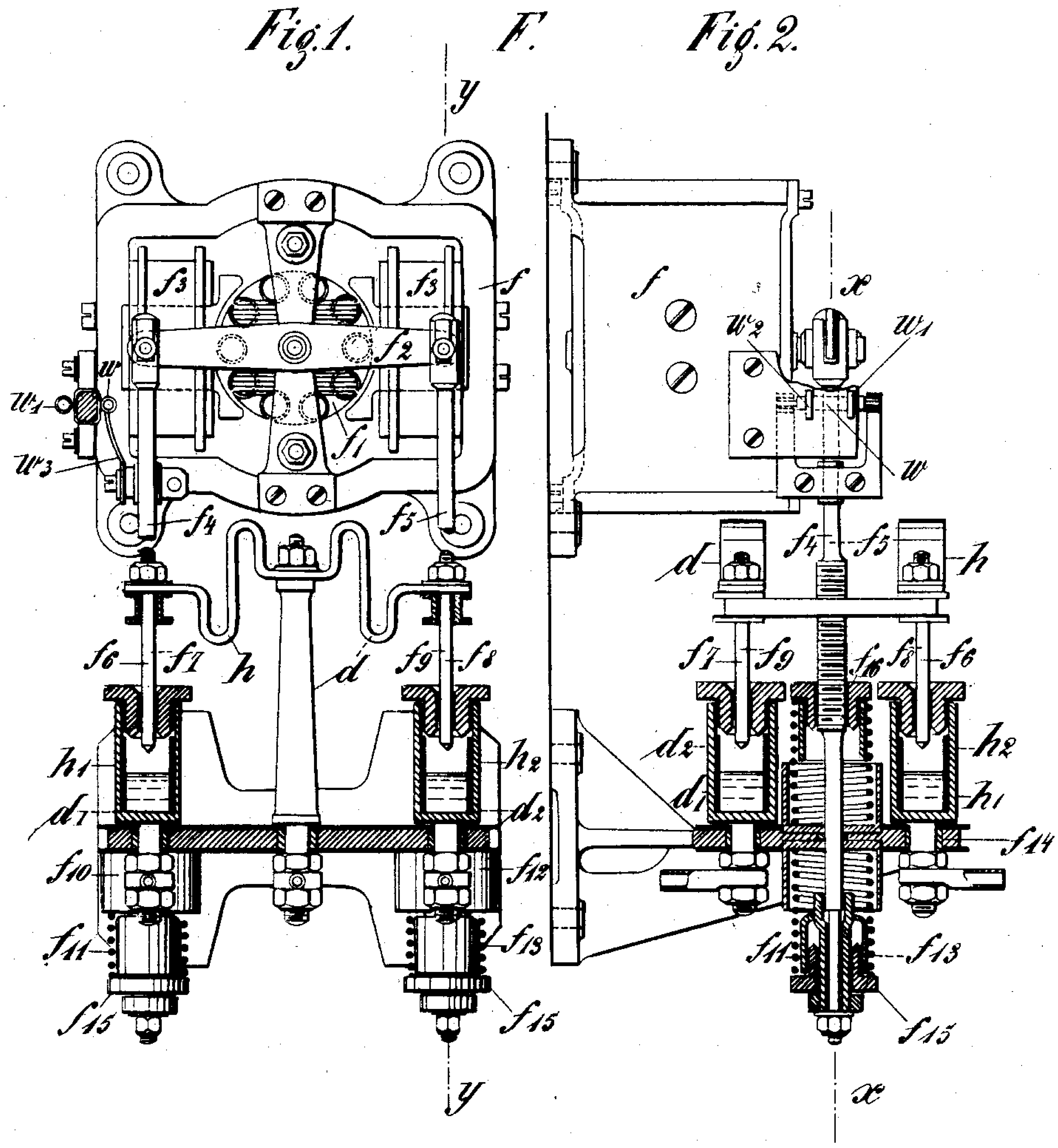
No. 682,978. Patented Sept. 17, 1901.

E. DICK.

SYSTEM OF ELECTRICALLY LIGHTING RAILWAY CARRIAGES.

(Application filed Feb. 25, 1899.)

(No Model.) 4 Sheets—Sheet 1.



Witnesses

Isidor Fischer

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(No Model.) 4 Sheets—Sheet 2.

Fig. 3.

B.

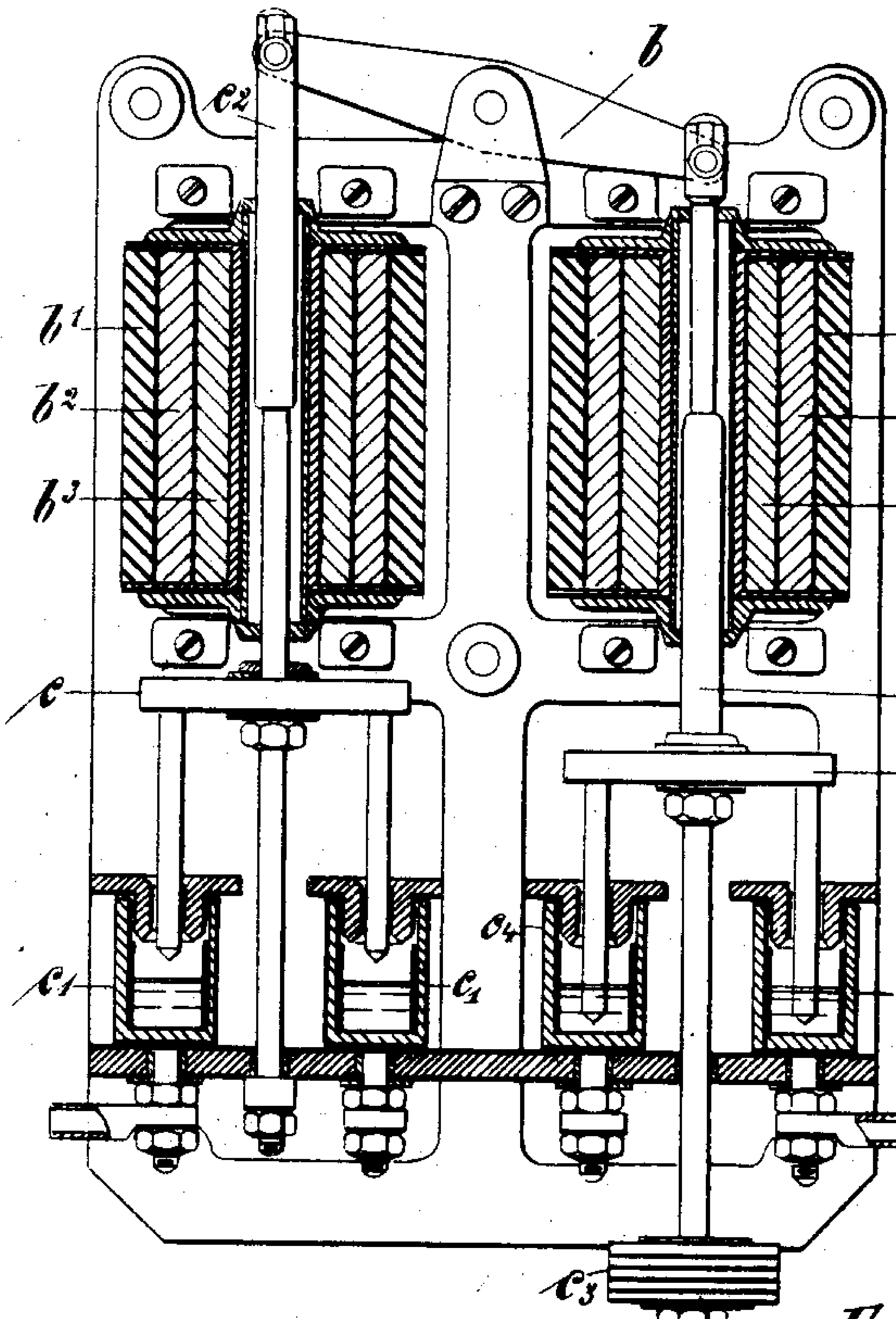


Fig. 4.

P.

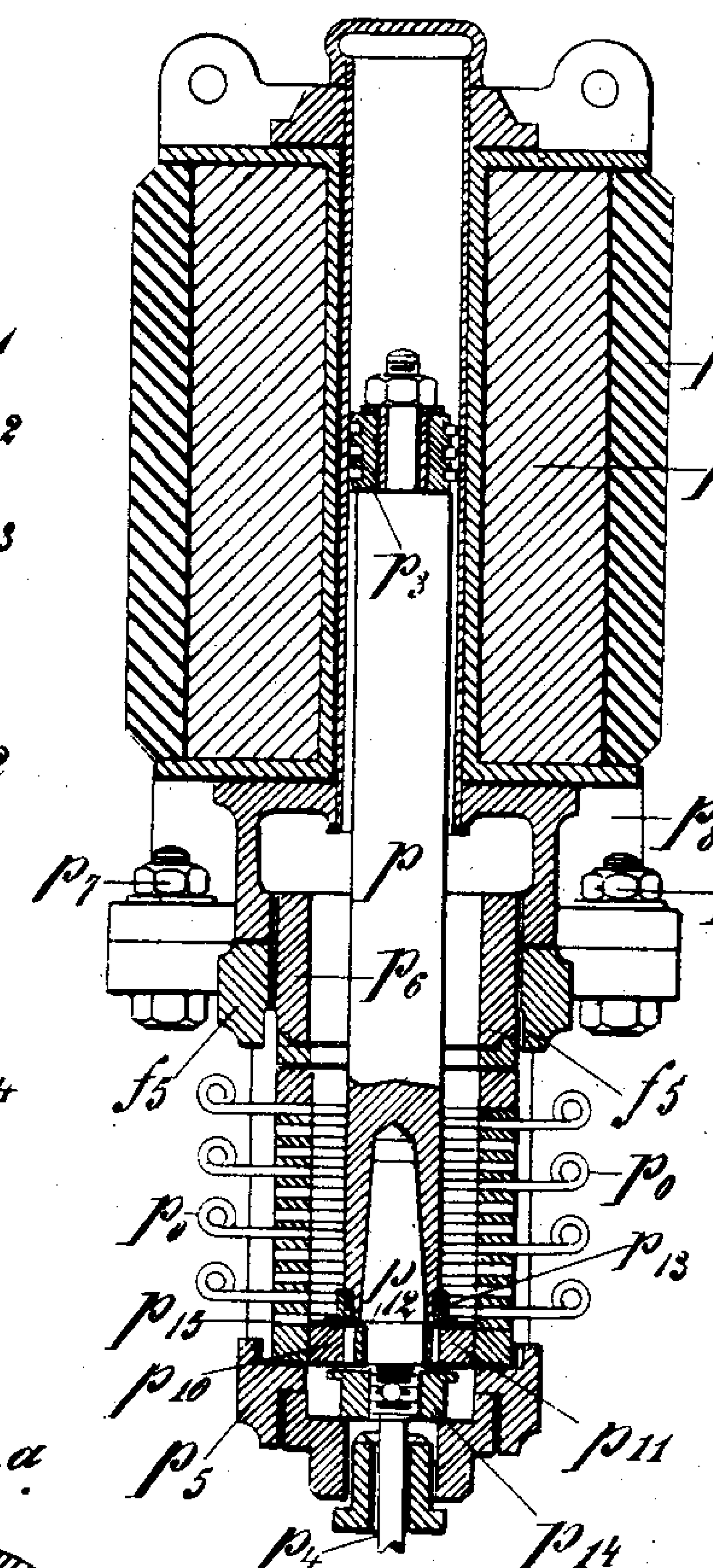
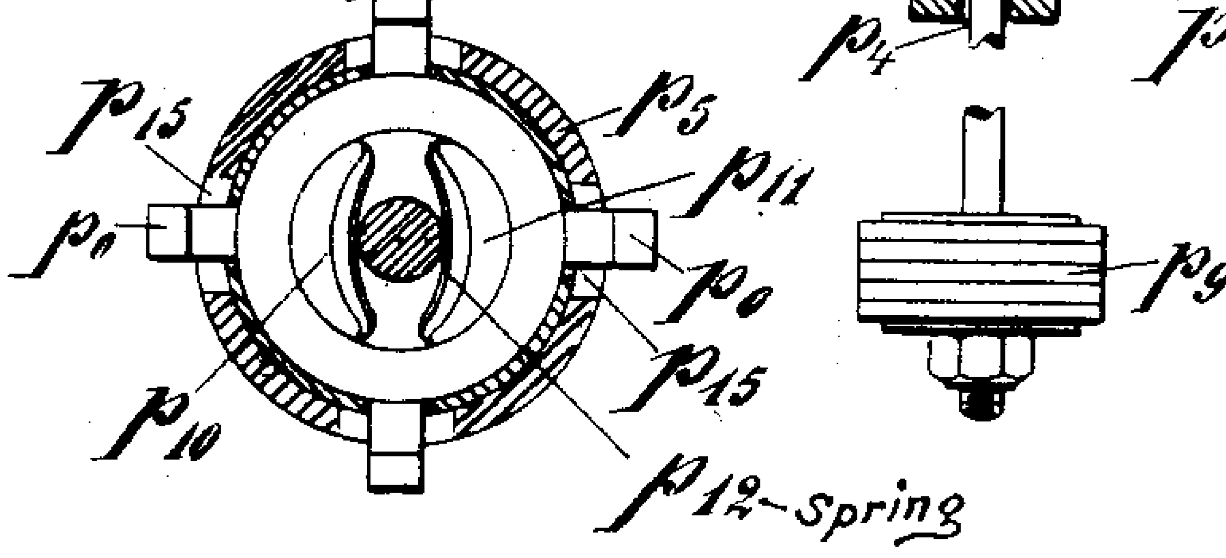


Fig. 4a.



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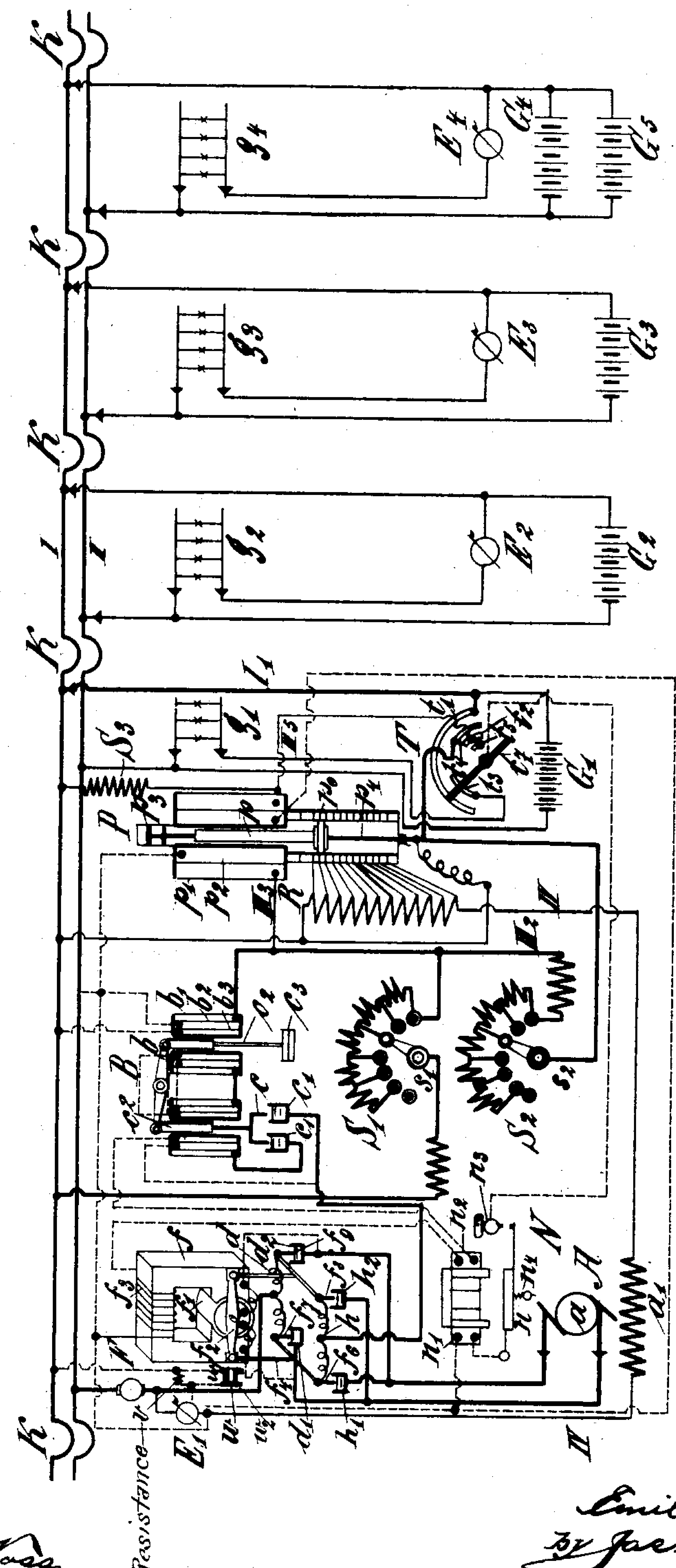
(No Model.) 4 Sheets—Sheet 3.

Fig. 5.



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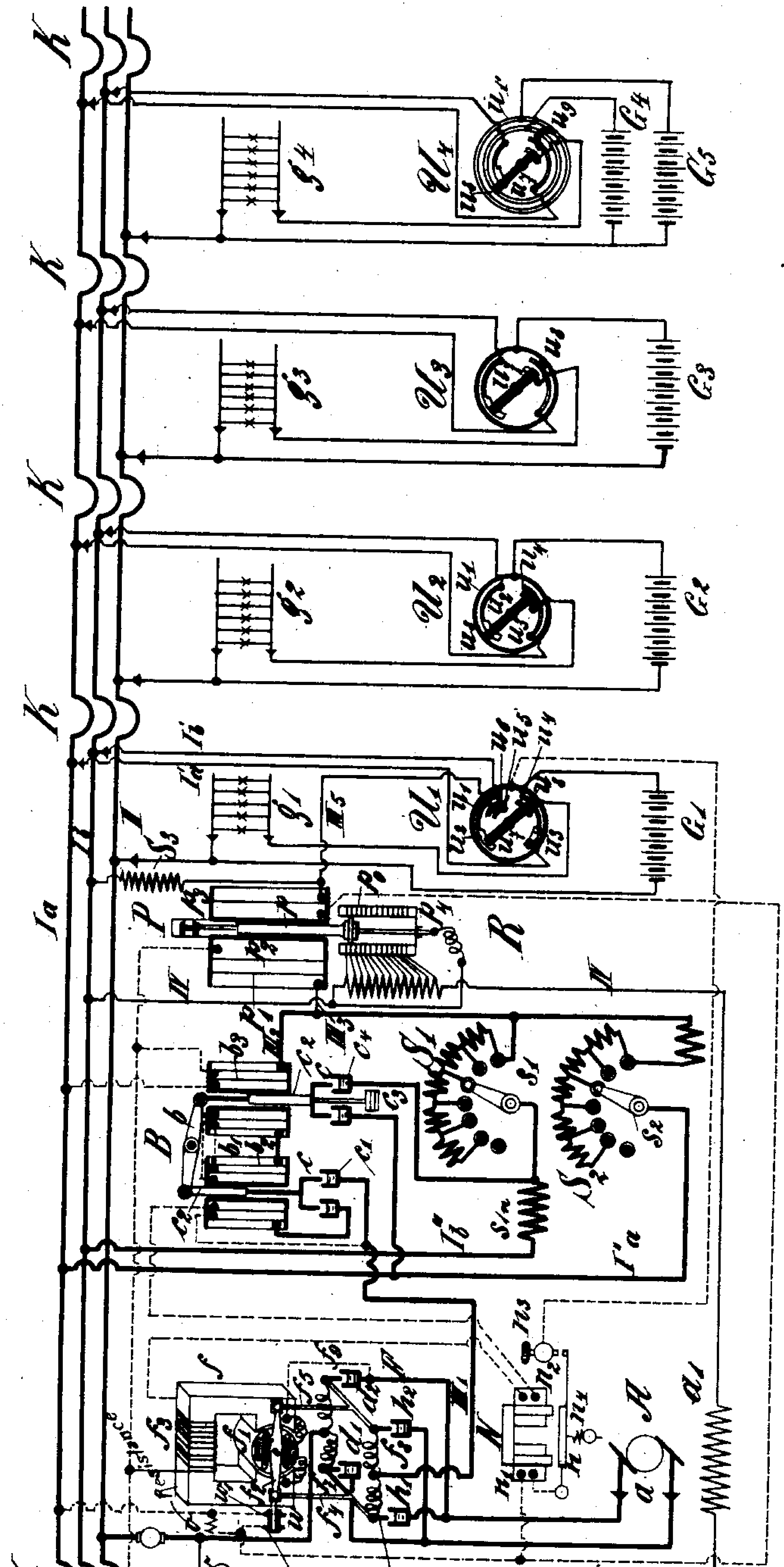
(No Model.) 4 Sheets—Sheet 4.

Fig. 6.



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UNITED STATES PATENT OFFICE.

EMIL DICK, OF BADEN, AUSTRIA-HUNGARY.

SYSTEM OF ELECTRICALLY LIGHTING RAILWAY-CARRIAGES.

SPECIFICATION forming part of Letters Patent No. 682,978, dated September 17, 1901.

Application filed February 25, 1899. Serial No. 706,835. (No model.)

To all whom it may concern:

Be it known that I, EMIL DICK, electrical engineer, a citizen of the Republic of Switzerland, residing in Baden, Austria-Hungary, have invented certain new and useful Improvements in the System of Electrically Lighting Railway-Carriages, as described in my application Serial No. 678,168, filed April 19, 1898, of which the following is a specification.

This invention relates to improvements in that system of electrically lighting railway-carriages wherein a dynamo and secondary batteries are employed, such as described in my application, Serial No. 678,168, filed April 19, 1898.

The object of the invention is to generally improve the construction and operation of such systems; and with this object in view the invention consists in the improved construction, arrangement, and combination of parts hereinafter fully described and afterward specifically claimed.

For a clearer understanding reference will now be had to the accompanying three sheets of drawings, forming a part of this specification, upon which like letters of reference indicate like parts, and whereon—

Figures 1 and 2, Sheet I, represent, respectively, a front and side view, partly in section, on line x x, Fig. 2, and line y y, Fig. 1, of the automatic commutator F; Fig. 3, a vertical longitudinal section through the axis of the solenoids of the switch B. Figs. 4 and 4^a are respectively a vertical and a horizontal section of the resistance-regulator P, the former through its axis and the other at line x x, Fig. 4. Fig. 5, Sheet II, shows the working of the said apparatus when the lamps have been switched in and the batteries do not require charging. Fig. 6, Sheet III, shows the working of the aforesaid apparatus when the batteries require charging while the lamps are on.

The construction of the apparatus F, B, and P will be described first, then the working of the system with reference to the diagram on Sheet II, and lastly of that with reference to diagram on Sheet III.

Automatic commutator F, Figs. 1 and 2.—This apparatus, Figs. 1 and 2, consists of an electromagnet f, between the poles of which a perforated parallel-wound armature f' is adapted to rotate. To the perforated armature f' is coupled the double-armed lever f^2, to the ends of which are articulated the draw-rods f^4 f^5. Each of these rods carries a cross-piece, to which are secured, respectively, two insulated contact-pins f^6 f^7 and f^8 f^9. The contact-pin f^9 and its quicksilver-cup d^2 are not seen in Figs. 1 and 2. The two front pins f^6 and f^8 are conductively connected together by means of the flexible copper band h and the back pins f^7 and f^9 by the band d. The pins f^6 f^7 f^8 f^9 dip each into an iron quicksilver-receptacle h' d' h^2 d^2. In order to guide the said pins and prevent the quicksilver being thrown out, each of the said receptacles is furnished with an insulated cover. The connecting-rod f^4 carries through the spring w^3 a contact-roller w, which is furnished with a platinum mantle and insulated from the frame, and when the apparatus is at rest bears against both the plates w' and w^2, Fig. 2, connecting the same conductively. In this position the lever f^2 is retained by two pairs of springs f^{10} f^{11} and f^{12} f^{13}. The springs f^{10} f^{11}, belonging to the first pair, abut against the opposite sides of the support-plates f^{14}, which carry the quicksilver-cups and guide the draw-rod f^4 and act in opposite directions upon the flanged nuts f^{15} f^{16}, screwed upon the latter. The springs f^{12} f^{13}, which are only partly visible in the drawings, act upon the draw-rod f^5 in an analogous manner. By turning the nuts f^{15} and f^{16} the lever f^2 is so regulated that in its horizontal position all the pins f^6 to f^9 are lifted out of the quicksilver in their cups. The construction of the apparatus F will show that two springs alone may retain the apparatus at rest—say the springs f^{10} f^{12}, or f^{11} f^{13}, or f^{10} f^{11}, or f^{12} f^{13}. The cups h' and d^2 are conductively connected together as well as h^2 with d'. The direction in which the armature rotates changes with the direction in which the train runs, and f^6 is either conductively connected with h' and f^7 with d', or f^8 with h^2, and f^9 with d^2. When the lever f^2 has left its position of rest, the circuit is broken between w' and w^2.

The construction of the commutator described, compared with the one described in the application hereinbefore referred to, has so far attained a reduction of the quicksilver-cups—viz., from six to four—as owing to the employment of the contact devices w w' w^2

the resistance r, the quicksilver-cups k' k^2, (see patent application,) and the double-armed lever described in the said patent are dispensed with. The formation of sparks in the cups when switching the resistance r in and out of the exciting-circuit IV is thus obviated and the regulating resistance is also used when stopping. The new construction differs also from the former in the employment of the regulating-springs f^{10} f^{11} f^{12} f^{13}, whereby the apparatus is set at rest and freed from vibrations.

The automatic switch, Fig. 3.—The construction of this apparatus being minutely described in the application hereinbefore referred to, a further description is not essential. The solenoids employed therein may, however, consist each of only two coils insulated from each other. For instance, the left solenoid may have the two coils b^2 and b^3 and the right solenoid the coils b' b^3, which will not affect the working of the apparatus. When using the apparatus in the system shown by the diagram on Sheet III, the right of the two iron cores c^2, suspended from the lever b, will also have, besides the balance-weight c^3, a contact-fork c, which when the apparatus is at rest will form contact between the quicksilver-cups c^4 and break the same when the iron cores c^2 are drawn in. The contact-fork, which dips into the cups c' c', performs always the function described in the application hereinbefore referred to.

The resistance-regulator, Figs. 4 and 4^a.—This apparatus consists of a solenoid having two coils p' p^2 and a soft-iron core p therein. The height at which it is retained is controlled by the action of the coils. The lower end of the core p reaches into a hollow cylinder, which consists of a number of superposed flat copper rings p^0, which are insulated from each other by mica disks placed between the same. The disk p^0 and the mica disks between are inclosed in a cylindrical casing p^5, fixed by two screws p^7 to the regulator-frame p^8. The bottom of this casing has a concentric hole in its periphery 4, symmetrically longitudinal slots p^{15}, and a cover p^6 screwed in, by which latter the disks p^0 are pressed tight against each other, so as to constitute a hollow cylinder. Each of the disks p^0 has a tongue projecting through one of the longitudinal slots p^{15}, the said disks relatively to their tongues being successively displaced from each other ninety degrees, the tongue of each fourth disk projecting through the same slot p^{15}. Each of these tongues has an eye to which is soldered the cable connected with the element of the regulating resistance.

To the upper end of the iron core p is fixed an insulated piston p^3, which slides in a tightly-closed tube and serves simply to dampen too vigorous movements of the core p. At the lower end of the core p a contact and a guide-rod p^4 are arranged, which latter passes through the casing p^5, and at its lower end is furnished with a regulating-weight p^9. The iron core p and the guide-rod p^4 are insulated from the frame p^8. The said contact consists of two segments formed from a carbon disk. The two segments p^{10} p^{11} are held between two disks p^{13} p^{14}, the former being placed around the core p and the latter screwed upon the guide-pin p^4. Two copper springs p^{12} press the carbon segments p^{10} p^{11} against the wall of the hollow cylinder, whereby a good contact is obtained between the guide-pin p^4 and the respective copper disk p^0. The solenoid has two coils p' and p^2, insulated from each other, which assist each other in their action upon the core. The coil p^2 consists of thin wire and the coil p' of comparatively stronger wire.

The construction of this regulator compared with that described in the application hereinbefore referred to embodies thus some improvements, which consist in the employment of only two insulated coils p' p^2 and in the improved construction of the contact device, whereby sparks which may occur are not only dispersed over a long line corresponding with the periphery of the carbon segments p^{10} p^{11}, but are also blown out by the magnetic field of the core p.

Working of the system shown in Sheet III, Fig. 5.—This system is applicable to trains which have during the day sufficient time at disposal for charging the batteries, no further charging thus taking place when the lamps are switched in. Before dealing with the working itself a few remarks are necessary.

The switch T is situated in the car in which are employed the apparatus F B P N with the resistances S', S^2, S^3, R, and v and the dynamo A. Each car is provided with a battery G' G^2 G^3 G^4 G^5, a switch E^2 E^3 E^4, and a group of incandescent lamps g' g^2 g^3 g^4. K indicates the cable-couplings employed between the carriages. The last car on the right side of the drawings is furnished with two batteries G^4 G^5, as it is presumed that this carriage will be periodically disconnected, and therefore requires battery of greater capacity. The switch T employed in the generator-carriage serves for charging and lighting. In the drawings its lever is shown in the position when the light is on. The switch T consists of the contact-plates t' t^3 t^4 t^5 t^6 and the contact-lever t^7. The latter when in the position as shown in the drawings connects the two plates t' and t^3. The incandescent lamps g' in the generator-carriage are thus switched on. If the contact-lever t^7 is turned in the direction of a watch-hand a quarter of a revolution, it will arrive in the position for charging. The lamps g' are thus switched off and the lever t^7 connects the plates t' t^4 t^5 t^2. If the contact-lever t^7 is turned in the same direction further, it will again connect the plate t' with t^4, and the lamps g' will come into function, &c. When the train stops, a weak current from the batteries G' G^2 G^3, arranged in parallel, will circulate in the main circuit II through the magnet-coil f^3 of the automatic commutator F, the right bobbin n^2 of the relay N, and through the inner coil b^3 of the automatic switch B back to the main circuit I. In the same manner a weak current flows through the high-resistance coil p^2 of the dynamo-regulator P and the contacts w^2 w w'. This causes the iron core p of the regulator P to be raised and the resistance R to be switched into the exciting-circuit IV of the dynamo A, whereby the loss in the excitation is also reduced to a minimum. The switch E' serves to prevent unnecessary consumption of energy in case the system is not used for days. After having arranged the train the resistances S' and S^2 are regulated by means of the contact-levers s' s^2, so as to correspond approximately to the number of lamps and batteries. The position of these levers need not be varied afterward.

The charging takes place as follows: The lever t^7 of the switch T from the position shown has been turned ninety degrees and the contact-plates t' t^2 t^4 t^5 are connected with each other. The switches E^2 E^3 E^4 are open. As soon as the train, and thereby the armature a of the dynamo A, is set in motion there will be a tension at the brushes of the dynamo corresponding to the number of revolutions and to the intensity of the exciting-circuit. The current flows through the armature-coil f' of the commutator F, which causes the lever f^2 to be turned to one or the other side, according to the direction of the train, which determines the direction of the current. When turning the lever f^2, the contact-roller w leaves the plates w' w^2 belonging thereto, which causes the resistance v to be switched into the circuit of the coil p^2 of the regulator P. The effect of the coil p^2 on the iron core p being thereby considerably weakened, the iron core p will descend and switch off all the elements of the regulating-resistance R, so that the exciting-coil a' is exposed to the full tension of the battery. After the commutator F begins to act the middle coil b^2 of the automatic switch B will receive current. If the train has attained a certain minimum speed, the tension of the dynamo will slightly exceed that of the batteries and the apparatus B will switch the dynamo in the circuit of the batteries. If the speed of the train increases, the intensity of the current delivered to the batteries will also increase to a maximum degree, and this current flowing through the thick outer coil b' of the apparatus B causes, obviously, the contact-fork c to be retained in the switching-on position all the more. After leaving the coil b' the dynamo-current branches off in three currents, which join again in the main circuit I. The first branch is formed by the resistance S^2, the second by the resistance S', and the third by the coil p'. The resistance S^3 is short-circuited through circuit III^5 I'. The current circulating through these branches are, according to Kirchoff, proportionate to the tension, and vice versa proportionate to the resistances. The regulator P is now adjusted so as to switch the largest part of the regulating-resistance R into the exciting-circuit IV, when the current flowing through the coil p' amounts to i amperes and when the charging-current in the main circuit I II has reached its maximal tension. The maximum loss of tension in the three branches, amounting to e volts, the currents in the three branches will be determined by their resistances. The strength of current delivered to the batteries is equal to the sum of the currents in all three branches. By the aid of the variable resistance S^2 it is possible to vary the strength of the charging-current as may be desired without affecting the nature of this regulation, and thus the train may be composed of any desired number of carriages. When switching the dynamo onto the batteries, this combination also serves for checking the shocks which may occur in the currrent, and thus weakening the effect of the same on the dynamo—*i. e.*, the wheels. When the tension of the charging-current in the main circuits I II has reached its maximum, the armature n of the relay N is attracted and, owing to the force of the coil n^2, will overcome the counter power of the spring n^4. When the contact-spring n of the armature touches the contact-pin n^3, the resistance of the coils n' is switched in parallel to the resistance v. The power of attraction of the inner coil p^2 of the regulator P is thus increased, the iron core p is raised to a relative higher position, which causes the exciting-circuit of the dynamo to be weakened, the tension will fall to about 2.2 to 2.4 volt per element of the battery, which causes the charging-current to be reduced to zero. The regulator P then acts as a tension-regulator and retains the tension at a limit of 2.2 to 2.4 volts, so as to prevent any further charging of the batteries.

The operating of the relay N is minutely described in the patent application filed 19th of April, 1898, hereinbefore referred to.

Occurrences during the illumination.—When the lamps are lighted, all the switches E^2 E^3 E^4 are inserted and the switch T is in the position shown in the drawings. When the train has stopped, the batteries cover the requirements of the lamps. When the train starts, the dynamo is connected with the main circuit in an analogous manner as during the charging and the apparatus take over their functions already described. Owing to the altered position of the lever t^7 the former circuits of the resistance S^2, the outer coil p' of the regulator P, and the contact n^3 of the relay N are interrupted and the contact-resistance S^3 is switched in series with the coil p' of the regulator P. The loss in the coils p', additional to the loss in the resistance S^3 during the flow of a current of i amperes, is equal to the difference between the maximum charge tension of the batteries and the normal tension of the lamps. If J indicate the strength of current required for supplying all the lamps, the strength of current divided through the resistance $S'=J-i$, provided that the volts at the terminals of the dynamo are equal to the maximum charge tension of the batteries. The resistance S′ expressed in "ohms" must therefore be equal to the

$$\frac{\text{(Maximum charge tension} - \text{normal lamps tension)}}{J-i}$$

If the strength of current passing through the resistance S′ decreases owing to the decrease of the volts at the dynamo-terminals, the batteries will deliver a part current to the lamps, so that the tension of the lamps will practically remain constant. The batteries being very little used during the journey, the tension will vary maximally 2.5 per cent. below or over the normal lamp tension. The limes will be very seldom reached.

The working of the system shown on Sheet III, Fig. 6.—This system is specially applicable to trains which run only at night. In this case the batteries are charged simultaneously with the supply of the lamps direct from the dynamo. Before proceeding with the working of the system itself attention is drawn to the following points: In this system three main circuits are employed I^a I^b II, which pass through all the carriages. While employing in the system shown on Sheet II each carriage with an ordinary switch, in the system shown on Sheet III each carriage is furnished with a switch U′ U^2 U^3, through which the batteries are partly connected with the circuit I^a and partly with I^b, the lamps in the meantime being switched on or off. The switch U′ consists of a cast-iron casing in which are employed the contact-plates u' u^2 u^3 u^5 u^6. Through the cover of the said casing passes a shaft on which are secured the insulated contact-springs u^7 u^8. This shaft and that of the switch U^2 U^3 U^4 are always turned ninety degrees. Springs are employed to insure the correct setting of the said shaft and the contact-spring. The said shafts turn always in the direction of a watch-hand and are prevented from turning back by click devices. The covers are each formed with a round opening, below which a disk is secured upon the said shaft, having a half white and a half red face. When the cables in the train are connected with each other, the switches U′ U^2 U^3 U^4 must be in such a position that the red part and white part of the disk will be alternately visible in the adjacent carriages to indicate the opposite position of the contact-springs u^8. When light is required, the contact-springs u^7 u^8 of the switches U′ U^2 U^3 U^4 may be in the position shown in the diagram on Sheet III. If the lamps require switching on, the switch is turned ninety degrees. If the lamps require current, a further turn of ninety degrees, &c., takes place, the guard is thus always gradually obliged to set the said switches, as required. Each carriage is thus equally installed. The installation of the carriage which contains two batteries is, however, slightly varied, one battery being connected with the circuit I^a and the other with the circuit I^b, and vice versa. The switch U^4 has besides the contact-plates u' u^2 u^3 u^4 the plate $u^{1'}$, and upon the shaft are employed three from each other insulated contact-springs u^7 u^8 u^9, whereby the switching of the batteries described is effected.

The functions of the automatic apparatus F B P are identical with those already described. A repetition of the occurrences during the charge—*i. e.*, at day-time—appears, therefore, unnecessary, so that the working of the installation has only to be taken into consideration when simultaneously lighting the lamps and charging. When the lamps are on, the contact-springs u^7 of the switches U′ U^2 U^3 U^4 connect the contact-plates u^2 with u^4, and when the train stops a contact between the main circuits I^a and I^b is also formed through the apparatus B by inserting the small resistance s' n by means of the right contact-fork c and the quicksilver-cups c^4. All the batteries G′ G^2 G^4 G^5 thus operate in feeding the lamps g' g^2 g^3 g^4 g^5 when the train stops. When the train starts, the connection of the dynamo with the main circuit is effected as previously described, with exception of the apparatus B, which breaks contact at the cups c^4 when connecting the dynamo with the lamps and batteries. The circuit of I^a may be specified as charge-circuit and I^b as light-circuit. The main circuit from the dynamo splits from the cable III^2 into three branches, one of which currents flows over the coil p' of the regulator P and the constant resistance S^3 to the light-circuit I^b, the second one over S′ s' n, also to I^b, while the third one flows over S^2 to I^a. The resistance S^3 S′ and the resistance of the coil p' are determined after the previously-described method. The regulator thus regulates, due to the branch currents p' to S^3, principally the amount of current flowing to the lamps g' g^2 g^3 g^4, the tension of the dynamo being allowed to reach the maximum charge tension of the batteries. The current delivered to the batteries G′ G^3 G^5 ready for charging depends, then, on the resistance S^2 and on the condition of the charge in the batteries G′ G^3 g^5. As soon as the lamps require extinguishing the contact-springs of the said switches are turned ninety degrees. In order to obtain light the next night, the contact-springs of the switches are turned ninety degrees. In this position the batteries G′ G^3 G^5 are switched onto the light-circuit I^b for the purpose of regulating the lamp-tension, which has practically remained the same, while the batteries G^2 G^4 are switched onto the charge-circuit I^a.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is—

1. In a system for electrically lighting trains, the combination with a dynamo, secondary batteries, and their circuits of a lamp-circuit containing incandescent lamps, a magnet the helix of which is in the lamp-circuit, an armature adapted to rotate between the poles of said magnet, a double-armed lever coupled to the armature, draw-rods hinged to said lever, contact-pins borne upon said draw-rods and a cup containing quicksilver into which the contact-pins may dip, and an automatic switch mechanism, substantially as described.

2. In a system for electrically lighting trains, the combination with a dynamo, secondary batteries, and their circuits of a lamp-circuit containing incandescent lamps, a magnet the helix of which is in the lamp-circuit, an armature adapted to rotate between the poles of said magnet, a double-armed lever coupled to the armature, draw-rods hinged to said lever, contact-pins borne upon said draw-rods and a cup containing quicksilver into which the contact-pins may dip, and an automatic switch mechanism embodying two solenoids, each consisting of two coils insulated from one another and soft-iron cores adapted to reciprocate in said solenoids, one of said cores carrying a balance-weight and the other a contact-fork, and cups containing quicksilver into which said fork is adapted to dip to make the circuit.

3. In a system for electrically lighting trains, the combination with a dynamo, secondary batteries, and their circuits, of a lamp-circuit containing incandescent lamps, a magnet the helix of which is in the lamp-circuit, an armature adapted to rotate between the poles of said magnet, a double-armed lever coupled to the armature, draw-rods hinged to said lever, contact-pins borne upon said draw-rods and a cup containing quicksilver into which the contact-pins may dip, automatic switch mechanism, and a resistance-regulating device, substantially as specified.

In witness whereof I have hereunto signed my name, this 11th day of February, 1899, in the presence of two subscribing witnesses.

EMIL DICK.

Witnesses:

FRIEDRICH BINDER,
ALVESTO S. HOGUE.