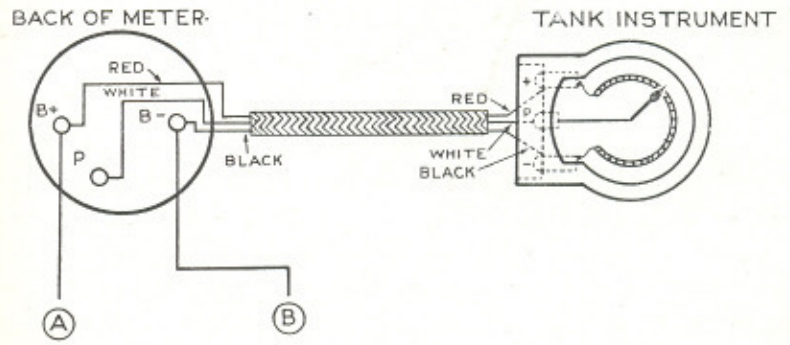
To Test Meter (Gauge). Connect the positive terminal of a battery to the terminal marked B + on the meter, then connect one lead of a voltmeter to the negative of the battery; the other voltmeter lead should then be connected, firstly, to terminal B — on the meter, and secondly to terminal P on the meter. In both instances a voltmeter reading should be obtained, which indicates that the wires inside the instrument are not broken.

DIAGRAM OF CONNECTIONS FOR ELECTRIC PETROL GAUGE



A. Connected to the top terminal of No. 3 (ignition) fuse on the distribution board. The gauge therefore only reads when the ignition switch is on and the No. 3 fuse in position.

B. Connected to the earth terminal on the back of the metal instrument board.

To Test Tank Attachment. (a) Connect the positive terminal of a battery to the terminal B + on the tank attachment, and connect one lead of the voltmeter to the negative battery terminal; the other voltmeter lead should be connected to the terminal marked B — on the tank attachment, and a voltmeter reading should be obtained, showing that there is a circuit through the resistance.

(b) Connect the positive battery terminal to the terminal marked B + on the tank attachment, and the negative battery terminal to one side of the voltmeter; the other side of the voltmeter should then be connected to the terminal marked P on the tank attachment, and a voltage reading should be obtained whatever the position of the

float. Should the voltage reading drop to zero, it would show that the unit is faulty.

To Test Cable. Connect the positive terminal of a battery to the end of one of the cores, and the negative battery terminal to one side of the battery voltmeter; the other side of the voltmeter should then be connected to the other end of the same core, and a full battery reading should be obtained. Repeat this test with the other two cores. Should a voltmeter reading not be obtained, it will show that there is a break in the core under test.

SPECIAL NOTE. IMPORTANT.

1. Great care must be taken when either connecting up or disconnecting the Gauge that the terminal **P** (or white wire) is not short circuited to either **B** + or B — or the red wire or black wire. Neglect of this precaution may result in the potentiometer being burnt out.
2. On no account should the float arm be bent other than as supplied. The float arm provides both top and bottom stops which prevent the contact arm over-travelling the potentiometer.
3. Please give the following details in all communications dealing with apparatus.

   Year, and model of car.
   Code numbers of meter and tank attachment.

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INSTRUCTIONS

for the Care and Maintenance of the

HOBSON K-S "TELEGAGE" FUEL LEVEL INDICATOR

as fitted on the

20/25-h.p. Rolls-Royce Car

Manufactured by

H. M. HOBSON, LTD.

47-55, The Vale, ACTON, LONDON, W.3.

Telephone :: Shepherds Bush 3321 (4 lines)
Telegrams :: :: "Assemblage, London"

Works — LONDON AND WOLVERHAMPTON

July, 1938

(3 H)

(For Books No. XII and XIV Comb.)

Hobson K-S "Telegage" Fuel Level Indicator.

The fuel level gauge actuates an indicator situated on the instrument board. Diagrams of the system are given in Figs. 1 and 2.

So long as the indicator continues to function correctly it should on no account be disconnected at any point. The description and instructions which follow are given in order that the user may understand the working of the apparatus and be in a position to deal with exceptional and unforeseen developments.

The indicator, which is shown in section in Fig. 3, comprises a "U" tube containing a special red liquid. One leg of the "U" tube is connected to the top of the main tank, and the other to the bottom through a pair of small bore copper pipes. The fitting on the tank to which these tubes are connected is shown in section in Fig. 4. It comprises a stand-pipe extending to within a short distance of the bottom of the tank. A third pipe is taken from a small air pump situated under the dashboard indicator, to a point just below the mouth of the stand-pipe in the tank. All three pipe lines are enclosed for protection within a single flexible metallic tube, the unions provided on the pipes being of different sizes to ensure correct connections.

The indicator is operated by the hydraulic pressure-head due to the depth of fuel in the tank, and in order to ensure that this head shall be proportional to the total depth of fuel under all conditions, special provision is made to exclude fuel from the stand-pipe. Under running conditions this is effected by a series of cups—one of which is shown in Fig. 4—mounted on the outside of the stand-pipe and connected by small pipes with the lower end of the latter. Rocking or surging of the fuel due to movement of the car uncovers one or other of these cups, which tends to empty itself through hole **D** and the small pipe referred to, and, in so doing, entraps bubbles of air. The latter are released into the stand-pipe, and displace any fuel

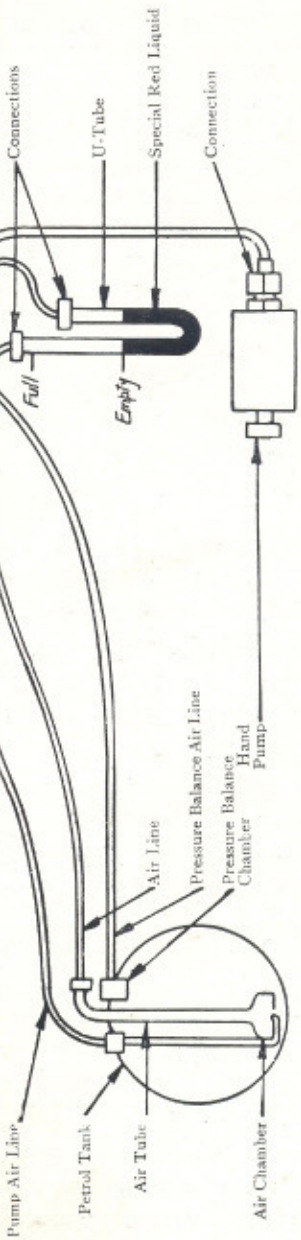

FIG. 1. TELEGAGE IN OPERATION. TANK EMPTY.

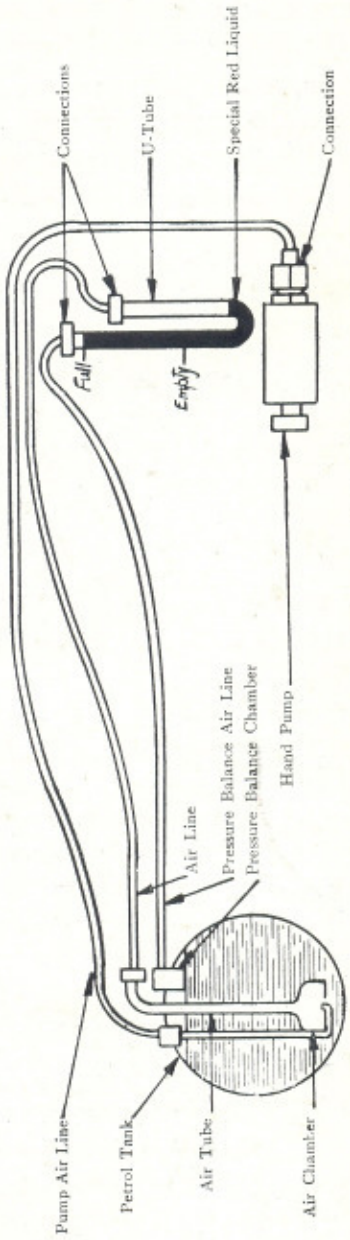

FIG. 2. TELEGAGE IN OPERATION. TANK FULL

which may have risen therein due to absorption of air, condensation of fuel vapour, or change of temperature of the pipe line.

Such effects are the more pronounced where the pipe lines are of exceptional length, as in the case of the Rolls-Royce car, and will cause the gauge reading to vary slightly when the car has been standing for any length of time. Normally the variation is of little consequence,

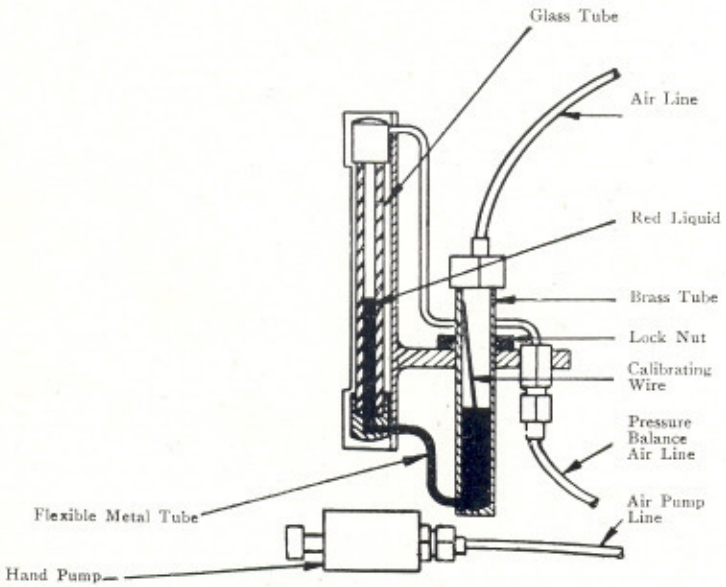

FIG. 3. HEAD.

and in any case is corrected as soon as the car has again run for a short distance. In order to obviate this slight temporary inaccuracy, however, the Rolls-Royce car is provided as a refinement with a small hand pump, operation of which feeds air into the stand-pipe independently of that supplied automatically as described, and enables a correct reading of the gauge to be given under all conditions.

When the car has been standing, and it is desired to ascertain the amount of fuel in the tank, the hand pump should be given three or four strokes, after which the gauge reading will correctly represent the contents of the tank. It is preferable that the pump should also be operated when the tank is being filled if it is desired simultaneously

to obtain an accurate reading of the indicator. If the main tank be filled rapidly—from a pump, for example—the gauge indication may be delayed for a few seconds, owing to the use of small bore tubing between the front glass tube and the back brass tube of the gauge. This tubing is used to damp out the oscillations of the indicating liquid when running.

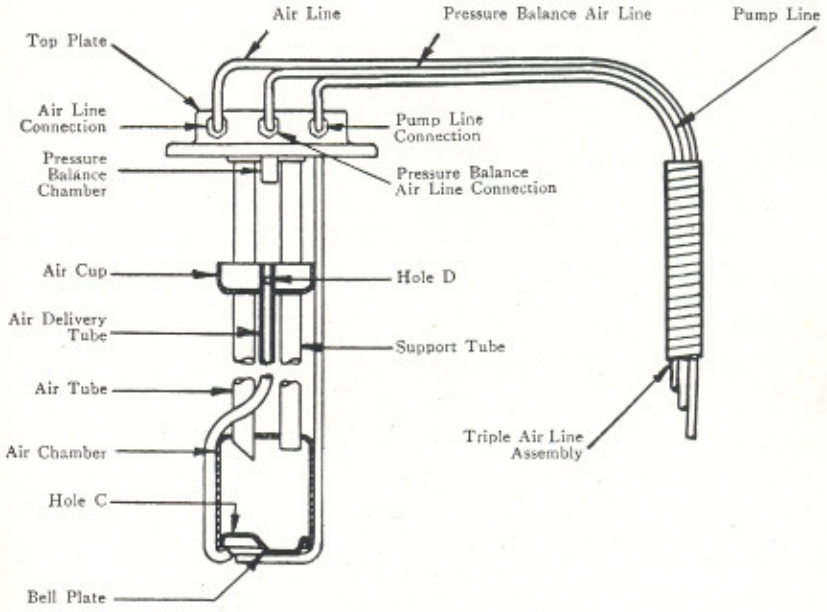

FIG. 4. TANK UNIT.

No harm can result from excessive use of the pump, but no useful purpose is served by operating it more than the amount required to stabilise the indicator reading.

The pump need not be used under normal running conditions, as the rocking or surge of fuel within the tank will supply the required air automatically, as explained.

Unless any of the pipe lines has been disconnected for any reason or some part of the apparatus accidentally damaged, the gauge will continue to function indefinitely.

Disconnection of the pipe lines, however, may result in deposition within them of beads of fuel or water, which will cause faulty or erratic reading of the gauge.

To correct this, the indicator pipes must be disconnected at both ends, *always disconnecting the rear ends first*, and a hand tyre pump *securely* connected to the front end. The air pump line need not be disconnected. About forty strokes of the pump as a minimum will serve to dry out the water or fuel, the pipes being reconnected immediately afterwards, coupling up the front ends first.

A rapid fall of the gauge reading when the car has been standing a short time indicates a leak in the pipe line between the gauge and the bottom of the tank. To confirm this, each pipe in turn should be disconnected at both ends, disconnecting the rear end first, and with one person holding a finger on the front end, another should suck on the rear. If the suction produced will hold the tongue for one minute the line is in order.

The unions should be inspected for dirt or flaws. It is of vital importance that they should be perfectly airtight.

If the connections are re-made when there is some fuel in the tank, the small hand pump must be used to restore the indicator reading.

INSTRUCTIONS FOR CHARGING & OPERATING

Exide

Starting, Lighting, Ignition Batteries

in Ebonite Containers

FOR

20/25 h.p. Rolls-Royce Cars.

(3 H)

FIFTH EDITION

Publication No.
4034
(For Books No. XII and XIV Comb.)

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Exide

Starting, Lighting, and Ignition Batteries, in Ebonite Containers, for 20/25 h.p. Rolls-Royce Cars.

(1) Specification.

Model .. .. 20/25 H.P.

Description: Exide Battery type .. 6XSM7-1L.

Specific gravity of acid (at 60° F.).		
In climates with air temperature ...	Ordinarily below 90° F. (32° C.).	Frequently above 90° F. (32° C.).
Filling-in acid for first charge	1·340	1·260
When fully charged ...	1·280 (" normal " gravity)	1·210 (" low " gravity)

First charge current .. .. .. 2½ amps.

Normal charge current (see par. 18, first section) .. .. 4 ,,

Capacity when fully charged :—

Starting—for five minutes.. .. 110 ,,

Lighting—at 3 amperes .. .. 17 hours.

Voltage across terminals of battery .. 12

(2) First Charge.—Fill the cells with pure " Accumulator " sulphuric acid—previously diluted to 1·340 (1·260*) specific gravity, and cooled to approximately atmospheric temperature—to ½ in. above the tops of the plates.

(3) Allow the battery to stand for 12 hours, then restore the level of the acid to ½ in. above the tops of the plates by adding acid of the same specific gravity as originally used.

(4) See that the filling plugs are in position ; connect as described in par. 19 for charging from an outside source and charge as detailed overleaf.

* For " low " gravity acid batteries ; see par. 1.

(*a*) When time permits it is recommended that the charge be given at 2½ amperes for not less than 96 hours (see par. 24 with reference to maximum temperature permissible).

Alternatively, the charge may be given at 4 amperes for not less than 70 hours, provided the maximum temperature permissible (see par. 24) is not exceeded.

Should the maximum permissible temperature be reached, the current must be reduced, or the charge suspended. If this has to be done, the time required for the charge will be proportionately increased.

The charge should be continued until :—

(*b*) gas is freely evolved in every cell.

(*c*) the voltage across the battery and the specific gravity of the acid in every cell remain constant over 5 successive hourly readings.

(**5**) Take specific gravity readings of the acid in each cell (see par. 11) and adjust by adding distilled water if the specific gravity is above 1·290 (1·220*), or by adding acid of 1·340 (1·260*) specific gravity if the acid is below 1·270 (1·200*). Charge for another hour and test again. In this way adjust until the specific gravity of the acid after correction for temperature (see par. 12) is between 1·270 (1·200*) and 1·290 (1·220*), *but only after making certain that the voltage and gravity have remained constant for at least 5 hours.*

(**6**) Adjust the level by the addition or withdrawal of acid as required until it is ½ in. above the tops of the plates. The first charge is then complete.

(**7**) Discharge the battery through resistances or lamps at the rate of about 5 amperes until the voltage across the battery with the current passing is 10·8, then recharge at 4 amperes until all the plates again gas freely. The recharge will require approximately 15 hours. The battery is then in good condition for being placed on the car and connected up to the electrical system.

(**8**) **Batteries must be properly installed.**—The battery must be well packed in its box so that it cannot move. The cable terminals should be well coated with pure vaseline (not grease) before putting the battery into service.

* For "low" gravity acid batteries ; see par. 1.

(**9**) **Maintenance of battery in service.**—The top of the battery should always be kept clean, and, as far as possible, dry; attention should be given immediately to the least sign of corrosion occurring on the terminals.

A useful adjunct in connection with keeping the top of the battery free from acid is a small sponge, which should be used in conjunction with a bowl of clean water to remove acid from the top of the battery. Water wetness, unlike acid wetness, is non-corrosive and will quickly dry.

See that the vent-plug passages are kept clear.

Keep the terminals and connections well vaselined, clean on their surfaces in contact and firmly screwed up, but do not use abrasives for cleaning, i.e., file, emery paper, sand paper.

Do not allow metal tools or other metal to short circuit any terminals of the cells.

Do not inspect the battery with the aid of a naked light, and on no account disconnect any of the battery terminals or connections when any charge or discharge current is passing, for such a course incurs risk of an explosion, destructive to one or more cells, and involving personal risk.

(**10**) **Pure water must be added to all cells regularly and at sufficiently frequent intervals to keep the acid at the proper height.**

Never allow the level of the liquid in the cells to fall below the tops of the separators.

Add pure water regularly to each cell until the level of the liquid is ½ in. above the tops of the plates.

Plugs must be removed to add water, then replaced and tightened after filling.

DO NOT ADD ACID, ONLY PURE WATER.

Putting acid into the cells to bring up specific gravity may do great harm, and should never be done except by an experienced battery man. Acid should only be used to make good loss from sloppage, or by leaks.

Do not add any water containing even small quantities of salts of any kind.

Distilled water, melted artificial ice, or fresh rain-water are recommended.

Use only a clean, non-metallic vessel for handling the water.

Add water regularly, although the battery may seem to work all right without it. Distilled water for "topping-up" purposes can be obtained from an Exide Service Station or chemist.

Always keep plates well covered.

If a vent plug is left out, or loose, the acid may splash out of the cell. If a plug is lost or broken, obtain a new one at once.

In cold weather, always add the water just before charging, or running the car, so that the water and acid will be mixed, and freezing thus avoided.

"Dopes":—

All Exide batteries utilise pure, dilute sulphuric acid only. At no time should "dopes" of any description be added. The use of any such "dope" renders the Exide guarantee null and void.

(11) The best way to ascertain the condition of the battery is to test the specific gravity (density) of the acid in each cell with a hydrometer. This should be done regularly, but not just after adding water.

A reliable specific gravity test cannot be made after adding water, until it has been mixed by charging the battery.

Fig. 1 illustrates the Chloride Company's special hydrometer syringe used to test the specific gravity of the acid. To take a reading, insert the end of the rubber tube in the cell, squeeze the rubber bulb, and then slowly release it, drawing up acid from the cell until the hydrometer floats. The reading on the graduated stem of the hydrometer at the point where it emerges from the solution is the specific gravity of the acid. After testing, *the acid must always be returned to the cell from which it was taken.*

FIG. 1. Type S-1 Hydrometer Syringe.

The gravity reading is expressed in "points"; thus, the difference between 1·250 and 1·275 is 25 points.

(12) Correct for temperature (see table under par. 13). The correction may also be obtained approximately by *adding* one point to the reading for every 2½ degrees in temperature of the acid *above* 60° F., and by *subtracting* one point for every 2½ degrees of temperature of the acid *below* 60° F. Thus, if the reading is

1·290 with acid at 50° F., the specific gravity corrected to 60° F. is four points less than the reading, or 1·286.

(13) When all cells are in good order, the gravity will test about the same (within 25 points) in all.

Specific Gravity of Acid in Cells with "normal" gravity acid at various states of discharge.

Condition of Battery.	Actual hydrometer readings at temperatures of							
	40°F. (4°C.)	50°F. (10°C.)	**60°F. (16°C.)**	70°F. (21°C.)	80°F. (27°C.)	90°F. (32°C.)	100°F. (38°C.)	110°F. (43°C.)
Fully charged	1·288	1·284	**1·280**	1·276	1·272	1·268	1·264	1·260
Half discharged ...	1·207	1·204	**1·200**	1·196	1·193	1·189	1·186	1·182
Fully discharged ...	1·115	1·113	**1·110**	1·107	1·104	1·101	1·098	1·095

Specific Gravity of Acid in Cells with "low" gravity acid at various stages of discharge.

Condition of Battery.	Actual hydrometer readings at temperatures of							
	50°F. (10°C.)	**60°F. (16°C.)**	70°F. (21°C.)	80°F. (27°C.)	90°F. (32°C.)	100°F. (38°C.)	110°F. (43°C.)	125°F. (52°C.)
Fully charged	1·214	**1·210**	1·206	1·202	1·198	1·194	1·191	1·186
Half discharged ...	1·163	**1·160**	1·157	1·154	1·150	1·147	1·144	1·138
Fully discharged ...	1·102	**1·100**	1·098	1·095	1·091	1·088	1·085	1·081

In order to facilitate the use of various hydrometers when determining the density of the acid, we give below a conversion table of principal readings required :—

Density or Specific Gravity.	*Twaddell's Hydrometer Degrees.*	*Baumé Degrees (approx.).*
1·170	34	21
1·200	40	24
1·225	45	26·5
1·265	53	30
1·270	54	30·5
1·275	55	31
1·280	56	31·5
1·285	57	32
1·350	70	37·5
1·840	168	66

The specific gravity of the acid in the cells when fully charged

should be within .010 (10 points) above or below the value given in the tables.

When the battery is found to be more than half discharged, use the lamps sparingly until, by charging the battery, the specific gravity is restored to a value not less than that given in the tables opposite "half discharged."

An exhausted battery is always the result of lack of charge or waste of current. If, after having been fully charged, the battery is soon exhausted again, there may be trouble somewhere else in the system, which should be located and corrected.

(**14**) **Specific gravity in one cell markedly lower than in the others, especially if successive readings show the difference to be increasing, indicates that the cell is not in good order.** If the cell also regularly requires more water than the others, a leaky container is indicated.

Even a slow leak may, in time, drain a cell of all its acid, and a leaky container should immediately be replaced with a good one.

If there is no leak, and if the gravity is, or becomes, 50 to 75 points below that in other cells, a partial short circuit or other trouble within the cell is indicated.

A partial short circuit, if neglected, may seriously injure the battery, and should receive prompt attention.

In the case of a leak or other trouble within the cell, such as a short circuit, do not attempt to open the cell, but communicate with the nearest Exide Service Station, or The Chloride Electrical Storage Co., who will advise where the battery should be sent.

(**15**) **An alternative method of ascertaining the state of discharge of a battery is to test the voltage (while the battery is delivering current) by means of a voltmeter.**

The battery may be discharged with safety until the voltage, taken with head lights **on,** falls to 10·8 volts across the battery, or 1·8 volts on any individual cell, but should not normally be allowed to continue discharging below these values (except momentarily for the purpose of tracing a faulty cell as described in par. 16.)

Should the above values be reached, *it is important to charge the battery promptly, and not to allow it to stand in a discharged condition, as this may shorten its life.*

(**16**) **Failure of one or more cells.**—If, when the battery is supplying current, its voltage becomes prematurely low, it may be due to one or more cells having become faulty.

This condition is best ascertained by the use of a small voltmeter, with which each cell should be tested independently, whilst the head lamps are lighted, and the faulty cell or cells located.

Ordinarily, it may be expected that all six cells will work together in much the same condition.

In such a case of failure, the makers of the battery should be consulted.

It should be understood, however, that failure is considered *most unlikely* within a period of three years' service, if proper care be taken of the battery.

(**17**) **Testing for condition of charge.**—We recommend that a small voltmeter be carried. The reading of a voltmeter when the battery is on open circuit is no real indication of the condition of the battery. For voltmeter readings to be of any real value, a battery must be discharging at a moderate current, e.g., lighting the head lamps, at the time the readings are taken. If, with a current passing, each cell shows 1·95 to 2 volts, and the specific gravity of the acid is not less than ·010 (10 points) below the values given in the tables in par. 13 opposite "fully charged," when the battery is thought to be fully charged, it is reasonable to assume that the battery is in a healthy condition.

(**18**) The best results, both in starting and in lighting service, will be obtained when the system is so adjusted that the battery is normally kept well charged, but without excessive overcharging.

Too little charging is indicated by the specific gravity frequently falling below a value midway between those given in par. 13, opposite "half discharged" and "fully charged," in which case either a greater proportion of the running should be done with the charging switch closed or the battery should be given a special charge.

It is important that the battery be kept fully charged, but not overcharged at a high rate of current, as this may cause the temperature limit of 110° F. to be exceeded, and the cells may suffer due to evaporation from the electrolyte and by disintegration of the plates.

Too much charging is indicated by the specific gravity of the acid being generally about the "fully charged" value given in the tables in par. 13, and by unusually frequent "topping-up" being required.

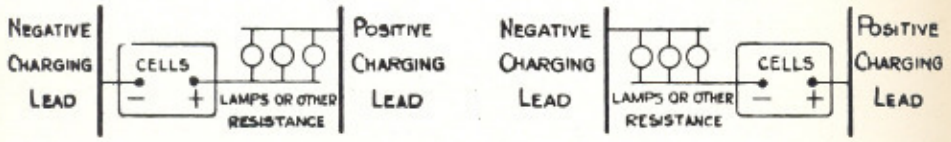
Note that *too little charging* causes an unhealthy condition of the plates ; *too much charging* results in abnormal wear and tear.

(19) Charging in Garage from External Source.—A uni-directional current is necessary.

If the supply be alternating, suitable rectifying apparatus must be used. There are reliable types of valve and metal rectifier apparatus of suitable ampere capacity on the market. Instructions for the operation of these will normally be supplied by their makers.

If the current from the public supply main, or other source, be direct, the charging current must necessarily be supplied through a suitable switch and a variable resistance, or set of lamps, preferably carbon filament, suitably arranged to act as a variable resistance.

Incandescent lamps or radiator elements are convenient for this purpose. To find the size in watts of lamps or radiators required for use as resistances, multiply the voltage of the mains by 4. If carbon filament lamps are used, the candle power required is similar to the voltage of the mains. For example, on 200 volt mains, the watts taken by the lamps or elements connected in parallel (Fig. 2) should be 800, or the total candle power of carbon filament lamps 200.



Connections when Negative main or neither main is earthed.

Connections when Positive main is earthed.

FIG. 2.

Note that values lower than the above may be used, thereby reducing the number of lamps required and the demand on the mains, but, if this is adopted, the time required for charging will, of course, be proportionately increased.

It is, of course, only the current taken by the lamps or elements, and not their brightness, that determines their suitability for use as resistances.

Before connecting up the battery for charging purposes, it should be confirmed that the resistance is in the main showing the higher potential to earth, i.e., that one terminal of the battery is in direct connection with the earthed main. The mains may be tested by

connecting a wire from the water pipe or other " earth " to a lamp of " mains " voltage, the other wire from the lamp being connected to each of the mains in turn (Fig. 3). (Be particularly careful not to short circuit the mains when testing in this manner. Unless one has some familiarity with matters of this kind, it is preferable to call in an electrician.) If the lamp lights to full brilliancy on one main and not on the other, the main on which it does *not* light is the one which is earthed, and the battery should be connected to it. If the lamp does not light on either main, or it glows dimly on both mains, neither of the mains is earthed, and it is preferable in these circumstances to connect the battery to the negative main.

FIG. 3.
Diagram of connections for testing for near the main.

(20) The polarity of the charging wires to the battery may be tested by dipping their ends in a glass of water, to which a teaspoonful of salt has been added. In doing so it is assumed that a charging or limiting resistance, or lamp of " mains " voltage, is already in series so as to avoid trouble from short circuiting (Fig. 4). Bubbles of gas will form on the negative wire.

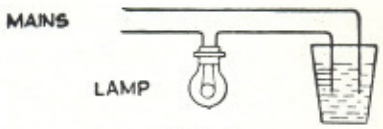


FIG. 4.
Diagram of connections for polarity test.

It is necessary to be quite certain that charging current is flowing into the battery in the correct charging direction.

(21) Limit the current to a value not exceeding 4 amperes by varying the lamps or other resistance (par. 19) in series with the battery (Fig. 2.)

(22) Completion of Charge.—The charge should be continued until the conditions detailed in par. 23 are fully complied with. Note par. 24 *re* temperature permissible. Avoid overcharging either in quantity or time.

(23) A battery charge is complete when, with charging current flowing at the normal charging rate (see par. 1), **all cells are gassing (bubbling) freely and evenly, and the gravity of the acid in all cells has reached a maximum : that is, has shown no further rise during five hours.** The battery is fully charged when all of the plates in all of the cells have given back all of the acid, of which the best indication is that charging will produce no further rise in gravity ; the gravity has reached a maximum.