No. 647,155. Patented Apr. 10, 1900.

W. F. RICHARDS.

AUTOMATIC SWITCH FOR ELECTRIC CAR LIGHTING APPARATUS.

(Application filed June 5, 1899.)

(No Model.) 3 Sheets—Sheet 1.

Fig 1.

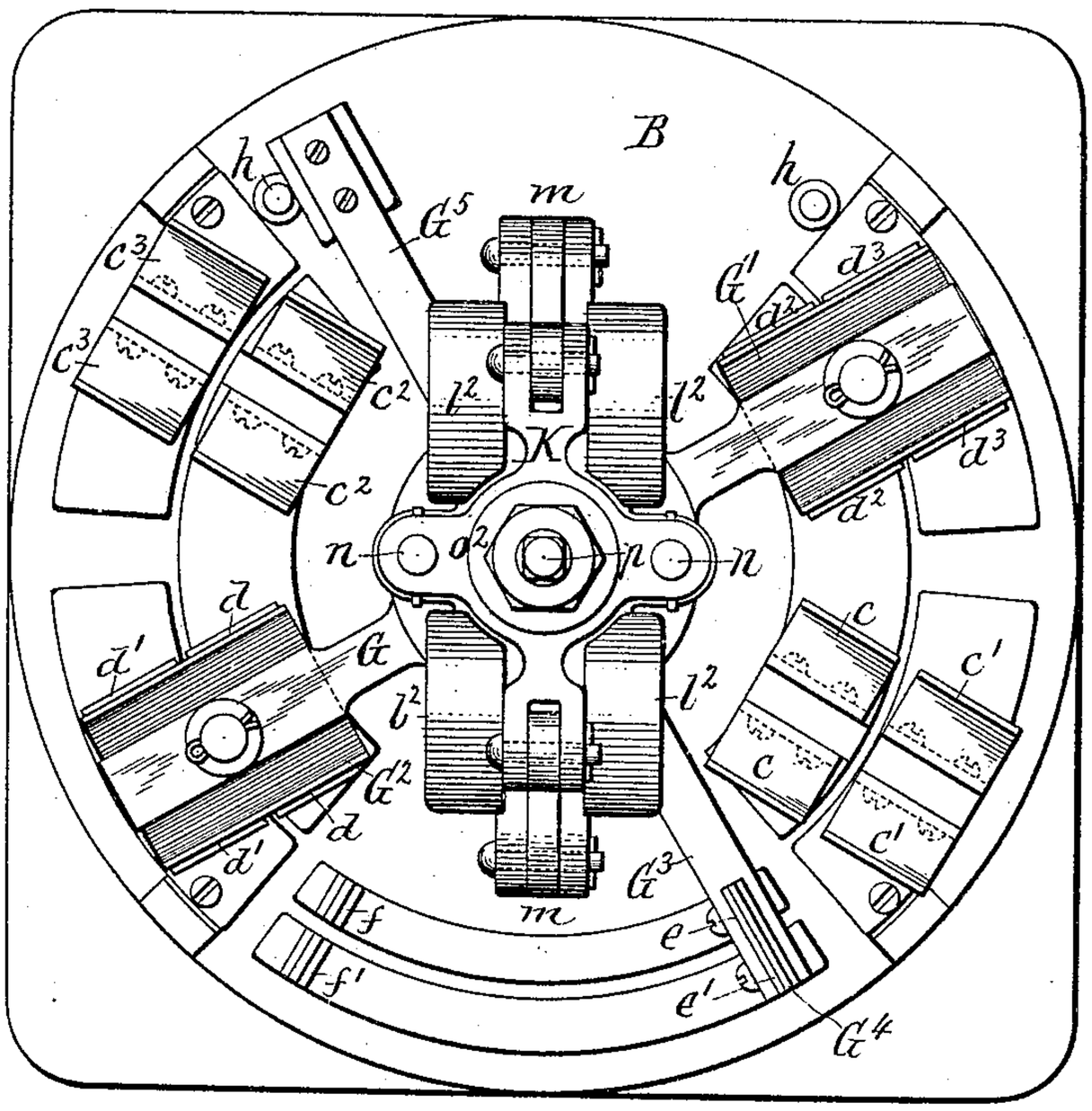
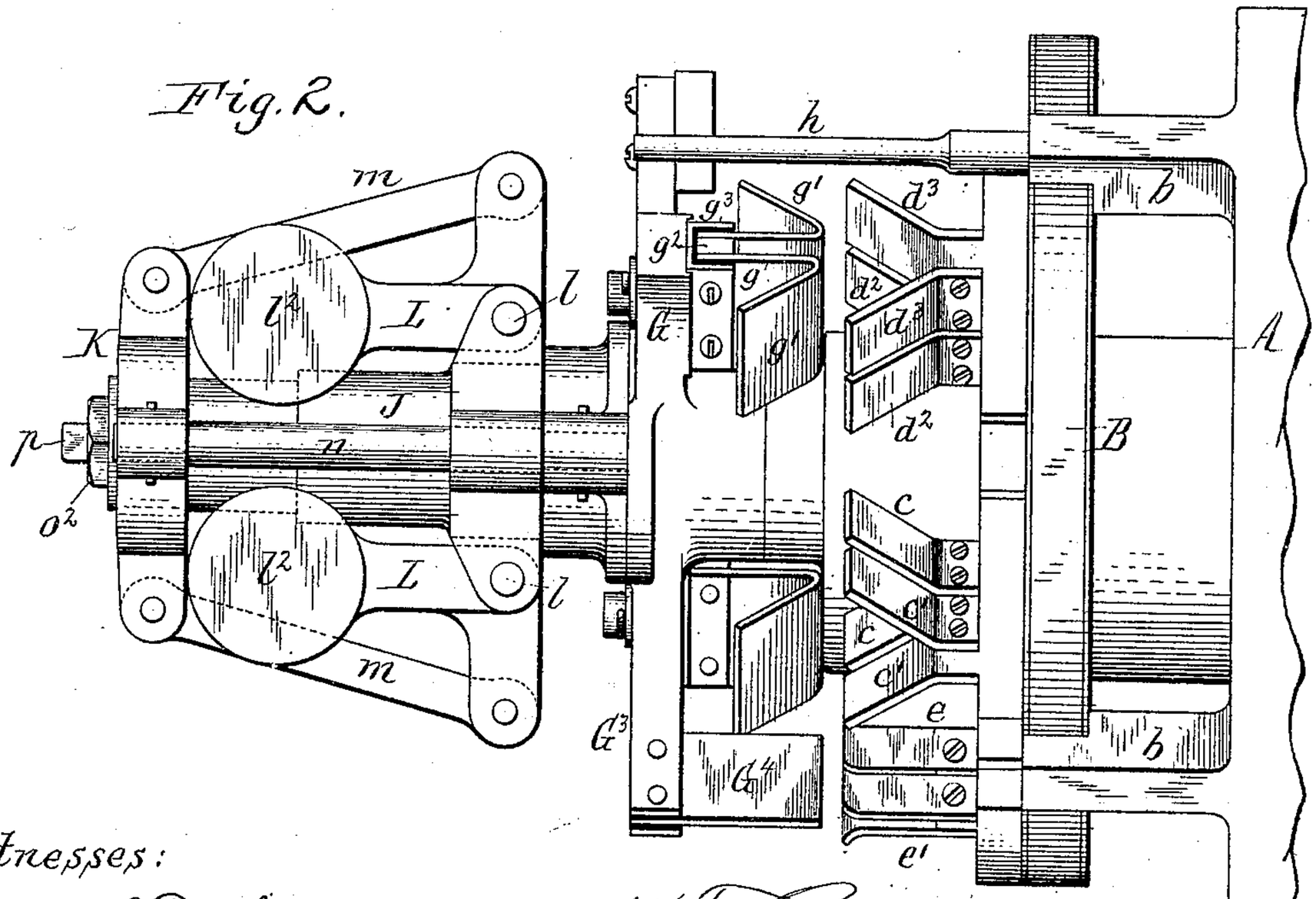


Fig. 2.



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(No Model.) 3 Sheets—Sheet 2.

Fig. 3.

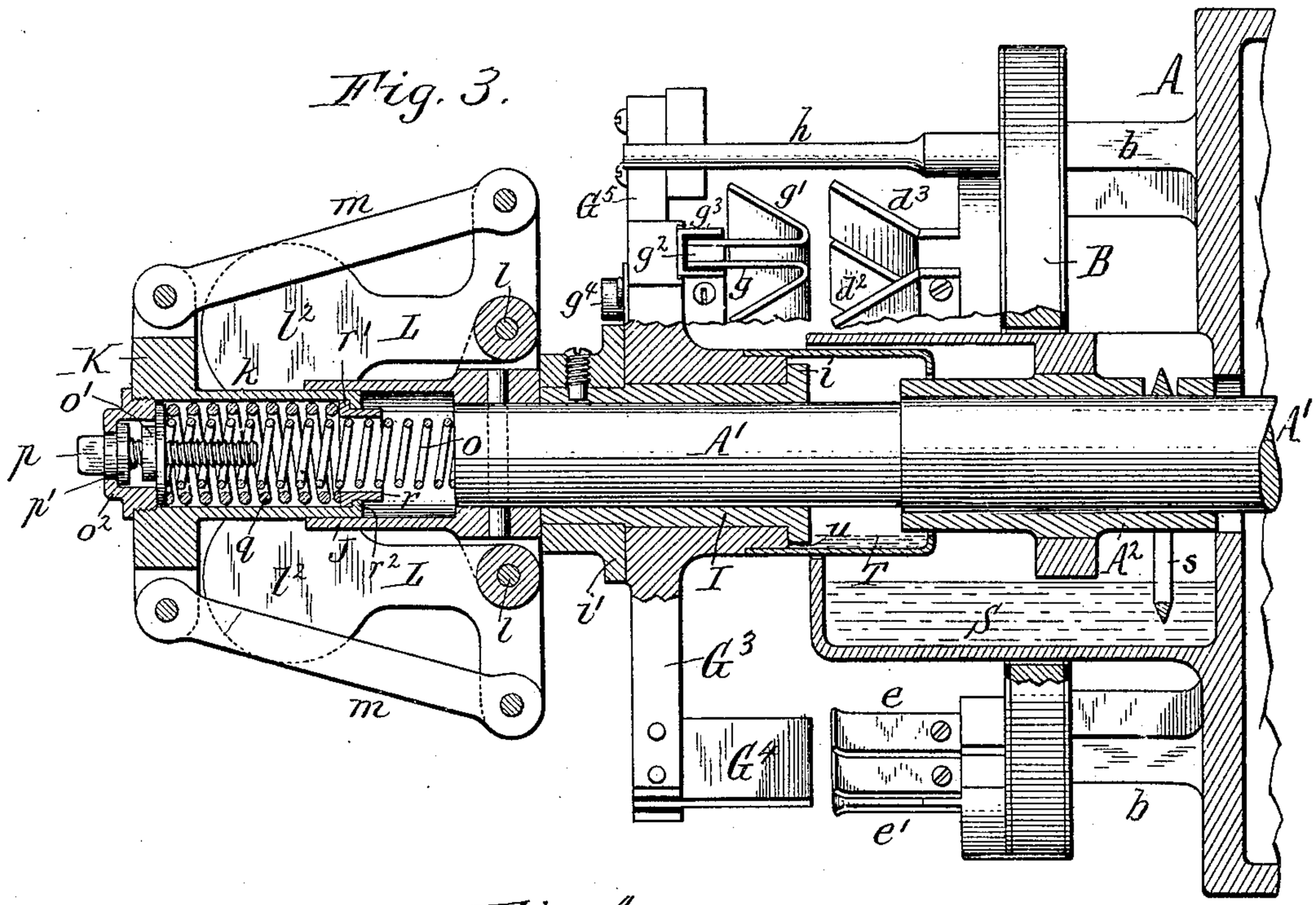

Fig. 4.

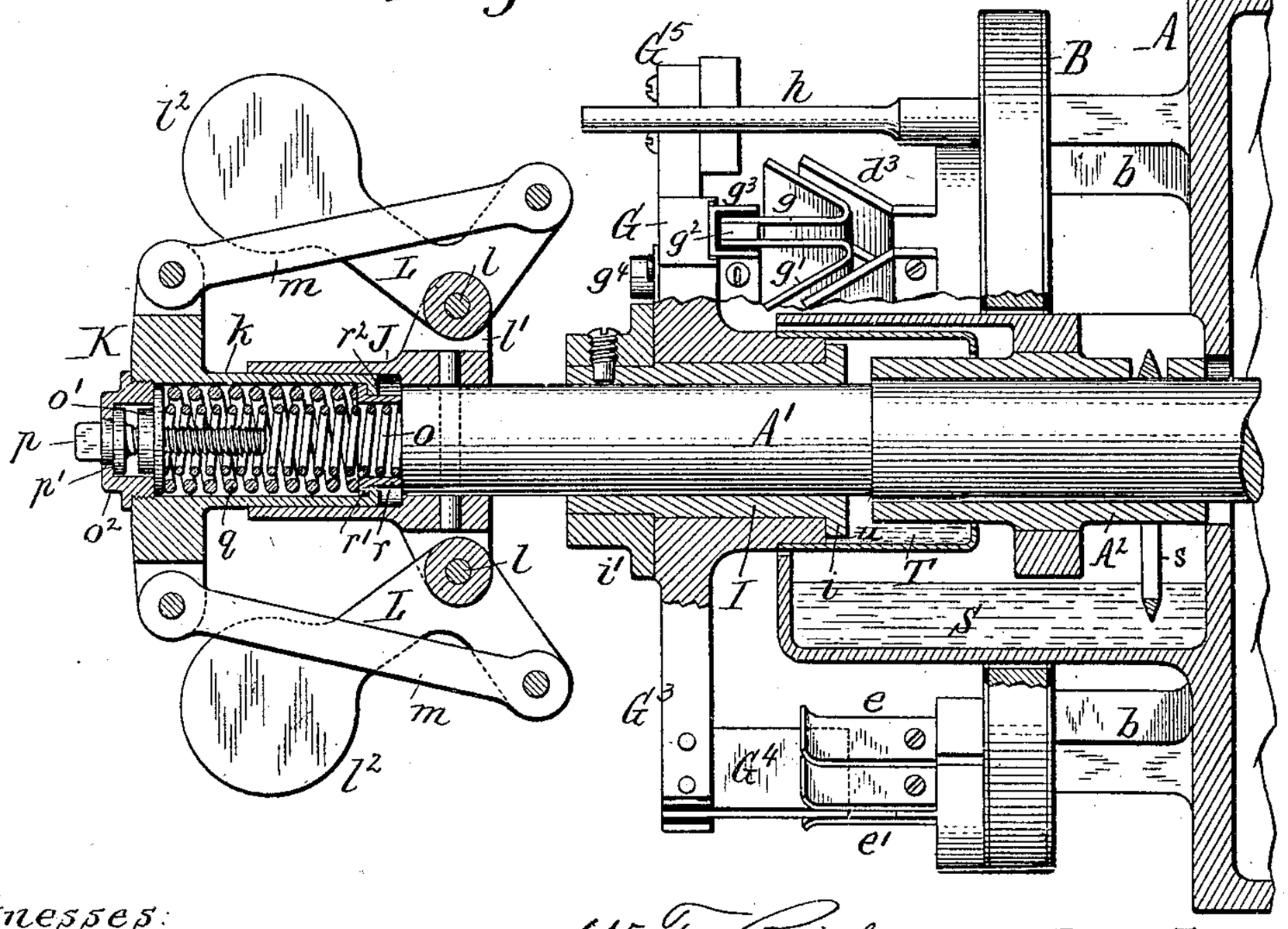

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Fig. 5.

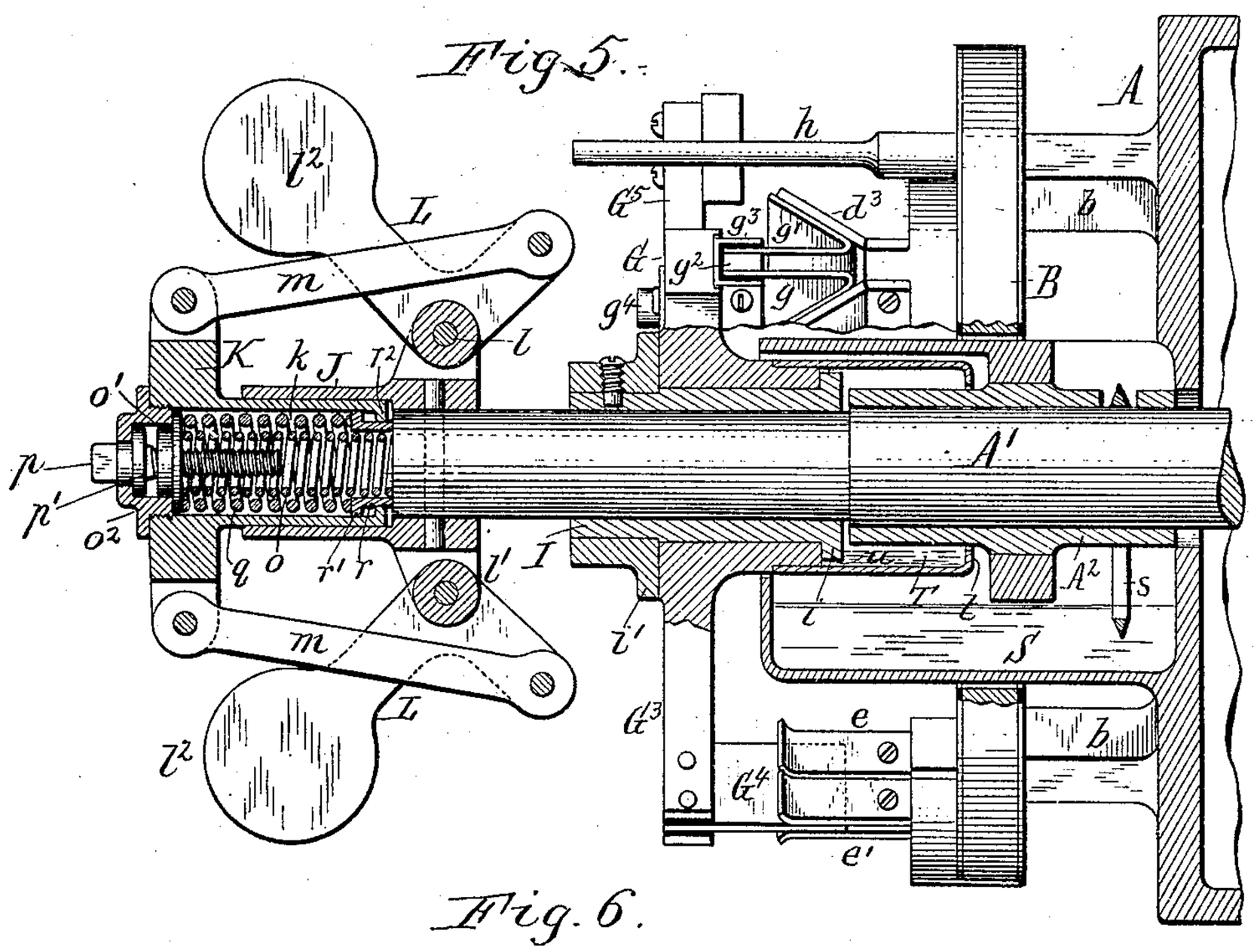


Fig. 6.

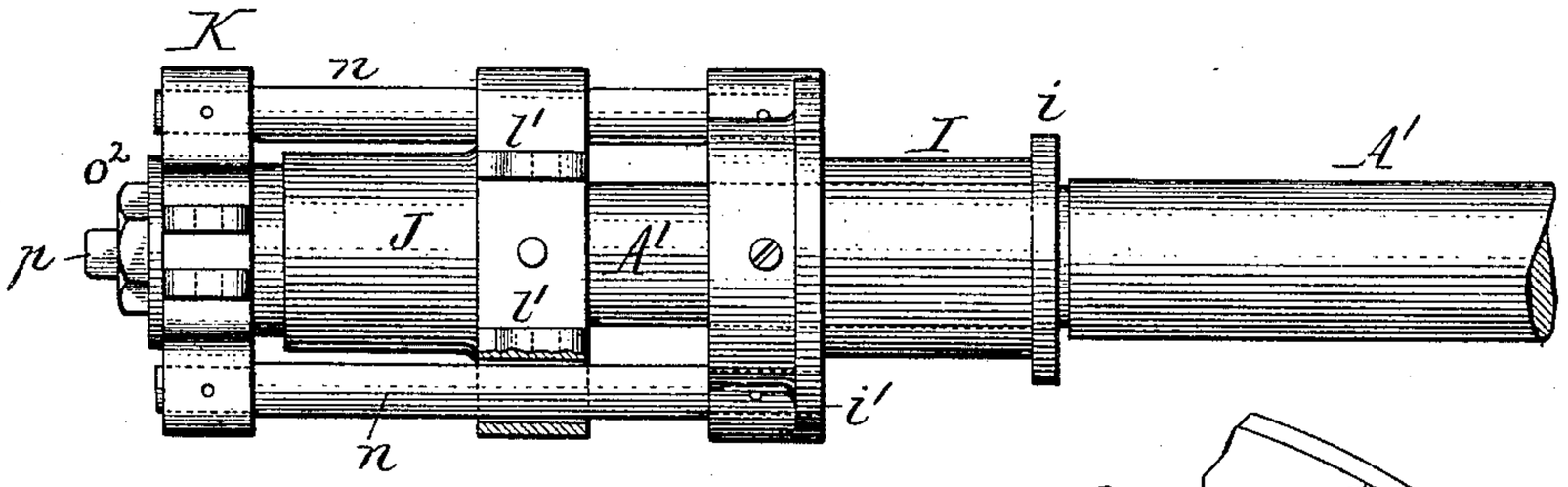


Fig. 7.

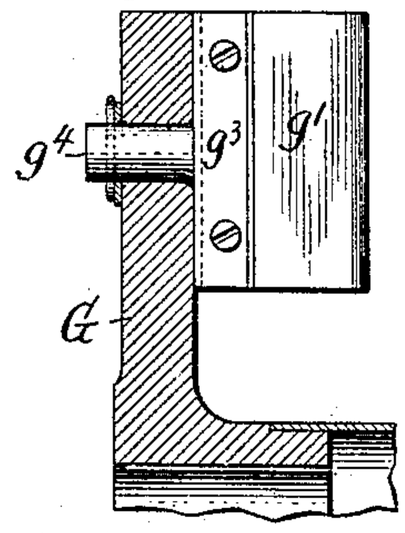
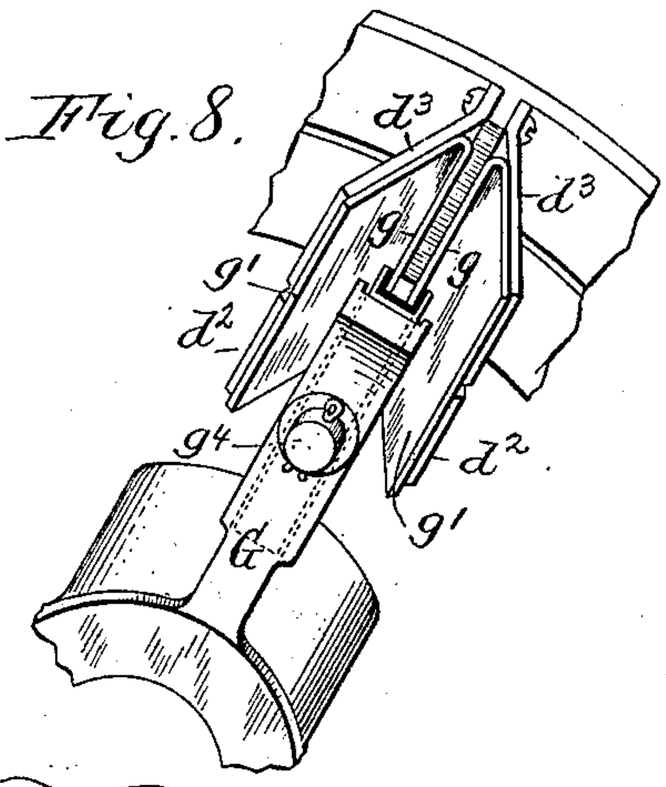


Fig. 8.



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UNITED STATES PATENT OFFICE.

WILLARD F. RICHARDS, OF BUFFALO, NEW YORK, ASSIGNOR TO CHARLES M. GOULD, OF NEW YORK, N. Y.

AUTOMATIC SWITCH FOR ELECTRIC CAR-LIGHTING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 647,155, dated April 10, 1900.

Application filed June 5, 1899. Serial No. 719,434. (No model.)

To all whom it may concern:

Be it known that I, WILLARD F. RICHARDS, a citizen of the United States, residing at Buffalo, in the county of Erie and State of New York, have invented new and useful Improvements in Automatic Switches for Electric Car-Lighting Apparatus, of which the following is a specification.

This invention relates to an automatic switch for electric-lighting apparatus of railway-cars, and more especially to switches of this kind having a reversible switch-lever which coöperates with two sets of contacts on the switchboard of the dynamo which is used in connection with the lighting apparatus, so that the lever connects the contacts of one set when the dynamo-shaft runs in one direction and connects those of the other set when the shaft runs in the opposite direction. Automatic switches of this kind are shown and described in Letters Patent of the United States No. 602,182, dated April 12, 1898, and No. 617,121, dated January 3, 1899, both granted to E. J. Preston and A. B. Gill.

The principal object of my invention is to so construct the automatic shifter or governor of the switch-lever that the lever has a comparatively-short range of movement in engaging with and leaving the contacts of the dynamo-switchboard, so as to effect a quick "make and break" and prevent sparking and the burning of the contacts resulting therefrom. When such burning occurs, the contacts prevent the proper entrance of the switch-plugs into the contact-sockets of the switchboard and impair the efficiency of the lighting apparatus.

The invention has the further objects to provide simple means for regulating the resistance offered to the automatic centrifugal governor or shifter of the switch-lever, to provide simple means for lubricating the switch-lever and its carrying-sleeve and to improve the construction of the contact-plugs and sockets with a view of insuring a full and efficient contact.

In the accompanying drawings, consisting of three sheets, Figure 1 is a front view of the switch and its controller. Fig. 2 is a side elevation thereof, showing the position of the parts when the dynamo is at rest. Fig. 3 is a longitudinal sectional elevation of the switch, showing the parts in the same position. Fig. 4 is a view similar to Fig. 3, showing the position of the parts when the battery is connected with the field-magnets of the dynamo for exciting the same preliminary to switching in the lighting or service circuit. Fig. 5 is a similar view showing the position of the parts when the dynamo has reached the normal voltage and is connected with the service-circuit. Fig. 6 is a top plan view of the carrying-sleeve of the switch-lever and the connection between the same and the sliding head of the governor or shifter, the governor arms and balls and the links which connect the arms with said head being omitted. Fig. 7 is a fragmentary longitudinal section of the switch-lever, showing the swiveling connection of one of its contacts. Fig. 8 is a fragmentary perspective view of the switch-lever and the adjacent portion of the dynamo-switchboard.

Like letters of reference refer to like parts in the several figures.

A is the frame of the dynamo, and A′ the armature-shaft, which turns in the usual bearing A^2, projecting from the dynamo-frame.

B is the upright switchboard, connected with the dynamo-frame by the usual brackets *b*.

c c′ c^2 c^3 are contacts arranged on the face of the switch-board on diametrically-opposite sides of its center and constituting one set of armature, field, and light-circuit terminals, and *d d′* d^2 d^3 are similar contacts constituting the other set of armature, field, and light terminals.

e e′ and *f f′* represent the two sets of battery and field contacts for exciting the field-magnets of the dynamo. The wire connections leading from these various contacts are well understood in the art and are therefore not shown in the drawings.

G is the oscillating switch-lever, arranged opposite the switchboard B and provided on its front side, on diametrically-opposite sides of its pivot, with plugs or contacts G′ G^2, which are adapted to enter between the opposing blades of one or the other set of switchboard-contacts *c* c^3 and *d* d^3. The opposing blades or springs, which form each of the main con-

tacts c c^3 and d d^3, diverge outwardly, so as to form a V-shaped mouth or socket, which receives the corresponding plug of the switch-lever. Each of these plugs preferably consists of two elastic plates or flat springs, the inner portions or shanks g of which are substantially parallel with each other, while their outer portions are bent outwardly and rearwardly in opposite directions to form elastic wings g'. The wings of each plug converge forwardly at an angle corresponding to that of the opposing V-shaped contact-socket of the switchboard, so that the wings of the plugs bear against the walls of the sockets upon entering the same. The shanks g of the wings are connected at their inner ends by a metallic block g^2, which separates the shanks, allowing the same and the wings g' to yield laterally for accommodating themselves to the V-shaped contact-sockets of the switchboard. The connected inner ends of the plug-shanks are secured in a channeled head g^3, which is carried by the switch-lever and from which they are isolated, as shown. In order to enable the plugs to adapt themselves to any imperfections in the construction or postion of the contact-sockets, each plug is swiveled to the switch-lever by a stud g^4, arranged parallel with the armature-shaft. The stud projects rearwardly from the block and turns in an opening or bearing formed in the switch-lever, the stud being confined in its bearing by a cotter or other suitable means. In case the contact-sockets of the switchboard have slight imperfections or are not exactly in a radial position on the switchboard, the swiveled construction of the plugs permits the same to turn into proper alinement with the sockets in entering the same, so as to obtain an efficient contact.

G^3 is the auxiliary arm of the switch-lever, which carries a plug or blade G^4, adapted to engage with one or the other pair of battery and field contacts e e' and f f', and G^5 is the stop-arm of the switch-lever, which is adapted to engage against one or the other of two stops or rods h, projecting from the switchboard for limiting the oscillating movement of the switch-lever in both directions when its plugs arrive opposite the contacts of the switchboard. The various contacts of the switchboard are so arranged relatively to the plugs of the switch-lever that the plug G^4 of the field and battery contacts e e' and f f' connects a pair of these contacts before the main plugs G' G^2 connect the main sets of contacts, so as to switch the battery into the field-circuit of the dynamo in advance of switching the service-circuit into the dynamo or main circuit. The switch-lever is carried by a sleeve I, upon which it turns and which is free to slide upon the armature-shaft for shifting the lever toward and from the switchboard. The switch-lever is confined against longitudinal movement on the carrying-sleeve I by a projecting flange i, formed at the inner end of the sleeve, and a collar i', secured to the outer end thereof.

J is a longitudinal socket rigidly secured to the outer end of the armature-shaft, and K is the movable head of a centrifugal governor or shifter, which is provided on its inner side with a tubular stem or extension k, which slides lengthwise in the socket J.

L L represent elbow-levers arranged on diametrically-opposite sides of the sockets J and pivoted at their angles to said socket by transverse pins l, which pass through the levers and through lugs l', formed at the inner end of the socket. The outer arms of these elbow-levers are provided with weights l^2, while their inner arms are connected with the movable governor-head K by longitudinal links m, whereby the governor-head is caused to slide lengthwise of the armature-shaft as the revolving governor-weights move in and out under the influence of centrifugal force. The weights and their levers are preferably bifurcated or arranged in pairs, so as to admit the links m between the members of the same, as shown in Fig. 1.

n represents longitudinal rods which connect the carrying-sleeve I of the switch-lever with the governor-head K and which are secured at their outer ends in perforated lugs of the head and at their inner ends in similar lugs formed on the collar i' of said sleeve, as shown in Fig. 6. By this connection the carrying-sleeve is compelled to take part in the sliding movements of the governor-head.

o is a comparatively-light primary spring arranged in the socket J and the tubular stem k of the governor-head and abutting at its inner end against the adjacent end of the armature-shaft and at its opposite end against an adjustable follower or nut o'. This follower bears against a removable cap o^2, secured in an axial opening formed in the outer side of the governor-head and has a screw-threaded opening which engages with a rotary longitudinal screw p, which passes through the cap o^2 and extends into the hollow stem of the governor-head. This screw is provided with a stop-collar p', which bears against the inner side of the cap o^2, so as to hold the screw against outward movement, and the projecting end of the screw is square or flat-sided, so that it can be turned by a suitable wrench.

q is a secondary spring arranged in the stem k of the governor-head around the primary spring o and adapted to come into action when the centrifugal weights of the governor overcome the resistance of the primary spring. This secondary spring is considerably heavier or stiffer than the primary spring and bears at its outer end against the follower o' and at its inner end against a sliding abutment or thimble r, arranged in the inner end of the stem k of the governor-head. This thimble projects normally beyond the inner end of the stem k and is provided at its outer end with

an outwardly-extending flange r', which bears against the outer side of an inwardly-projecting flange r^2, formed at the inner end of the stem k, so as to limit the inward movement of the thimble in the stem, while permitting the stem to slide inwardly on the thimble when the latter abuts against the end of the armature-shaft, as shown in Fig. 5. The light primary spring o is so long that it extends inwardly some distance beyond the sliding thimble r when the dynamo is at rest and the switch-bar is open or fully withdrawn, as shown in Figs. 2 and 3, so that the light spring is compressed in advance of the heavy spring.

The inward movement of the screw p is resisted by the heavy spring, which bears against the follower o'. The follower, while free to move lengthwise of the screw, is held against turning by its frictional contact with the heavy spring, so that upon turning the screw the follower is caused to traverse the same, thereby increasing or diminishing the tension of the springs.

When the dynamo is set in motion by the running of the railway-car, the switch-lever G is caused to turn in the same direction as the armature-shaft of the dynamo by the frictional contact of its carrying-sleeve I with the shaft, the sleeve and lever turning with the shaft until the stop-arm G^5 of the lever strikes the stop h in front of it, when the lever is arrested in the proper position to bring its contact-plugs G' G^2 in line with the opposing set of switchboard-contacts. In the normal retracted position of the switch-lever (shown in Figs. 2 and 3) the governor-weights are in their innermost position and held in that position by the light spring o, which tends to move the sliding governor-head K outwardly. The thimble r is in its innermost position and out of contact with the armature-shaft, and the heavy spring q is therefore inoperative and does not affect the action of the governor. As the speed of the armature-shaft increases the spreading governor-weights gradually overcome the resistance of the light spring o and move the switch-lever forward sufficiently to cause its plug G^4 to enter between the opposing battery and field contacts e e' or f f', as shown in Fig. 4, thereby switching the battery into the circuit of the field-magnets, exciting the latter and assisting the dynamo in quickly reaching the desired normal voltage. The light spring is made of such length or stiffness that as soon as the switch-lever moves inwardly far enough to connect the battery and field contacts the sliding thimble r comes in contact with the end of the armature-shaft and forms a stationary abutment for the inner end of the heavy spring q. The heavy spring is now brought into action and supplements the resistance of the light spring. The heavy spring is made so stiff that it prevents the further advance of the switch-lever until the increasing speed of the armature-shaft reaches the necessary degree to produce the desired voltage or output of the dynamo. As soon as this speed is attained the centrifugal governor overcomes the added resistance of the heavy spring and shifts the switch-lever into engagement with the opposing main contacts of the switchboard, thereby switching the dynamo into the light or other service circuit. This circuit is maintained as long as the speed of the dynamo remains at or above the normal; but as soon as the speed falls below the normal the compressed heavy spring reacts and withdraws the switch-lever from said main contacts through the medium of the governor-head and the connections between the same and the carrying-sleeve I of the switch-lever. When the dynamo again attains the normal speed, the heavy spring is again overcome, and the switch-lever is returned into engagement with the main contacts of the switchboard in the manner above described. It will thus be understood that the light spring o alone resists the making or closing of the battery and field-circuit and that the heavy spring q comes into action after said circuit is established and resists the making or closing of the service-circuit until the voltage of the dynamo is raised to the desired predetermined degree, when the centrifugal governor or shifter overpowers also the heavy spring and causes the dynamo to be switched into the service-circuit. As the heavy spring is under considerable compression when in action, it promptly retracts the switch-lever and breaks the circuit quickly the moment that the speed of the dynamo falls below the normal. The switch-lever is thereby caused to make and break the main or service circuit by a comparatively short and quick movement, which prevents sparking and burning out of the switch-contacts. The short heavy spring forms a stiff resistance, which varies comparatively little during the fluctuations of the voltage from the normal to points above the normal, thereby maintaining a full and reliable contact and avoiding the imperfect and uncertain contact which results from the employment of a single long spring which is comparatively light.

The elbow-levers L of the governor are so arranged that their weighted arms are substantially parallel with the armature-shaft and their other arms at right angles thereto when the weights are in their innermost position, as shown in Fig. 3. This peculiar arrangement of the elbow-levers, in connection with the arrangement of the links m, gives the governor or shifter a favorable leverage against the resisting-springs, which is effective in all positions of the levers.

By means of the adjusting-screw p and follower o' the tension of the heavy spring can be readily regulated for obtaining the proper resistance.

In order to further insure an efficient contact of the switch-plugs and sockets, sufficient clearance is left between the inner end of the stem K of the governor-head and the end of the armature-shaft to prevent said stem from

coming in contact with the shaft in the innermost position of the governor-head, so that the governor is free to firmly force the elastic plugs into their sockets as long as the dynamo runs at or above the proper normal speed, thereby securing a close contact, which is not affected by the vibrations of the car, and insuring a steady light service. The diverging springs forming the contact-sockets preferably have a comparatively-small pitch, or, in other words, are arranged at a comparatively-small angle to the face of the switchboard, so that the switch-plugs are not tightly wedged between the springs, but simply bear against the same like flat contacts. This construction permits the springs *o* and *q* to easily withdraw the plugs when the voltage of the dynamo falls below the normal. The elastic shanks and wings of the switch-plugs are deflected toward each other when forced into the V-shaped contact-sockets of the switchboard, and therefore have a constant tendency to spring outwardly, and this action of the plugs assists the springs *o* and *q* in withdrawing the plugs from the contact-sockets. This feature, in connection with the flaring construction of the contact-sockets above described, permits the use of smaller governor-weights and lighter springs.

S is the usual oil receptacle or chamber, which incloses the bearing of the dynamo-shaft and from which oil is supplied to the top of the shaft by the usual loose ring *s* or any other suitable feed device.

T is any auxiliary lubricating chamber or reservoir arranged in the main receptacle S and serving to supply oil to the hub of the switch-lever G and its carrying-sleeve I. This auxiliary reservoir consists of a horizontal tube which extends through an opening formed in the front wall of the main receptacle and surrounds the inner portion of the carrying-sleeve and the outer portion of the shaft-bearing, so as to receive the surplus oil dropping from the dynamo-shaft. The front portion of this tube is secured to and closely fitted upon the hub of the switch-lever, so that said hub closes the front end of the tube. The tube is provided at its inner end with an inwardly-turned annular lip or dam *t*, which extends to within a short distance of the surface of the shaft-bearing, so as to retain a sufficient quantity of oil in the auxiliary reservoir to keep the switch-lever and its carrying-sleeve well lubricated. The flange *i* of the carrying-sleeve I is somewhat smaller in diameter than the internal diameter of the reservoir T, so as to leave a narrow space *u* between these parts through which the oil passes to the carrying-sleeve and the switch-lever. Any overflow of the auxiliary reservoir T is discharged into the main reservoir.

I claim as my invention—

1. The combination with a dynamo and its switchboard having terminal contacts, of a switch member capable of moving toward and from said contacts, a centrifugal governor or shifter mounted on the dynamo-shaft and connected with said switch-lever, a light spring arranged to resist the initial forward movement of said lever, and a heavier spring which is arranged to come into action after the light spring and which resists the subsequent forward movement of said lever, substantially as set forth.

2. The combination with a dynamo and its switchboard having terminal contacts, of a switch member capable of moving toward and from said contacts, a centrifugal governor or shifter mounted on the dynamo-shaft, a light spring arranged lengthwise of the dynamo-shaft and interposed between the movable head of said governor and the dynamo-shaft, and a heavy spring arranged concentric with said light spring and bearing at its outer end against said head and adapted to come into action after said light spring, substantially as set forth.

3. The combination with a dynamo and its switchboard having terminal contacts and the dynamo-shaft provided in its outer end with a socket, of a switch member movable toward and from said contacts, a centrifugal governor mounted on the dynamo-shaft and connected with said switch member, the movable head of the governor having a tubular stem which slides in the socket of the dynamo-shaft, and light and heavy springs arranged in said socket and stem between the bottom of the socket and the governor-head, substantially as set forth.

4. The combination with a dynamo and its switchboard having terminal contacts and the dynamo-shaft provided in its outer end with a socket, of a switch member movable toward and from said contacts, a centrifugal governor mounted on the dynamo-shaft and connected with said switch member, the movable head of the governor having a tubular stem which slides in the socket of the dynamo-shaft, a movable thimble or abutment capable of sliding in said stem and projecting normally beyond the same, a light spring arranged in said socket and stem between the bottom of the socket and the governor-head, and a heavy spring arranged in said stem between the governor-head and said thimble or abutment, substantially as set forth.

5. The combination with a dynamo and its switchboard having terminal contacts and the dynamo-shaft provided in its outer end with a socket, of a switch member movable toward and from said contacts, a centrifugal governor mounted on the dynamo-shaft and connected with said switch member, the movable head of the governor having a tubular stem which slides in the socket of the dynamo-shaft, an adjustable follower arranged in said stem, a light spring arranged in said stem and socket between the bottom of the socket and said follower, and a shorter heavy spring also arranged in said stem and bearing at its outer end against said follower, substantially as set forth.

6. The combination with a dynamo and its switchboard having terminal contacts and a switch member movable toward and from said contacts, of a sliding governor-head movable lengthwise on the dynamo-shaft and connected with said switch member, a collar secured to the dynamo-shaft, a spring bearing against said governor-head, weighted levers pivoted to said collar and having outwardly-projecting arms, and longitudinal links connecting said arms with said head, substantially as set forth.

7. The combination with the dynamo-shaft and its bearing and the switchboard having terminal contacts, of a movable carrying-sleeve mounted on the dynamo-shaft, a switch-lever mounted on said sleeve, a main oil-reservoir for lubricating said shaft-bearing, and an auxiliary oil-reservoir arranged within said main reservoir around said shaft-bearing and supplying oil to said switch-lever and its carrying-sleeve, substantially as set forth.

8. The combination with the dynamo-shaft and its bearing and the switchboard having terminal contacts, of a movable carrying-sleeve mounted on the dynamo-shaft, a switch-lever mounted on said sleeve, a main oil-reservoir for lubricating said shaft-bearing, an auxiliary reservoir surrounding the adjacent portions of said shaft-bearing and said carrying-sleeve and consisting of a tube secured to the hub of said switch-lever and provided at its rear end with an inwardly-extending lip or dam which retains the oil in said tube, substantially as set forth.

9. The combination with a switchboard having a tapering contact-socket, of a switch member having a contact-plug which is composed of two separate elastic shanks, projecting forwardly from their support and free to be sprung toward each other, and oblique wings which extend outwardly and rearwardly from the front ends of said shanks and are adapted to enter said socket, substantially as set forth.

10. The combination with the switchboard having a tapering contact-socket, and a switch member which is movable toward and from the switchboard, of a swiveling contact-plug arranged on the face of the switch member and supported on the same by a stud which extends rearwardly from the plug and is journaled on the switch member, and on which the plug swivels freely in adjusting itself to the tapering socket in entering the latter, substantially as set forth.

Witness my hand this 31st day of May, 1899.

WILLARD F. RICHARDS.

Witnesses:

JNO. J. BONNER,

ELLA R. DEAN.