Golf Car Batteries

New Ratings Match Power To Use

By ROBERT L. BALFOUR
Vice President
Club Car, Inc., A Johns-Manville Company

IF GAS RATIONING becomes a reality gasoline powered golf cars and boats will probably be among the early casualties. This could present a very great and expensive problem for golf courses using gasoline powered golf cars. It is causing such courses to take a long and careful look at electric powered golf cars.

Even if gas rationing does escape the scene, courses using gasoline powered golf cars must think twice about the smoke, noise, odor and pollution problems. There is the distinct possibility that anti-smog devices may have to be installed on all gasolne powered golf cars at costs that could run all the way from $75.00 to $125.00 per golf car.

Light-weight electric golf cars are now being marketed that will provide 36-54 and even 72 golfing holes on a single battery charge, even on the hilliest and most mountainous golf courses.

Thus, it is becoming more and more important that all personnel having anything to do with golf coursess fully understand the golf car battery and its maintenance.

Electric golf cars are now being powered by batteries identified as 75, 88 or 106-minute batteries, instead of the old rating of 180, 195 or 220 ampere-hour batteries. The American Golf Car Manufacturers' Association and Battery Council International have adopted the new rating system.

Generally speaking the 75-minute battery is the equivalent of the old standard 180-amp battery: the 88-minute battery is the equal to a 195-amp battery and the 106-minute battery replaces what was formerly known as a 220-amp battery.

The new rating system will enable golf course personnel to better understand the service they can expect from the batteries being used in their electric golf cars.

A battery is rated by testing with a special battery discharge tester which discharges the battery at a constant rate of 75 amps. It should be done at a temperature of 80° F. This machine records the elapsed time for the voltage to drop to 5.25V per battery, or 31.5 volts for a set of six batteries. This is not a fully discharged or dead condition, but represents a safe level of discharge which will allow the battery to be recharged and put back into service. Therefore, a battery which can be discharged at a constant rate of 75 amps for 88 minutes before the machine senses a voltage drop to 5.25 volts is known as an 88-minute battery.

Each battery contains approximately 400 cycles of life. If a battery is charged after only 50% of its power has been used (specific gravity of 1.200-1.210) only one-half cycle is removed from its life and the batteries should normally perform for two times 400, or 800 battery charges, before they must be replaced.

The golf car that is operated with batteries at or below the 50% reserve may actually achieve another 18 holes of golf, but can do so only by deep-cycling the batteries and removing the energy four to six times faster. A deep-cycled battery will cost the owner two to three full cycles of the 400-cycle batteries' life and result in having to replace batteries after 166 to 200 battery charges.

It is very important that the golf car you buy must not simply have the capacity of going 36 holes of golf on a single charge. It must have the capacity of going 36 holes of golf without deep-cycling the batteries below the critical 1,200 specific gravity level.

A golf course's net profit picture on golf car rentals will improve considerably if they adopt a policy of retiring a golf car to the car shed for charging when the specific gravity reaches the 50% reserve level of 1,200 specific gravity. **Furthermore, it only costs 13.6 cents worth of electricity to charge a set of batteries at the 50% reserve level and it takes 27.1 cents worth of electricity to charge batteries after they have been deep-cycled.**

The owner of golf cars will want to know how much current is being drawn from the batteries in each golf car being evaluated. The golf course having a sizeable golf car fleet would find it will pay excellent dividends to own a good ammeter (an instrument for measuring electric current in volume) as well as a sensitive voltmeter. With these two pieces of equipment, each golf car being considered can be tested for power consumption.

Providing you water, charge and care for your batteries properly, a golfer maintenance man should be able to predict how many rounds of golf the golf car will give each day before having to deep-cycle the batteries; how many months of service one can expect from the batteries; approximately what your electrical costs will be for charging the batteries.

The average golf car being operated with full pedal acceleration will draw an average of 75 amps from the batteries and if the batteries last 88 minutes under these conditions they are considered to be 88-minute batteries.

If a heavy golf car operates with a full pedal amperage draw averaging 150 amps (twice the standard draw of 75 amps), an 88-minute battery becomes only a 44-minute battery and will need to be deep-cycled after 22 minutes of full pedal operation.

If a light golf car operates with a full pedal amperage draw averaging only 38 amps (one-half the test draw of 75 amps), an 88-minute battery becomes a 176-minute battery and will need to be deep-cycled only after 88 minutes of full pedal operation.

Amperage draw against a battery will vary depending on the operating weight of the golf car itself, the

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GOLF CARS PRIVATE VS. CLUB OWNERSHIP

By DENVER BROWN
Sales Mgr., Special Vehicle Div.
Otis Elevator Company

GOLF has really come into its own in the past 10 years and that can be attributed to many factors; increased earning power on the part of the average American, more leisure time available to the working golfer, more and more women taking up the game, increased television coverage, bigger purses being offered on the pro circuit, and an increase in the number of golf facilities available to the public.

But perhaps the single most important factor in the growth of golf is the golf car. It also represents, today, the most profitable revenue-producing item for a golf club, whether public or private.

At one time, the golf car was anathema on the course. Who wants those vehicles driving all over, cluttering up the course? And after all, where's the exercise in golf if you use a golf car?

Now, the golf car has come of age. It does not take the exercise out of golf. The exercise is in playing the game, being outside and competing. Most important is the fact that the golf car has speeded up play, vital with the growing numbers of golfers taking to the fairways. And it has opened up more golf to more elderly golfers who were unable to play because of the strain of walking 18 holes.

Grounds maintenance personnel also recognize the benefits of the golf car. With today's turf tires, the golf car does less damage to the course than golf shoes.

Because a golf car fleet is recognized as a necessity, new clubs opening up figure a fleet in the operating budget. However, some older clubs, although a small percentage, still allow member ownership of golf cars. How do they go about converting to a club owned fleet?

Let's take a minute to balance private ownership of cars against club ownership, looking at it from both the individual standpoint and club mangement.

In all cases, I am referring to the electric golf car. Eighty percent of all golf cars in use today are electric and this number will increase as more and more people are becoming conscious of the need, not only to conserve fuel but also to eliminate the noise and pollution caused by gas-consuming vehicles. Also, the figures I quote are for the Otis four-wheel electric golf car although initial purchase prices are about the same, regardless of brand.

Let's say a golfer owns his own car for which he paid $1500.00. For evaluation purposes, we will use five years as an average life span of a golf car with a resale value of $400.00 at the end of five years. During those five years, he'll put out about $45.00 a year for insurance. He will probably also replace the complete set of batteries twice during those five years at a cost of $150.00 each set. Golf cars require tune-ups, just like any other moving vehicle, and the cost for two of those during the five year period will run about $75.00. Service calls for such things as flat tires or blown fuses, etc., are all to be considered.

If his club offers storage and maintenance facilities, he can keep his car at the club for a monthly storage fee of approximately $15.00 and an additional $10.00 per month for preventative maintenance and get-ready charges. This is strictly a matter of convenience and is not mandatory. If he opts to keep it at home, he must count in the cost for a trailer and a slightly increased electric bill for recharging that vehicle at home.

So what is the golf car costing the individual owner? Taking into consideration the maintenance and service costs, replacement of batteries and the initial purchase price, the cost comes to about $3600.00 over the five year period, less the $400.00 resale value.

Now what if that golfer plays at a club or facility which maintains its own golf car fleet? What would be the rental cost to him and how would it balance out against his own membership of the golf car?

If he plays a round of golf a week for 52 weeks at an average car rental rate of $8.00 per round, it would cost him $2,080.00 over a five year period. But he would probably split the cost with a playing partner. And this is all. He would not have the hassle of maintaining his own car, of providing storage and of worrying about winter storage in areas with seasonal play, nor would he be faced with the expense of replacing an outdated or worn out car.

From the club's point of view, what is more important is that the rental income represents practically clear profit to the club and just as important, to the members of that club, decreases the amount of yearly assessments. In short, an individual cannot justify ownership unless he plays more than three times per week, year round.

One golf car alone, acquired by the club (and we will discuss the methods of acquisition later) for $1,500.00 and rented out five times a week for 52 weeks at a rental rate of $8.00 (national average), would bring in $2,080.00 for the first year. And that's based on only one rental per day. On weekends that car will be rented out twice a day on the average — depending on play.

As you can see, that car has brought in a profit in the first year of operation. The second year, the profit picture is even better when the initial purchase is no longer a factor.

Granted there are services and maintenance costs, replacement of batteries, etc., just as with private ownership of golf cars. Even taking that into consideration, the profit picture is still impressive.

And remember, too, that the electric golf car is a simple machine to maintain. Take Otis' golf car. It comes with its own built-in charger and plugs into any 110 volt outlet. No auxiliary power equipment is needed. It has a cycolac body with a welded tubular steel frame. It is weather resistant and its high-impact, rugged cycolac body is rust

(continued on page PP)

Illustrated: New 12 hp Turf-Truckster with optional automotive steering.

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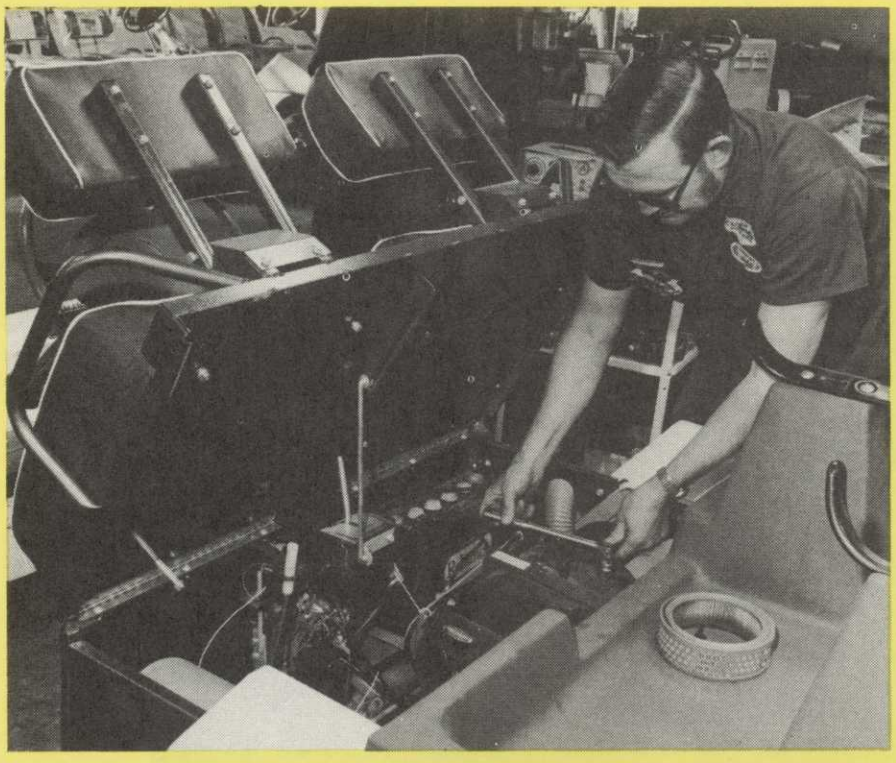
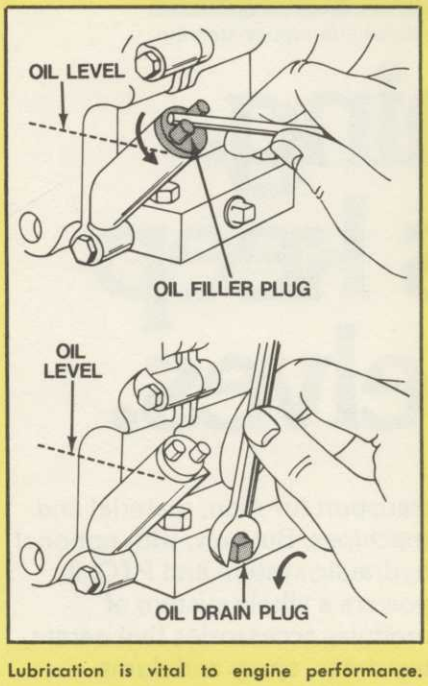
Nine Points

By DANIEL L. HEDGLIN
Cushman Service Manager



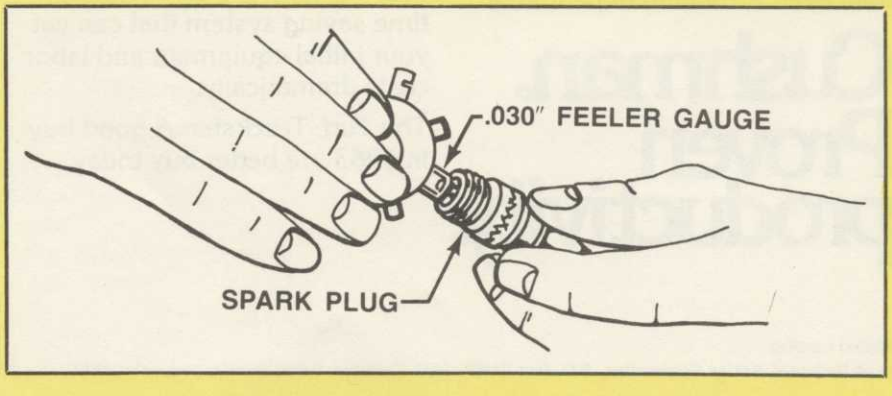
Small engine maintenance is not difficult. It does require regular checks on vital parts. Here workman checks engine and replaces air cleaner.



Lubrication is vital to engine performance.

Check engine markings for specifics.

Gap on spark plug should be checked regularly.



WANT TO GIVE your golf cars or gasoline-powered utility vehicles nine lives? Here's how!

Golf course superintendents and their crews often can prevent serious problems that require expensive overhauls if they follow daily, routine maintenance pointers. So, by adhering to the following nine simple step-by-step small gasoline engine maintenance pointers, you can add years and miles of dependable service to golf cars and utility vehicles.

Keep Air Cleaners Clean: Cleanliness is essential to air-cooled engines on golf cars since the engines operate close to the ground and at low speeds. Thus the engines are vulnerable to dirt. It wears out more engines than do long hours of operation. Even a small amount of dirt will wear out a set of piston rings in a few hours.

Check the air cleaner daily, especially if the vehicle is being used under extremely dusty conditions. Dry air cleaner elements should be cleaned by removing them and tapping them lightly on a flat surface to remove dirt. After cleaning in this manner, if it is not possible to see light through the element, it has served its useful life and should be replaced.

Check or Change Oil: Small engines have small crankcases, so the oil level should be checked daily. The oil should be changed at intervals recommended by the engine manufacturer. Change the oil while the engine is warm. This will allow the oil to flow more freely and carry away more contamination. Refill the crankcase to the proper level with a good grade of oil of the recommended viscosity or weight.

Spark Plugs: Worn, dirty or improperly adjusted spark plugs can cause hard starting and faulty operation. Spark plugs should be changed every 100 hours of operation. Before removing the spark plugs, blow or clean the area around the spark plug to avoid the possibility of dirt or sand getting into the engine. Since it is generally not economical to clean spark plugs, they should be relpaced with new ones. Be sure to check the gap of the electrodes on the new spark

For Smooth Running Engines

plug, since it is unlikely that it will be properly set for your engine. Gap the plug to the engine manufacturer's specifications.

Start the plug in with your fingers to avoid cross-threading. Use a wrench only after you know it is started properly. Tighten the plug tight but don't over-tighten. A torque wrench will assure the proper setting.

Points: Inspect the breaker points every 500 hours or yearly and replace them if necessary. Points that are pitted or burned should be replaced.

Care should be exercised when handling a new set of points. Clean the new set of points with a piece of lint-free paper and then avoid touching the contacts with your fingers. The oil from your hands can cause a new set of contacts to start burning and fail prematurely.

Install the new set of points and carefully adjust the gap to the manufacturer's recommended setting. Remember that in many engines the correct point setting will also assure proper timing. On engines having variable timing, it will be necessary to adjust the timing with the aid of an automotive timing light.

Condenser: The condenser is an inexpensive part, but is just as important to the ignition system as the points. Therefore, it only makes good sense to replace the condenser every time the points are replaced.

Clean Combustion Chamber: Automotive fuels, constant speed and load operation gradually result in build-up of tetraethyl lead deposits in the combustion chamber of golf cars and gasoline-powered utility vehicles. Manufacturers usually suggest that the combustion chamber be cleaned every 100 to 300 hours of operation to remove these lead deposits.

To clean the chamber, remove the cylinder head and scrape or wire-brush the lead and carbon deposits from the head, around the valves and from the piston top. Then reassemble the cylinder head, using a new gasket. When tightening the cylinder head screws, be sure to tighten them in an alternate sequence. For best results, tighten them with a torque wrench to the manufacturer's specifications.

Cleaning Exhaust Ports: Two-cycle engines will get a build-up of carbon in the exhaust system. These carbon build-ups are just as detrimental in the exhaust port as they are in the cylinder head. If these ports are left to build up with carbon, hard starting and a loss of power will be the result. To clean the exhaust ports, remove the muffler and/or exhaust pipe and clean the ports with a wooden dowel.

Carburetor Adjustments: Lack of engine power and black sooty exhaust smoke indicate the fuel mixture is too rich. An over-rich mixture can be caused by either a clogged air cleaner or a carburetor needing adjustment. So, always check the air cleaner before adjusting the carburetor.

Main fuel adjustment—First, turn the "main fuel" screw clockwise until it bottoms lightly **(don't force it)**, then back out two turns. With the engine thoroughly warmed up and running at full throttle and full load, turn the "main fuel" screw in until the engine slows down (lean setting). Then turn the screw out until the engine regains speed and then starts to slow down (over-rich

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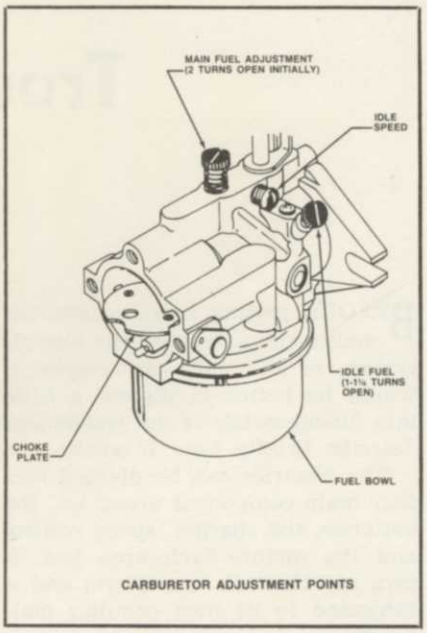
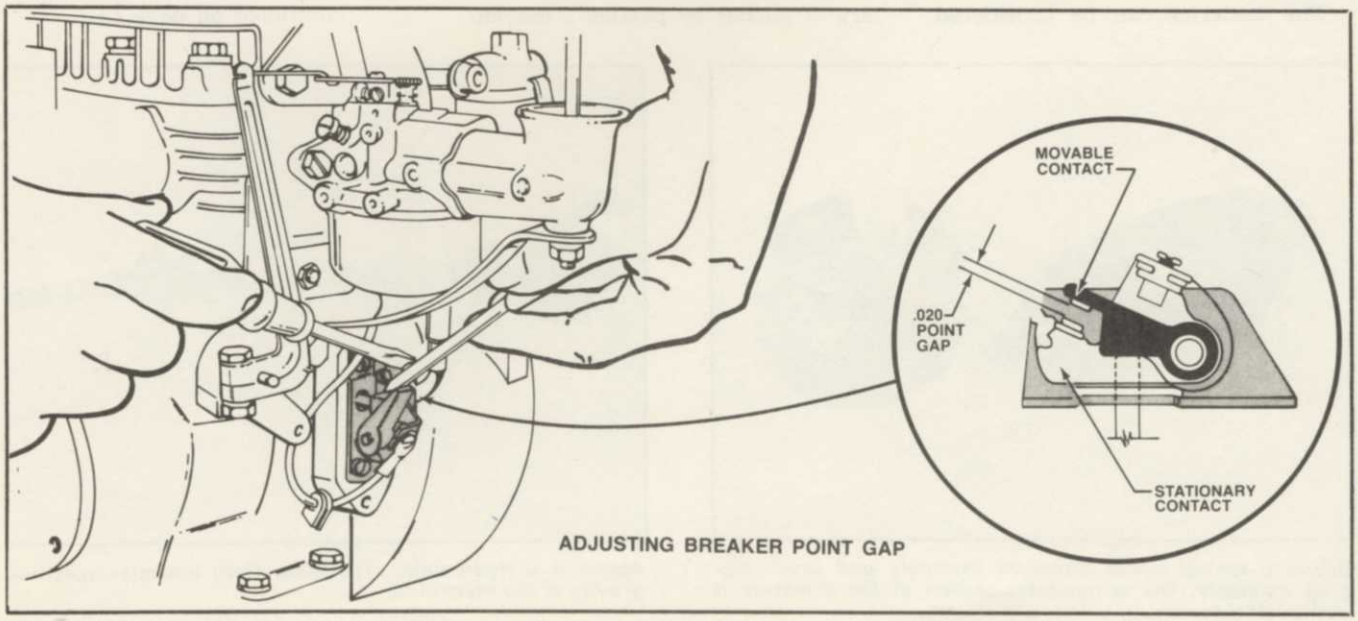
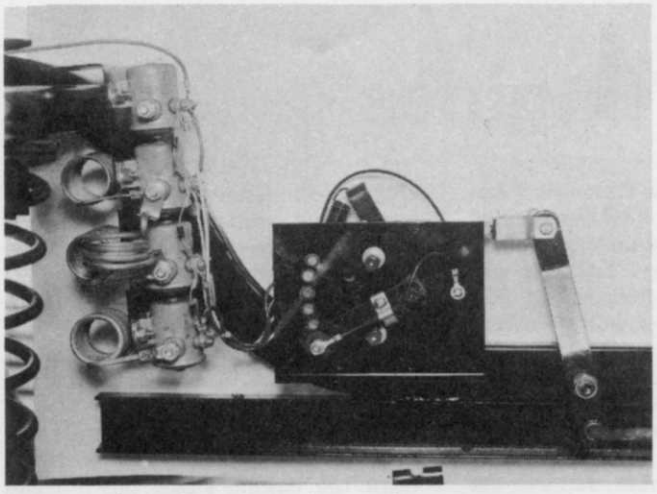


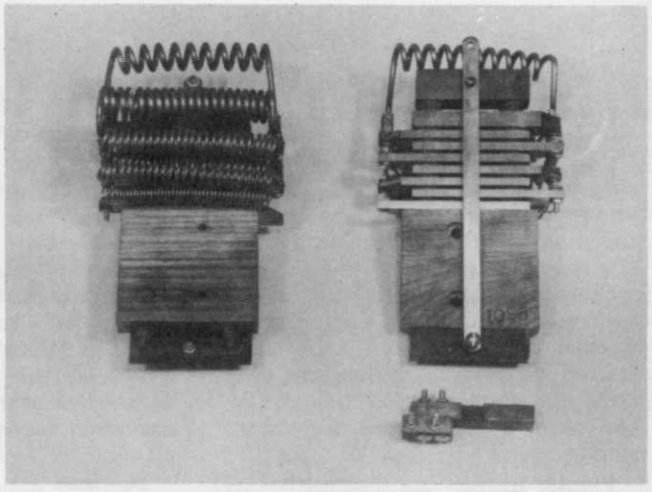
CARBURETOR ADJUSTMENT POINTS



ADJUSTING BREAKER POINT GAP



Version of a solenoid speed control arrangement. Contacts on face plate activate the solenoid holding coils as the foot pedal is depressed.



Typical sliding bar speed control. Resistor coils mounted on the back side of switch are at the left. At right stationary bass is shown. Item in lower right is the brush on sliding bar.

Golf Car Trouble-Shooting

By CHARLES W. POOLE
Engineering Manager
Electric Vehicle Div.
Westinghouse Electric Corp.

BEFORE getting into a diagnostic malfunction study of the electric system of the golf car, maybe it would be better to digress a little into fundamentals of the system and describe briefly how it works.

The electrics can be divided into four main component areas, i.e., the batteries, the charger, speed control and the motor. Each area has its own specific task to perform and is subjected to its own peculiar malfunctions.

The batteries can be considered as the fuel tank of the vehicle and as such they have to be initially filled up with energy before the vehicle can be made to perform. And in the process of performing, obviously, they become empty again. In the case of electric storage batteries the re-energizing is accomplished by passing an electric direct current through the batteries. Actually in one end and out the other. This may sound strange, but the electricity is not stored in the battery at all but by passing a current through the battery, internal changes take place which enable electricity to flow from the battery at a later time.

What happens when an external electrical source is applied to the battery is a chemical action between the negative and positive place in each battery cell This action is aided and in fact couldn't take place without the presence of the electrolite, which is a solution of water and sulfuric acid. Later, when an electrical demand is placed on the battery, this chemical action reverses itself and causes electrons or electricity as we know **it** to flow from the battery.

It is the condition of the electrolite which indicates the state of this chemical action and hence the state of charge of the battery.

The tool used to test the electrolite is called a hydrometer and no electric vehicle repair or mainte-

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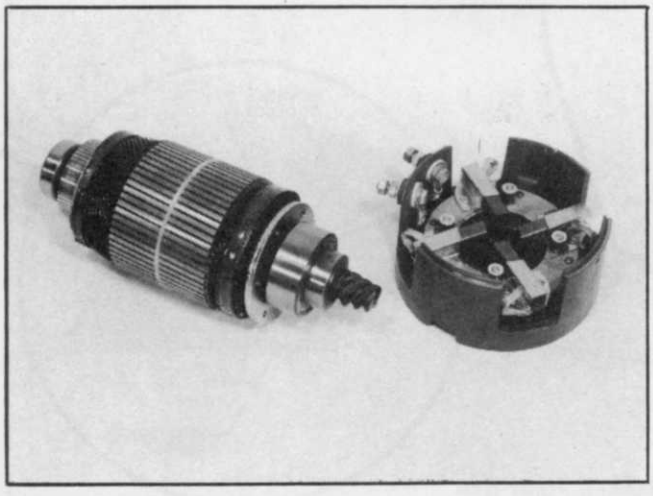
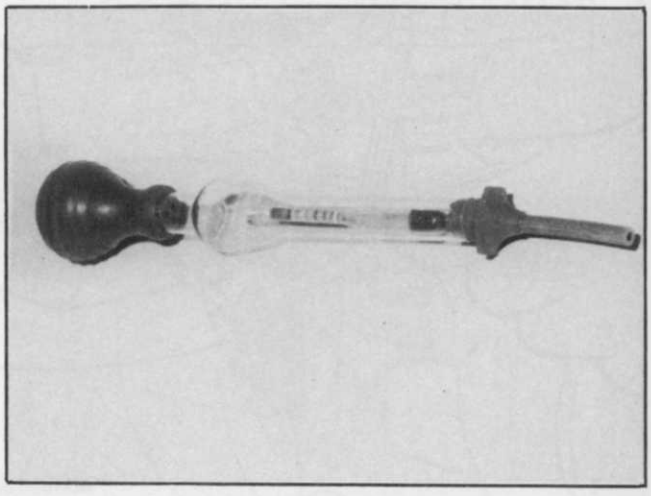


This is a typical motor armature assembly and brush rigging assembly. The commutator section of the armature is at the left side.



Above is a Hydrometer. The inner float indicates specified gravity of the electrolite.

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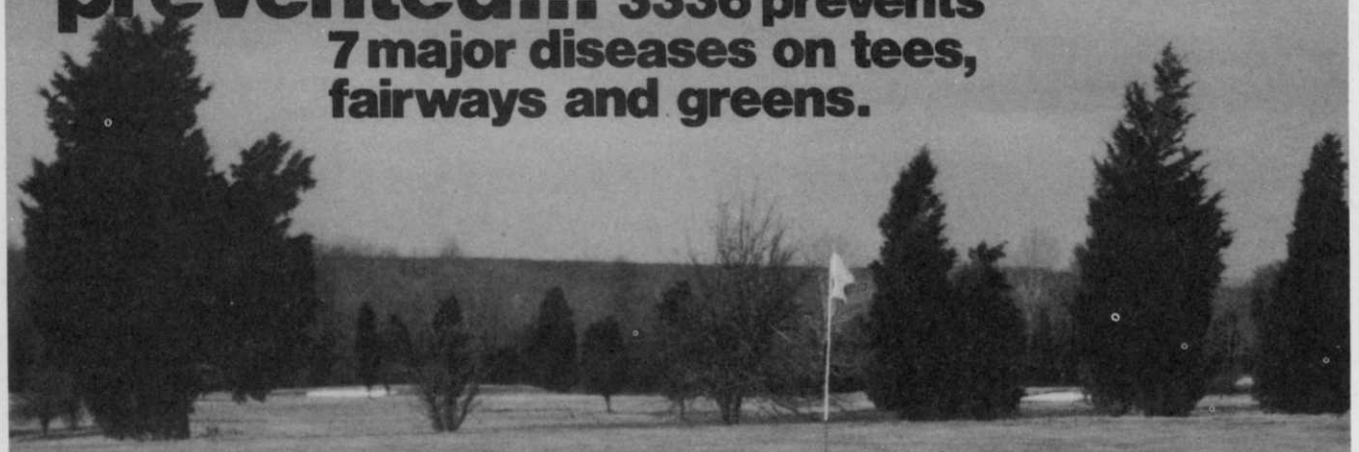

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GOLF CAR TROUBLE-SHOOTING

(from page HH)

nance shop should be without one. The hydrometer measures the specific gravity (sp. gr.) of the electrolite which is approximately 1.26 when the batteries are charged or the complete chemical charging action has taken place. When the batteries are completely discharged or a complete chemical reversal has occurred, the sp. gr. is about 1.18.

Don't let the term specific gravity throw you, it simply means "times the weight of water." Hence, an electrolite with a 1.26 sp. gr. is 1.26 times heavier than water. Therefore, the lower the sp. gr. number the closer the electrolite is to water, and the battery less able to perform.

It would be very convenient if we could simply plug or connect the batteries to the nearest electrical wall socket receptacle for some period of time in order to recharge the batteries. Unfortunately, this cannot be done for two very good reasons.

First, the electricity delivered by the utility companies is of the type called alternating current which would not create the required internal chemical action of the battery.

Secondly, the supply current is usually at a potential of 110 volts. Most golf car electric systems run on a 36 volt battery pack and the recharging voltage should only be slightly higher to avoid battery damage.

This then dictates the need for a charging system which in essence does two things; steps the supplied voltage down to a more acceptable level and changes the alternating current to a direct current. Another necessary feature is a timer switch which shuts off the charging operation after a predetermined time period.

The next aspect of the electrical system is the speed control device. As the name implies, this enables the operator to manipulate the vehicle at various speeds as desired. The type of speed control most often encountered in golf cars is of the stepped resistor method.

The resistors, usually four, are connected in series into the battery power supply circuit and are bypassed individually by advancing the speed control foot pedal.

The by-passing can be accomplished by a copper sliding bar arrangement or by other more sophisticated methods. Usually solenoid contractor units.

The function of the resistors is to create a voltage loss in the supply line from the batteries to the motor. Therefore, as each resistor is bypassed, the voltage to the motor increases until all resistors are bypassed and the motor is receiving full battery voltage and so can perform at maximum power.

Finally, the motor which converts the electrical power into useful, mechanical work is again usually of the series-wound traction type. This means that the coil windings on the rotating armature shaft are connected in series in the battery power circuit with the coil windings of the stationary motor field.

This is achieved by means of the stationary carbon brushes and the rotating commutator section of the armature shaft, which enables current to pass through the rotating armature coils.

One other necessary requirement is the ability to reverse the rotational direction of the motor. This is done by changing the polarity of either the motor armature coils or the field coils. To accomplish this a heavy-duty contact manual switch is employed.

That then briefly outlines the basics of the system, so if a cry for help is received from an irate golfer on the 5th tee whose car has pooped out, what do we do.

In trouble shooting malfunctions in any piece of equipment, always start with the simplest possibilities. In this case, if the car will not run, assume that the electrical energy from the batteries is not reaching the motor. This then could mean:

1. A loose terminal connection in the power circuit at any one of the connecting points, i.e., the batteries, motor, speed control, or the forward reverse switch.
2. A broken power cable, unlikely, but possible.
3. Poor or no electrical contact in the forward/reverse switch.
4. Poor or no electrical contact in the speed control system or a broken resistor coil.
5. Poor or no electrical contact between motor brushes and the commutator.

Looking for loose or broken leads in the field should not be difficult to do or fix on the spot. Checking the forward/reverse switch for good continuity maybe possible in the field, depending on the construction of the switch. Similarly with the speed control. If it is a simple, sliding-bar type then a visible inspection should tell if it is making good or bad contact. If a solenoid switch is employed, place the forward/reverse switch in neutral, then manipulate the foot pedal. All solenoids should close with definite clicks if working properly. If not, the problem could be in the activating circuit or the solenoid contacts. This then would lead to more difficult and complicated trouble shooting and would require repair shop work.

Checklist For Golf Car Trouble Shooting

Problem	Check Points				
Car will not run	Check battery for charge	Check for loose or broken leads & connections	Check forward/ reverse for good connections	Check speed control for good contact	Check motor brushes for good contact
Car runs slow	Check battery for charge	Check brakes & mechanicals	Check speed control	Check motor brushes	
Car runs slowly then stops	Check battery for charge	Check speed control	Check motor brushes		
Car takes off suddenly	Check speed control				
Battery not accepting charge		Check charger fuse, leads and connections	Check AC supply for voltage		Suspect sulfated battery; Replace

♦ For More Details On Preceding Page Circle (135) On Reply Card