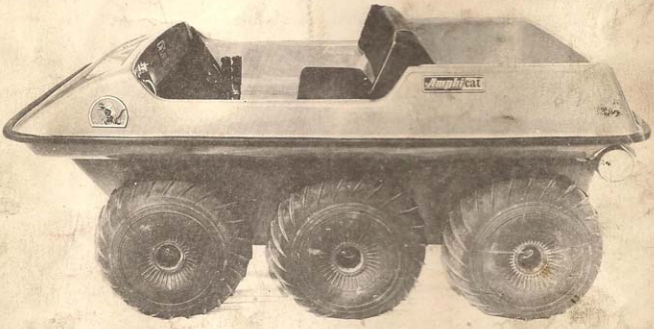
Amphicat

Sole United States Distributor:
MOBILITY UNLIMITED, INC

# SERVICE MANUAL

MODEL NO. 0079, 0080, 0081, 0082




MAGNA AMERICAN CORPORATION
Raymond, Mississippi 39154

Bulletin 511368 11-68 Rev. 10-1-69 PRICE $2.00 Litho in U.S.A.

# AMPHICAT

## SERVICE AND REPAIR MANUAL

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## SPECIFICATIONS

### CAUTION

**Amphicats** are made to operate over all types of terrain. Prolonged operation on hard surfaced roads will shorten tire life. Operators who anticipate operation in water should assure themselves that body drain plugs are in place and secure and that previous operation over certain terrain has not punctured the body sufficiently to allow entry of water.

LENGTH - 87"

WIDTH - 53"

HEIGHT - 35"

WEIGHT - 560 App.

SPEED - 25 MPH - Land, 2 MPH Water

STARTER - Elec. w/Aux. Recoil

CLUTCH - St. Lawrence - Torque Sensitive

DRIVE - Variable Speed, Torque Sensitive St. Lawrence belt drive and roller chain

TRANSMISSION - Dual drive multiple disk with planetary gear reverse system immersed in oil

MUFFLERS - Exterior mtd. - Donaldson

BRAKE - Hand operated steel band with woven lining

THROTTLE - Hand operated, Automatic return to idle

TIRES - High Flex, low pressure, pneumatic

BODY - Vacuum formed ABS high impact plastic

SEATING CAPACITY - Two (2) persons

LIGHTING Two (2) 35 Watt Sealed Beam Headlights

FUEL TANK - 5 U. S. Gallons

LUBRICATION - ENGINE (SACHS) - 25.1 using SAE 40 (or 50) automotive Engine Oil

BREAKER POINT GAP - (SACHS ENGINE) - .016 Inch

SPARK PLUG - (SACHS ENGINE) - Bosch M240T1 or Champion UK10

SPARK PLUG GAP - (SACHS ENGINE) - .025 to .030 inch

CARBURETOR - (SACHS ENGINE) - Tillotson Diaphram type

CARBURETOR FUEL VALVE SETTING - Low Speed Valve - 1 Full Turn, - High Speed Valve - 1 Full Turn

BATTERY - 12 Volts, 32 Ampere hour rating. Dimensions 7 3/4" Long, 5 1/8" Wide and 7 3/8" High to top of Terminals

ENGINE -

Sachs, Model SA-280 16 H.P.
Weight - 72 lbs.
Swept Capacity - 277 CC (16-902 Cu. In.)
Type of Operation - 2 Cycle
Bore - 71 MM (2.795 In.)
Stroke - 70 MM (2.756 In.)
No. of Cylinders - One
Compression ratio - 8-1
Out Put - 16 H.P. at 5200 RPM
Ignition - Bosch flywheel magneto 75 Watts
Lighting Output - 12 Volt, 75 Watts
Ignition Timing - Stopped - 0.4 MM (0.016 IN.) before TDC
Running - 4.0 MM (0.157 IN.) before TDC
Contact Breaker Gap - 0.4 + 0.05 (0.016 + 0.002 In.)

AIR CLEANER - Donaldson - Micro Filter

TORQUE CHART -

| | |
|---|---|
| Crankcase bolts | 15.9 - 17.4 Ft. Lb. |
| Cylinder head bolts | 33.3 - 34.7 Ft. Lb. |
| Armature base plate | 2.9 - 4.3 Ft. Lb. |
| Contact Braker Hub | 4.3 - 5.8 Ft. Lb. |
| Magneto ring in Housing | 6.5 - 8.0 Ft. Lb. |
| Cylinder nuts | 18.1 - 19.5 Ft. Lb. |
| Fan nuts | 3.6 - 5.1 Ft. Lb. |
| Crankcase, Magneto Side | 39.1 - 43.4 Ft. Lb. |

SECTION II

# INSTALLATION

## MAKE READY FOR DELIVERY

In order to insure customer satisfaction after delivery, the following operations must be performed:

1. Cut strapping and remove carton top and ends from crate.
2. Remove tires from crate.
3. Inspect **Amphicat** visually for body damages which may have occured in transit.
4. Remove and check contents of tool kit and material envelope for the following:
   a. Owners Manual
   b. Parts Manual
   c. Engine Tool Kit
   d. Wheel lug wrench
   e. 20 Wheel lug nuts
   f. 2 # 40 chain connector links
   g. I valve stem cap
   h. 4 bolts for fastening seat back to Engine cover
   i. Ignition Key, (Tied to Ignition Switch)
   j. 1 Body drain plug
5. Seperate RH from LH tires and inflate to 63". (Note; Tires will swell from ½" to 1" in circumference after they have been inflated for awhile. The 63" circumference should be re-checked after a period of (10) ten hours. If correction is needed, completely deflate tire and re-inflate to 63" O.C.

Fig. 2-1

6. Charge battery
   a. Fill the battery with battery grade electrolyte of 1.250 to 1.265 specific gravity
   b. Allow battery to stand a minimum of fifteen (15) minutes
   c. Place battery on fast charge for fifteen (15) minutes. In cold weather longer charging periods are desirable
   d. Install battery in battery rack
7. After battery has been installed, turn ignition switch (see 3 in Fig. 2-2) to START to check starting circuit. Also,pull light switch (see 4 in Fig 2-2) to "ON" and check lighting
8. Remove engine brace strap which supports engine in transit
9. Check bolts and nuts
10. Fill gas tank with fuel to which has been added the proper amount of oil. The Sachs engine uses a 25.1 ratio of gas to SAE 40 HD oil. (1 quart to 6 gallons). **Do not use 2 cycle oil.**
11. Start **Amphicat**

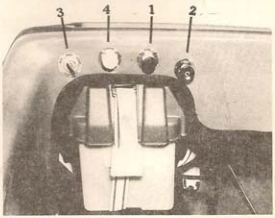


Fig. 2-2

   a. Pull FUEL VALVE handle to on. (See1 in Fig. 2-2) Note: Each time engine is turned off FUEL VALVE should be closed to prevent possible siphoning of fuel and flooding engine.

b. Pull choke on. (See 2 in Fig. 2-2)

c. Turn starter switch to "START" cranking engine until it fires. (See 3 in Fig. 2-2) When engine fires, push choke knob off and continue cranking until engine starts. In some cases, choke may be left partially on and then opened gradually as engine warms up. If engine floods from excessive choking, crankcase must be drained.

d. Check idle adjustment. (See 1 in Fig. 2-3) Valve should be turned counter-clockwise one full turn from fully closed.

e. Check High Speed adjusting valve. (See 2 in Fig. 2-3) Valve should be turned counter-clockwise one full turn from fully closed and then adjusted slightly for smooth high speed operation. CAUTION: Valve minum opening is one full turn. Leaner setting will diminish lubricating oil supply and result in premature piston, ring and cylinder wear.

Fig. 2-3

12. Drive **Amphicat**

a. Check forward controls. **Amphicat** sholud travel stright line when both levers are held firmly forward.

b. Check turns Right and Left.

c. Check brakes.

d. Check reverse. **Amphicat** should travel straight line when reverse pedal is depressed.

13. Delivery to customer

Complete instructions for operating and maintenance of **Amphicat** are included in the owner's manual packed with each machine. Be sure that the customer receives this material and that he is instructed to read it throughly before putting his vehicle into operation. The following items are so important they should be discussed with the customer at the time of delivery.

a. Correct gasoline and oil mixture. One (1) quart of SAE 40 (or 50) automotive type oil to six (6) gallons of regular brand gasoline.

b. Be sure Customer understands the starting procedure. Point out crankcase drain at rear of engine so Customer will know how to drain crankcase in the event of flooding.

c. Be sure Customer knows how to operate steering controls.

d. Be sure Customer understands chain lubrication and maintenance.

e. Caution Customer to follow engine break-in period - 20 - 30 hours below maximum output.

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## SECTION III

## SYSTEMS OPERATION

### CARBURETION

This is the system that controls the intake of air-fuel into the two-cycle engine.

When the piston is on the up stroke, it creates a partial vacuum in the crankcase. When the piston is on the down stroke, it compresses the crankcase charge and seals off the crankcase from the carburetor.

Gasoline, in it's liquid state, burns relatively slowly with an even flame. However, when gasoline is combined with air to form a vapor, the mixture becomes highly inflammable and burns with an explosive effect. To obtain the sharpest, strongest explosion, the fuel and air must be correctly proportioned and thoroughly mixed. It is in the function of the carburetor to accomplish this.

Gasoline vapor will burn when mixed with

air in a proportion from 12:1 to 18:1 by weight. Mixtures of different proportions are required for different purposes. Idling requires a relatively rich mixture; a leaner mixture is desirable for maxium economy under normal load conditions; high speeds require a rich mixture for maximum power. The carburetor is designed to deliver the correct proportion of fuel and air to the engine for these various conditions.

A shutter or butterfly valve in the throat regulating the amount of air drawn through the carburetor. To vary the speed of the engine, the throttle shutter opens or closes, regulating the amount of fuel-air-mixture drawn into the engine.

A richer fuel mixture is required for starting a cold engine. A second shutter, called a choke, is placed in the throat forward of the jets, to restrict the flow of air. When shut ter is closed, more gasoline flows into the air stream, resulting in a richer fuel mixture. When normal operating temperature is reached, the choke is opened and the standard ratio of gasoline and air is allowed to flow through the carburetor.

IGNITION

The ignition system provides a high voltage electric current which causes a spark to jump the spark plug gap within the cylinder and thus ignite the compressed fuel-air-mixture in the cylinder. The ignition system consists of the magneto drive coil (s), breaker point (s), and condenser, and the ignition coil assemblies (y). A permanent magnet built into the flywheel revolves around the magneto drive coils. As the magnet moves past the coils, the direction of the magnetic flux through the coil is changed from one direction to the other. Self-inductance of the magneto drive coil circuit, completed through the breaker points. When the points open, the flux changes direction very rapidly, inducing a higher current in the coil which flows through the ignition coil primary windings. The ignition coils transform this current to a very high voltage which is sufficient to discharge across the spark plug gap.

The lighting system coils produce alternating current which changes in frequency and voltage in proportion to the engine speed. On models having electric starting, this alternating current output is converted to direct current by a diode bridge rectifier and used to charge the battery. Direct current from the battery is then used to power the headlights and the electric starter motor.

POWER FLOW

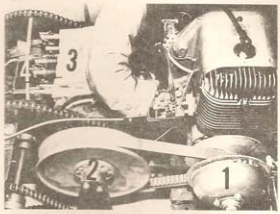


Fig. 3-1

Engine power is transmitted to the driving wheels by means of a torque sensitive torque converter and a mechanical transmission. (See 3 in Fig. 3-1) The torque converter primary (See 1 in Fig. 3-1) sheave is mounted on the engine crankshaft and its secondary sheave (See 2 in Fig. 3-1) is mounted on the left hand end of the transmission shaft. The primary sheave is centrifugally operated and engages as engine speed increases. The sheave assembly halves are separated by three (3) spring and roller assemblies which ride on fingers of the drive plate and pin assembly on the stationary hub. As the engine speed increases, centrifugal effect forces three (3) spring and roller assemblies in the ramp plate outward against the contour of the ramp plate, forcing the movable sheave axially into contact with the drive belt. As the sheaves are brought together, the drive belt is forced outward to ride on a larger diameter of the primary sheave assembly, increasing belt speed. Since the belt length remains constant, the secondary sheave halves spread apart, allowing the belt to ride on a smaller diameter. In this way, the engine transmits power through a variable ratio, presenting the engine with a mechanical advantage most favorable for its operating speed.

The drive ratio between the primary and secondary sheaves is variable from approximately 3:1 to 1:1. Power from the secondary sheave is transmitted through the transmission input shaft to the idler sprocket assemblies (See 4 in Fig. 3-1) and on to the center inner axles. The center inner axles are in turn, driving the front and rear axles by means of roller chains and sprockets.

OPERATING INSTRUCTIONS:

Fig 3-2

1. The throttle is hand operated and is attached to the right hand steering control lever. Pulling the throttle lever reaward opens the carburator throttle fly, increasing engine speed. When the lever is released the engine returns to idle speed.

2. Ignition-Starter Switch. (1 in Fig. 3-3) **Amphicat is** equipped with a key operated ignition-starter switch located on extreme Left hand side of control panel. There is a spring return from the START position to the ON position. After engine starts, release the key and the switch will return to the ON position.

3. Fuel Valve. ((2 in Fig. 3-3) In order to prevent possible fuel siphoning by the carburetor or leakage after engine shut down, the **Amphicat** is equipped with a PUSH-PULL fuel valve located to the right of the light switch. To open PULL knob outward. To close PUSH knob inward. FUEL VALVE should always be closed when **Amphicat** is stopped.

4. Choke. (3 in Fig. 3-3) The choke control knob is located on the dash panel to the right of fuel valve , Pull knob outward for cold starting. After engine fires, push knob inward gradually until engine warms up. If engine is stopped after having been run to warm up time try restarting without choking. If engine will not start pull out choke and crank until engine fires then push choke back in.

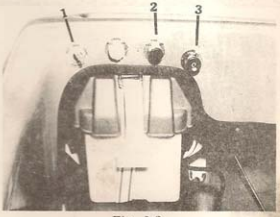


Fig. 3-3

5. Starter. The electric starter is the primary means of starting engine and the manual recoil starter is provided as a secondary starting method.

6. Engine cover fasteners. Engine covers are attached to the body under each end of seat by means of hinges. To remove the cover lift rear end of cover. Pull cover hinge pins on each side of front of cover and seat assembly and lift the cover out of **Amphicat**. (Fig. 3-4)

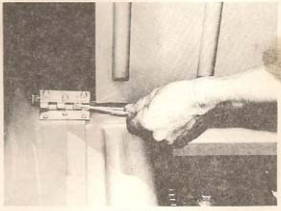

Fig. 3-4

7. Brakes. **Amphicat** is not equipped with a parking brake. Stopping is achieved by pulling firmly rearward on steering control levers. Brakes are also used for steering during forward travel.

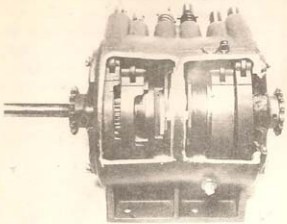

Fig. 3-5

8. Steering. The transmission in **Amphicat** is actually two separate driving units assembled into a common housing. The right hand side of the transmission drives the right hand wheels and the left hand side of the transmission drives the left hand wheels. The two transmission units are coupled together through manipulation of two control levers or the reversing pedal.

Fig. 3-6

Fig 3-7

Fig 3-8

Fig 3-9

To travel forward open the throttle to give engine operating speed and push forward firmly and simultaneously on the two (2) control levers. (See Fig. 3-6) To turn left maintain forward pressure on right control lever and pull rearward on left control lever. (See Fig. 3-7) To turn right maintain forward pressure on left hand control lever and pull rearward on right hand control lever. (See Fig. 3-8)

During high speed travel slight turns are made simply by releasing forward pressure on the control levers on the side to which turn is intended. Pulling back firmly on the control levers in this instance would result in a high speed sharp turn which could upset the vehicle.

Reverse travel is achieved by putting the steering control levers in neutral and depressing the foot operated pedal under front edge of seat. (See Fig. 3-9) Most efficient reversing is achieved with light pedal pressure. Reverse is not steerable.

## FUEL-OIL MIXTURE (SACHS)

Fuel tank capacity is five (5) U.S. gallons. It should be filled to about 4 1/2 gallons with branded regular grade gasoline to which has been added SAE 40 (or 50) automotive type motor oil. The correct ratio is 25:1 (or one (1) quart to six (6) gallons). Oil and gasoline should be premixed in separate containers to assure proper mixing.

## HOW TO START ENGINE

1. Make sure crankcase drain valve is located at rear of engine under electric starter is closed. Valve is sliding bar type with one end of bar being serrated. The serrated end should be away from valve when valve is closed.
2. Pull FUEL VALVE to ON.
3. Pull CHOKE knob to outward.
4. Open throttle slightly.
5. TURN IGNITION-START switch to start position, cranking engine until it fires. (NOTE: Since all fuel lines are empty it may take a few moments of choking before sufficient fuel reaches the carburetor. ) When engine fires, partially open choke and continue cranking until engine runs, then gradually open choke fully as engine warms up.
6. As soon as engine begins running, release ignition key which will automatically return to ON.
7. To stop engine, turn IGNITION-START switch to OFF position.
8. If headlights are required pull L I G H T switch to ON. Do not leave switch in ON position when engine is stopped. Since the generator in **Amphicat** is a 75 Watt system

and the headlamps together draw 70 Watts the battery will drain quickly during prolonged periods of operation with lights ON. Owners should be so instructed and have access to a trickle charger to maintain battery power. Since the charging system in **Amphicat** does not include a voltage regulator, prolonged periods of operation without lights might result in overcharging of battery. In such cases running with lights ON is recommended.

9. RECTIFIER - **Amphicat's** electrical charging system is equipped with a fuse rectifier located on the right side of engine and fastened to the chassis. Should the charging system fail, remove the rectifier cover and examine the two (2) five (5) amp fuses. If these fuses are burned out, replace with new ones. CAUTION: Disconnect battery ground cable before attempting rectifier repairs.

Fig. 3-10

NOTE: **Amphicats** bearing serial numbers prior to 4063 were equipped with SACHS engines having a 40 Watt electrical system, These engines use rectifiers incorporating one fuse only. In either case the fuse is OPEL # 1238300 and can be obtained at any Buick-Opel dealer.

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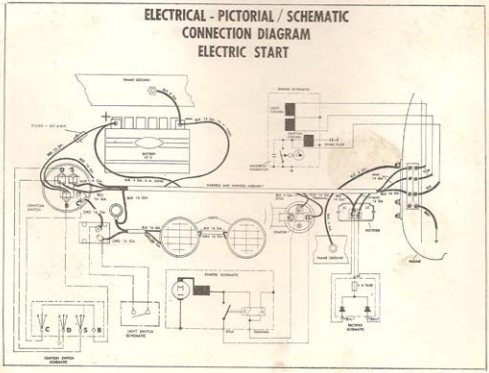
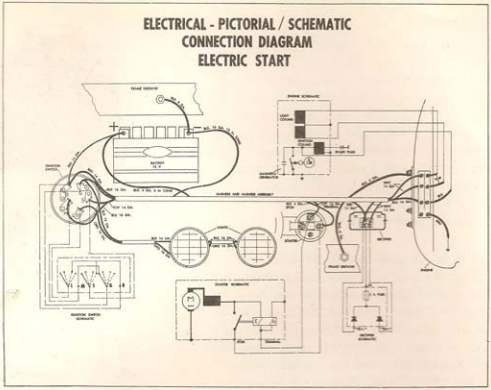
SECTION IV

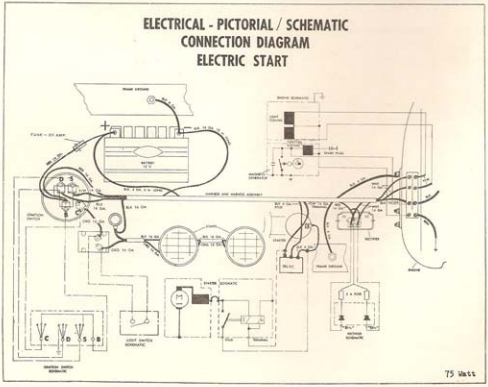
**WIRING DIAGRAM**



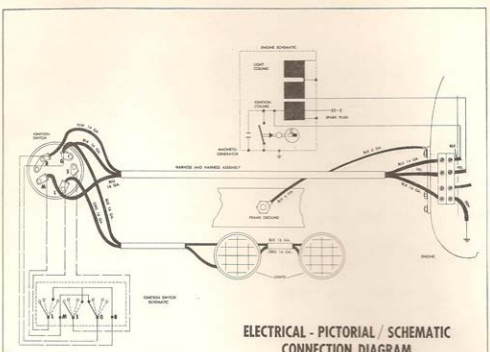

FOR 40 WATT SYSTEM AMPHICAT WITH SEPERATE STARTER AND LIGHT SWITCH




FOR 40 WATT SYSTEM AMPHICAT WITH INTEGRAL STARTER LIGHT SWITCH




FOR 75 WATT SYSTEM AMPHICAT



**ELECTRICAL - PICTORIAL / SCHEMATIC**
**CONNECTION DIAGRAM**
**MANUAL START**

FOR MANUAL START AMPHICAT WITH INTEGRAL START LIGHT SWITCH

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## SECTION V
## TROUBLE SHOOTING

### DESCRIPTION

This section provides some trouble shooting procedures for **Amphicat**. Suggestons for determining cause of malfunctions are outlined. Being able to locate the cause of trouble in an improperly operating **Amphicat** is as important as being able to correct the problems.

Technicians should avail themselves of every opportunity to throughly familiarize themselves with **Amphicat's** operating systems and mechanical makeup so that they can then take a systematic approach to trouble shooting.

Any service operation can be broken down into three (3) basic steps.

1. Identifying the problem.
2. Determining the cause of the problem.
3. Correcting the problem.

An accurate description of the trouble is essential for good trouble shooting. The owner's comments are a valuable source of information which serves as a clue to the cause of the problem. In so many cases the owner does not know the cause but his comments concerning the problem itself will, in all probability, materially assist the technician in determining the cause.

Ask questions about:

1. ENGINE
   a. How long had it been run?
   b. Did it idle O.K.?
   c. Did it run up to top speed smoothly?
2. CHASSIS
   a. Were all chains properly adjusted and lubricated?
   b. Were sprockets in alignment?
   c. Were all six (6) wheels pulling?
   d. Are there any loose or lost bolts or nuts?
   e. Are all axle pins in place and secured?
   f. Are tires inflated equally and at 63" circumference?

3. STEERING

a. Will **Amphicat** move
b. Will it travel straight forward or does it pull to right or left?
c. If it does not travel straight forward, is one side completely or only partially inoperative?
d. Do the stopping brakes function?
e. Does the reverse function?

4. BODY

a. Are there any water leaks and if so where?
b. Was the drain plug installed?
c. What type of terrain was the **Amphicat** in?
d. Did operator strike stones, trees, fences or fall in holes at high speeds?

STARTING

1. Hard to start or won't start.

a. Empty gas tank.
b. Fuel valve closed.
c. Water or dirt in fuel.
d. Vapor locked fuel system.
e. Fuel lines connected backward.
f. Filter clogged with foreign material.
g. Choke not properly adjusted.
h. Engine flooded.
i. Carburetor mounting loose.
j. Carburetor fuel valves improperly adjusted.
k. Spark plug fouled or incorrect spark plug.
l. Loose wires.
m. Breaker joints dirty, burned or improperly set.
n. Low compression.
o. Worn piston and rings.
p. Air leak at fuel valve.
q. Air filter clogged.

2. Engine won't crank over.

a. Piston frozen in cylinder.
b. Broken connecting rod or crankshaft.
c. Foreign object on top of piston.
d. Dead battery.
e. Loose wires.

3. Engine cranks extreamly easy.

a. Loose spark plug.
b. Loose cylinder head.
c. Low compression.
d. Hole burned in piston.
e. Broken or worn rings.
f. Crankcase seals worn.

4. Won't start but backfires.

a. Flywheel key sheared.
b. Wiring around rear of engine shorted.
c. Lean fuel mixture.
d. Timing maladjuster.
e. Carburetor mounting loose.

STARTING-ELECTRIC STARTER

1. Starter cranks to slowly.

a. Weak battery.
b. Loose or corroded connections.
c. Starter faulty.
d. Engine run without oil-gas mixture.

2. Starter will not crank engine.

a. Dead battery.
b. Faulty starter switch.
c. Wire connections loose or broken.
d. Starter wiring system not grounded.
e. Engine frozen.

RUNNING-LOW SPEED ONLY

1. Low speed miss.

a. Incorrect gas-oil mix.
b. Carburetor idle adjustment too lean or too rich.
c. Spark plugs improperly gapped, dirty or broken.
d. Loose or broken ignition wires.
e. Spark plug terminal loose.
f. Weak coil or condenser.
g. Breaker points burned, dirty or improperly gapped.
h. Cylinder gasket.
i. Leaking crankcase seals.

RUNNING-HIGH SPEED ONLY

1. High speed miss.

a. Water in fuel.
b. Spark plug heat range incorrect.
c. Spark plugs improperly gapped or dirty, cracked insulator.
d. Ignition wires loose or broken or faulty insulation.
e. Coil or condenser weak.
f. Breaker points burned, dirty or improperly gapped.
g. Engine improperly timed.
h. Combustion chambers carboned or fouled.

2. Poor accelaration, low top rpm.

a. Vapor lock.
b. Incorrect gas-oil ratio.
c. Old fuel.

d. Fuel hoses plugged or kinked.
e. Fuel filter restricted.
f. Carburetor diaphram faulty.
g. Incorrect carburetor mixture adjustments.
h. Needle valve setting incorrect
i. Inlet needle and seat worn or sticky.
j. Timing out of adjustment.
k. Spark plug dirty or improperly gapped.
l. Loose, broken or badly insulated high tension leads.
m. Breaker points worn or improperly gapped.
n. Coil or condensor weak.
o. Piston rings stuck or scored.
p. Excessive carbon on pistons and cylinder head.
q. Carburetor high speed needle set too lean.

3. Idles well, but acceleration poor, dies at full throttle.

a. Incorrect gas-oil ratio.
b. Fuel lines or passages obstructed.
c. Fuel filter clogged.
d. Carburetor diaphram faulty.
e. Needle valve setting incorrect.
f. High speed nozzle or jet clogged.
g. Dirt or packing behind needles and seats.
h. Choke partly clogged.
i. High speed needle set too lean.
j. Breaker points burned, dirty or improperly gapped.
k. Timing out of adjustment.
l. Fuel tank vent blocked or closed.

RUNNING-HIGH AND LOW SPEED

1. Engine overheats.

a. Incorrect gas-oil ratio or improperly mixed fuel.
b. Engine not assembled correctly during repair (binding)
c. Lean mixture.
d. Improper timing.

2. Engine stops suddenly or freezes up.

a. No oil in gas or no fuel.
b. Fuel connector faulty.
c. Cylinder or crankshaft scored.
d. Bent or broken rod, crankshaft or stuck piston.
e. Ignition failure.
f. Frozen bearing.

3. Engine knocks excessively.

a. Incorrect gas-oil ratio.
b. Spark plugs too hot.
c. Flywheel loose.
d. Crankshaft end play excessive.
e. Carbon in combustion chambers and exhaust ports or on pistons.
f. Worn or loose bearings, pistons, rods or wrist pins.
g. Loose assemblies, bolts or screws.
h. Manual starter not centered.
i. Carburetor running to lean.

4. Vibrates excessively or runs rough and smokes.

a. Too much oil mixed with gas.
b. Idle or high speed needles too rich.
c. Needle valve incorrectly adjusted.
d. Air passage to carburetor obstructed.
e. Faulty ignition.

5. No power under heavy load.

a. Faulty ignition.
b. Faulty ignition.
c. Breaker points improperly gapped or dirty.
d. Ignition timing late.
e. Carbon buildup on piston head.
f. Cylinder scored or piston stuck.
g. High speed adjustment lean.

ENGINE RUNS-**AMPHICAT** WILL NOT MOVE

1. Torque converter belt broken.
2. Torque converter primary pulley loose on engine shaft.
3. Steering control connecting rods disconnected.
4. Clevis pins connecting center axle tubes to outer axles sheared or omitted.
5. Main idler shaft sprockets loose on shaft.
6. Transmission drive sprockets loose on ring gear hubs.
7. Torque converter secondary pulley key left out.
8. Chains broken.
9. Forward clutch actuators incorrectly adjusted.
10. Forward clutches worn out.
11. No oil in transmission.
12. Operator depresses reverse pedal simultaneously with operating forward controls.

ENGINE RUNS - STEERS FORWARD - WILL NOT TURN TO RIGHT OR LEFT

1. Brakes not properly adjusted.
2. Forward clutch actuators not properly adjusted.
3. Steering control levers not properly rigged.
4. Chain broken on one side or the other.
5. Inner axle tube sprocket broken.
6. Key sheared in main idler sprocket hub.

7. Forward clutches inside transmission damaged on one side.
8. Transmission main shaft broken.
9. Right or left brake band broken.

**AMPHICAT** STEERS WELL FORWARD AND TO RIGHT AND LEFT BUT NO REVERSE

1. Reverse actuators disconnected from reverse pedal.
2. Reverse actuators disconnected from reverse bands inside transmission.
3. Torque converter belt worn and slipping.
4. Operator applies too much foot pressure combined with worn belt.
5. Steering controls not in neutral position.

FORWARD DRIVE CONSTANTLY DRIFTS TO RIGHT OR LEFT

1. Tires not equally inflated.
2. Load weight not equally distributed.
3. Forward clutch actuators not equally adjusted.
4. Front wheels out of alignment.

STEERS TO RIGHT OR LEFT IN REVERSE

1. Tires not equally inflated.
2. Reverse actuator not equally adjusted.
3. Idler drive chain broken one side.
4. Center axle tube sprocket broken one side.

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SECTION VI

## TUNE-UP PROCEDURE

### FACTORS AFFECTING PERFORMANCE

Because the **Amphicat** is primarily a fun vehicle the operator may not pay much attention to all of its systems as long as the engine is running well. His first concern will be the performance of the engine because only when it malfunctions will he be aware that something is wrong. Most people who own an **Amphicat** will not be mechanically inclined enough to realize that something could be on the verge of failure as long as they have a good running engine and as long as the vehicle can be operated.

In view of the above, it is well for the technician to inspect all systems and assemblies whenever he is called upon to repair or adjust any part of the **Amphicat.**

### FUEL SYSTEM

Engine life and performance depends mainly on a supply of clean fresh gasoline properly mixed with the correct ratio of recommended oil. A tank of fuel which has been allowed to stand for long periods will lose gasoline through evaporation resulting in a mixture too rich in oil. This results in hard starting, smoky exhaust, spark plug fouling and gummed up carburetor passages.

Incorrect carburetor adjustments may cause poor engine performance at any speed, premature engine wear due to lean gas-oil mixture and poor fuel mileage. Faulty choke operation results in hard starting, smoky exhaust, loss of power or engine flooding.

The diaphram pump in the carburetor is operated by alternating vacuum and pressure from the crankcase. Loose power tube or a split power tube results in hard starting, lean fuel-oil mixture.

Leaky fuel lines are dangerous. Fuel escaping onto the floor of the vehicle is a fire hazard.

Loose carburetor mounting bolts result in lean fuel supply to engine. Loose exhaust tube mounting bolts or leaky exhaust tubes allow gases to escape into the engine compartment causing body warpage.

### IGNITION SYSTEM

Incorrect spark plug heat range reduces engine performance or causes premature engine failure. A weak spark results in hard starting, misfiring or poor performance. Spark plugs should be checked frequently to assure good engine performance.

### COMPRESSION

Compression must be well sealed by the piston and rings in the cylinder to realize maximum performance and power. A compression check is important because an engine with low compression cannot be tuned sucessfully or will be hard to start.

### CHAIN DRIVES

In order to assure long chain and sprocket life the chain tension must be correct. Chains should be sufficiently tight to prevent the

rollers from jumping teeth on the sprocket but not so tight that the sprocket shaft bearings are excessively preloaded. All chains should be lubricated frequently. Because they operate at high speeds a graphitic lubricant in a good carrier liquid is recommended. This type of lubricant repels water but adheres well to the fast moving chains.

Sprocket alignment must be maintained at all times. Misalignment causes premature wear of chains and sprocket teeth and premature bearing failure.

TRANSMISSION

Drive the **Amphicat** and check all the steering controls for proper operation. If steering is erratic or does not function, adjust it. Customer may not realize that something is amiss and a few minutes spent in adjusting will satisfy him immensely.

TIRES

Improperly inflated tires detract from performance, appearance and tire life. Under inflated tires create drag on the propelling systems and demands more power. Steering control is reduced and tire damage on turns is more likely.

Over inflated tires increases possibility of puncture and causes "weather cracking".

SECTION VII

## FUEL SYSTEM

**To be supplied later. — — — — —**

SECTION VIII

## IGNITION AND ELECTRICAL SYSTEM

**To be supplied later — — — — —**

SECTION IX

## TRANSMISSION AND STEERING

### DESCRIPTION

This section gives service instruction on the **Amphicat** transmission and steering mechanism including removal, tear down, repair and replacement.

The transmission is unique in that it is two seperate drive mechanisms contained in one housing and no internal adjustments are possible. All parts need only be installed in their proper order and sequence and then the controls must be adjusted externally.

### REMOVAL OF PRIMARY TORQUE CONVERTER PULLEY

1. Lift engine cover.
2. Disconnect throttle and choke at controls at carburetor.
3. Remove exhaust tube mounting nuts at rear of cylinder head.
4. Disconnect cable connections from electric starter.
5. Disconnect engine to frame ground cable.
6. Disconnect battery charging and lighting circuit wiring at junction block on engine blower housing.
7. Loosen four (4) engine mounting plate bolts and two (2) engine snubber bolts.
8. Remove engine from **Amphicat** body.
9. Place suitable block in blower housing opening to prevent flywheel from turning. A wood dowel may be inserted into exhaust port. Piston can then be carefully brought up to the dowel to stop further movement of crankshaft.
11. Insert clutch dismount tool into center of primary clutch unit. Tighten tool until it contacts PTO end of crankshaft.
12. Strike dismount tool with a hammer, and retighten tool until clutch slides off crankshaft. Remove the tool from the clutch. CAUTION: Do not strike dismount tool excessively hard. Doing so may cause damage to crankshaft.

Re-assemble in reverse order of disassembly.

### REMOVAL OF DRIVEN CLUTCH AND TRANSMISSION

1. Disconnect master links of the two (2) chains running from the transmission to the idler sprocket.

Fig. 9-2

2. Remove the two (2) bolts which fasten the transmission shaft support bracket to the bearing collar on left end of transmission.

Fig. 9-3

3. Remove four (4) bolts which fasten transmission housing to chassis plate. There are two (2) bolts on lower front and two (2) bolts on lower rear sides of transmission . The nuts are welded to the underside of the chassis plate so no wrench is required to hold them.

Fig 9-4

4. Disconnect steering control rod weldment at end of weldment.

Fig. 9-5

5. Remove torque converter drive belt from secondary pulley.
6. Remove transmission from **Amphicat** and place it on work bench.
7. Pull off transmission shaft support bearing collar. This collar is a light press fit and should lift off by hand. At most it will require only two (2) blade type screw drivers inserted under collar and prying outward.

Fig. 9-6

8. Remove bearing retainer ring from end of transmission shaft.

Fig. 9-7

9. Remove bearing and bearing spacer. A bearing or gear puller must be used to remove this bearing.
10. Remove the driven pulley from the transmission shaft. A bearing splitter which will fit behind the pulley hub may be required to pull the pulley off. CAUTION: Do not strike outer edges of pulley.

Fig. 9-8

To replace the secondary pulley, reverse the above procedure. However, to facilitate replacement of the pulley on the shaft, be be sure shaft is clean and free of burrs. Pulley should slide easily onto the shaft. When placing the transmission assembly onto the frame, place the drive belt onto the support bearing collar only until the transmission is secured both to the chassis and to the bearing support brace. Then put the belt onto the pulley.

DISASSEMBLY OF TRANSMISSION

1. Remove transmission from **Amphicat** following procedure for Removal of Secondary Torque Converter Pulley and Transmission.
2. Drain oil from transmission.
3. Remove the six (6) cap screws from the outer edge of transmission covers and pry off. This will remove the cover, the ring gear and bearing assemblies, and the driving sprockets as a unit. In the event that repairs to the ring gear assembly are necessary, it can be more easily done after removal of the cover with the gear assembly.

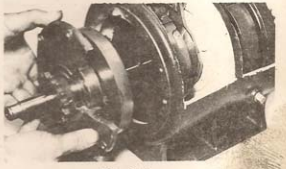


Fig. 9-9

4. Remove the planetary gear carriers assemblies.
   a. Sometimes when removing the ring gear assembly, the pinion carrier plate will adhere to it and will be found on its inner surface. In this event, removal of the ring gear assembly will expose the three (3) planetary gears and the sun gears still mounted onto the gear carrier and the assembly parts can be removed individually or as an assembly.

Fig.9-10

5. Remove the clutch discs. In removing the planetary gear carrier, some of the clutch discs may adhere to its inner surface.

Fig. 9-11

6. Remove the bronze pinion bearing and clutch collar. (See Fig 9-11)
7. Remove the loading spring retainer and the loading spring.

Fig. 9-12

8. Remove the clutch pressure plate and the thrust bearing.

Fig. 9-13

9. Remove all connecting clevis and cotter pins which attach the control linkage to the female actuators at top front of transmission. (See 2 in Fig. 9-14)

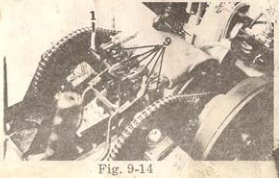



Fig. 9-14

10. Remove the two (2) hair pin retainers from the upper pivot rod (See 1 in Fig. 9-14) and remove the rod. The control linkage can now be pivoted away from the actuators. Do not remove the lower pivot rod unless the transmission case is being replaced with a new one.

Fig. 9-15

11. Remove the actuator plates. This will require unscrewing the female actuator shaft from the male actuator. It is not necessary to remove the female actuators unless repairs of replacement of them is necessary.
12. Remove the three (3) bolts which fasten the cam plates to the inner transmission wall. Note that while only three (3) bolts are used to mount the cam plates, there are six (6) holes provided. Only three (3) holes will match holes in the transmission wall on either side. This is done so as to assure proper mounting of the cam plates in exactly correct position on each side. It also provides for interchangeability of the plates from one side to the other to double the operating ramp life.

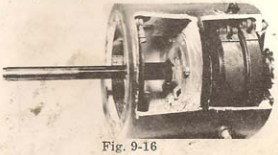


Fig. 9-16

13. Unscrew female actuators which are connected to the brake bands and remove the brake bands.

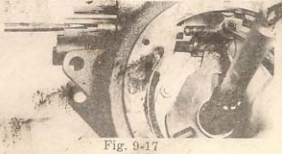


Fig. 9-17

The right hand ring gear is composed of the ring gear, an internal bronze bearing, an external ball bearing and an expansion plug fitted into the open end of the ring gear hub. The bronze bearing can be removed by driving it inward after removing expansion plug. The outer ball bearing can be removed by pushing it off from the inner side of the ring gear through the two (2) holes provided in the ring gear.

The left hand ring gear is essentially the same as the right hand side except that no expansion plug is used in the hub. There is an oil seal in the hub to prevent oil from passing out over the transmission shaft.

REASSEMBLY OF THE TRANSMISSION

1. Reinstall the cam plates. Since the bolt holes are not equally spaced, it will be necessary to turn the plate until the three (3) correct mounting holes are found which match the holes in the transmission wall.
2. Reinstall the brake assembly.
3. Reinstall the reverse brake band assembly.
4. Reinstall the cam actuator plates, making sure that the ramp side faces the center of the transmission.
5. Install the pressure plate thrust race. This is the thicker one of the two (2) races which fit on either side of the radial thrust bearing.
6. Install the pressure plate thrust bearing.
7. Install the outer pressure plate thrust race.
8. Install the pressure plate with the mechined counterbore toward the thrust bearing.
9. Install the loading spring, points down toward the pressure plate.
10. Install the retainer ring against the loading spring.
11. Install the clutch collar, followed by the bronze pinion bearing.
12. Install the clutch discs onto the clutch collar beginning with an outer disc and alternating with an inner disc until five (5) outer and four (4) inner discs have been installed.
13. Align the lugs on outer discs.
14. Install the planetary gear carrier over the clutch discs. Since the outer clutch discs may not have been perfectly aligned, it is imperative to make sure the carrier goes completely down over all of the discs.

    Install the pinion carrier thrust plate.

    Install the sun gear and the three (3) planetary gears.
17. Install the outer pinion carrier thrust plate.
18. Install the ring gear and bearing assembly. When the ring gear is placed over the planetary gears, hold the main shaft and hold the ring gear to assure proper meshing of the planetary gear teeth with the internal ring gear teeth.
19. Reinstall the driven pulley locator snap ring on the transmission shaft.
20. Reinstall the driven pulley woodruff key and the driven pulley. The transmission shaft might be rusty or scratched and should be buffed with crocus cloth to facilitate replacement of the pulley.
21. Reinstall the support bearing spacer and the support bearing.
22. Reinstall the support bearing collar.
23. Fill the transmission with one and one-half (1½) quarts of Automatic Transmission Fluid. Use Chevron Oil Company Oil Number B-10112 or its equivalent.

If the repair operation required removal of the female actuators, they will have to be readjusted before the control linkage can be reconnected to the actuators. Final adjustments can not be made until the transmission has been reinstalled and the **Amphicat** started. Preliminary adjustments are as follows:

1. FORWARD CLUTCH ACTUATORS - (The two center shafts)

   Completely depress the actuator. Measuring from the transmission face, adjust the actuator so that a space of five-eights (5/8) inches is achieved between this face and the back of the roll pin. (See Fig. 9-18)

Fig. 9-18

2. REVERSE ACTUATORS - (The two intermediate shafts)

   Insert a clevis pin into the link connector hole. Pull the actuators out as far as they

will move. Measuring from the transmission face, adjust the actuator until a space of one and one-eighth (1 1/8) inches to the back of the clevis pin is achieved. (See Fig 9-19)

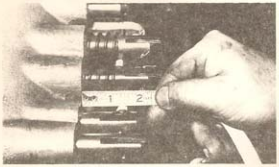


Fig. 9-19

3. STOPPING BRAKE ACTUATORS -

(The two (2) extreme outer shafts)

Insert a clevis pin into the linkage connector hole. Pull the actuators out as far as they will move. Measuring from the transmission face, adjust the actuator until a space of one and three-eight (1 3/8) inches to the back of the clevis pin is acheived. (See Fig. 9-20)

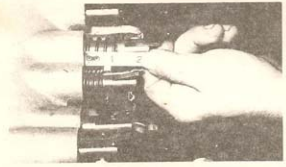


Fig. 9-20

After these preliminary adjustments have been made, the control linkage can now be reinstalled if it has been removed for repairs.

REPLACING TRANSMISSION INTO CHASSIS

1. Place complete unit into its proper place on on the chassis. Before droping the driven pulley end of the transmission down into place, put the variable speed belt into the driven pulley hub.
2. Align the four (4) transmission mounting bolt holes and install the mounting bolts. (See Fig. 9-4)
3. Install the two (2) one-fourth (1/4) inch by five-eighths (5/8) inches bolts which fasten the transmission support bracket to the bearing support collar. (See Fig. 9-3)
4. Replace the two (2) idler shaft driving chains on their sprockets and connect them with the master links.
5. Reconnect the two (2) steering control links.
6. Reconnect the carburetor air intake hose to the carburetor.
7. Reconnect throttle and choke cables.
8. Reinstall foot well.
9. Reinstall engine cover and seat assemblies.

The **Amphicat** can now be started up for testing the transmission.

ADJUSTMENT OF STEERING LEVERS

Both steering levers should be in the same approximate position when they are moved to the forward drive position. If they are not, check them for possible distortion. In the full forward position they should not strike the dash. In the full braking position, the lower end of the steering levers should not strike the forward chassis crose member.

If the levers strike the dash before the full forward clutch engagement is accomplished and if the lower end of the lever strikes the front chassis cross member, this indicates too much travel on the two (2) center clutch actuator shafts and on the two (2) outer or braking actuator shafts.

If the levers strike the dash before full forward clutch engagement but adequate braking is achieved, check position of the adjusting clevises at front end of steering control linkage. This also applies in a reverse situation where complete forward engagement is achieved with steering levers clear of the dash but adequate braking cannot be achieved because the lower end of the lever strikes the front chassis cross member. (See Fig. 9-21)

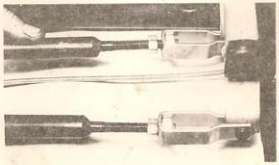


Fig. 9-21

**Amphicat** transmissions are two separate assemblies in one transmission case connected together in operation by means of the steering levers. Since there are two (2) drive assemblies, there must be two (2) driven assemblies to transmit engine power through the transmission to the three (3) drive wheels on each side of the vehicle. (See Fig. 9-22 & 9-22-A)

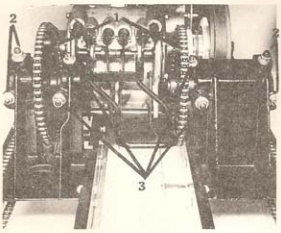



Fig. 9-22

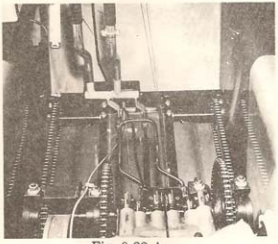


Fig. 9-22-A

The above is accomplished by means of two (2) idler assemblies, one (1) on each side of the transmission and connected to each side of the transmission by means of sprockets and chains.

The idler shaft assemblies are mounted on ball bearings and the bearings are supported by adjustable collars, two (2) collars on each end of each shaft. The adjustable collars are attached to large support castings which are mounted between the two (2) side members on each side of the chassis.

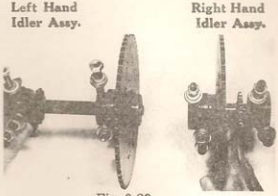



Fig. 9-23

REMOVAL AND REPLACEMENT OF THE IDLER SHAFT ASSEMBLIES

1. Disconnect the chain from transmission sprocket to large idler drive sprocket. (See 1 in Fig. 9-22)
2. Disconnect the intermediate chain from idler shaft to center axle sprocket.
3. Loosen and remove the two (2) outer shaft braces. (See Fig. 9-22)
4. Loosen the two (2) inner shaft bearing mounts and remove the idler shaft assembly. (See 3 in Fig. 9-22)

The large idler drive sprocket is keyed to the idler shaft and locked in place by means of a set screw. The small sprocket is welded into the drive shaft. In the event that replacement of either the shaft, the main drive sprocket or the bearing is required, the idler sprocket will have to be realigned with their mating sprockets when the assembly is reinstalled.

REINSTALLATION OF THE IDLER SHAFT ASSEMBLIES (See Fig. 9-22)

1. Install main sprocket woodruff key into key slot.
2. Install main drive sprocket onto shaft. Do not tighten set screws at this point.
3. Install ball bearings and snap rings on each end of idler shaft.

   (NOTE: The main drive sprocket on the right hand idler is mounted between the bearings while it is mounted on the right hand end of the left idler assembly. Bearings and support must be removed and replaced according to the particular make up of the shaft being repaired.)
4. Install idler shaft bearing mounts onto bearings on each end of idler shaft.
5. Install idler shaft assembly onto idler assembly support. The threaded end of the bearing mounts are equipped with two (2) one-half (½) inch flat washers, two (2)

one-half (½) inch lockwashers and two (2) one-half (½) inch jam nuts. Place one (1) nut, one (1) lockwasher and one (1) flat washer on each mount in the order named and run the nut down to the end of the threads. Insert the threaded end of the inner mount through the slotted hole in lower front side of the support. The threaded end of the outer bearing mount is inserted through the upper slotted hole on the right side of the idler support. Install a flat washer, a lock washer and a nut on each in the order named and run the nut down finger tight.

6. Install the idler shaft braces. The threaded portion of each brace is equipped with three-eights (3/8) inch flat washer, lockwashers and jam nuts in the same manner as described for the bearing mounts. The threaded portions of the braces are inserted into the slotted holes of the support which are open on one side of the hole. Again run jam nuts up finger tight.

7. Place the intermediate drive chain on the center axle sprocket and the small sprocket on the idler shaft and connect the chain ends with a master link.

8. Visually align the idler shaft sprocket with the axle tube sprocket and lightly tighten the bearing mounts and braces.

9. Using a suitable straight edge, align the main drive sprocket with the transmission drive sprocket. The main drive sprocket must be moved on the shaft to accomplish this alignment. It will be necessary to change positions of the bearing mounts and shaft braces slightly by changing position of the jam nuts on the threaded portions of the mounts and braces.

10. After initial alignment is completed, install the idler drive chain and connect its ends with a master link.

11. Tighten both the idler drive chain and the intermediate drive chains by tightening the jam nuts on the bearing mounts and braces under the idler shaft supports. Tighten each one the same amount until both chains are tight and re-check repeatedly for sprocket alignment.

## OUTER AXLE

There are six (6) outer axles, all of which are interchangeable. They slip into the outer ends of the axle drive tubes and are retained by means of a hardened steel clevis pin. The wheel and axle can be removed by removing the cotter pin and clevis pin from the tube and simply pulling the assembly out.

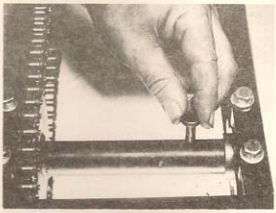
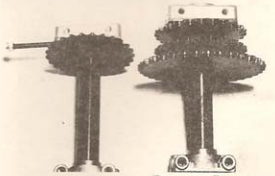


Fig. 9-24

The mounting flange of the axle is equipped with three (3) welded lug bolts. The bolts can be replaced in the event of damage but must be spot welded into the flange.

## INNER AXLE TUBE AND SPROCKET



Corner Inner Axle Tube Assy.

Center Inner Axle Tube Assy.

Fig. 9-25

All of the inner axle tube and sprocket assemblies are welded assemblies, mounted into bearing equipped mounting blocks. The outer mounting blocks have ball bearings in them and the inner mounting blocks have bronze bearings in them. The front and rear mounting blocks also incorporate chain tightener studs which fit through holes in the front and rear chassis cross members to allow tensioning of the driving chains.

## REMOVAL AND REPLACEMENT OF INNER AXLE WELDMENTS - FRONT AND REAR, RIGHT AND LEFT

Fig. 9-26

1. Remove outer axle retaining clevis pin and remove wheel. (If all wheels will be removed at once, vehicle should be raised on blocks prior to removal of wheels.) (See Fig. 9-24)
2. Remove the four (4) bolts which fasten the outer sael plates and gaskets to the mounting blocks outside of the body.

Fig. 9-27

3. Remove the nuts and washers from the chain tightener studs.
4. Remove the two (2) bolts on the top of both chassis members which fasten the axle weldment to the chassis.
5. Slide the axle assembly away from the chassis cross member far enough so that the chain tightener studs clear the cross member.
6. Move the inner bearing block on the tube toward the sprocket.
7. Twist the axle tube assembly toward a position which would place it parallel with the side chassis members and remove the assembly.

The outer ball bearing is held in place on the end of the tube by means of a snap ring. To replace the bearing, remove the snap ring and pull the block and bearing off of the tube. Press the bearing out of the block and replace it and seal if necessary. Reinstall the assembly onto the axle tube.

## REPLACING THE AXLE TUBE ASSEMBLY

1. Place the assembly between the chassis side members and twist it back to a position parallel to the front or rear chassis cross members. Make sure that the chain tightener studs both point toward the cross member.
2. Push the inner bearing block toward the inner end of the axle tube until it comes up against the side frame member.
3. Slide the whole assembly toward the chassis cross member and allow the chain tightener studs to enter their holes in the cross member.
4. Locate the holes in the top flange of the side members over the holes in the bearing blocks and insert the bolts. Tighten the bolts finger tight only.
5. Install the axle tube drive chains and connect with master links.
6. Install a flat washer and nut on each chain tightener stud and tighten them evenly. Since the bearing block mounting holes are slotted, it is possible to pull the axle tube assemblies unevenly. This would cause the axle drive chain to prematurely wear itself or the sprocket. It would also cause the tube ends to bind in the bearings causing premature failure of those parts. It behooves the repairman to make sure that the front and rear axle tubes are parallel to the center axle tube and at exactly ninety degrees (90°) to line of travel.

This can be accomplished satisfactorily by disconnecting the intermediate drive chain from idler assembly to the center axle tube. Remove all tires from outer axle flanges. With axle tube bearing block mounting bolts tight and chains right, the three (3) axels should turn easily by turning the one axle by hand.

If the center axle has not been removed, a measurement can be made from each end of the center axle tube to the corresponding ends of the front or rear tubes. Because of cramped conditions, this will not be easy on the left side.

7. After chains are tight and check has been made to assure alignment of axle tubes, bearing block mounting bolts must be tightened.
8. Reinstall outer seal plates and gaskets.
9. Reinstall axle and wheel assembly.

## REMOVAL AND REPLACEMENT OF CENTER AXLE TUBE WELDMENT - RIGHT HAND SIDE

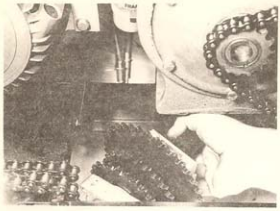


Fig. 9-28

Because of the congested conditions in this area, removal of the center axle tube is more complicated but essentially the same as removal of the front or rear axle tubes. To remove the center axle tubes, proceed as follows:

1. Disconnect the intermediate idler chain.
2. Disconnect the front and rear axle drive chains.
3. Remove the center axle and wheel assembly.
4. Remove the four (4) outer seal plate mounting bolts and remove the plate and gaskets. (See Fig. 9-27)
5. The inner bearing block mounting bolts on the center axle are inserted from the inner side of the inner chassis member. Remove these two (2) bolts.
6. Remove the two (2) outer block bolts from the top of the outer chassis member.
7. Slide the axle tube assembly rearward.
8. Slide the inner bearing block toward the sprocket end of the tube.
9. Twist the assembly toward a position parallel with the side chassis members and remove the assembly.

## REMOVAL OF LEFT HAND CENTER AXLE ASSEMBLY

Removal of this axle assembly is essentially the same as removal of right hand side. There is somewhat more cramping here which will require special attention.

After disconnecting the drive chains as described in removal of the right hand center axle and removal of the wheel and axle and the outer seal plate parts, proceed as follows:

1. Remove the torque converter V belts.
2. Remove the transmission support bracket on the driven pulley end of the transmission.
3. Slide the inner axle assembly rearward past the driven pulley. Twist the axle toward a position parallel with the side frame members until the inner end is clear of the chassis frame member and remove the bearing block. Pull the axle tube up between the driver and driven pulley.

To reinstall the assembly, reverse the above procedure.

The make up of this center axle is similar to the front and rear assemblies except for having three (3) welded sprockets on it. All bearing blocks are the same except that the center axle blocks do not include chain tightener studs.

## REPLACEMENT OF CENTER AXLE ASSEMBLY

To replace center axle assembly, reverse the foregoing procedures described for removal of the assembly up to the point of securing the bearing blocks.

Before tightening the bearing blocks securely, make sure that the axle tube turns freely in the bearings. Tighten the four (4) bolts and again check freedom of the shaft. If the transmission is removed, a three-fourths (3/4) inch round rod can be inserted through the hole in the right and left axle tubes to assure tube alignment. However. the control linkage on the lower front side of the transmission prevents insertion of this rod when the transmission is in place.

SECTION X

## ENGINE OVERHAUL

**To be supplied at later date**

## ENGINE AND VEHICLE MAINTENANCE

### ENGINE

The **Amphicat** engine does not have intake nor exhaust valves. Fuel vapors are drawn through the carburator, then through passages in the cylinder wall and down into the crankcase where they are compressed. The most practical method for lubricating the moving parts of the engine is to mix the lubricating oil with the fuel. Eventually the oil reaches he combustion chamber where it is burned and discharged through the exhaust system. In this way the engine draws a fuel-oil mixture proportionate for speed requirements.

Both peak engine performance and lubrication depends on maintenance of the correct ratio of oil to gasoline. Too little oil in the gasoline leads to premature wear of engine parts and particularly of the rings, piston and cylinder wall. An engine should not be run at all with raw gasoline in the fuel system.

For the same reasons given above, the recommended carburetor fuel valve setting should be followed.

High altitude operation results in a loss of power because of the rarefied air. The reason for this is that the ratio of air to fuel mixture is reduced resulting in too much fuel going into the combustion chamber.

The operator is inclined to lean out the carburetor for high altitude power loss. By doing this the amount of lubricant supplied in the fuel is also reduced.

### FUEL RECOMMENDATIONS

The SACHS engine uses an automotive grade SAE 40 or 50 motor oil. DO NOT USE OUTBOARD MOTOR OILS. Outboard motor oils are designed for use in water cooled engines and are not suitable for use in high temperature, air-cooled engines.

DO NOT USE TWO (2) CYCLE OILS. Experience has shown that excessive spark plug fouling results when two (2) cycle oil is used particularly at low speed operation.
Use a good grade of clean, regular gasoline. High octane fuels may be used but offer no advantages over regular grade.

To avoid unneccessary cylinder and/or piston scoring and premature engine wear, it is important that the gasoline and oil bethoroughly mixed before putting the fuel in the tank. This is especially true in zero or subzero temperatures. Unless the fuel and oil are properly mixed, the engine could run on a lean mixture until agitation by running mixes the oil and fuel. By then damage would have occurred to the engine.

Gasoline and oil should be mixed prior to filling fuel **tank.**

Keep engine cylinder and cylinder head cooling fins free of trash. If air passage is restricted engine will **overheat.** The air baffle mounted over the top of the cylinder head must never be removed and discarded.

### PREPARATION FOR STORAGE

1. CARBURETOR

   Drain fuel from lines. Close FUEL VALVE at dash. Start engine and let it run until carburetor runs dry.

2. CYLINDER

   Remove spark plug, pour one (1) tablespoon of oil (SAE 40 or 50) through spark plug hole. Crank engine a few times to distribute oil over piston, rings and cylinder wall. Replace spark plug.

3. FUEL TANK

   Completely drain the tank. If oil-gasoline mixture is allowed to stand for long periods the oil **will** become gummy.

4. BODY

   Wash exterior with warm water and a mild detergent. Strong soaps and abrasives should not be used. Dirt or grime which has become imbedded into the body surfaces may be removed with a good grade of rubbing or polishing compound. Rinse well after washing. The inside of the body can be cleaned with detergent and warm water. Grease, oil and dirt accumulations are hard to remove. However, if the drain plug is inserted and the body filled with water and detergent deep enough to cover the floor and allowed to stand for awhile, the detergent will break up most of the grease and oil. A good rinsing will then wash it out. CAUTION: Do not use paint thinners or carbon tetrachloride to remove tar or for general cleaning cleaning as such solvents may soften ABS plastic.

5. WAXING

The ABS plastic surface may be waxed at any time with automotive or household wax. The surface should be throughly cleaned before wax is applied.

A paste wax will provide the best protection because dirt or grease or grime will be more apt to slide off of awell waxed surface. If the color has become dull of faded original luster and gloss may be restored by use of rubbing compound before waxing. The color is cast into the body material and will not rub off.

6. TIRES

If the **Amphicat** is allowed to stand in one place for long periods, the weight of the machine will cause the tires to flatten slightly at the point of ground contact. During storage for prolonged periods raise **Amphicat** off of the wheels by placing suitable blocks under body. Reduce tire pressure.

7. CHAINS

Apply oil to all chains to prevent corrosion.

BODY REPAIR

The **Amphicat** body can be rather easily repaired by hot air welding, soldering or with bonding agents.

1. HOT AIR WELDING

This method requires the use of a hot air generating machine and plastic welding rod. It is electrically operated and contains a heater element over which air is blown by a fan. This results in a controlled flow of hot air at a given point.

The crack or tear is first cleaned throughly and then using a graver or sharp wood chisel cut a V the full lingth of the tear similar to preparation of metal for welding. Direct the blast of hot air toward one end of the point to be welded and apply the end of the welding rod at that point. As the material softens the "welding rod" will melt into and fill up the "V" which was cut into the material.

The best results are obtained with the above method by pushing the welding rod along the tear. After welding is completed the finish can be smoothed over with a graver or a wood chisel.

2. SOLDERING

Most rips, tears and cracks can be repaired with relative ease by using a heavy duty soldering iron. If welding rod is not available, thin slivers of ABS cut from scrap may be used.

Apply the hot soldering iron at the beginning of the crack and slowly feed some rod into the crack. It flows easily and fuses well. DO NOT USE A TORCH OR OPEN FLAME.

3. PATCHING

A large hole can be patched by placing a larger piece of ABS over the hole and either pop riveting it or bonding it to the original surface. (NOTE: Patches on the lower body should be bonded. If pop rivets are used, place a suitable gasket between mating surfaces and be sure that pop rivets are plugged.)

4. DRAINING BODY

One (1) drain hole is provided at the rear of the body. If water accumulates in floor, remove the drain plug and tilt the body to the rear. Water will flow out.

5. RECTIFIER FUSE

The rectifier contains two (2) five (5) ampere fuses which are the same as used in the Opel automobile. They may be obtained from any Buick-Opel dealer and their part number is 1238300. To replace fuses disconnect the postive leads from the battery and then remove the cover from the rectifier by removing the knurled screw. Replace fuses and then replace the cover and reconnect the battery leads.

NOTE: SACHS Engines with 40 Watt systems have only one (1) fuse in rectifier.

6. LUBRICATION

ENGINE:

Lubrication of the engine is accomplished with each fill of the fuel tank and no other is required.

AXLE OUTER SEALS:

Fill with good grade of chassis grease every 25 hours and immediately prior to or after prolonged periods of operating in water.

CHAINS:

Every 25 hours or as required in dusty conditions. Use SAE 30 oil or dry lubricant in a carrier solution.

TRANSMISSION:

Fill to level plug every 50 hours with Automatic Transmission fluid Chevron Oil Company number B-10122 or equivalent.

BEARINGS:

All bearings are either sealed ball bearings or oilite bronze and require no further lubrication.

SECTION XII

# SPECIAL TOOLS

**To be supplied at later date**