No. 637,773. Patented Nov. 28, 1899.

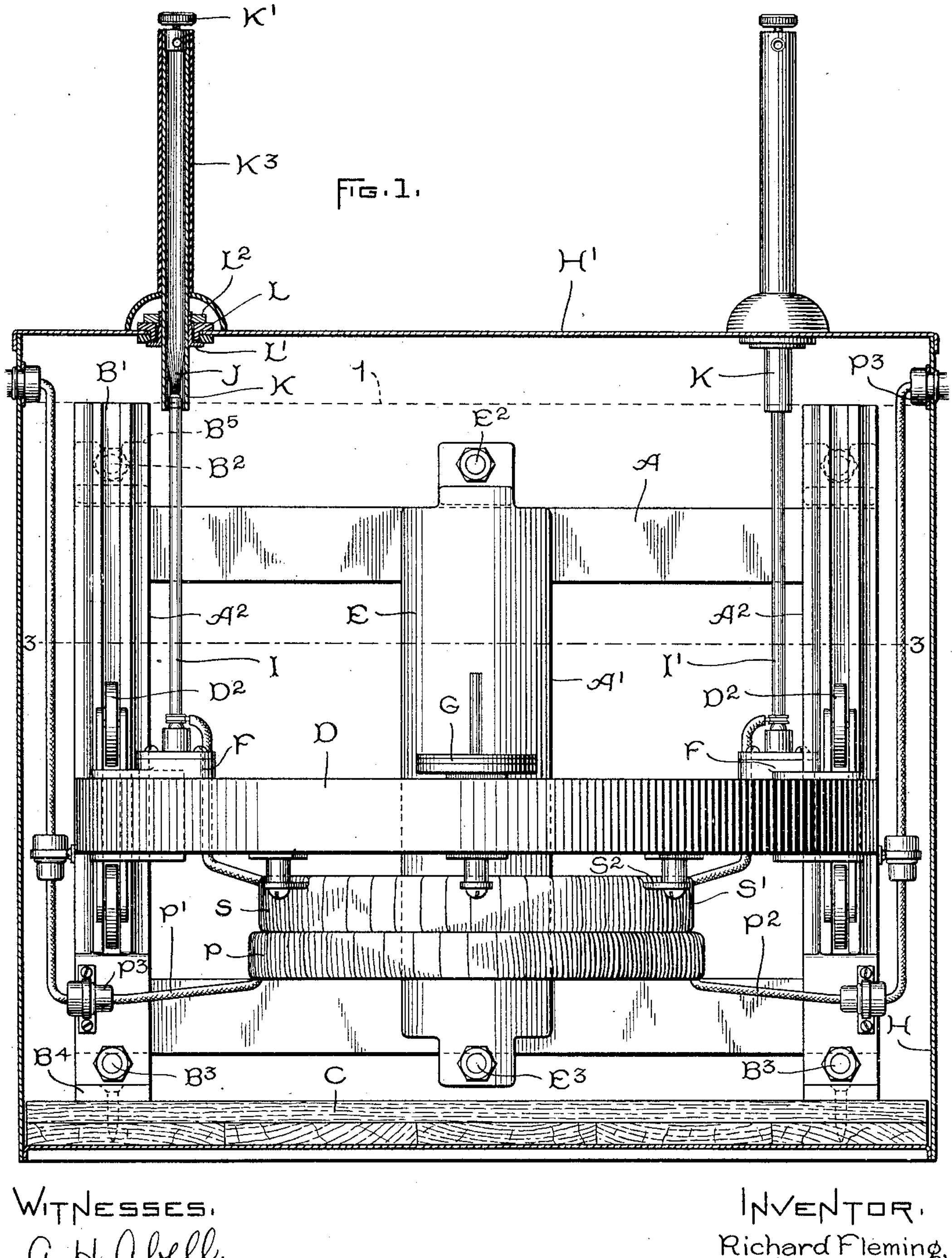
R. FLEMING.

CONSTANT CURRENT TRANSFORMER.

(Application filed June 6, 1898.)

(No Model.) 4 Sheets—Sheet 1.

FIG. 1.



Witnesses.
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THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

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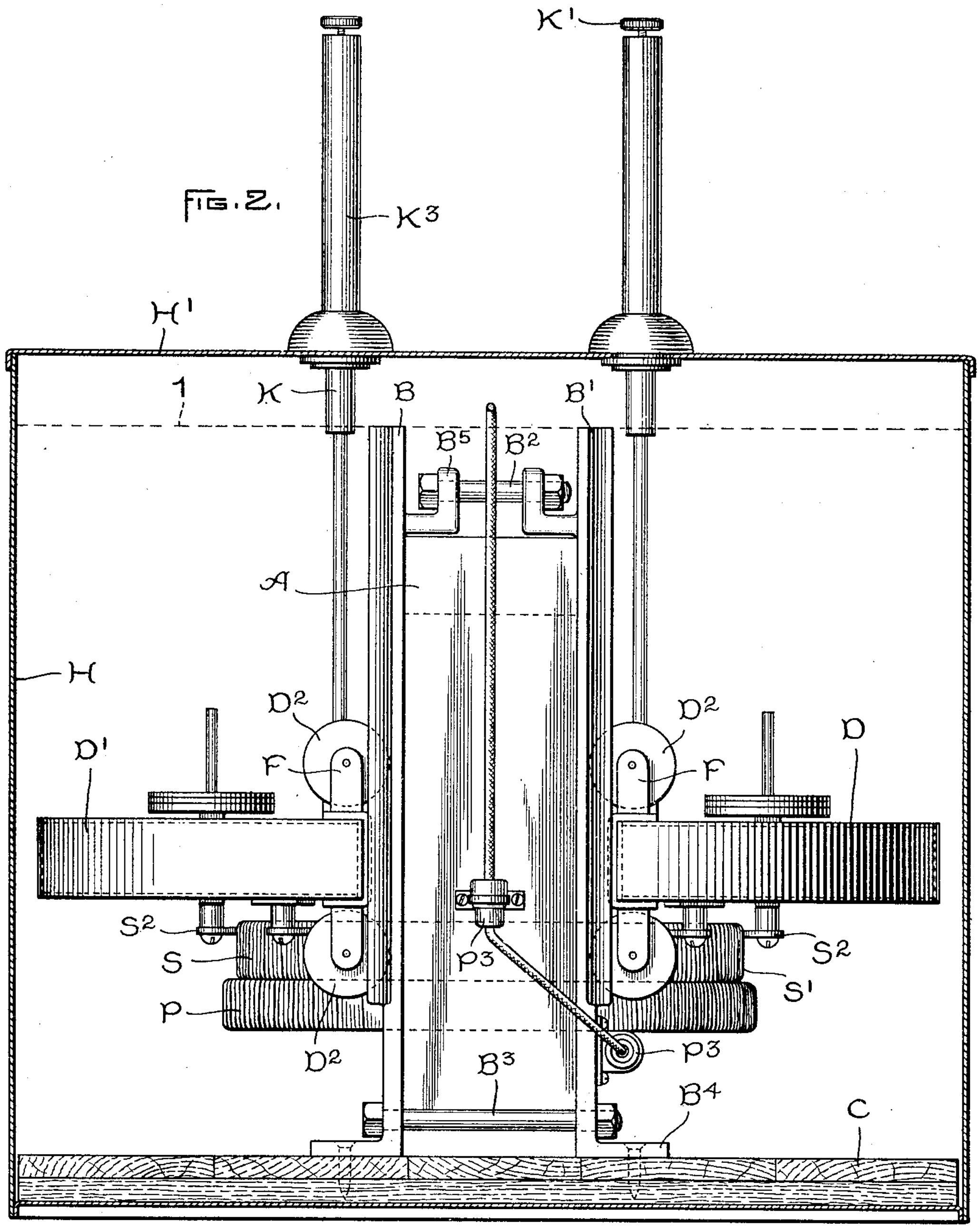
FIG. 2.



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(No Model.) 4 Sheets—Sheet 3.

FIG. 3.

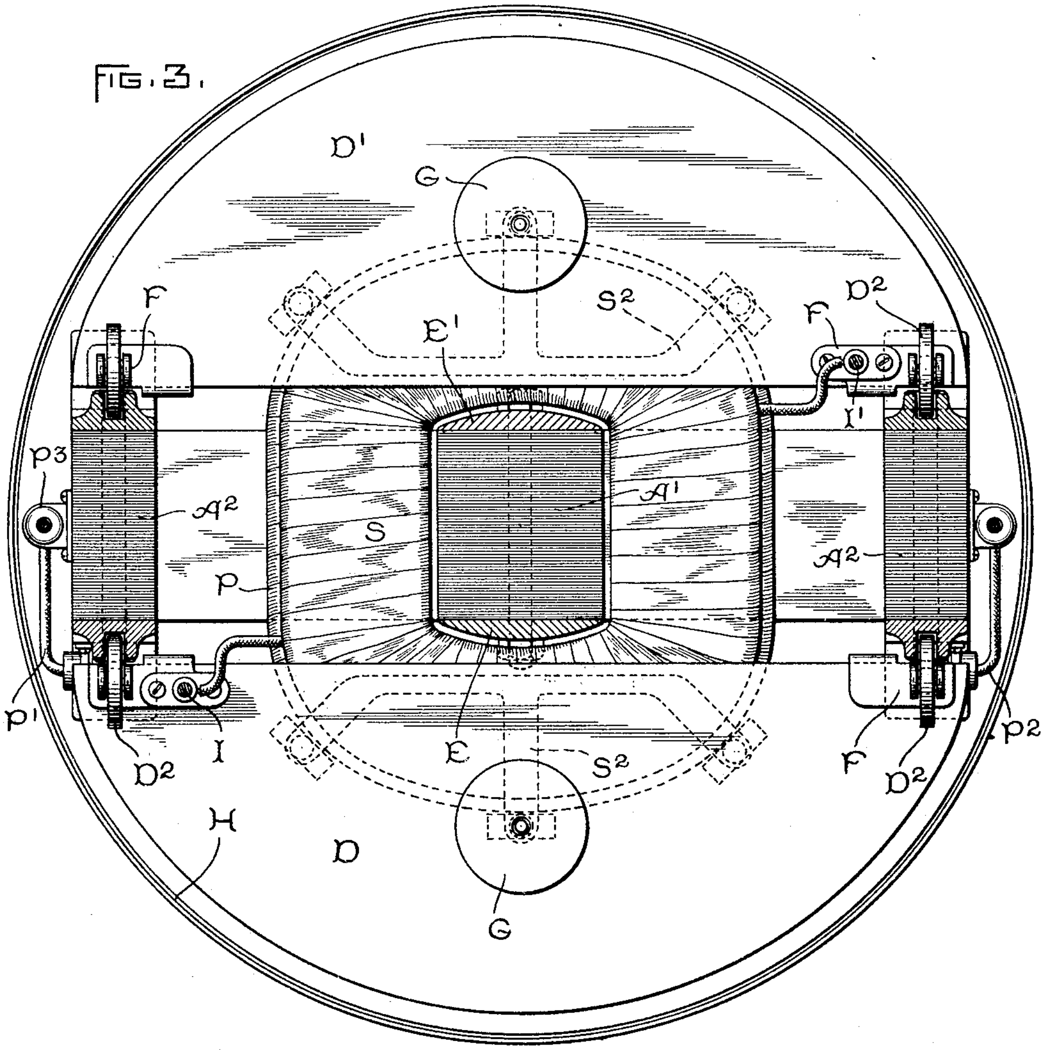

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FIG. 4.

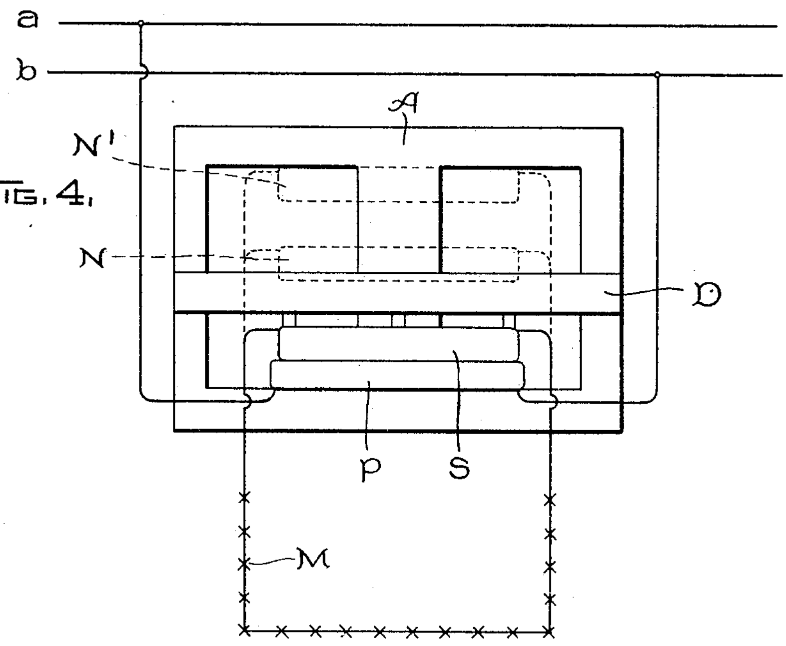

FIG. 5.

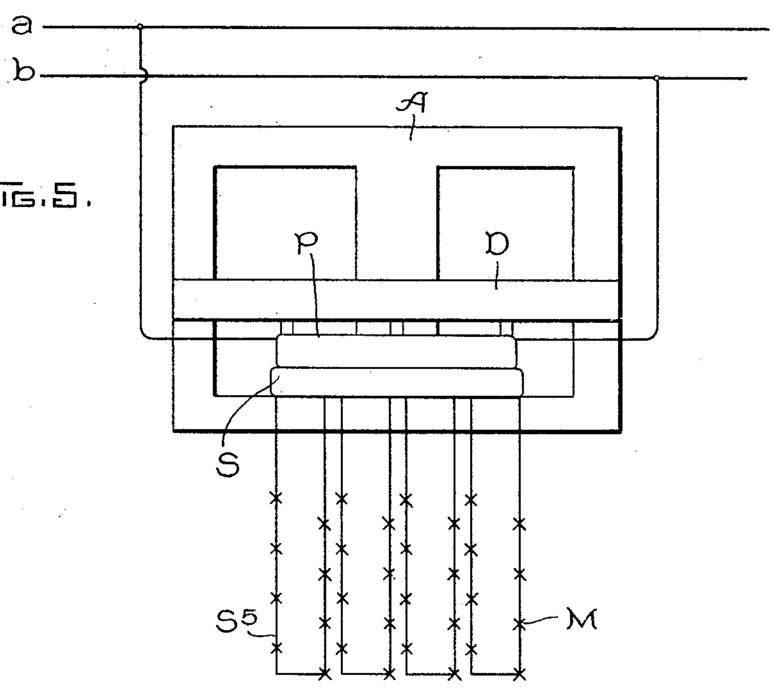

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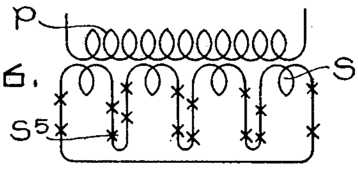
FIG. 6.



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UNITED STATES PATENT OFFICE.

RICHARD FLEMING, OF LYNN, MASSACHUSETTS, ASSIGNOR TO THE GENERAL ELECTRIC COMPANY, OF NEW YORK.

CONSTANT-CURRENT TRANSFORMER.

SPECIFICATION forming part of Letters Patent No. 637,773, dated November 28, 1899.

Application filed June 6, 1898. Serial No. 682,676. (No model.)

To all whom it may concern:

Be it known that I, RICHARD FLEMING, a subject of the Queen of Great Britain, residing at Lynn, in the county of Essex, State of Massachusetts, have invented certain new and useful Improvements in Constant-Current Transformers, (Case No. 760,) of which the following is a specification.

The present invention relates to transformers, and has for its object to provide a constant-current self-regulating transformer of improved construction and arrangement.

A further object of my invention is to provide a system of distribution employing transformers to supply current to translating devices in which the working potential of the secondary or load circuit is subdivided to a safe working amount.

My invention also has for its object to provide a constant-current self-regulating multicircuit transformer.

In the accompanying drawings, which show an embodiment of my invention, Figure 1 is a front elevation of a transformer with the casing in section. Fig. 2 is an end view of the same. Fig. 3 is a section taken on the line 3 3 of Fig. 1. Fig. 4 is a diagram of the circuit connections. Fig. 5 is a modification in which the secondary is connected to a multicircuit system of distribution, and Fig. 6 is a diagram of connections of the transformer shown in Fig. 5.

The transformer consists of a rectangular core-body of laminated iron A, having a central portion A′, which is surrounded by the primary and secondary coils P and S. The laminæ forming the sides of the core are held between clamps B and B′, which are secured together at the upper end by a bolt B^2 and mounted in lugs B^5, and at the lower end by a bolt B^3. The bottom end of each clamp is formed with a foot B^4, which acts as a support to maintain the core in position, which is secured by screws to the wooden base C. The clamps, in addition to holding the laminæ together, act as guides for the rollers D^2, which are secured to the floats D and D′. The cross-section of the clamps is best shown in Fig. 3, where it will be seen that the rollers are mounted in deep grooves, which prevent them from moving laterally. The central portion A′ of the core is composed of a body of laminæ connecting the top and bottom sides of the core, and the laminæ are secured in place by plates E and E′, which are secured at the top by a bolt E^2 and at the bottom by a bolt E^3. The core as arranged forms a closed magnetic circuit, with the coils surrounding the central portion A′ and the sides A^2 serving to complete the magnetic circuit. Since the laminated core is built up of sections, the primary and secondary coils may be wound and insulated in the proper manner before being mounted in place.

The primary coil P is stationary and rests on the lower side of the core, and extending therefrom are leads P′ and P^2, located on opposite sides of the coil, which convey current to and from the coil. The leads are insulated from the surrounding casing and the core by insulating-bushings P^3. The secondary coil has an external wrapping of tape S′, and secured to the coil by the tape are two similar supports S^2. (Best shown in dotted lines in Fig. 3.) These supports are preferably made of metal on account of strength; but insulating material may be employed, if desired, especially where very high potential is used and the primary made the moving element. The supports S^2 have three arms, which extend beyond the outer periphery of the coil and are secured to the floats by screws.

The floats D and D′ are similar, each consisting of a semicircular tank made of thin sheet metal the portions of which are united in a manner to make it air-tight. Mounted on the inner edge of each float and opposite the parallel guides formed by the clamps are frames F, each of which is provided with a pair of rollers D^2, one being situated above the other below the float. Each float being provided with four rollers, two above and two below, is prevented from twisting out of line and is free to move up and down.

Mounted on short studs on the top side of the floats are counterweights G, which are employed to adjust the floating tendency of the coil. The transformer works by repulsion, and in order that the coils may be in a position for operation at all times the parts are so adjusted that the moving coil—in this instance the secondary—has a tendency to move toward the primary or stationary coil.

Surrounding the transformer is a thin sheet-metal casing H, provided with a removable cover H'. The casing is filled with oil up to the point indicated by the dotted line 1, so that all of the working parts are submerged. By balancing the weight of the coil by a float submerged in oil the relative effect of the friction between the moving and stationary parts is reduced to a minimum, and as the regulation of the transformer is dependent upon the free movement of the coil up and down it will readily be seen that this becomes a matter of importance. In addition to assisting the coil in its vertical movements the oil acts as an insulator and also as a cooling medium to keep down the temperature of the transformer.

Two of the frames F are provided with vertically-extending rods I and I', which are connected, respectively, to opposite ends of the secondary coil S. On the upper end of each rod is a contact-brush J, made of strips of conducting material and so arranged that it makes good contact with the tube K, but at the same time offers practically no resistance to the movement of the coil. The tubes K are similar in construction, and each is provided with a plug in the top having a binding-screw K' to form a terminal for the line-wire. The tube is insulated from the cover H' of the casing by a two-part insulating-bushing L, and the bushing is secured to the tube by means of a sleeve L' and nut L^2. Surrounding the tube is a sleeve K^3 of insulation to prevent the person handling the apparatus from getting shocks and also to decrease the liability of short circuits from loose wires.

In the present instance the secondary coil is shown as being movable; but in so far as my invention is concerned the relation could be reversed and the primary made the moving member. There is, however, an advantage more or less great, depending upon the voltage of the transformer, in making the secondary the moving element, as it involves less trouble in insulating.

In Fig. 4 the circuits are illustrated diagrammatically. The primary coil P is connected to the circuit-mains *a* and *b*, which are connected to any suitable source of alternating current. In circuit with the secondary S are a number of translating devices M, of any desired character, the ones shown consisting of arc-lamps; but any other form of translating devices may be employed. As the load on the secondary changes, due to cutting translating devices into or out of circuit, the position of the moving coil with respect to the stationary coil is changed, the position shown in full lines indicating the full-load position, the dotted-line position N representing half-load, and the dotted-line position N' representing the short-circuited position. As the load on the secondary changes the repulsion between the primary and secondary coils varies, and the moving coil will promptly adjust itself with respect to the stationary coil, and the current in the load-circuit will remain constant. This arrangement of coils will also compensate for changes of potential in the main circuit, for as the current varies in the primary its repelling force varies and the secondary will assume a new position in accordance therewith.

In Fig. 5 is shown a modification of my invention in which the secondary of the transformer supplies current to a multicircuit system of distribution. In this form I prefer to make the secondary the stationary element on account of the number of wires leading from it and to mount the primary P on the float in such a manner that it will move freely toward and away from the secondary. While I have shown a system of distribution in which a step-down transformer is employed, my invention is equally applicable to a system in which a step-up transformer is employed or to a system in which either the primary or secondary, or both, are connected to a multicircuit system of distribution. The construction of the core, float, &c., being similar to that shown in Figs. 1, 2, and 3, further description is unnecessary. The secondary coil S may be subdivided into two or more coils. In the present instance it is divided into four coils S', S^2, S^3, and S^4, as shown in Fig. 6, and the translating devices M are connected in circuit with loops S^5, the ends of which are connected to two separate coils. By this arrangement of circuits I am enabled to subdivide the potential of the secondary system, so that the danger from handling is reduced by a considerable amount and also the strain on the insulation. Preferably this method of connection is used where the electromotive force is over three or four thousand volts.

What I claim as new, and desire to secure by Letters Patent of the United States, is—

1. The combination of two inductively-related coils mounted so as to have a tendency to move in one direction relatively to each other, and means for partially counteracting said tendency by fluid-pressure.

2. The combination of two relatively-movable coils immersed in fluid and a body of given specific gravity immersed in fluid of higher specific gravity and mechanically attached to one of said coils.

3. The combination of a core, a primary and a secondary coil movable with respect to each other, a body of insulating fluid in which the coils are immersed, and a float connected to one of the coils and also immersed in the insulating fluid.

4. The combination of the primary and secondary windings capable of movement with respect to each other as the inductive action between the windings varies, due to changes in load, a body of fluid insulating material,

a float arranged to support the weight of at least one of the coils, and means for directing the movements of the moving coil.

5. The combination of an iron core, a moving and a stationary coil so arranged as to repel each other, a body of fluid, a float mounted in the fluid and connected to the moving coil, the arrangement of the coil and float being such that the weight of the coil is sufficient to balance the floating capacity of the float, and means for adjusting the floating tendency of the coil and float.

6. The combination of an iron core, a moving and a stationary coil, a body of fluid insulating material, a float for supporting the moving coil, rollers mounted on the float and guides for the rollers to prevent the moving coil from twisting out of line.

7. In a transformer, the combination of an iron core, a moving and a stationary coil, a body of fluid insulating material, a float for supporting the coil, means for guiding the movements of said float, and a traveling electrical connection between the moving coil and a stationary part of the transformer.

8. In a transformer, the combination of a laminated-iron core, plates for clamping the laminæ together, guides formed in the plates, a moving and a stationary coil, a float for supporting the moving coil, comprising two separate elements which are set on opposite sides of the guides, and rollers on each element of the float which travel in the guides and prevent the moving coil from twisting out of line.

9. In a transformer, the combination of a rectangular core having a central portion which is surrounded by the primary and secondary coils, a body of fluid insulating material in which the coils are submerged, a float for supporting one of the coils, contact devices carried by the float and connected to the moving coil, and a stationary contact arranged to establish connection with the contact device on the float.

10. In a transformer, the combination of a rectangular core having a central portion which is surrounded by the primary and secondary coils, clamps at opposite ends of the core for holding it together, each clamp being provided with a groove, a two-part float for supporting one of the coils, a body of fluid insulating material, frames on opposite ends of each float, and rollers mounted in the frames which travel in the grooves in said clamps.

11. The combination of a core, a moving and a stationary coil mounted thereon, a contact device carried by the moving coil, consisting of a rod with a brush on the outer end, a stationary tubular conductor arranged to make connection with the moving contact, and a body of insulating material which surrounds the tubular conductor.

12. The combination of a core, a coil mounted thereon, a subdivided coil in inductive relation to the first-named coil, and loops or circuits in which translating devices are connected, formed between the subdivisions of the coil.

13. The combination of a core, a primary coil mounted thereon, a subdivided secondary coil mounted in inductive relation to the first-named coil, and loops or circuits for translating devices formed between the subdivisions of the secondary coil, which subdivisions connect all of the loops in series.

14. The combination of a coil, a subdivided coil in inductive relation to the first-named coil and adapted to be repelled thereby, loops or circuits containing translating devices and connecting the subdivisions of the coil, and means for supporting one of the coils in such a manner that it is free to change its position with respect to the other coil as the load varies.

15. The combination of a plurality of coils in inductive relation to each other, one of said coils being subdivided, translating devices connected between the subdivisions and means for allowing a relative motion between coils in response to variation of current in said coils.

In witness whereof I have hereunto set my hand this 24th day of May, 1898.

RICHARD FLEMING.

Witnesses:
DUGALD MCKILLOP,
HENRY O. WESTENDARP.