(No Model.) 2 Sheets—Sheet 1.

E. THOMSON.

REGULATING DEVICE FOR ALTERNATE CURRENT CIRCUITS.

No. 370,573. Patented Sept. 27, 1887.

Fig. 1.

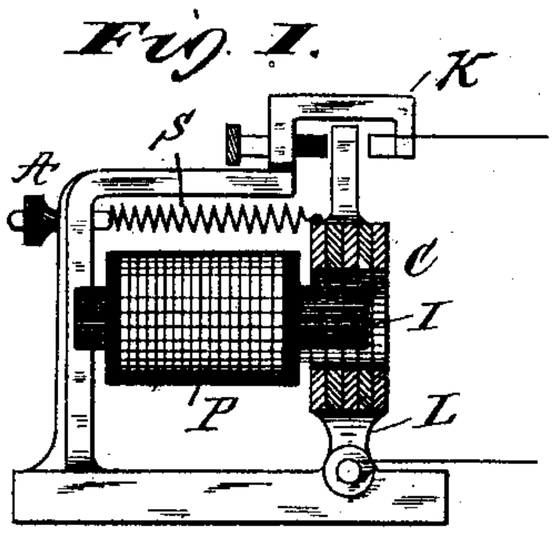


Fig. 2.

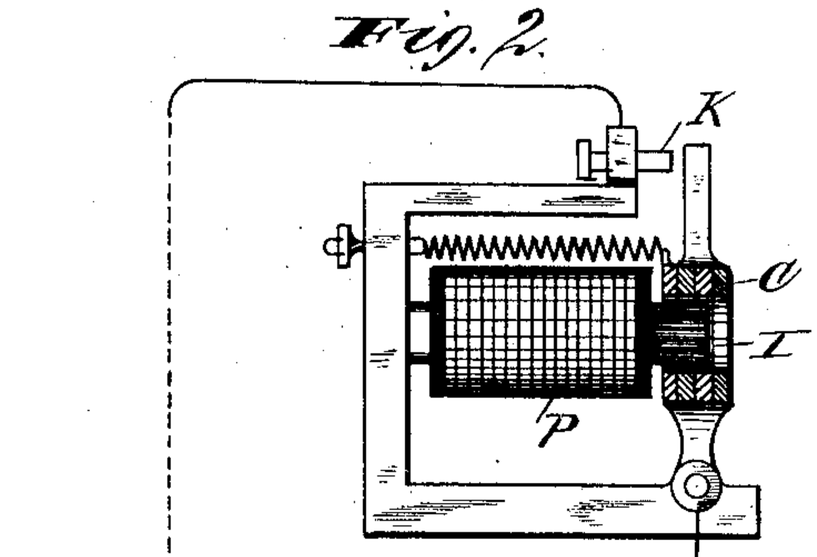


Fig. 3.

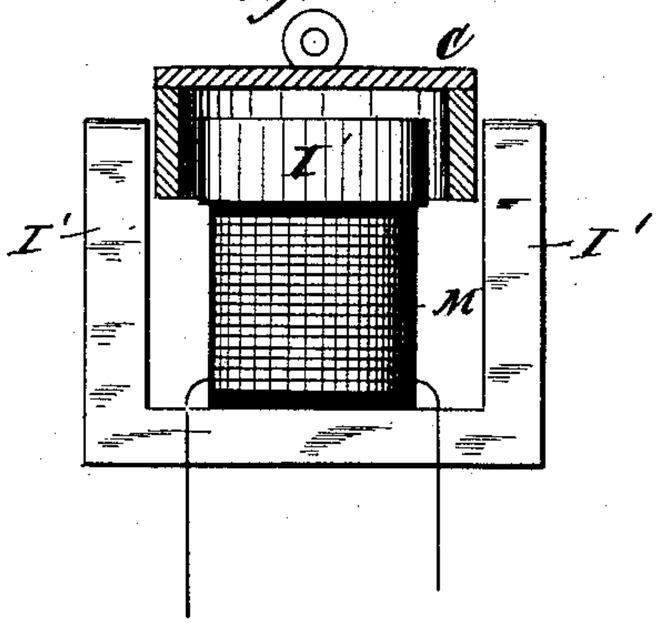
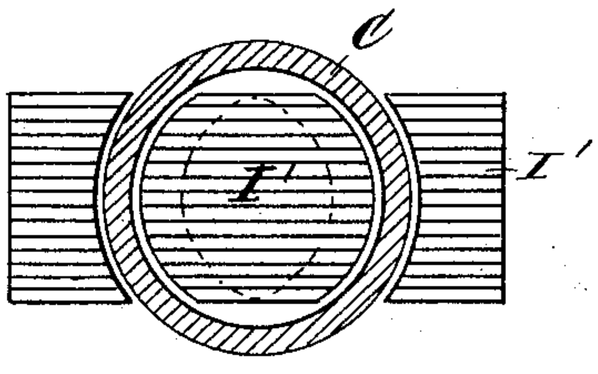


Fig. 4.



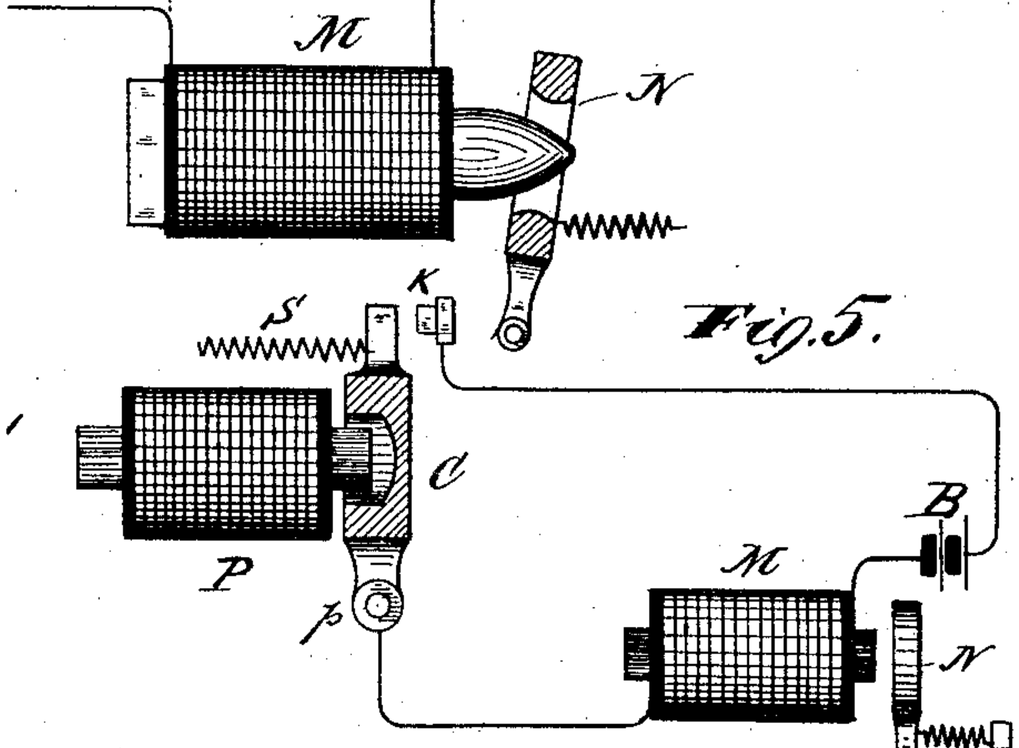


Fig. 5.

Fig. 6.

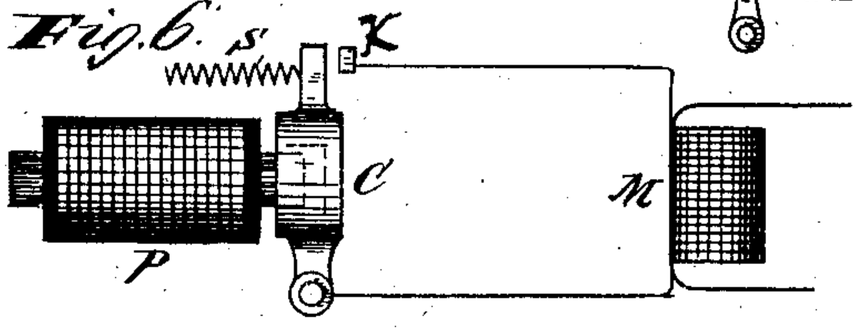
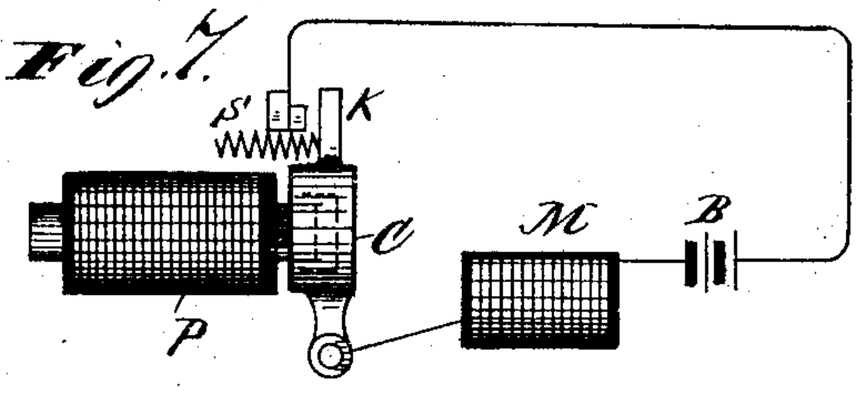


Fig. 7.



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Townsend & MacArthur
ATTORNEYS

(No Model.) 2 Sheets—Sheet 2.

E. THOMSON.

REGULATING DEVICE FOR ALTERNATE CURRENT CIRCUITS.

No. 370,573. Patented Sept. 27, 1887.

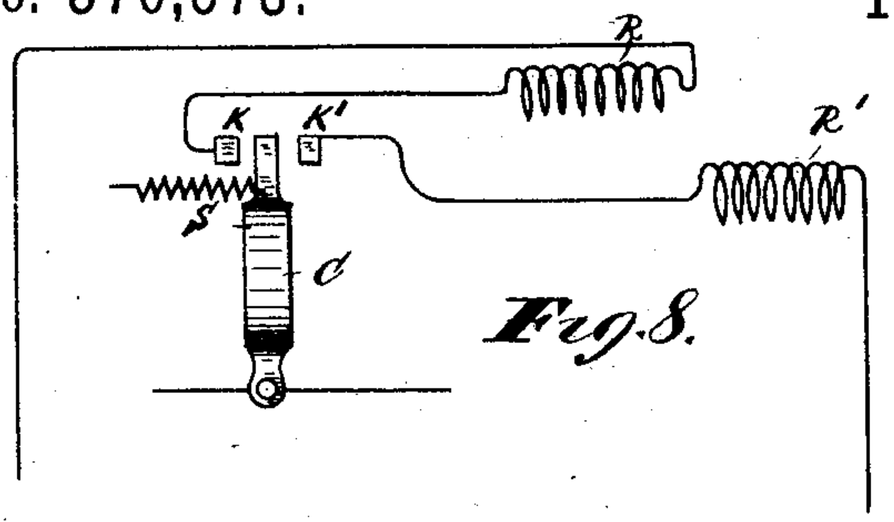


Fig. 8.

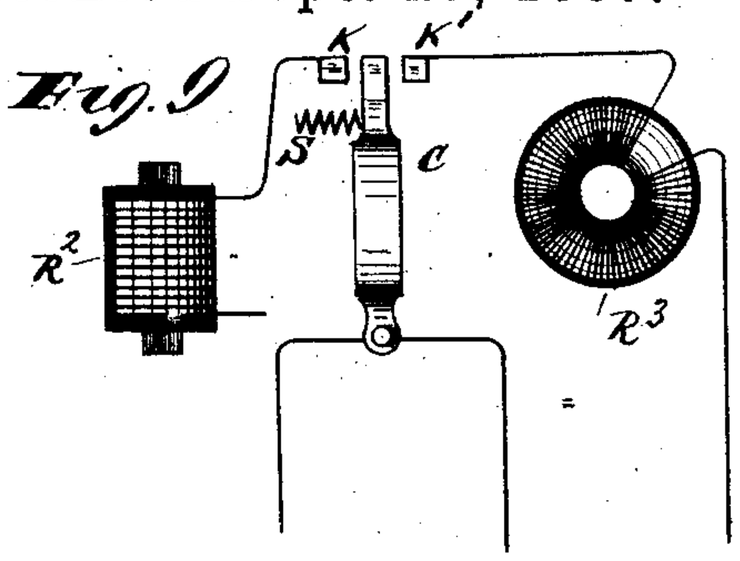


Fig. 9.

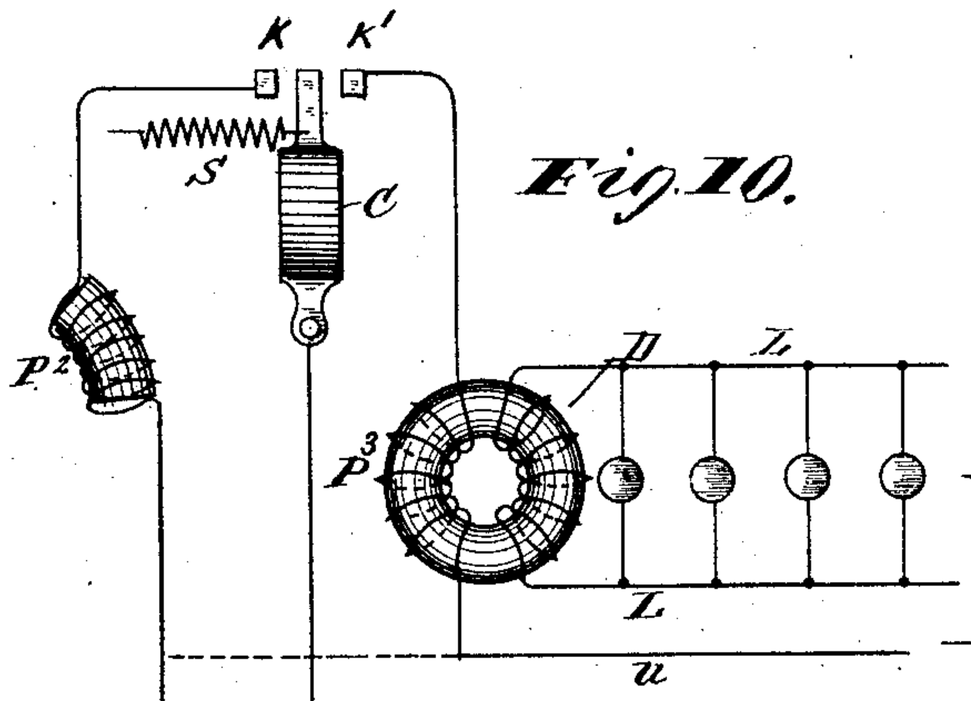


Fig. 10.

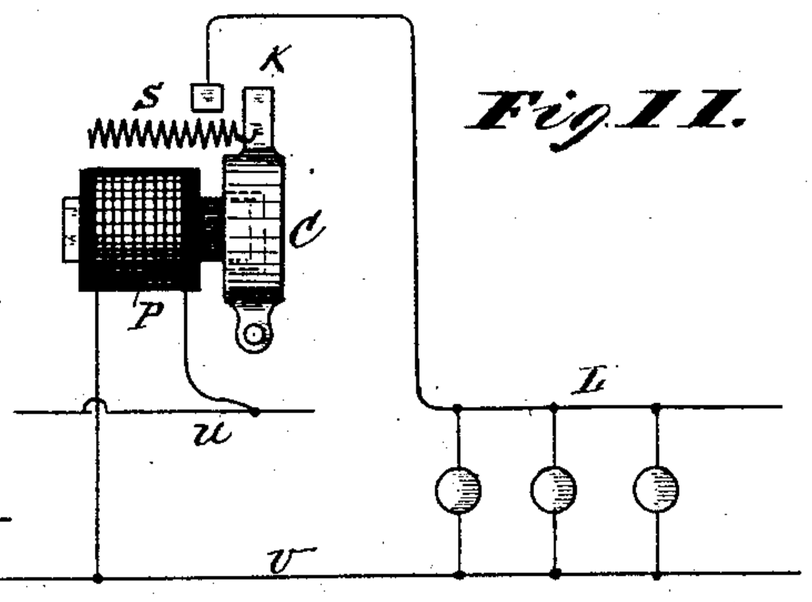


Fig. 11.

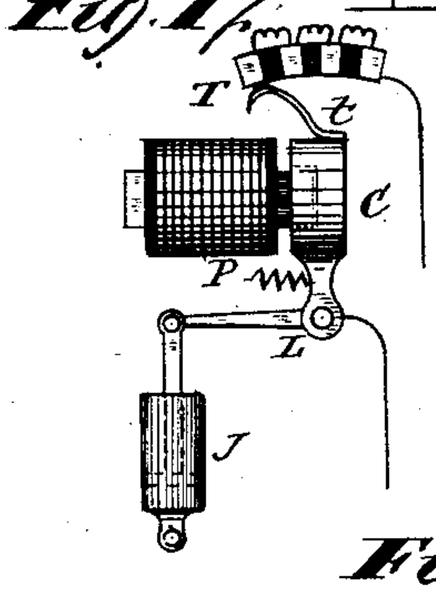


Fig. 12.

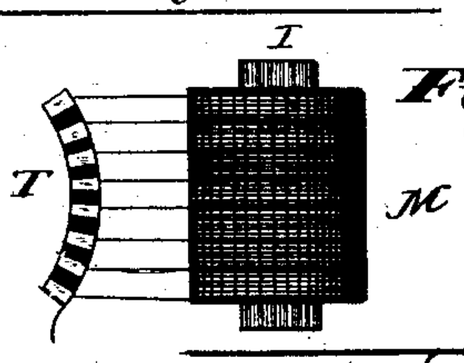
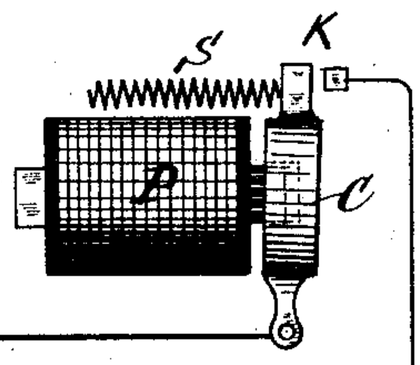


Fig. 13.



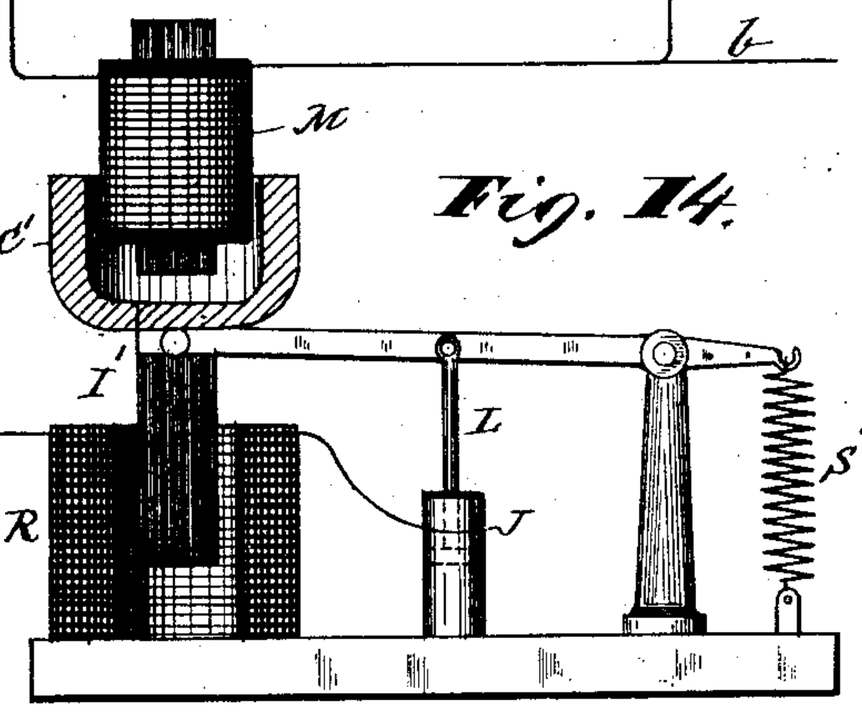


Fig. 14.

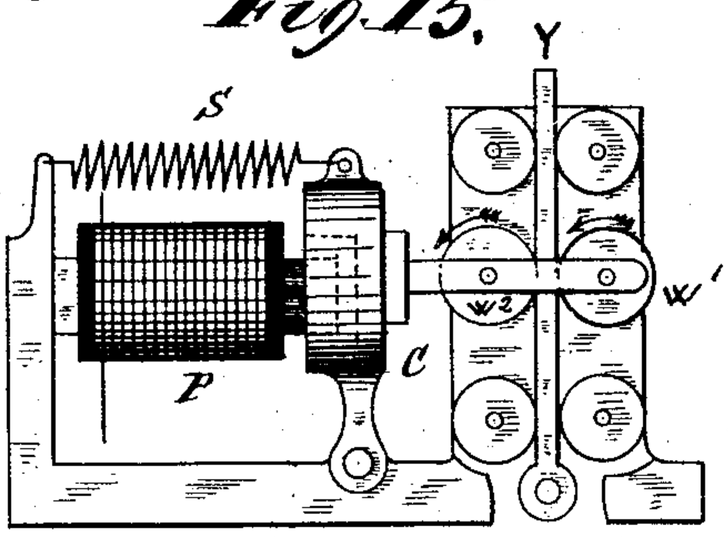


Fig. 15.

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UNITED STATES PATENT OFFICE.

ELIHU THOMSON, OF LYNN, MASSACHUSETTS.

REGULATING DEVICE FOR ALTERNATE-CURRENT CIRCUITS.

SPECIFICATION forming part of Letters Patent No. 370,573, dated September 27, 1887.

Application filed April 6, 1887. Serial No. 233,887. (No model.)

To all whom it may concern:

Be it known that I, ELIHU THOMSON, a citizen of the United States, and a resident of Lynn, in the county of Essex and State of Massachusetts, have invented certain new and useful Regulating Devices for Alternating-Current Circuits, of which the following is a specification.

The object of my invention is to provide a means whereby a device of any nature may be controlled in its action or thrown into and out of operation by means of alternating electric currents.

My invention consists in the combination, with devices of a suitable nature to set up a repulsive action by the agency of induced electric impulses produced directly or indirectly by the alternating current, of an electric contact operated or governed by such device and controlling an electric circuit. Instead of the electric contact operated by the device in which the repulsive action is set up any controlling or operating part of a mechanical motor mechanism may be employed, as will be hereinafter more fully set forth.

The device in which the repulsive action is set up by the alternating currents consists, essentially, of an electric coil, in which the alternating currents flow, and a conducting band, ring, or other shape, which is placed in inductive proximity to the coil or to a magnetic field produced by said coil, and is the seat of alternating currents of high self-induction, which, through their tendency to prolong themselves after being once set up, are each carried over into the period of action of the inducing impulse or field succeeding that by which each one is set up, so that there is a resultant constant repulsion tending to move the coil and the conductor away from one another, instead of a movement first in one and then in the other direction. This portion of my invention may be constructed so that the alternating-current coil or the conductor upon which it acts inductively, one or both, may be movable under the effect of the repulsion. For the sake of simplicity I have in the accompanying description shown the induced-current conductor as movable.

Referring to the accompanying drawings, Figure 1 is a side elevation of a device embodying my invention. Fig. 2 shows a modification of the device and an application of the same. Fig. 3 shows in side elevation a modified form of an electro-motive device, which may be controlled by the opening and closing of a contact and may be used to effect other operations. Fig. 4 is a plan of the same. Figs. 5, 6, 7, 8, 9, 10, 11, 12, and 13 illustrate, diagrammatically, modifications of my invention and various applications of the same. Fig. 14 illustrates another application of the invention. Fig. 15 illustrates a modification in which the device repulsively acted upon by the alternating currents is combined with a mechanical motor mechanism which takes the place of the electric circuit and circuit-controller.

Referring to Fig. 1, P indicates a coil of conducting-wire, which may be included in a circuit or portion of circuit carrying alternating electric currents, and I an iron wire or other subdivided core for said coil.

C indicates a band or ring of copper, which is preferably of low resistance and is mounted on a lever, L, pivoted so that when the conductor is repelled by the operation of the alternating currents in coil P said lever may serve to close an electric contact by bringing a conducting portion of the lever or a conducting-piece attached thereto into connection with an electric conducting-stop, K. A spring, S, adjustable at A, normally tends to hold the lever away from the contact-stop K. Increase of current in coil P or access of current thereto, if sufficient in amount, will overcome the retractor S and cause the conductor to move and close contact at K, which closure of contact may be variously utilized as a means of controlling or bringing into action other devices.

The movement produced by the alternating currents in coil P might be employed for opening a normally-closed contact, as indicated in Fig. 2. In this figure M indicates a device which is brought into action by the opening of such contact, the circuit closed at the contact being a shunt around M, so that the effect of the alternating currents in coil P is to permit current to flow in the coils of the electro-magnet M and cause the same to attract an armature, N, against the force of a retractor.

The electro-magnet M and its movable ar-

mature may be utilized in any desired way. In the example shown in Fig. 2 the electro-magnet M is supposed to be one suitable for use on an electric current in which a continuous or direct current flows; but such device might be one which would be responsive to alternating currents and be thrown into action in the same way, either by opening or closing of a contact produced by the repulsive action of alternating currents in the coil P. Thus, for instance, as indicated in Fig. 3, the coils M might act on a core provided with a copper cap, C, over the end I′ of said core, the repulsion established on the flow of alternating currents in M producing the movement of the conductor C in the same manner that the conductor C of Fig. 1 is moved. The core I′ may have extensions, as indicated, carried around to the outside of the conductor C, to intensify the field in which the conductor moves.

The device, Fig. 3, may be used as a motor agent for various purposes.

In Fig. 5 the application of the apparatus shown in Fig. 1 to controlling the action of an electro-magnet, M, in the direct circuit of a battery, B, is illustrated. When currents of sufficient strength flow in the coil P, the circuit of the battery B through M is closed and the armature N is attracted.

The armature N may be connected with any device.

Instead of closing the direct circuit to the device M, the conductor C, by its movement, may close a shunt around said electro-magnet by the closure of the contact at K, as indicated in Fig. 6; or the opening of a contact at K may be employed for breaking the circuit of the device M, so as to throw the same out of action by the alternating currents in the coil P, Fig. 7.

The secondary devices M described may be replaced by an electric resistance, R or R′, as indicated in Fig. 8, or by a reactive coil, R^2 or R^3, Fig. 9, which shall take the place of a resistance for alternating currents, such reactive coils acting by counter electro-motive force set up in the coils themselves, which are suitably wound on iron cores of any desired shape.

In Fig. 10 the application of my invention to throwing the primary of an induction-coil into or out of circuit is indicated.

P^2 or P^3 indicate the primary of an induction-coil whose secondary is employed for supplying electric lamps L or other devices connected in multiple arc.

The operation of the conductor C serves, as indicated, to throw such primary into or out of action between mains *u v*, each supposed to carry alternating electric currents.

In Fig. 11 my invention is illustrated as applied to throwing a group of lamps, L, into and out of multiple-arc connection between alternating current-mains *u v*. In this case the coil P is in a multiple-arc connection between the mains, and the repulsive action set up by the alternations of current in its coil throw the lamps L out of circuit by opening a contact at K.

The contact K is normally closed by a spring, S, which may be adjusted to such a degree that with a normal potential between the mains the contact shall remain closed, while on an increase of potential the increase of repulsive action in the devices P C shall result in cutting off the lamps and preventing injury to them by undue current.

The devices C, instead of acting on a simple contact, may move a contact, *t*, Fig. 12, over a set of contact-blocks, T, thus introducing into a circuit a greater or less amount of an artificial resistance in obvious manner.

J indicates a dash-pot connected to the lever L, and employed for the purpose of preventing sudden or violent movements of the same.

The arrangement of devices, Fig. 12, may be employed in any situation where it is desirable to employ a variable resistance for the purpose of controlling the flow of current to any device directly or indirectly.

The set of contacts T may be connected to the sections of a sectional coil, M, Fig. 13, wound on a core, I, the coil M forming a reactive coil whose reactive effect would depend upon the number of its sections in circuit, as determined by the movement of the contact *t*, under the effect of the repulsion set up between the conductor C and the core or coil P.

In Fig. 14 the device controlled consists of a coil, M, which is an alternating-current circuit, *a b*, and has a copper band or conductor in the shape of a cap, C′, over its pole. The conductor C when repelled closes a shunt around the coil M, while if the alternating currents cease or diminish to a sufficient degree in the coil P the retractor S will open the shunt and allow the alternating current on main *a b* to flow in coils M, thus causing a repulsion of the conductor C′. The movements of the conductor C′ may be utilized for the purpose of introducing a core, I′, into a coil, R, to a greater or less extent, by mounting said conductor C′ and core I′ on a lever, L, provided with a retractor, S′, which acts in opposition to the repulsive effects on conductor C′. If the coil R be in an alternating-current circuit, the reactive or counter electro-motive-force effects in the latter will be varied through the movements of the core I.

The movements of conductor C might be employed to act on any other kind of an electric contact which would be of proper character to govern the flow of current to the coils M.

The actions described with reference to Fig. 14 might be modified, if desired, either by arranging the parts so that contact K should be open instead of closed when the current in coil P is strengthened, or by arranging the core I′ on lever L, so that the repulsion of conductor C would withdraw the core instead of inserting it.

It is not essential that the device controlled

by coil P and its copper circuit or closed conductor be controlled by electric contacts, as it would suffice for many purposes to have the conductor C or the coil P, whichever may be made movable, operate on some portion of a mechanical motor device in such way as to release or control the action of the same according to the nature of the operation which it is desired to perform. For instance, the conductor C might operate the escapement of a train of wheel-work, or in other way operate on a mechanical motor after the manner commonly employed, where an ordinary electromagnet in a continuous-current circuit is used as the means for controlling or bringing into operation a second device, when it is desired to relieve such magnet of work and to put the work upon some other device controlled thereby. Thus, for instance, as indicated in Fig. 15, the conductor C may move friction-rollers W^2 W', which are kept in rotation by any suitable means in the same direction, as indicated by the arrows, and have between them a movable bar, Y, with which one or the other of the friction-rollers is caused to engage by the movements of the conductor C. The friction-rollers W^2 W' are set so as to allow the bar Y free passage between them, and the bar will be moved up or down by the operation of one or the other of the rollers, according as the spring S or the repulsive action between P and C preponderates. The bar Y as thus moved may operate in any way to govern a resistance, move a switch, depress a lever, move a magnet-core, or perform any other of the operations which may be effected through the closure or opening of an electric contact, K, by the movement of a conductor, C, as before explained.

What I claim as my invention is—

1. The combination, substantially as described, of a device in which alternating currents act to produce a continuous repulsive effect and an electric contact or its equivalent, as described, controlled by said device, as and for the purpose set forth.

2. The combination of a coil on an alternating-current circuit, a closed circuit in inductive relation thereto, and a contact-point or its equivalent, as described, controlled by the repulsive action set up through the flow of alternating current in the coil.

3. The combination of an alternating-current coil, a closed conductor in which currents of high self-induction are set up by said alternating current, so as to produce, as described, a continuous repulsive effect, and means actuated by the repulsive action established for causing movement of a second device in either of two directions, according to the strength of the alternating current.

4. The combination, with an alternating-current circuit, a conductor in which currents of high self-induction are produced by said alternations, and an electromotor device, or its equivalent, as described, controlled by the variations of repulsive effect between said conductor and the inducing field or coil acting inductively upon it.

5. The combination, with a coil, P, in an alternating-current circuit, of the movable conductor C, a spring tending to hold said conductor in the magnetic field established by the alternating currents in the coil, an electric contact governed by said movable conductor, and an electromotor device whose circuit is connected to the contact so that it will be governed in its action by the alternating currents in the coil, as and for the purpose described.

6. The combination, with an alternating-current circuit, of a device in which repulsive action is established by the alternating currents and a mechanical motor whose operation is governed by said device, as and for the purpose described.

7. The combination, with a coil and a conductor movable away from the magnetic field established by said conductor through the repulsive effects set up by alternating currents in the coil and conductor, of a second coil connected to an alternating-current circuit, a movable conductor which is repelled away from the magnetic field established by alternating currents in said coil, and an electric contact governed by the movement of the first-named conductor for controlling the flow of alternating currents to the second coil.

Signed at Lynn, in the county of Essex and State of Massachusetts, this 2d day of April, A. D. 1887.

ELIHU THOMSON.

Witnesses:
J. W. GIBBONEY,
EDWARD A. BERDGE.