DYNAMO LIGHTING FOR MOTOR CARS

BY

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CHAPTER I

INTRODUCTION AND GENERAL PRINCIPLES

WE do not propose to enter into a technical description of the various workings of the dynamo lighting systems hereafter described, rather confining ourselves to the broad outline of their various features, and indicating the main points wherein the various systems differ, in the hope of enabling the reader to bring an intelligent working knowledge to bear on the machine with which he has to do.

Electric lighting systems may be compared for practical purposes to a water pumping plant, and may be divided into four separate parts: 1. The dynamo, which raises the pressure of electricity to the right voltage, as the pump raises the pressure of water to the necessary "head." 2. The accumulator or storage battery, which stores the electricity similarly as the tank or reservoir stores the water pumped up. 3. The electric lamps or bulbs, which use up the stored electrical energy much as a water motor or fountain uses it; and 4. The wiring and switches, corresponding to the piping and taps of a hydraulic system.

The Dynamo.—Considering firstly the dynamo. This consists of five essential parts: (*a*) the armature, a rotating cylindrical magnet wound round with wire in which the current is generated; (*b*) the commutator, which is suitably connected to the armature windings and rotates with them; (*c*) the brushes, which press on the commutator and collect the current from it, passing it out to the necessary wires of the system; (*d*) the field magnet, which may be either a permanent or an electro-magnet or a combination of both, its function being to give a strong magnetic field for the armature to rotate in; (*e*) the bearings and other purely mechanical details of the machine.

It should be remembered that the output of the machine depends: (1) roughly on the strength of the field; (2) on the speed with which the armature rotates; and (3) on the number of turns of wire upon the armature, although there are other factors which limit the output, such as heating, dimensions, and efficiency.

Choice of Machine.—In choosing a dynamo it is well to ascertain beyond the usual facts of design, output, and weight that the bearings and commutator are generously proportioned, as these are the two weak points of lighting dynamos owing to the restricted space at the disposal of the designer. A machine should also be chosen in preference which gives its maximum working output at a low speed, and also the speed which the dynamo "cuts in," or begins to generate effectively, should receive attention.

The Accumulators.—These are generally the same description of cell used for ignition work on cars, but they must be of a sufficiently large size and very robust to take the heavy currents generated by the dynamo. It is best to employ the cells supplied by the maker, as this gives more satisfaction both to the manufacturer who knows the battery is right, and to the user who can fall back on the maker in the event of the cells failing. A common error in the rating of batteries may be noted here. Batteries for ignition purposes are rated in "Ignition ampere hours" which are really double the real capacity in lighting hours. Thus a battery rated at 80 ignition ampere hours has only a capacity of 40 ampere hours for lighting, and a cell of 30 ampere hours would give an ignition rating of 60 ignition ampere hours, a barbarous survival of the bad old days.

It will be understood that 40 ampere hours means a discharge of one ampere for forty hours and two amperes for 20 hours, and so on, whatever the voltage of the cell or batteries, be it 4, 6, 8, or 12 volts.

It should be noted that the efficiency of a battery decreases if a large current be taken; thus in the 40-ampere hour cell under notice, if 5 amperes were taken it would not give eight hours' light as it theoretically should, but probably rather less than seven, as 5 amperes is rather too large a current to take from a battery of that size for long.

The discharge rate is generally stated on the side of the cell by the makers, but a safe rule is to allow a discharge of one-tenth the full capacity in ampere hours; thus a 50-ampere hour cell could be discharged safely at 5 amperes.

This rate can be exceeded for short periods but at a considerable loss of efficiency.

We shall not enter into details for maintenance of accumulators, as the general rules that apply to ignition cells apply equally well to lighting batteries. The chief points to remember are:—

1. Do not leave the cells discharged.

2. Keep the cells filled with acid well over the plates.

3. Vaseline the terminals and keep the tops of the cells clean to avoid leakage.

4. Pack the cells tightly in their case to avoid jolting and vibration.

Examine the cells occasionally; because they are hidden away in a box don't neglect them—the battery and the tyres are generally the two worst-treated accessories on the car.

Lamps.—By lamps we mean the projectors in contradistinction to the "bulbs."

The essential points of a lamp are that it should give light, a detail that some manufacturers appear to overlook, and this light-giving property depends solely upon the shape of the reflector. Every maker has his own idea of the curve or shape of the reflector, which should be a parabola or some derivation of it. The only real test is an actual road trial, photometrical tests being practically useless. The light should be projected well ahead, so as to pick out cyclists and unlighted carts, etc.: any illuminant, even a naphtha flare, will light up the immediate neighbourhood of the car, and with the advent of tarred roads and fast night driving the searchlight type of reflector is essential.

Referring to the use of coloured reflectors, in fog their utility does not seem proved, and allowing for the small number of times they are required during the year their employment hardly seems worth while; in any case, the use of amber-coloured bulbs seems to entirely solve the difficulty.

Secondary, considerations for lamps are that they should be water and dust tight, that the head lamps at least should have focussing arrangements, they should be of pleasing contour and devoid of superfluous projections rendering them difficult to clean.

Lamps of the freak type necessitating special bulbs should not be purchased.

Bulbs.—The wonderful improvement effected in the metal filament lamp has made the electric lighting of cars possible, but there are certain details in the choice of bulbs which should be noted. The brass cap should be large enough to hold the bulb mechanically through the medium of the plaster filling, and the contacts should be capable of carrying the current adequately. The filament should be of the right shape for the particular reflector in which it is to be used, and should be in the right focal centre (this is generally located well back in the bulb); and lastly the glass bulb should preferably be pipless in front and must be of a sufficient diameter and area to dissipate the heat generated by the filament, and be large enough to maintain its vacuum and to receive the occluded gases from the filament without lowering the vacuum to any marked extent.

Small bayonet holders should be used in preference to large as the latter cut away a large portion of the most useful part of the reflector.

The earlier tungsten lamps had brittle filaments, which were fragile, and could not satisfactorily be wound in the concentrated or focussing form required for motor-car headlights. A subsequent development, known as the drawn-wire process, has made it possible to produce a ductile tungsten filament of great strength, which is sufficiently flexible to be wound in any desired form (Fig. 1).

Perhaps one of the greatest advantages of the recent types of automobile electric lamps is the fact that they can be effectively used in reflectors designed on theoretically correct lines. In the case of gas lamps, considerations of ventilation, cleanliness, and temperature enter into the design of the reflector units—and these considerations are generally at variance with the efficient reflection and distribution of the light.

For practical purposes it may be said that the

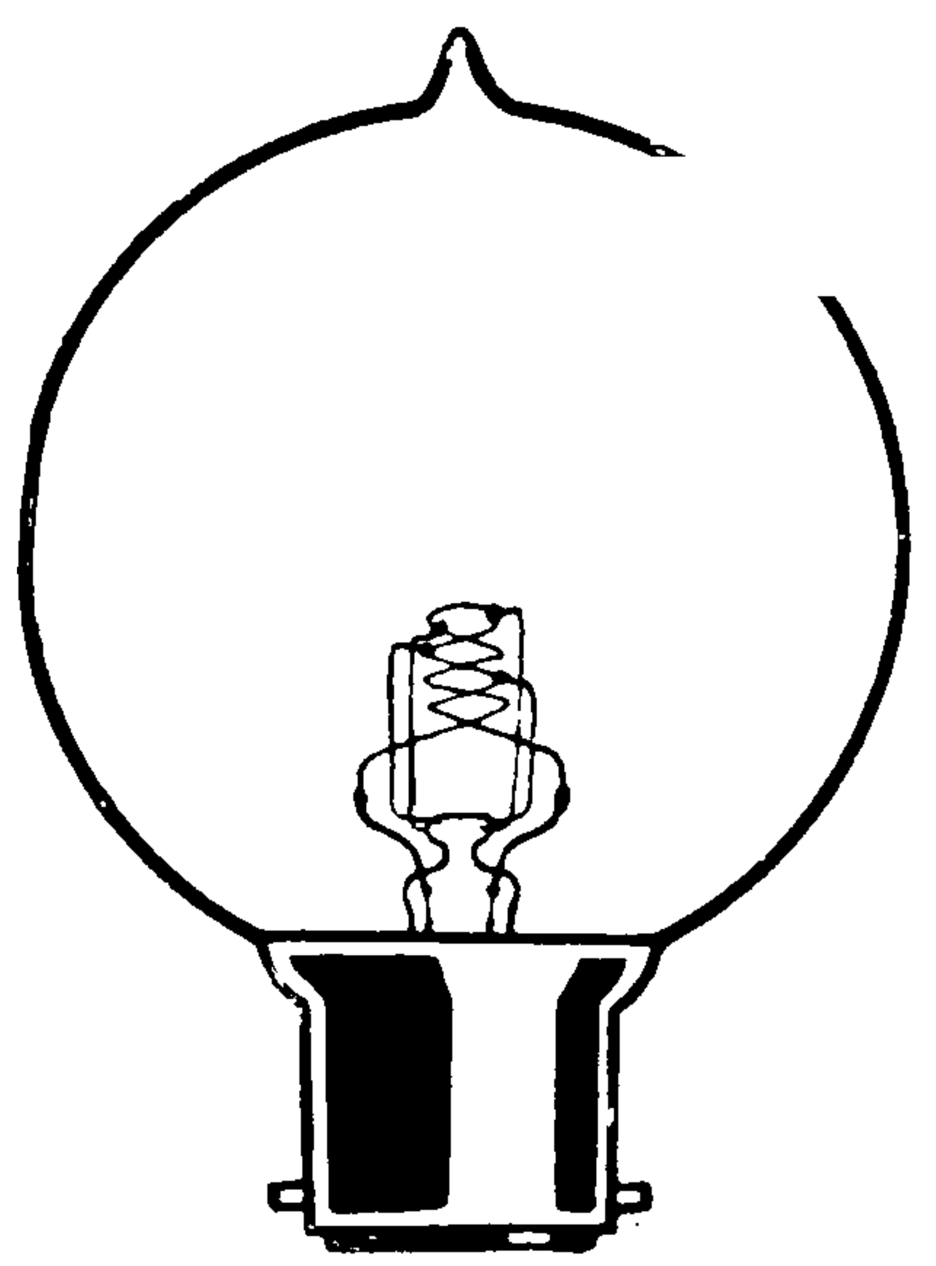


Fig. 1.

Headlight Lamp (Helical Coil Filament).

headlight lamps, in which the filament is concentrated into the smallest possible space, when used in conjunction with a parabolic reflector, provide a sufficiently close approximation to the theoretical ideal.

CHAPTER II

FITTING THE SYSTEM

Fitting the Dynamo.—Owing to the fact that at the present date many car manufacturers do not provide suitable provision for fitting the dynamo, various positions have to be chosen, each of which has some advantage or disadvantage. We propose to take the various possible positions in order.

General Considerations.—In fitting the dynamo, a firm, preferably non-magnetic, base should be chosen in a clean and dry position. Care should be taken not to fit too near the exhaust pipe. The dynamo, if fitted on the chassis frame, should be well stayed to prevent vibration. The machine should not be driven from the two to one gear if it can possibly be avoided.

Position.—There are two main positions in fitting the dynamo which require consideration—the dynamo can be fitted before or behind the gear box (Fig. 2). If the dynamo be fitted before the gear box, that is to the engine, fan, flywheel, or shaft between the flywheel and gear box, the variations of speed will be high and high rates of speed will be met with, *e.g.*, when the engine is accelerated for hill climbing on first or second gear; and consequently the wear and tear on the dynamo will be greater. A compensating advantage, however, will be that a higher mean rate of charging will result, moreover, even when the car is at rest, say in a traffic block, the engine will still be turning and the battery charging.

When driving from behind the gear box the dynamo will naturally only charge when the car is in motion, and therefore the periods of charging

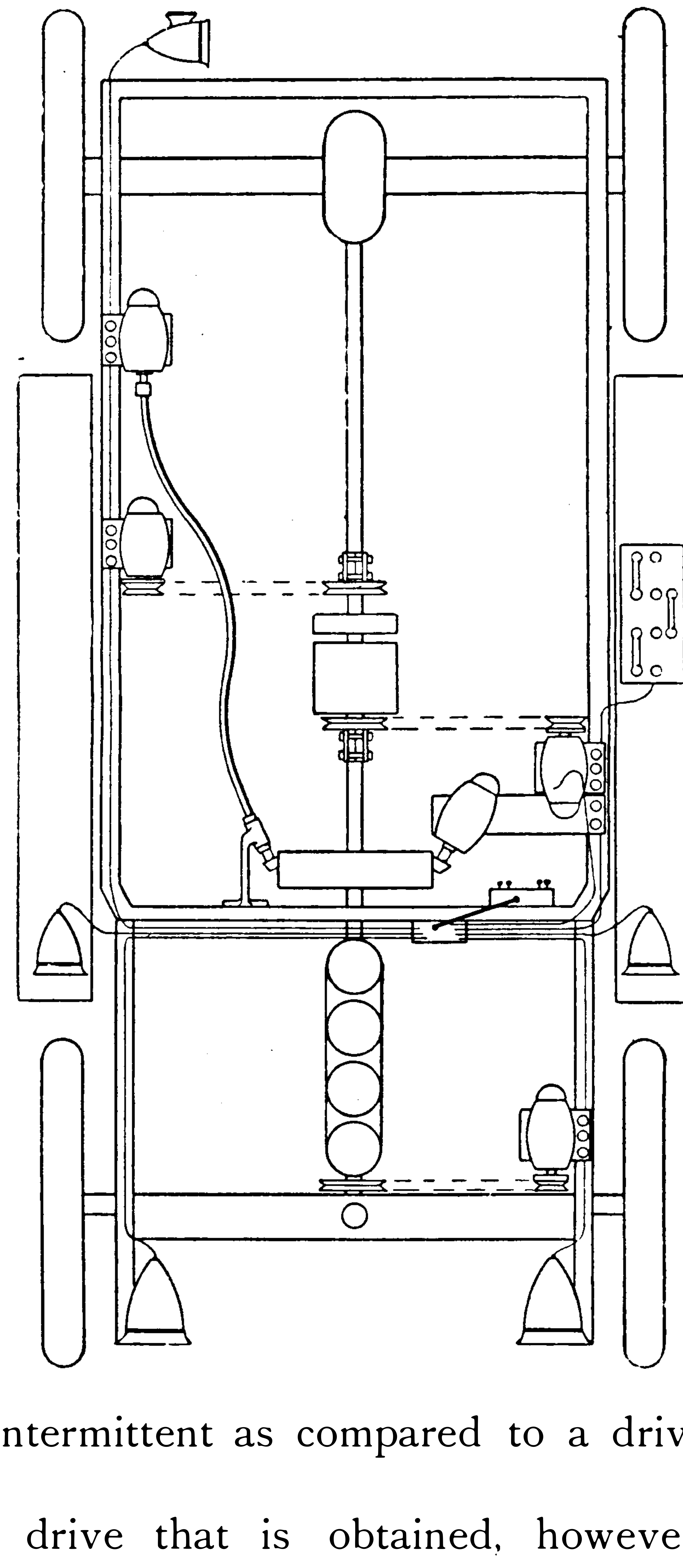


Fig. 2.

will be intermittent as compared to a drive from the engine.

The drive that is obtained, however, is much steadier and has a smaller range of fluctuation from the propeller shaft than on the engine side when the engine is in a lower gear, and therefore the wear and tear on the dynamo is much less.

Driving.—The method of driving the dynamo should be through a belt, either flat or V (Fig. 3), as this runs much sweeter than a chain or gear drive, and also gives a certain amount of slip at high speeds. In awkward positions, or where it is required to strike the dynamo off when running, a friction gear may be employed driving through a flexible shaft (Fig. 4). By varying the pressure of the friction roller upon the flywheel through a spring any suitable maximum output may be arranged. The roller can

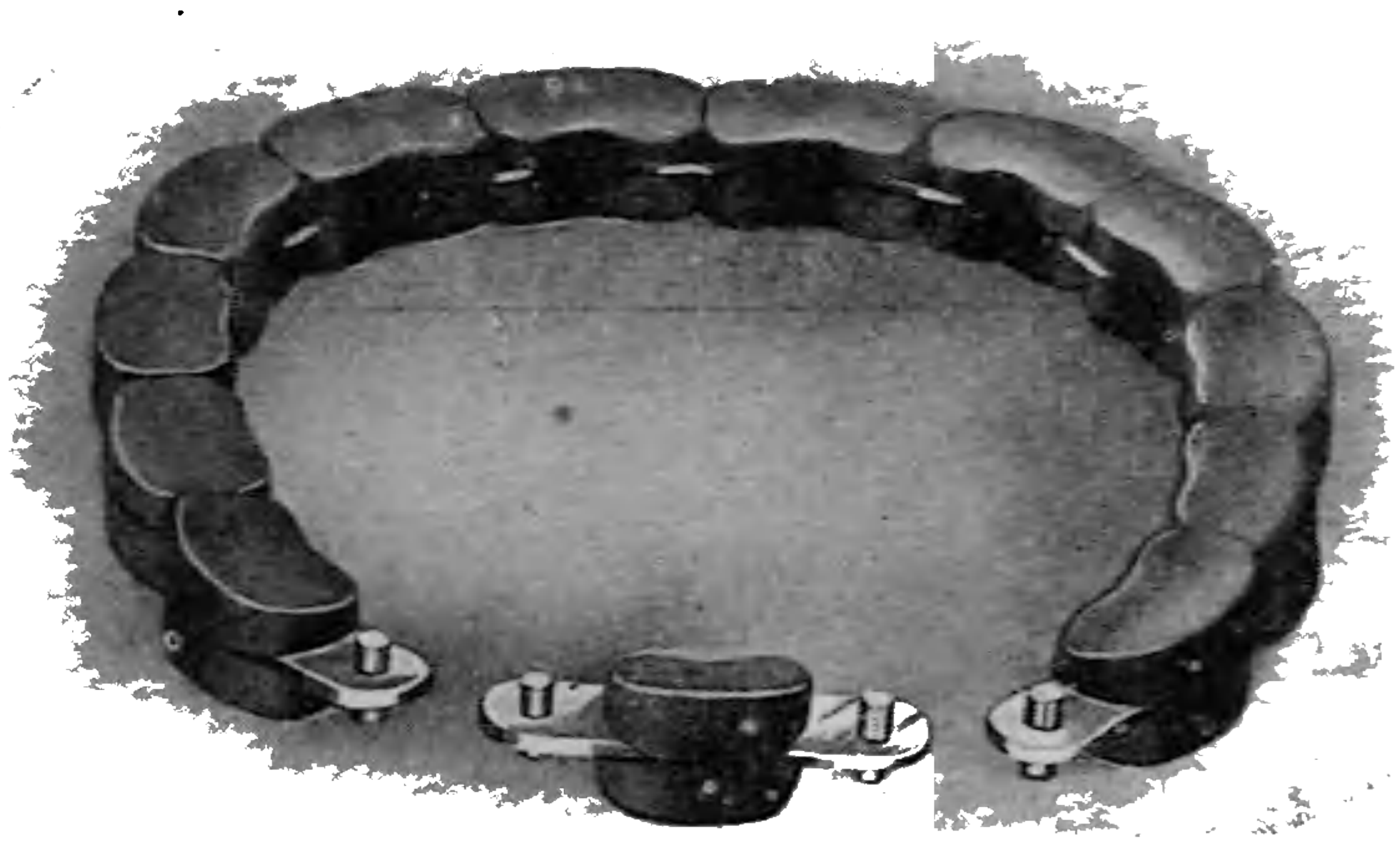


Fig. 3.

be withdrawn from contact altogether by releasing the spring through a suitable Bowden wire.

Another method of accomplishing the same result is through a spring loaded jockey-pulley.

Although many people inquire if their machines should not be able to be struck out of action, there is no real need to do so, as the wear of the commutator and bearings is so slight, and the power needed to turn the dynamo, even when loaded, so small, that the necessity is more sentimental than real.

In fitting, make quite sure that no water or dirt can be thrown on the belt, as these, particularly water, shorten its life very considerably.

Where there is not room to get a satisfactory length of belt drive, a silent chain may be employed, but every effort should be made to employ a belt drive where possible.

When installing the dynamo, consideration should be given to two points, *i.e.*, whether the car is high or low geared, that is, whether geared for town or

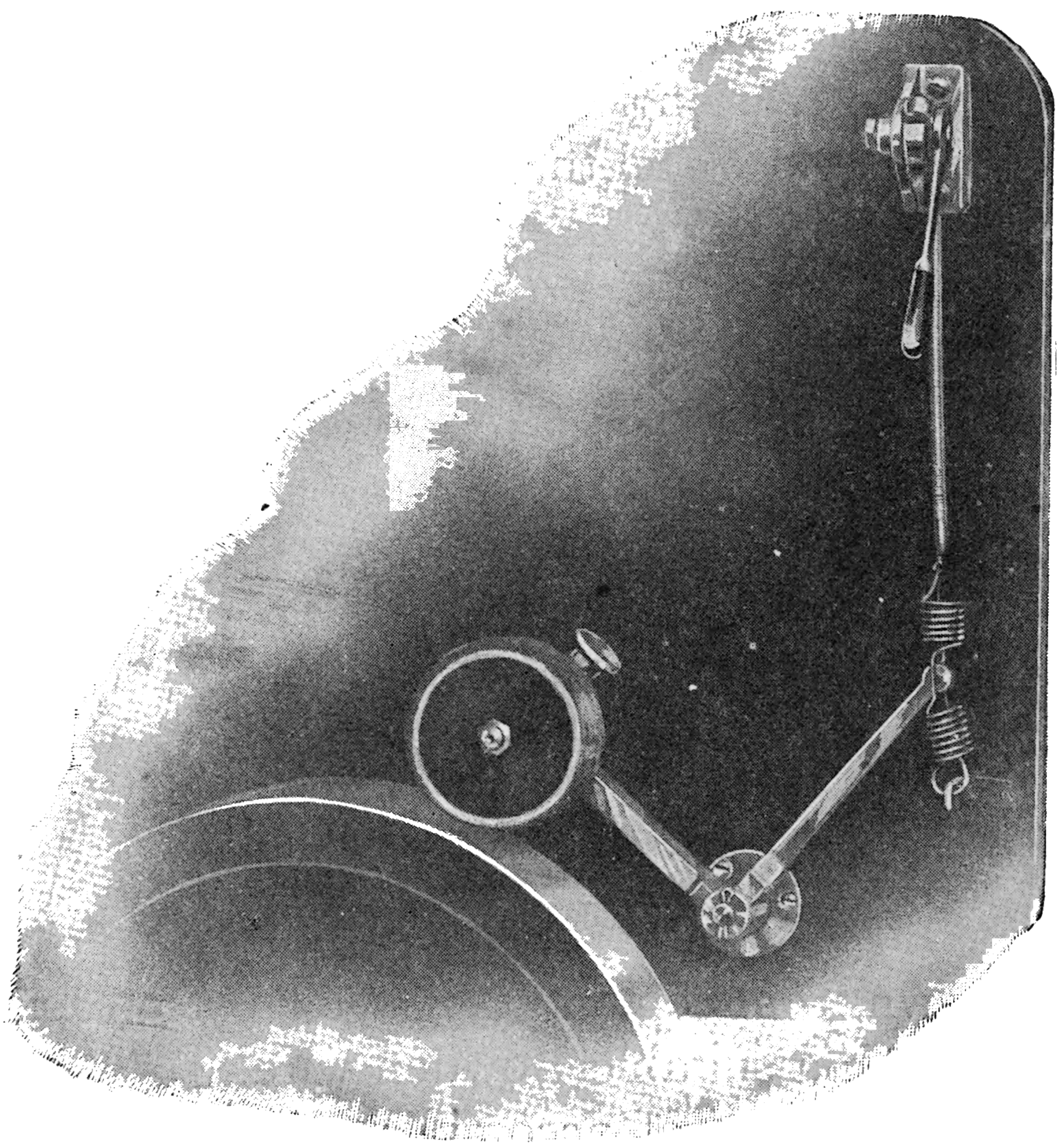


Fig. 4.

country use, and secondly, whether the car is to be used during the day as well as at night, or for night and theatre use only.

Gearing.—With regard to the question of gears, a low-geared car will obviously attain its maximum engine speed at a lower rate of travel than that of a normally or high geared car, such as an ordinary touring car. It will in this case be necessary to gear the dynamo somewhat lower than for the corresponding speed of a touring car with a lower engine speed.

If the dynamo be too high geared it will cut in at a low car speed, but will be rotating ineffectively at moderate and high car speeds, as its maximum output point will have long since been passed.

On the other hand, if the machine be too low geared, its cutting-in speed will rarely be reached in town, and the battery will never be fully charged.

The above applies also to a country or touring car in the opposite sense. A car which is arranged to cut in at 12 or 15 miles an hour, and give its maximum output at 20 or 25 miles, if driven slowly in town will probably not reach the cutting-in speed at all, and therefore again the batteries will never be fully charged.

With regard to the second consideration, for normal day and night running, the current stored during the day with the current given by the dynamo should prove enough for the lamp consumption by night, but for cars used only by night, such as theatre cars, doctors' cars, and advertising vans, the dynamo must give enough output to feed the lamps direct without drawing on the battery at all, and care must be taken to get a sufficiently large machine to do so.

As the output of many machines can be raised at will by gearing higher or tightening the slipping clutch, a little trial and error will soon give the mean normal output suitable for give and take conditions both in town and country by day and by night.

Drive from the Fan Pulley (Figs. 5, 6).—On the whole this is the most desirable position when there is room under the bonnet, as it is very accessible. Where possible a triangular drive should be arranged, that is, the belt should pass over the engine pulley to the fan, from the fan pulley to the dynamo, then from the dynamo pulley back to the engine. This provides a long elastic length of belt, moreover it has the further (adventitious) advantage that at very high speeds the belt will tend to slip, thereby saving undue wear and tear, even in those machines fitted with slipping clutch mechanisms.

From the Flywheel.—Generally speaking a drive from the flywheel necessitates such a large pulley on the dynamo to avoid excessive speeds as to be out

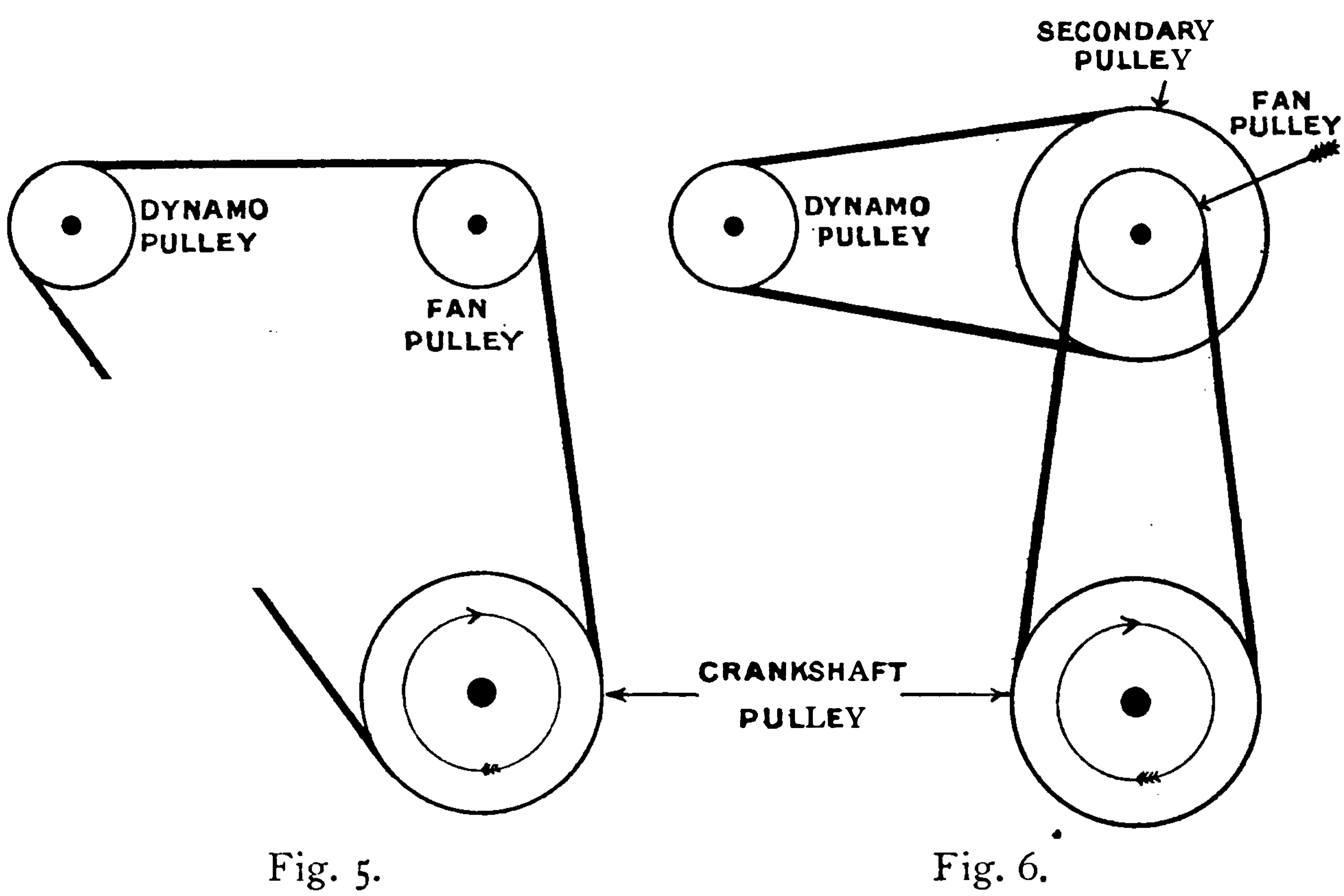


Fig. 5. Fig. 6.

of the question, though some form of friction drive may sometimes be used, either direct or through a flexible shaft, or a smaller pulley be fitted concentric with the flywheel and bolted to the side (Figs. 7, 8). Fig. 78, p. 64.

From the Clutchshaft.—This is a very favourite position, and on the whole very satisfactory. It has the disadvantages that when the clutch is withdrawn, the dynamo slows down, and that the motion of the clutchshaft throws the two pulleys momentarily

preferable, but in most cases the shoes are outside, thus preventing the fitting of the belt.

If the pulley is fitted to the propeller shaft it

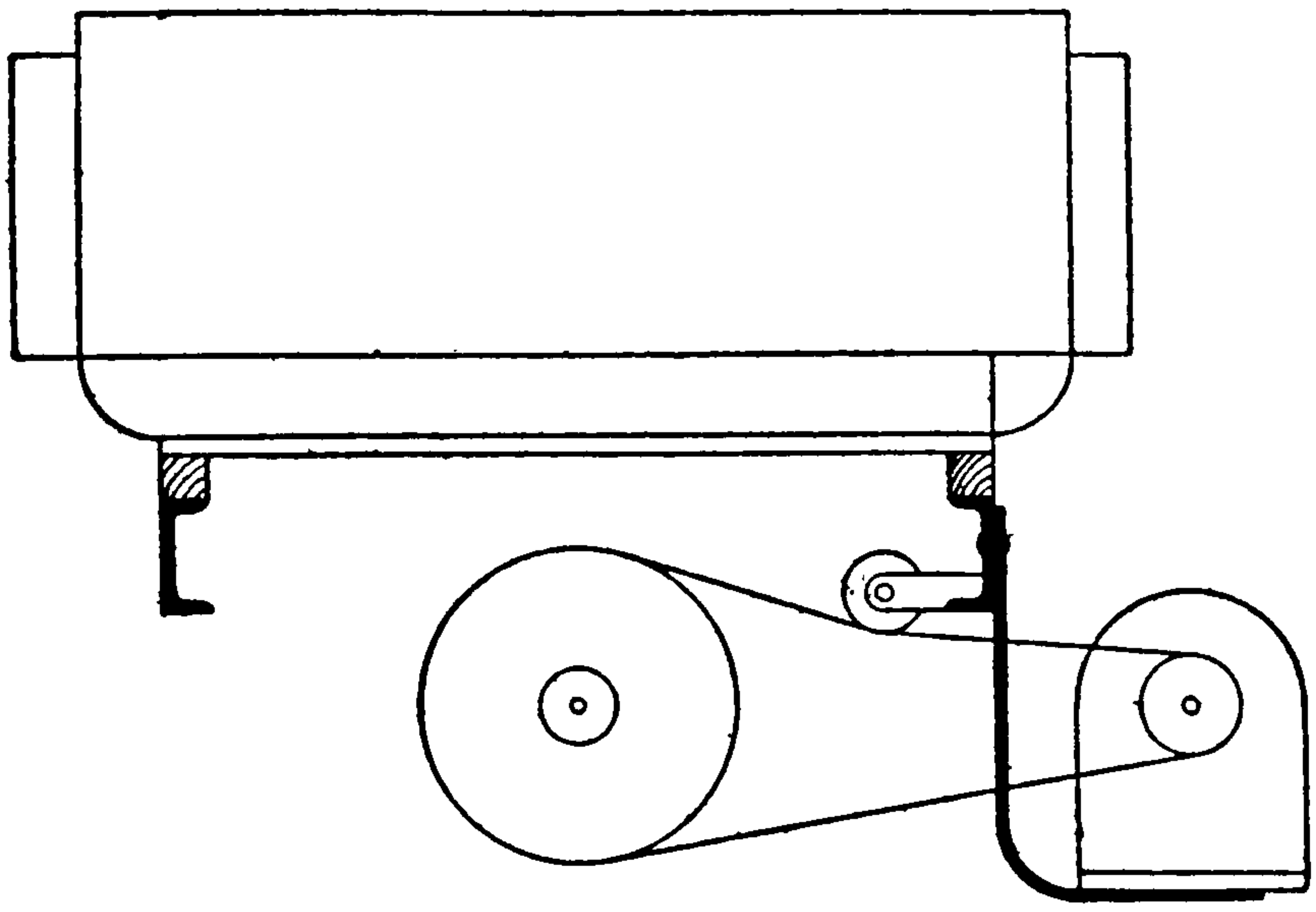


Fig. 10.

should be arranged as close to the gear box as possible in order to render the vertical movements

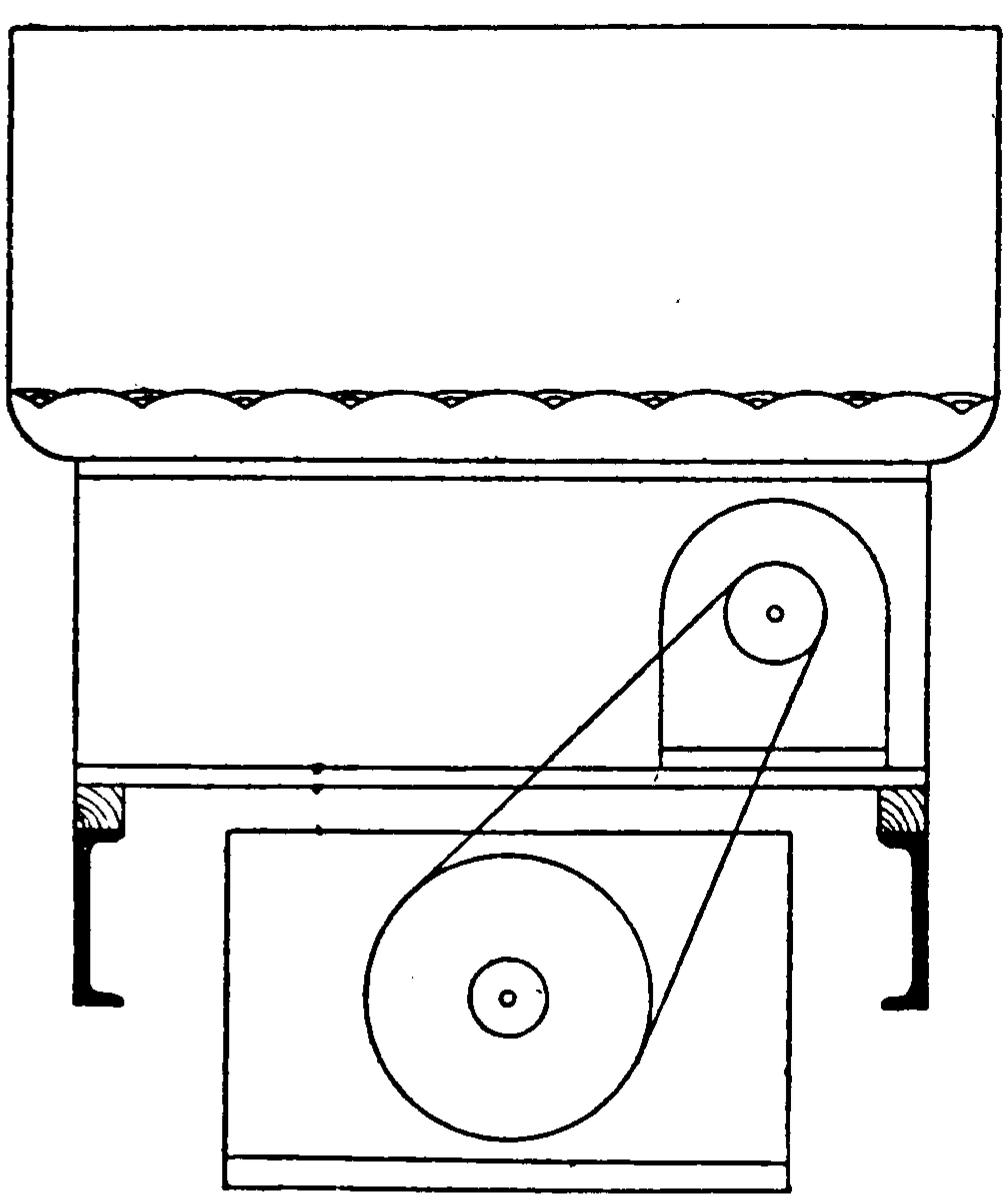


Fig. 11.

of the shaft caused by road inequalities as small as possible. This position has the great advantage of allowing an ample length of belt, as the dynamo can be hung on a bracket from the chassis or screwed to the steps at the side. Care must, however, be taken to see that the silencer and torque rods, etc., do not foul the belt, and the belt itself should be enclosed from mud and water.

Having satisfactorily mounted the dynamo and its drive, we will next turn to the important matter of wiring up.

CHAPTER III

WIRING THE CAR

Wiring Up.—No part of the installation of a lighting set calls for more care and attention than the wiring up, and every precaution should be taken to do this not only in the most thorough way but also to use the best materials.

Half the troubles met with in dynamo sets are through careless fitting up and wiring.

There are two systems of wiring up, the single-insulated and the double-insulated return.

The *single-insulated system* follows that universally used in the ignition system of the car and has the great advantages of simplicity and avoidance of duplication of wiring. It can, moreover, be more readily connected with existing ignition apparatus. If a fault occurs with this system of wiring it is very easily located.

The *double-insulated return* system is more generally employed, owing doubtless to the fact that most lamp holders are made for this system. It is claimed when a single fault occurs owing to the double insulation that no damage will be done, as the insulation of the second conductor will still prevent a short-circuit. It should be noticed, however, that in the event of the second conductor's insulation being pierced (and it is quite likely that both would go together being under the same staple) the fault is much more difficult to find, particularly if the two faults are in different parts of the wiring system. Again the battery has often to be wilfully earthed in order to take advantage of the horn, coil, or dual ignition system now fitted to most cars, therefore a single leakage on the other conductor will bring about a short-circuit.

As already stated, then, whether a single or double insulated return be used, every care should be taken to see that the best insulation is employed and that the wiring is carefully and neatly fixed to the chassis by clips or other suitable means. Wires must not be festooned around, as they are liable to sway about and fray out or catch in some moving part. The conductors should be ample to carry the current without

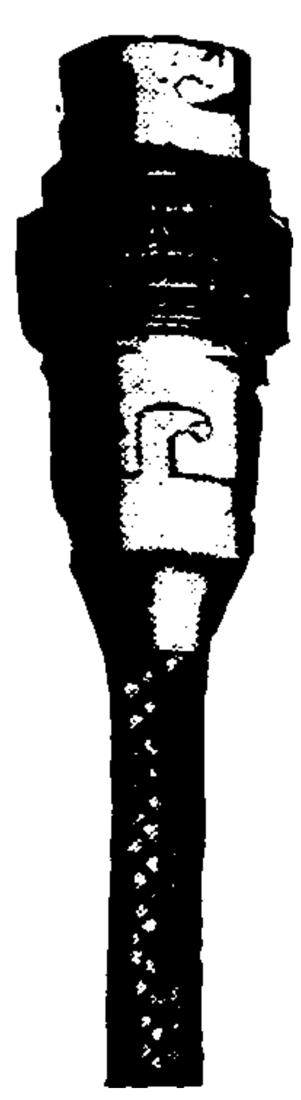


Fig. 12.

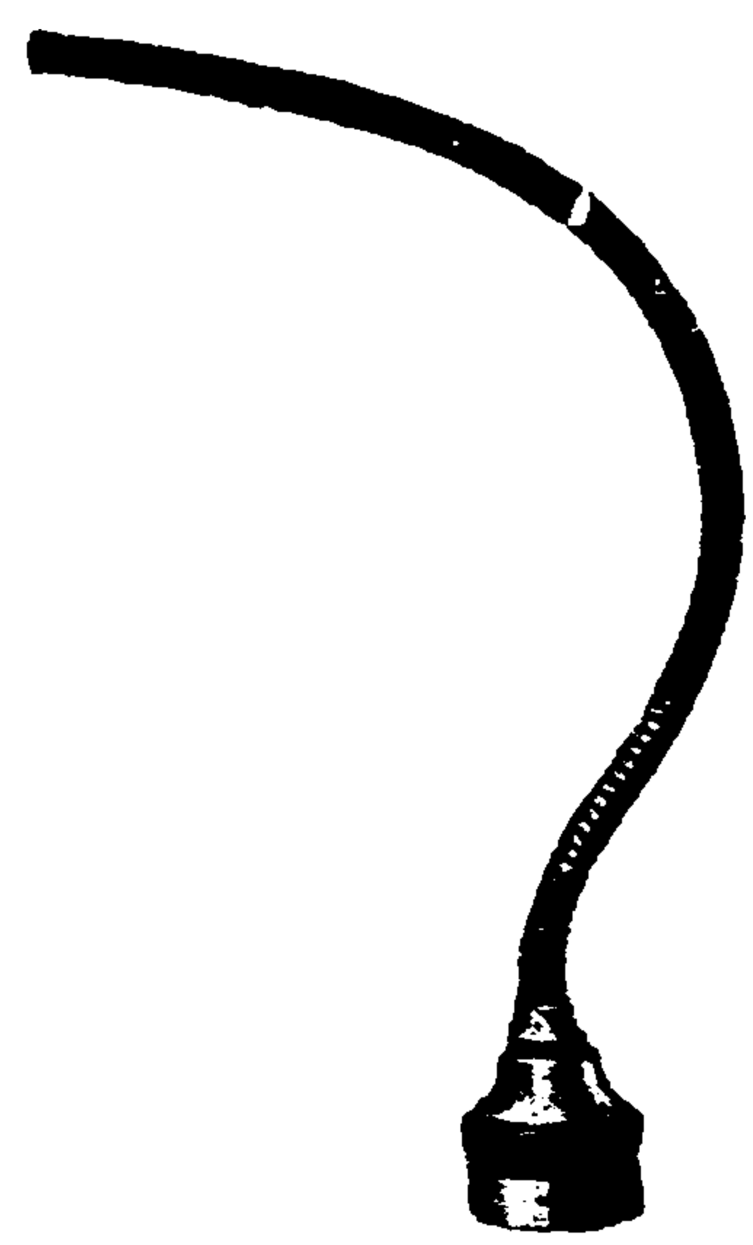


Fig. 13.

an undue voltage drop and should preferably be either armoured themselves or run in suitable flexible metallic tubing with fibre bushes at the end of each length to prevent chafing.

Fig. 12 shows a suitable plug or adapter for the ends of the wiring leading to lamps. It is simply a bayonet socket fitting into one end of a double holder, the other end of the holder accommodating the lamps. Where pin plugs are employed Fig. 13 shows a suitable armoured connection of metallic tube with watertight socket for screwing to the chassis. A screwed ring holds the pin plug to the body of the fitting to avoid the connections vibrating out of place.

The illustration, Fig. 14, shows the usual connections of a dynamo set, that is, the dynamo and lamps are in parallel with the accumulator which floats on the mains.

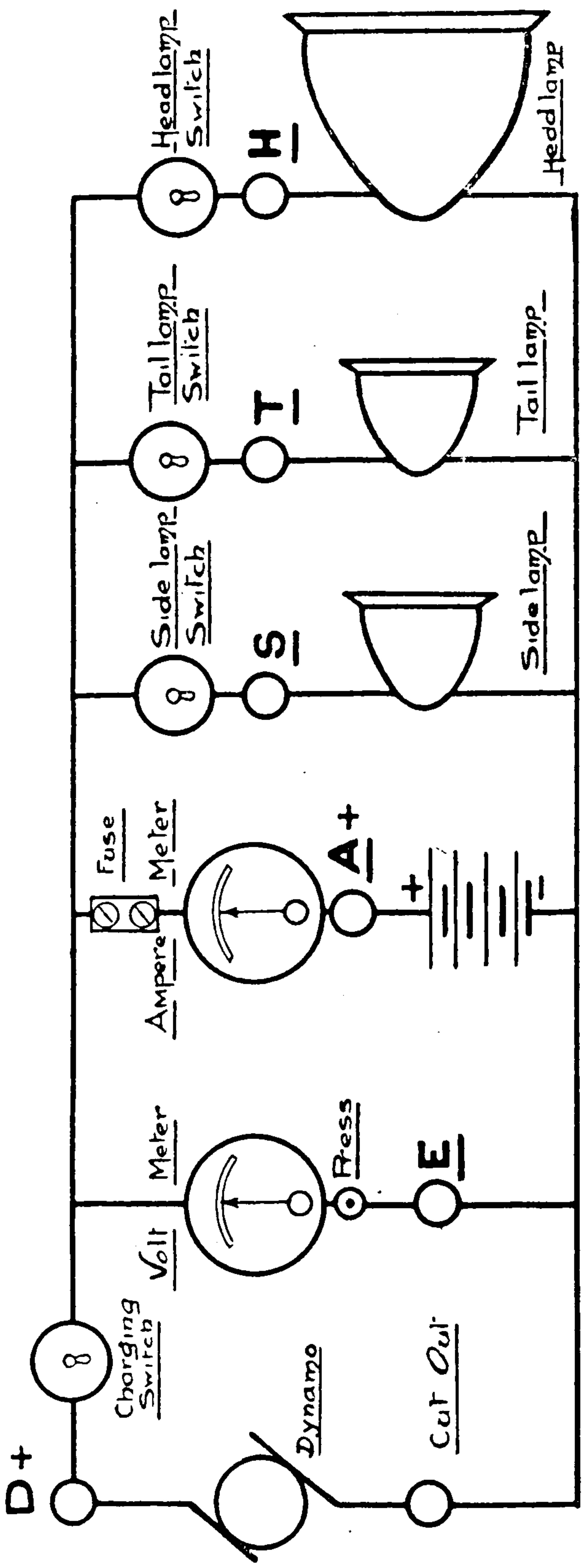


Fig. 14.—Double-Insulated System.

Thus if the lamps are on and the dynamo is not charging, the battery provides the whole current ; if the battery is partially generating, the current for the lamps is supplied by the dynamo and accumulators together. As the speed of the dynamo rises, its output should soon equal that of the lamp consumption, at which stage no current will enter or leave the battery, and finally at full output the dynamo current will supply the lamps and store a surplus in the battery. If the lamps are not on, the whole dynamo output will be stored in the cells—this happens during daylight running.

It is preferable to choose a dynamo whose output at 20 miles an hour equals or exceeds the consumption of the lamps, otherwise one is dependent on daylight charging to make up the surplus current required by the lamps, *i.e.*, the difference between the full dynamo output and the lamp consumption has to be drawn from the batteries which must be charged by daylight running, which is not always available.

In the diagram, Fig. 15, the negative wire is shown earthed or utilising the frame as return. With the ordinary two-wire or double-insulated wire system the negative side instead of being the frame will simply be another insulated wire similar to the positive side. In this case twin wire is usually used, the connections being made directly from the lamp or dynamo to the switchboard, and not with single wires as shown in the diagram. This avoids soldered joints. The wiring, however, gives exactly the same connections.

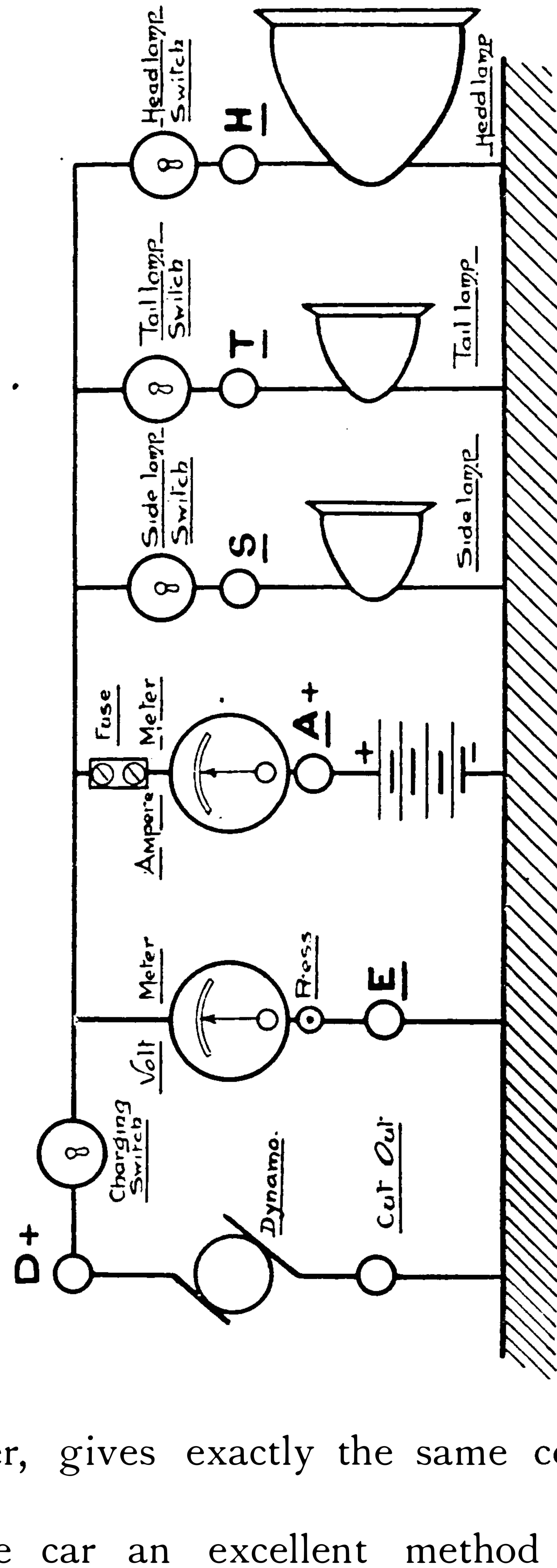


Fig. 15.—Single-Insulated System.

When wiring the car an excellent method of ascertaining if the tail lamp is burning correctly is to wire this lamp in series with another situated on the dash or steering column (Fig. 16). If the tail lamp goes out, that on the dash being in series will naturally go out as well. This method has the advantage of simplicity over those using magnetic relays to light up an indicator lamp on the switchboard, and further, no current is wasted in the magnet coils. If the light of the dash lamp be objected to, it is an

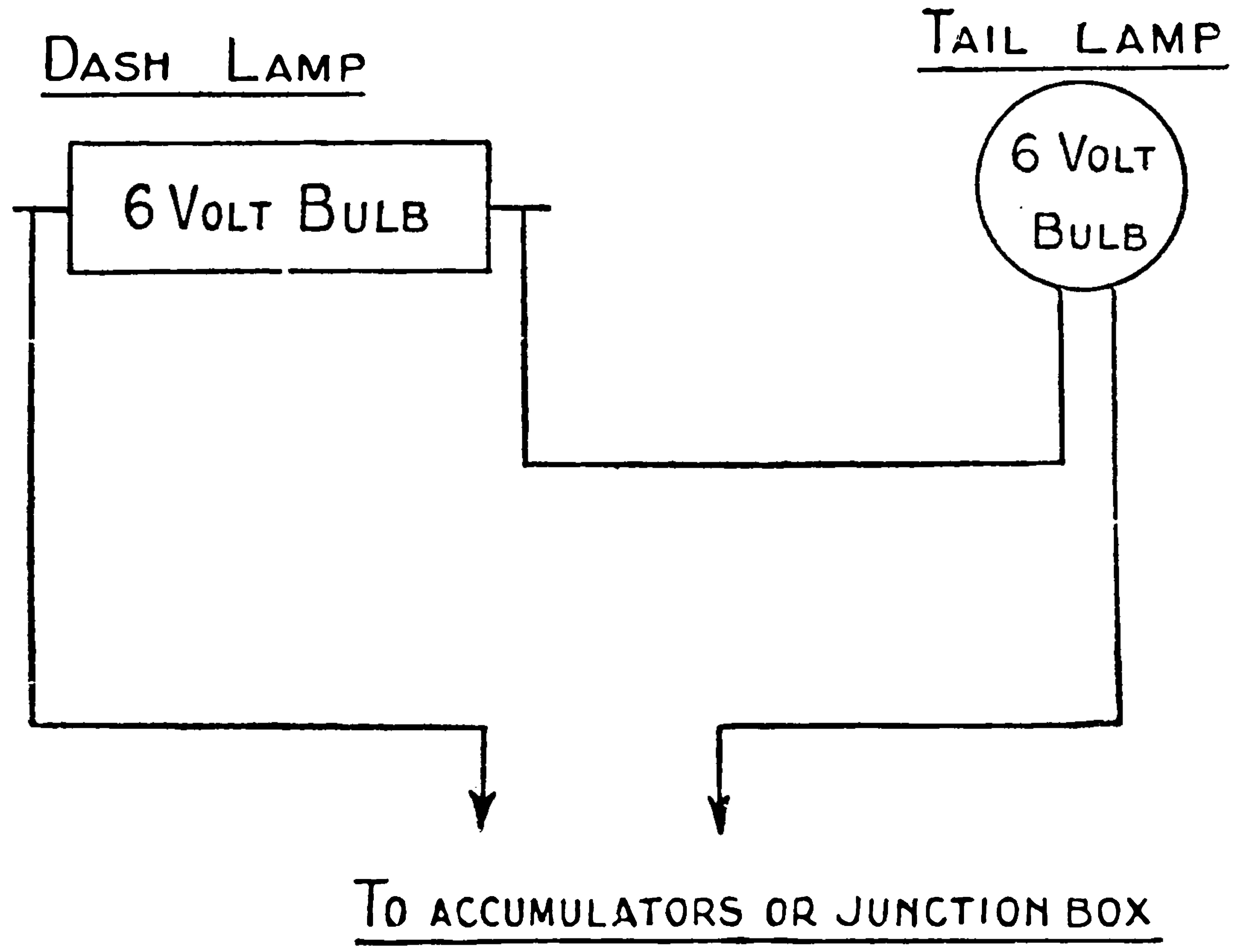


Fig. 16.

easy matter to obscure it by gumming a small piece of tissue paper over the lens of the dash lamp; this will give a diffused light devoid of glare but enough to render objects on the dash, such as the speedometer and lubricators, quite visible.

Difficulties in Obtaining Constant Output.—With varying speed of a dynamo as usually constructed the output also varies, thus the greater the speed the greater the output.

If this were permitted to occur unchecked on a

extensively copied, is to employ permanent field magnets which have, of course, a fixed strength and give a good output at low speeds. As the speed rises the armature (which is itself, of course, a rotating magnet) begins to grow stronger and exert a counter-magnetising effect against the permanent field magnets. This is known as armature reaction, and when sufficient speed is attained, the magnetism of the armature will counteract that of the fields and a state of balance is set up, the effect being that no greater output can be obtained.

This effect is also obtained with wire wound fields in a somewhat similar but more complicated way by using what are called neutral poles between the two main poles, so that as the speed of the armature increases, the magnetism is shunted back by the neutral poles more and more, thus leaving the armature with its normal magnetising flow at any speed.

Still another method is to use four brushes, two main and two auxiliary.

The main brushes are connected with the two auxiliary brushes, so that at low speeds they help to strengthen the magnetism, while at high speeds they give current to the outer circuit.

This method is very efficient, but calls for rather more complicated connections than the usual two-brush method.

In ordinary lighting practice many machines have what is known as a compound winding, that is, in addition to the ordinary shunt magnetising coil, the main current is also made to pass round the magnets with a view to further strengthening them as the load increases. In car dynamos this property is made use of in some cases, but in the inverse sense, in that the main current or series coil is used to weaken the existing magnetism as the speed increases, thereby keeping down the tendency of the current to become excessive.

It is well known that certain metals increase in resistance as their temperature rises, and this property has been used in one or two systems by putting a length of iron or nickel wire in series with the shunt coils, the consequence being that as the current tends to rise the coil of iron wire becomes hot, its temperature begins to rise, and the current which would normally flow to the shunt coil is choked back, thereby effecting the necessary cutting down of the current at maximum speeds.

These various systems will subsequently be more fully described when explaining the machines to which they are peculiar.

It should be understood that although the various devices described keep the output of current within reasonable bounds an accumulator is necessary not only to effect the final steadying effect and to store up the surplus energy not used by the lamps, but also to light the car when it is at rest or moving at such a slow speed as not to generate sufficient energy to light the lamps.

The Cut-Out.—When the car is at rest the dynamo naturally ceases to rotate, and the battery would under ordinary conditions begin to discharge backward through it in the effort to drive it as an electric motor. To remedy this disadvantage recourse is had to an apparatus known as a cut-out. As with the maximum output governor already described these may be divided into electrical or mechanical cut-outs.

Electrical Cut-Outs.—The commonest type of electrical cut-out, of which there are many variations, consists of a magnet or solenoid which is energised from the dynamo and which attracts a moving armature against the action of a spring when the voltage of the dynamo is about equal to that of the accumulator, thereby closing the circuit and enabling the dynamo to charge the cells (Fig. 17).

This type of apparatus has the disadvantage of being very delicate and easily derangeable in the hands of the ordinary driver: the contact surfaces are liable to give trouble, as owing to the small power of the magnets the contacts have to be rather light.

A certain amount of current is used, too, by the magnet coils, which under certain circumstances are liable to burn out. It is claimed that the contacts only break at "no voltage," but in practice this rarely occurs.

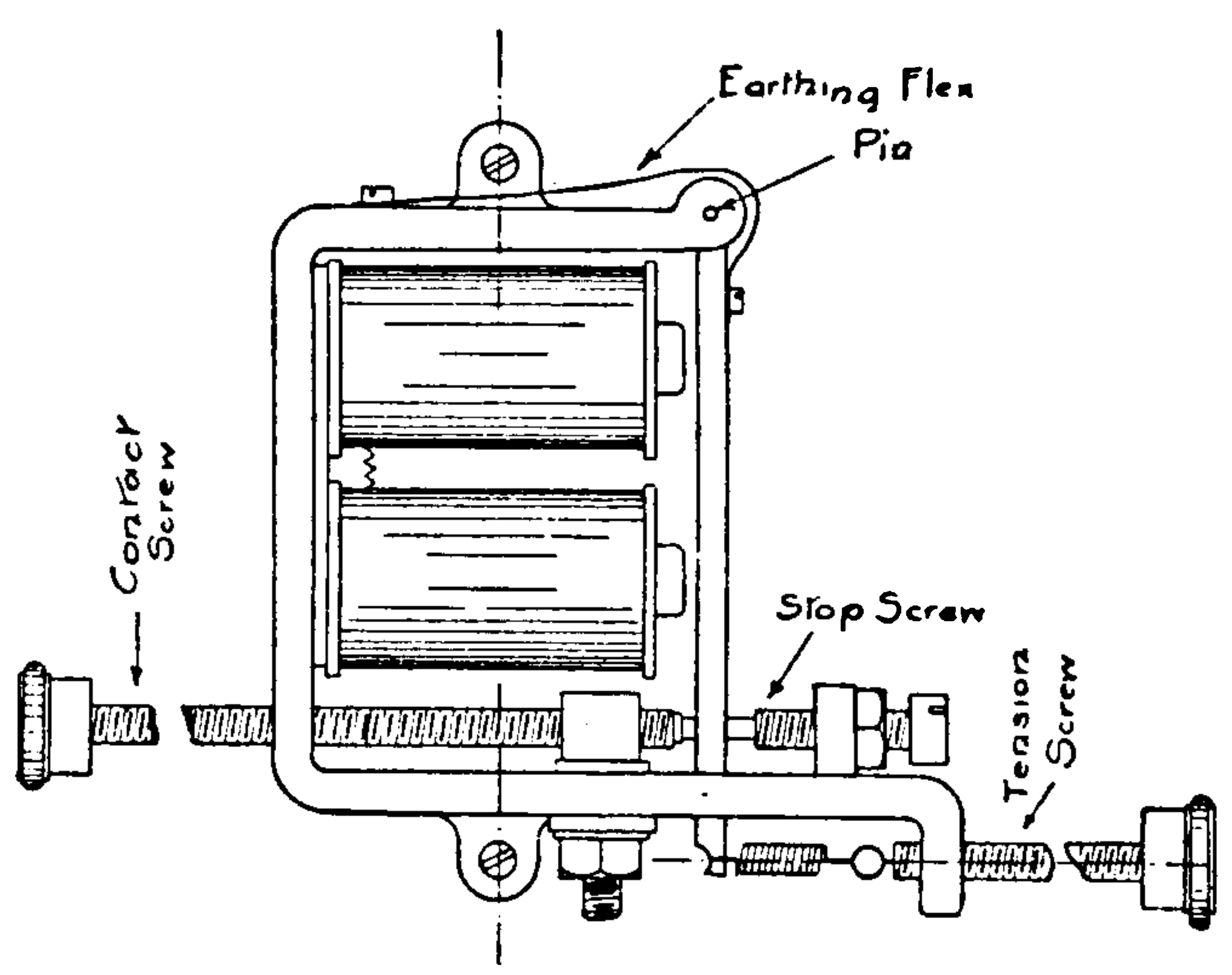


Fig. 17.

Furthermore, when the dynamo is running slowly and the lamps are on, the battery being rather run down, there is a liability for the contacts to act as a trembler or chatter, owing to the voltage of the dynamo being too near that of the battery for the cut-out really to decide whether it shall stay on or off.

The general tendency is, therefore, against the electrical cut-out as too delicate for commercial purposes; there is, however, a certain electro-mechanical modification which may be described.

The Free Wheel Cut-Out.—As we have pointed out already, if the current from the cells be allowed to flow back through the dynamo, it will tend to become a motor, and in the system we are describing this is actually allowed to occur, but in the pulley which drives the dynamo is placed a free wheel, similar to that used on a bicycle. The dynamo then becomes a motor, but can rotate freely with no tendency to turn the engine; when, however, the engine speed is sufficient to generate, the free wheel takes up, and the motor is then driven by the engine as a dynamo.

The free wheel is arranged to give a slight clicking noise, so that the fact that the dynamo is "motoring" shall not be overlooked when leaving the car for the night, the main charging switch being then turned off. The dynamo when running as a motor takes only about 1 to 2 amperes which does not matter during the short periods in actual driving in which "motoring" occurs.

Mechanical Cut-Outs.—These consist almost without exception of a centrifugal arrangement, whereby when the governor weights collapse owing to the stopping or insufficient speed of the machine, the contact points are forced apart by a spring acting in opposition to the governor. Another method consists of a disc rotating in a mercury bath: when the speed of the disc is sufficiently high, the mercury is carried round, and makes contact with an insulated plug, thereby closing the circuit.

The various devices will be described more fully in relation to the machines illustrated in the following pages.

CHAPTER IV

PERMANENT MAGNET SYSTEM

Mira.—The dynamo we propose to describe first is the Mira Magnetolite (Fig. 18), which, introduced in 1909, has been very little altered in principle since that year, and since it is the simplest of all dynamos will serve as an example which can be easily understood.

The magnetolite system consists essentially in employing a permanent magnetic field to excite the armature which rotates between the magnet poles, and, furthermore, to use the fixity of this magnetic field to limit the output of the dynamo at high speeds so that heavy currents shall not destroy the accumulator or burn out the lamps.

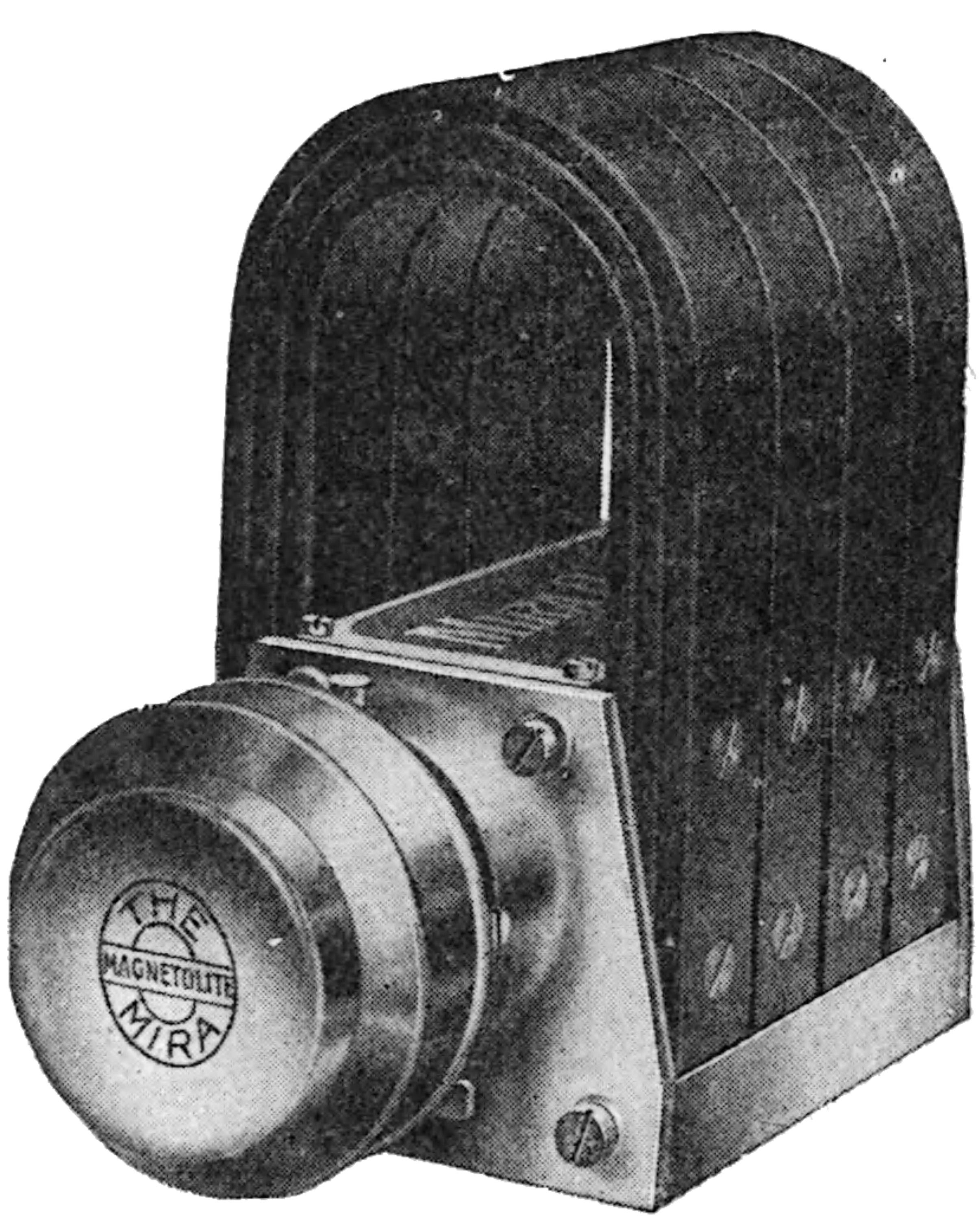


Fig. 18.

Fig. 19 shows a section of the dynamo from which the simplicity of the machine will be readily grasped.

The dynamo itself consists of three or four permanent magnets of three blades or lamina tions each, between the poles of which rotates a laminated tunnel armature carrying the usual copper commutator, and mounted on ball bearings at each end. One of the bearing end-plates carries the brushes which collect the current, the other bearing

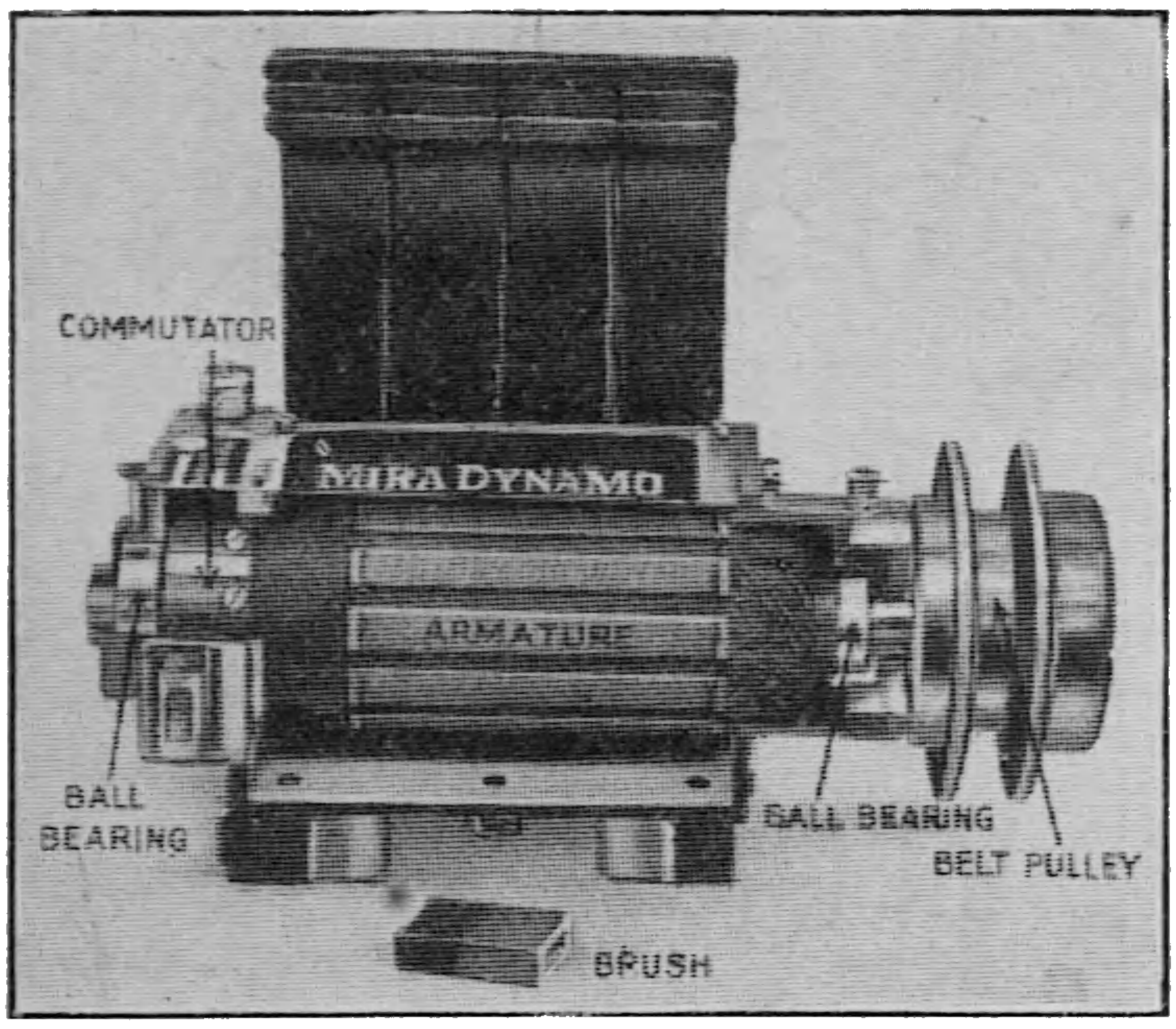


Fig. 19.

plate carries an insulated slip ring which serves to carry the current from one brush to the cut-out (Fig. 20), which is located in the aluminium pulley, and consists of a small balance weight working by centrifugal force against the action of a spring which tends to keep the contacts separated. One of these contacts is the brush holder which communicates with the live

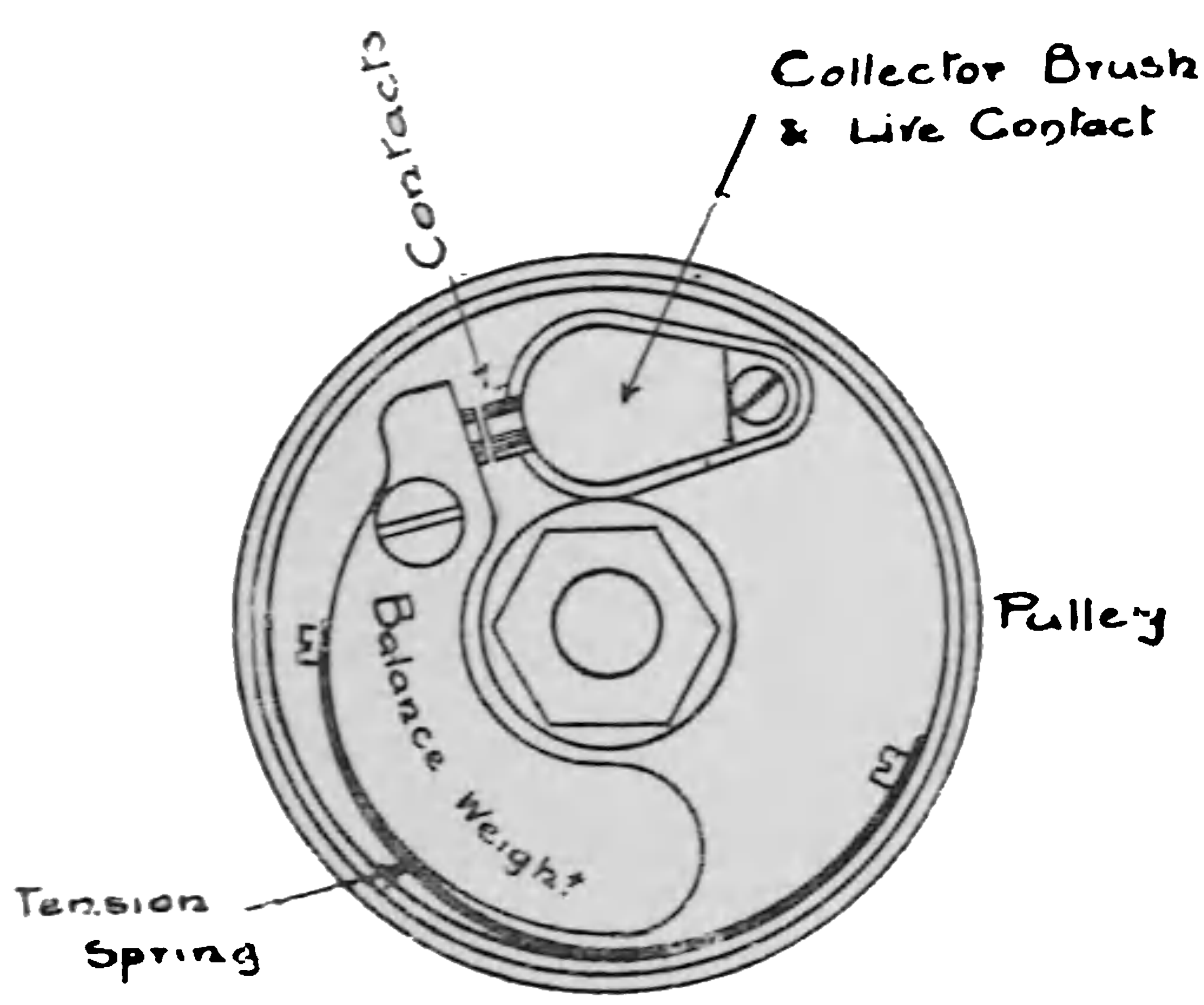


Fig. 20.

slip ring and the negative brush, the other is the earthed balance weight.

Referring to the diagram, Fig. 21, it will be seen that when sufficient speed is obtained to generate current, the balance weight flies out and earths the negative brush, thereby putting the machine in circuit provided the charging switch is closed. From the

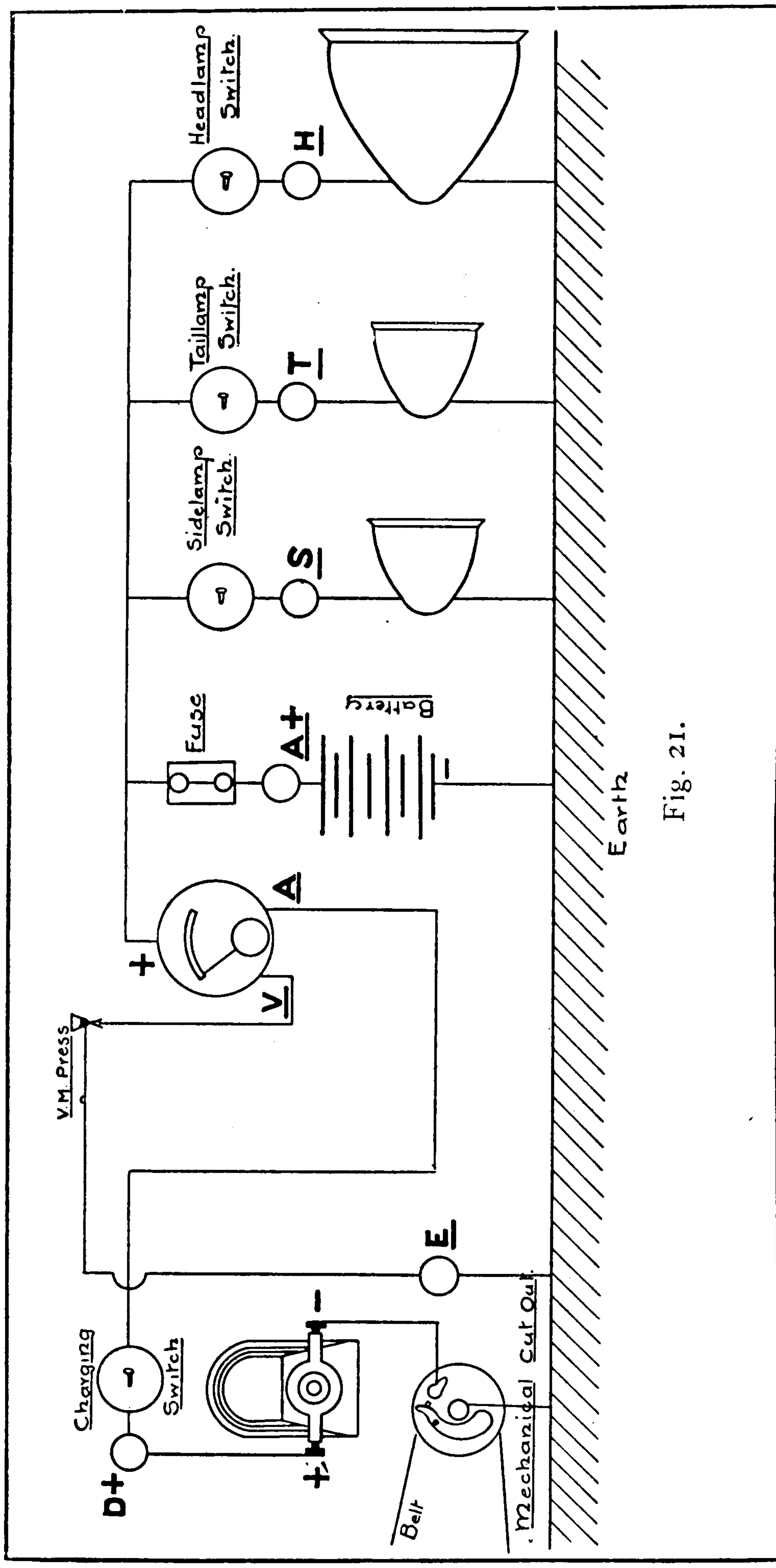

Headlamp Switch
H
Taillamp Switch
T
Sidelamp Switch
S
Fuse
A+
Battery
Earth
A
+
V
V.M. Press
E
Charging Switch
D+
+
-
Belt
Mechanical Cut Out

Fig. 21.

Figs. 25, 26 are the accumulators and Figs. 27, 28, 29, lamps usually supplied with these sets, and the ordinary garage wiring diagram is shown (Fig. 30).

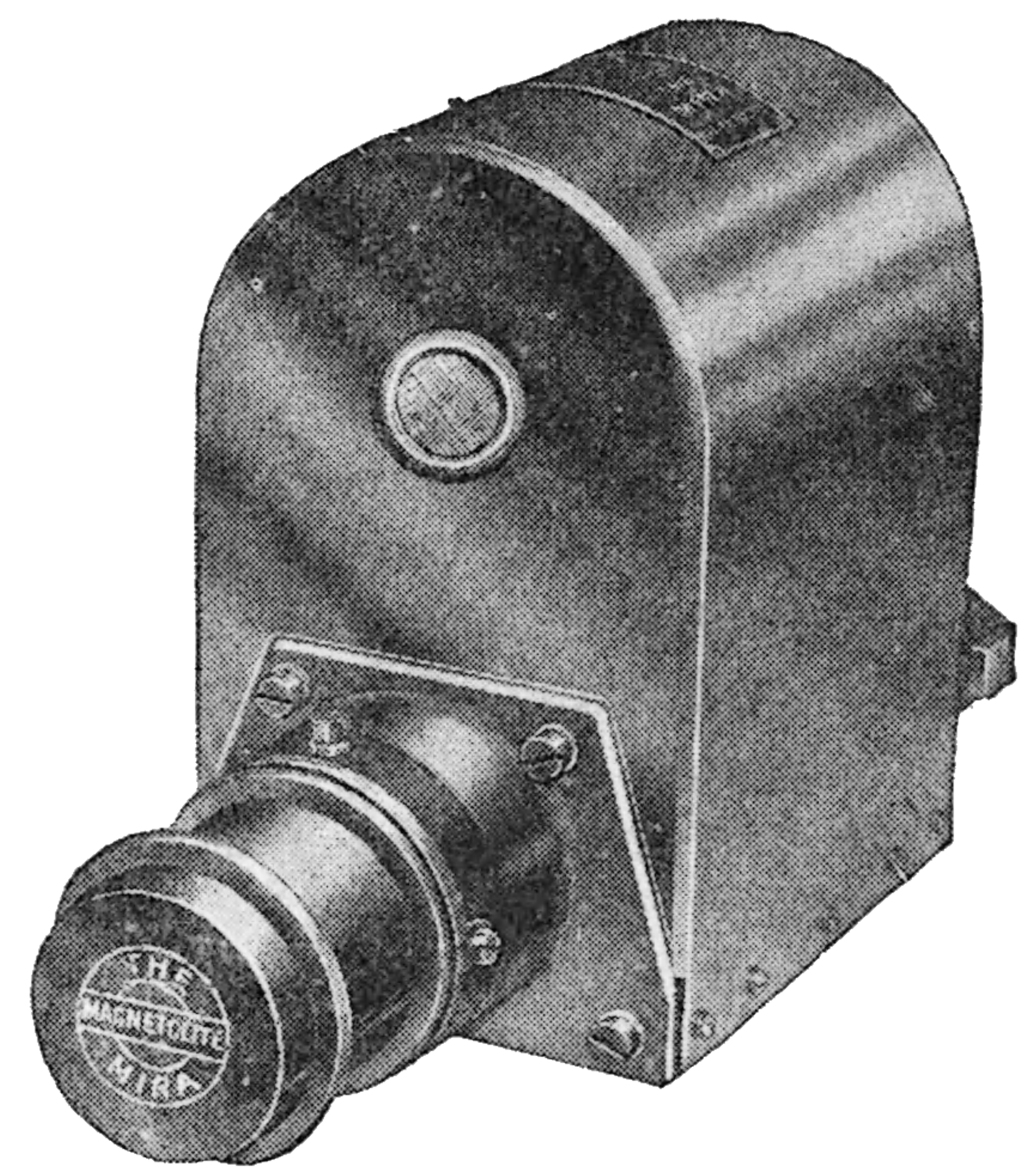


Fig. 22.

Armoured cable is employed with a single live conductor to convey the current; the return from the lamp being *via* the armouring or frame back to the

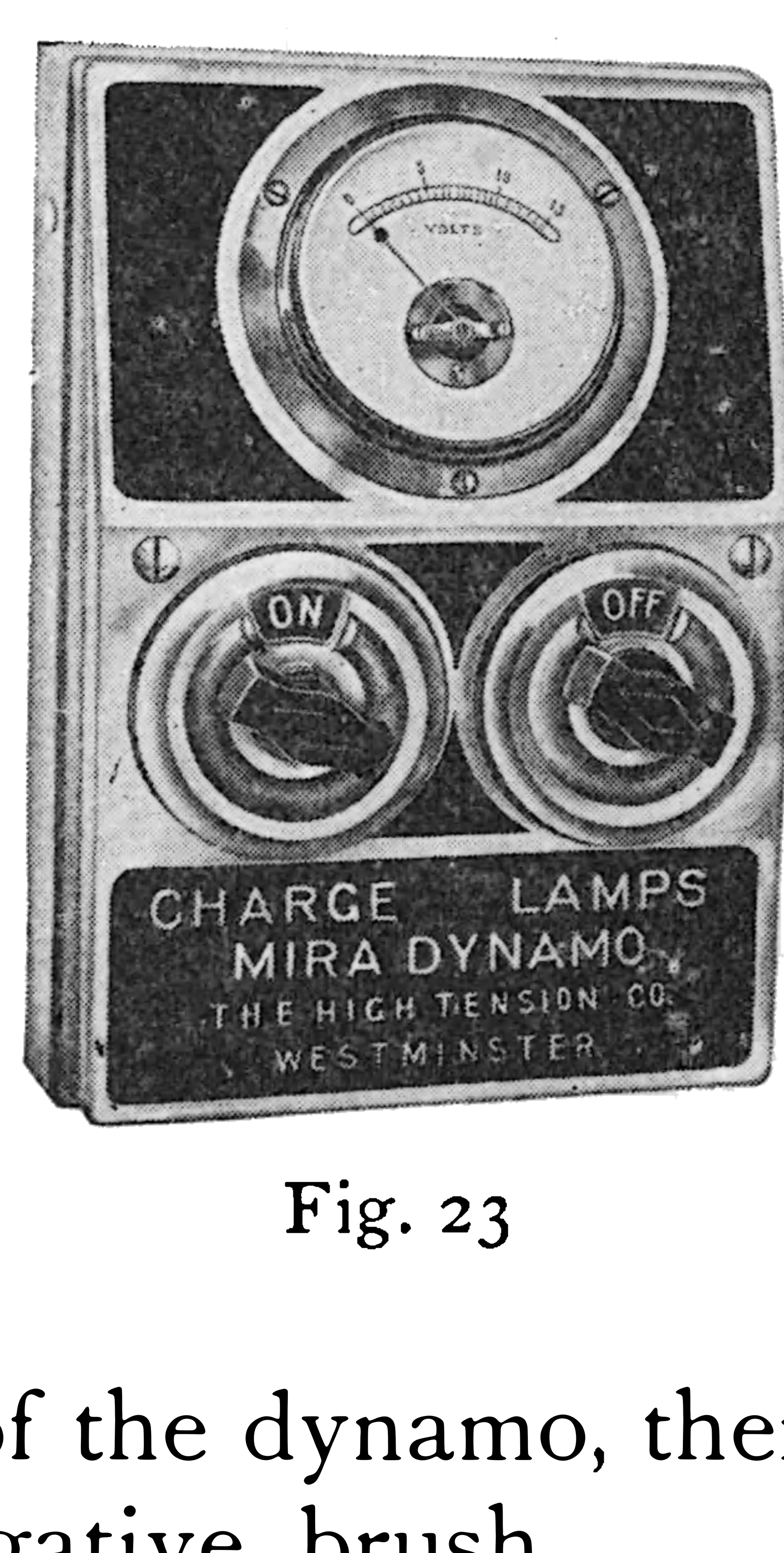


Fig. 23

battery and base of the dynamo, thence by the earthed cut-out to the negative brush.

The Mira machine holds an R.A.C. Certificate for 3,500 miles of satisfactory behaviour.

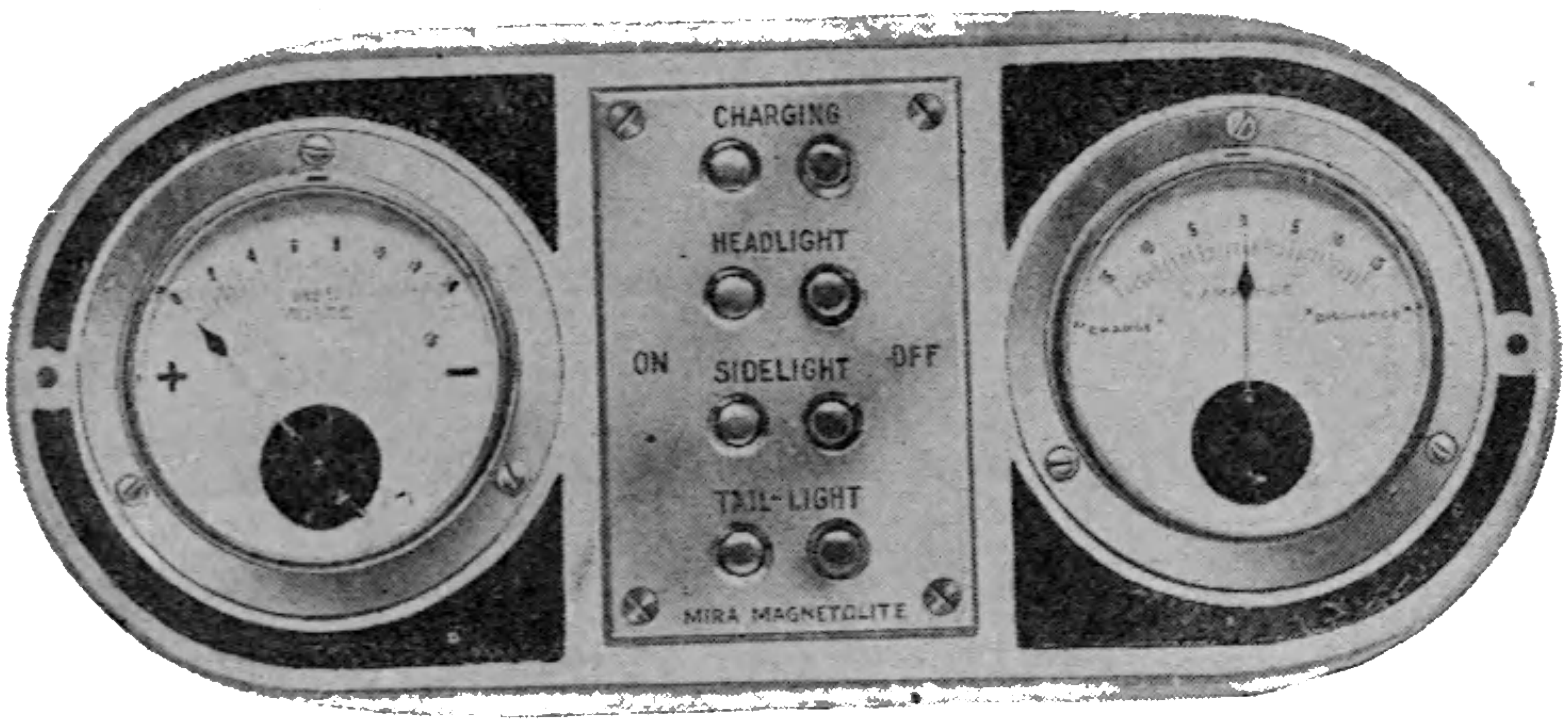


Fig. 24.

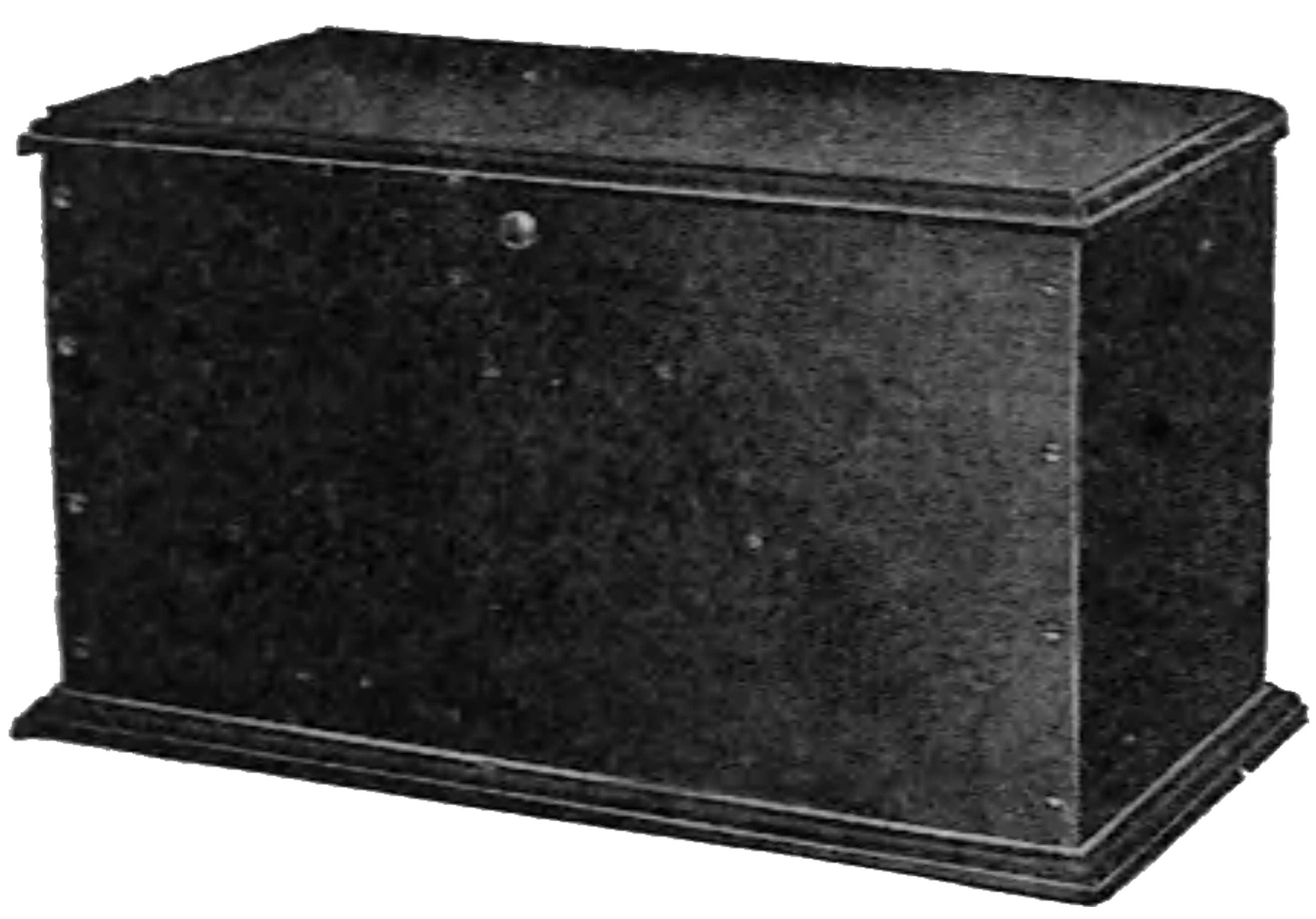


Fig. 25.

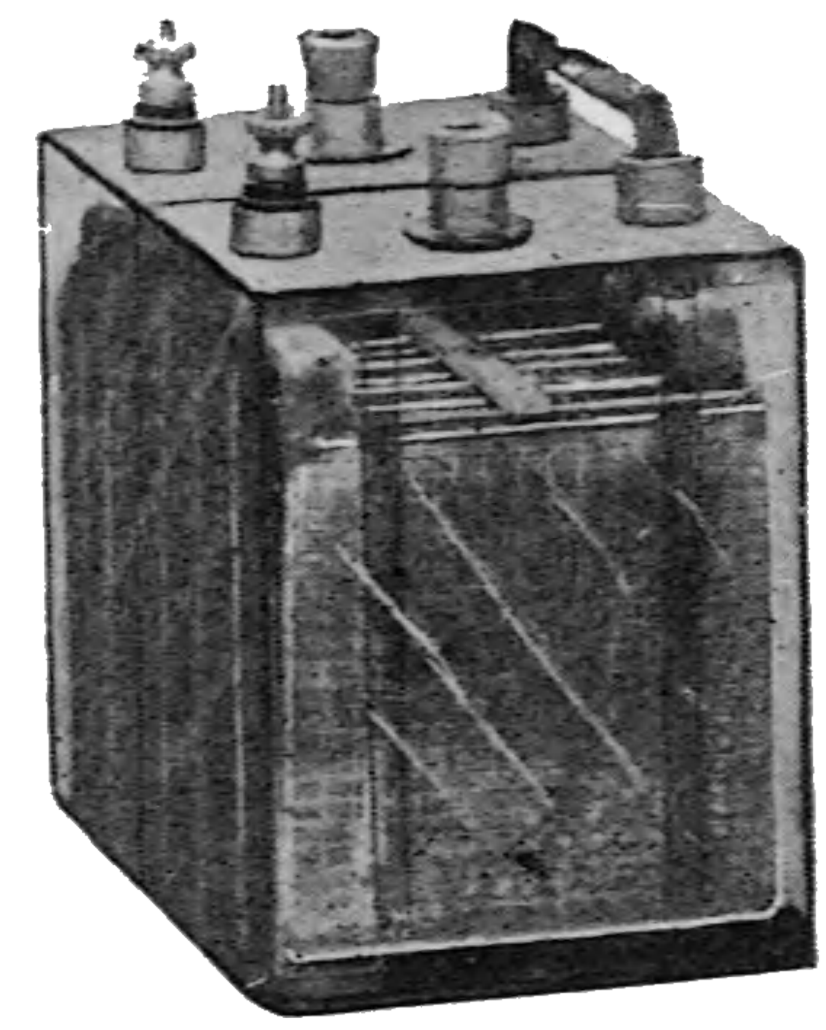


Fig. 26.

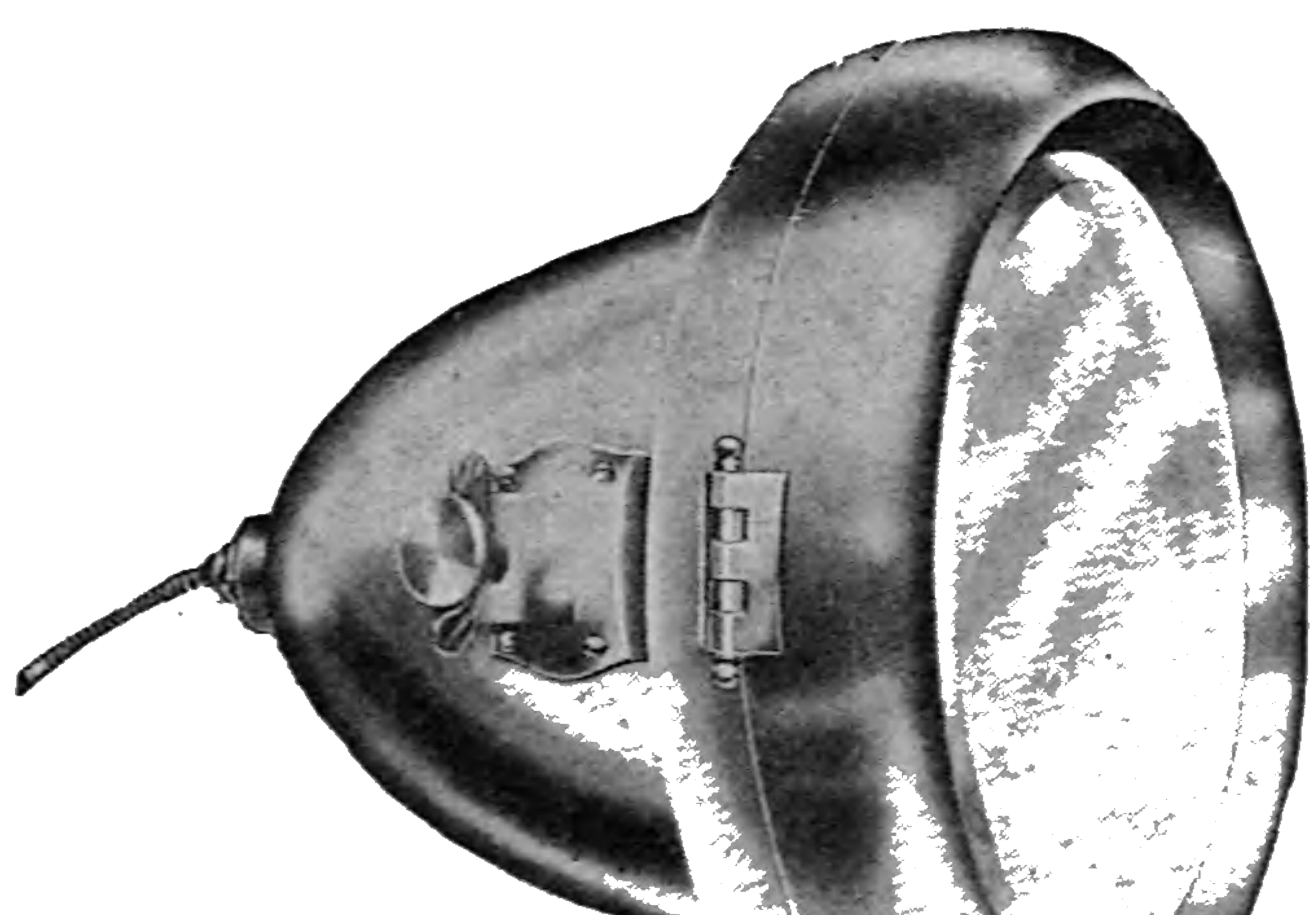


Fig. 27.

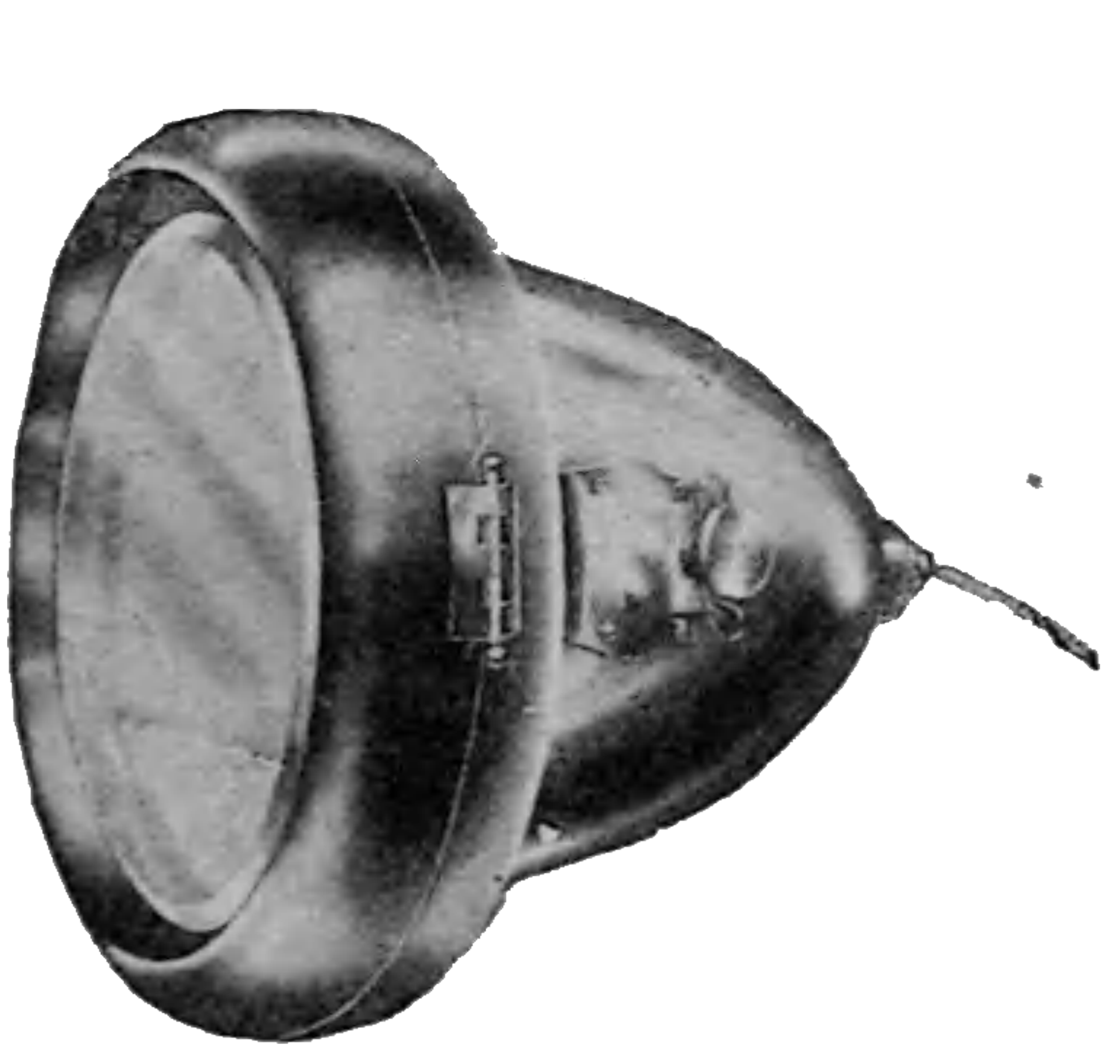


Fig. 28.

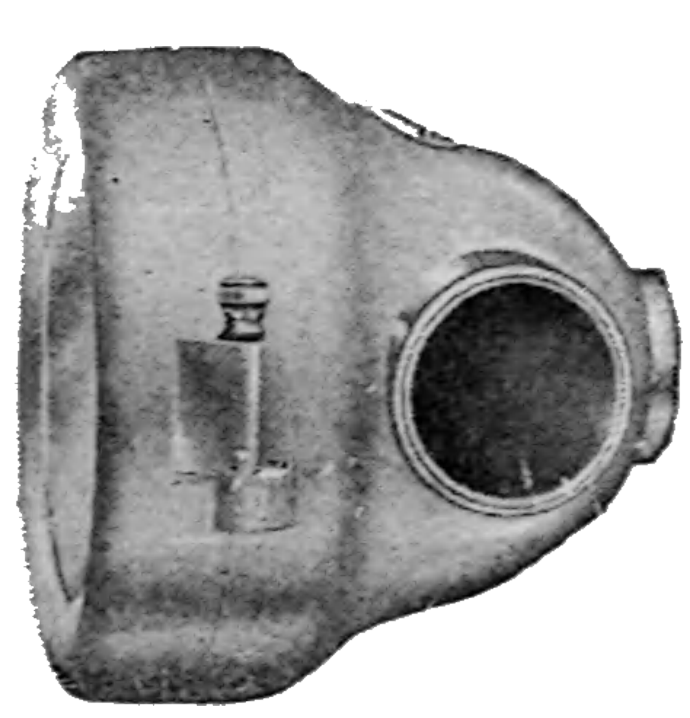


Fig. 29.

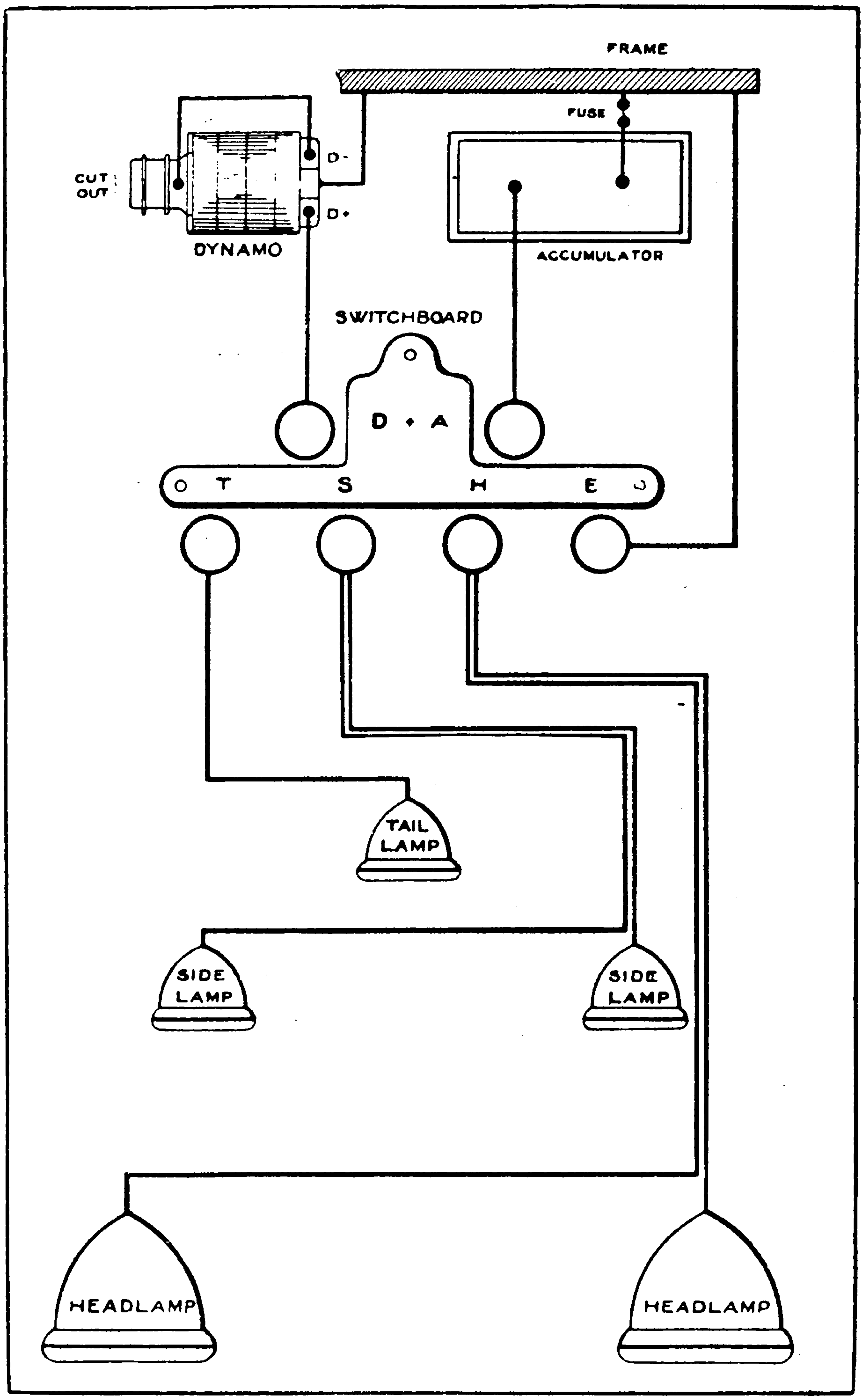

FRAME
FUSE
CUT OUT
D-
D+
DYNAMO
ACCUMULATOR
SWITCHBOARD
D + A
O T S H E
TAIL LAMP
SIDE LAMP
SIDE LAMP
HEADLAMP
HEADLAMP

Fig. 30.

CHAPTER V

PERMANENT AND ELECTRO-MAGNET SYSTEM

Ducellier.—This dynamo (Figs. 31 and 32), though employing permanent field magnets, works on an entirely different principle to the last described, in that it has two field windings, one to supplement the magnetism of the permanent magnets and another wound in the opposite sense and connected to a

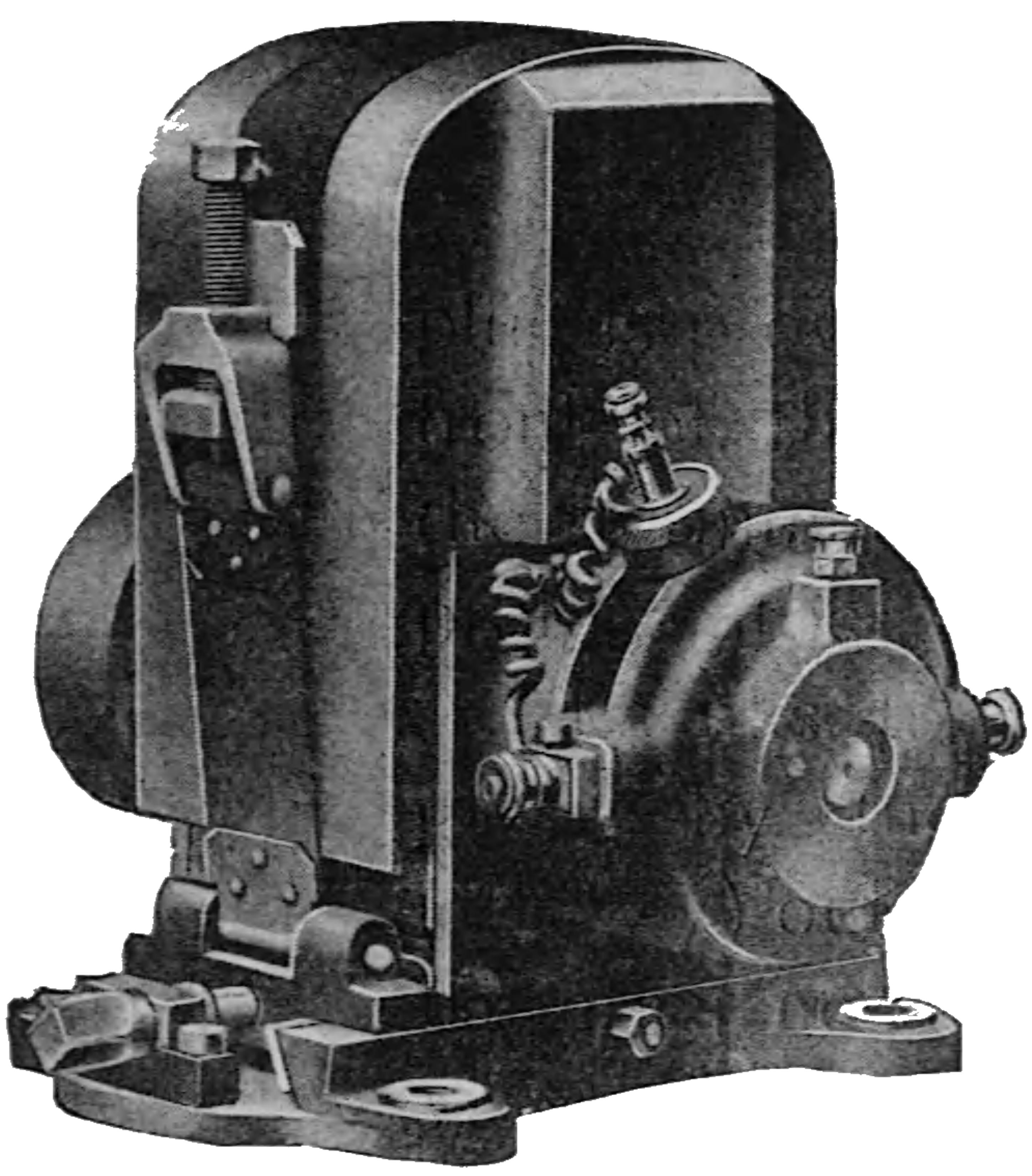


Fig. 31.

third brush to demagnetise the fields when the speeds rise above a certain limit.

The speed of the dynamo rises to a maximum of 3,000 R.P.M., the full output being given at 1,800. The current is collected by two large brushes from a wide copper commutator, the [illegible] brush simply serving to control the maximum [illegible]t through the field winding.

To prevent the battery discharging through the dynamo when the machine ceases to rotate, a neat

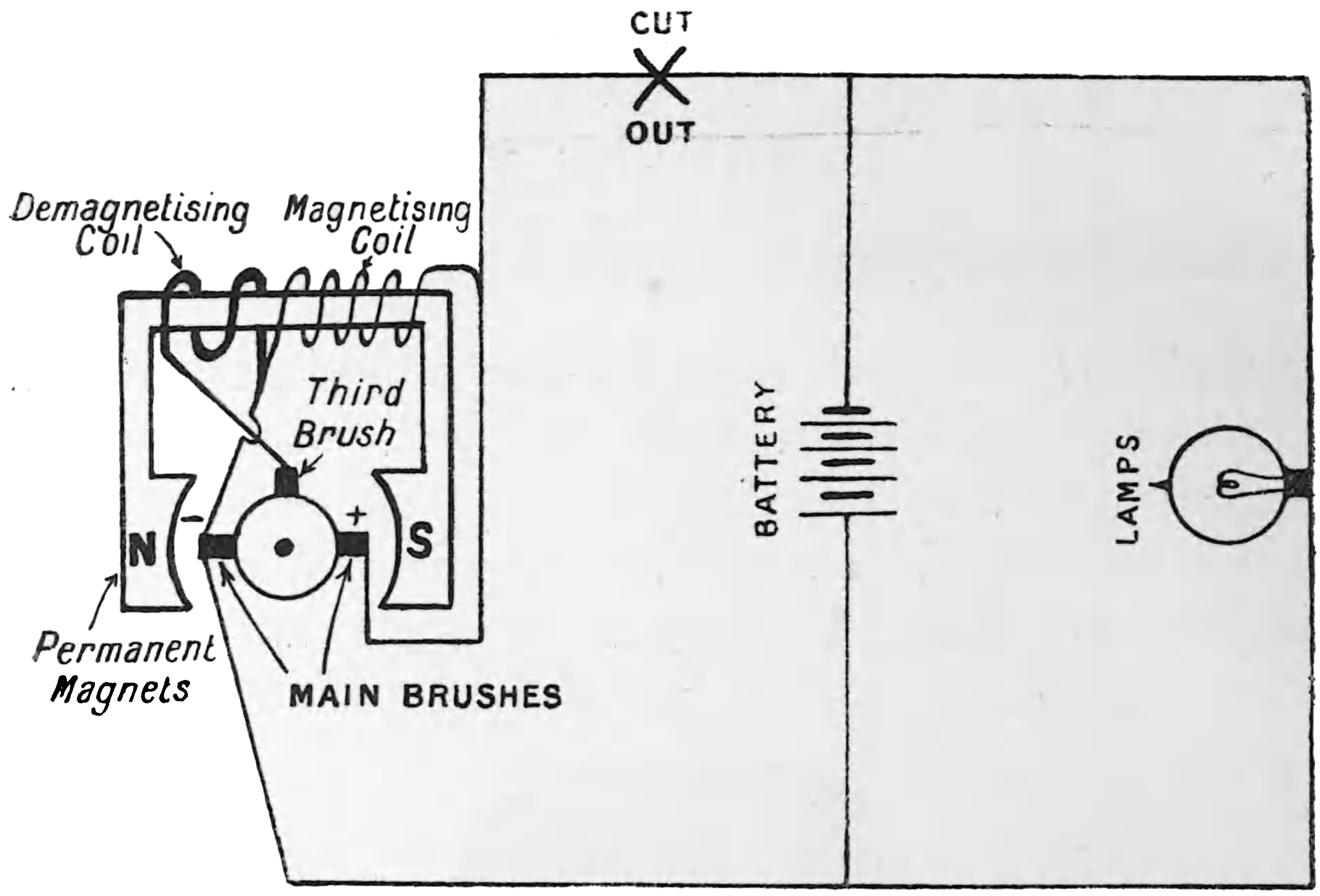


Fig. 32.

brass case containing an electrical cut-out is provided which may be fixed to the dash or other suitable position (Fig. 33). This cut-out when once fitted

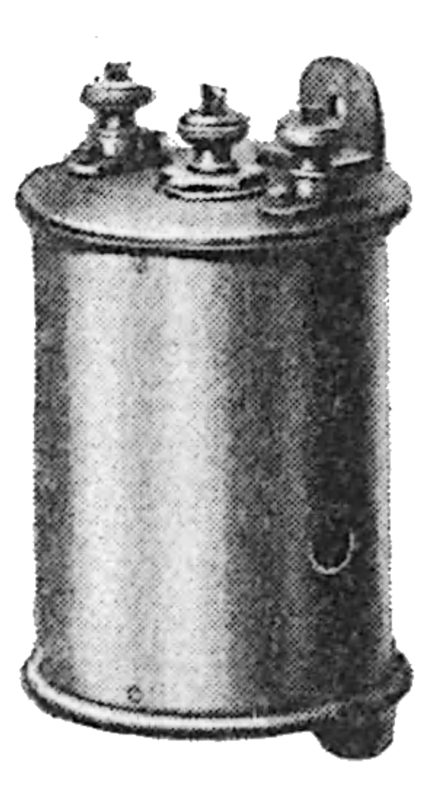


Fig. 33.

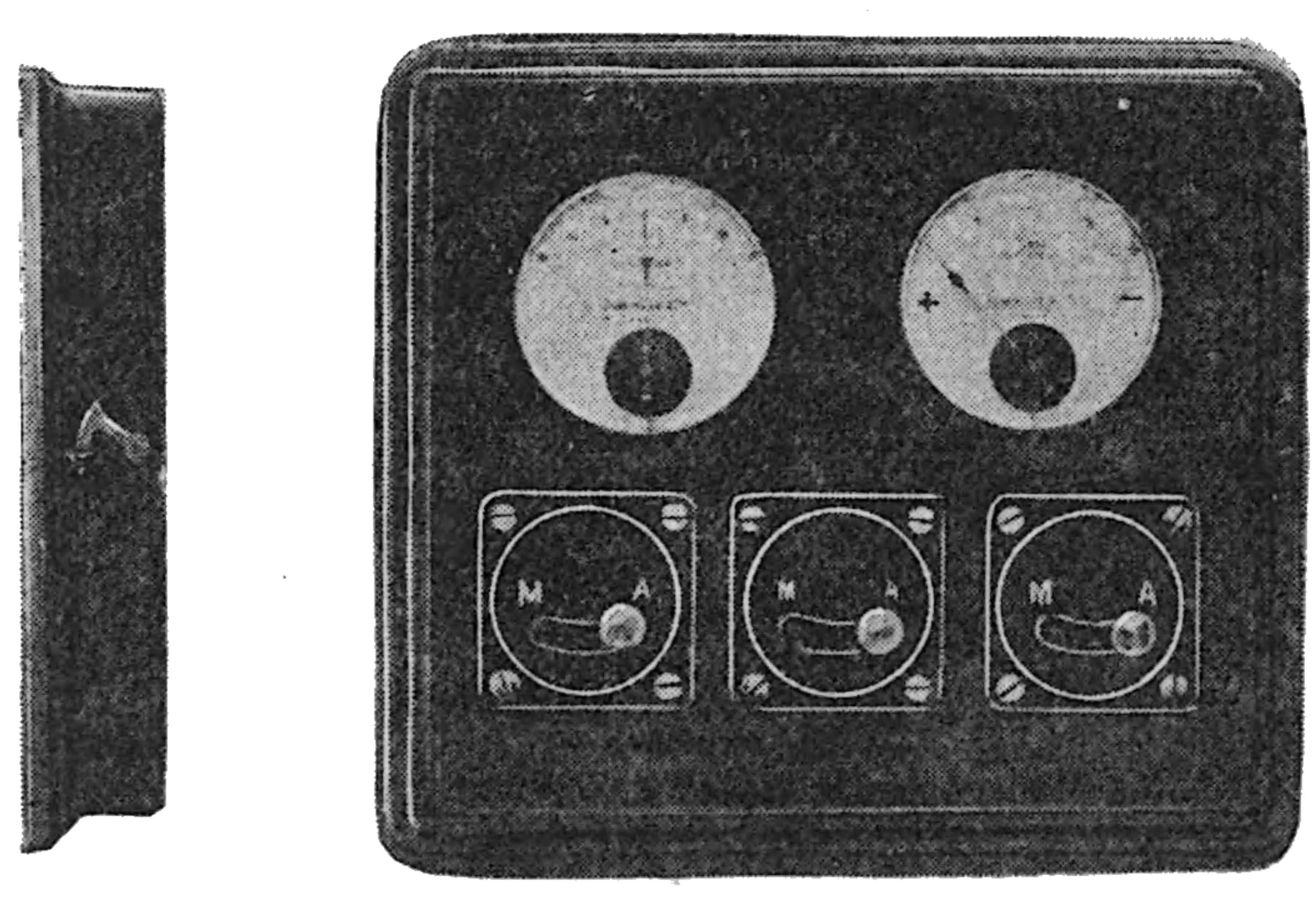


Fig. 34.

should require no adjustment and should not be interfered with.

The dynamo itself is provided with slide rails to tighten the belt, thereby obviating cutting of the same.

The output of the Ducellier dynamo is 200 watts,

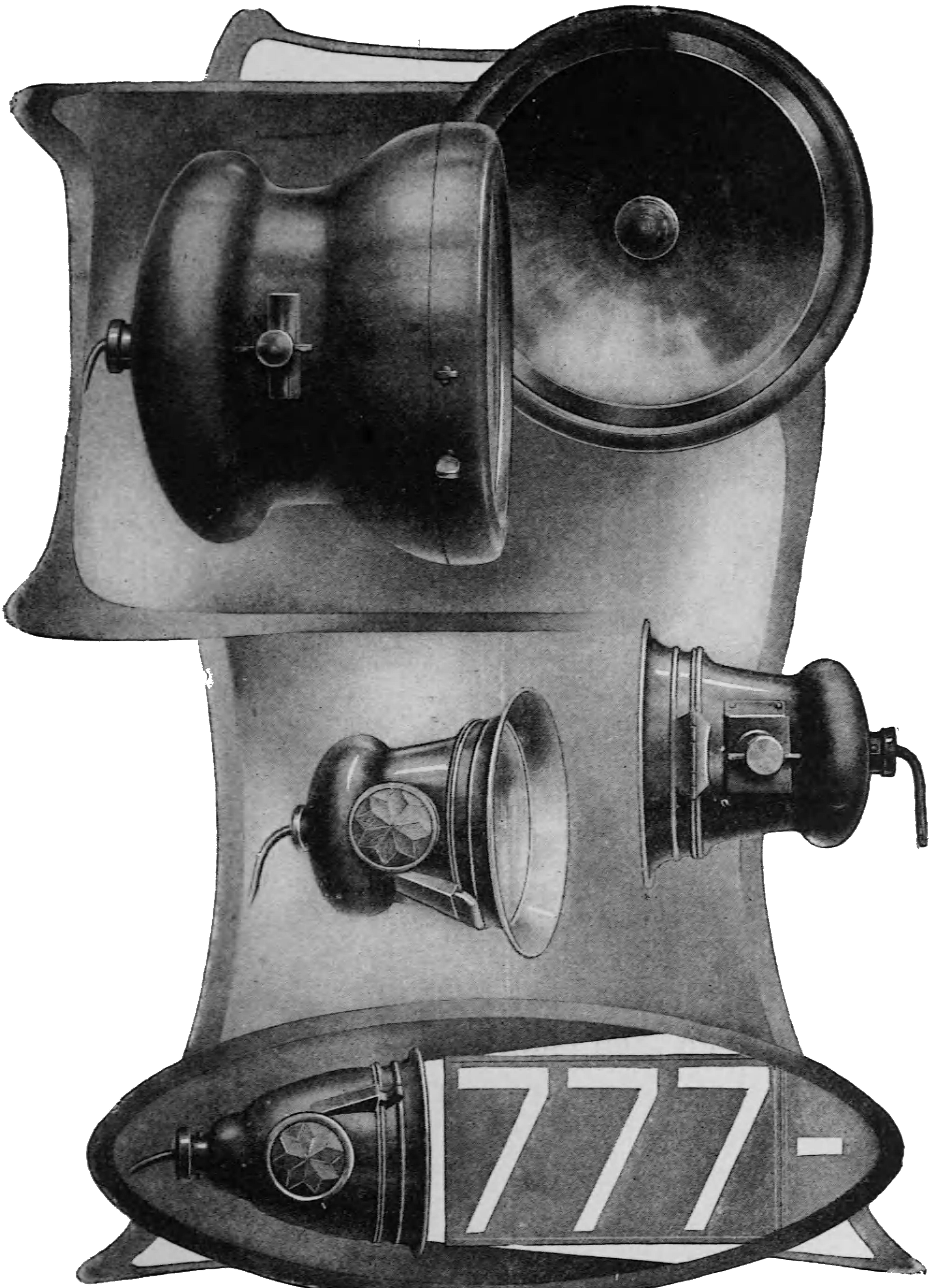


Fig. 35.

that is 15 amperes at 12-14 volts, according to the state of charge of the battery.

The switchboard (Fig. 34) carries three switches, the two outer ones controlling respectively the two head lamps and the side and dash, the third the dynamo. There are also mounted on the board a

Fig. 36.

suitable ammeter and voltmeter, these instruments being always in circuit.

The batteries (Fig. 36) supplied are of 12 volts and have capacity of 60, 80, or 100 ampere hours to choice.

The Ducellier set is completed by a series of very handsomely-finished lamps, having parabolic reflectors constructed of silvered copper (Fig. 35).

regulating the output of the machine. This arrangement ensures absolutely perfect commutation.

When the speed of the machine has increased sufficiently to supply current to the line, an armature reaction is set up which reduces the current in the resistances; this action increases until there is no current at all between the main and auxiliary brushes, as they will be at equal potentials. Fig. 39 gives the curves showing this action.

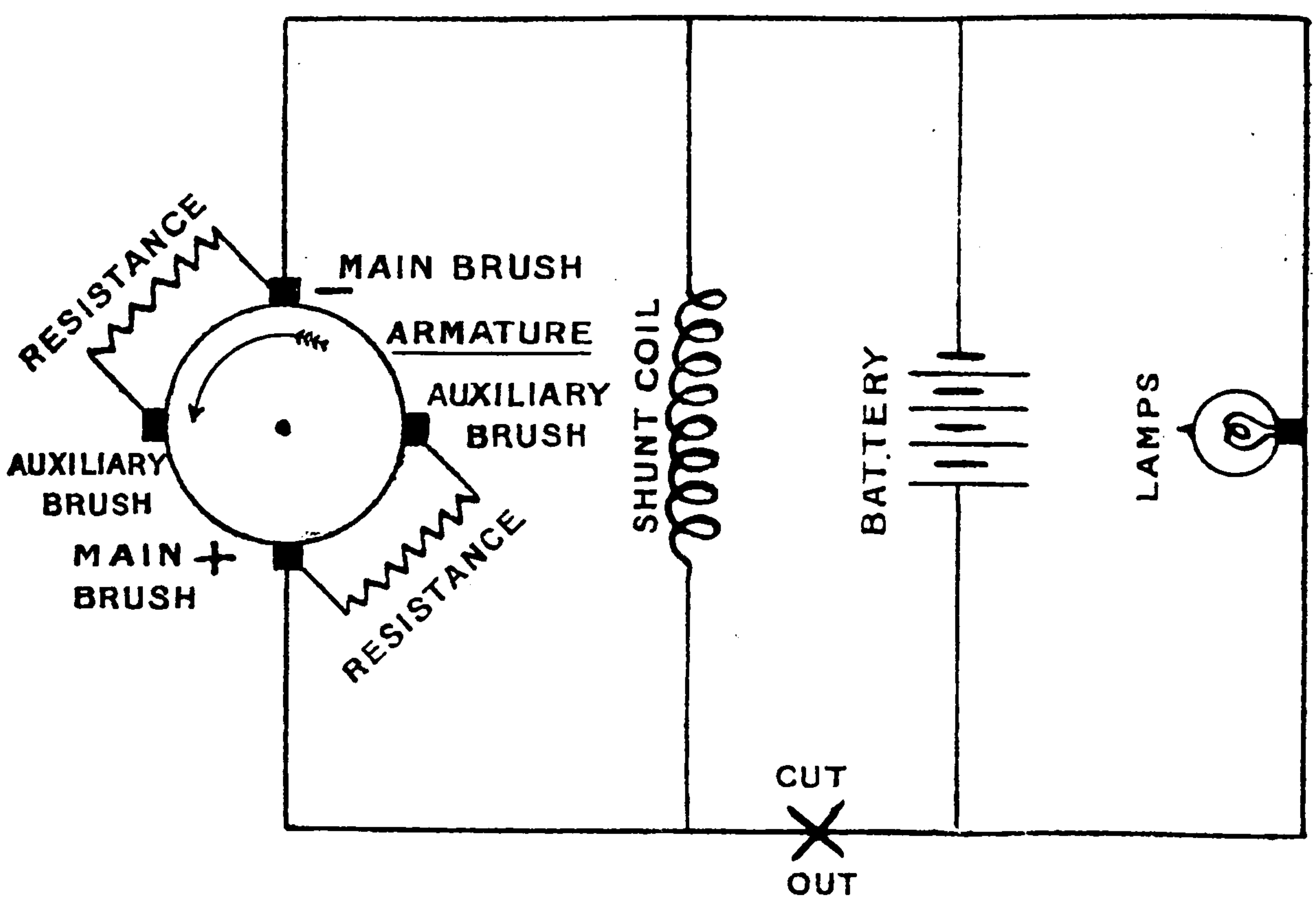


Fig. 38.

The machine is very substantially constructed, especially so the commutator and brushes. The armature rotates on large ball bearings and since the speed of the machine is low for its output the wearing parts should last indefinitely.

The cut-out differs from the older pattern of T. & M., as it is now of a magnetic type, of positive action, with large contact surfaces, and requires no adjustment.

It consists of an electro-magnet controlled by a combination of windings which operate a plunger so as to "make and break" the main circuit when the dynamo is running at or below its generation speed.

Two types of machine are made, one giving an output of 10-12 amperes at 12 volts, the other 7-8 amperes at 12 volts, with a maximum output of 180 and 120 watts respectively.

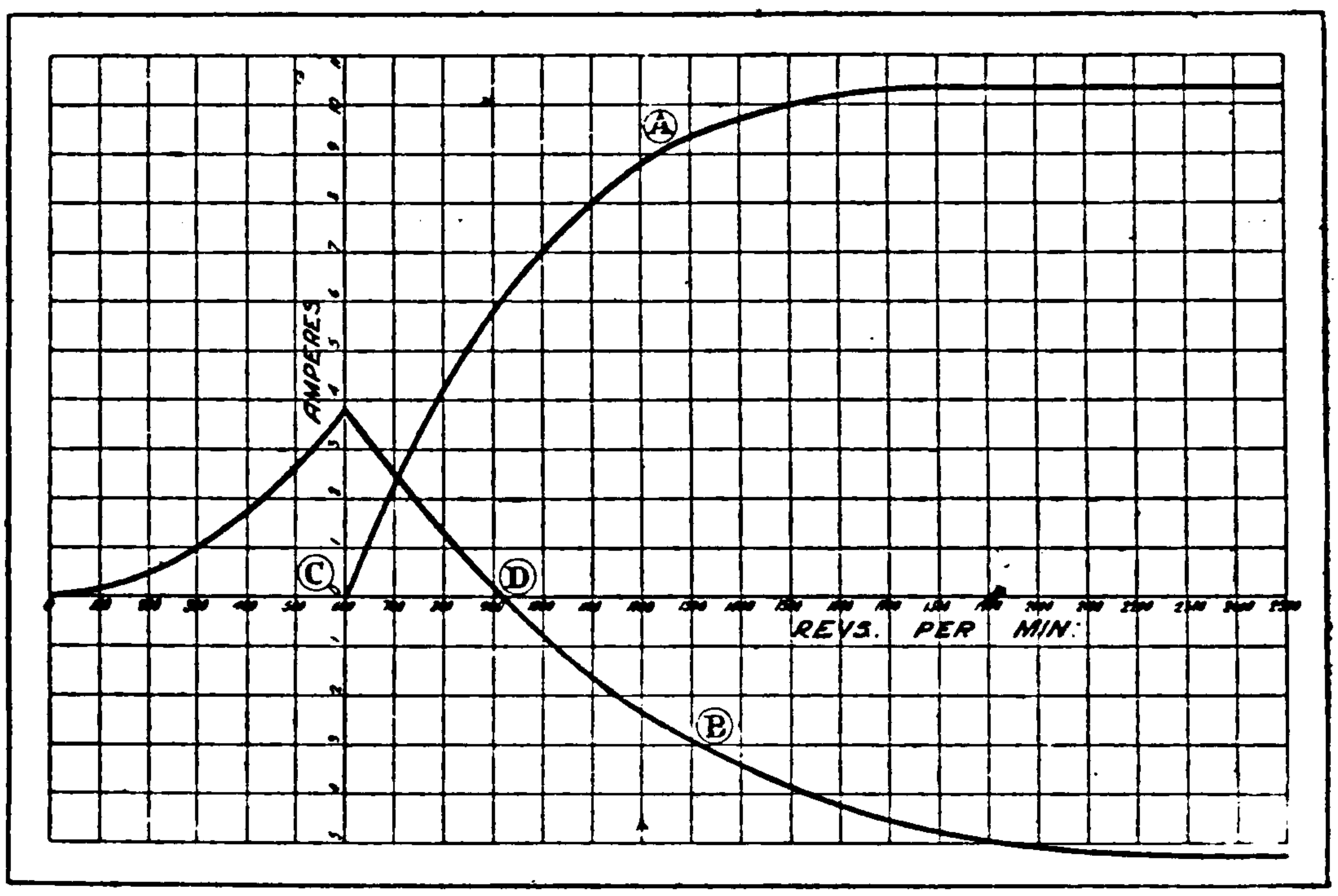


Fig. 39.

A, Current to the line wires.
B, Curve showing current between a main and auxiliary brush.
C, Point at which machine starts to supply current to the line wires.
D, Point at which the auxiliary brush is neutral.

Fig. 41 shows the standard type of lamp usually supplied with this outfit.

Various types of switchboard are provided to suit individual tastes, but all have an ammeter and two controls—one for charging the battery, and the other for selecting the particular lights required. Fig. 40 illustrates one.

A field fuse is provided to protect the dynamo should anything go wrong with the wiring.

Fig. 40.

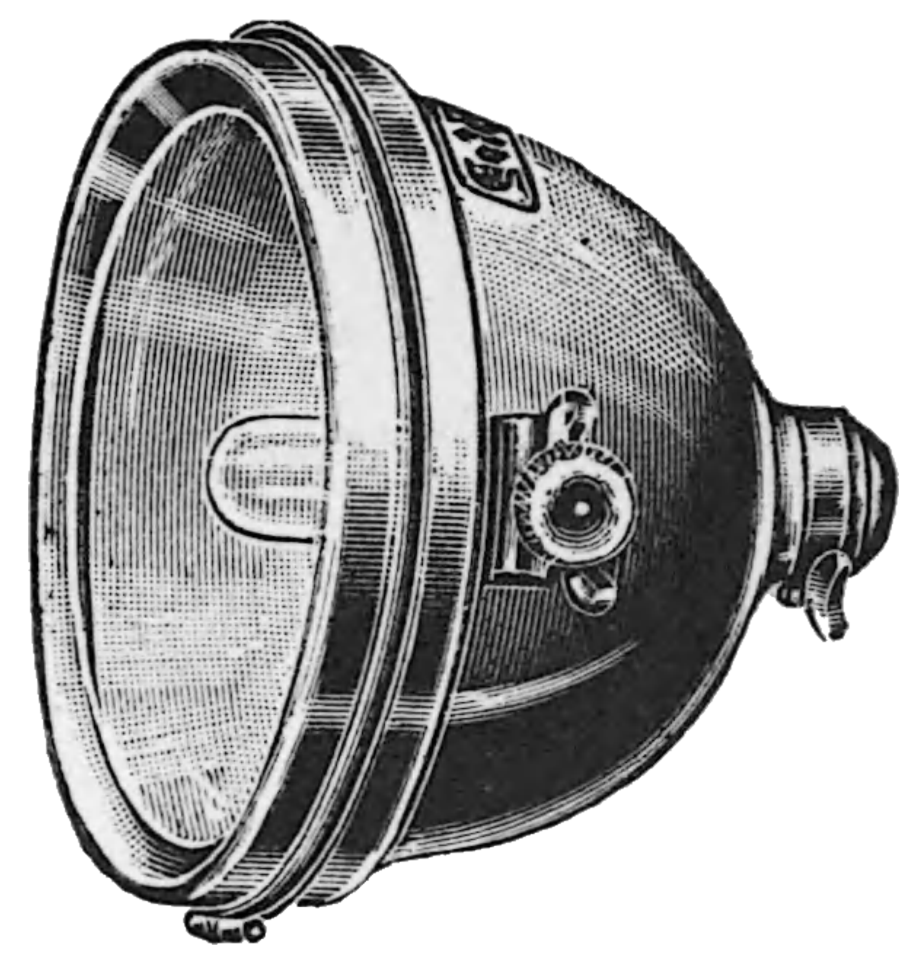


Fig. 41.

The accumulators supplied with the set have a capacity of 40 ampere hours at 12 volts, and weigh 48 lbs. The battery box is provided with detachable

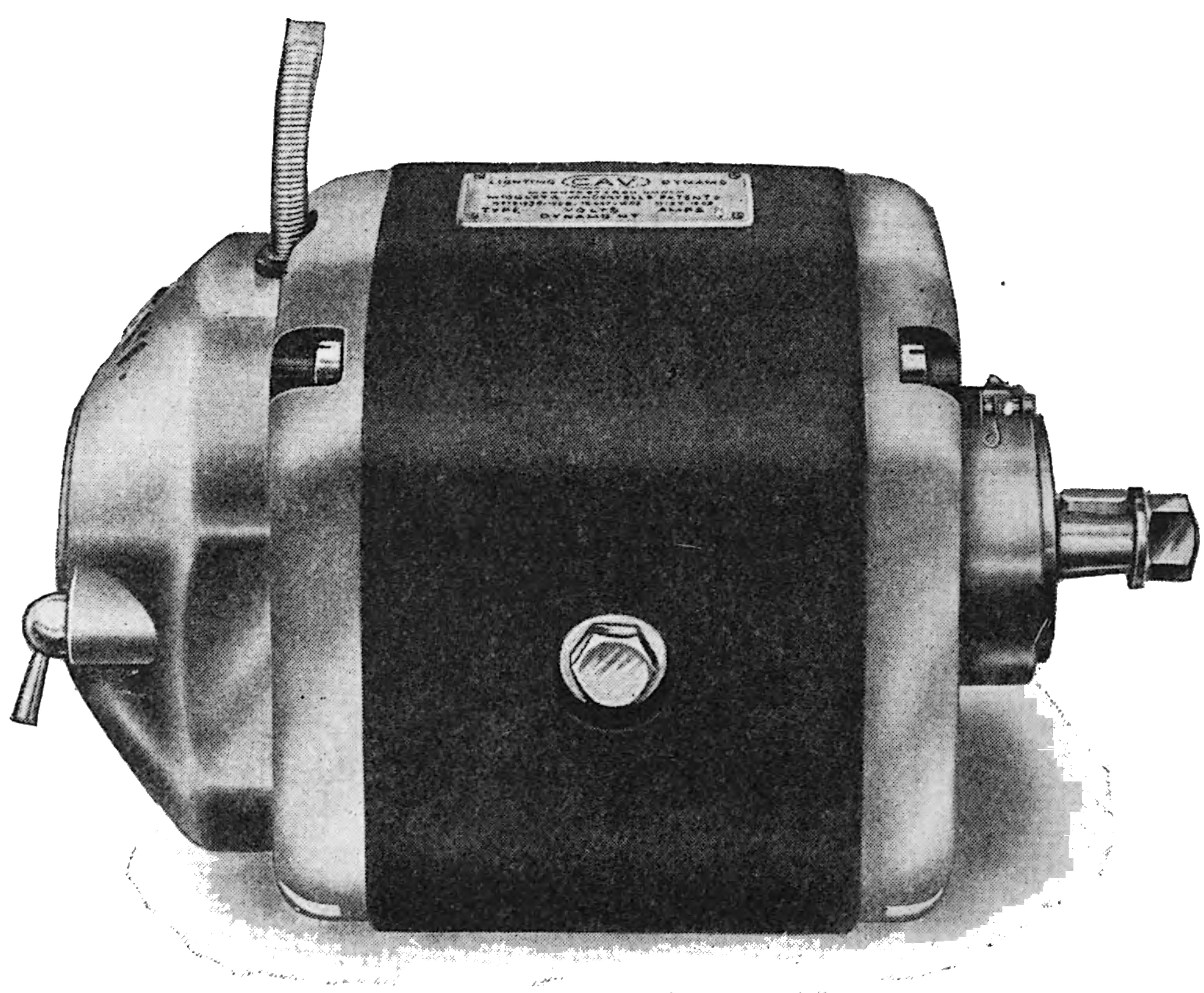


Fig. 42.

catches, so that it can readily be removed for cleaning and examination.

C.A.V.—A very popular dynamo of simple design is the C.A.V. (Fig. 42). This machine is very similar to the ordinary shunt wound dynamo, except that it is fitted with two auxiliary unwound poles N, S (Fig. 43). The effect of these poles is to shunt

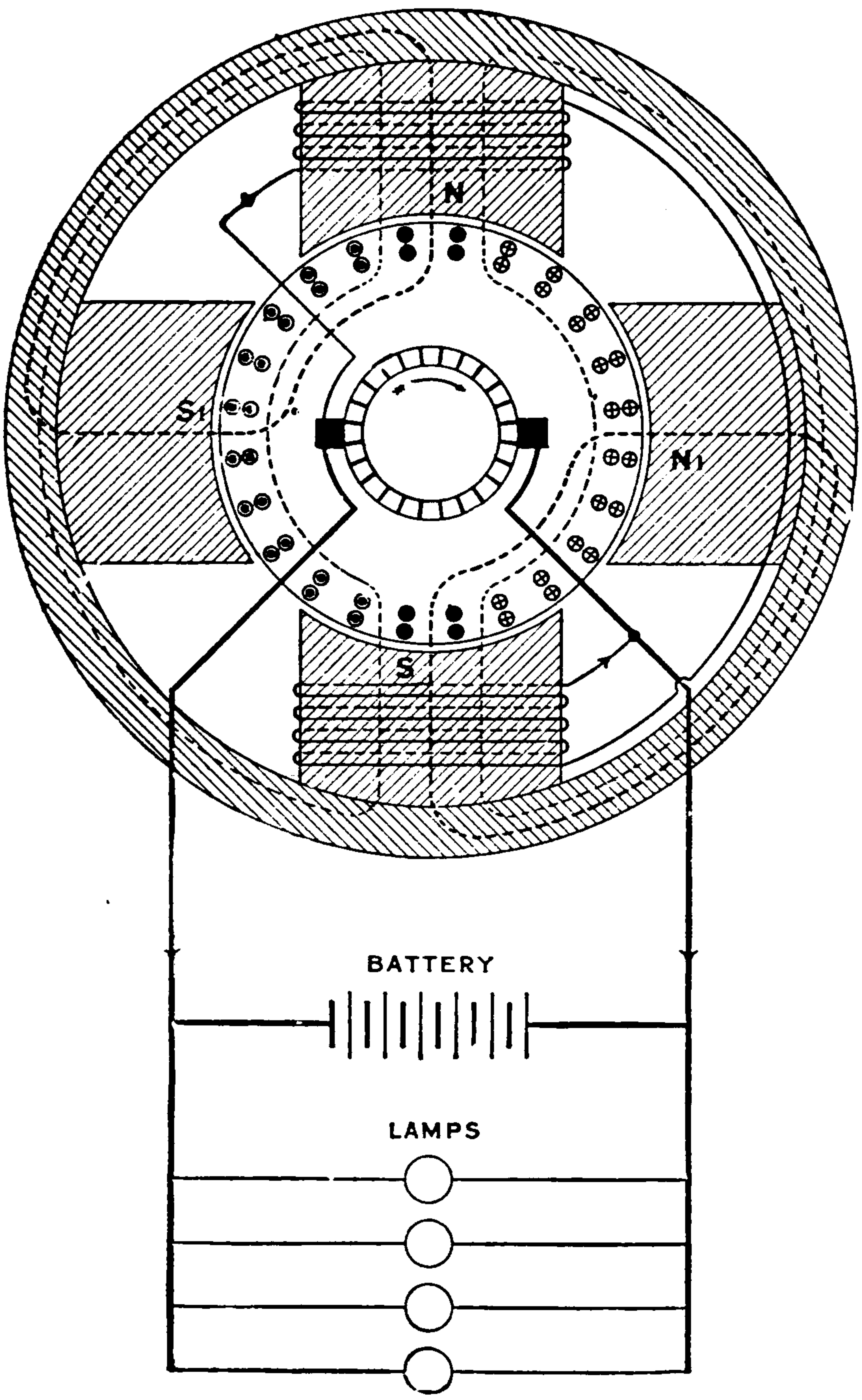


Fig. 43.

the distorted magnetic flux back through the body of the machine when high speeds are attained, instead of allowing it to traverse the armature itself, thereby keeping the output practically constant even at high speeds. The armature (Fig. 44) is drum wound, having a 48-part copper commutator. The brushes (two in number) are sufficiently wide to short-circuit two windings of the armature, thereby cross magnetising the armature, and aiding the shunting effect of the

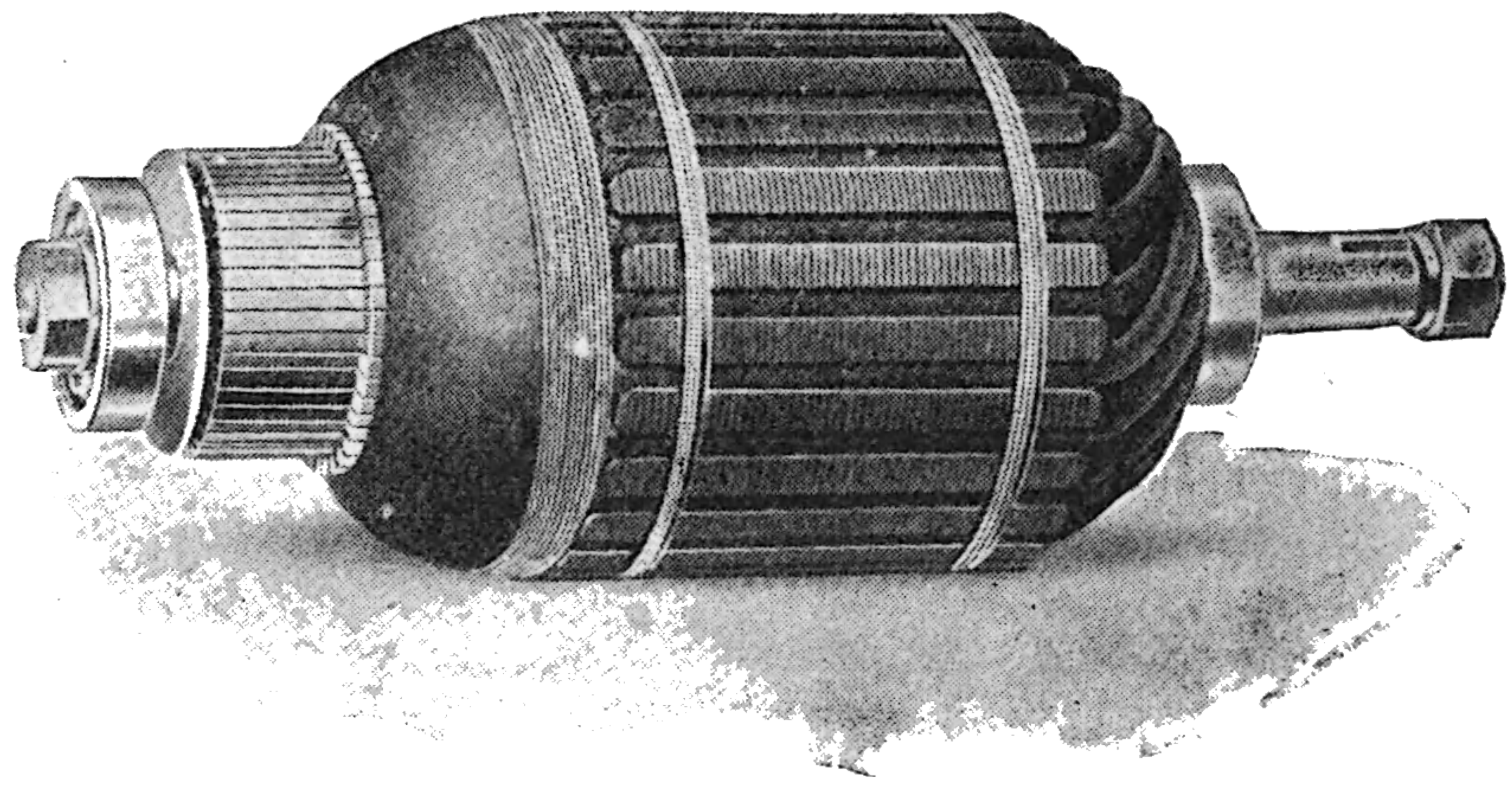


Fig. 44.

subsidiary poles as above described. At the end of the armature shaft within the driving pulley is found the free wheel which takes the place of the cut-out as ordinarily known. This free wheel is similar to

Fig. 45.

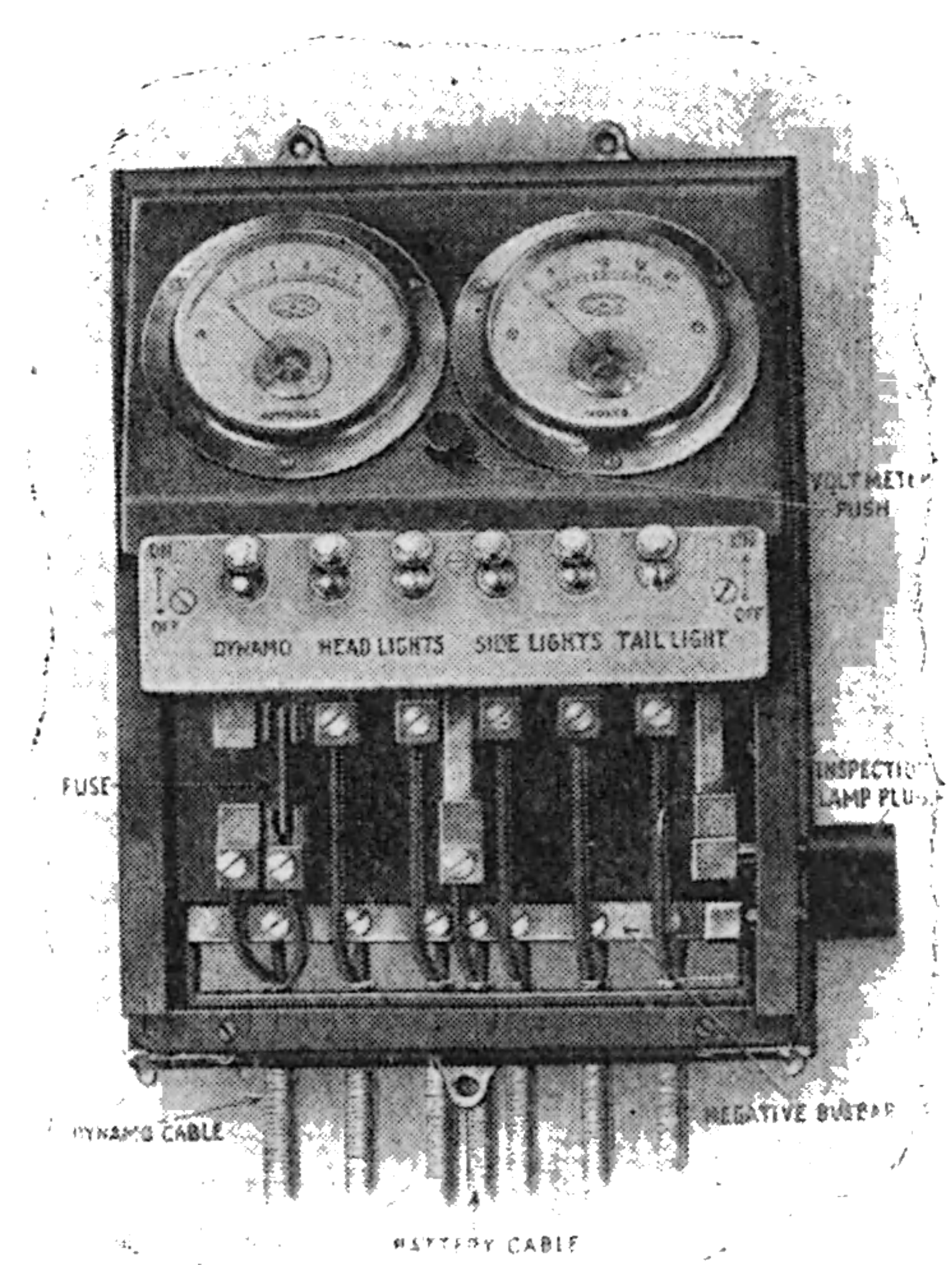


Fig. 46.

that usually found on bicycles, but with stronger springs, fitted so that, when free wheeling or motoring, the ticking noise draws attention to the fact that the dynamo has not been switched off.

The working of the free wheel is as follows: as soon as the pulley is driven by the engine at a speed sufficient to enable the dynamo to begin to generate (about 500 R. P. M.), the pawl engages, and the dynamo commences to be driven until such time as the pulley speed falls below 500, when the dynamo takes current from the battery and runs as a motor, the free wheel overrunning the engine or "motoring." This motoring will continue even when the engine is stopped, but the maximum current taken will only be about 1½ amperes which is practically negligible. When the car is left for any considerable period, the charging switch must be turned off, the ticking of the free wheel drawing attention to this fact. The current wasted in the free

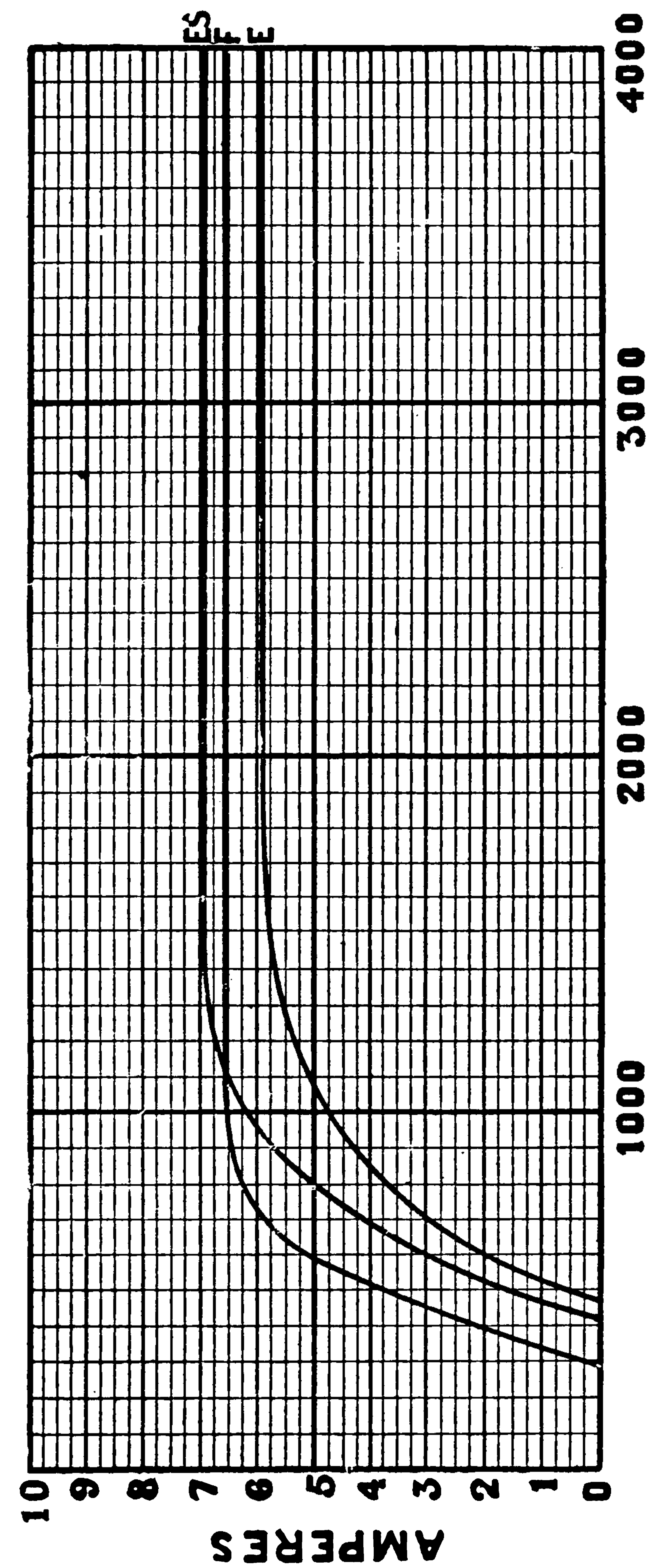


Fig. 47.

wheel is very small, probably not more than that consumed in the coils of a magnetic type of cut-out.

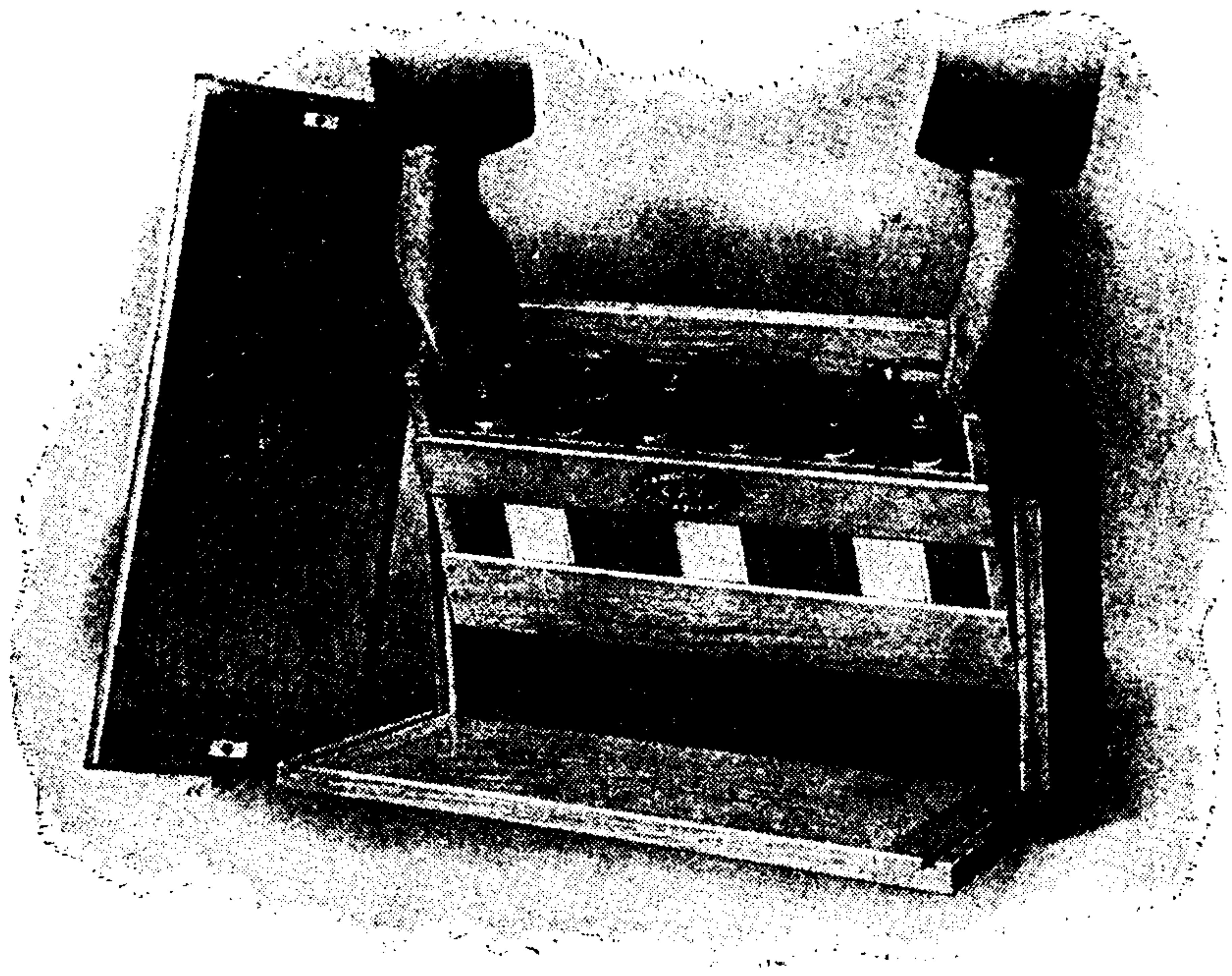


Fig. 48.

This dynamo is made in six sizes, the standard or E type giving 6 amperes at 12 volts, and weighing 21 lbs.

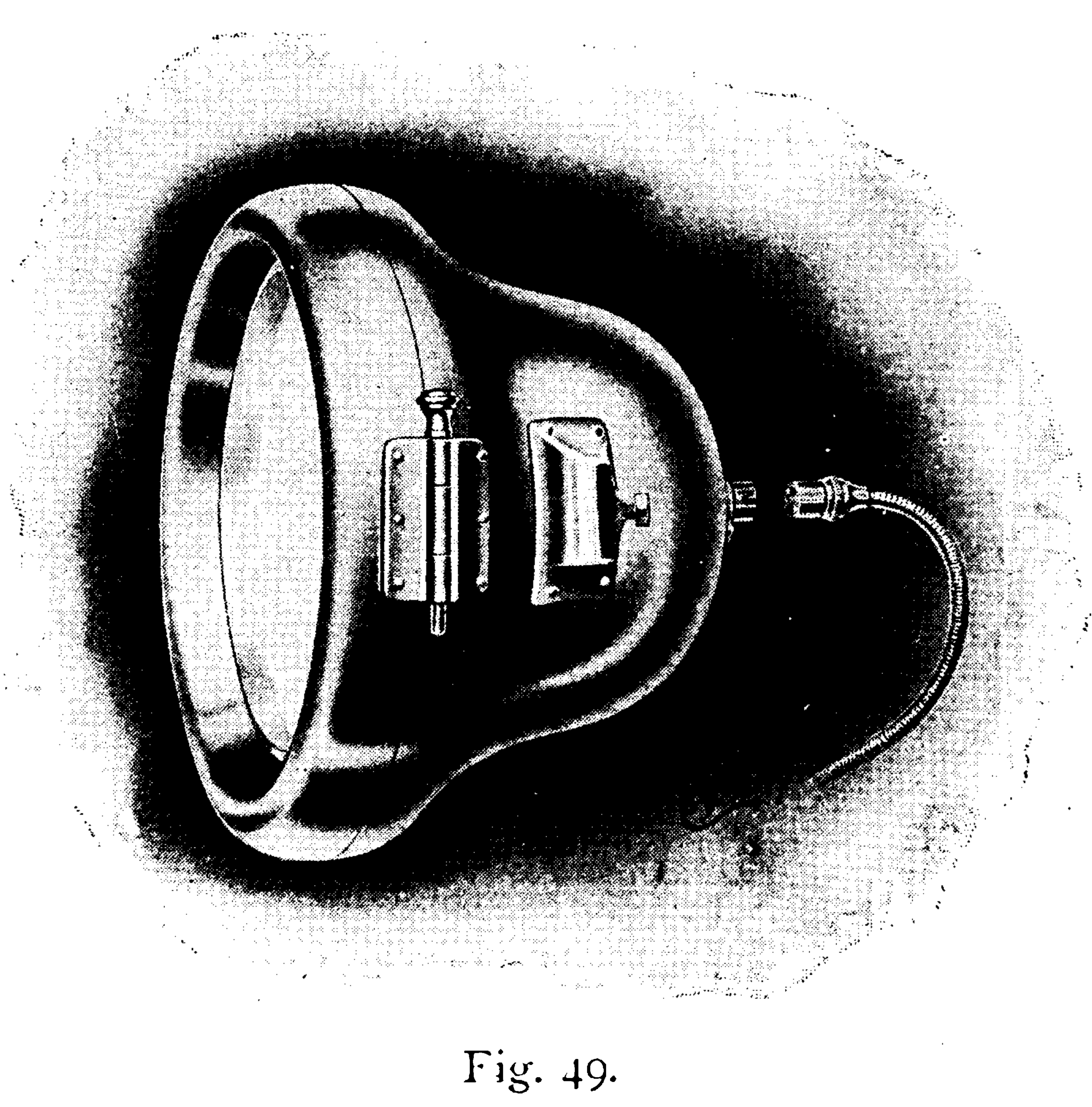


Fig. 49.

The standard switchboard (Figs. 45, 46) provided with these sets is of the slanting desk pattern, com-

given to the excellent system of wiring (Fig. 52). Special spirally wound brass armoured conductors are

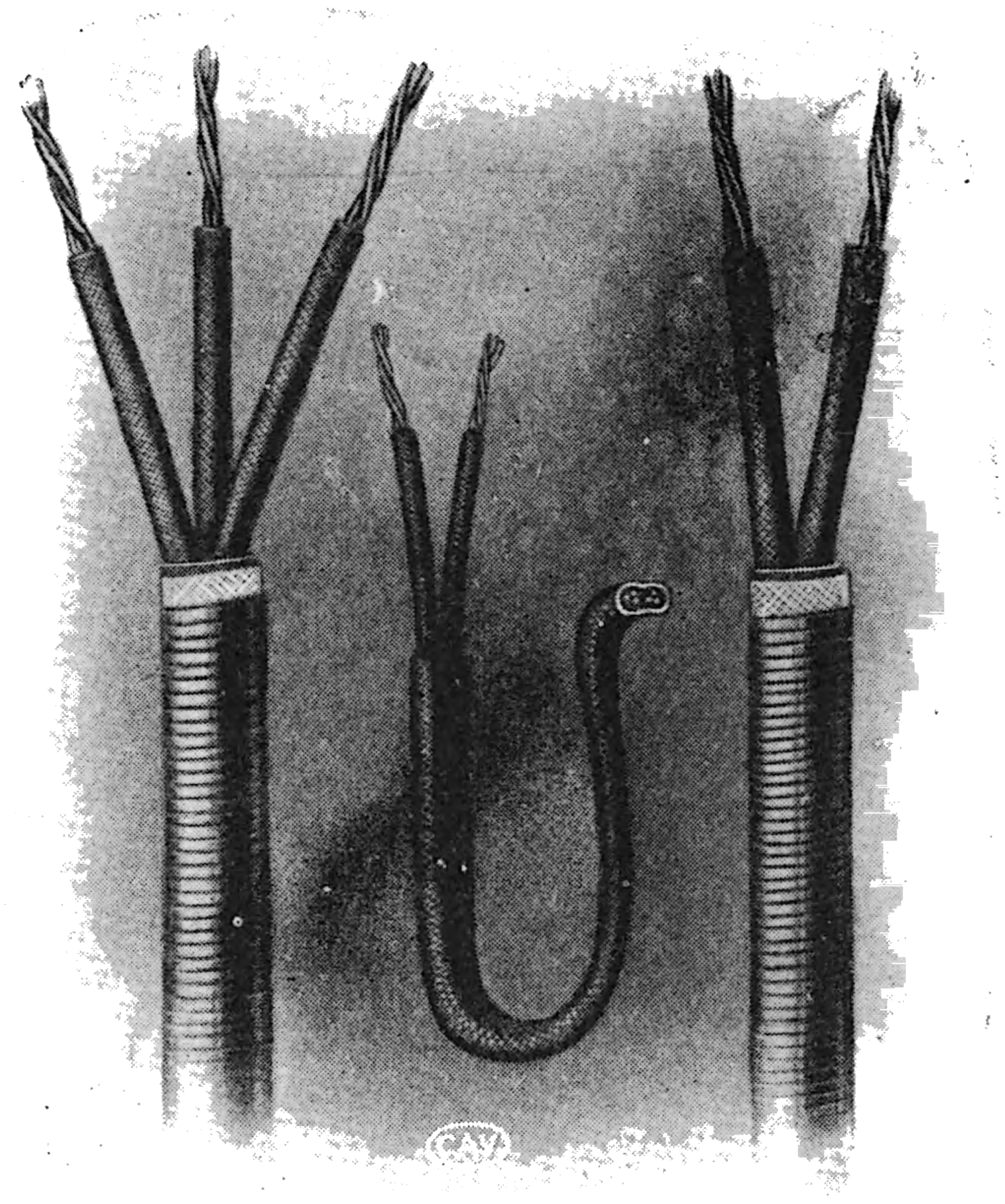


Fig. 52.

supplied to conform to the conditions required, viz., conductors for the lamps, ditto for the main wires from

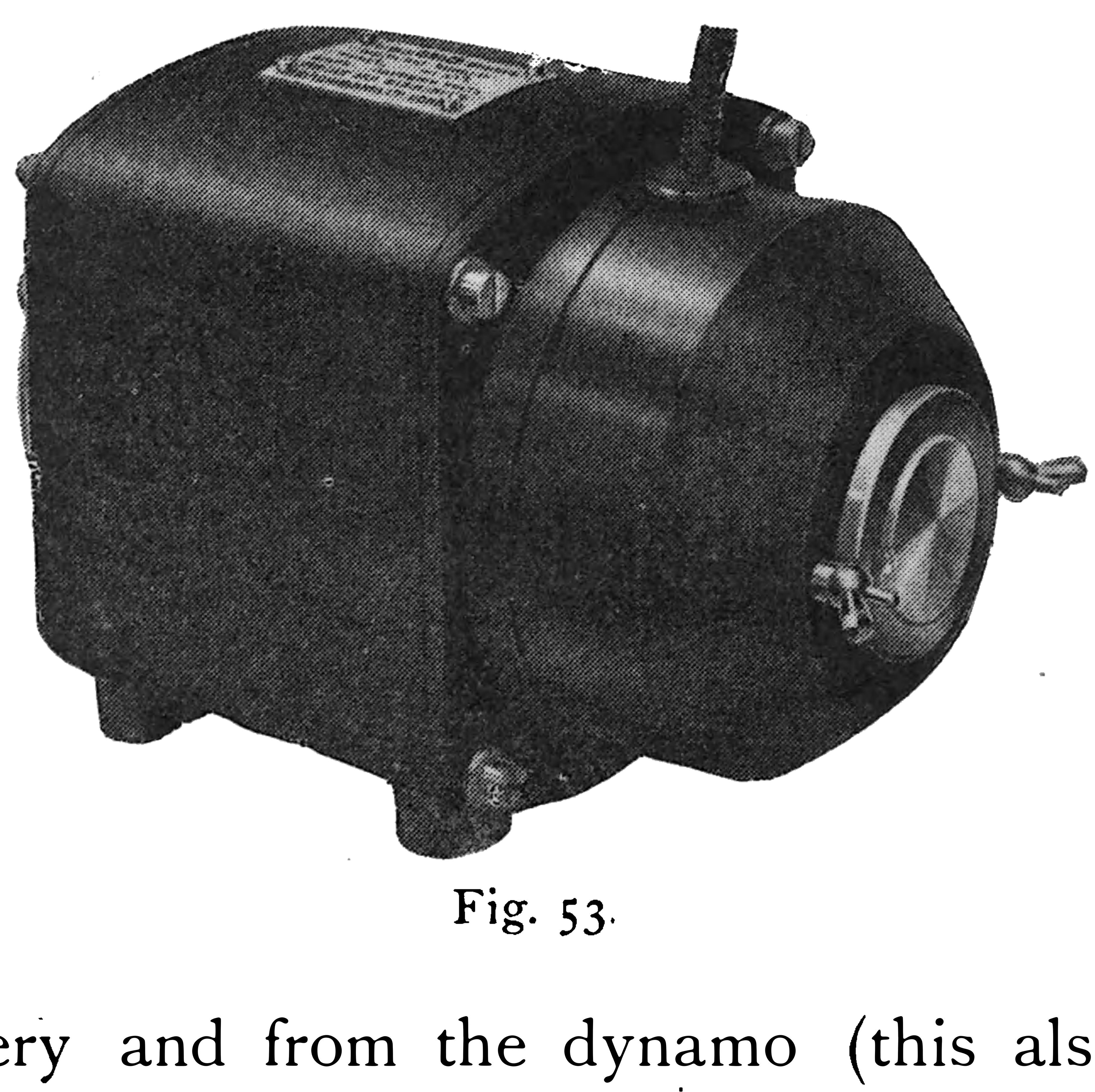


Fig. 53.

the battery and from the dynamo (this also carries a third wire for the field circuit). Owing to the strength of the armouring there is no need to draw the wires through copper tubes, etc., and the wiring of the car is much facilitated.

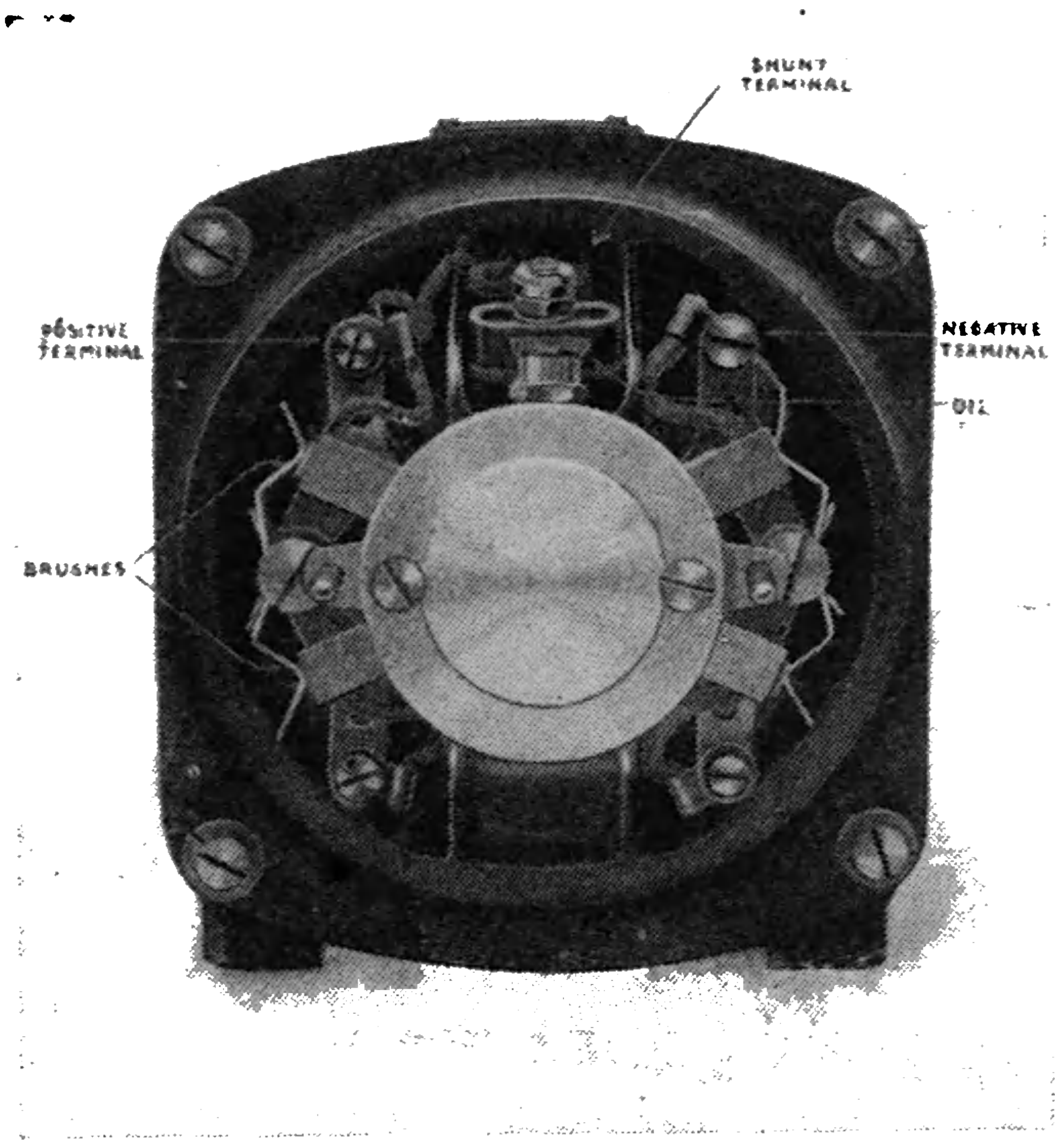


Fig. 54.

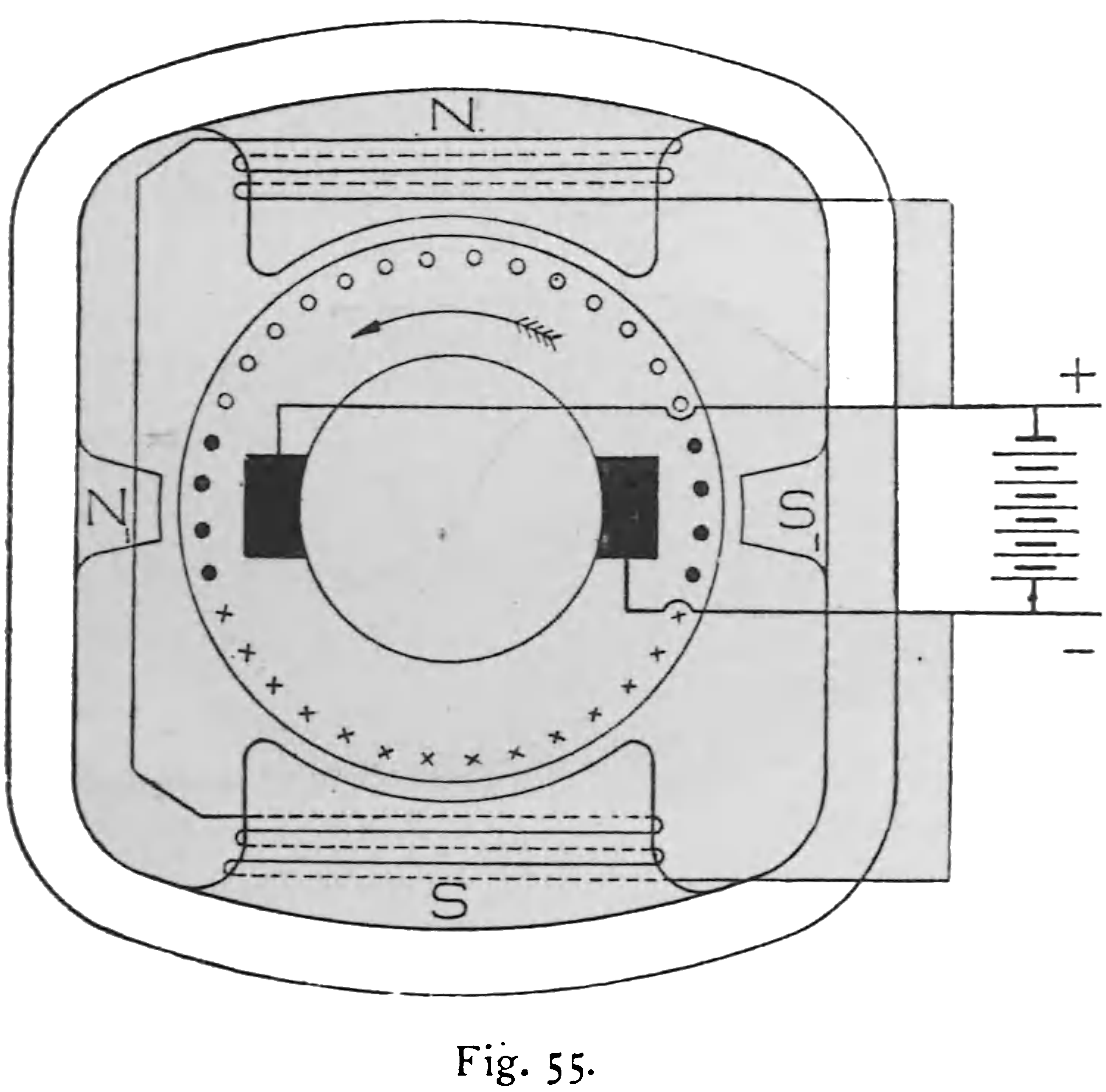


Fig. 55.

This dynamo has been awarded an R.A.C. Certificate for 4,000 miles performance.

Brolt. — The principle of the Brolt dynamo is somewhat similar to that of the last machine described in that it has two auxiliary poles (Figs. 53, 54, 55). These auxiliary poles carry no winding but

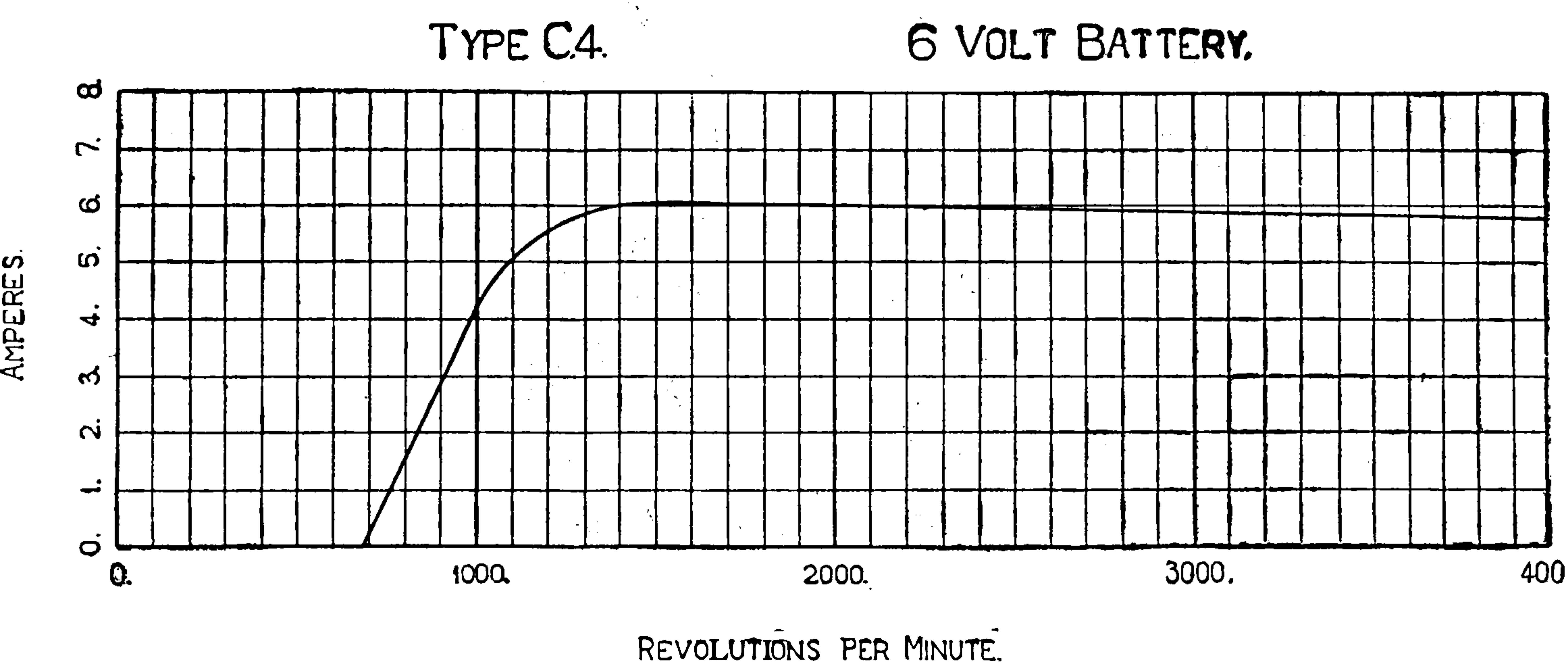


Fig. 56.

are excited by the cross magnetisation caused by the working current in the armature.

This machine has also but two brushes which are wide enough to short-circuit several armature coils

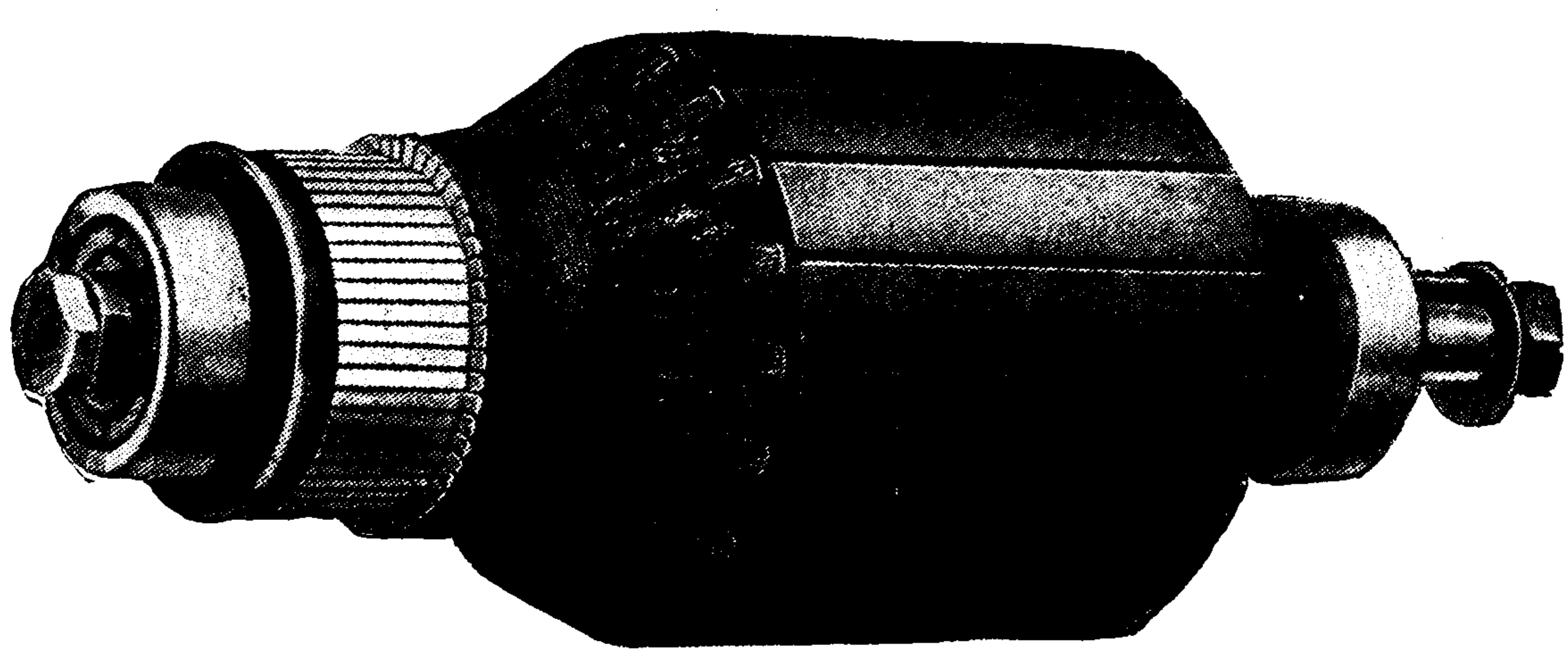


Fig. 57.

during the period of commutation, as shown by the black dots in the diagram. Any increase in speed causes a consequent short-circuiting current in these coils which reacts and weakens the main field, keeping the output current constant (Fig. 56). For convenience each wide brush is actually divided into halves, the two being electrically connected together.

This dynamo reaches its full output at a very low speed, thereby saving undue wear and tear of the bearings and commutator. The armature itself (Fig. 57) is devoid of any cut-out fittings, being the only moving part in the system, the cut-out proper being a magnetic one of the usual type fitted within the switch-

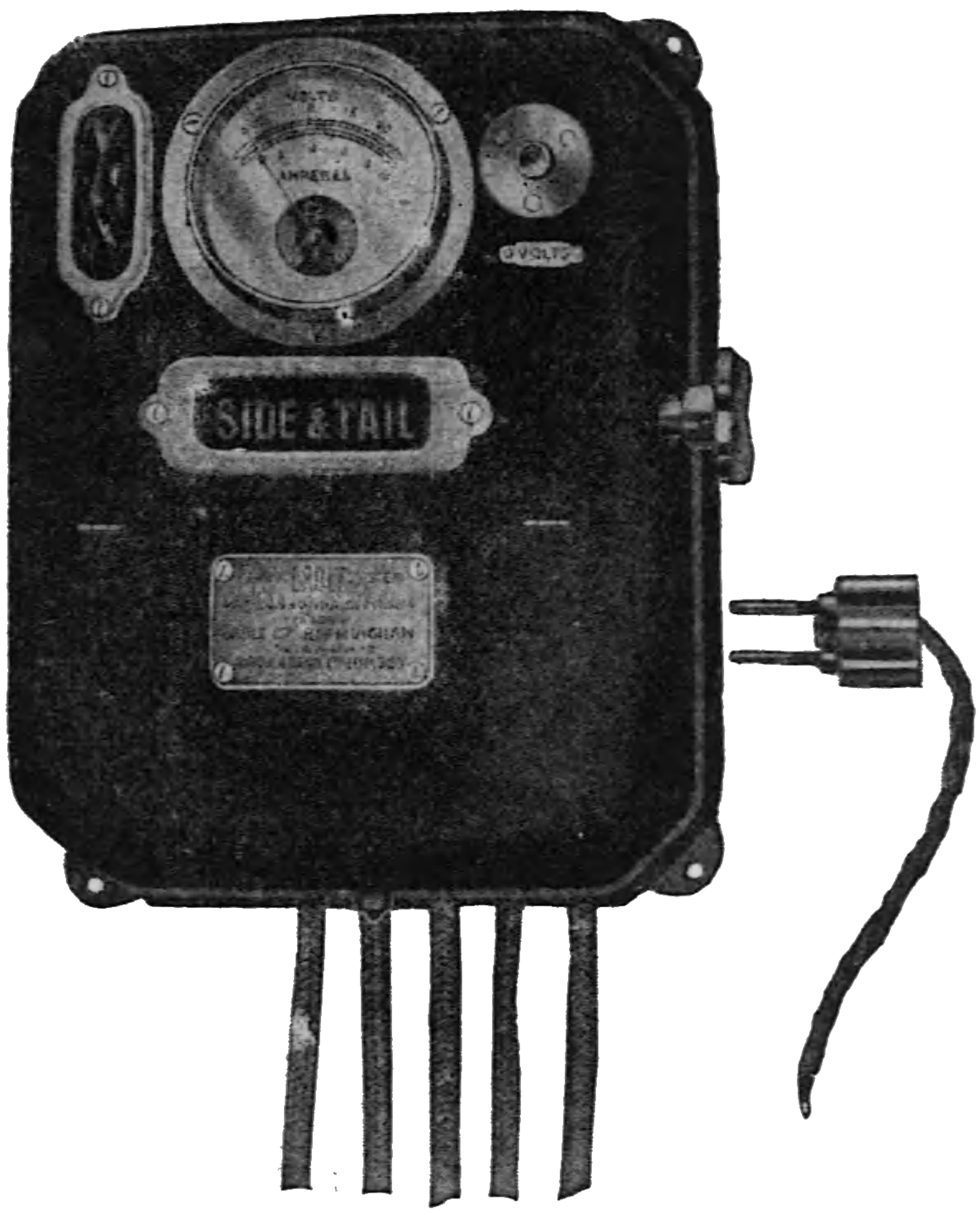


Fig. 58.

board, which has several novel points of design (Fig. 58).

A combined ammeter and voltmeter is employed located at the top of the board, while directly under it is a window indicating the lamps turned on by the knob at the side. The combinations given by the switch are :—

1. Dynamo and lamps off.
2. Dynamo charging.

3. Dynamo charging, side and tail.
4. Dynamo charging, head, side, and tail.
5. Dynamo charging, head and tail.

The voltage can be read by pressing a button on the right-hand side which momentarily disconnects the main charging current.

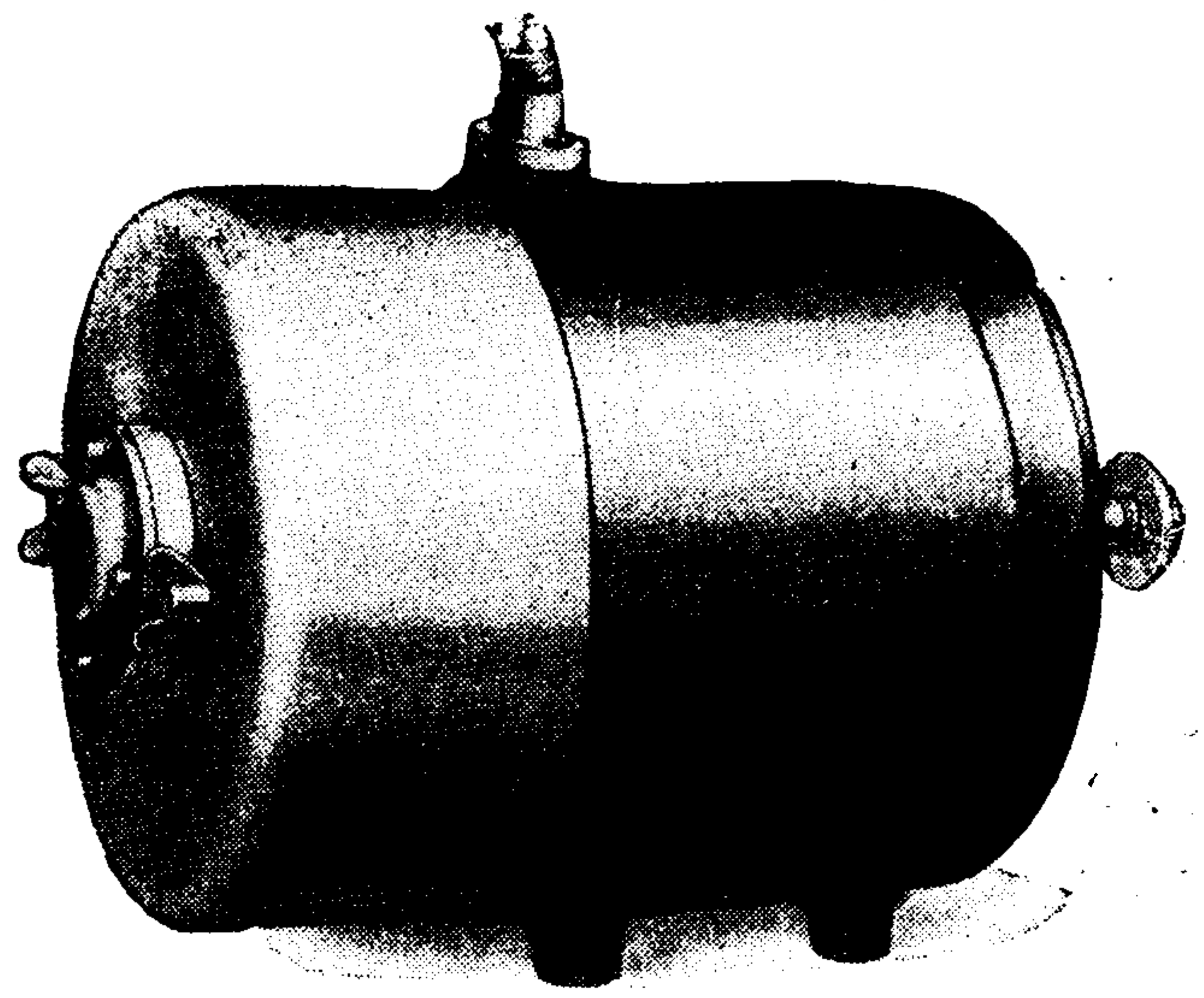


Fig. 59.

Should the tail lamp go out, a small lamp lights up behind the red window on the left-hand side of the board, thereby acting as a tell-tale without the necessity of carrying a double quantity of spare bulbs. A plug for inspection lamp is provided, also a fuse to protect the battery.

The standard type dynamo gives an output of 6 amperes at 12 volts at 1,100 R.P.M. and weighs 25 lbs., the switchboard weighing $3\frac{3}{4}$ lbs. The battery usually supplied has a capacity of 33 ampere hours at 12 volts, and is put up in a neat teak case for fixing on the running board of the car; a very neat set of lamps is also supplied with this set.

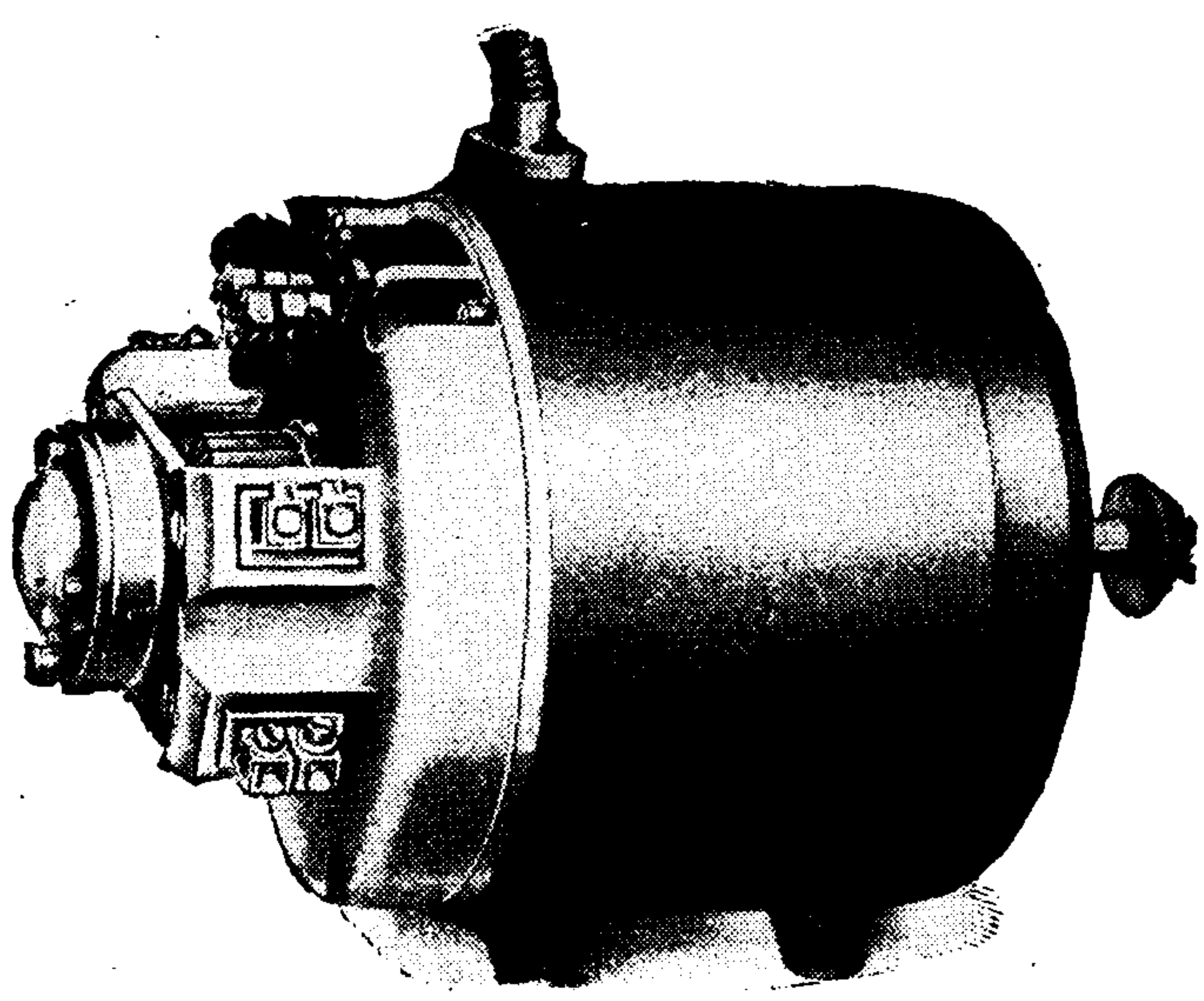


Fig. 60.

Leitner.—The Leitner dynamo (Figs. 59, 60) was one of the first machines to be successfully used on cars and is simply an ordinary shunt wound dynamo with an additional subsidiary brush or brushes.

The following description applies to a 4-brush machine :—N and S (Fig. 61) represent the two pole pieces and C and C_1 the two main brushes which are connected to the main circuit through the auto switch or cut-out. The shunt windings C_2 have one of their

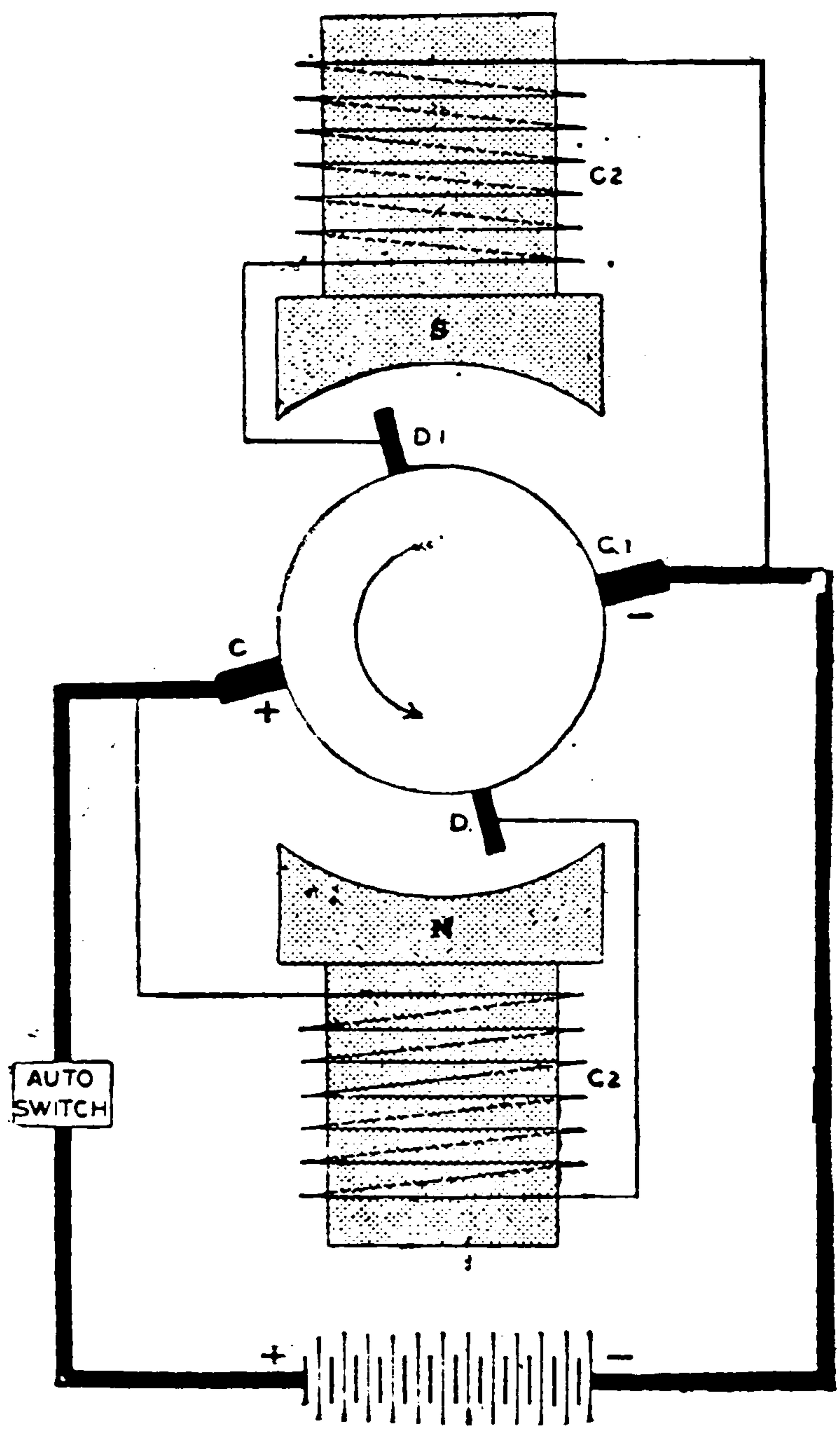


Fig. 61.

ends connected to these brushes, the other ends being connected with the subsidiary brushes D and D_1.

If the direction of rotation be counter-clockwise there will be a difference of pressure between the subsidiary brushes D and D_1; this will aid the rapid excitation of the poles N and S. But as the current on load flows out of the armature through C and C_1

the armature magnetisation distorts the field magnetism in the direction of rotation and in consequence the voltage between the subsidiary brushes is first lowered and then reversed in sign. This voltage, which increases with speed and load, opposes that of the field, so that the latter is weakened in proportion by counter E.M.F.

The machine itself is strongly constructed and well enclosed, the armature runs on ball bearings and gives its rated output at 1,500 revolutions in the small size and at 1,000 in the large, the machine being wound to give

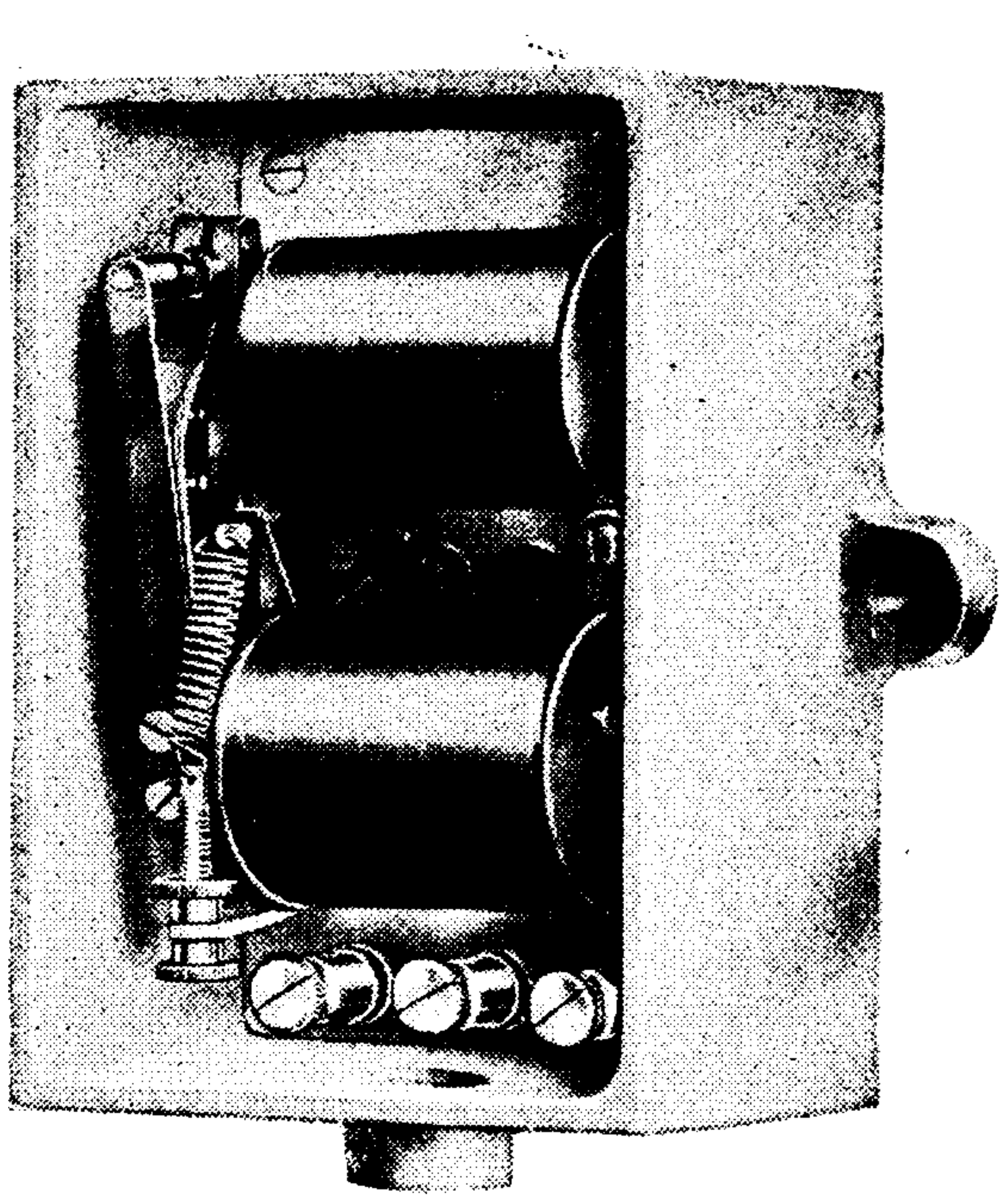


Fig. 62.

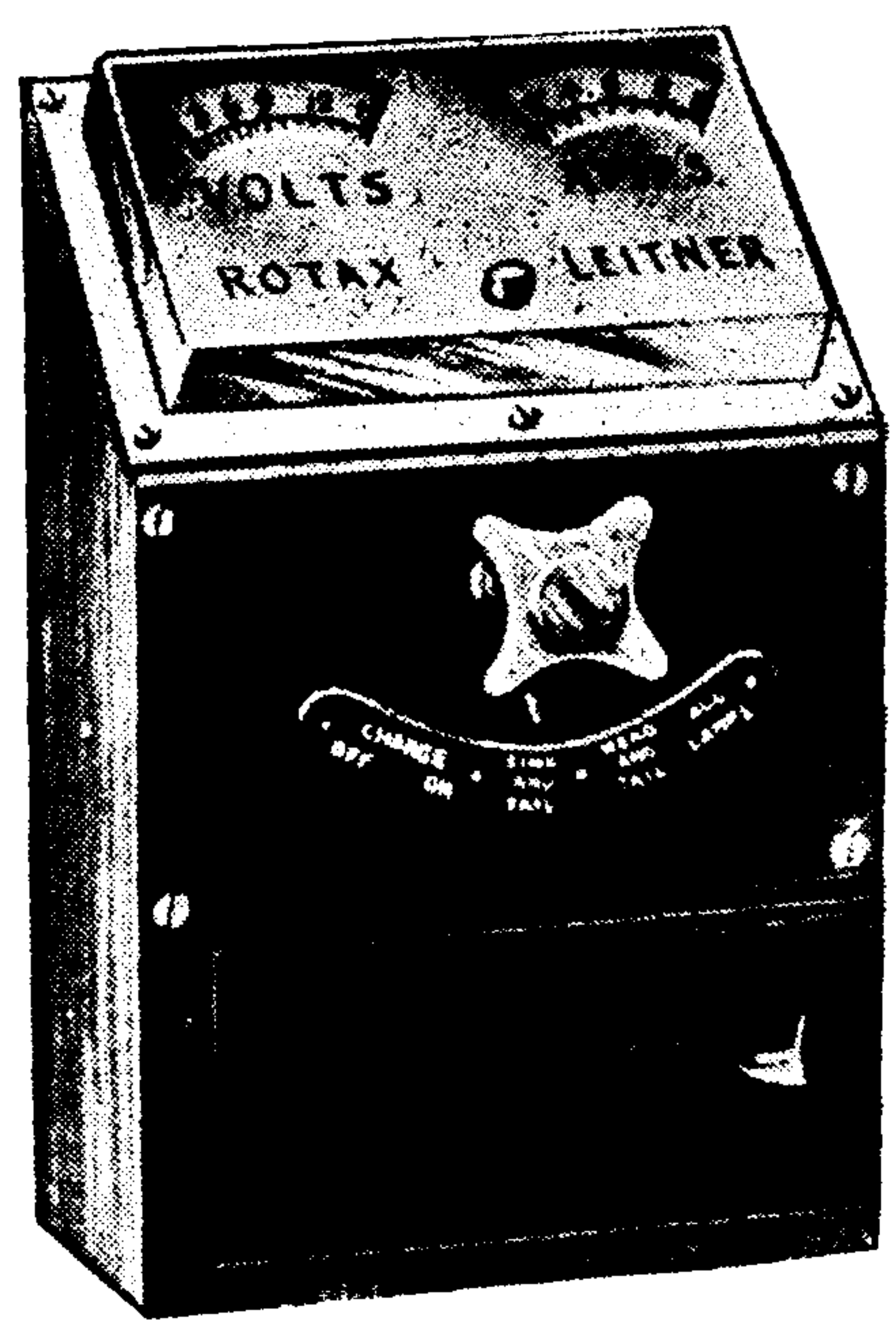


Fig. 63.

12 volts. Weights of machines, 60 watts 17 lbs., 120 watts 19½ lbs. The auto switch or cut-out (Fig. 62) is of the electro-magnetic type already described and is generally fixed within the switchboard (Fig. 63). This latter is of the sloping desk variety and contains volt and ammeters, also a progressive switch or "combinator" by which various selections of lamps and charging may be obtained. These are as follows:—

Day Running

Charge { *Off.*—Dynamo running light.
On.—Three-quarters or full charge (depending on type selected).

If all four are at the top the acid is too strong, and water should be added. Three beads indicate the cell is fully charged, two beads that the cell is about

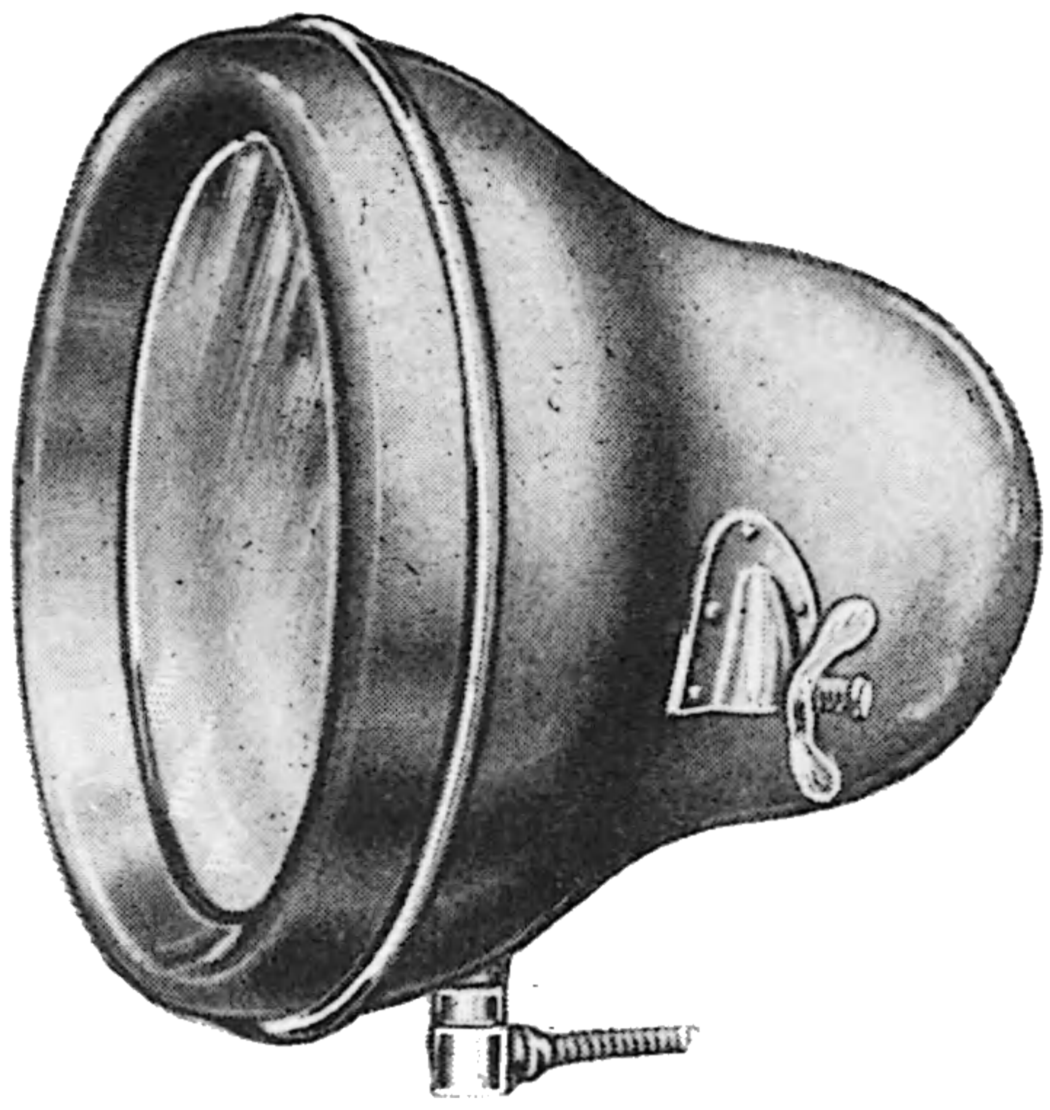


Fig. 66.

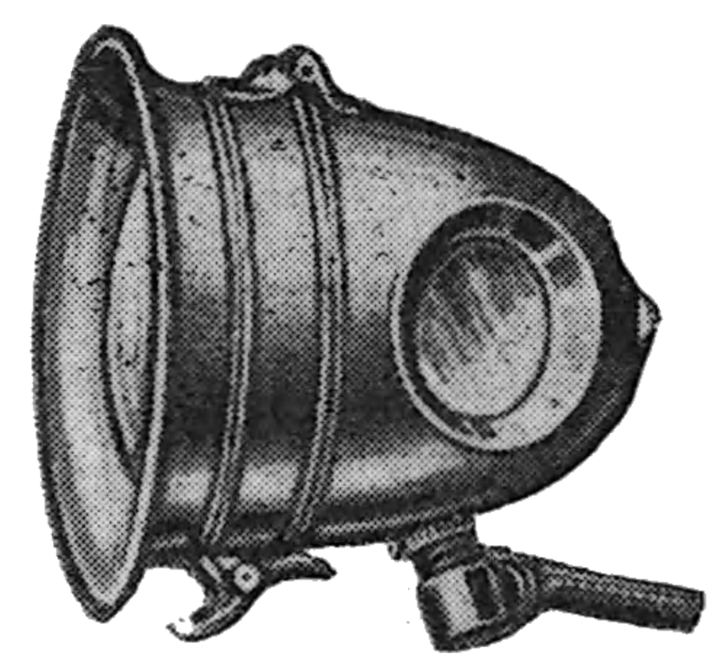


Fig. 67.

two-thirds charged, one bead one-third charged, and no beads floating indicates that the battery is practically fully discharged. The capacity of the batteries varies from 20 to 55 ampere hours depending on

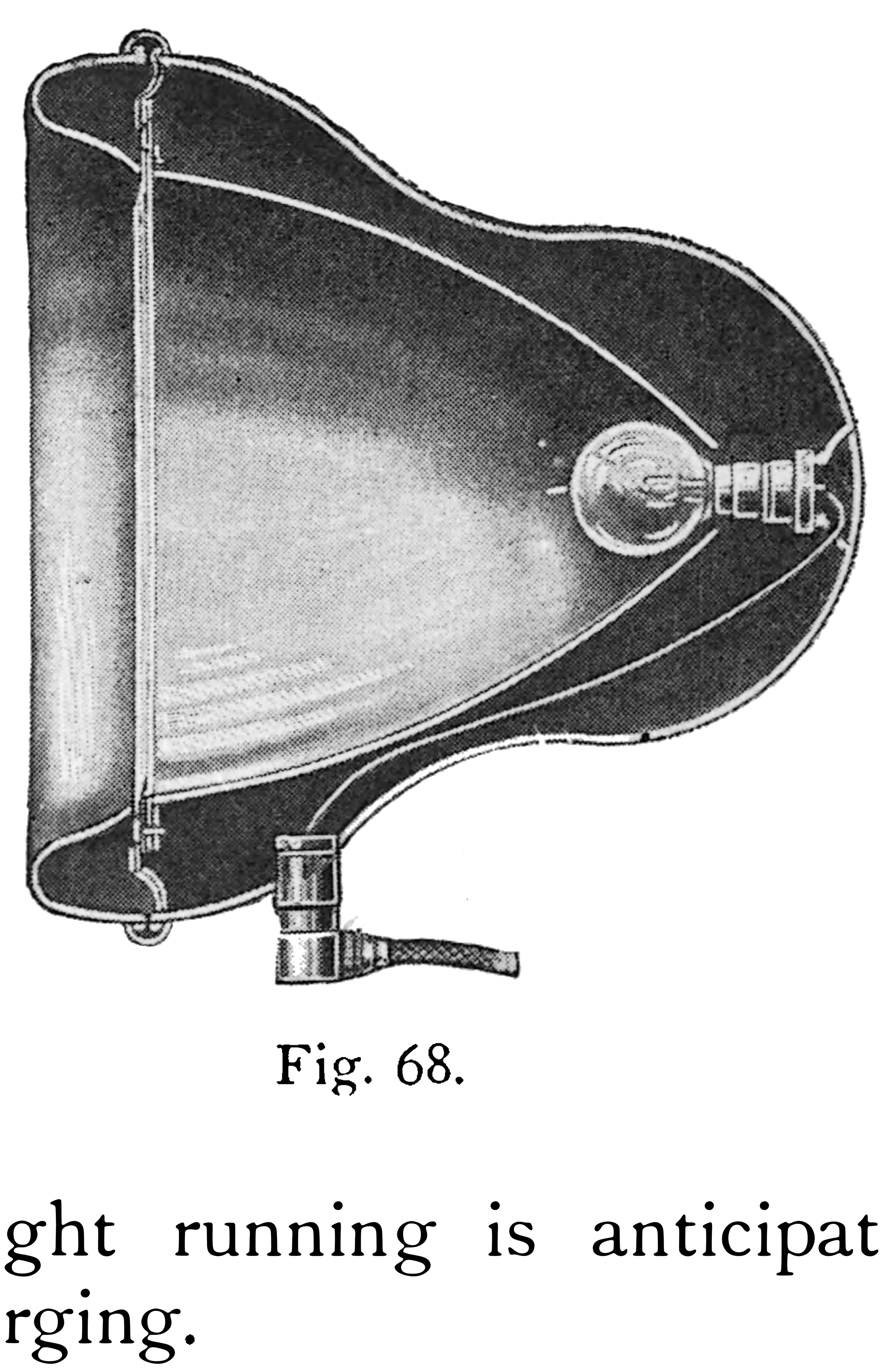


Fig. 68.

how much night running is anticipated in relation to the day charging.

Figs. 66, 67 show the general appearance of the lamps usually employed with this set, also a section of the head lamp (Fig. 68) showing the scientifically designed parabolic reflector. As in some early patterns the lampholders are non-focussing, the bulbs supplied by the makers should be used in order to get the filament in the exact focus.

Fig. 69 shows the output curve characteristic of one of the standard machines. The steadiness of the output will be noticed, also the early cutting in speed.

The wiring of this system is generally carried out in flexible metallic tubing with special bushes fitted at the ends and junctions to prevent fraying of the conductors.

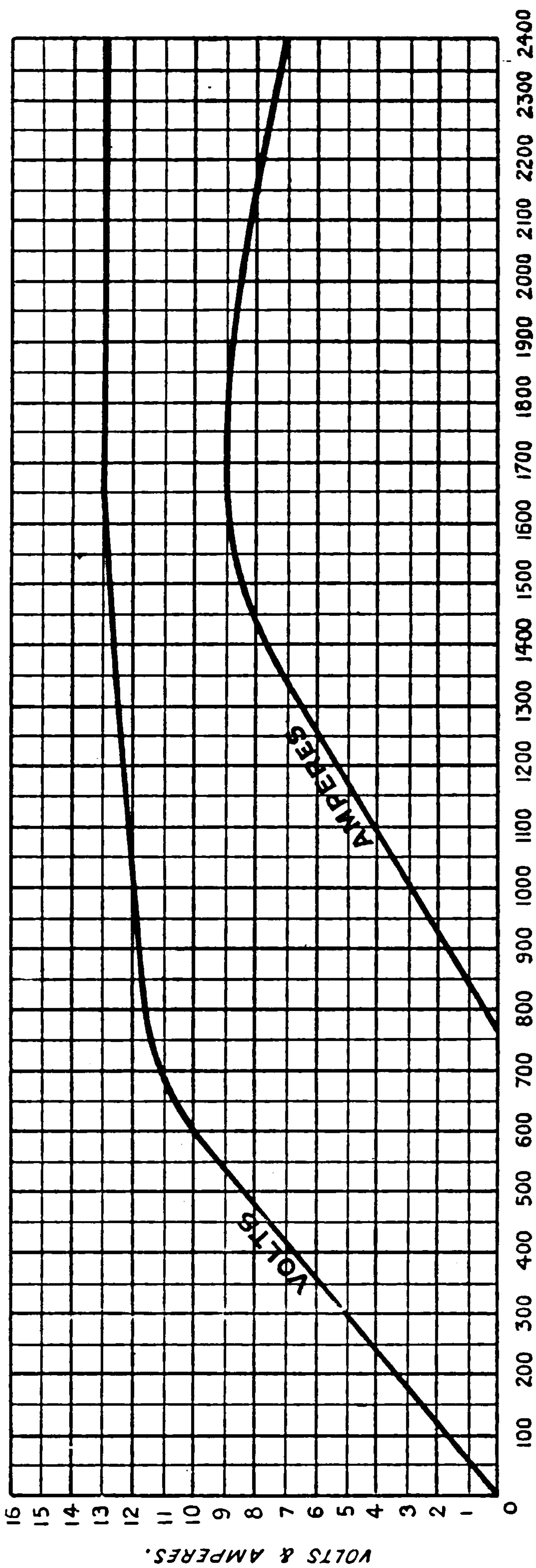


Fig. 69.

CHAPTER VII

ELECTRO-MAGNETICALLY CONTROLLED SYSTEM

Magician.—The Magician dynamo, while giving a large output, achieves its end in a very ingenious way. The whole body of the dynamo (Fig. 70) is pivoted concentrically with the spindle, thereby allowing it

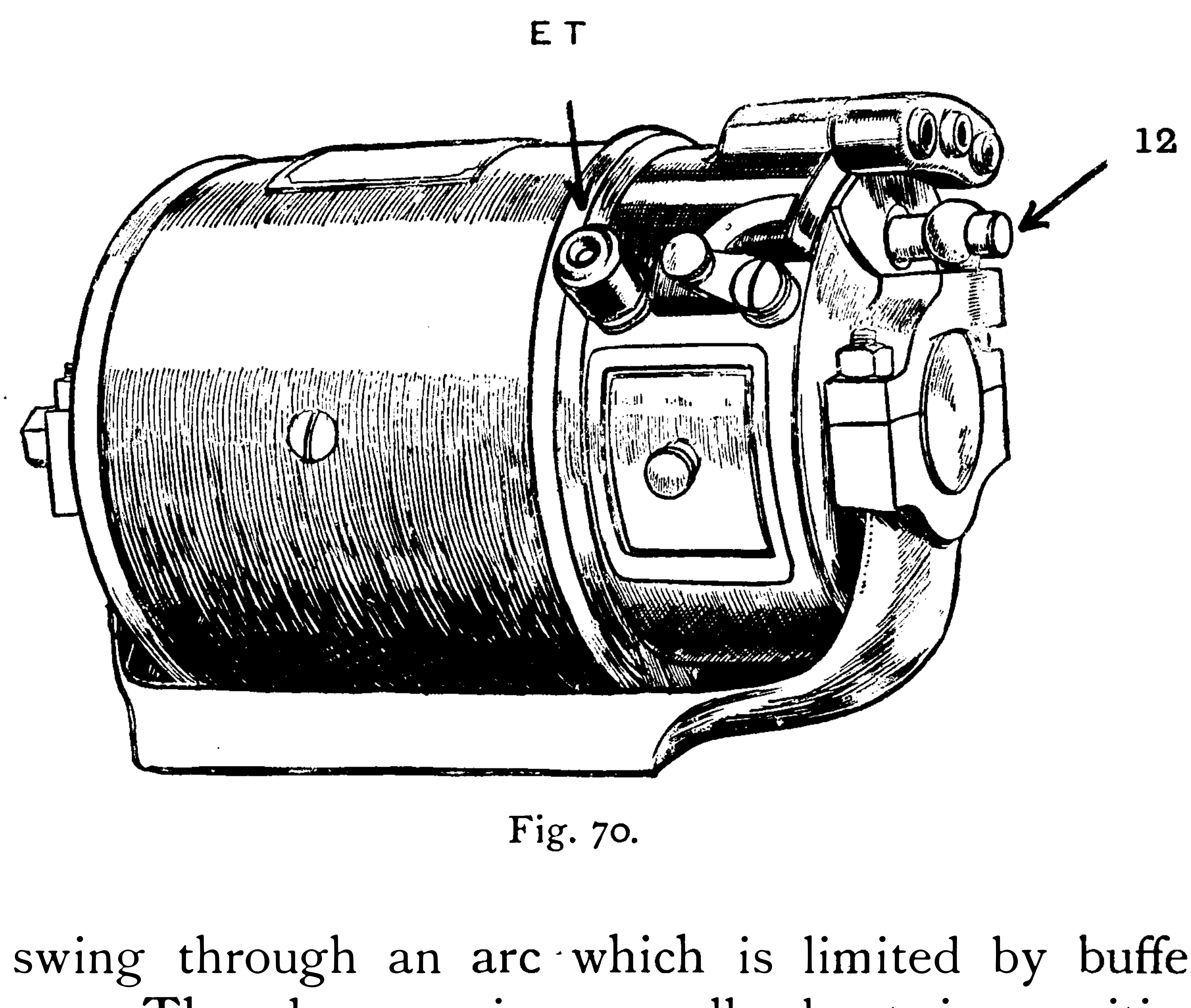


Fig. 70.

to swing through an arc which is limited by buffer stops. The dynamo is normally kept in position against one stop when at rest by a spring, but as soon as the armature commences to rotate and generate, the carcass begins to follow in the same direction till it meets the further stop. The main brushes are mounted on the swinging carcass and collect the current in the usual way, but a third fixed brush is connected to the field winding, so that when the speed is low (being in the maximum position) it energises the fields strongly, but as the speed increases and the carcass begins to turn, the brush gradually

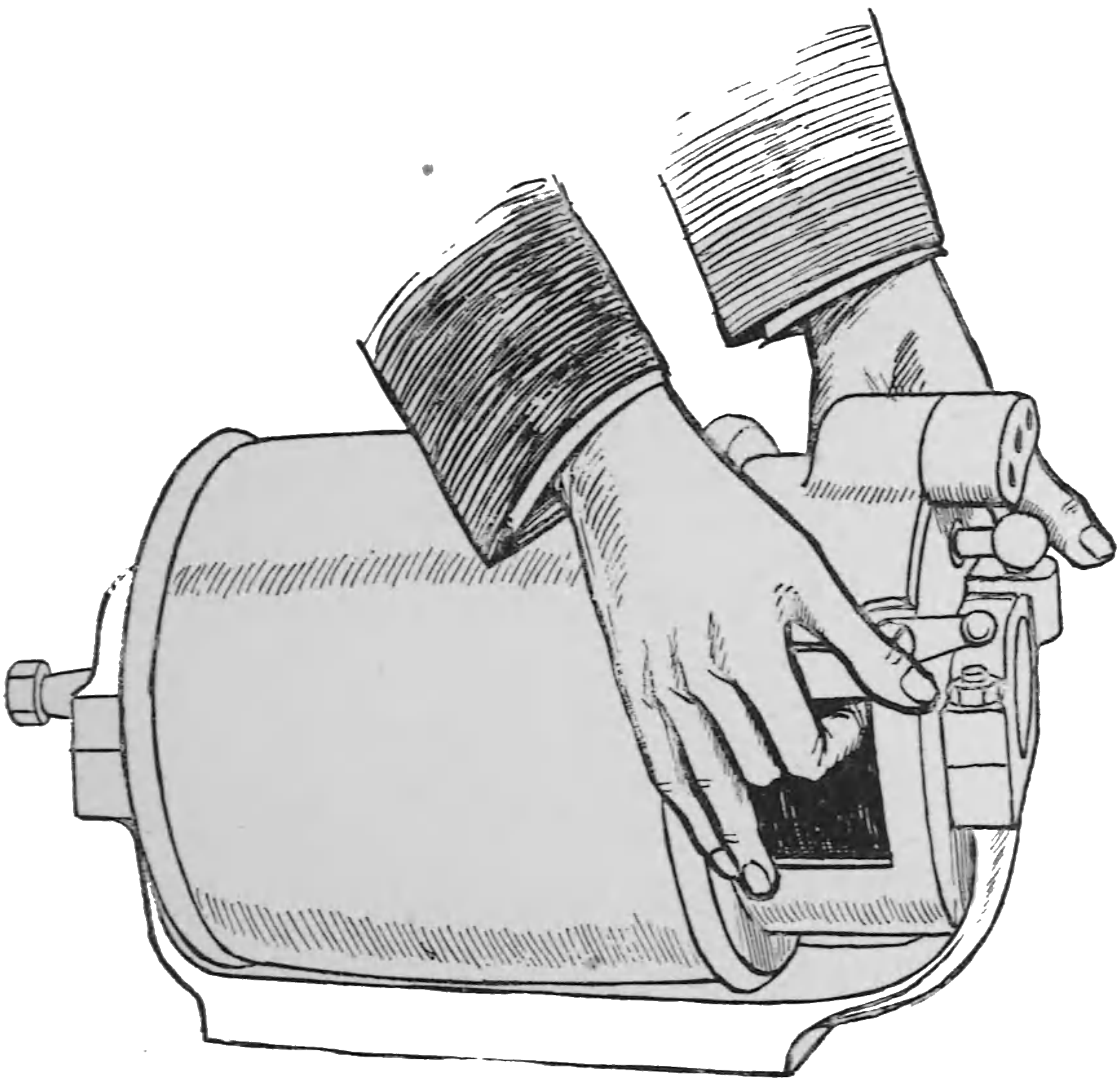


Fig. 71.

reaches a more and more inefficient collecting spot, thereby weakening the field and keeping the output constant.

The turning of the carcass is furthermore utilised to effect the cutting in and out (7, 8, 9, Fig. 72).

The automatic cut-out switch 12, Fig. 70, thus actuated, closes the circuit at about 800 revs. per minute.

Should a short-circuit occur, the rush of current rocks the field magnets over, and the dynamo cuts out and cuts in until the short-circuit is rectified,

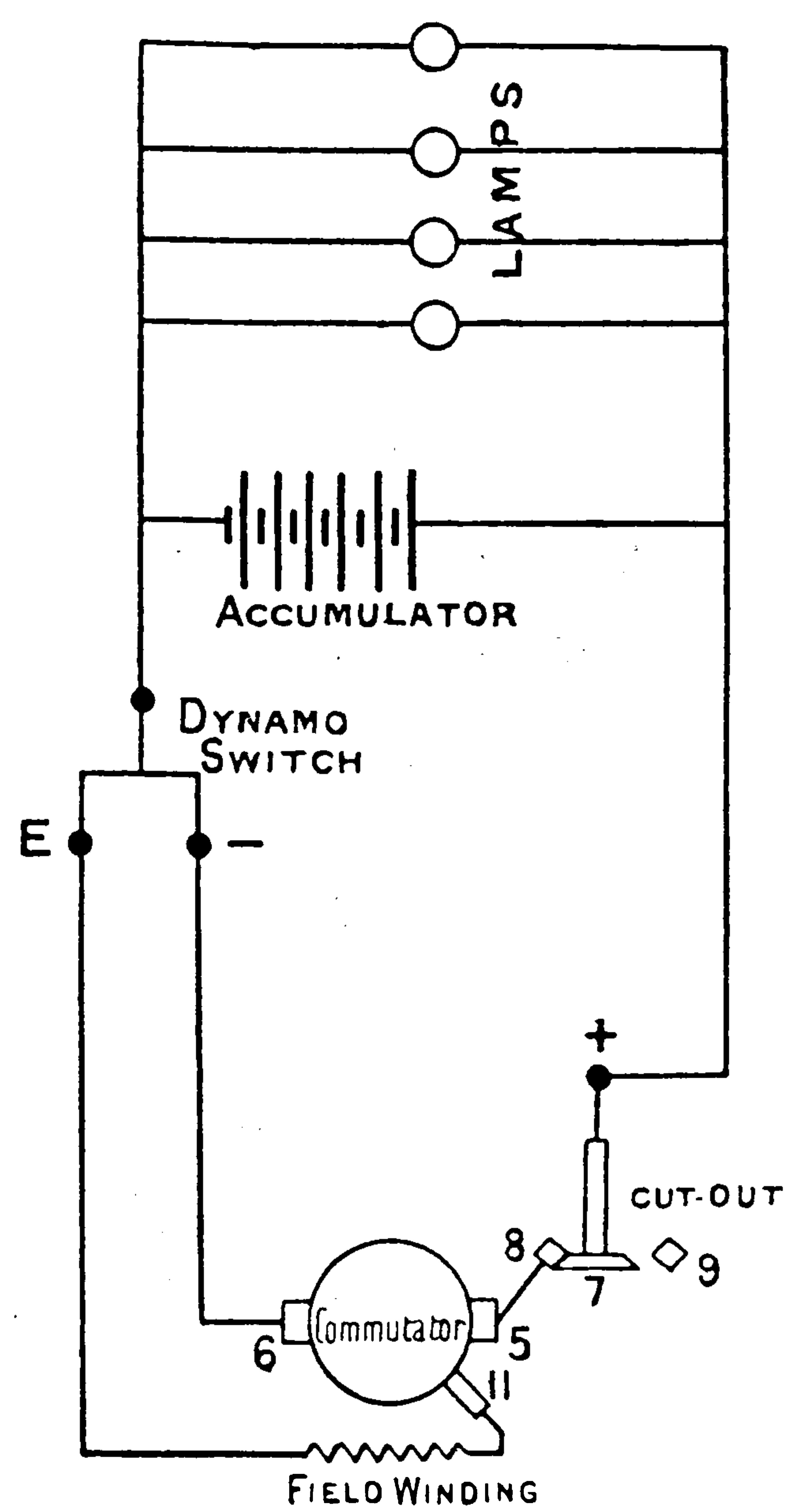


Fig. 72.

making a sufficient noise in the process to attract the driver's attention.

Another advantage is that the direction of rotation may be altered by moving the excitation brush, a different brush cover obtainable from the makers being all that is necessary.

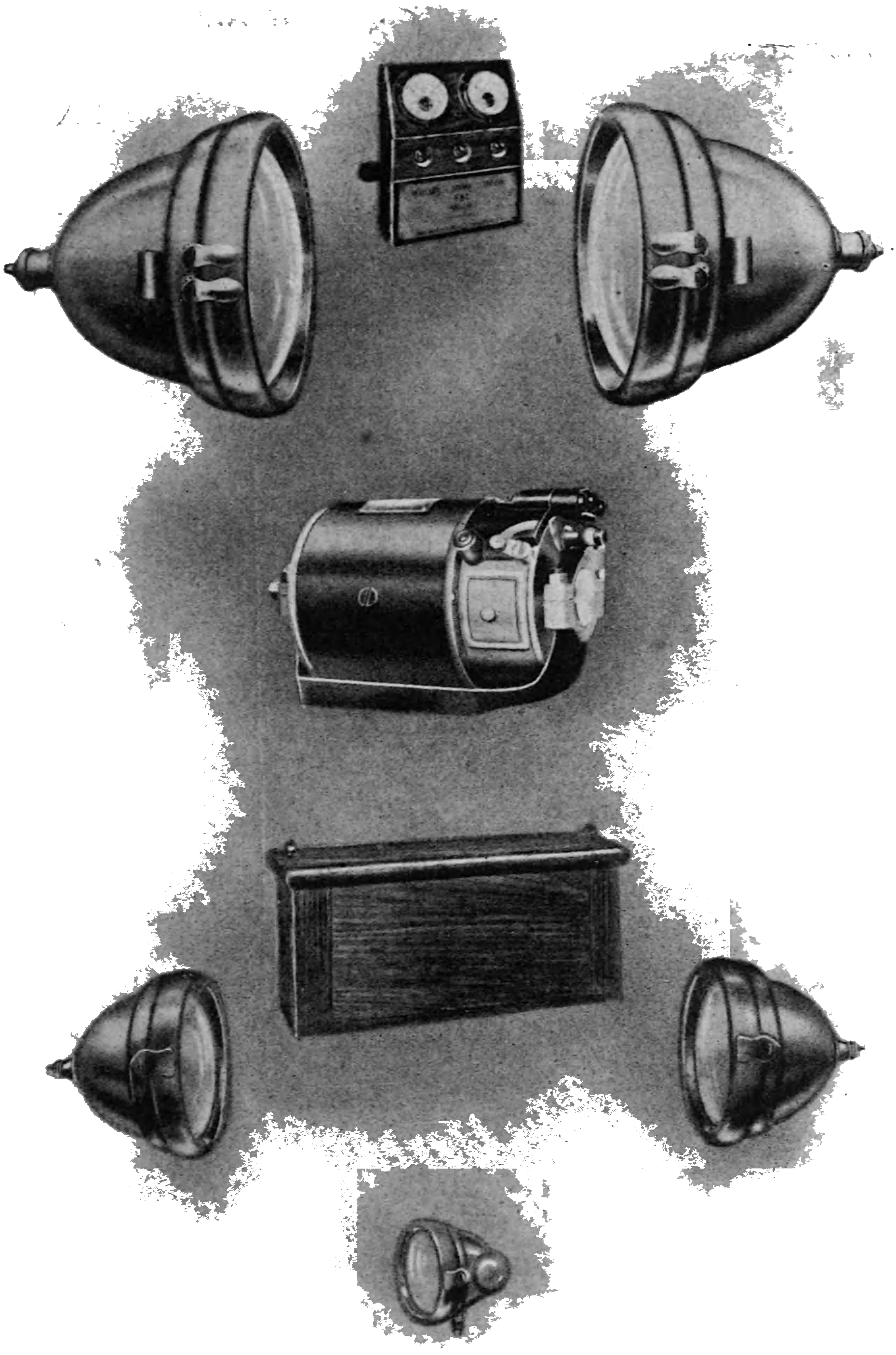


Fig. 73.

The ebonite brush cover is a special feature; all wire connections except the excitation carbon are contained in this cover. Fig. 71 shows the brushes being taken out.

Fig. 72 shows the wiring system. The field or excitation terminal E is here shown, and may be seen at ET, Fig. 70, which connects it with the excita-

Fig. 74.

tion brush, 11. This brush is carried on an adjustable bracket; by moving this bracket the output of the dynamo can be varied to any value between 8 and 20 amperes.

The output is 180 watts at 12 volts, which is

The only feature of importance is the double windings on the field, which are somewhat like those used on a "compound" machine but acting in the opposite sense. The first winding is the usual shunt winding connected over the brushes and energising the field in the usual way. The second winding consists of a few turns of coarse wire, but wound to energise the field in the opposite way to shunt, and connected in series with the battery and main circuit. The action of this arrangement is as follows: At low speeds the shunt coil begins to magnetise the fields, and a current is generated in the armature. This current is at first, owing to the low speed of the armature, quite feeble, and the magnetism due to the shunt coil will mount with the increasing speed of the dynamo. When, however, the speed of the machine rises, and therefore the strength of the current begins to approach the point at which it might be injurious to the battery and lamps, the current in the series coil will be found strong enough to excite a counteracting influence on the shunt coil, and any further increase of speed will be neutralised by the current flowing round the main or series coil, which, as we have said, acts in opposition to the shunt or building-up coils.

In this way a very simple and efficient machine has been constructed giving an excellent output curve (Fig. 76).

Fig. 77 shows a section of this machine and gives details of the working parts. It will be noticed that these are of the smallest number to give efficient working and are generously proportioned.

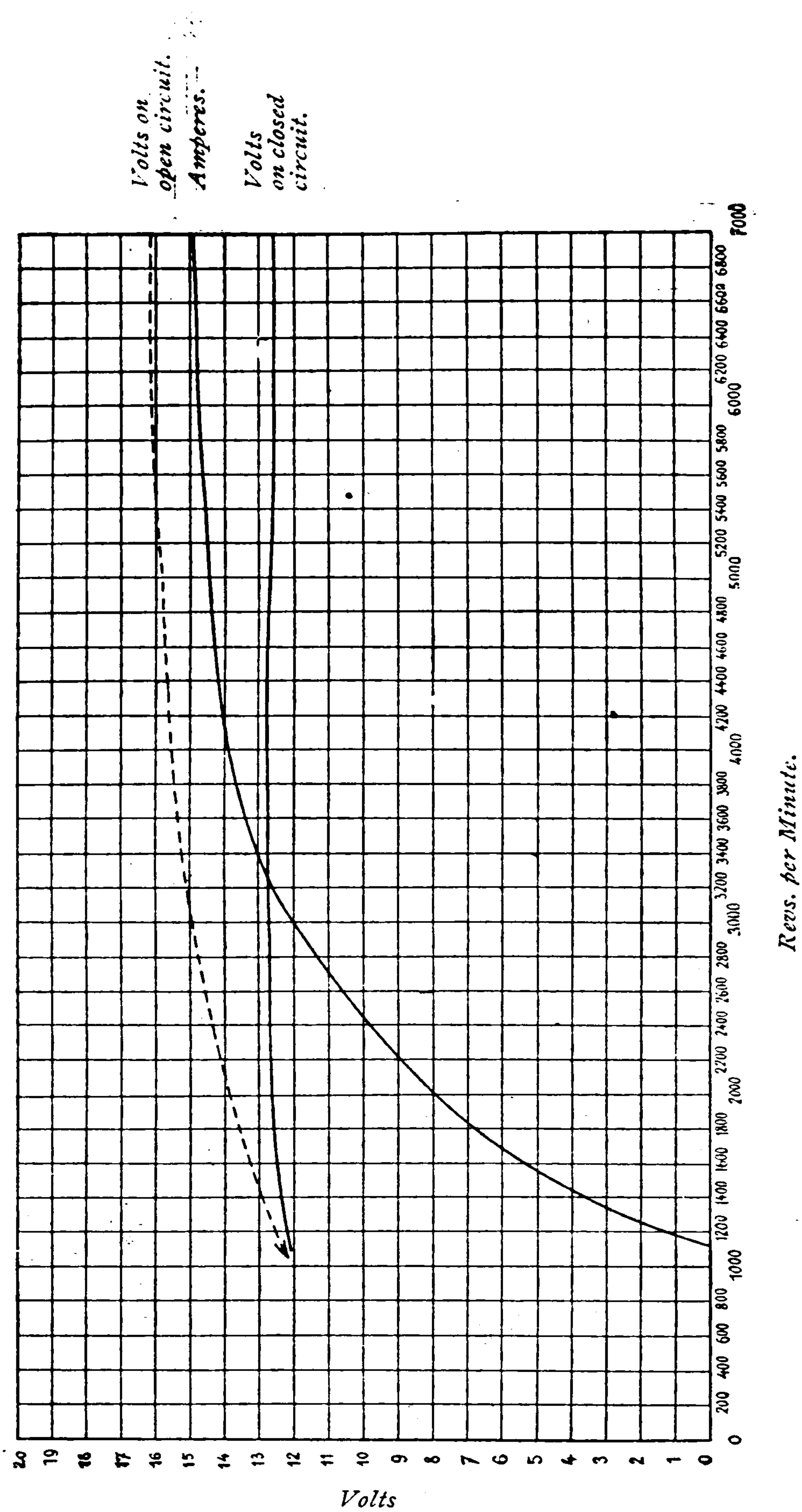
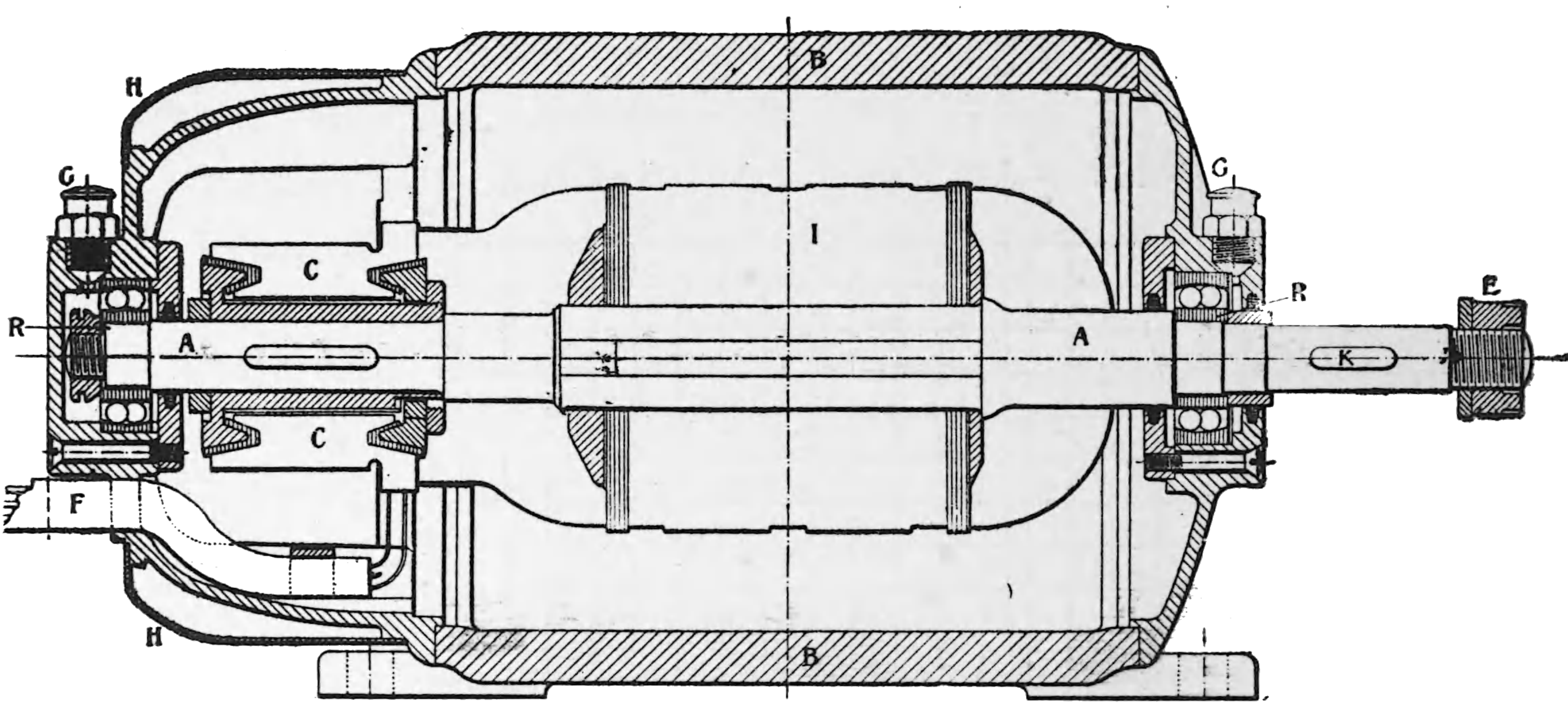

Volts on open circuit.
Amperes.
Volts on closed circuit.
Revs. per Minute.
Volts

Fig. 76.

Fig. 78 shows one of these machines installed on a chassis and driven from the flywheel.



REFERENCE.—A, A, shaft; B, carcass; C, commutator; E, lock nut; F, cables; G, G, lubricators; H, H, inspection cover; I, armature; K, pulley key; R, R, ball bearings.

Fig. 77.

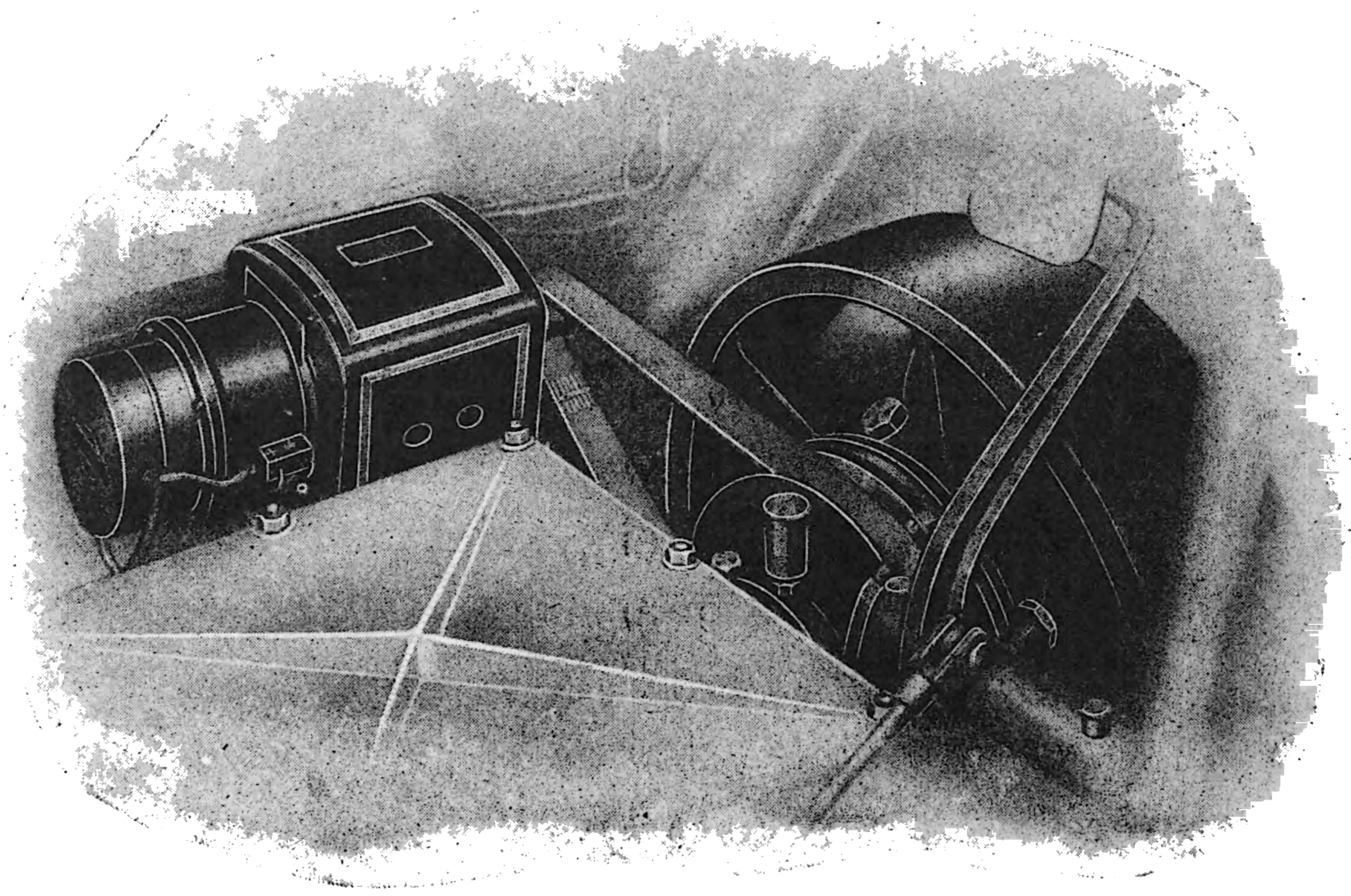


Fig. 78.

The output given by these machines is considerable, that of the large type being 25 amperes at 12 volts or 300 watts.

In order to prevent the current running back from the battery to the dynamo when the engine is stopped,

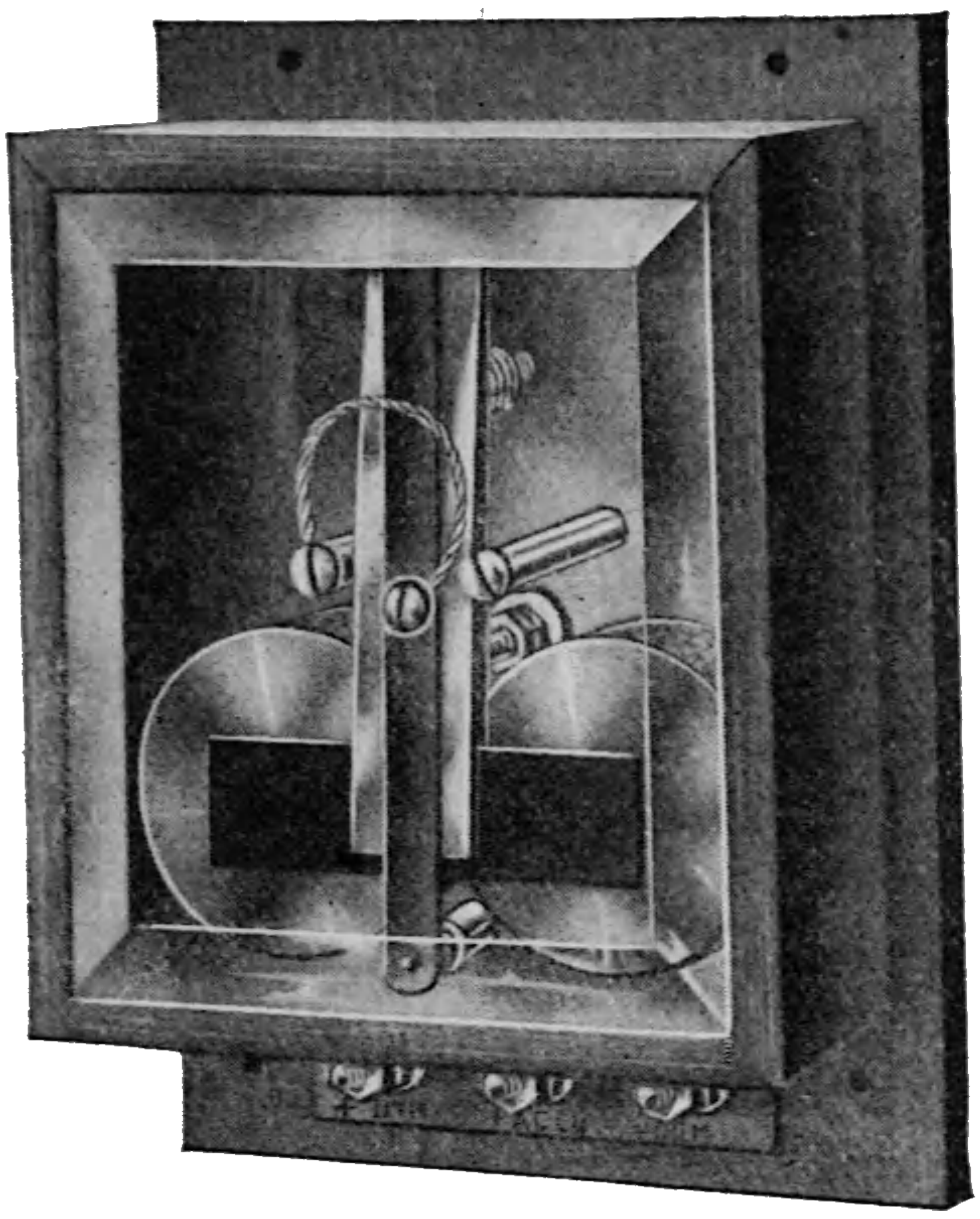


Fig. 79.

a cut-out of the usual electro-magnetic type is interposed (Fig. 79), being usually fixed to the dashboard,

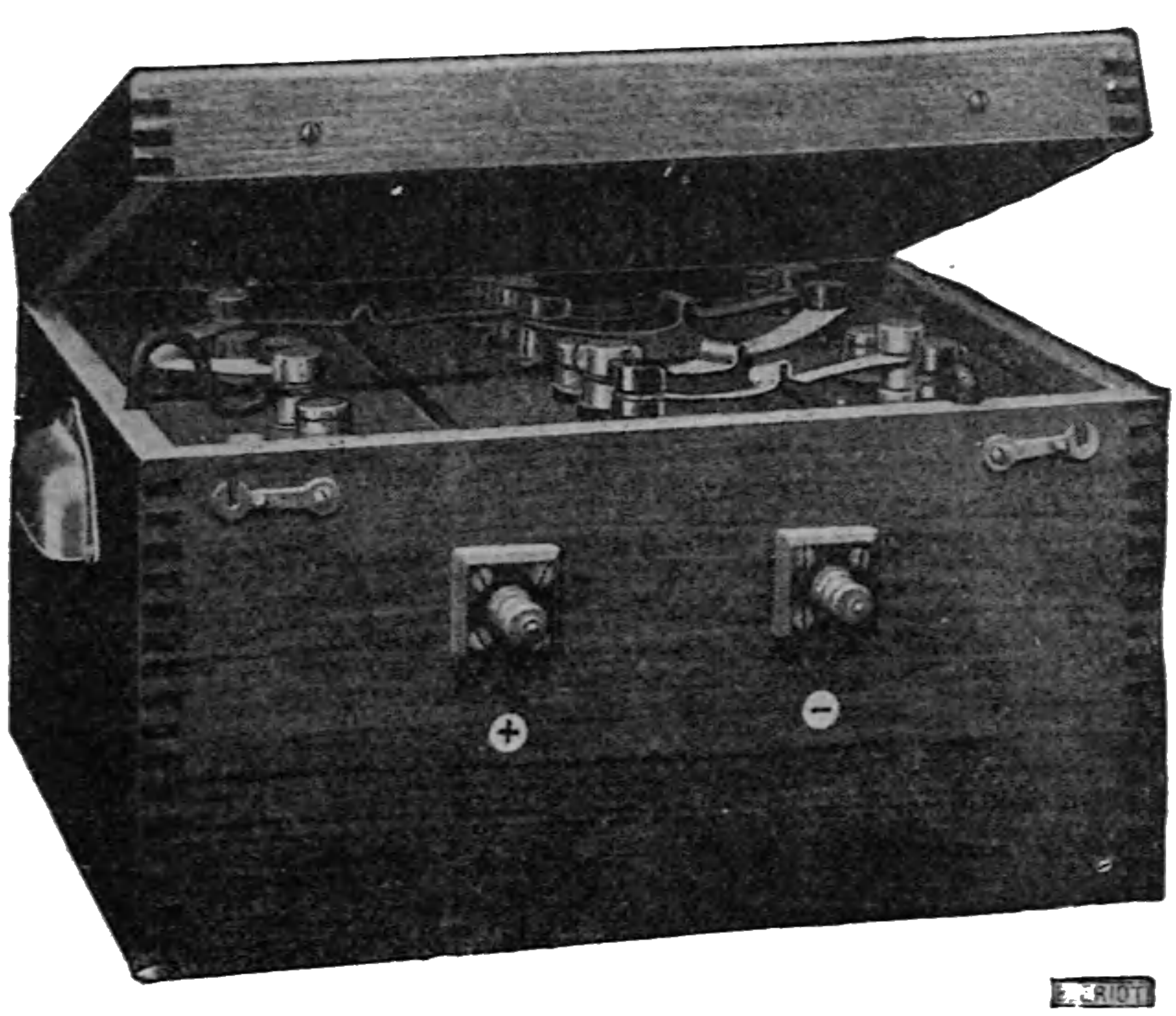


Fig. 80.

or where its satisfactory operation can from time to time be observed.

Owing to the large output of this machine the makers prefer to supply their own special accumulator (Fig. 80). This should be of at least 40 ampere hours capacity at 12 volts. The cells are of celluloid put up in a polished case with outside terminals plainly marked. No standard switchboard is issued with this set, the various ammeters, voltmeters, and switches being mounted in accordance with the requirements of each car.

The switch controlling the lamps is progressive in action, the sequence of lighting being as follows :—

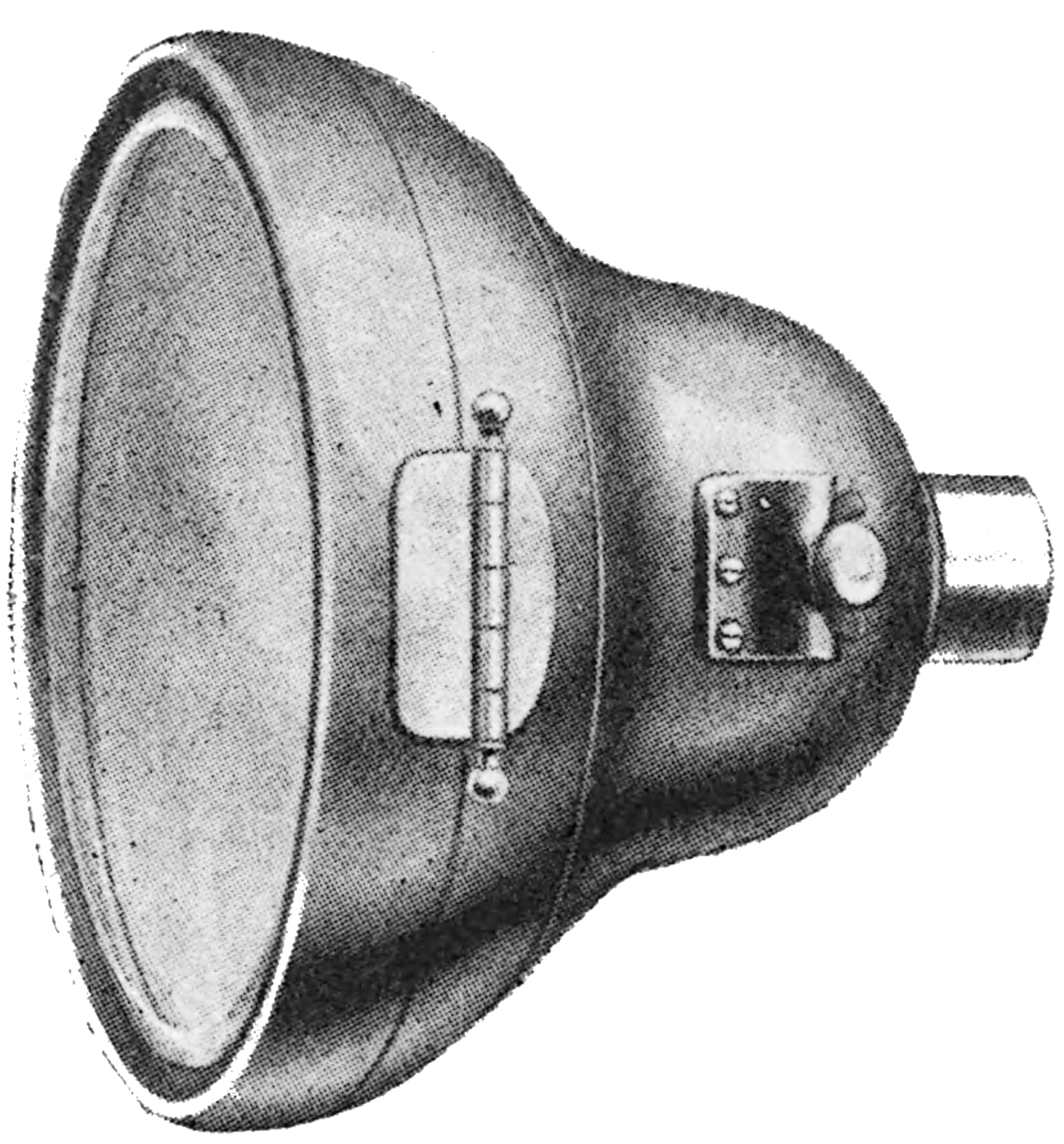


Fig. 81.

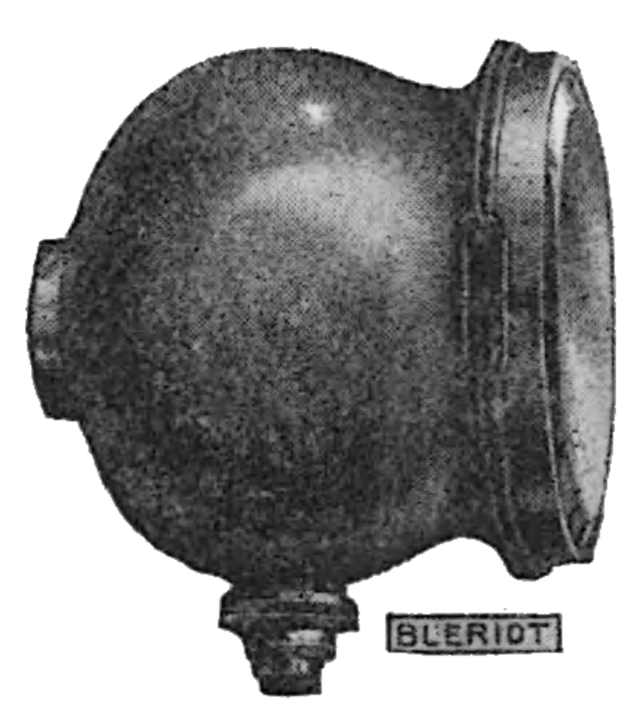


Fig. 82.

First stop—Side and tail on.
Second stop—Head, side, and tail on.
Third stop—Head only.
Fourth stop—All off.

A separate switch controls the dynamo circuit. Figs. 81, 82 show the head and side lamps supplied with this set, the reflectors being parabolic and constructed of silver rolled on copper.

Polkey-Jarrott.—The method of maximum control of the Polkey-Jarrott dynamo (Fig. 83) is very similar to that of the last described machine, in that it has a differentially wound series coil in opposition to the main field for limiting the maximum output.

The dynamo itself is designed to charge a 12-volt

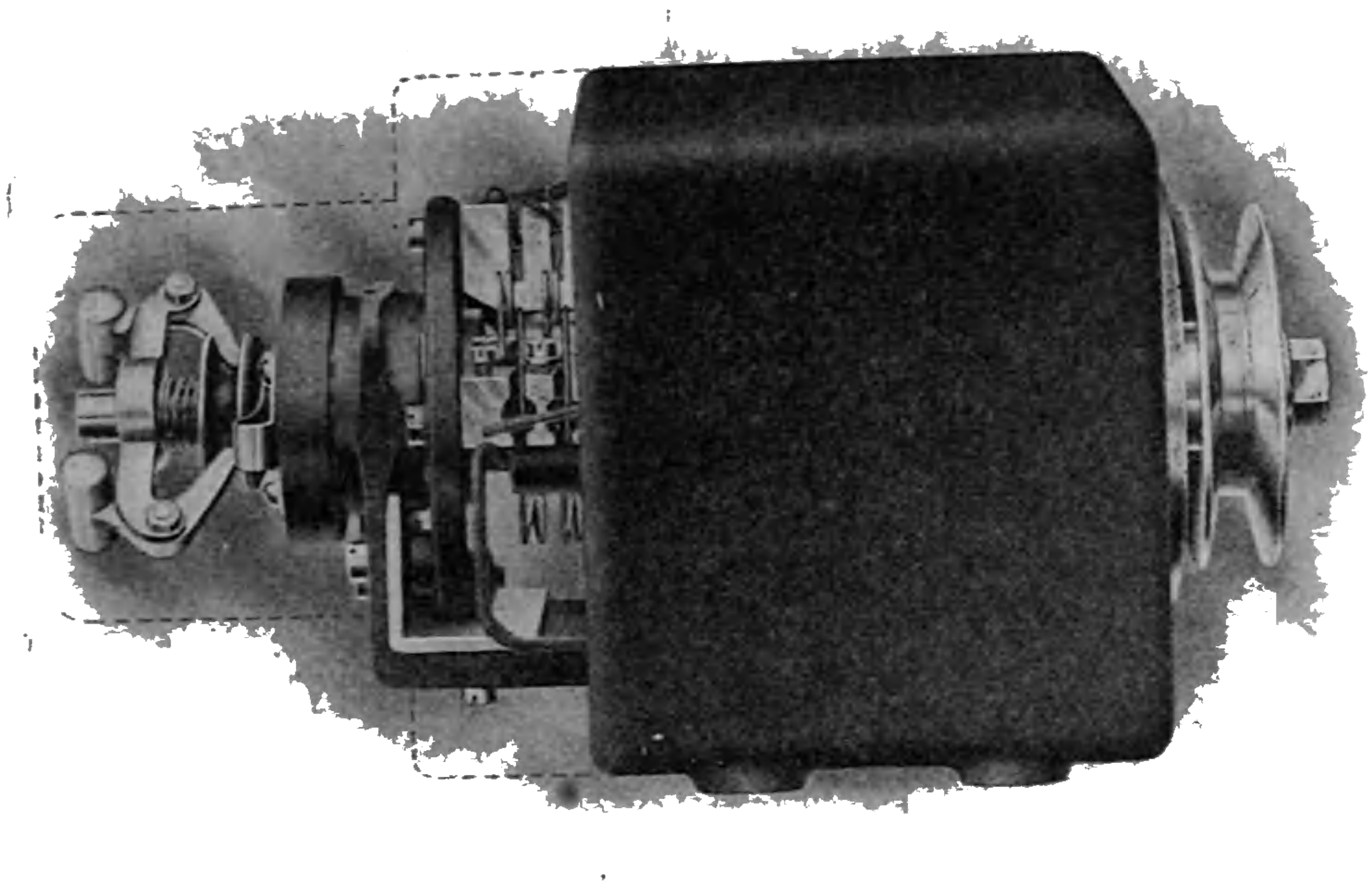


Fig. 83.

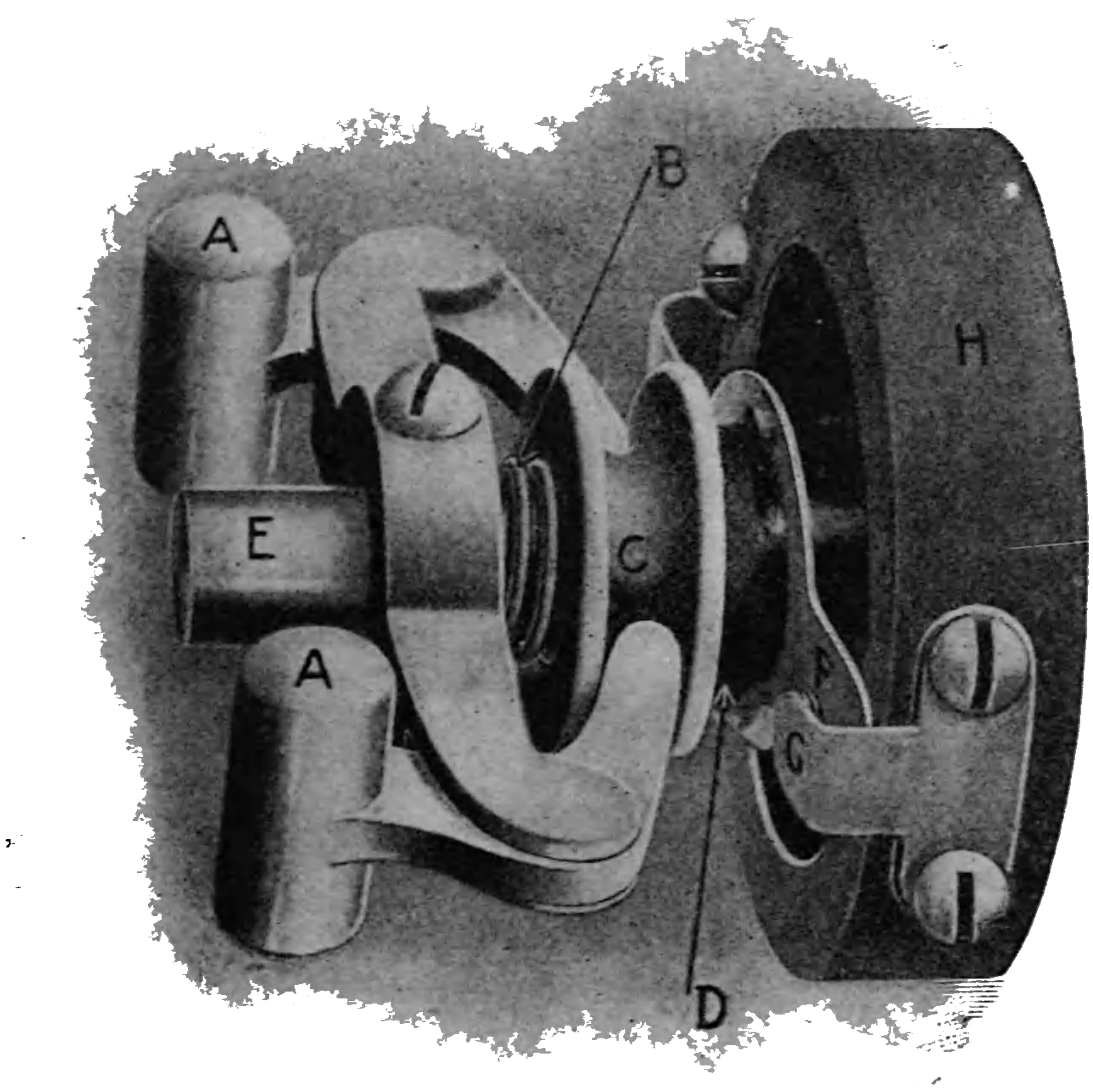


Fig. 84.

battery, at $6\frac{1}{2}$ amperes, giving 74 actual candle-power, that is, two head lamps of 24 candle-power, two side lamps of 6 candle-power in series, also the tail and inspection lamp in series.

The dynamo is very substantially constructed, runs

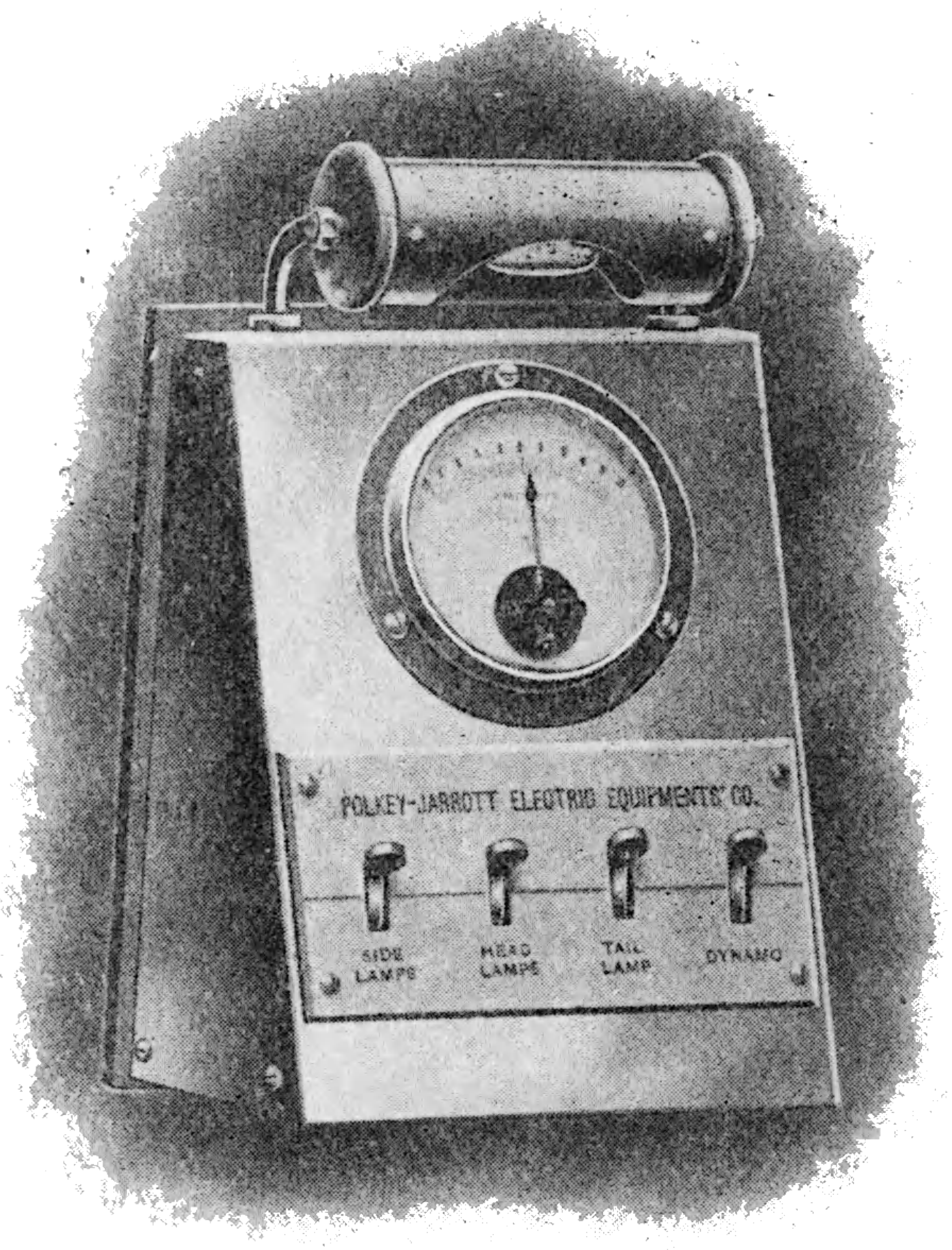


Fig. 85.

on ball bearings, and has a heavily constructed copper commutator, each of the three brushes being divided

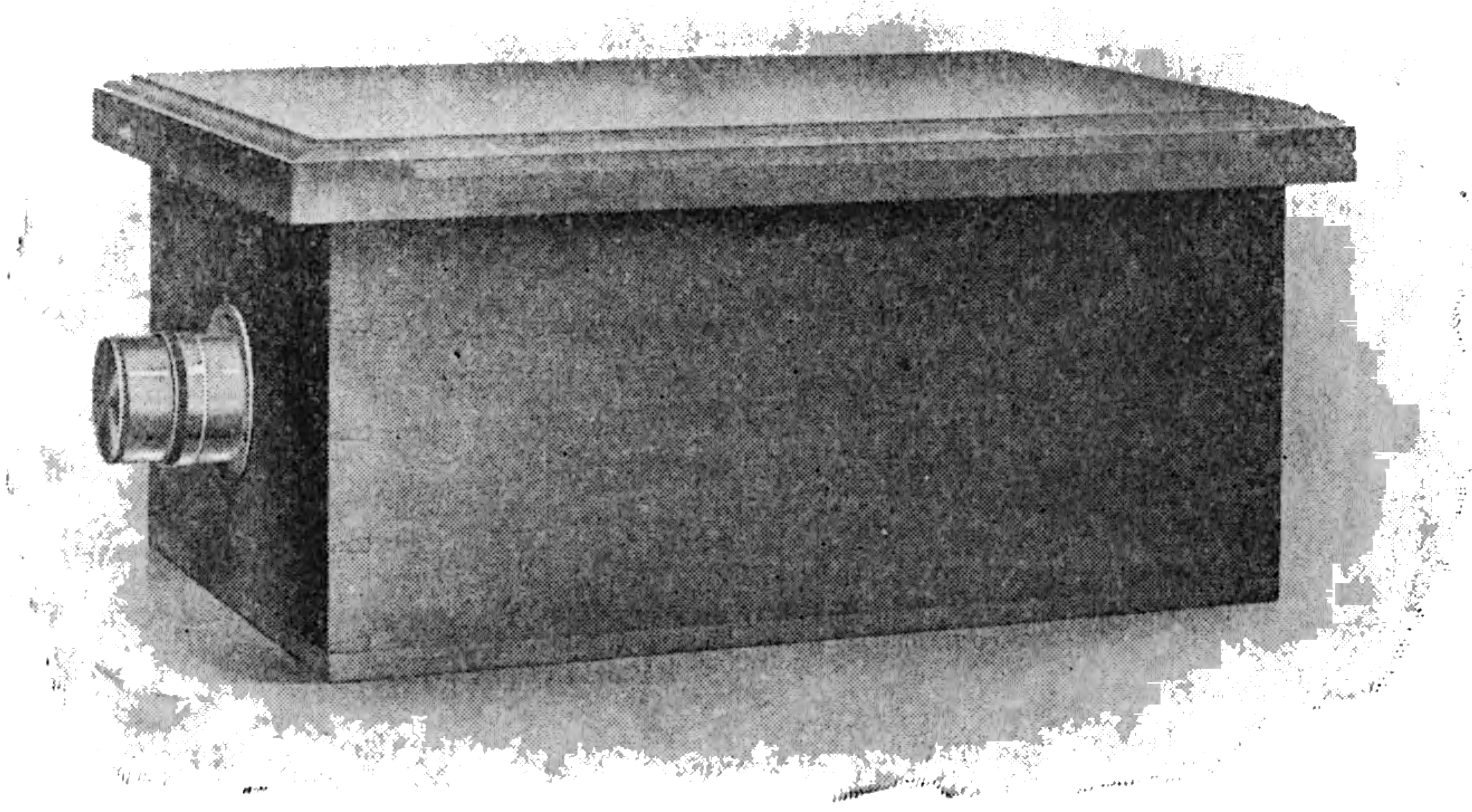


Fig. 86

into two parts having circular brushes. Two of these brushes are the usual main collectors, the third carries current to the field regulating coil.

Fig. 85 shows the switchboard, which is fitted with an ammeter and four switches controlling respectively

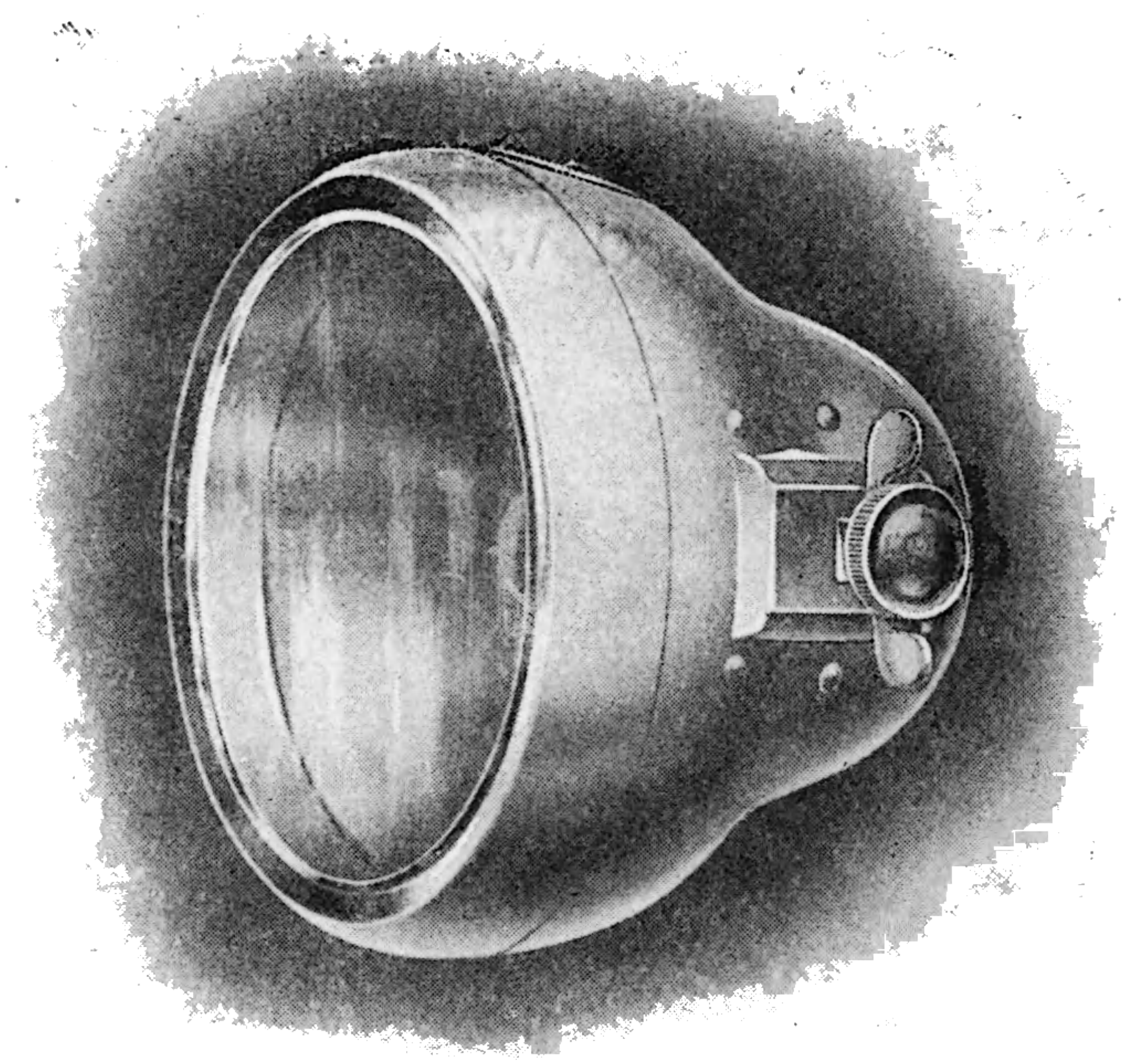


Fig. 88.

the charging head lamps (in parallel), side lamps (in series), and the tail lamp.

The battery with connecting plug at the side is

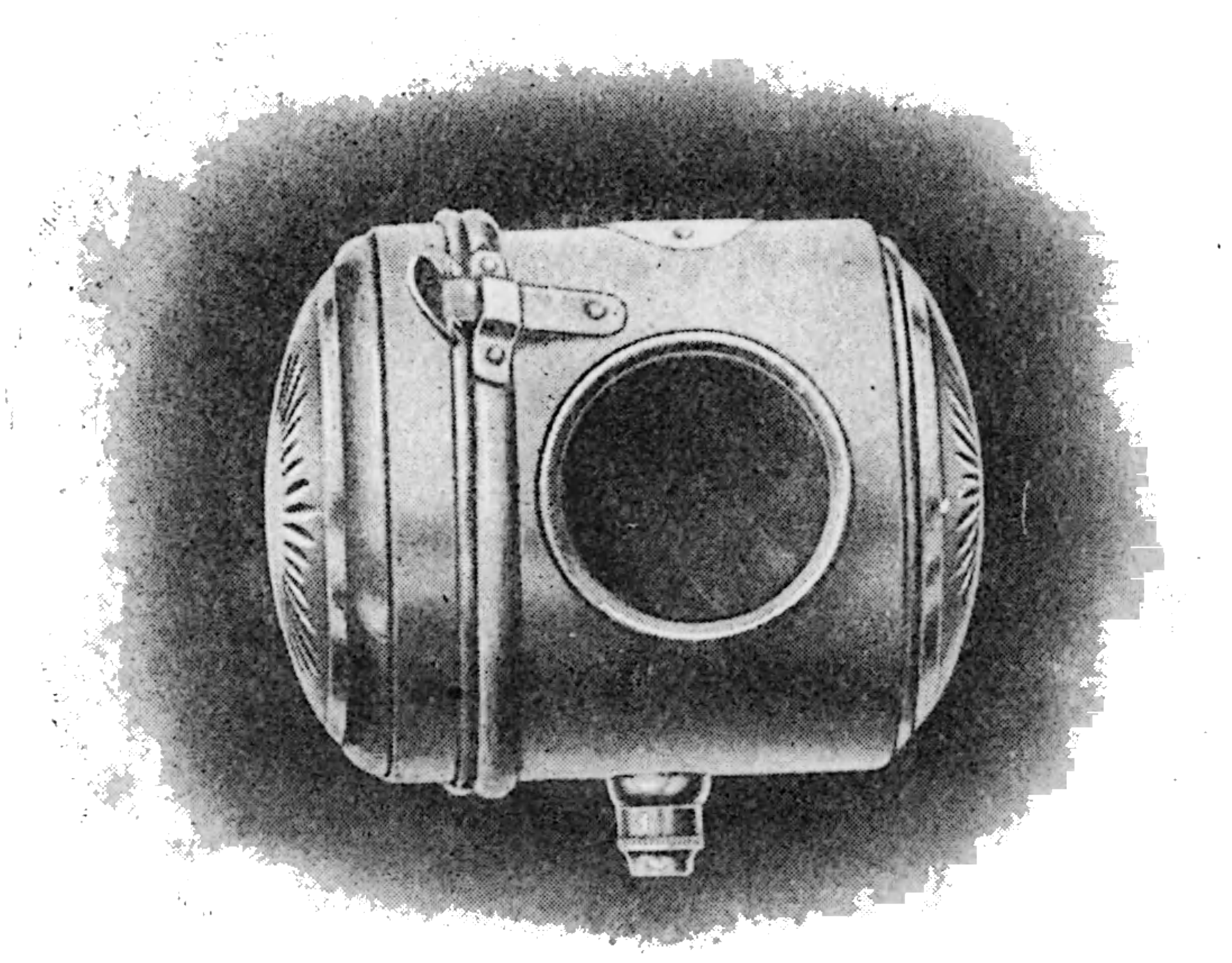


Fig. 89.

shown in Fig. 86. The cells have a capacity of 55 ampere hours at 12 volts.

The head, side, and tail lamps are shown respectively in Figs. 87, 88, 89. A novelty in their manufacture is the abolition of hinges and catches: the fronts of the lamp fittings are like the face of a watch, thereby giving a very clean finish, and rendering the lamps water and dust proof.

This set has gained an excellent R.A.C. Certificate for 2,000 miles running with all lamps on, night running only being allowed.

Facile.—The Facile dynamo (Fig. 90) is a machine of strong and simple construction. The dynamo itself is an ordinary shunt wound machine totally enclosed, the armature runs on ball bearings and is fitted with a massive commutator from which

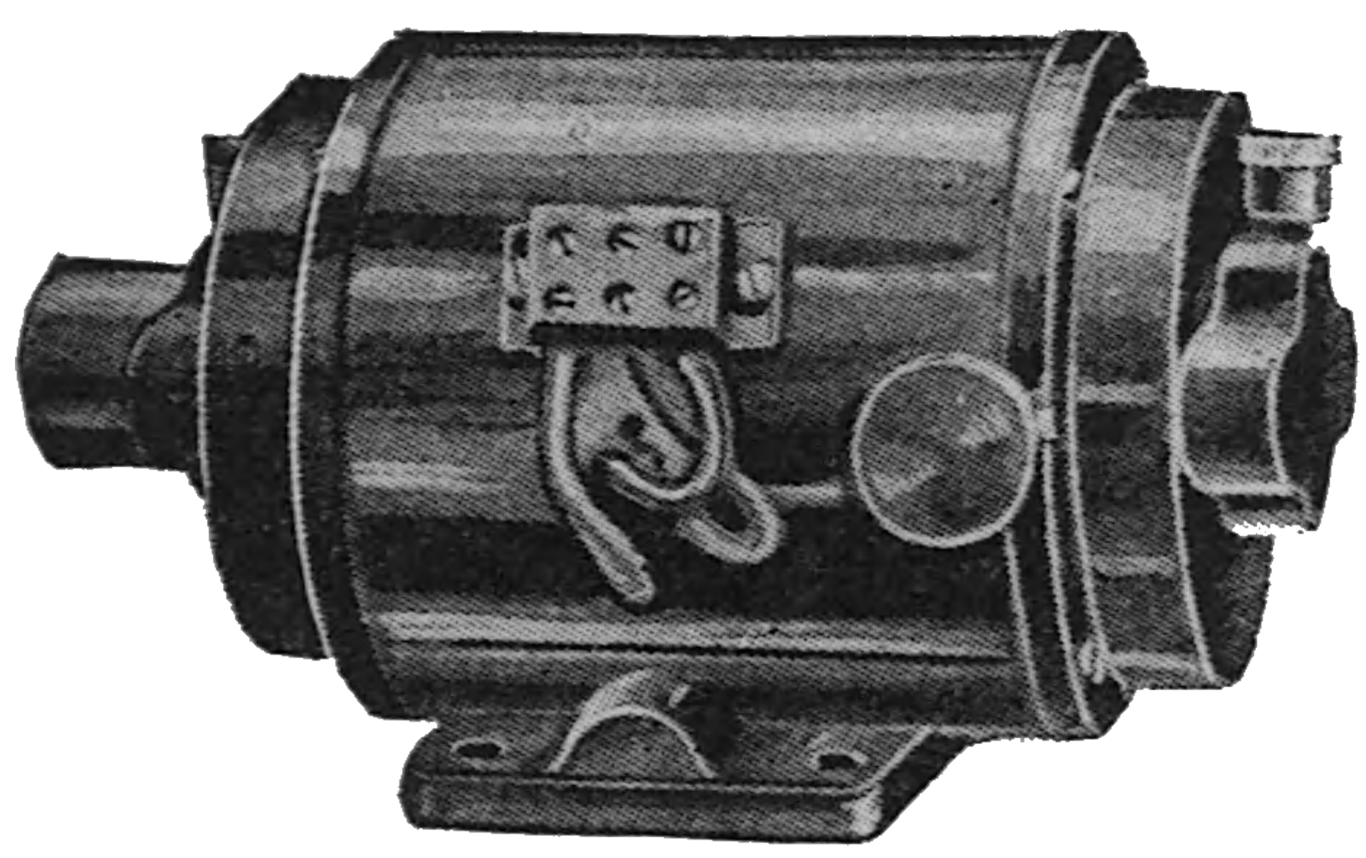


Fig. 90.

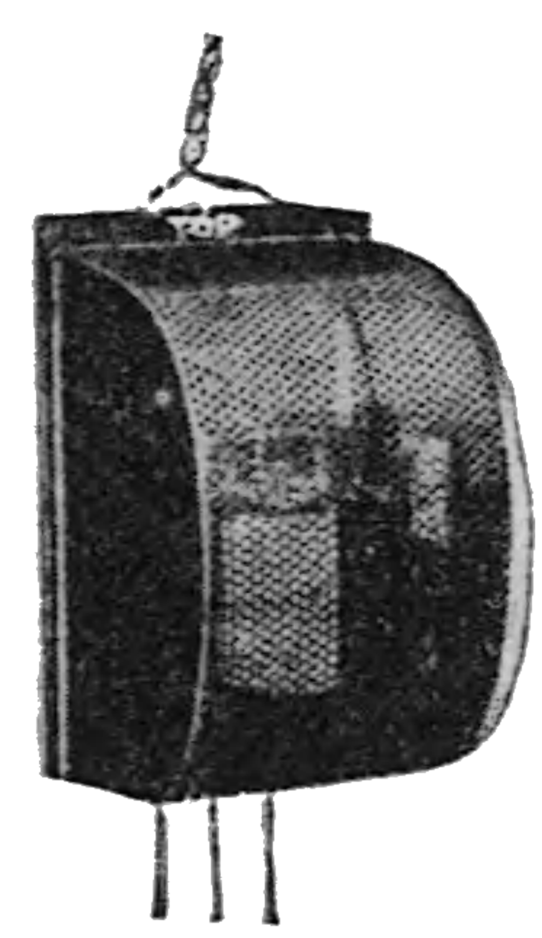


Fig. 91.

the current is collected by spring loaded carbon brushes.

The dynamo is connected to the controller (Fig. 91) by three wires, the two main leads and the shunt lead respectively. The controller consists of the usual electro-magnetic cut-out, with the addition of a further contact, the use of which is to cut a resistance into the shunt circuit, and thereby weaken it on the speed of the dynamo becoming excessive. The series of operations will therefore be as follows: When the dynamo generates sufficient voltage to begin charging the battery, the cut-out armature is attracted and closes the circuit; this should occur at a car speed of about 12 miles an hour. The output will now rise till the armature of the cut-out is further attracted by the magnet and an additional resistance is interposed in the shunt circuit, thereby weakening the field so that any further speeds up to say 55 miles an hour will not damage the accumulators or lamps.

The current from the controller is taken to the battery, thence to the switchboard (Fig. 92), from which it is distributed to the lamps in the usual way.

Fig. 92.

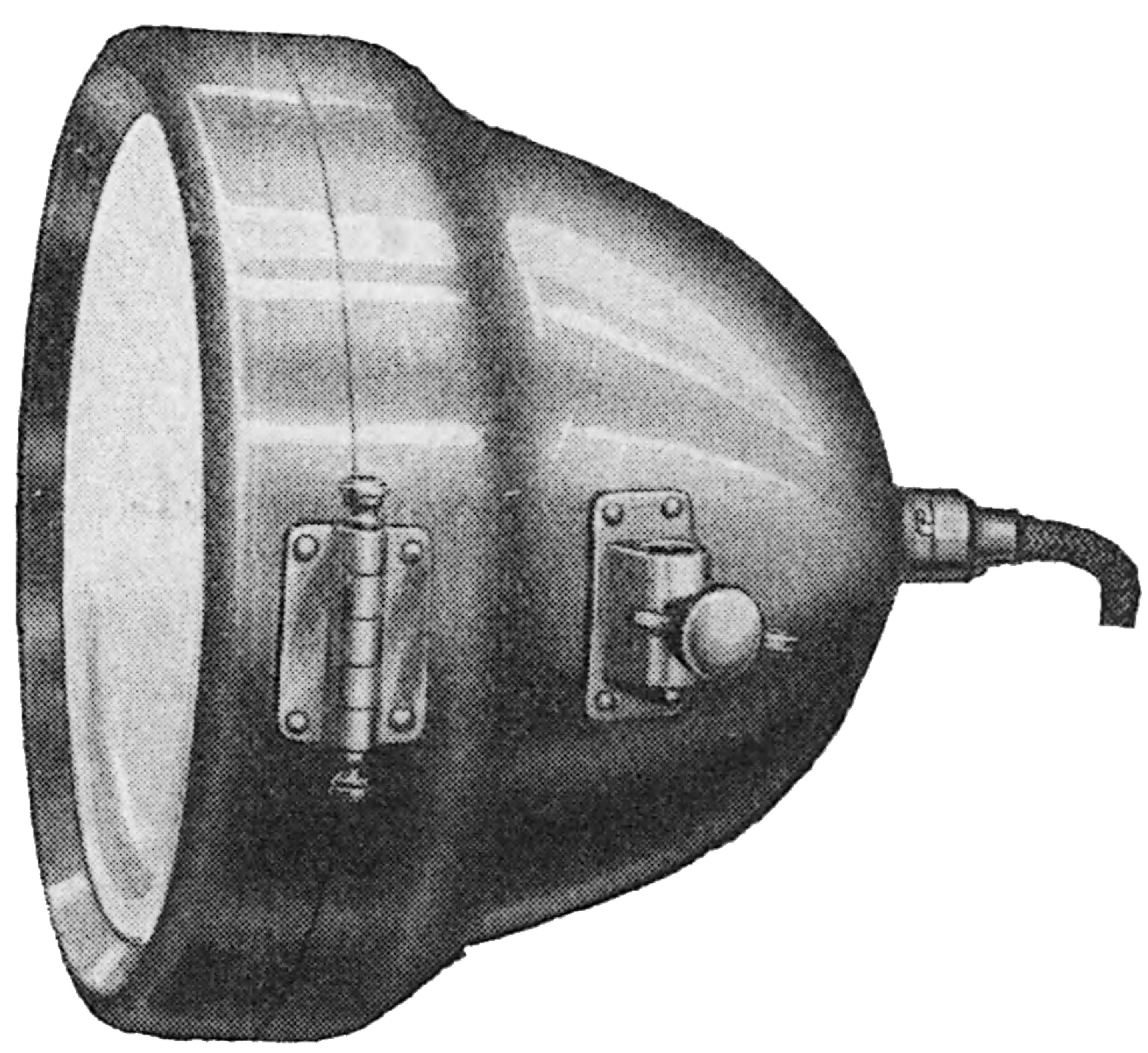


Fig. 93.

The head lamp usually supplied with this set is shown in Fig. 93.

The size of accumulator recommended for use with this set is a 60-ampere hour battery at 8 volts. The weight of an 8-volt dynamo giving 8 amperes is 45 lbs., extreme strength and simplicity being the main object.

The Bosch.—The dynamo introduced by the well-known firm of Robert Bosch follows in principle conventional lines, the great aim being to secure constant output. The machine, Fig. 94, is of the usual shunt-wound type, the output being controlled by variable resistances located within the switchbox. Shutters are provided at the end of the machine to inspect the commutator and to remove the brushes easily. The dynamo begins to generate its correct voltage (12 volts) at the low speed of 350 R.P.M.

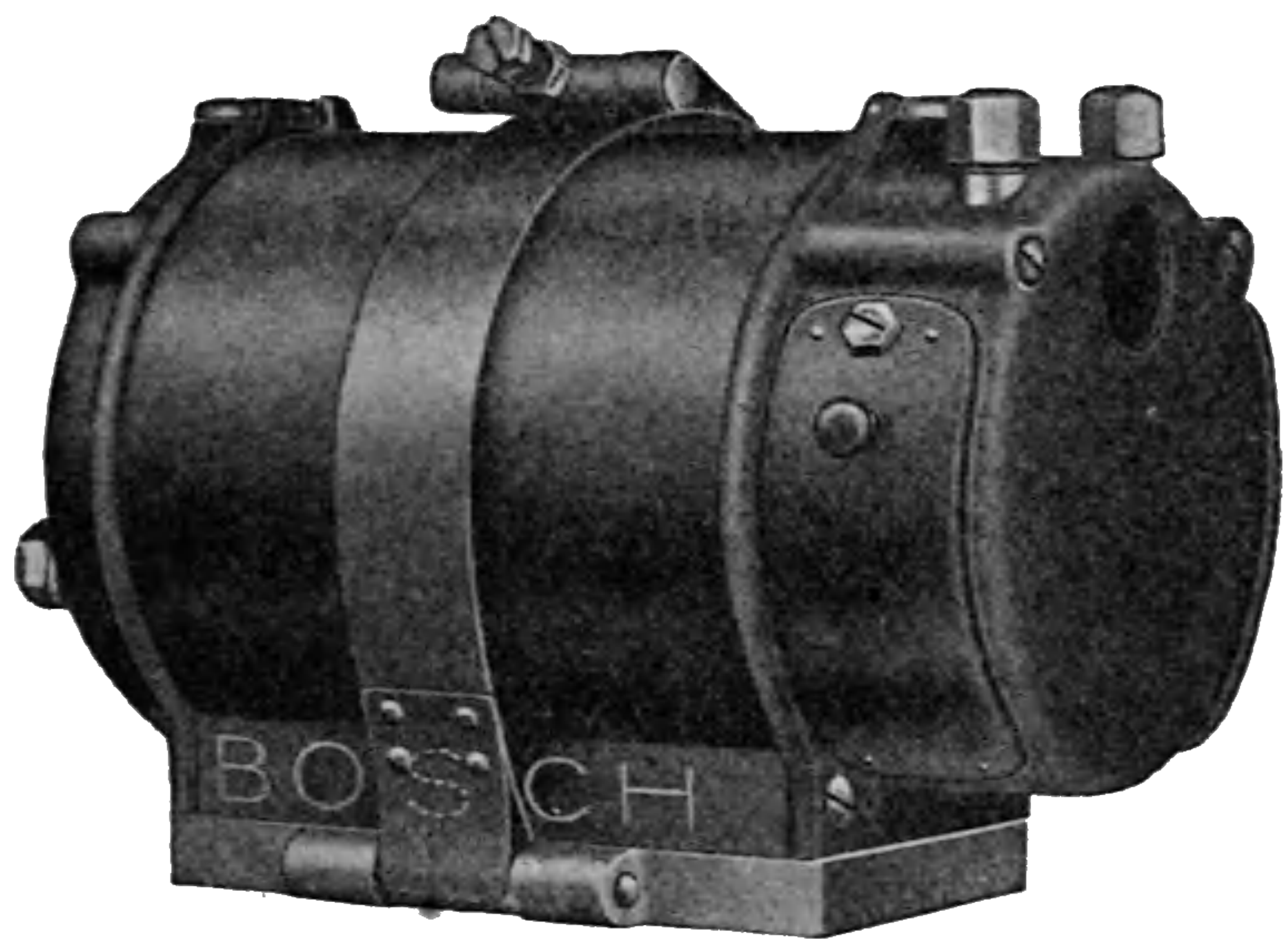


Fig. 94.

Owing to the efficiency of the regulators provided, the output of the generator is independent of any aid from the batteries, and these latter may be

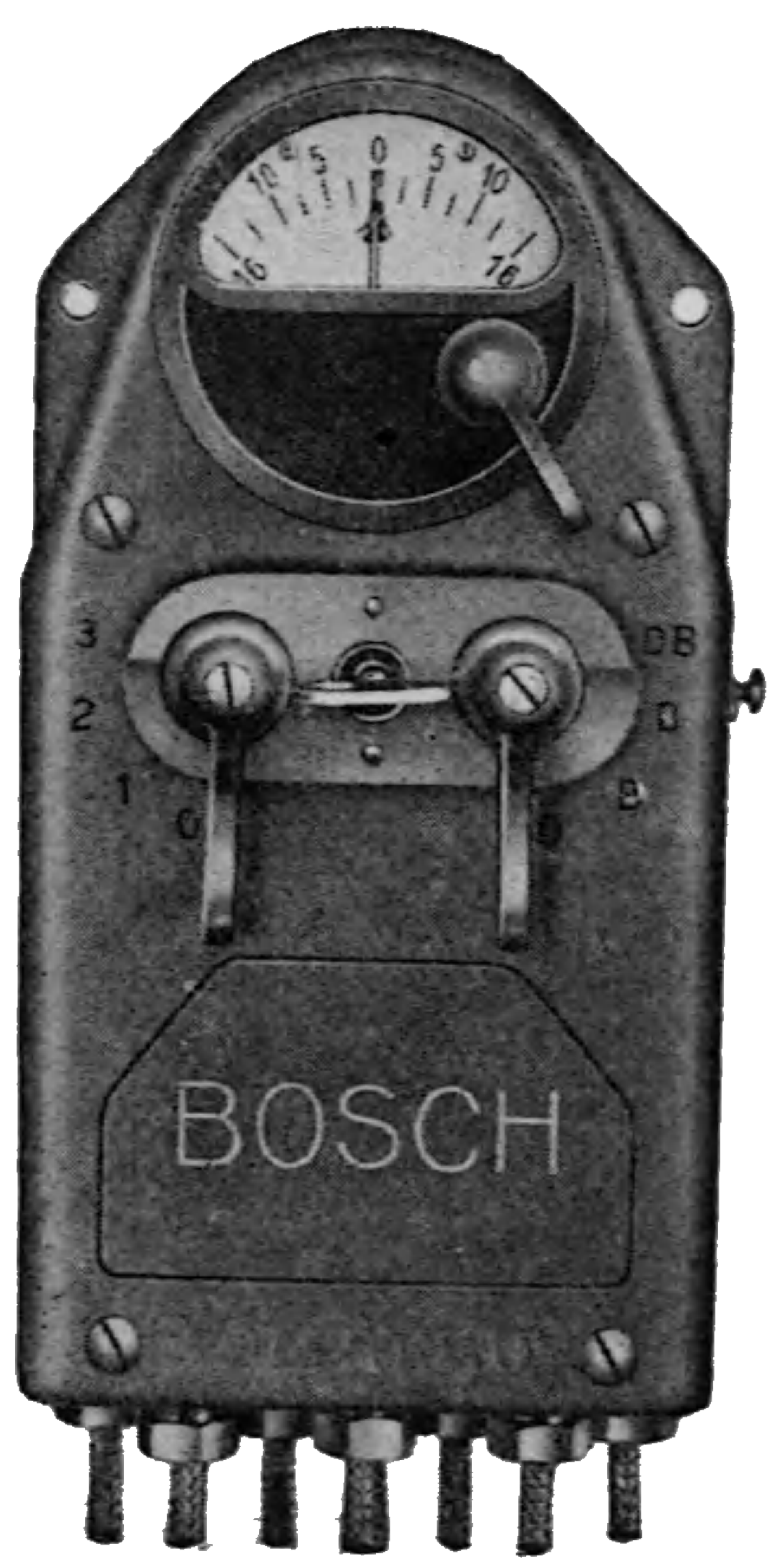


Fig. 95.

disconnected, if so required, without in the least endangering the bulbs.

The switchboard, Fig. 95, is of metal, and contains not only the field regulator but also the cut-out, which brings the battery into circuit when the correct pressure is attained by the dynamo. The instrument at the top is a combined volt and ammeter.

Two switch levers are provided; one connects the battery direct to the lamps, or puts the dynamo and battery together into action; the second lever switches on (1) the side and tail lamps, (2) the head, side, and tail lamps, or (3) the head and tail lamps only. The

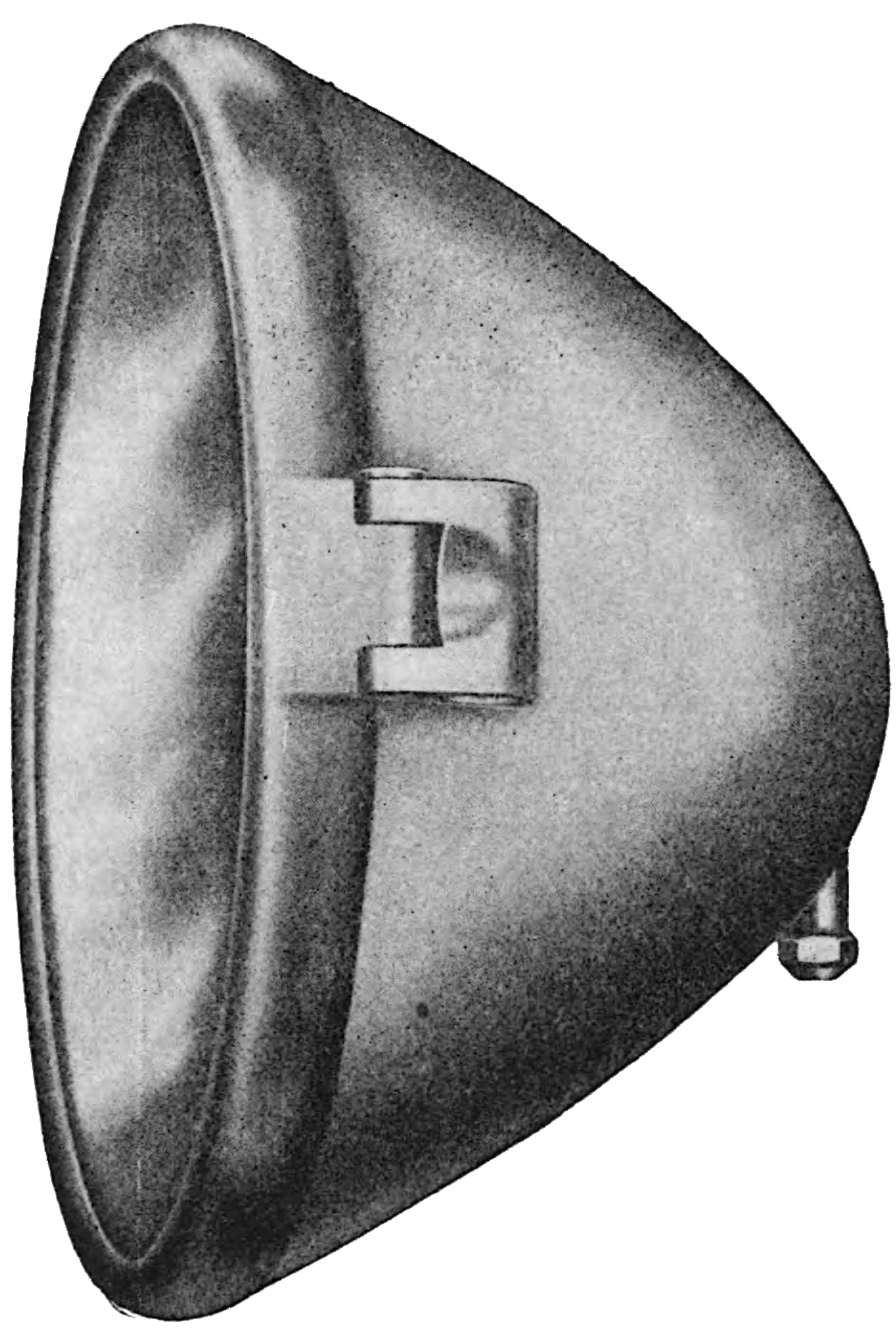


Fig. 96.

system of wiring is very complete and thorough, employing a single insulated conductor with a braided earth return similar to that described on pp. 20 and 31.

The lamps, Fig. 96, are of the usual parabolic design, with carefully curved reflectors which project the light ahead in an effective manner, yet without dazzle. The lamps are quite water and dust tight, and of handsome appearance.

The output of the dynamo itself is 100 watts at 12 volts, at a normal rate of revolution.

The **Eisemann** dynamo, Fig. 97, has several

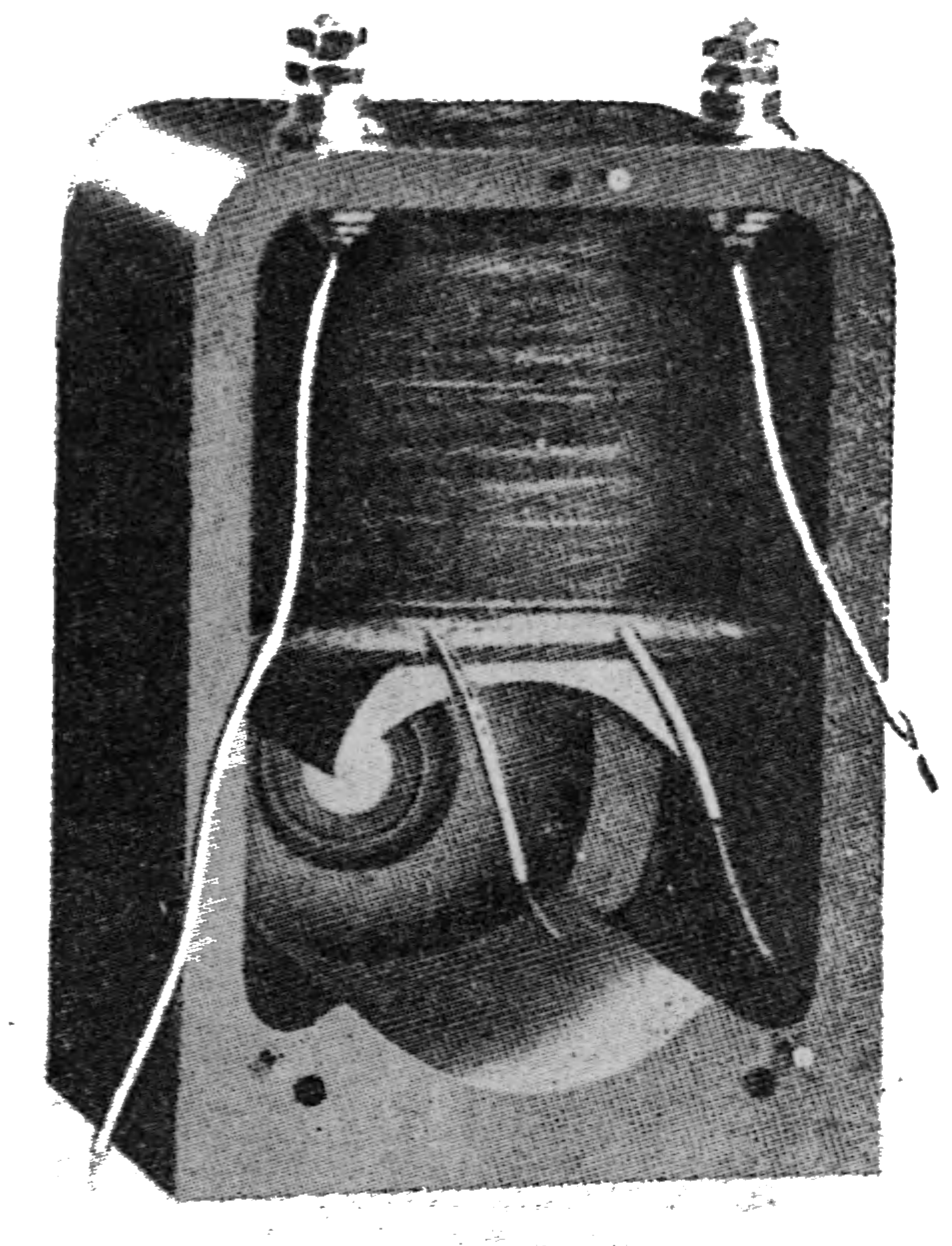


Fig. 97.

points of novelty in its construction, although the machine itself is of standard design.

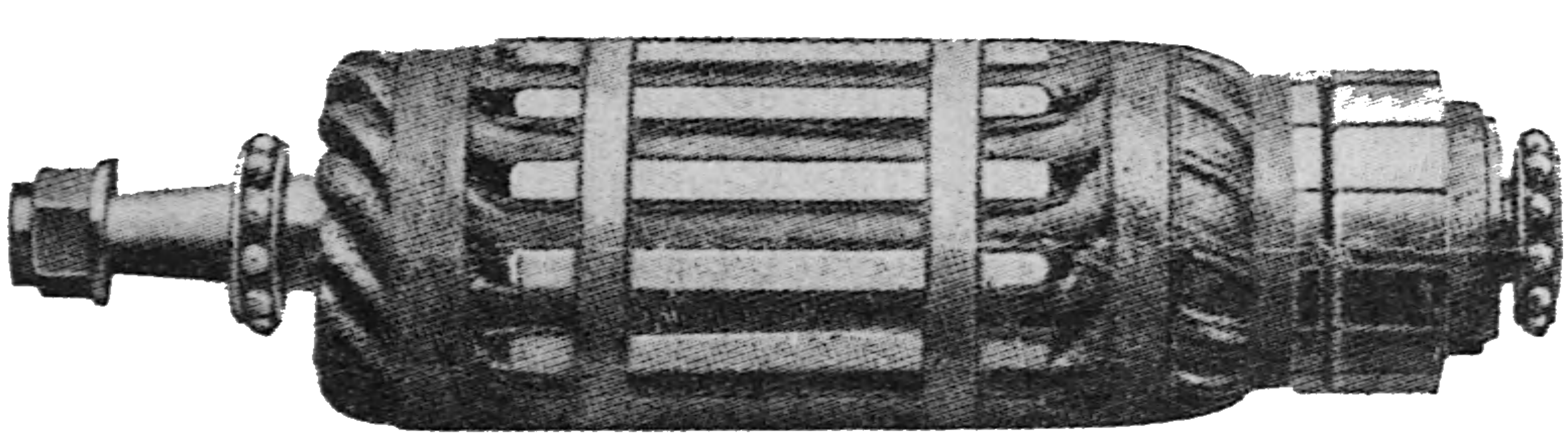


Fig. 98.

The body consists of an enclosed carcass with the upper pole only excited with a single winding. The armature, Fig. 98, is drum wound, easily demountable brushes and holders collecting the current from the commutator.

Situated at the top of the machine (Fig. 99) are the organs of regulation. These consist of three electro-magnets interconnected. The first magnet acts as the ordinary magnetic cut-out; the second breaks the circuit should the current rate become excessive; while the third breaks the circuit should the voltage

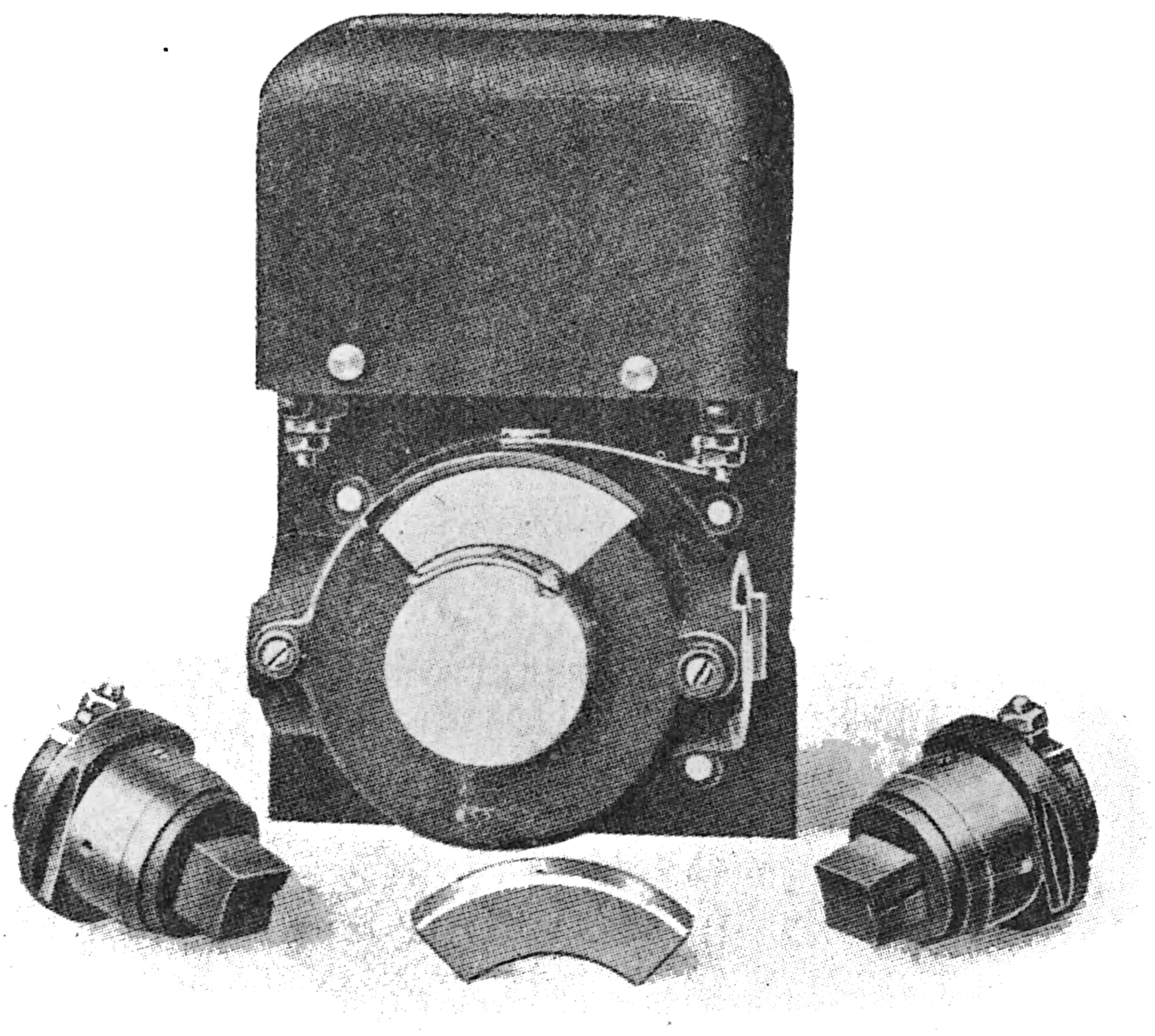


Fig. 99.

of the cells rise above certain limits. The output of this model is 180 watts, or 12 volts 15 amperes, cutting in at 400 R.P.M., and attaining its maximum output at 1,000 R.P.M.

The system of wiring is with armoured cable having a central line conductor, the return being by the armouring or earth as described on p. 31.

The switchboard, Fig. 102, of polished mahogany, is arranged for concentric wiring, with the tail and dashboard lights in series.

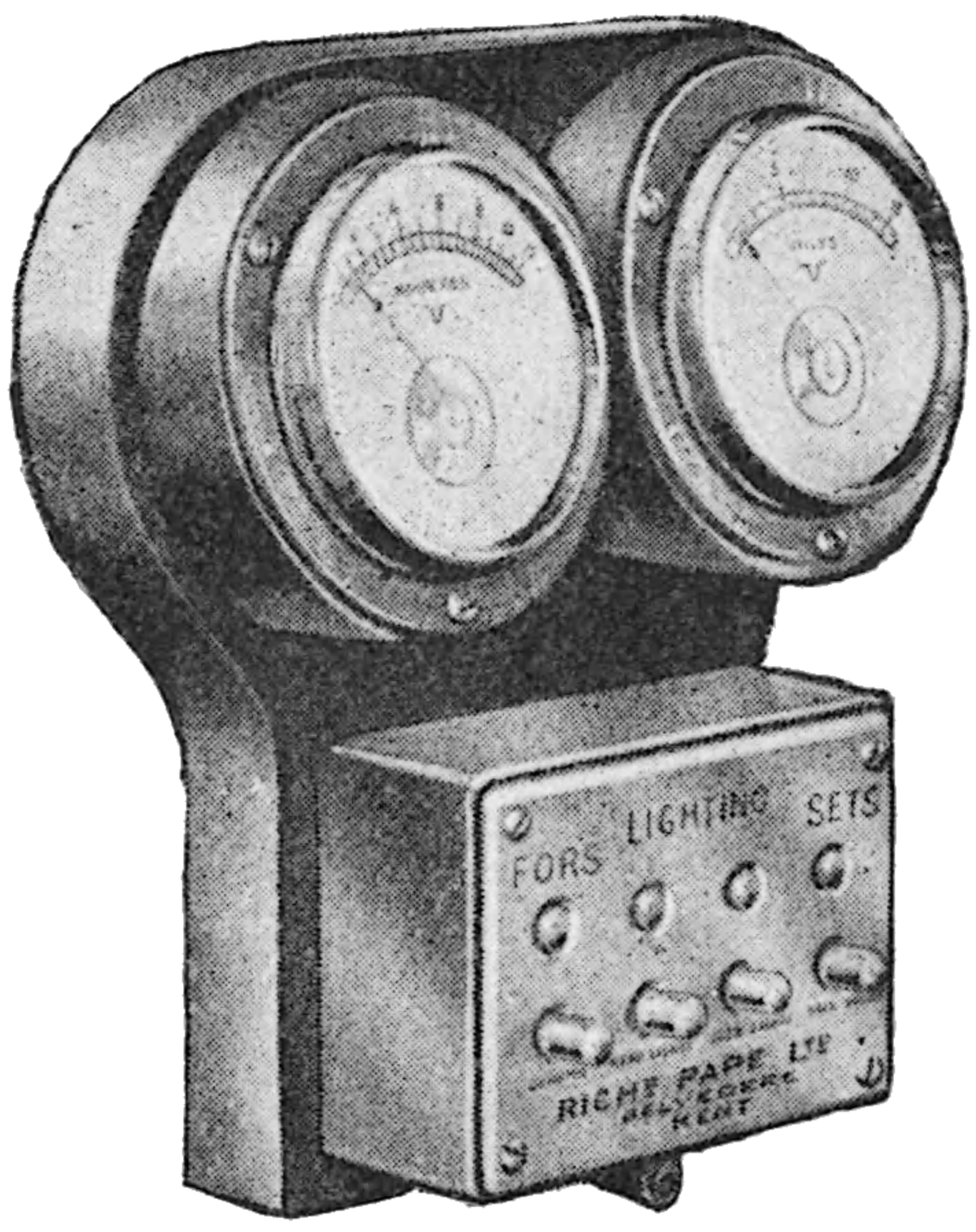


Fig. 102.

An armoured braided concentric cable is used, the outer braiding taking the place of a negative wire (see p. 20).

CHAPTER VIII

MECHANICALLY-CONTROLLED SYSTEM

Lucas.—The Lucas dynamo is of notably simple construction. The machine itself (Figs. 103, 104) is excited by a single shunt coil, this coil being cut out of action when the dynamo is switched off, thereby reducing friction to the minimum.

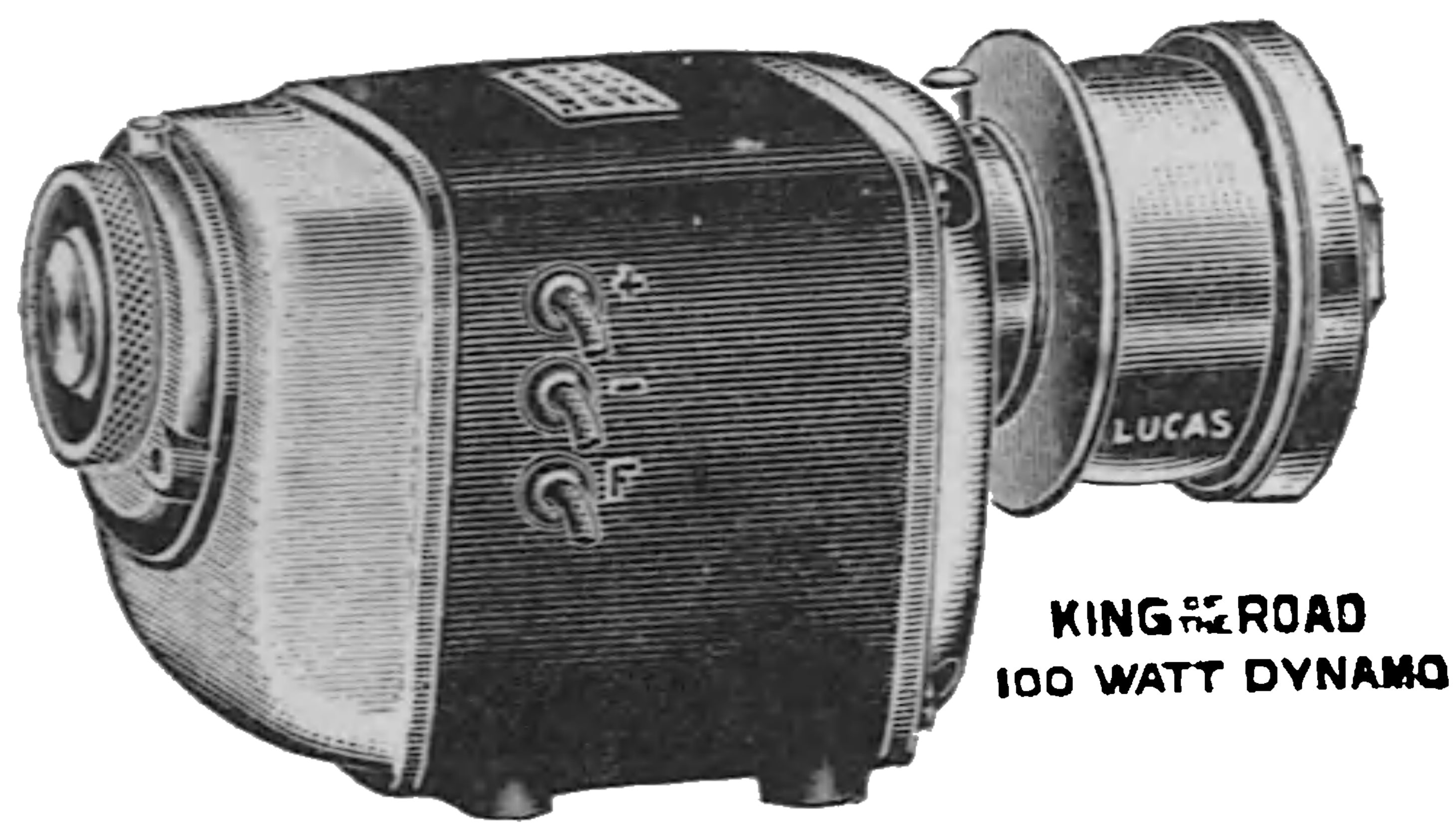


Fig. 103.

A 16-section drum wound armature rotates on ball bearings and is furnished with a very massive copper commutator of conventional design from which two stout Morganite brushes collect the current. The main point of novelty in this machine is the means adopted of ensuring the limitation of excess current, which is obtained by the use of a slipping clutch placed inside the driving pulley. This clutch con-

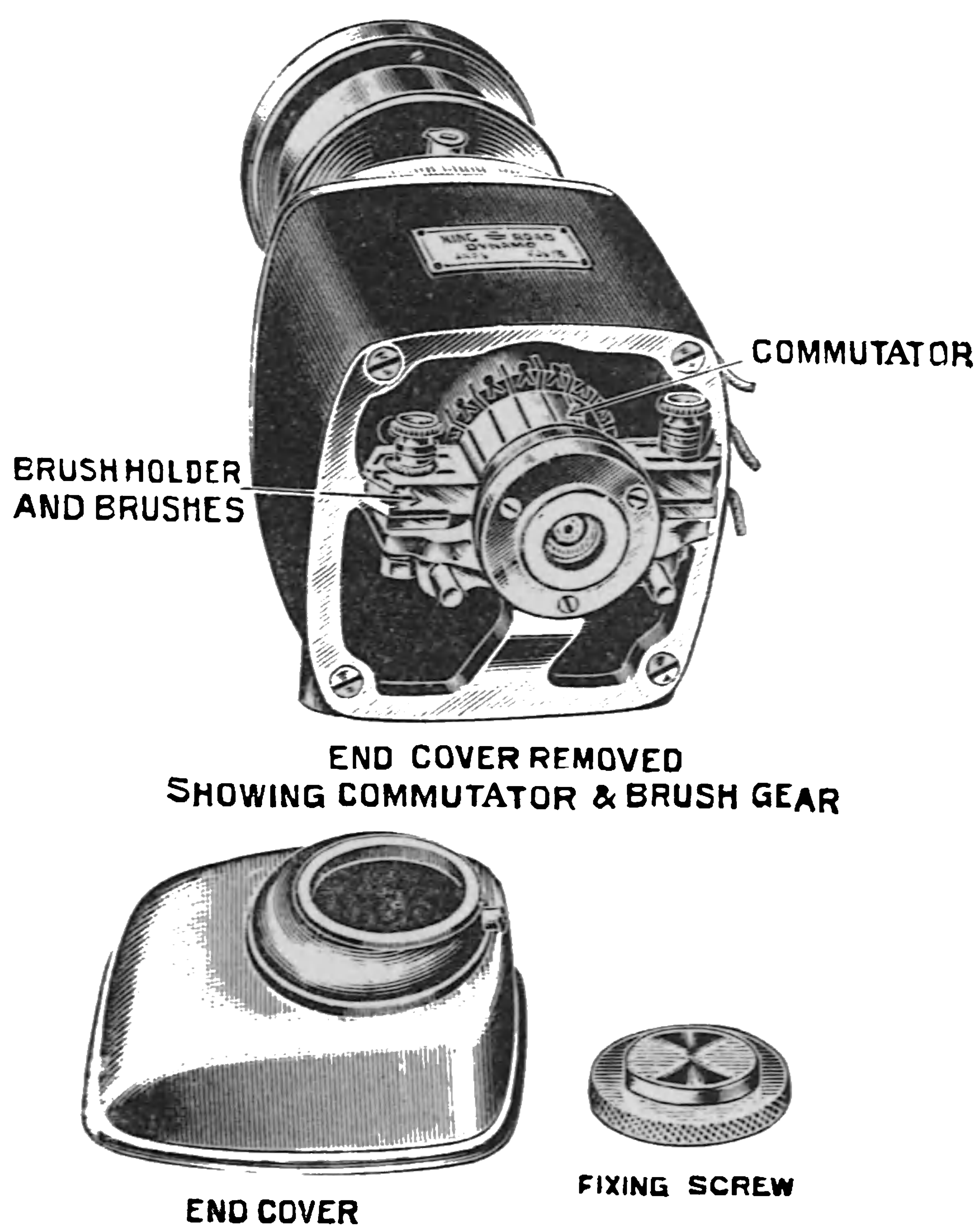


Fig. 104.

sists of a fibre-covered cone attached to the dynamo shaft but free to slide and pressed into contact with the cone of the pulley by a strong spring. Within the clutch are four small balance weights which act by centrifugal force, and tend to force the clutch out of engagement against the spring.

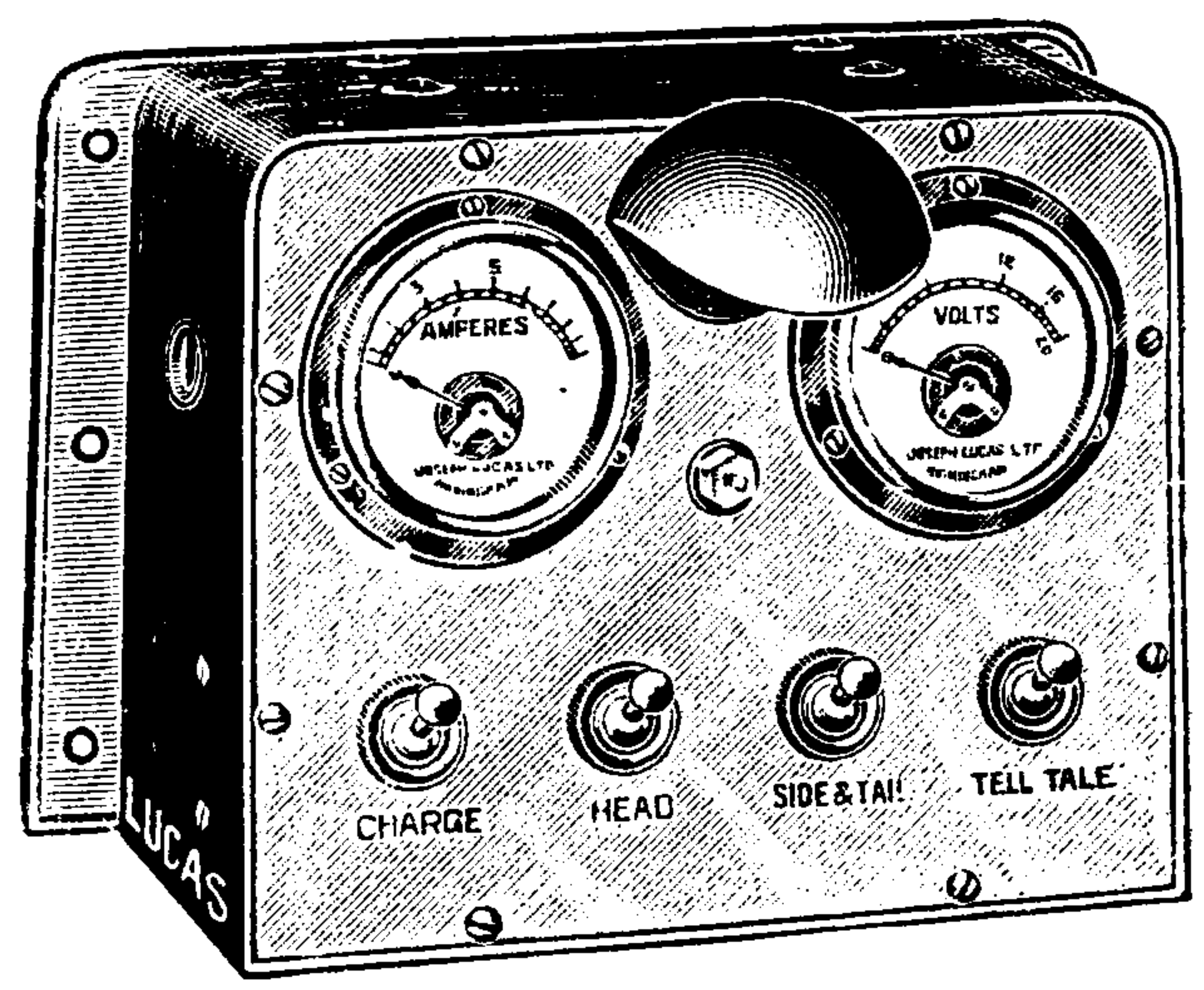


Fig. 105.

When the speed of the dynamo is high enough, these weights acting against the spring partially withdraw the clutch, allowing slipping to take place, thereby limiting the output of the machine. The slipping point of the clutch (and therefore a pre-determined output) can be arranged by an adjusting nut at the end of the shaft which compresses or loosens the spring govern-

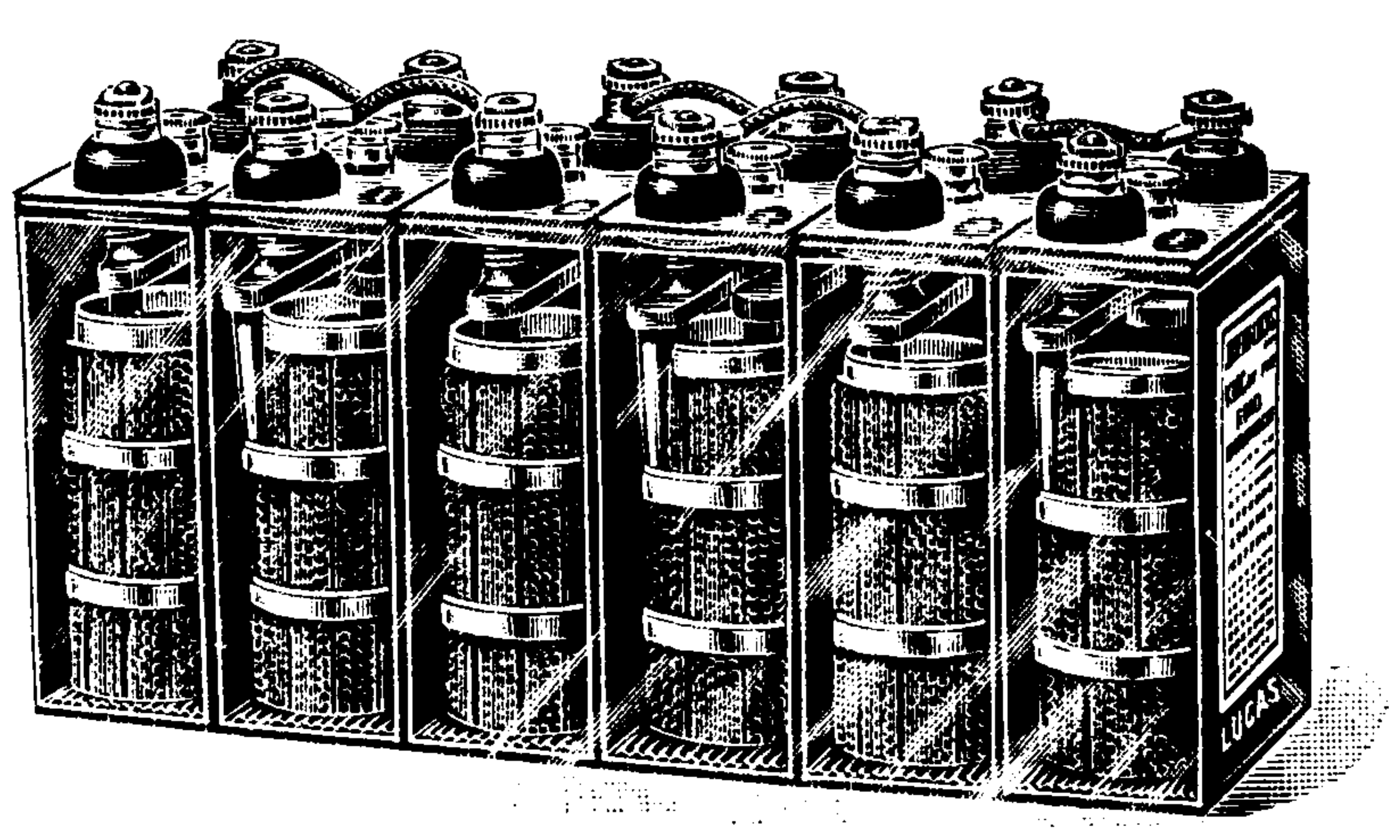


Fig. 106.

ing the slipping point at will. The clutch itself is enclosed and kept lubricated with thin oil.

The output of the dynamo is 100 watts (weight 25 lbs.) in the small size and 200 watts (weight 35 lbs.) in the large, pressure 12 volts.

To break the circuit an ordinary electro-magnetic cut-out is employed located within the switchbox (Fig.

105) which also carries an ammeter and voltmeter and switches controlling the charging, head, side, and tail lamps, also a switch for working the tell-tale or pilot bulb on the board itself. Should the tail lamp go out the tell-tale bulb will light up, thereby indicating that something is wrong. The tell-tale can also be worked independently.

Special Lucas accumulators (Fig. 106) are supplied

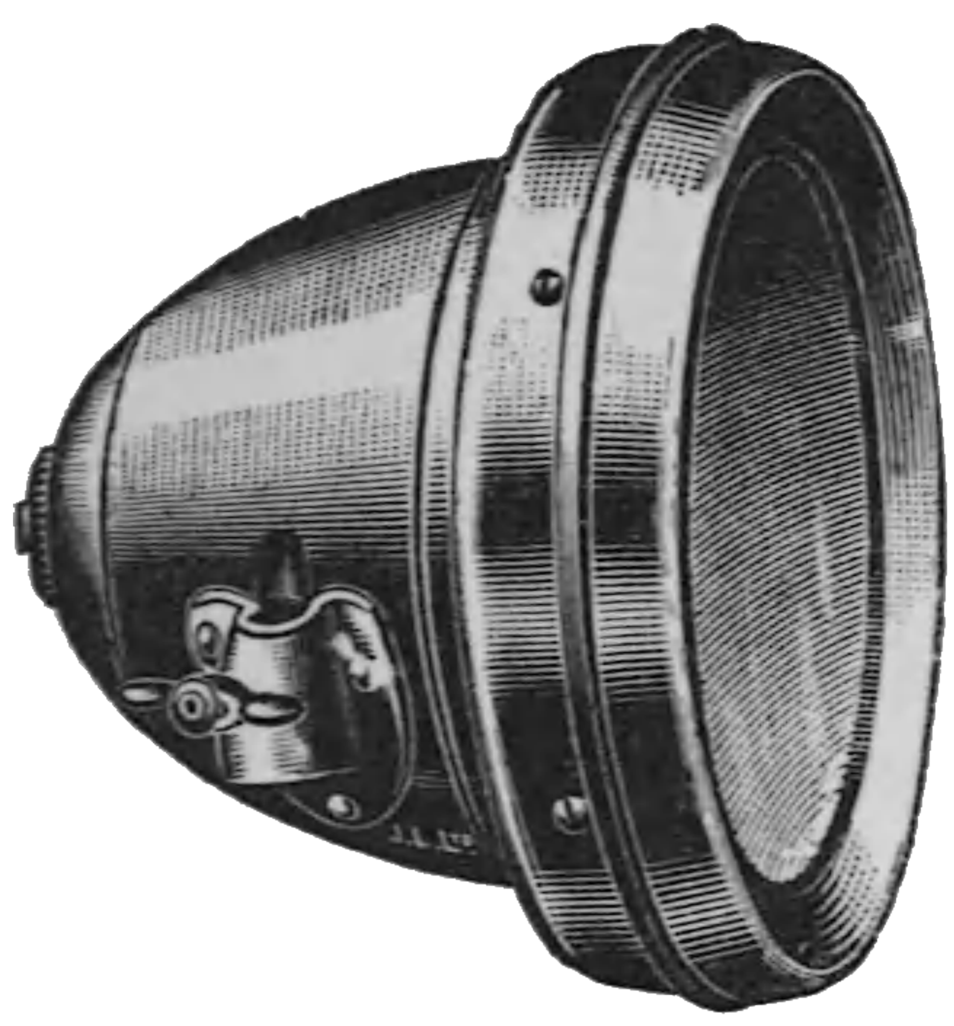


Fig. 107.

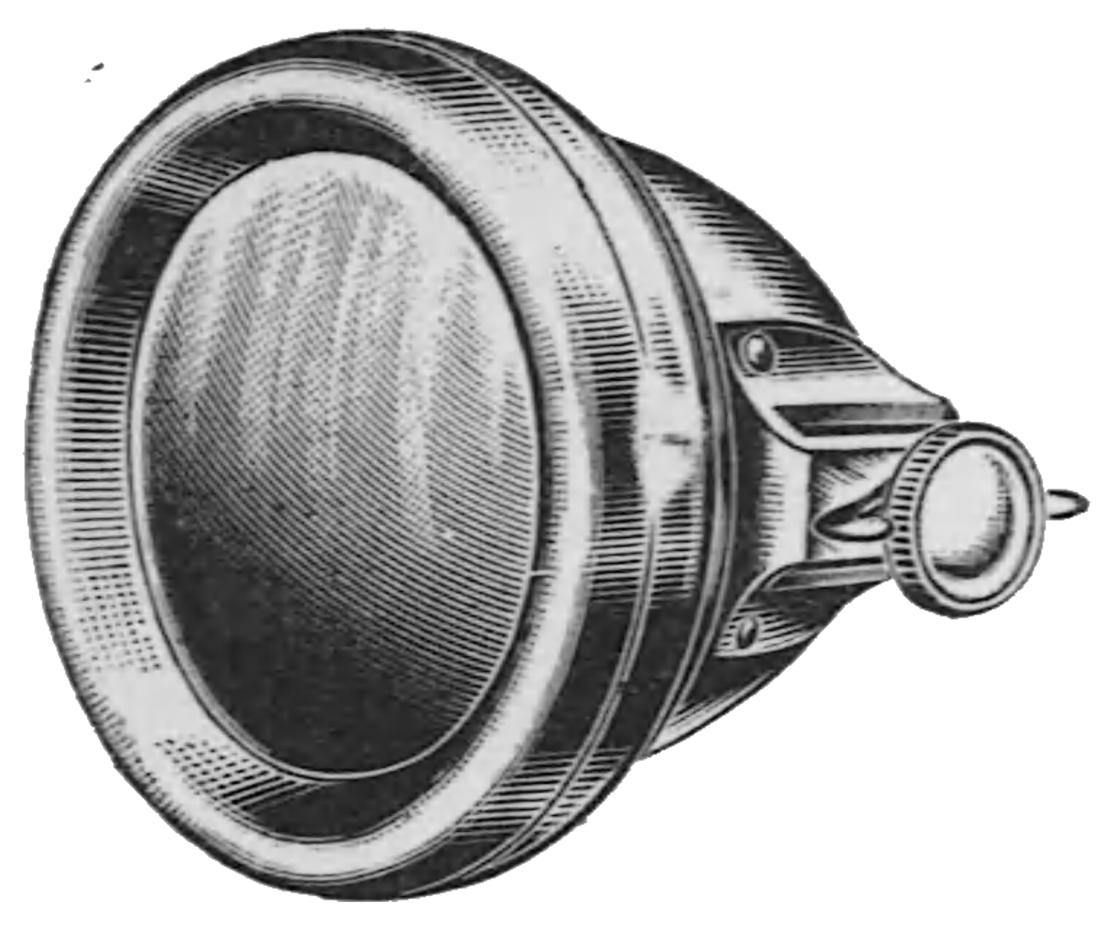


Fig. 108.

of 50-ampere hour capacity in acid-proof wooden boxes. The elements in this battery are cylindrical in shape, separated by porous pots to eliminate short-circuiting and prevent buckling.

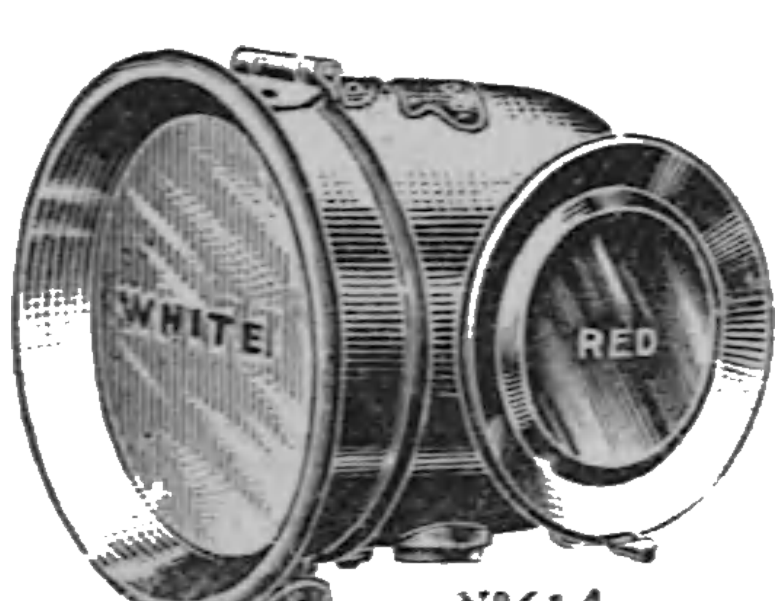


Fig. 109.

Figs. 107, 108, 109 show the set of lamps. A point about the head lamps worth noticing is that the back of the projector (which is of the parabolic type) is detachable together with the bulb and holder, so that the whole outfit is readily inspected without opening the front of the lamp, an operation always liable to allow the ingress of mud or dust.

Peto and Radford.—The Peto and Radford dynamo is of the totally enclosed four-pole shunt-wound type, with a centrifugal slipping pulley to prevent excess speeds (Fig. 110).

An aluminium casing at one end admits of ready

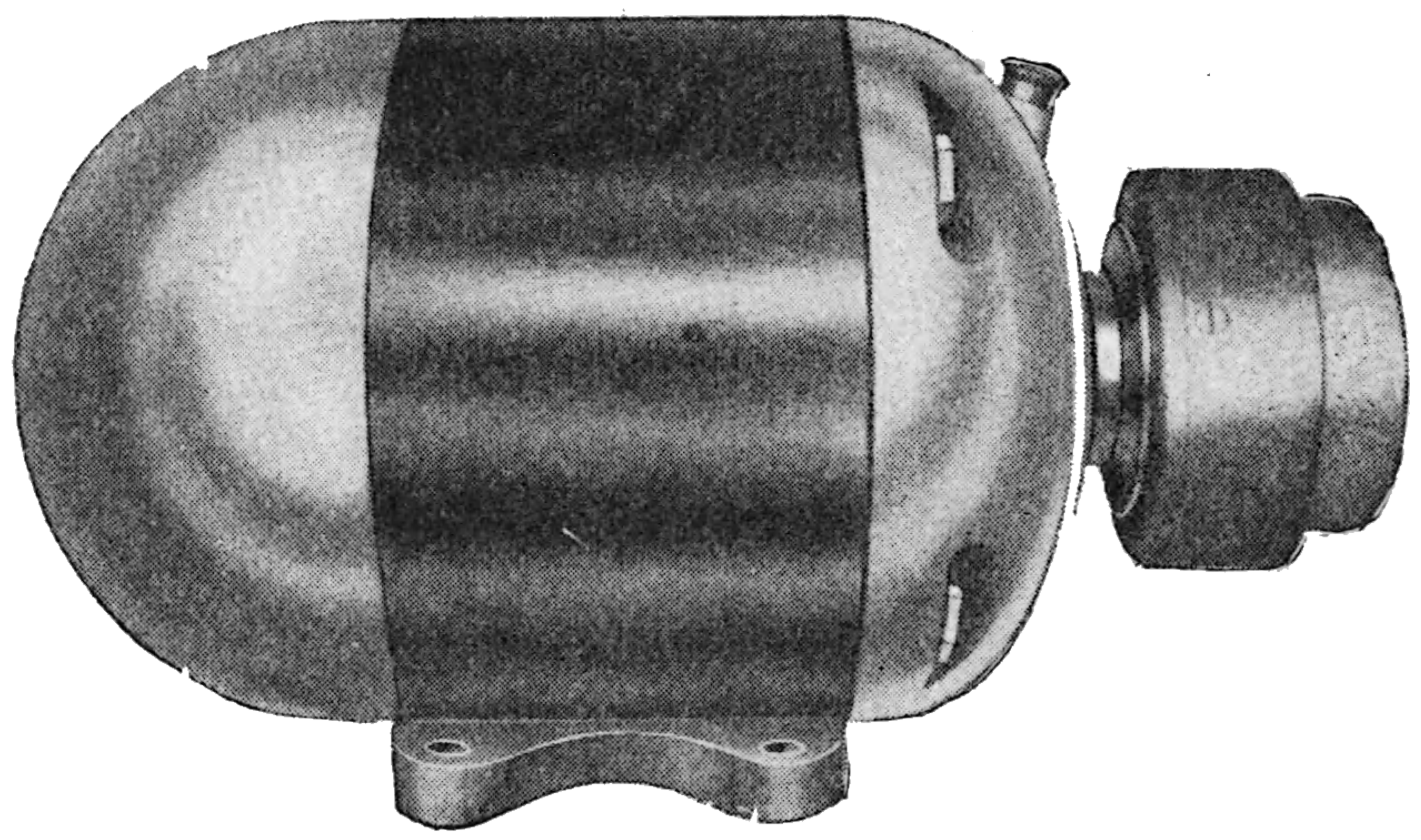


Fig. 110.

access to the brush gear, which is simple and substantial.

The armature, which is tunnel wound, runs on ball bearings.

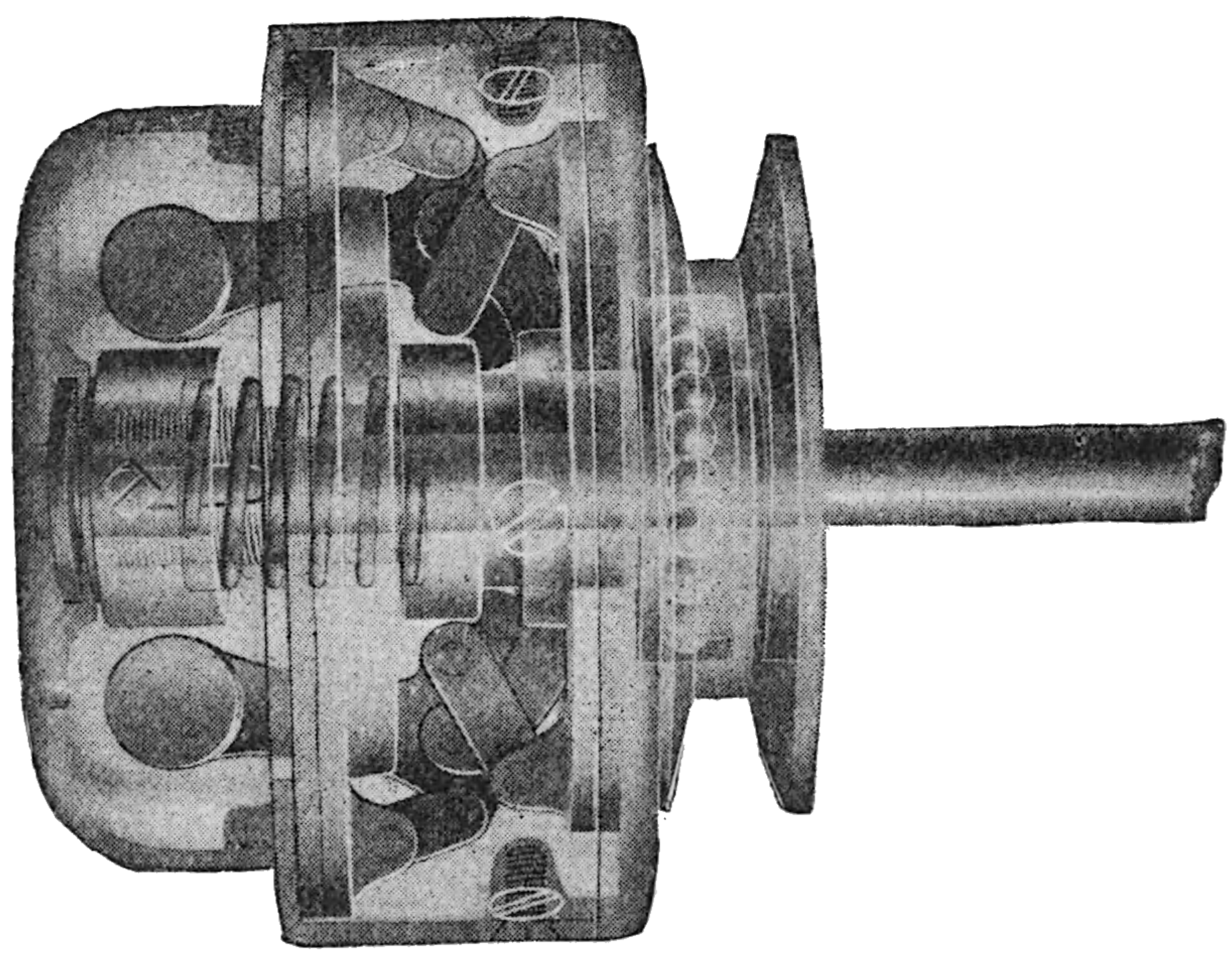


Fig. 111.

The dynamo is supplied in three sizes, giving 90, 150, and 250 watts respectively and wound for 12 volts.

The small set, which measures 8 × 6 × 6, weighs 21 lbs., and the large, which is a four-pole machine, measures $9 \times 7\frac{1}{2} \times 7\frac{1}{2}$.

The maximum output of the dynamo is controlled by two types of governed pulleys, one of which is shown (Figs. 111, 112). The mechanism is arranged

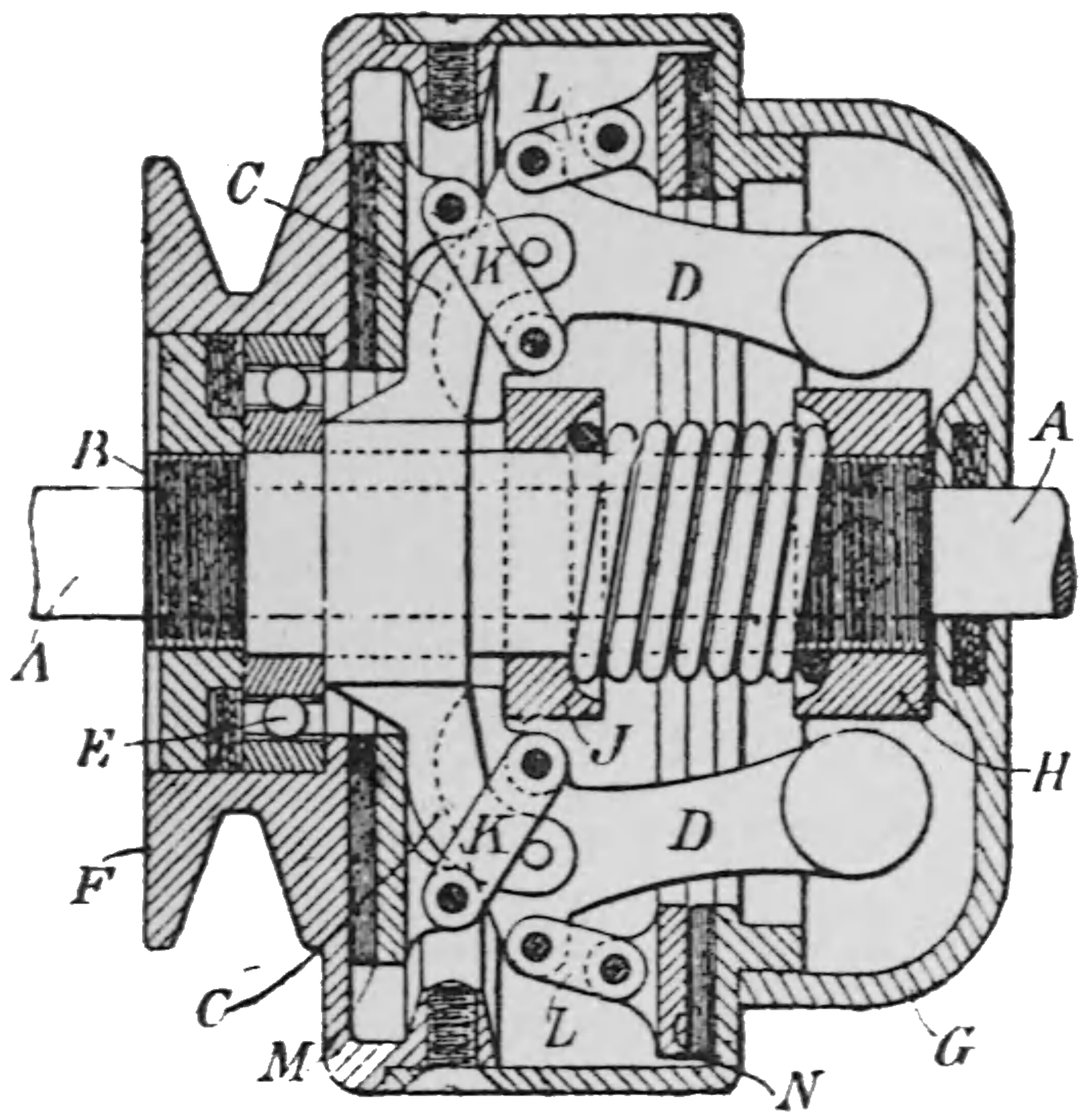


Fig. 112.

on one side of the pulley F and consists of two weights D, D acting through toggle levers K and L which work against the action of a spring J. This

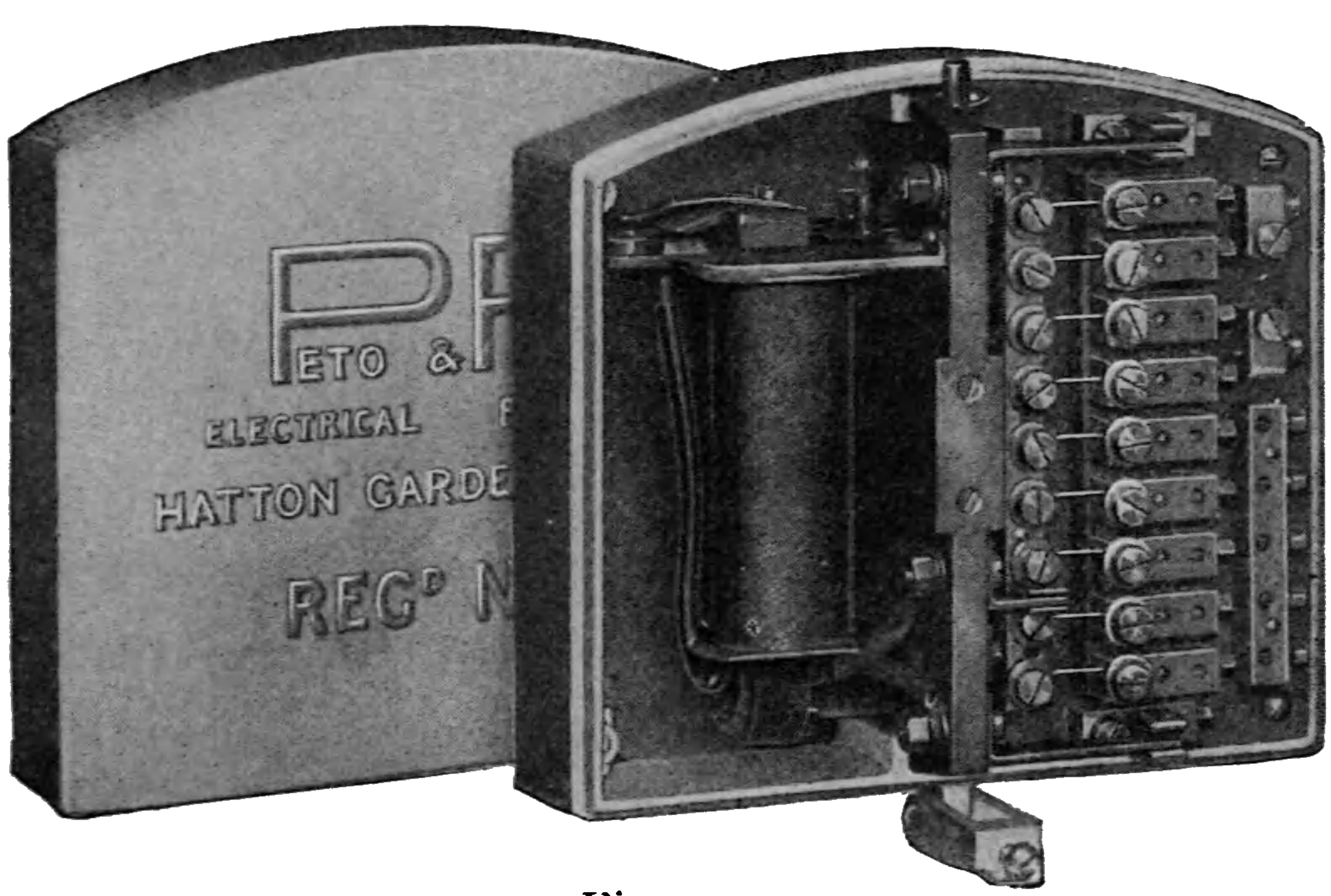


Fig. 113.

spiral spring presses the friction plates M N sliding on the shaft A against the cheeks of the pulley itself and its tension, and therefore the governing speed can be varied by means of an adjustable collar H. The pulley itself runs on a ball race E kept in place by a collar B. G is a detachable dust cover.

At speeds of 1,150, 1,000, or 850, R.P.M. for the respective dynamos, the governor weights begin to compress the spring and allow slipping to take place between the friction disc and the pulley, thus limiting the output of the dynamo.

A cut-in and cut-out of the ordinary electro-magnetic type is employed to prevent the current from the battery flowing into the dynamo when at rest, Fig. 113, which also shows a distribution box combined with the cut-out and with fuses in series with each circuit, thereby locating any short-circuit which might occur more easily than with the more usual single main fuse.

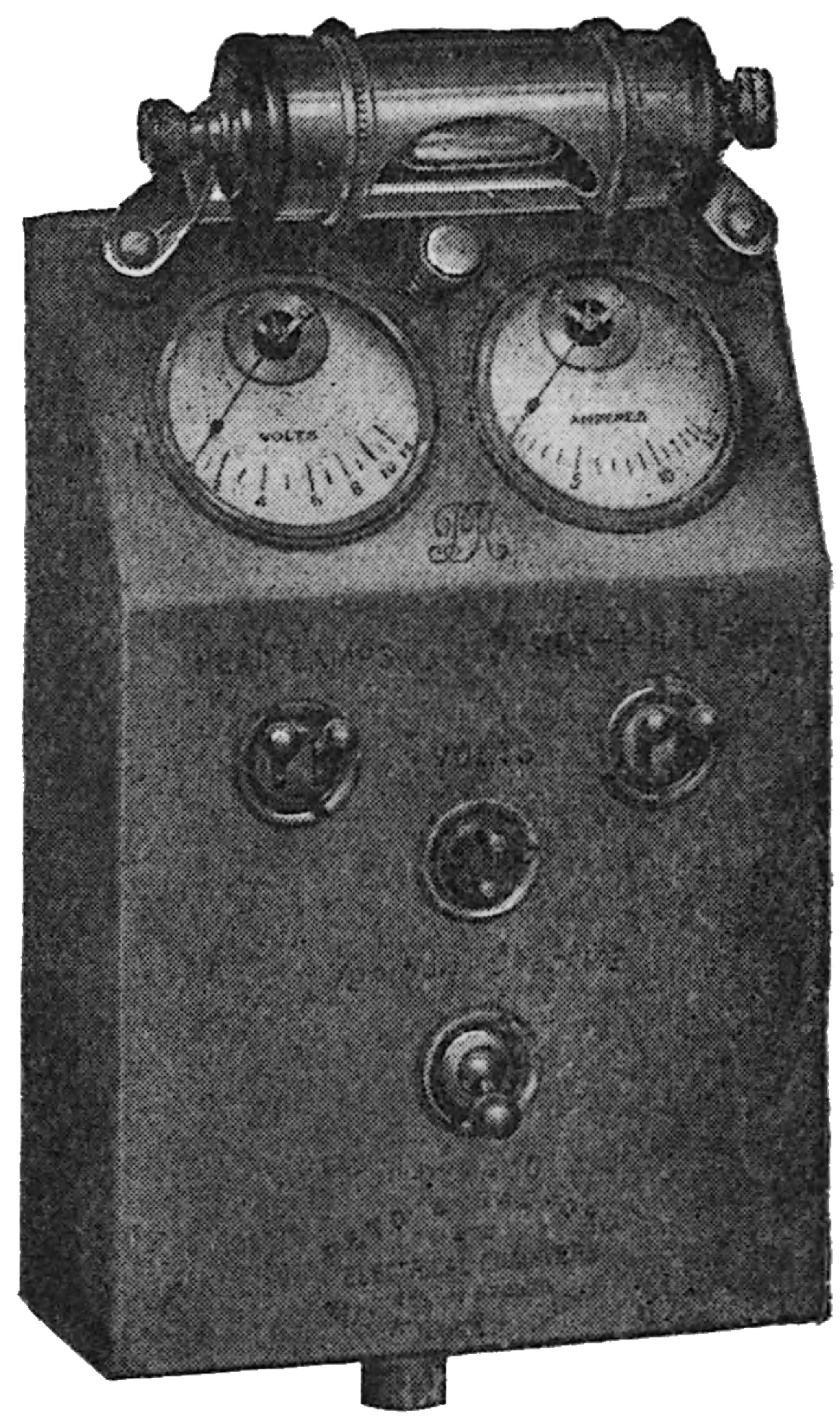


Fig. 114.

Fig. 114 shows the *de luxe* switchboard supplied with set. It has a separate ammeter and voltmeter with an illuminating bulb wired in series with the tail lamp for reading the dials at night. Separate switches control the two head, side, and tail lamps independently, and another switch is supplied to control the battery ignition. Pin plugs are provided for the installation of inspection lamps, etc. Other types are supplied.

The batteries recommended for use should have a capacity of 42 to 50 ampere hours at 12 volts, according to the system chosen. Fig. 115 shows the battery complete in its tray ready for lifting out of the polished wood case for inspection. Fig. 116 shows

E.B.C. — This dynamo is of the shunt-wound drum totally enclosed type. Irregular speed is counteracted by the armature being driven through a cone slipping clutch, actuated by a centrifugal four-arm governor which exerts an axial pressure over the inside face of the clutch; the governor is arranged to control the armature speed at 1,300 R.P.M., but by means of an accessible ring bolt this action can be altered and the amperage varied, thus any number of

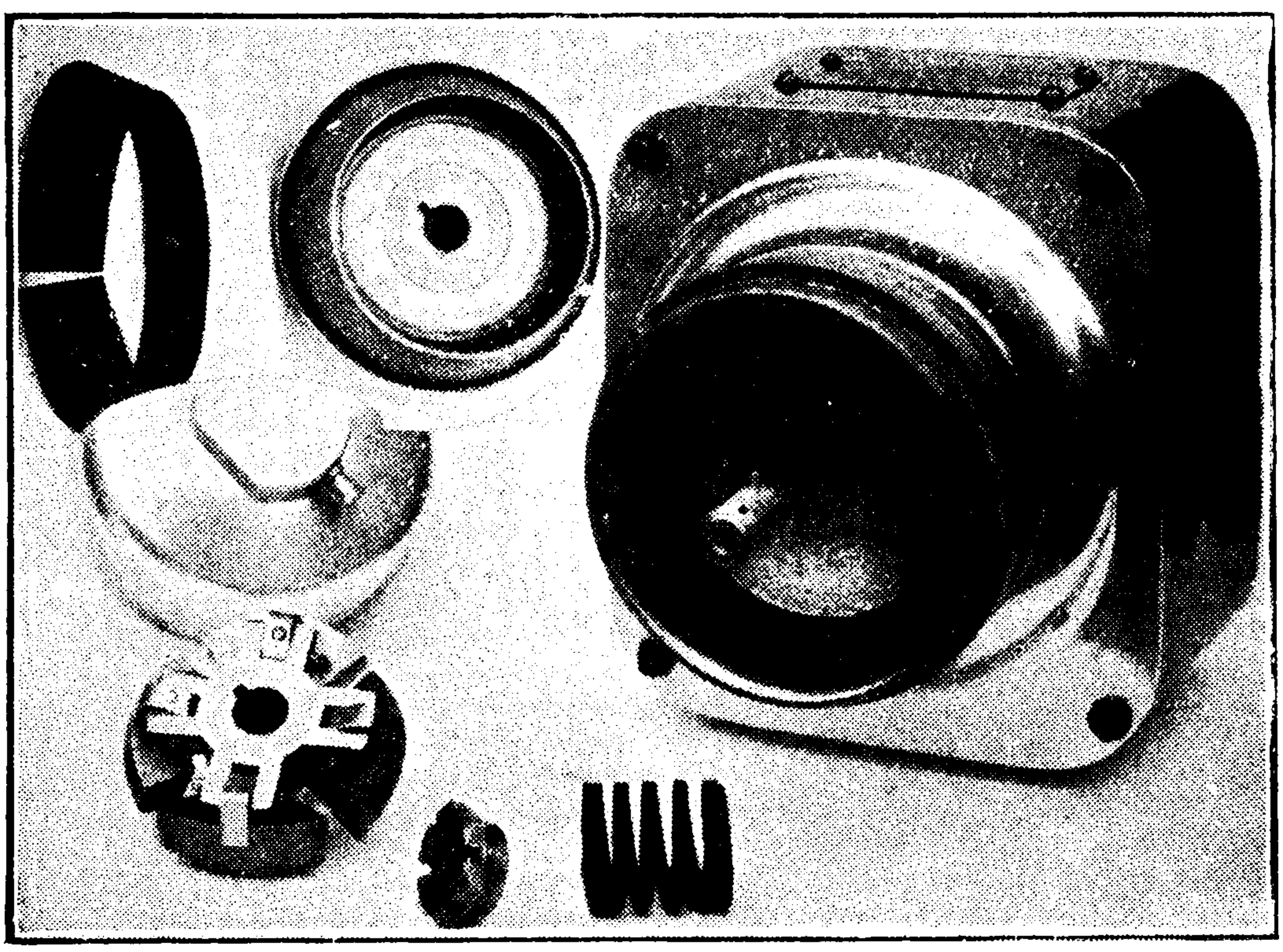


Fig. 117.

candle-power lamps may be used without under or over loading. Fig. 117 shows the various parts. In place of a cut-out there is a free-wheel clutch, and the dynamo is permanently connected to the accumulators as long as the switch is on. Should the switch be left on whilst the car is at rest, the accumulators run the dynamo as a motor. There is thus no danger of the armature short-circuiting the batteries, but the switch should not be left on, and the free-wheel gives a clicking noise as a warning.

The dynamo is supplied in three sizes, No. 1 having an 80-watt output, and wound for 8 volts 44 amperes. No. 2 is a 130-watt dynamo, 8 volts 55 amperes. No. 3 is a 200-watt equipment for large vehicles. The commutators are of hard drawn copper, insulated with mica; the brush-holders, of box type, contain square brushes and ample section.

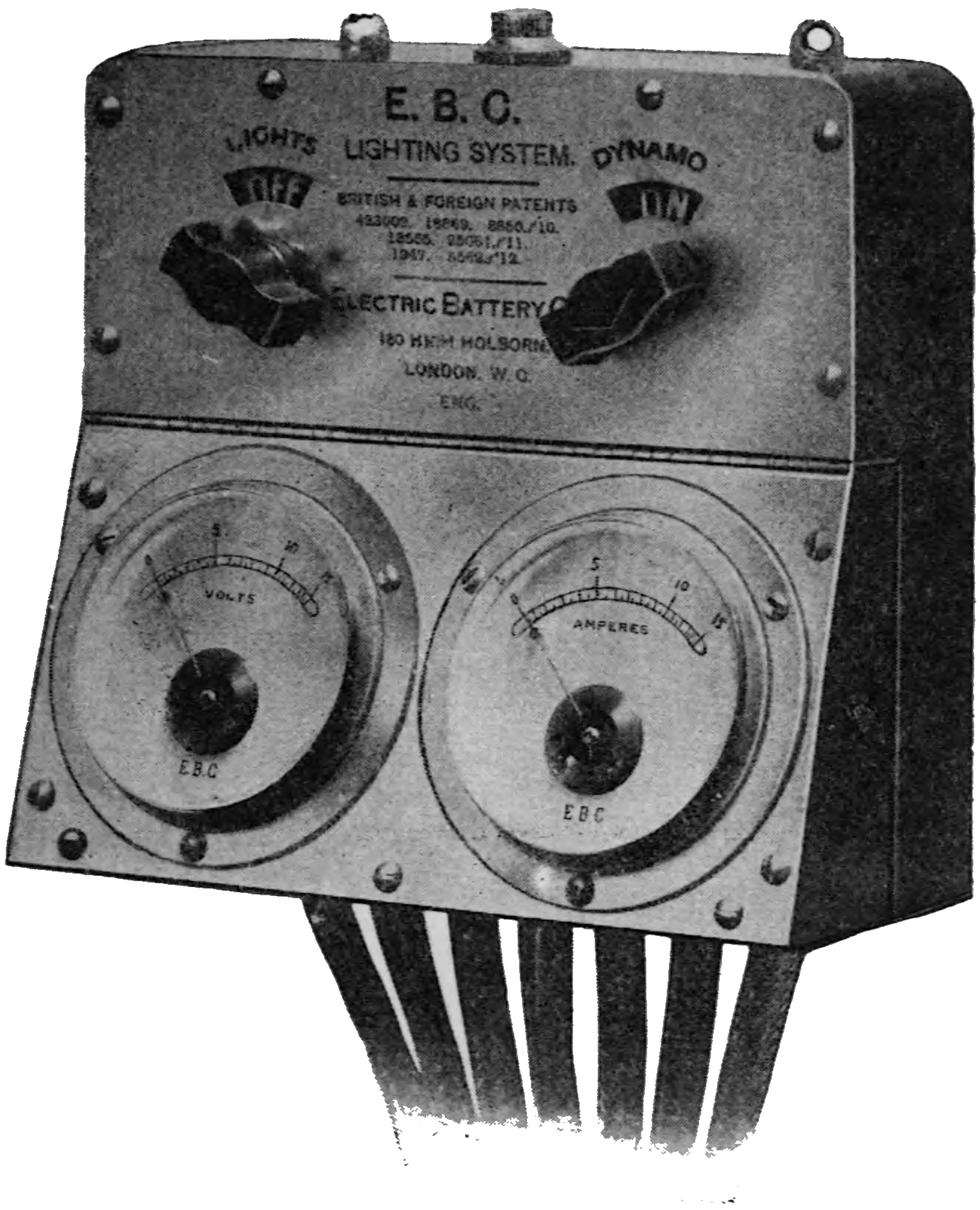


Fig. 118.

Fig. 118 shows the switchboard, which is provided with volt and ammeter, and switches for the control of each circuit; it is of polished rosewood with hinged metal front.

The accumulators are constructed to withstand heavy charging and discharging. The positive plates are of the improved Plantè form, in celluloid cells, the whole being fitted into teak boxes.

CHAPTER IX

HOT WIRE CONTROLLED SYSTEMS

Lithanode.—The standard voltage adopted for use with the Lithanode dynamo (Fig. 119) is 4 volts, it being claimed that this voltage is quite sufficient with properly designed lamps and bulbs, with the additional advantages that the filaments of the lamp are stronger and last longer, the set is easier to instal, and that a 4-volt battery is easily obtainable anywhere in the

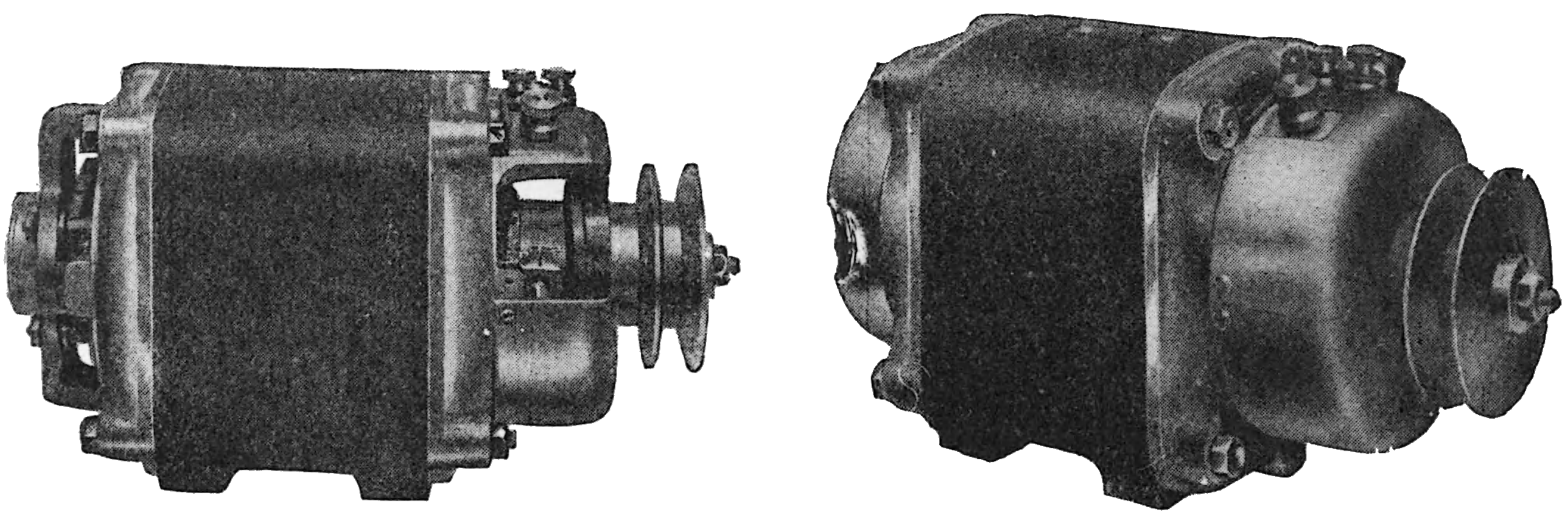


Fig. 119.

event of the cells breaking down; short-circuiting is also greatly minimised. But as a higher candle-power is frequently called for, 8 and 12 volt dynamos are also supplied; these work on exactly the same principle as the 4-volt set described.

The dynamo itself is of very simple construction, consisting of an ordinary shunt wound machine with the addition of a simple centrifugal cut-out, noticeable on the left hand of the machine. This cut-out consists simply of two arms carrying circular weights, kept in the normal position by two springs (Fig. 120) when at rest, thereby opening the circuit. When the dynamo attains sufficient speed to generate (about 1,000 R.P.M.), the weights fly out and two levers are pressed under the live contact spring (Fig. 121) so that the circuit is closed.

Fig. 120.

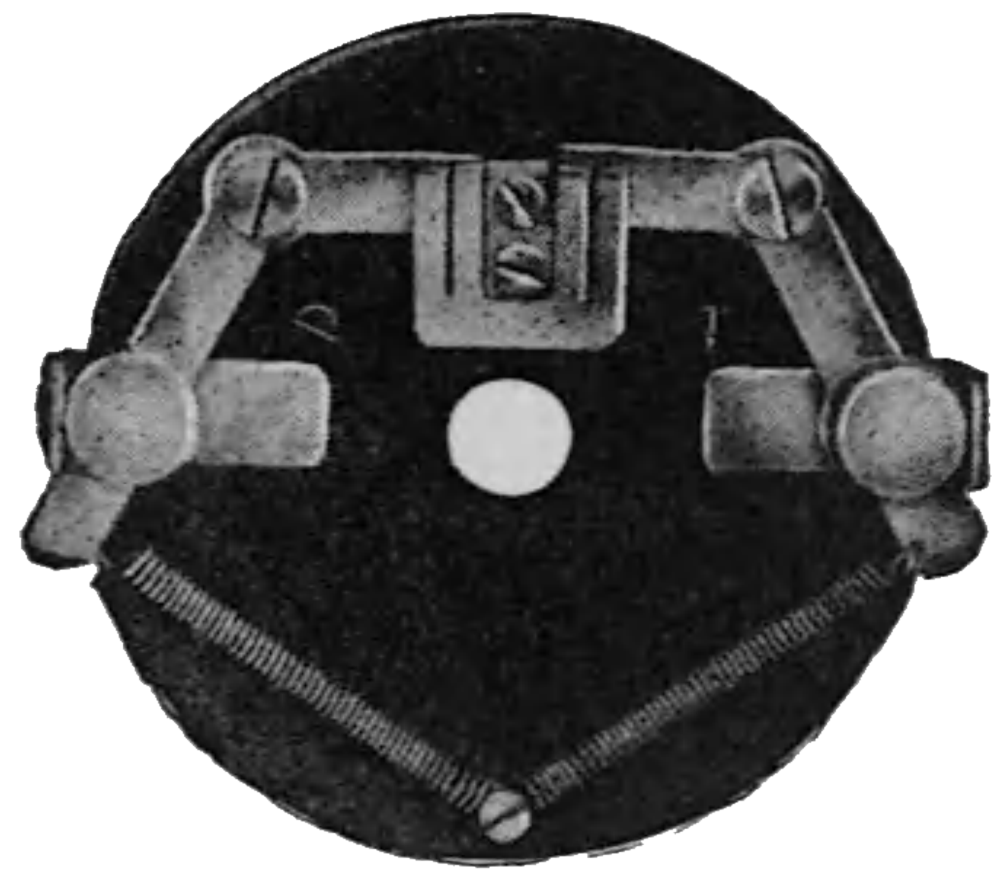


Fig. 121.

The weights themselves also complete the contact in pressing against the brackets. The two levers and the

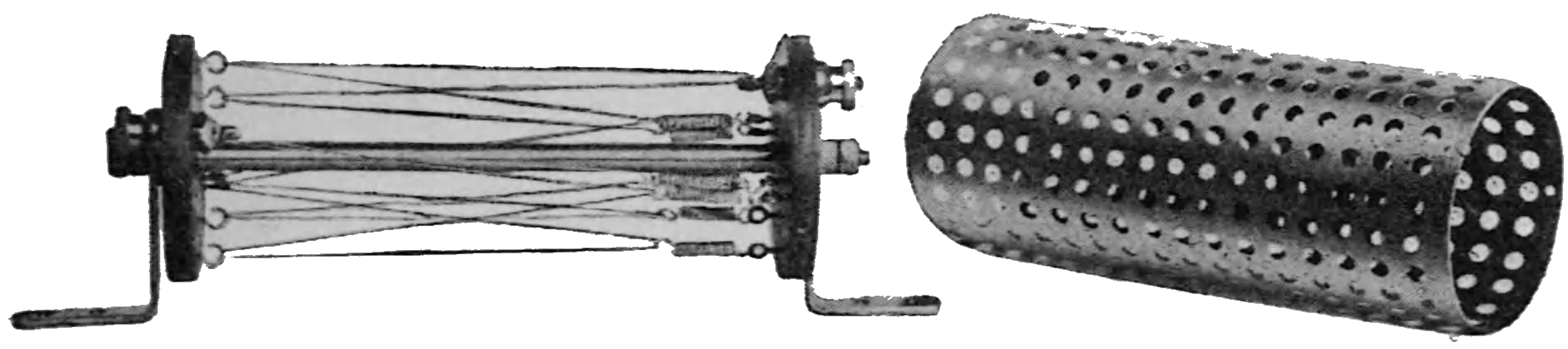


Fig. 122.

contact spring form a rubbing contact, which keeps clean even in the event of any sparking taking place. In order to prevent abnormal currents being generated at high speeds, the current is led through a nickel wire resistance (Fig. 122). The resistance of nickel wire rises proportionally to the heating effect due to the current, so that when a certain predetermined current (in this case about 10 amperes) is

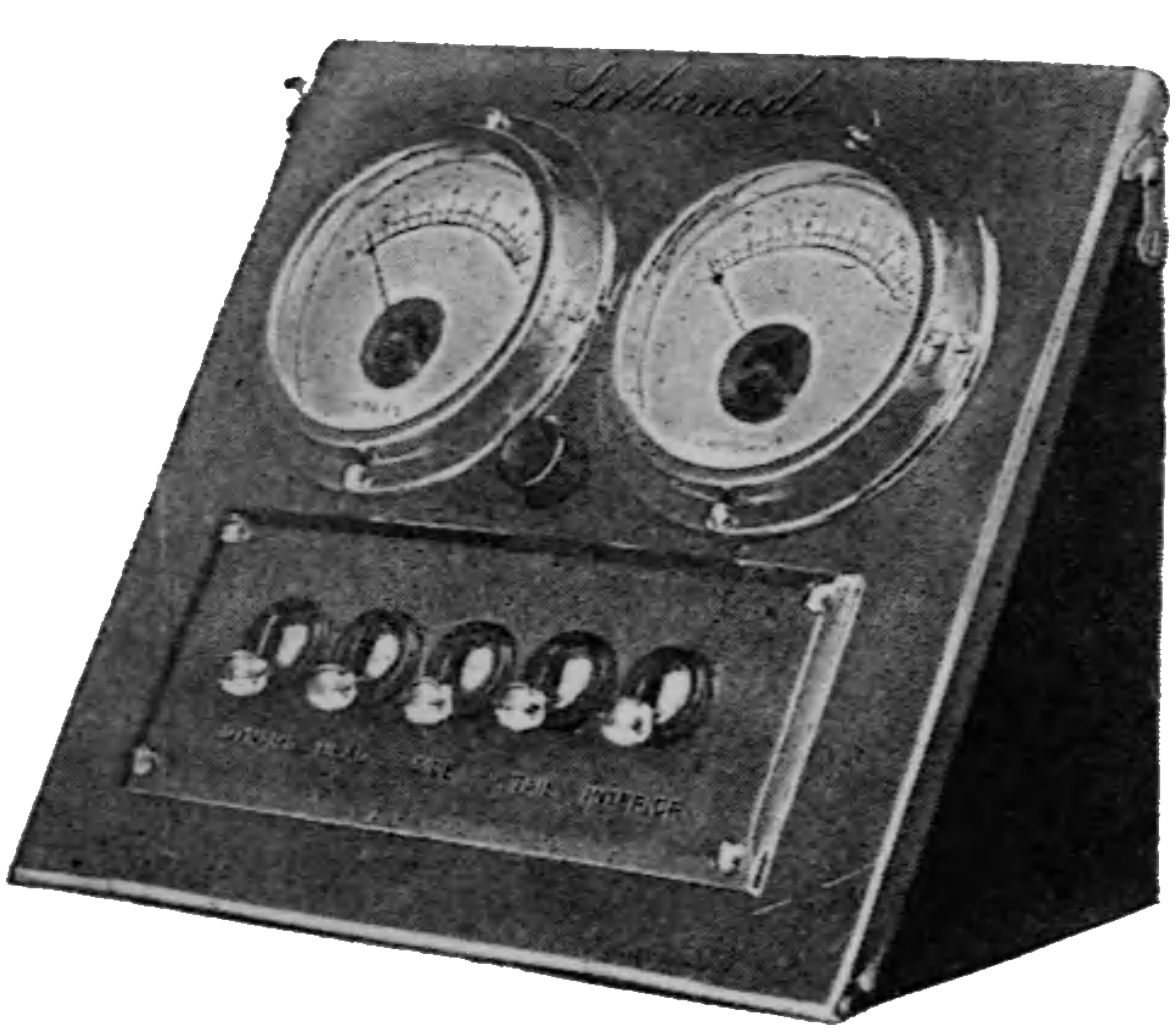


Fig. 123.

passing, the wire gets hot and the consequent resistance is sufficient to choke back any further rise in current that would otherwise take place.

The heat engendered in the wire is never sufficient to cause danger from burning, and the whole wire frame is enclosed in a perforated metal cover. An incidental use for the resistance is to employ it as a

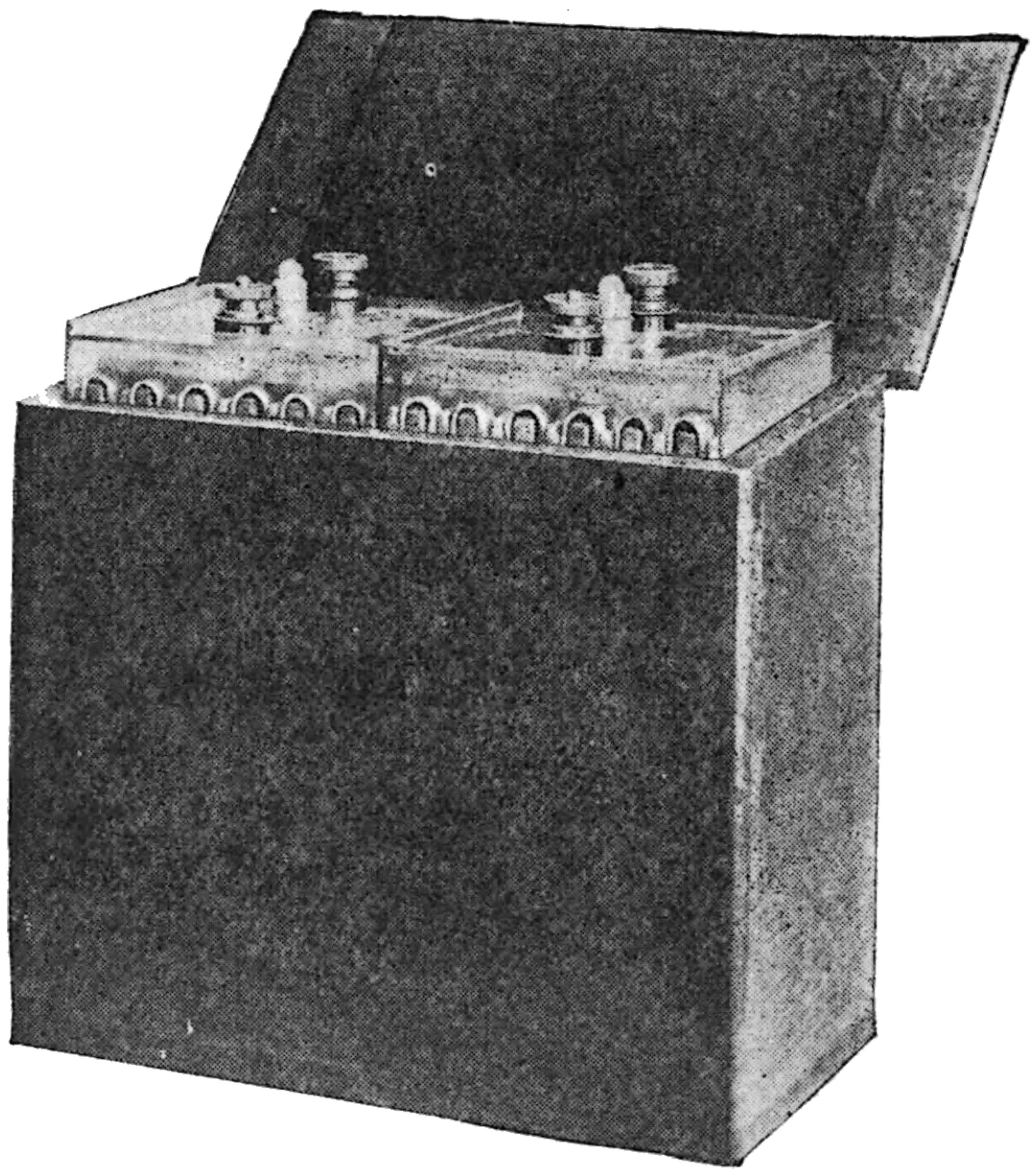


Fig. 124.

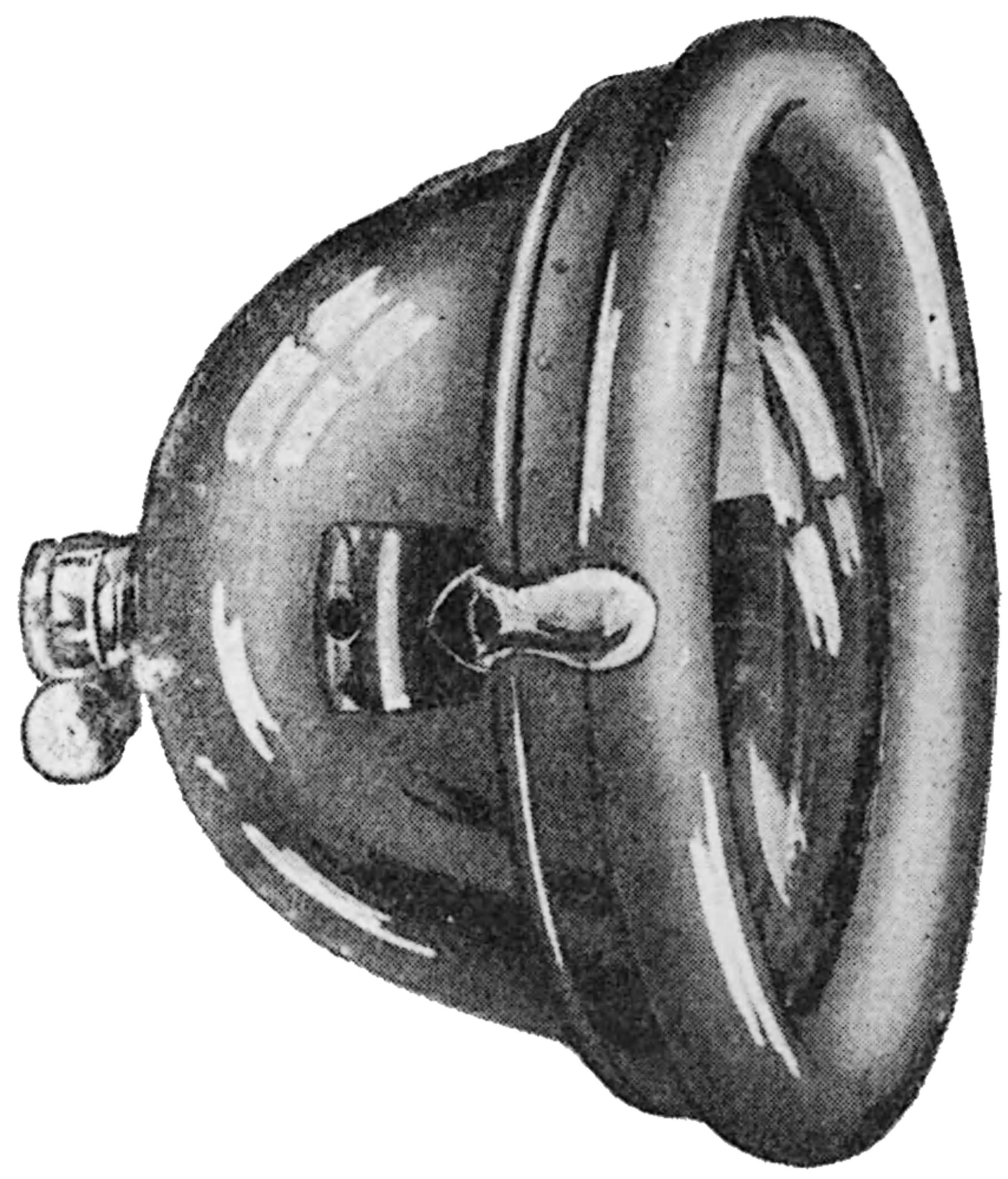


Fig. 125.

carriage warmer in cold weather, and by fitting a second resistance outside the car and operating a two-way switch, the resistance heater in the car can

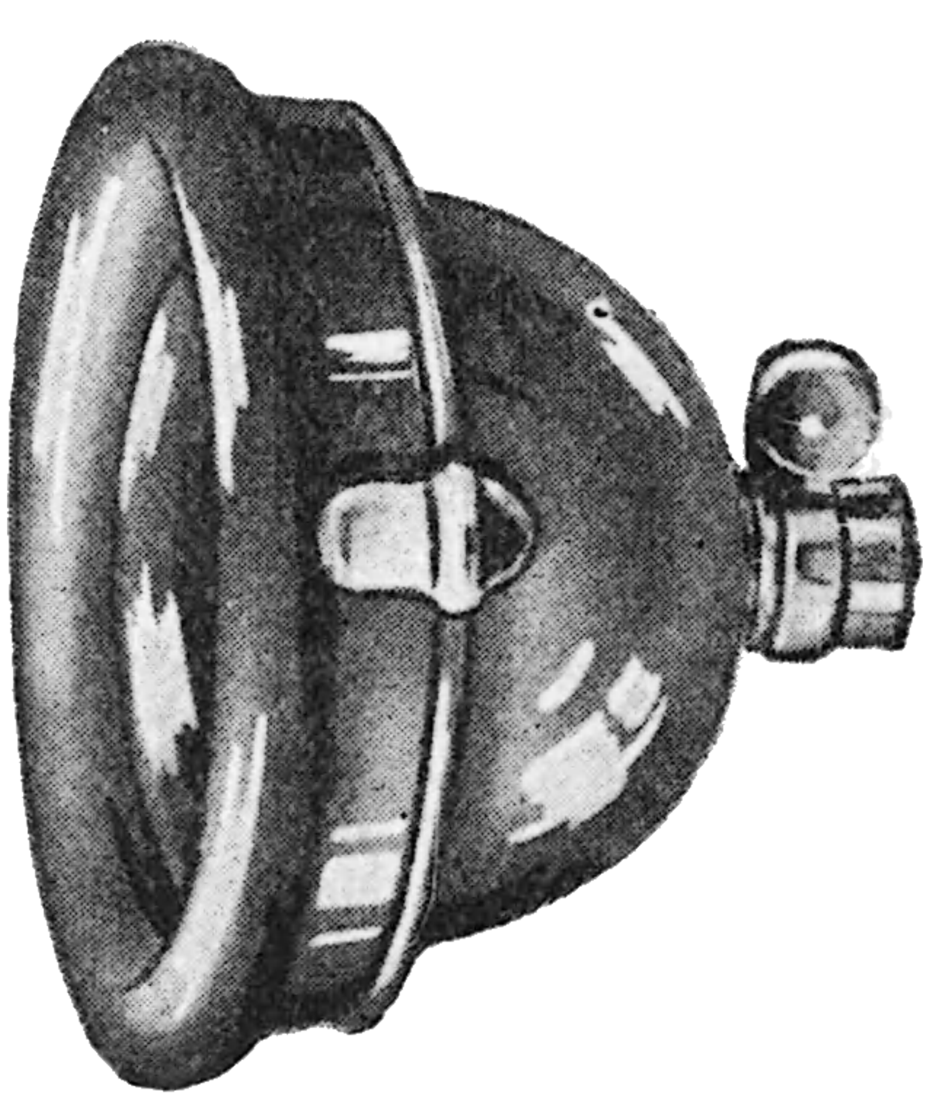


Fig. 126.

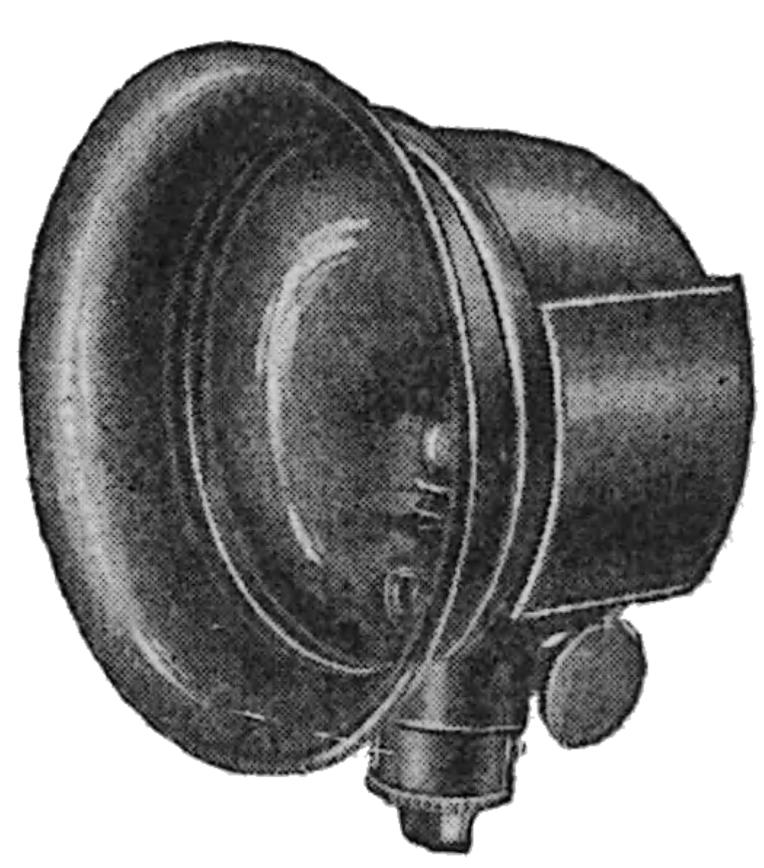


Fig. 127.

be thrown out of action, the one outside the car coming into action in warm weather.

The switchboard (Fig. 123) for this set comprises an ammeter and voltmeter, also five switches controlling the two head, two side, and tail lamps individually.

The 4-volt Lithanode battery is shown in Fig. 124, and the set of head, side, and tail lamps in Figs. 125, 126, 127.

For use in foggy weather, the makers supply an amber-coloured bulb which improves the light when driving through fog. This saves any alteration to the lamps, as when the fog bulbs are not required the ordinary clear bulbs can be replaced.

It should be remarked that as the voltage used in

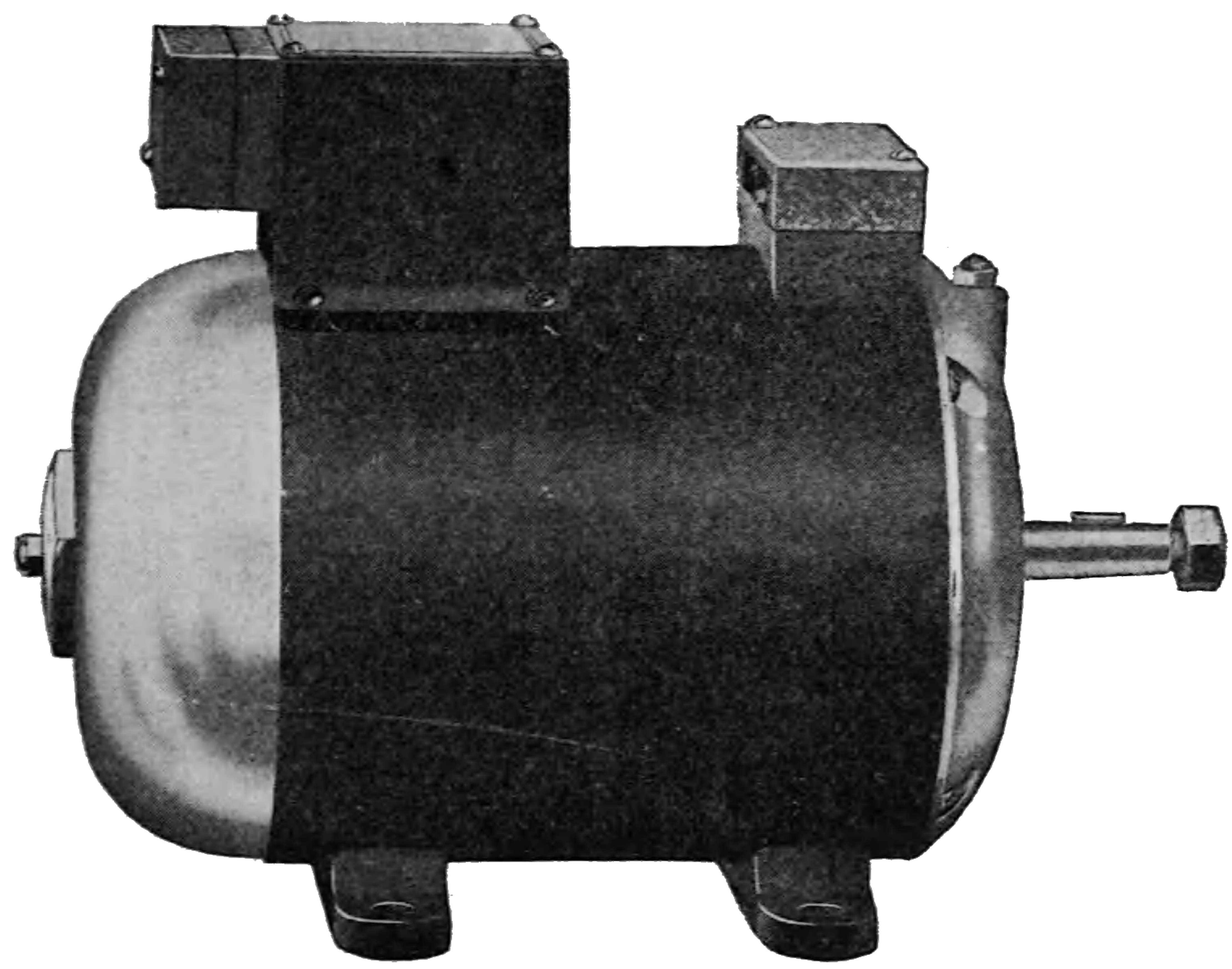


Fig. 128.

this set is low, in order to avoid resistance and consequent drop in voltage, special heavy conductors are supplied by the makers and these should be always used to obtain satisfactory results.

Rushmore.—The dynamo (Fig. 128) supplied by Messrs Rushmore depends upon the action of a hot wire similarly to the last machine described, but the application is somewhat different.

The dynamo itself follows standard lines except that it has a compound or differential coil (bucking coil) superimposed upon the ordinary shunt winding (Fig.

192). The iron wire resistance or ballast coil (which is wound on an asbestos spool) carrying the main current has both the terminals of the shunt and differential coils connected to its far end. The action is therefore as follows: At low and moderately low speeds the shunt winding is in action and the differential coil, being small, has practically no effect, therefore a moderate current is passed, sufficient to keep the accumulators in a proper state of charge. As soon, however, as the speed increases, the current tends to rise, and passing through the ballast coil, heats it and therefore throws a resistance in circuit. The effect of this is not only to choke the main current but to drive current through the hitherto almost inoperative differential coil which now begins to act in opposition to the main shunt, thereby weakening the main current and setting up a state of balance.

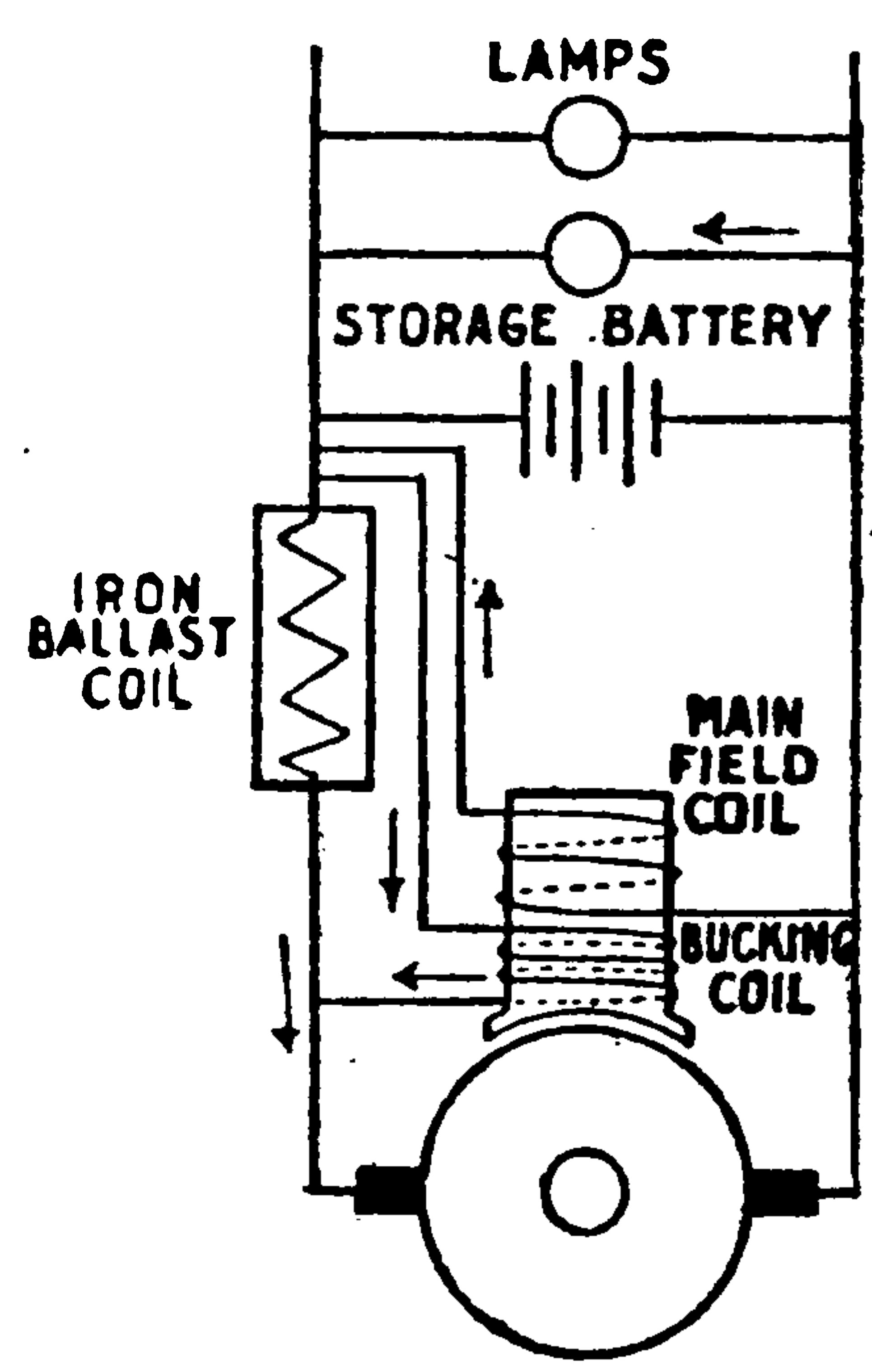


Fig. 129.

Fig. 130 shows very well the sudden rise in resistance which sets in with heating at a certain point of iron wire A as compared with, say, a german silver resistance B.

By making the ballast coil weaken the magnetic field through the differential winding, considerable energy is saved in driving the dynamo, which, were the ballast coil used as a choking resistance alone, would be rather wasteful. The dynamo begins to generate current at about 200 R.P.M., and gives its full output 14 amperes at 600 R.P.M., the voltage supplied being 6½ volts.

The dynamo in appearance is a simple two-pole enclosed type with steel poles, the tips being combed

circulating through the cells which tends to keep them in first-class condition. A simple magnetic

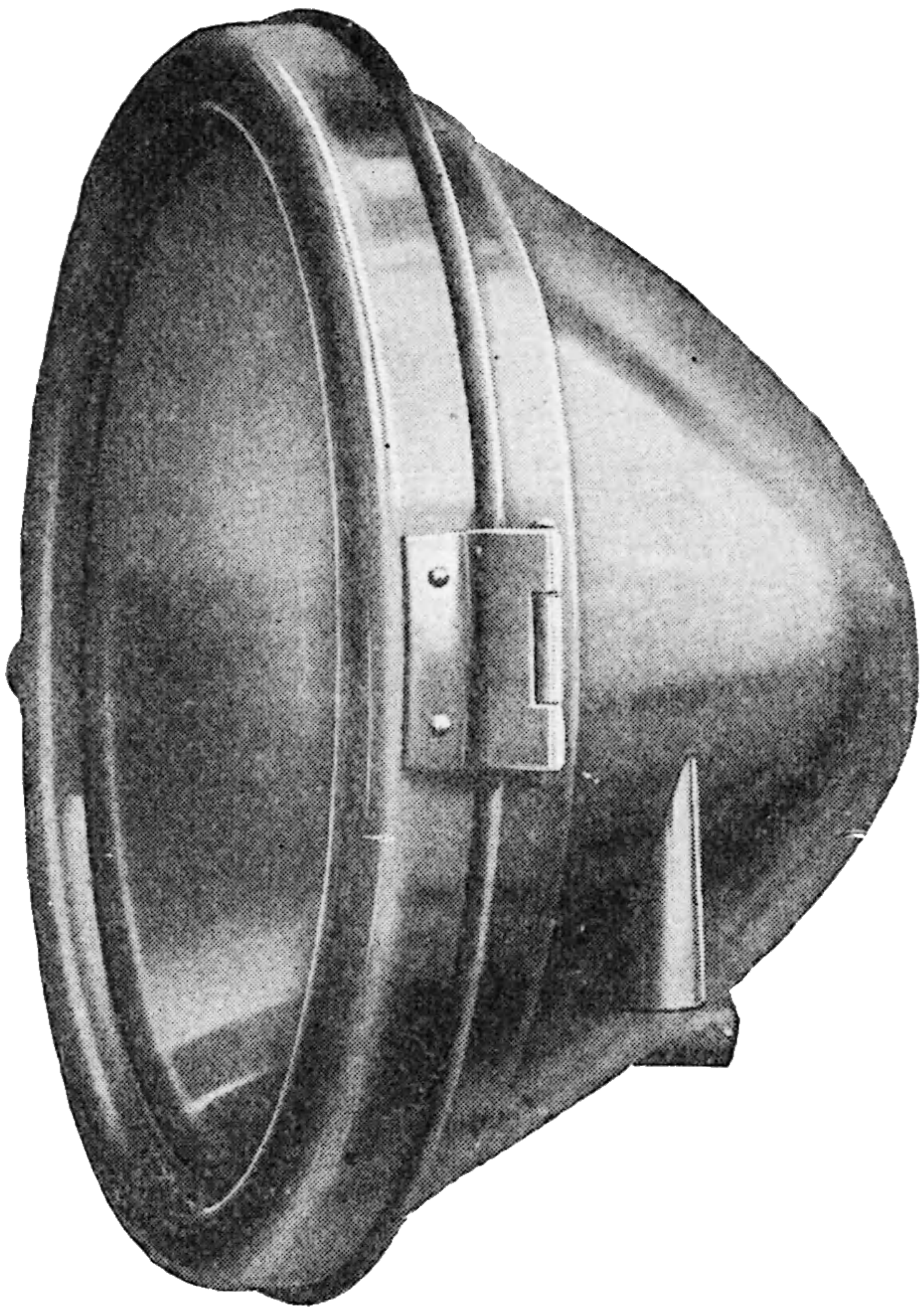


Fig. 132.

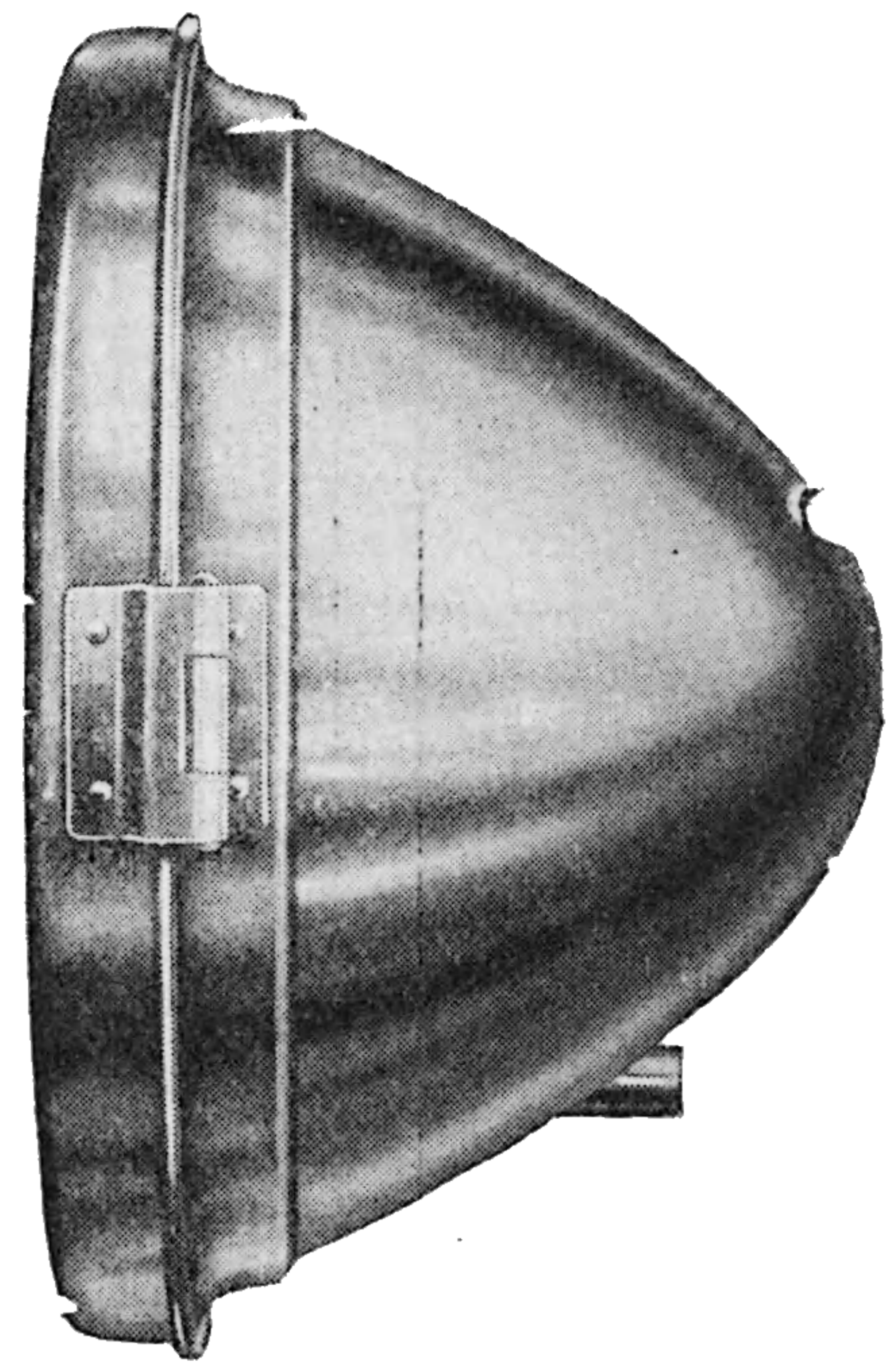


Fig. 133.

cut-out (Fig. 131), placed above the dynamo, is interposed to break the circuit when the machine is

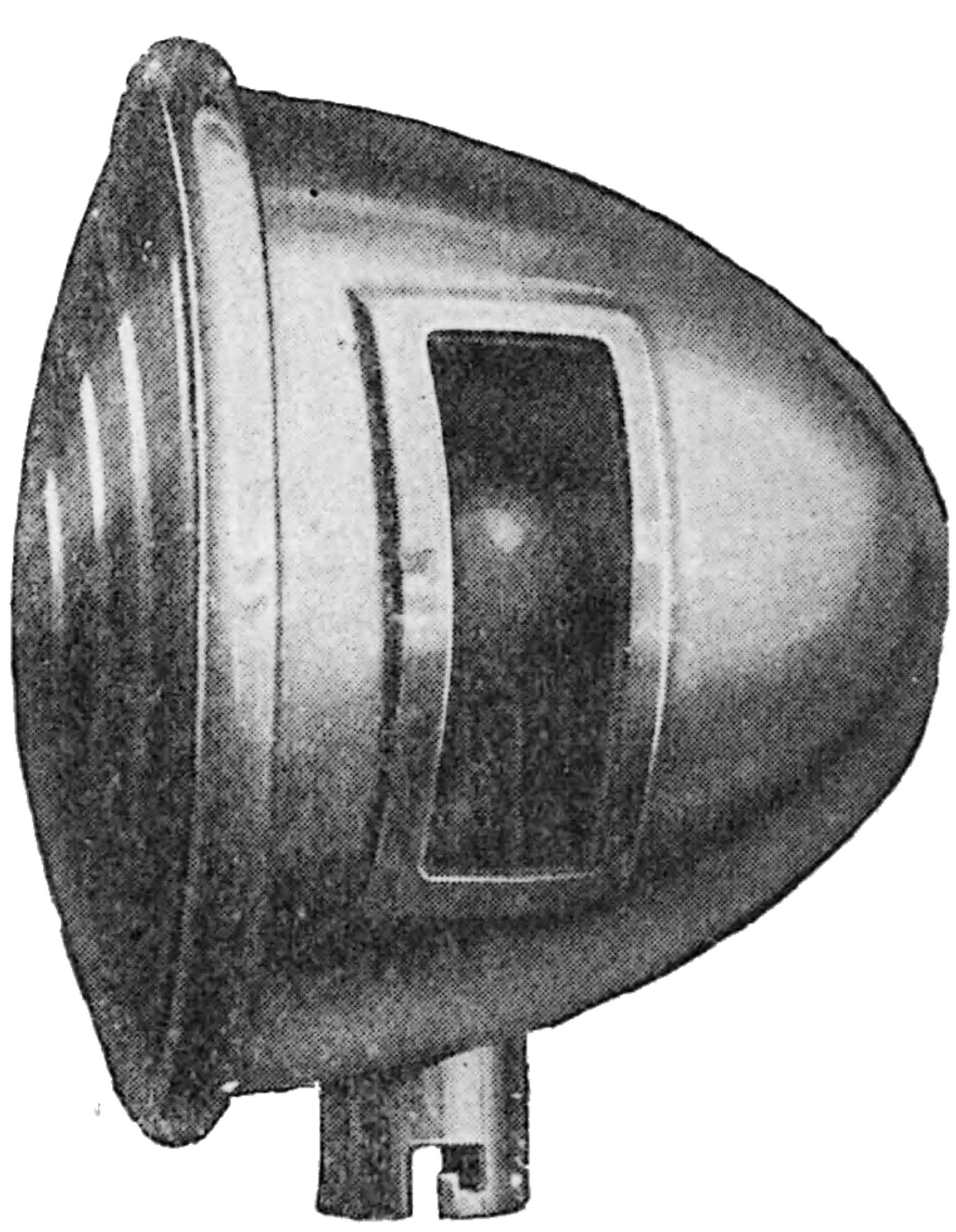


Fig. 134.

at rest. Two plain switches are provided on the switchboard: one controls the side and tail lamps, the other the head lamps, at the same time paralleling the ballast coil with the differential winding, and automatically increasing the dynamo output to meet the increased current used by the head lamps.

Figs. 132, 133, 134 show the head, side, and tail lamps respectively. The reflectors are of copper suitably silvered and of parabolic design. The bulbs of the side lamps are a little out of focus so as to throw a scattered ray.

The weight of the small dynamo, giving 15 amperes at 6½ volts, is 23 lbs., and the large size, giving 25 amperes at the same voltage, is 35 lbs.

CHAPTER X

SOME USEFUL ACCESSORIES

GENERALLY speaking the makers of lighting sets are content with supplying the outfit complete with the

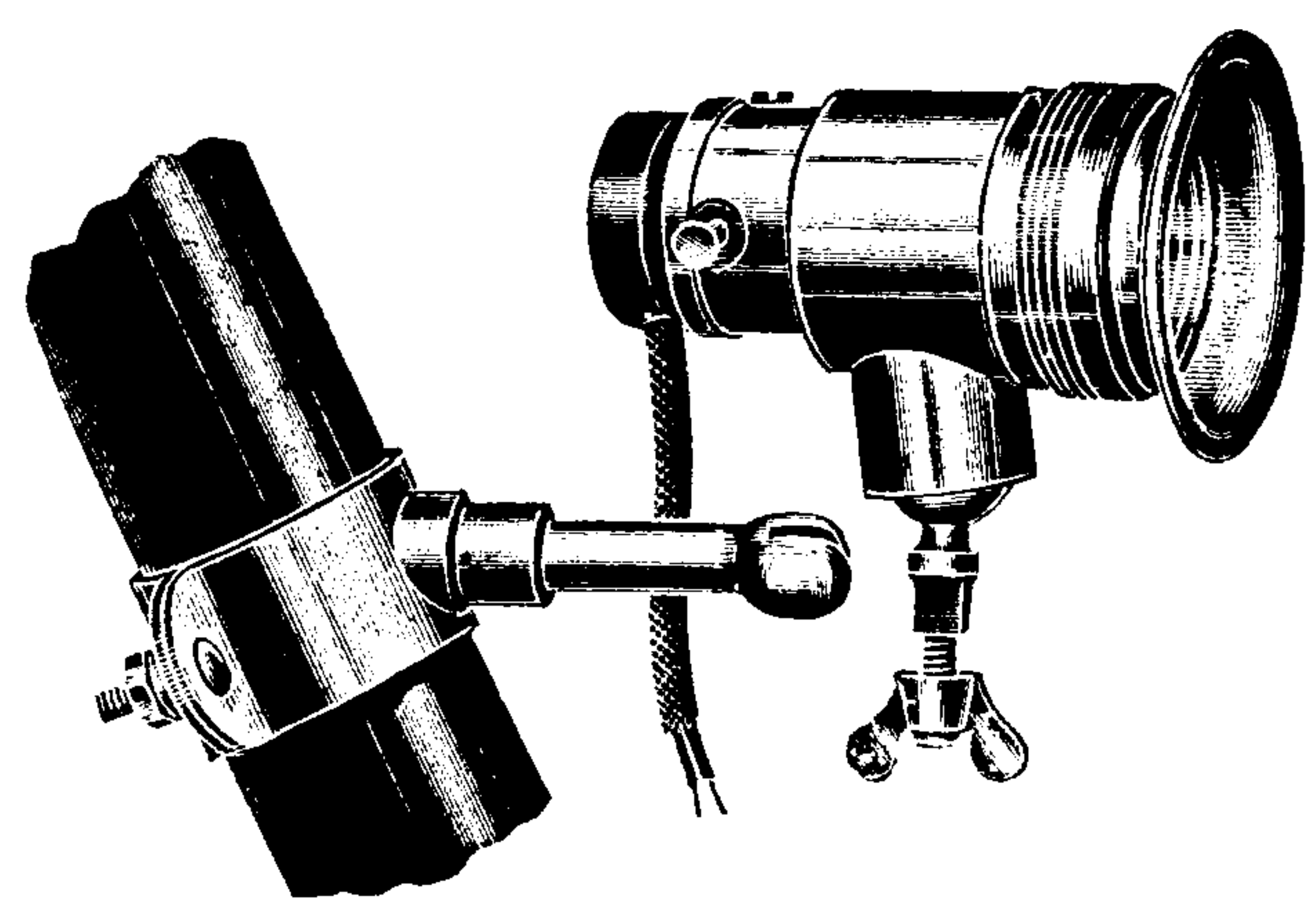


Fig. 135.

head, side, and tail lamps, leaving the accessories to the customer's choice, and we here propose to draw

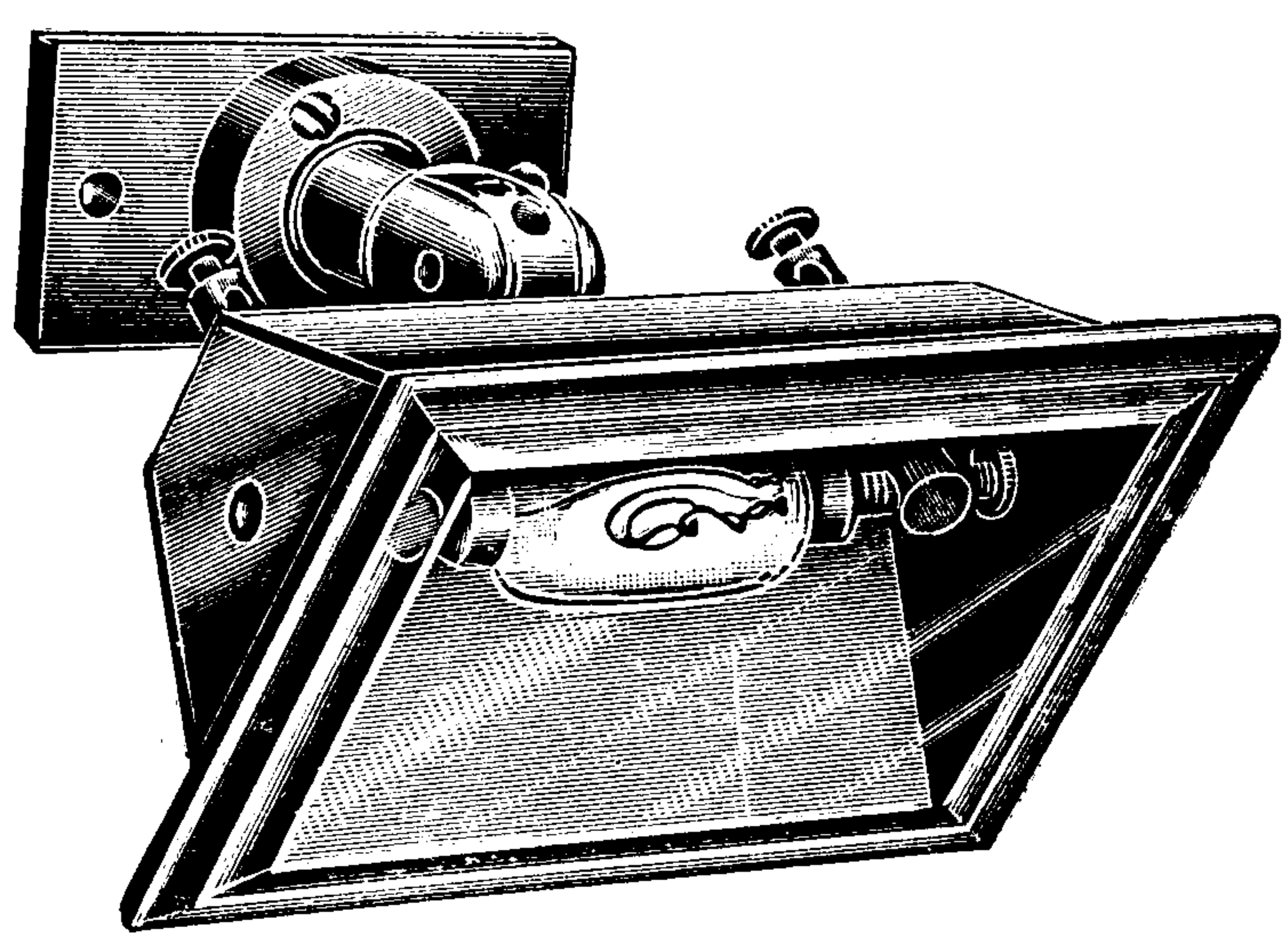


Fig. 136.

the reader's attention to a few of the more useful fitments.

A steering column lamp (Fig. 135) is very useful to read the various dials of the voltmeter and oil and

Cigar lighters are best avoided if the purchaser can bring himself to do without this luxury, as they always burn out quickly, and take a considerable amount of current, besides which they will not light a pipe satisfactorily.

A good horn is a *sine qua non*, and any of the better class types on the market may be depended on to give satisfaction.

A word may be said here *re* the wiring of interior lamps by coachbuilders, as they should be carefully watched in this respect. Insist on proper cables being installed under the upholstery and not bell wire which the majority of carriage builders seem to think

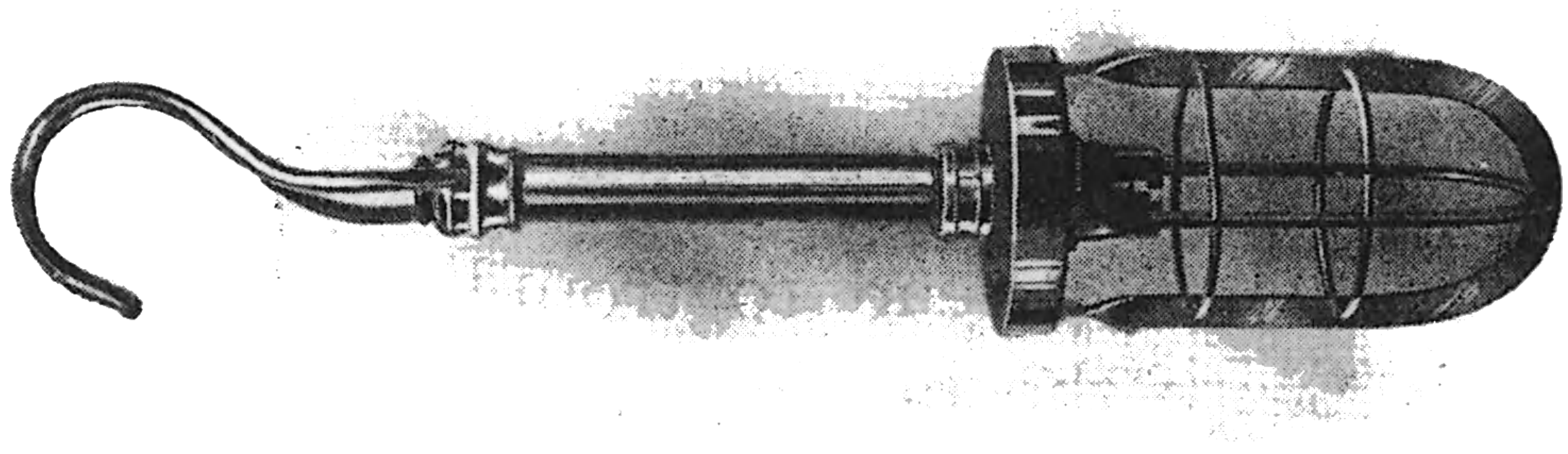


Fig. 140.

sufficient, the efficient wiring of a car being with them quite subservient to the effects of brocade and varnish. Shoddy bell wire and poor electrical connections have been the making of many nasty fires.

All wires from the bodywork should be brought to a terminal board so that if the body is removed it will not be necessary to rewire the carriage work.

Spares.—The following spare parts should always be carried :—

1. Length of fuse wire.
2. Spare brushes.
3. Set of bulbs.
4. Belt and one half-link for Vee belts.
5. Cut-out contacts (if electrical).

CHAPTER XI

UPKEEP AND MAINTENANCE

It should be fully realised that all dynamo lighting sets require attention in the same way as acetylene or oil, and that the various components of the set should from time to time be examined to see that they are in order.

Bearings.—First, with regard to the dynamo, the bearings must occasionally be oiled or greased in accordance with the instructions issued with the set. The driving belt, whether flat or "**V**" shaped, should be cleaned and tightened if necessary, as a slipping belt is often a cause of diminished output.

Commutator. — The brushes and commutator should be examined to see they are not wearing unduly, and any carbon dust must be cleaned out of the commutator cover. Commutators should be kept clean and bright with a little fine glass paper, but beyond this the armature had best be returned to the makers to be trued up; this, however, should be rarely necessary.

Contacts.—Where the cut-out is embodied in the machine itself, the contact points should receive attention in case any burning of the contact surface has taken place. If the cut-out is electrical, the contact points should be examined to see they are clean and unburned, and that the armature moves freely. Contacts that have become burned or worn should be touched up with a fine file or emery paper, care being taken not to alter the adjustment, and to see that the contact points or brushes meet squarely. If the cut-out is of the free-wheel type see that it works freely and that the lubrication is not too thick, thereby using more current than is necessary to make the dynamo motorise.

Batteries.—Batteries should receive weekly examination, care being taken to ascertain that all connections are sound, and all terminals free from corrosion. A little vaseline should occasionally be applied to the terminals.

See that the tops of the cells are free from acid which may have been thrown off as spray from prolonged charging, and see that the acid is well over the tops of the plates. Examine the bottom of the containers for any sludge that may have been thrown down and which is likely in abnormal quantities to short-circuit the plates or at least to cause leakage of current.

See that the cells are tightly wedged in their box so that they cannot shake about and break their connections. Make sure the screws holding down the box (if any) are not loose. Sometimes in coming unscrewed the heads work their way through the bottom of the celluloid cases.

After cleaning the battery, make sure the proper leads are replaced positive or red to the + or red terminal and negative or black to the – or black terminal—this is most important: failure in this matter will in many cases burn out the whole outfit.

If the car is laid up for any considerable period for repairs, etc., the cells must be removed about once a

the porcelain disc for some little distance. The same applies to the other end of the lamp lead where it enters the pin plug if these are used.

Switchboards.—In the event of it being necessary to dismount the switchboard, be careful to note and mark the leads belonging to the various terminals, so that when replacing them no mistakes shall be made. In the event of the ammeter or voltmeter sticking, the instruments should be returned to the makers as they are much too delicate to be tampered with by anyone not used to their manufacture.

In the event of the fuse blowing, be careful to replace with a piece of the correct fuse wire, and not with a hairpin or other unsuitable wire.

Before replacing the fuse, the cause (if not temporary) of the short-circuit should be ascertained and the defect remedied.

Searching for Faults.—Following is a table of likely defects and how to proceed to remedy them. Remember in searching for faults to try one thing at a time, otherwise it will be difficult to say what was the defect, if two parts of the system are interfered with at the same time.

1. All lights go out suddenly. Probable cause, (*a*) fuse blown, (*b*) battery connection broken, (*c*) battery lug broken.

2. Fuse blows or lamps go dull when one set of lamps are switched on. Short-circuit in either the wiring, flexible leads, or the bulb itself.

3. Lamps grow dimmer even when engine is turning fast. (*a*) Pulley slipping on engine shaft, (*b*) belt slipping, (*c*) dynamo defective, (*d*) cut-out not working, (*e*) broken connection.

Ascertain that the driving pulley is really quite firm on shaft; sometimes a pulley seemingly fixed will give when under load owing to engine vibration. See that the belt is sufficiently tight; if it is slipping the ammeter needle will generally oscillate violently. Examine dynamo and see that all appears in order, that brushes are bearing firmly on the com., and that the cut-out is really making contact. Make sure there is no break in the conductor between the dynamo and switchboard or between the board and the battery.

4. Dynamo fails to generate. Same as No. 3, (*f*) broken field coil connections.

5. Lamps will not light from the battery but light very brightly from the dynamo. (*a*) Broken wire from the battery to switchboard, (*b*) battery fuse blown, (*c*) lug or connection broken in the battery itself, (*d*) one or more cells empty of acid.

6. Lamps grow dimmer when dynamo is rotated at cutting-in speed, (*a*) broken field connection whereby armature only short-circuits the cells when cut-in works, (*b*) battery reversed.

General Instructions.—In the event of anything going wrong, always see what is the matter at once, otherwise extensive damage may be done.

Short-circuits are generally easy to locate by switching on one circuit at a time, first the side, then the head, and then the tail lamp circuits. Before jumping to a conclusion try the bulbs in a different holder which you know to be in good order—it may be that the bulb has only burnt out. A very troublesome short-circuit is caused by the earthing of one only of the conductors in each of two leads. Thus the negative wire of the head lamps may be earthed by chafing or other cause, and yet will not show it, as the current has nowhere to flow to, having reached earth.

The same may apply to the positive lead of, say, the side lamps which will burn quite well as long as they only are alight, but the instant the head and side lamps are switched on together, the positive and negative leaks close the circuit through the earth or frame and short-circuit the battery, thereby blowing the fuse. In this event there is nothing to be done but carefully examine the wiring of both doubtful circuits, and if nothing can be found, to completely rewire both, this is often the quickest in the end.

If your lights go out, a simple way of testing for the fuse, or partial battery discharge, is to read the voltmeter, or to blow the electric horn if one is fitted to the car, as these fittings are generally connected before the fuse.

Where a dual ignition system is connected to your batteries particular care should be taken to look out for shorts, as the insulation on coils and the like is generally not up to the standard required by lighting equipment. Prolonged running on the dual system (generally 4 volts) should be avoided as it tends to run down two cells unduly, thereby leaving the rest of the battery in a higher state of charge than the cells used. This also applies to 4-volt horns used on an 8 or 12 volt battery. In this event it is wise to occasionally change the cells over so that all shall get an even discharge.

Sometimes it will be found, owing to absence of adjustment or spares, that the belt cannot be tightened. A plan to get you home is to sprinkle the belt with fuller's earth or powdered resin. This should only be done as a last resource, and the resin should be scraped off as soon as possible, as it tends to harden the belt. Belts should be occasionally dressed with castor or collon oil to keep them supple and to exclude moisture. If the belt is not in good condition, the

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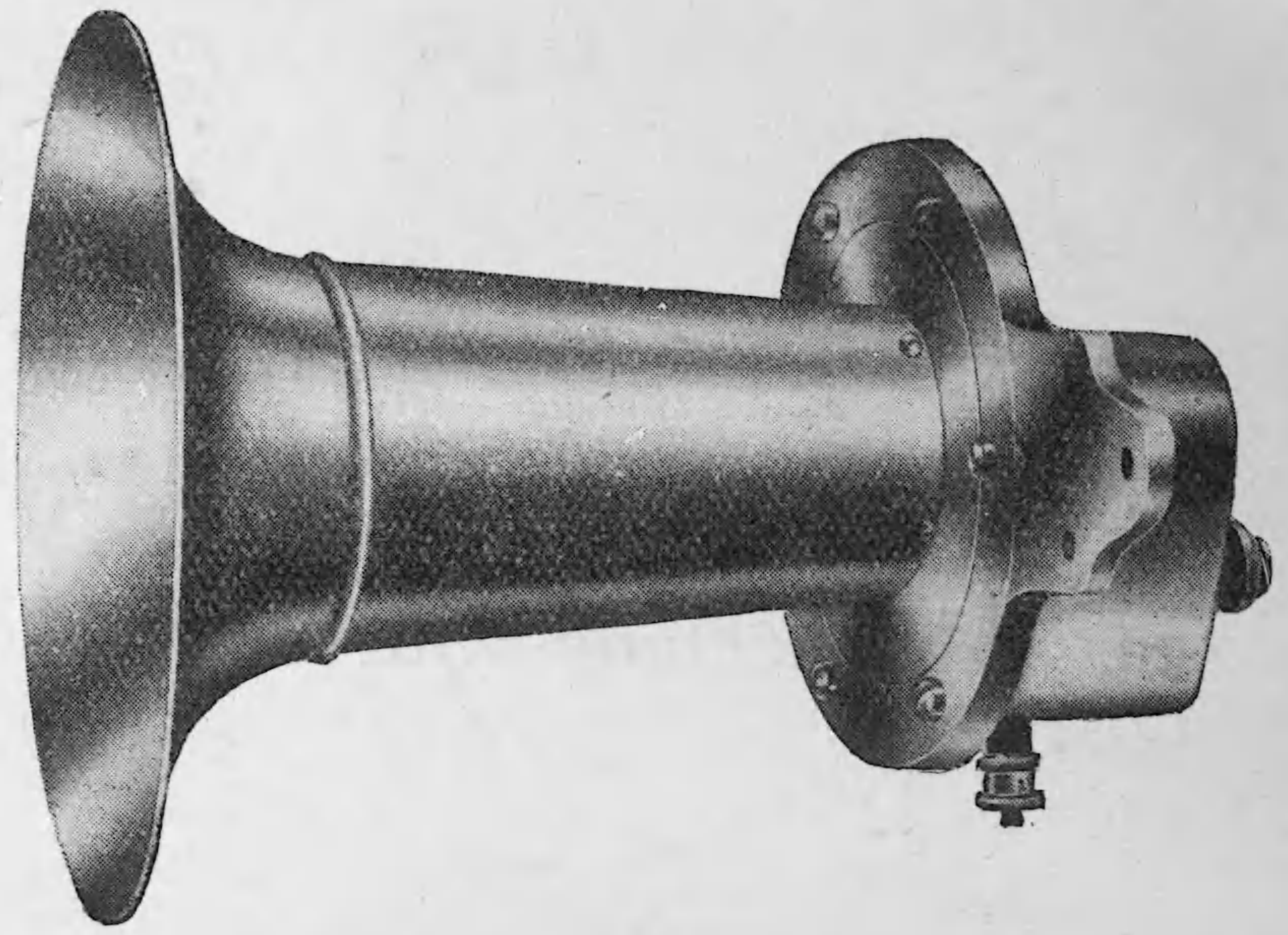

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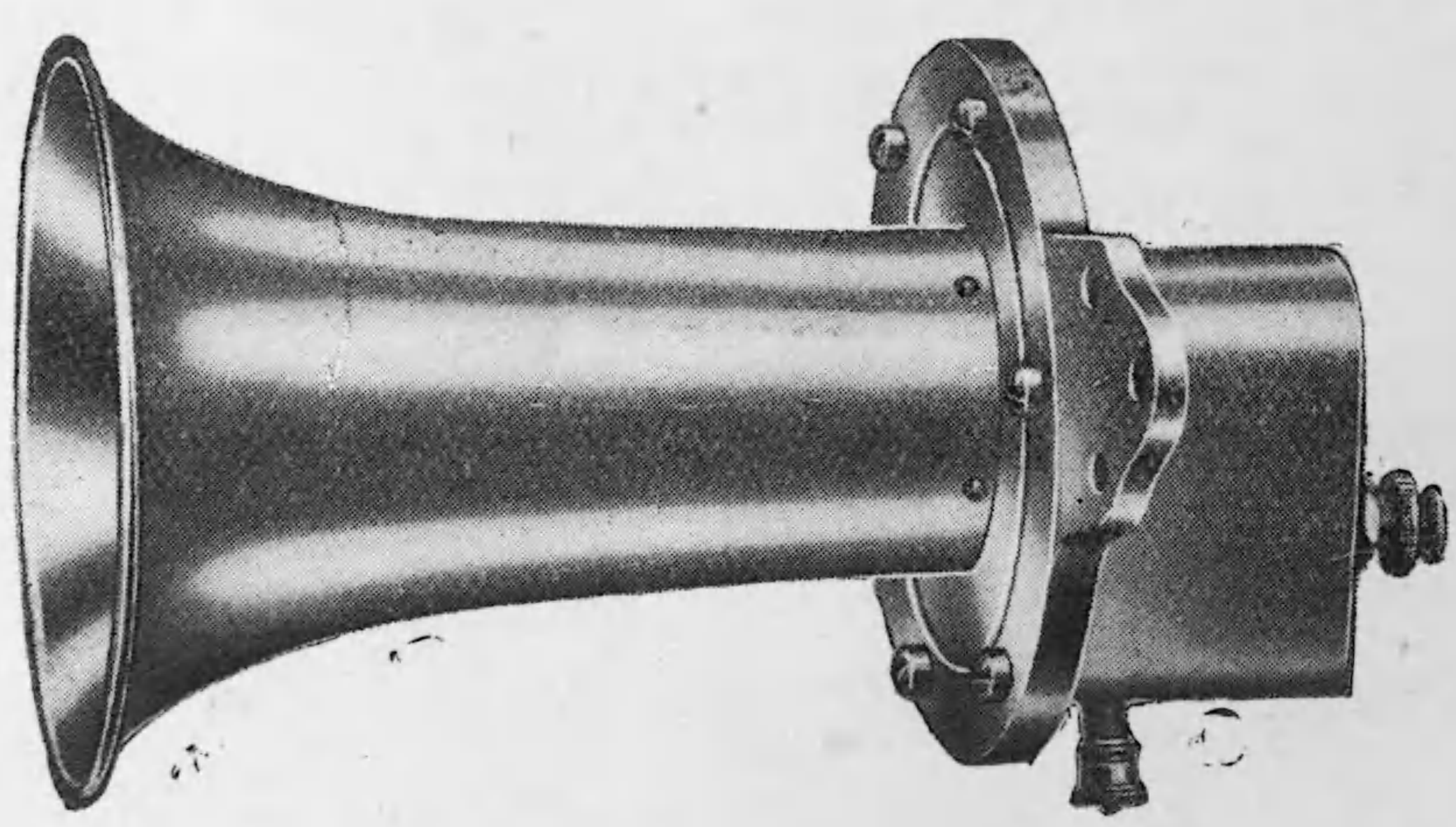

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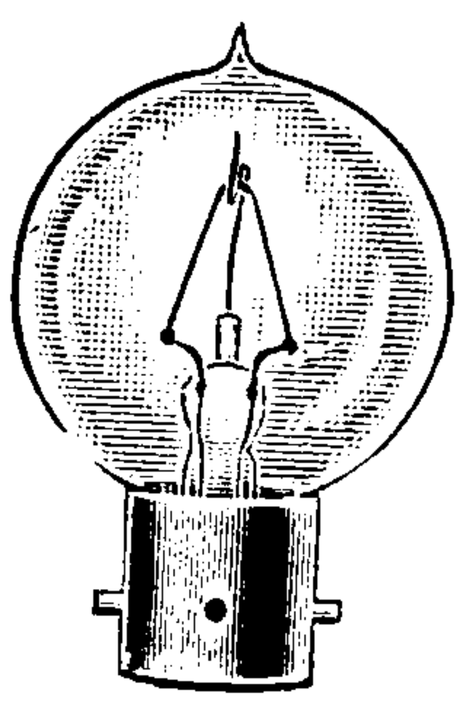

No.	Volt	Approx. c.p.	Price
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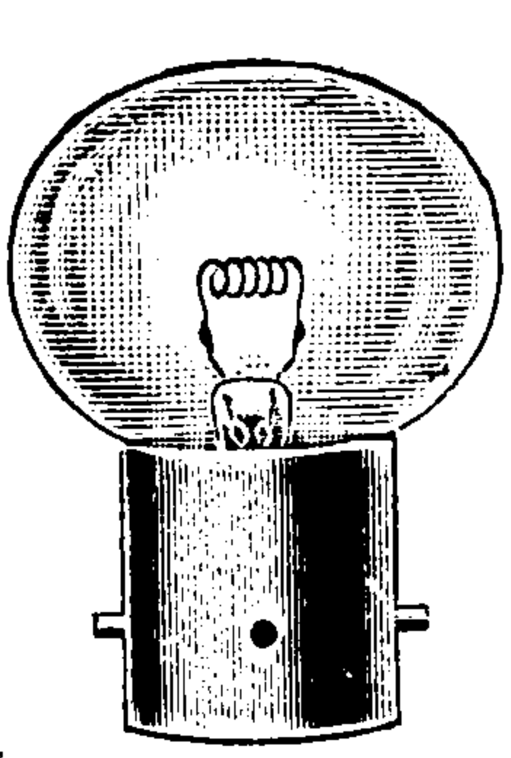
285	6	4·5	**1/4**
292	8	6	**1/4**
1404	12	12	**1/8**



No.	Volt	Approx. c.p.	Price
298	4	4	**1/4**
1441	6	4·5	**1/4**
1246	8	8	**1/4**
1537	12	6	**1/8**

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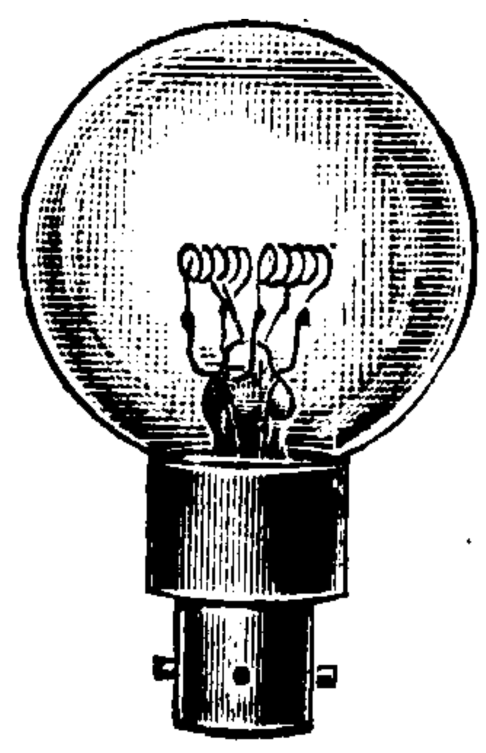

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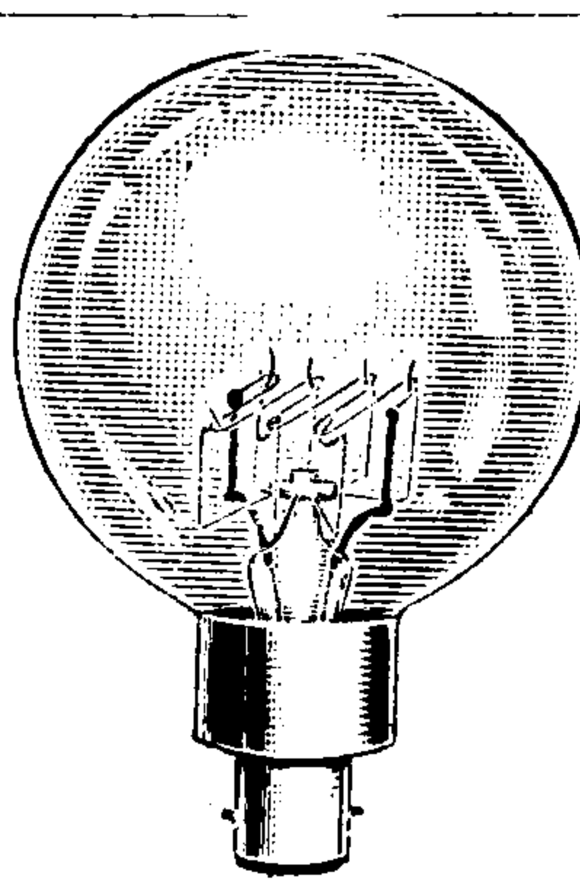

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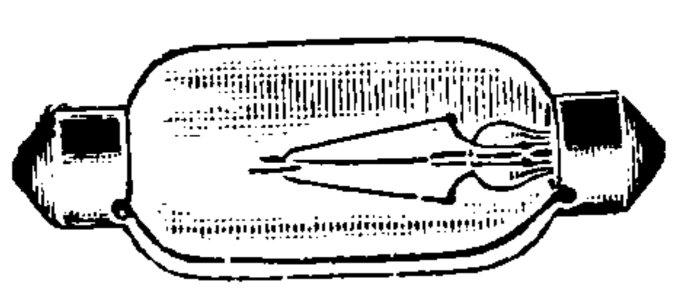

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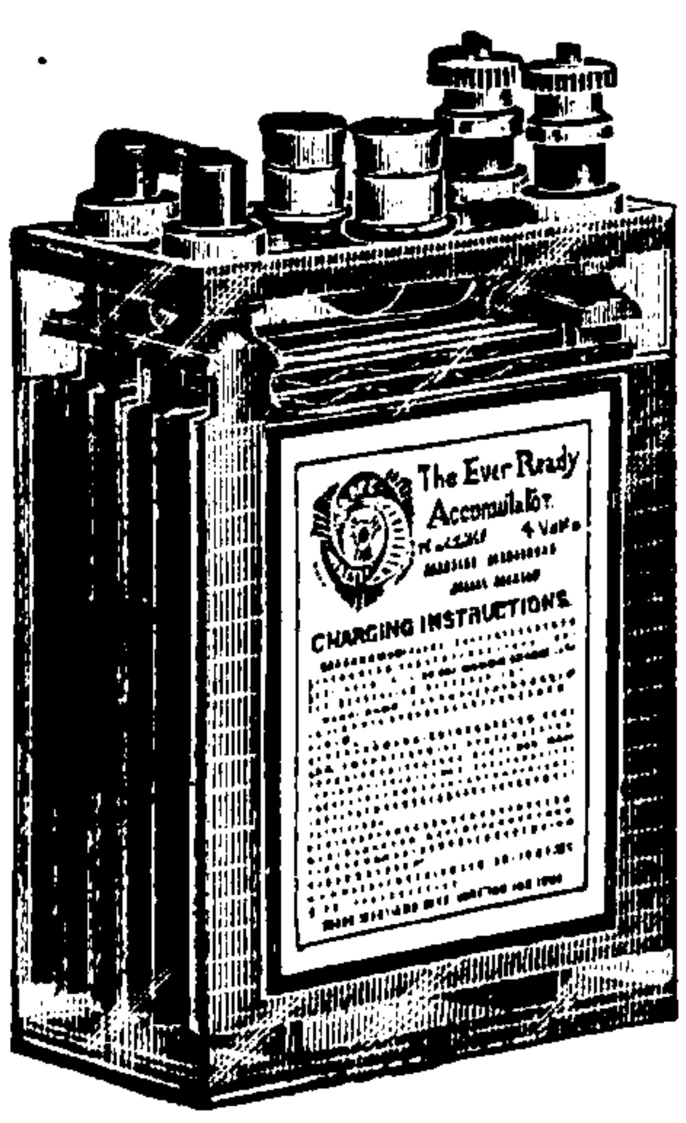

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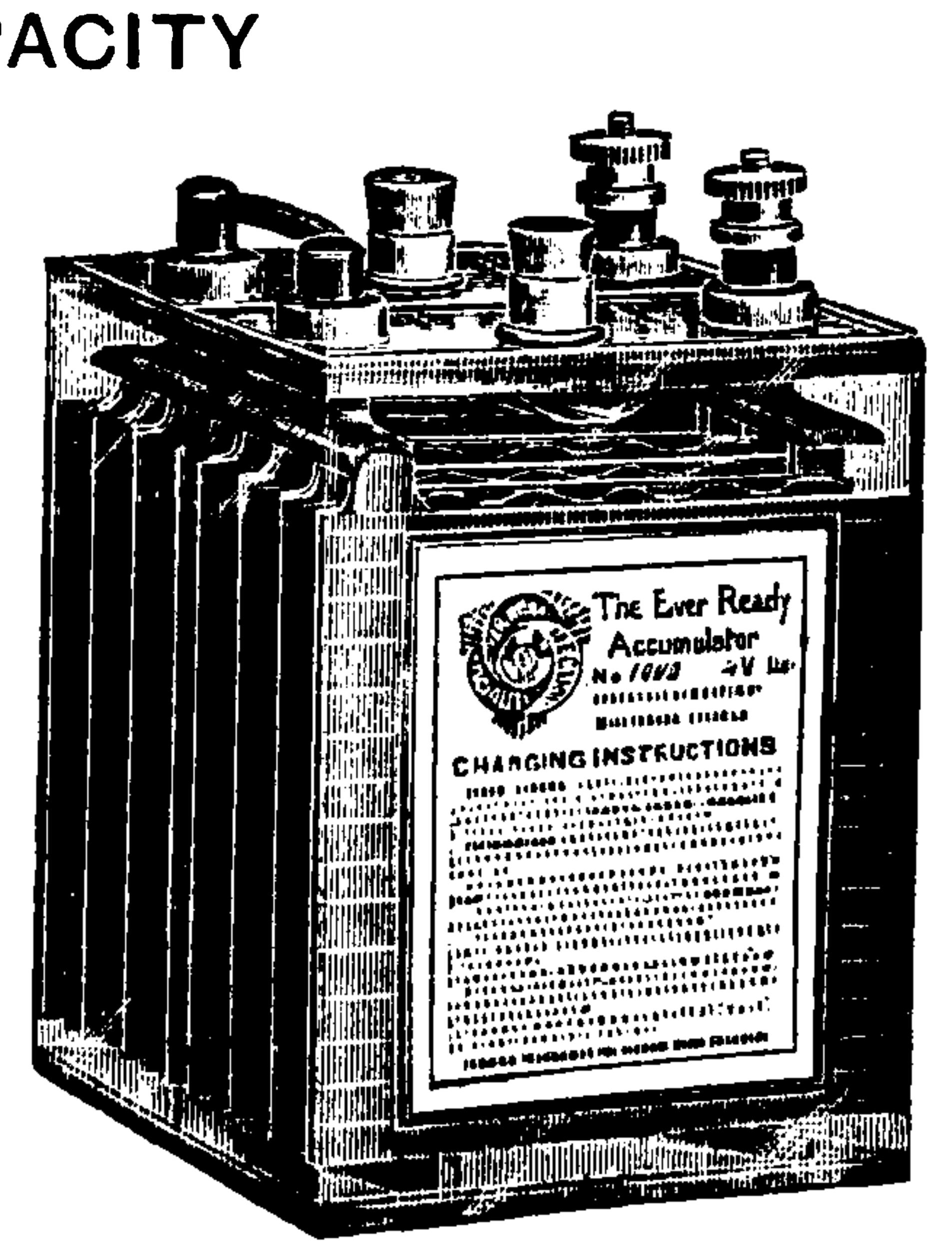
1330	4	100	**35/-**



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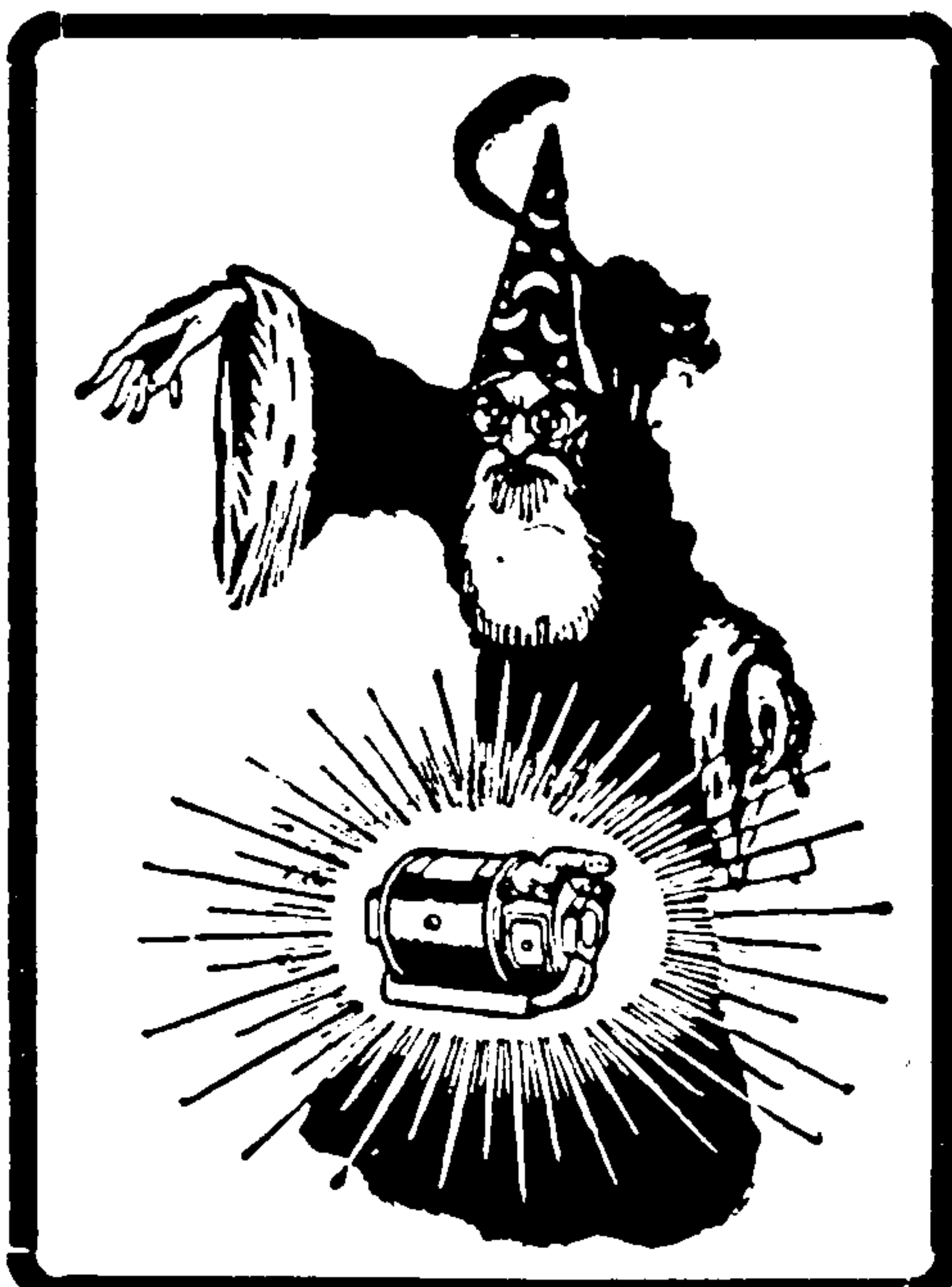

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