the above process can be filled with aluminum solder and filed smooth, giving the appearance of a new tank.

Small holes or cracks can be welded up without cutting and patching. Be sure to use a good grade of aluminum weldrod that is adaptable to sheet aluminum welding.

Thoroughly clean all surfaces to be welded and proceed with welding in prescribed method as recommended by weldrod manufacturer. Immediately after welding and before the tank cools, clean off excess flux in manner prescribed by weldrod manufacturer.

Various methods can be used in polishing a weld to get a semi-smooth appearance; namely power-driven polishing wheels, emery cloth used by hand, rotary files, and flat Vixen files which are available in various shapes and sizes. When the weld has been made on a highly polished tank, use a power-driven cloth polishing wheel with a polishing rouge to complete polishing of the weld.

After tank has been repaired, tested, (polished as necessary) use paint remover and steel wool to remove all old paint and transfer. Now apply good aluminum primer paint then the color paint as originally used on the motor. After paint has had time to dry, apply decals as outlined in the following instructions.

As a business and good-will builder, it is recommended that all tarnished or ragged transfers be replaced on motors that come to you for service. Your customer will be pleased, and the impression on others who see the motor will be to your credit. Transfers for most motors are still available, at low cost. If the original decals are not available, we can always supply an accommodation decal that will be suitable.

Install decals as follows:

1. Be sure that surface to which transfer is to be applied is clean and reasonably smooth.

2. Mix a solution of one-half 41-B Solution and one-half water.

3. Soak decal in solution eight seconds.

4. Quickly align in place with paper side out and wipe dry with a clean cloth.

5. Allow to set for a few minutes and peel off paper backing.

MODELS 3D10, 3D11

OVERHAUL INFORMATION

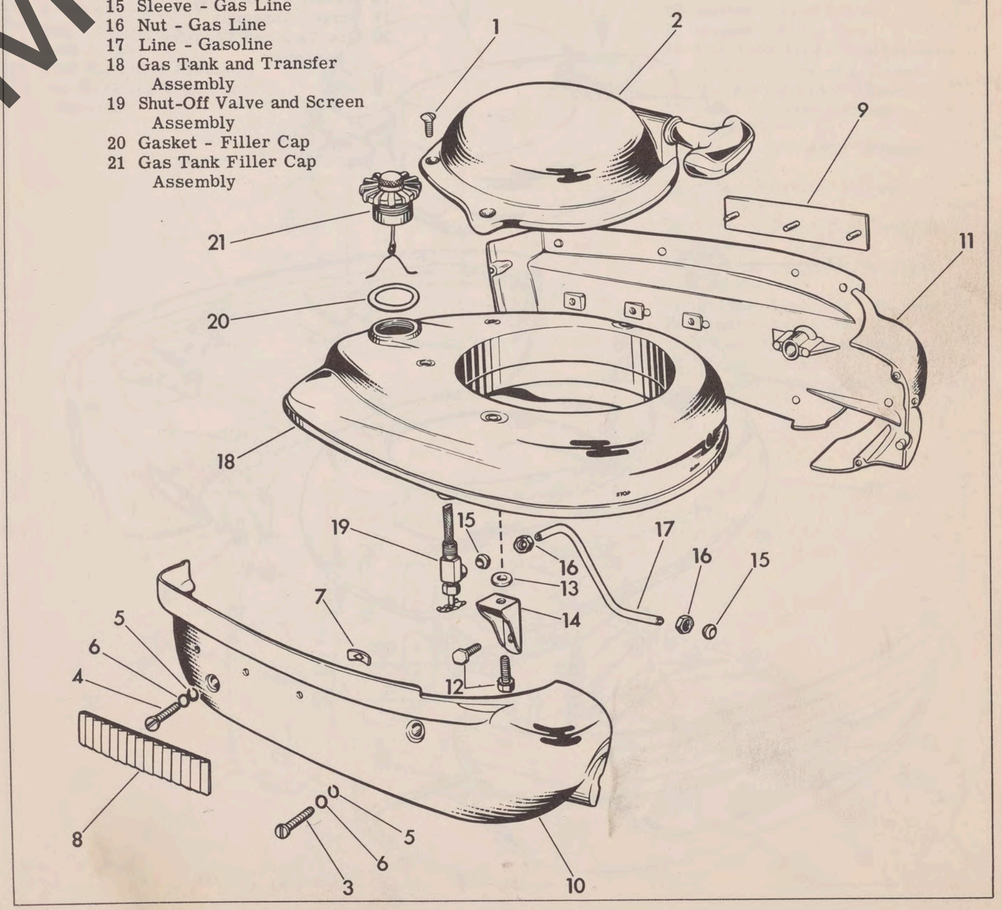
The exploded view is indexed in order of disassembly. Therefore to disassemble, remove parts in sequence of index numbers. To reassemble, put together in reverse sequence of index numbers. Special instructions for disassembly and assembly are given previously in this chapter. Be sure this chapter is read thoroughly before working on fuel tank and trim.

NOTE

Motor covers and other trim are included here with the fuel tank since they will normally be repaired and refinished at the same time as the tank.

LIST OF PARTS

1 Screw - Starter Housing
2 Starter Assembly
3 Screw - Side Cover Mounting, Front
4 Screw - Side Cover Mounting, Rear
5 Ring - Lock
6 Washer - Side Cover Mounting Screw
7 Nut - Plate to Cover Mounting
8 Plate - Motor Cover, Starboard
9 Plate - Motor Cover, Port
10 Cover - Side, Starboard
11 Cover - Side, Port
12 Screw - Gas Tank Mounting
13 Washer - Gas Tank to Bracket
14 Bracket - Gas Tank
15 Sleeve - Gas Line
16 Nut - Gas Line
17 Line - Gasoline
18 Gas Tank and Transfer Assembly
19 Shut-Off Valve and Screen Assembly
20 Gasket - Filler Cap
21 Gas Tank Filler Cap Assembly



FUEL TANK AND TRIM

MODELS 5S10, 5D10

OVERHAUL INFORMATION

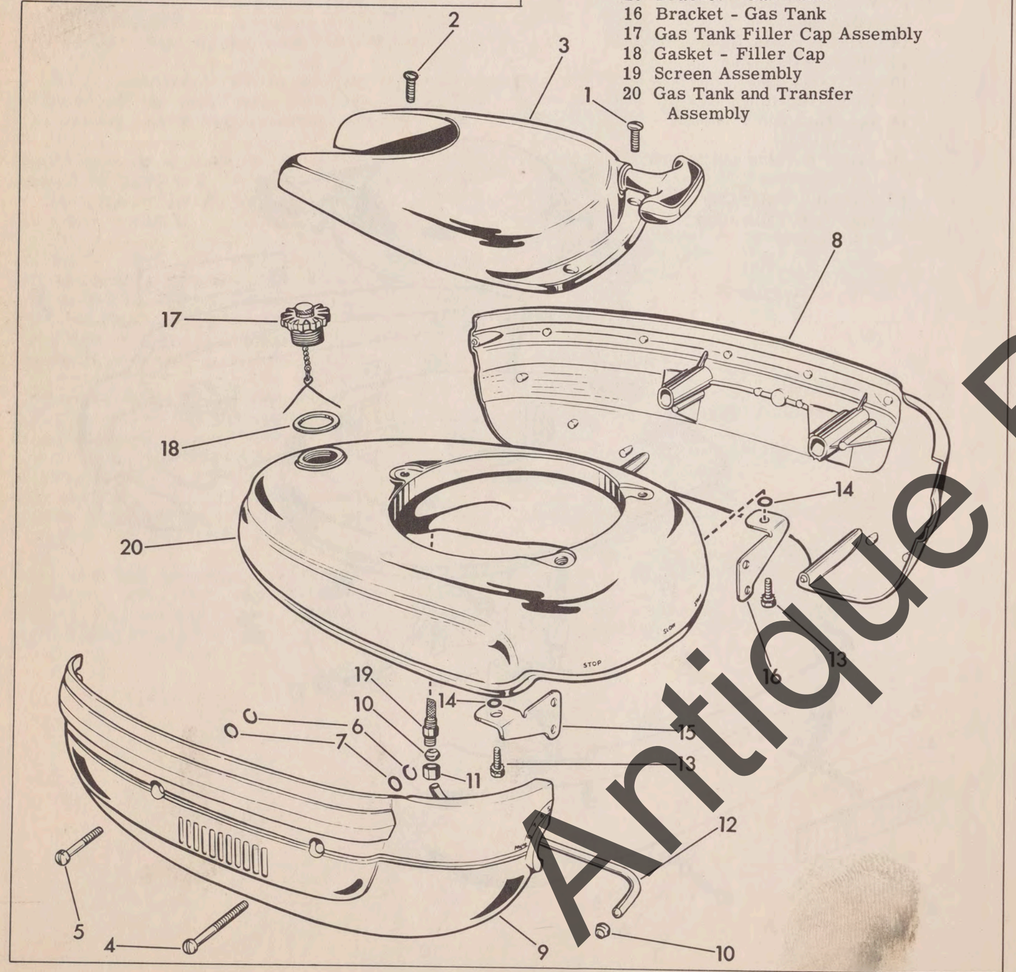
The exploded view is indexed in order of disassembly. Therefore to disassemble, remove parts in sequence of index numbers. To reassemble, put together in reverse sequence of index numbers. Special instructions for disassembly and assembly are given previously in this chapter. Be sure this chapter is read thoroughly before working on fuel tank and trim.

NOTE

Motor covers and other trim are included here with the fuel tank since they will normally be repaired and refinished at the same time as the tank.

LIST OF PARTS

1 Screw - Starter Housing, Front
2 Screw - Starter Housing, Rear
3 Starter Assembly
4 Screw - Motor Cover, Front
5 Screw - Motor Cover, Rear
6 Ring - Lock, Motor Cover
7 Washer - Plain, Motor Cover
8 Cover - Motor, Port
9 Cover - Motor, Starboard
10 Gland
11 Nut - Gas Line
12 Line - Gas
13 Screw - Gas Tank to Bracket
14 Washer - Gas Tank Mounting
15 Bracket - Gas Tank
16 Bracket - Gas Tank
17 Gas Tank Filler Cap Assembly
18 Gasket - Filler Cap
19 Screen Assembly
20 Gas Tank and Transfer Assembly



FUEL TANK AND TRIM

MODELS 12S10, 12D10

OVERHAUL INFORMATION

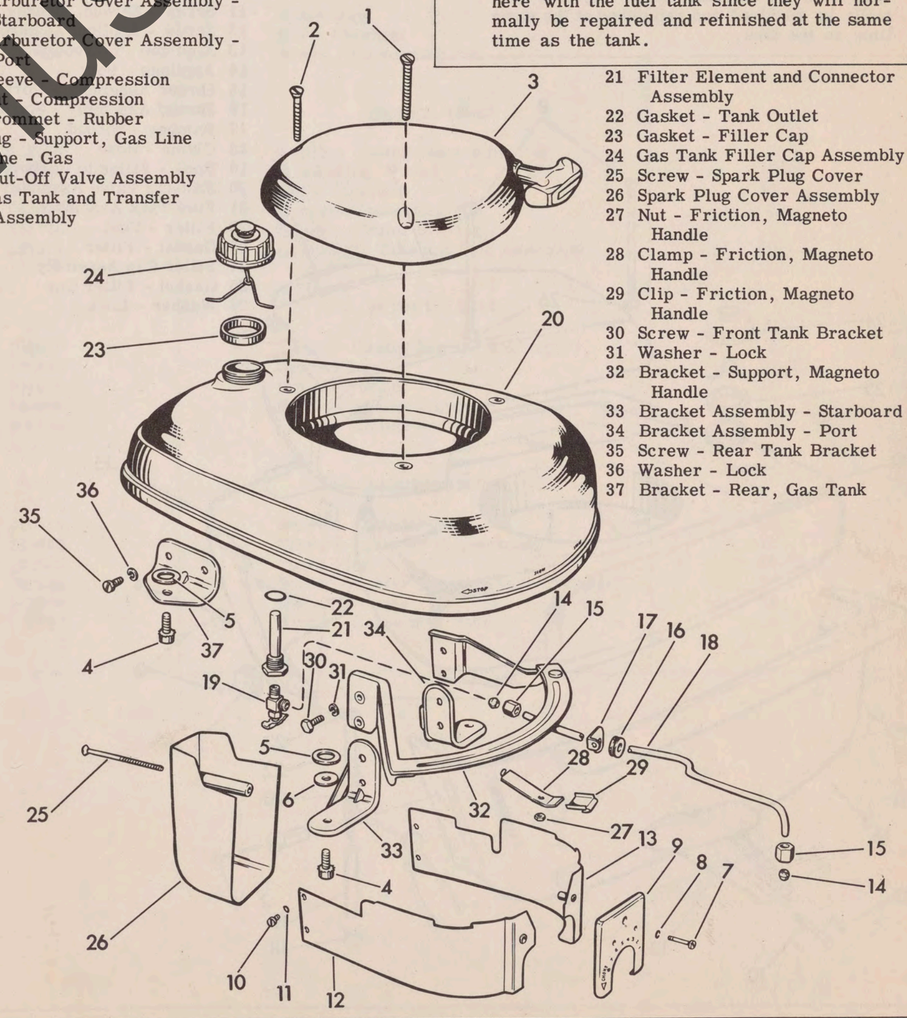
The exploded view is indexed in order of disassembly. Therefore to disassemble, remove parts in sequence of index numbers. To reassemble, put together in reverse sequence of index numbers. Special instructions for disassembly and assembly are given previously in this chapter. Be sure this chapter is read thoroughly before working on fuel tank and trim.

NOTE

Motor covers and other trim are included here with the fuel tank since they will normally be repaired and refinished at the same time as the tank.

LIST OF PARTS

1 Screw - Starter Housing Mounting, Long
2 Screw - Starter Housing Mounting, Short
3 Starter Assembly
4 Screw - Gas Tank Mounting
5 Washer - Gas Tank Mounting
6 Washer - Gas Tank Mounting
7 Screw - Carburetor to Cover
8 Washer - Lock
9 Clamp - Carburetor Cover
10 Screw - Carburetor Cover
11 Washer - Lock
12 Carburetor Cover Assembly - Starboard
13 Carburetor Cover Assembly - Port
14 Sleeve - Compression
15 Nut - Compression
16 Grommet - Rubber
17 Lug - Support, Gas Line
18 Line - Gas
19 Shut-Off Valve Assembly
20 Gas Tank and Transfer Assembly
21 Filter Element and Connector Assembly
22 Gasket - Tank Outlet
23 Gasket - Filler Cap
24 Gas Tank Filler Cap Assembly
25 Screw - Spark Plug Cover
26 Spark Plug Cover Assembly
27 Nut - Friction, Magneto Handle
28 Clamp - Friction, Magneto Handle
29 Clip - Friction, Magneto Handle
30 Screw - Front Tank Bracket
31 Washer - Lock
32 Bracket - Support, Magneto Handle
33 Bracket Assembly - Starboard
34 Bracket Assembly - Port
35 Screw - Rear Tank Bracket
36 Washer - Lock
37 Bracket - Rear, Gas Tank



FUEL TANK AND TRIM

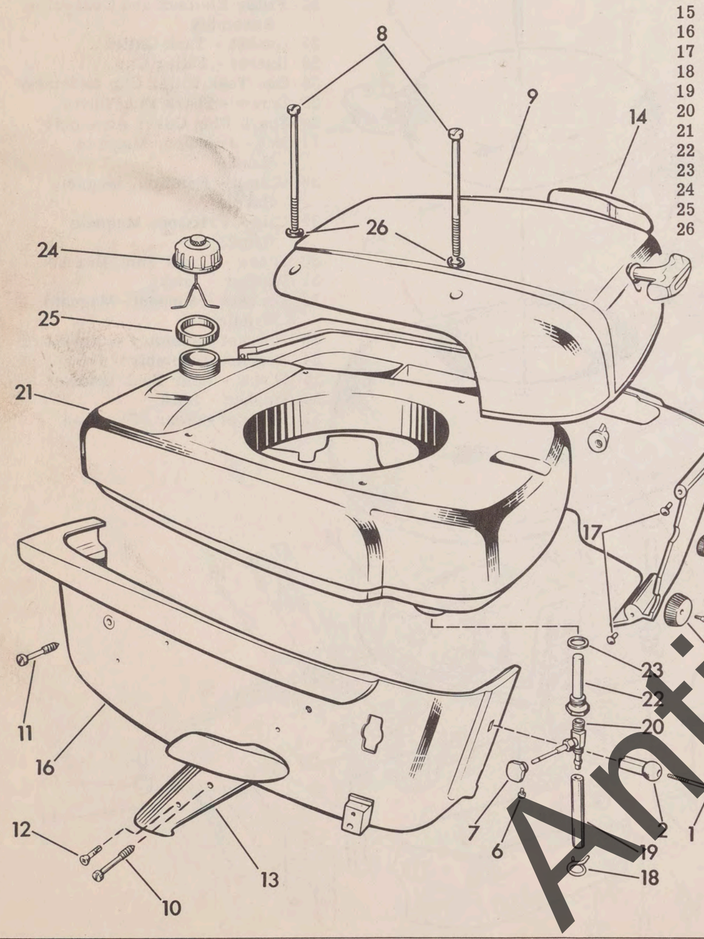
MODEL 12D11

OVERHAUL INFORMATION

The exploded view is indexed in order of disassembly. Therefore to disassemble, remove parts in sequence of index numbers. To reassemble, put together in reverse sequence of index numbers. Special instructions for disassembly and assembly are given previously in this chapter. Be sure this chapter is read thoroughly before working on fuel tank and trim.

NOTE

Motor covers and other trim are included here with the fuel tank since they will normally be repaired and refinished at the same time as the tank.



LIST OF PARTS

1 Screw - Choke Knob
2 Knob - Choke Control
3 Screw - Carburetor Knob
4 Slow Speed Control Knob Assembly
5 High Speed Control Knob Assembly
6 Screw - Knob to Shut-Off Valve
7 Knob - Shut-Off Valve
8 Screw - Starter Housing and Gas Tank Support
9 Starter Assembly
10 Screw - Shroud, Front
11 Screw - Shroud, Rear
12 Screw - Applique to Shroud
13 Applique - Starboard
14 Applique - Port
15 Shroud Assembly - Port
16 Shroud Assembly - Starboard
17 Bumper - Shroud
18 Clamp - Hose
19 Hose - Filter to Carburetor
20 Shut-Off Valve Assembly
21 Fuel Tank Assembly
22 Filter - Fuel
23 Gasket - Filter
24 Filler Cap Assembly
25 Gasket - Filler Cap
26 Washer - Lock

CHAPTER NINE-SPECIFICATIONS

RECOMMENDED TORQUE TENSIONS FOR FOLLOWING NUTS AND SCREWS

Part Number	Description	Torque (Ft./Lbs.)
	MODELS 3D10 AND 3D11	
130743	Nut - Flywheel	45
200322	Spark Plug	15-25
550067	Screw - Connecting rod	5
	MODELS 5D10 AND 5S10	
200322	Spark Plug	15-25
301988	Nut - Flywheel	45
550067	Screw - Connecting rod	5
	MODEL 12S10	
132679	Screw - Center bearing holding	8
200322	Spark Plug	15-25
301988	Nut - Flywheel	45
550969	Screw - Connecting rod	8
551749	Screw - Center bearing	8
590577	Driveshaft Tube and Stop Assembly	100
	MODEL 12D10	
132679	Screw - Center bearing holding	8
200322	Spark Plug	15-25
301988	Nut - Flywheel	45
550969	Screw - Connecting rod	8
551749	Screw - Center bearing	8
	MODEL 12D11	
21-486	Screw - Cylinder head	10
25-242	Screw - Cylinder to crankcase	10
200322	Spark Plug	15-25
203249	Screw - Center, crankcase to cylinder	10
301988	Nut - Flywheel	45
552183	Screw - Connecting rod	8

TABLE OF TOLERANCES AND SIZES

DESCRIPTION	3D10 & 3D11	5S10	MOTOR MODEL 5D10	MOTOR MODEL 12S10	12D10	12D11
Spark Plug Gap	.030	.030	.030	.030	.030	.030
Breaker Point Gap	.020	.020	.020	.020	.020	.020
Top & Center (Main) Crankshaft Journals	.8100 - .8105	.8080 - .8085	.8080 - .8085	.9980 - .9985	.9980 - .9985	.9995 - 1.0000
Bottom (Main) Crankshaft Journal	.8100 - .8105	.8075 - .8080	.8075 - .8080	.9980 - .9985	.9980 - .9985	.9995 - 1.0000
Crankshaft Crankpins (Rods)	.8100 - .8105	.8100 - .8105	.8100 - .8105	.8730 - .8735	.8730 - .8735	.8730 - .8735
Crankcase Bearing - Upper	.8125 - .8130	.8100 - .8105	.8100 - .8105	1.0000 - 1.0005	1.0000 - 1.0005	1.0025 - 1.0030
Clearance	.0020 - .0030	.0015 - .0025	.0015 - .0025	.0015 - .0025	.0015 - .0025	.0025 - .0035
Crankcase Bearing - Center	None	.8100 - .8105	.8100 - .8105	1.0015 - 1.0020	1.0015 - 1.0020	1.0025 - 1.0030
Clearance	None	.0015 - .0025	.0015 - .0025	.0030 - .0040	.0030 - .0040	.0025 - .0035
Crankcase Bearing - Lower	.8120 - .8125	.8100 - .8105	.8100 - .8105	1.0010 - 1.0015	1.0010 - 1.0015	1.0025 - 1.0030
Clearance	.0015 - .0025	.0020 - .0030	.0020 - .0030	.0025 - .0035	.0025 - .0035	.0025 - .0035
Piston - Top Ring Land	2.1195 - 2.1200	1.9335 - 1.9340	1.9335 - 1.9340	2.3662 - 2.3667	2.3662 - 2.3667	2.2420 - 2.2425
Piston Skirt	2.1215 - 2.1220	1.9355 - 1.9360	1.9355 - 1.9360	2.3715 - 2.3725	2.3715 - 2.3725	2.2470 - 2.2475
Piston Clearance at Skirt	.0025 - .0040	.0015 - .0030	.0015 - .0030	.0040 - .0060	.0040 - .0060	.0020 - .0035
Piston Rod - Crankpin Bore	.8110 - .8115	.8110 - .8115	.8110 - .8115	.8750 - .8755	.8750 - .8755	.8730 - .8740
Piston Rod - Piston Pin Bore	.4375 - .4380	.4375 - .4380	.4375 - .4380	.6251 - .6256	.6251 - .6256	.6157 - .6162
Piston Ring Gap - Compressed	.005 - .015	.005 - .015	.005 - .015	.007 - .017	.007 - .017	.007 - .017
Piston Ring Diameter - Compressed	2.1250	1.9375	1.9375	2.3750	2.3750	2.2500
Piston Ring - Width	.0925 - .0935	.0925 - .0935	.0925 - .0935	.0925 - .0935	.0925 - .0935	.0925 - .0935
Cylinder Bore	2.1245 - 2.1255	1.9375 - 1.9385	1.9375 - 1.9385	2.3765 - 2.3775	2.3765 - 2.3775	2.2495 - 2.2505
Drive Shaft	.37375 - .37500	.4370 - .4380	.4365 - .4375	.62375 - .62500	.4990 - .5000	.4990 - .5000
Drive Shaft Bearing - I.D.	.3765 - .3775	.4390 - .4400	.4390 - .4395	.6260 - .6270	.5020 - .5025	.5020 - .5025
Propeller Shaft Bearing Surface - Front	.4365 - .4375	.5615 - .5620	.4880 - .4883	.6870 - .6875	.6250 - .6255	.6250 - .6255
Propeller Shaft Bearing Surface - Rear	.4365 - .4375	.5615 - .5620	.4880 - .4883	.6870 - .6875	.6683 - .6688	.6683 - .6688
Propeller Shaft Bearing - Front I.D.	.4385 - .4400	.5635 - .5645	.4890 - .4900	.6885 - .6890	.6265 - .6270	.6265 - .6270
Propeller Shaft Bearing - Front O.D.	Cast In	Cast In	Cast In	Cast In	.9365 - .9370	.9365 - .9370
Propeller Shaft Bearing - Rear I.D.	None	None	.4890 - .4895	None	.6698 - .6703	.6698 - .6703
Shear Pin Size	*See Note	*See Note	None *See Note	*See Note	*See Note	*See Note

*NOTE:

3D10 & 3D11 - 1/8 x 7/8 in. #416 Stainless Steel
5S10 - 3/16 x 15/16 in. #11S-T3 Aluminum
5D10 - Propeller Pin Used, Not a Shear Pin
12S10 - .206 - .211 x 1-3/16 in. #416 Stainless Steel
12D10 - 3/16 x 1-3/16 in. SAE #73 Naval Brass, Non Leaded
12D11 - 3/16 x 1-3/16 in. SAE #73 Naval Brass, Non Leaded

GALE PRODUCTS

GALESBURG, ILLINOIS

PREPARED BY KEN COOK CO MILWAUKEE

LITHO U.S.A.