

(No Model.)

E. THOMSON.

MEANS FOR REGULATING ALTERNATING CURRENTS.

No. 516,847.

Patented Mar. 20, 1894.

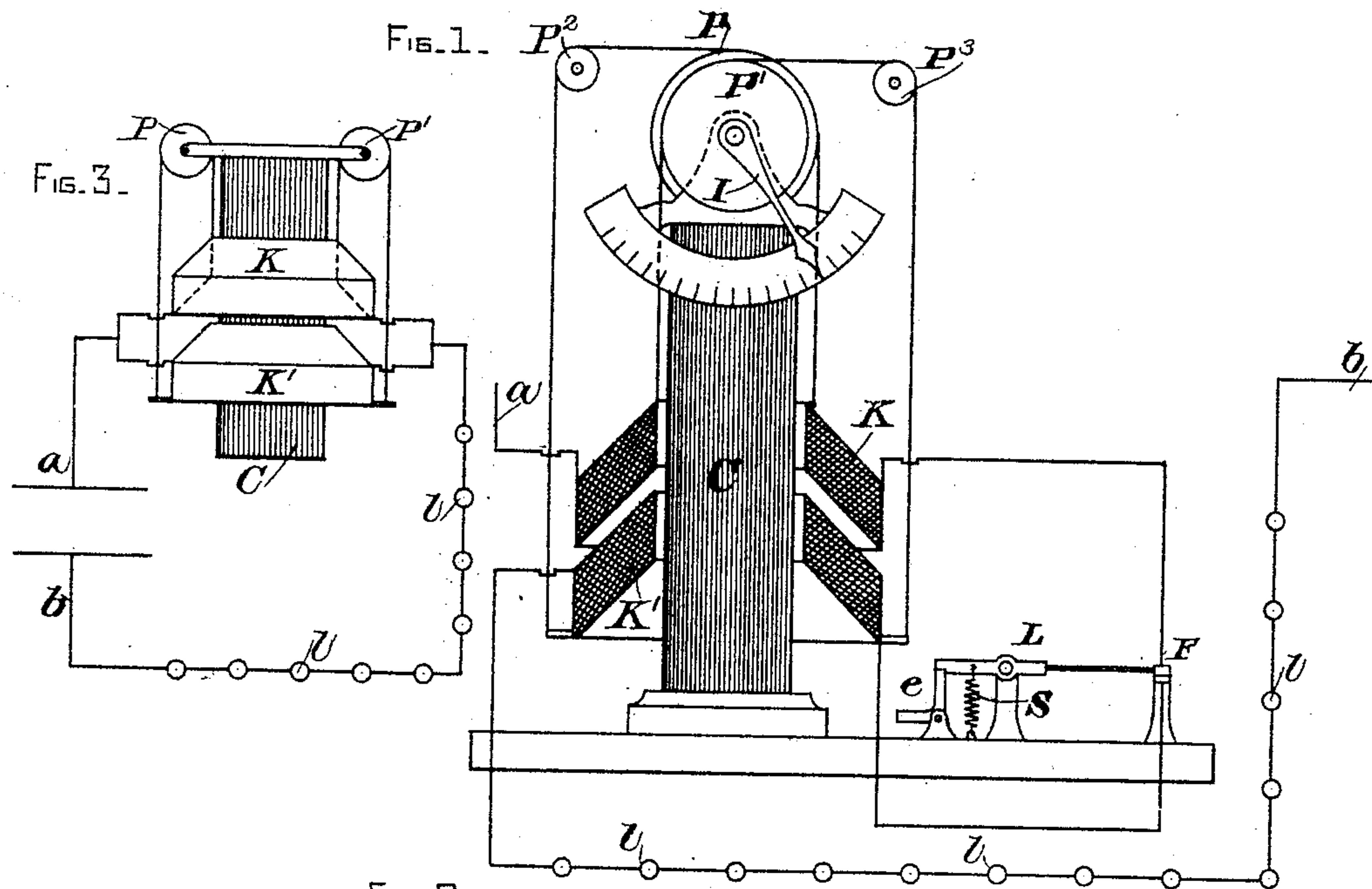
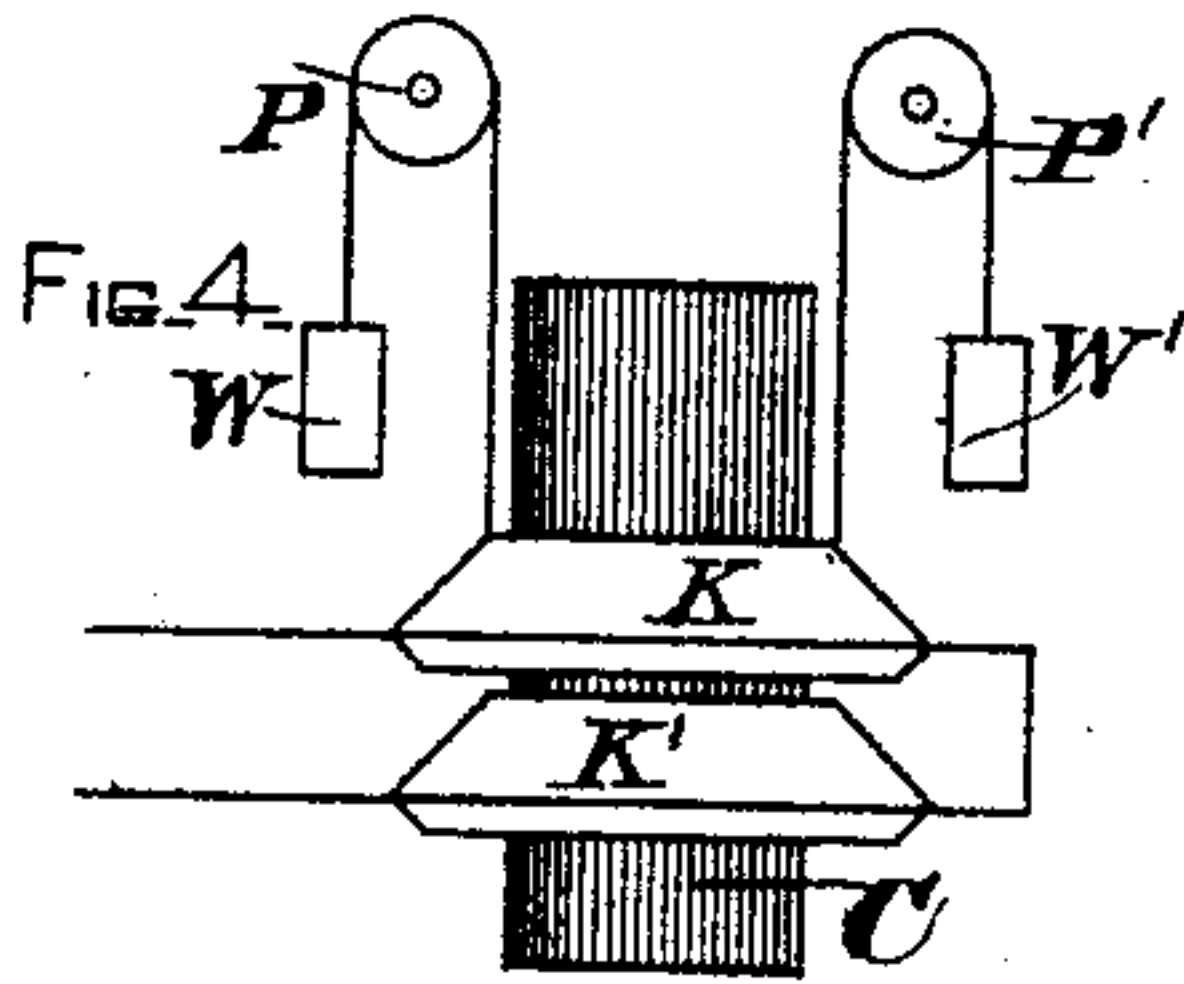
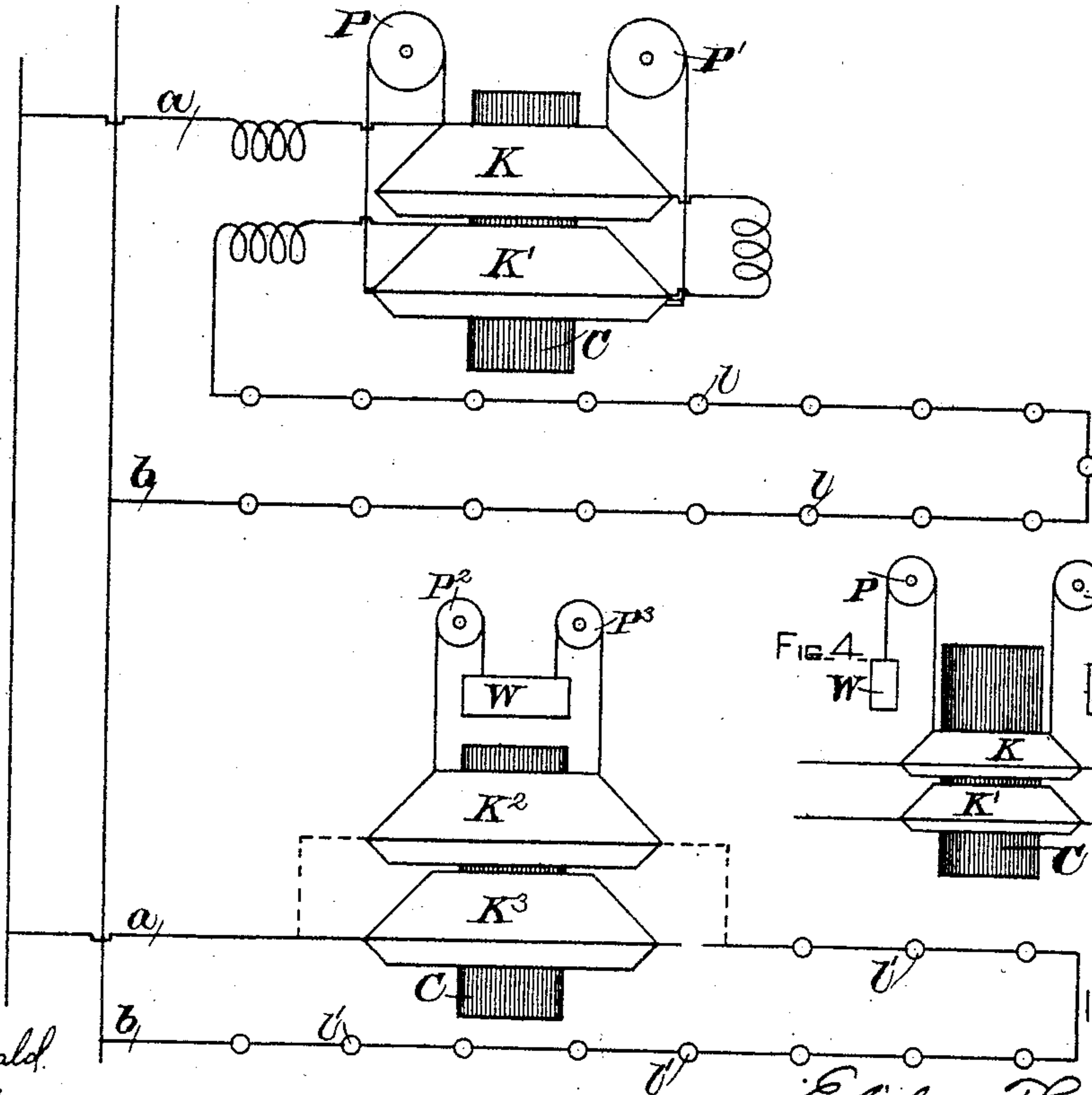


FIG. 2.



WITNESSES.

A. F. McDonald.
A. O. Orme

INVENTOR.

E. Thomson
by P. M. Knight
att'y

UNITED STATES PATENT OFFICE.

ELIHU THOMSON, OF SWAMPSCOTT, MASSACHUSETTS, ASSIGNOR TO THE
THOMSON-HOUSTON ELECTRIC COMPANY, OF CONNECTICUT.

MEANS FOR REGULATING ALTERNATING CURRENTS.

SPECIFICATION forming part of Letters Patent No. 516,847, dated March 20, 1894.

Application filed July 1, 1891. Serial No. 398,187. (No model.)

To all whom it may concern:

Be it known that I, ELIHU THOMSON, of Swampscott, in the county of Essex and State of Massachusetts, have invented a certain
5 new and useful Improvement in Means for Regulating Alternating Currents, of which the following is a specification.

My present invention relates to means whereby an automatic regulation of the re-
10 active effects of an alternating current is brought about by the agency of the current itself, for the purpose of securing a practically constant value of such currents in a circuit passing over a working resistance or other
15 portions of circuit in which work is to be done.

In the accompanying drawings Figure 1 is a sectional elevation of a regulator embodying my invention, showing the circuit connections. Figs. 2, 3 and 4 show modifications.

20 Fig. 1 shows a core C which may be a laminated iron core arranged to constitute a magnetic circuit in whole or in part for the surrounding coils of insulated wire K, K'. This core is preferably of the open circuit type to
25 facilitate mounting of the coils in place. These coils are shown as mounted in such manner that one coil balances the other partly, the difference being such that the coil K is able to move toward the coil K' except
30 when repelled by the currents in the coils. In a state of rest the coils K, K' would lie close together. Cords running over pulleys for counterbalancing are seen at P, P', P², P³, connecting the two coils so that they may
35 move freely. An electric circuit beginning at a passing through coil K, through switch contacts at F, through coil K', lights l, l, to b is shown and may be fed by connection to
40 terminals of a constant potential system with alternating currents. The coils K, K' are wound oppositely around the core, so that they are mutually repellant and mutually oppose each other's induction on the core to an extent proportional to their proximity. Un-
45 der these conditions if the coils K, K' have a tendency toward each other and the current traversing the circuit due to the potential and resistance does not exceed a certain value, the coils K, K' would remain together or re-
50 main at rest, and their effects on the core would so nearly destroy each other, that the

magnetizing and consequent reactive effects would be practically null. To render the coils still more nearly coincident as regards inductive relation to the core, one may be
55 made to enter partly within the other as shown. If, however, this current, by the cutting out of resistance or by an increase of potential, should exceed the certain value mentioned the coils would then overcome their
60 tendency to move together and be repelled one from the other to a distance such as would cause their effects upon the core C to increase sufficiently to introduce into the circuit of
65 which they form a part, a reactive "kick" or self-induction just such as will bring the current to its former value. This increase of inductive effect on the core as the coils are separated is due to the fact that each coil
70 is released or freed to a certain extent from the influence of the other. An indicator may be provided as at I, showing the amount of separation they attain, a device which is useful when the coils are boxed up so as to be
75 out of sight. This indicator is shown as a pointer carried by a pulley engaging with the supporting cords. Should it be desired to have the separation or repulsion of the coils finally open the circuit, as when that separation
80 has been extended to its full limit, an automatic switching device may be provided, as at e, e consisting of a detent holding up a lever L, which maintains contact at F in circuit with the coils. When the projection from
85 coil K' strikes the detent e and unlocks it from under the end of the lever L, the spring S pulls that end down and opens contact at F therefore acting as a safety switch in case
90 the reactive regulation of the coils K K' is exhausted due to the removal of too much resistance from its circuit.

My invention is applicable to the case of a series of incandescent lamps fed from constant potential mains, such lamps having provided in them shunting devices for maintain-
95 ing the circuit closed in case any of them break, or are withdrawn from the circuit, and my invention secures a constant current in the remaining lamps notwithstanding the constant potential existing at the terminals, simply by its reactive tendency or the self-inductive counter-force exerted against the in-
100

crease of current due to shunting of lamps. Any modifications in the kind or position of the coils might be used and many modifications in the arrangements or disposition for securing the effects mentioned may also be used.

Fig. 2 shows the apparatus without the indicator and safety switch, which are only attachments for adapting the apparatus to certain conditions and may under other conditions be dispensed with. The coils K, K' in Fig. 2 are both movable and connected by cords over pulleys P, P' so as to approach or recede from each other as before. In another part of Fig. 2 similar coils K², K³ are shown mounted so that one only is movable, viz. K², said coil being counterpoised in part by a weight W, with cords passing over the pulleys P², P³. The coil K³ is stationary, and is connected in series with the lights L', L'. The coil K³ may be wound as a closed circuited band without any electrical connection with the coil K². The amount of the counterpoise weight is adjusted to allow only that tendency toward the coil K³ which is required to keep the balance of current or keep the value of the current the same.

In Fig. 3 the coils K, K' are shown both movable and placed in parallel, such parallel connection being also shown by dotted lines in Fig. 2.

In Fig. 4 the upper coil K which is in series with the lower coil K' is shown as the only one movable, having counter-weights W, W' with pulleys P, P' for permitting this motion to overcome the stationary coil K'.

In each of the modifications which my invention may take the regulation is effected by an automatic production of reactive effects or self-inductive counter-effects to the flow of the current, and the apparatus adapts the amount of these effects to each case in which they are required to exist. The apparatus is also highly efficient since the magnetization of the core is very slight unless there is need for considerable regulation.

The actual resistance of the coils may be made very small so that they waste but little energy in that way. The apparatus is very well adapted to maintaining a substantially constant current value in a circuit of a single light fed from a source of constant potential of alternating currents conveyed from a line of varying potential, providing the variation does not exceed the capacity of the apparatus, hence it is capable of maintaining at practically standard brilliancy a light or a series of lights under conditions in which otherwise great fluctuations might take place. It is therefore adapted not only to secure uniform lighting but also to save the wear and tear of lamps.

To render the repulsive effect more even and uniform, one of the coils is made to enter only partially within the other, by its contracted portion as shown, the coils being preferably made conical for this purpose, so that the

coils never reach a position in which their effects on the core and space are exactly equal and opposite. In this respect my present invention differs from a reactive device wherein one coil may pass entirely over the other, as with the latter, the coil will pass from a position of inductive coincidence and no repulsion, to a position of maximum repulsion as the coils are leaving one another, and then to further positions of diminishing repulsion, giving an uneven or irregular variation of force as well as a dead center to start on, with the risk of either sticking fast or moving in the wrong direction.

In other regulators devised by me, such for example, as described in the Patent No. 377,217, issued September 27, 1887, I have shown devices where the coils were arranged to slide over each other; they therefore did not have a repulsive action of uniform strength with a constant current, but had a repulsion which varied according to the position of the coils, being least when the coils were directly superposed and greatest when one was about half off the other. The present apparatus differs from this plan, however, in securing a substantial uniformity of repulsion through the entire range of movement, or limiting the range of the movement to one in which a substantially uniform repulsion for a constant current is secured; for this reason a counterpoise by a constant weight will be found sufficient. In other words, the coils are so made, or one of them is so related to the other, that when traversed by a given current the repulsion will be substantially uniform in all positions of the coil; and by this means the coil may be counterpoised by a definite weight or a spring of definite tension, or its own gravitating tendency may be used, to cause it to take different positions with the same current flowing according to the resistance in the circuit. The open circuit core is especially adapted to reactive devices of this class, wherein two opposing coils act oppositely on a common core, for the polarity if any which is developed, is consequent, and the magnetic circuit, even with a closed core is partly through the air. An open circuit core has therefore substantially the same regulating effect herein as would a closed core, and presents the advantage of easy placing and removal of the coil, a point of special importance where the coil is movable on the core, and would therefore be difficult to wind *in situ*, and be specially liable to damage requiring repair.

What I claim as new, and desire to secure by Letters Patent, is—

1. A regulator for alternating currents comprising a core, coils thereon relatively movable under the influence of alternating currents flowing in them, such coils having a range of motion wherein the mutual repulsion is substantially constant for a constant current, and a constant approximating means opposing the repulsion of the coils.

2. A regulator for alternating currents com-

prising a core, coils relatively movable there-
on under the influence of alternating cur-
rents flowing in them, such coils restricted to
a range of motion wherein the mutual repul-
sion is substantially constant for a constant
current, one of said coils having a contracted
portion within the other coil, and constant
approximating means opposing the repulsion
of the coils.

10 3. A regulator for alternating currents com-
prising a core, coils upon such core relatively
movable under the influence of alternating
currents flowing therein, such coils restricted
to a range of motion wherein the mutual re-
pulsion is substantially constant for a con-
stant current and one of them entering partly
within but engaging with the other coil when
they are brought together, and constant ap-
proximating means opposing the repelling in-
fluence of the current in the coils.

20 4. A regulator for alternating currents com-
prising coils relatively movable under the in-
fluence of alternating currents flowing there-
in, such coils restricted to a range of motion
25 wherein the mutual repulsion is substantially
constant for a constant current, an open cir-

cuit iron core surrounded by said coils, and
constant approximating means opposing the
mutual repulsion of the coils.

5. In an alternate current regulator the com- 30
bination of mutually inductive coils, one or
both being vertically movable and suspended
so as to be partly counterbalanced, and sub-
ject to a constant gravitating force.

6. In an alternate current regulator, the 35
combination of the mutually inductive coils,
mutually repulsive by the action of the cur-
rents traversing them, and connected to-
gether so as to partly counterbalance one an-
other. 40

7. In an alternate current regulator, the
combination of the mutually inductive coils,
mutually repulsive by the action of the cur-
rents traversing them, and cords and pulleys
connecting said coils together. 45

In witness whereof I have hereunto set my
hand this 23d day of June, 1891.

ELIHU THOMSON.

Witnesses:

JOHN W. GIBBONEY,
E. M. BENTLEY.