E. R. CLIFF.

ELECTRIC TRANSFORMER AND GOVERNOR.

APPLICATION FILED MAR. 5, 1908.

942,544. Patented Dec. 7, 1909.

2 SHEETS—SHEET 1.

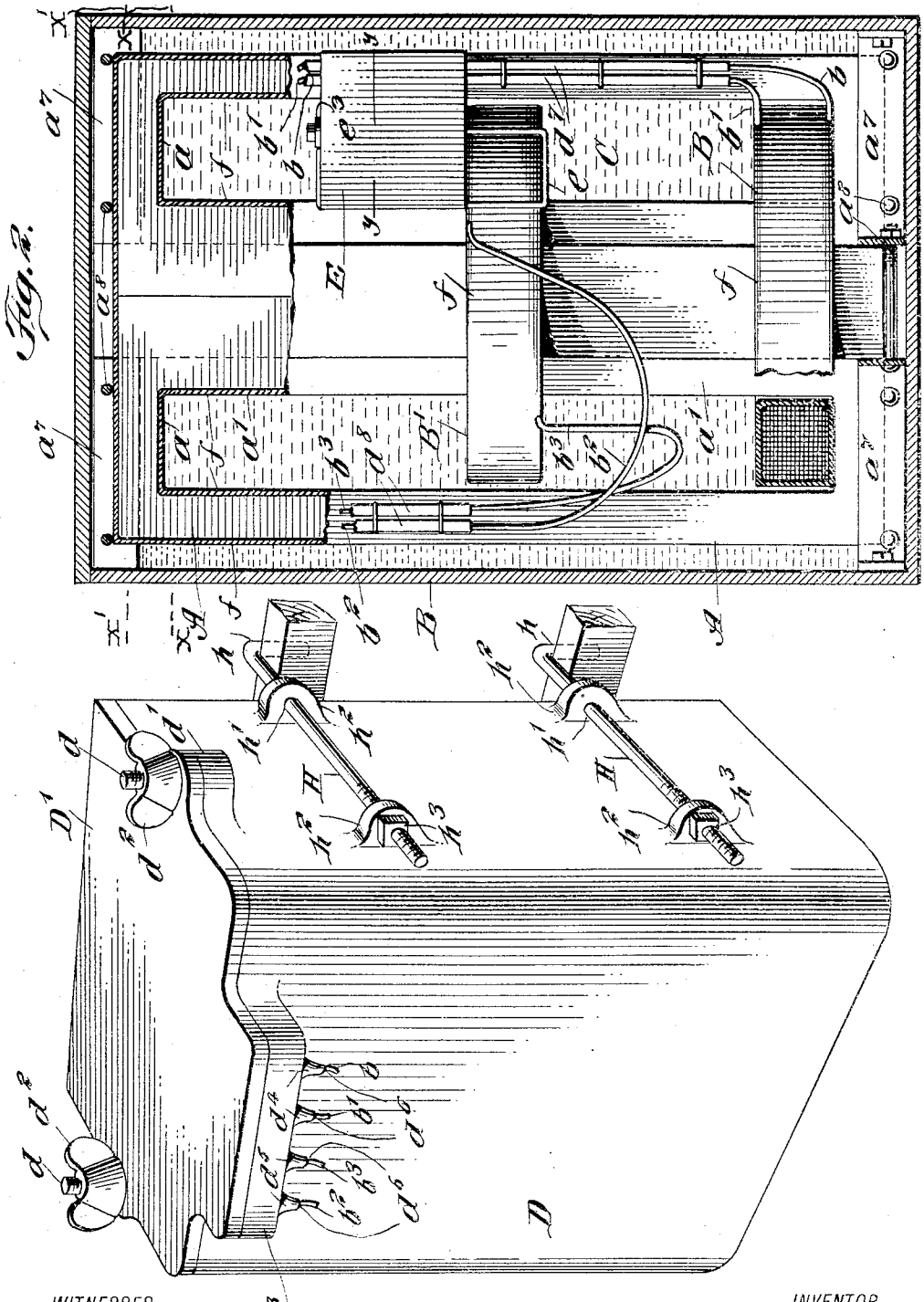

Fig. 2.

Fig. 1.

WITNESSES

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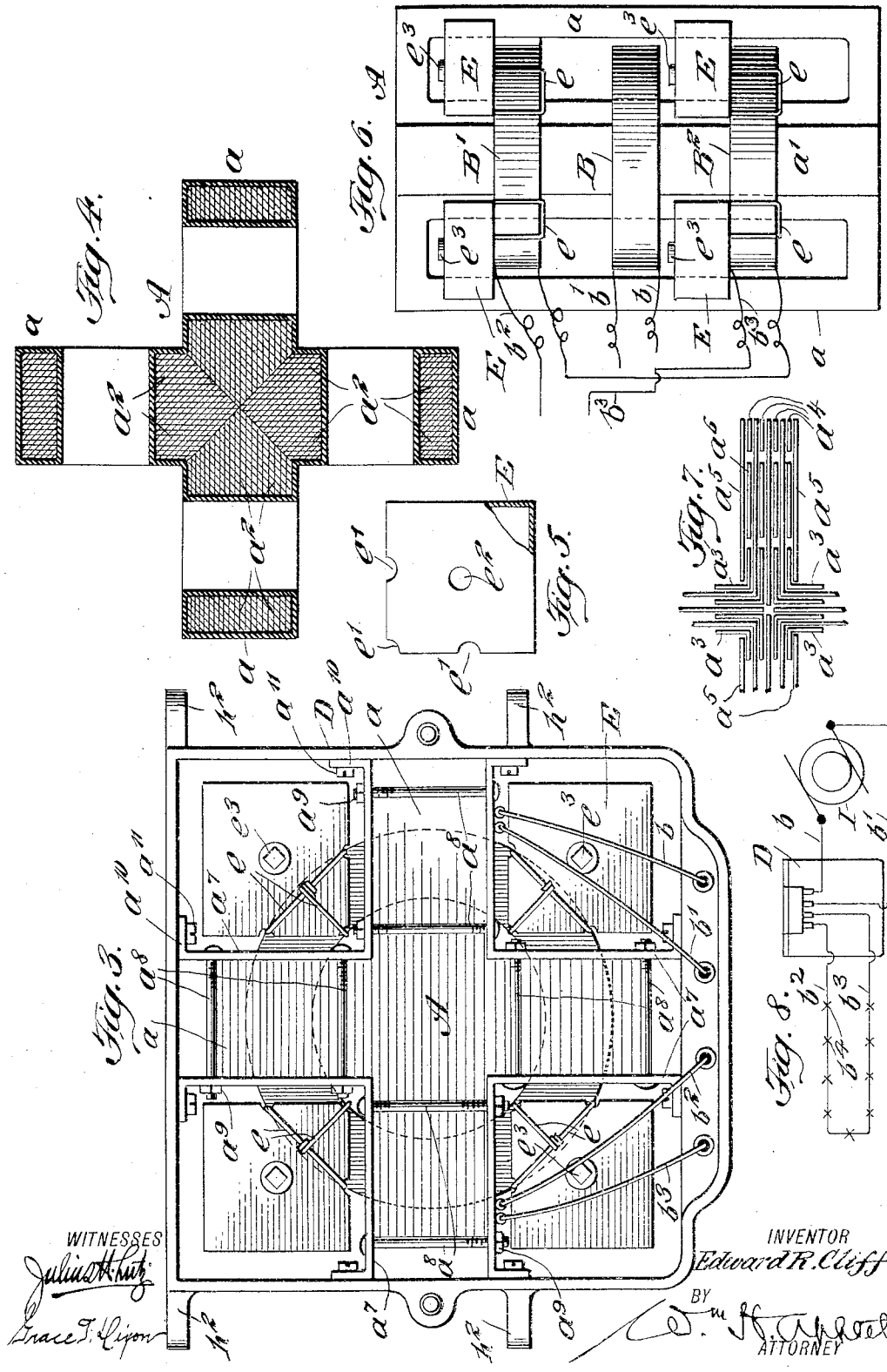

UNITED STATES PATENT OFFICE.

EDWARD R. CLIFF, OF NEW YORK, N. Y.

ELECTRIC TRANSFORMER AND GOVERNOR.

942,544. Specification of Letters Patent. Patented Dec. 7, 1909.

Application filed March 5, 1908. Serial No. 419,340.

To all whom it may concern:

Be it known that I, EDWARD R. CLIFF, a citizen of the United States, and a resident of Port Richmond, borough and county of Richmond, in the city and State of New York, have invented certain new and useful Improvements in Electric Transformers and Governors, of which the following is a specification.

My invention is designed for use in connection with systems of electric lighting, in which the lights or other units, operated by alternating currents, are arranged in serial circuits, and relates more particularly to the transformers and governors by which such currents are automatically transformed and regulated, and the strength of current in each circuit rendered uniform whether the whole or only part of the lights or other units of such circuit are in operation; the object of the invention being to increase the efficiency of transformers and governors of this class and to provide mechanism of this character, which, while greatly simplified in some of its parts, shall, at the same time, be more durable and efficient in operation.

To these ends, the invention consists in certain peculiarities of constructions and combinations of parts, the specific forms of which preferred in practice will first be described, and the novel features of the invention then pointed out in the subjoined claims.

Referring to the accompanying drawings, which form a part of this specification, Figure 1, is a view in isometric projection of an electric transformer and governor constructed in accordance with my invention, the same being shown as applied to the cross-arms of a telegraph pole; Fig. 2, a view showing the inclosing case in vertical transverse section, with parts of the magnetic circuit and primary coil broken away, and a portion of the buoyant vessels removed; Fig. 3, a plan view of the transformer and governor, with the cover of the inclosing case removed; Fig. 4, a horizontal transverse section of the magnetic circuit detached, taken in the plane $x\ x$ of Fig. 2; Fig. 5, a plan view of one of the buoyant vessels detached, with a part of its top broken away; Fig. 6, a side elevation of the magnetic circuit detached, with a slightly modified arrangement of primary and secondary coils thereon; Fig. 7, a horizontal transverse sectional detail detached, also taken in the plane $x'\ x'$ of Fig. 2 of a magnetic circuit of a slightly modified construction, with parts broken away, and Fig. 8, a diagrammatic view, on a reduced scale, to be hereinafter described.

In all the figures, like letters of reference are employed to designate corresponding parts.

A indicates a magnetic circuit, which is or may be constructed of a number of open center rectangular frames or sections a disposed in radial relationship with respect to one another around a common axis, and united and firmly bound together at their inner edges to form by this union a central core a^1. In the construction of this circuit soft iron is employed, and the circuit either cast therefrom in the appropriate form to suit it to its intended use, or made up from plates of that material as preferred. In the form of the invention which I have selected for purposes of illustration however, the circuit is made up from soft iron plates, which are cut or otherwise pressed out into the required form, and the respective radiating frames or sections a built up from them by placing the plates side by side in the proper relationship to effect that result and then firmly binding them together to form the completed structure. In Fig. 3 of the drawing I have shown these constituent plates as constructed in the form of open center rectangles a^2, while in Fig. 7 I have illustrated them as made in the shape of imperforate rectangular strips a^3, a^4, a^5 and a^6, of the required dimensions to suit them to the purposes for which they are intended, with the strips a^3, which form the central or core portion a^1 of the circuit, bent along their longitudinal median lines to the required extent to convert them into angle-iron, as shown. For binding these constituent plates together, in whichever of the forms they may be constructed, various means may be employed. I prefer however to make use of angle irons a^7 for the purpose, which are constructed of the proper form to fit between the adjacent radiating frames or sections a and are firmly clamped upon their coöperating plates by bolts a^8, which are passed across the plates at the respective top and bottom ends of the radiating frames or sections from one angle-iron to the other and are provided on their free ends with appropriate nuts a^9. As thus constructed in any of the ways specified, a closed magnetic circuit is formed through which the magnetic lines of force will flow when excited by

passing upward through and along the outer portions of the radiating sections a, and thence downward through the core a^1, and so on, as long as the exciting cause of this force is active.

Within the circuit A, and around the core a^1, as shown in Fig. 2, are arranged a primary coil B, and a secondary coil B^1, of which the primary coil B is secured to the magnetic circuit at the lower end of the core a^1, by cords or otherwise, with the secondary coil B^1 disposed above it. With the primary and secondary coils thus arranged, the primary coil B is connected in circuit with the dynamo or other source of electric supply (not shown) through suitable conductors b and b^1, while the secondary coil B^1, is connected in circuit with the lights or units through which its controlling or governing action is brought into use, by appropriate conductors b^2 and b^3, as shown more particularly in Fig. 8, wherein the transformer and governor is illustrated, with its primary coil connected in circuit with a source of alternating electric current supply I, and its secondary coil or coils similarly connected in circuit with a number of electric lights or other units b^4 arranged in series. The primary and secondary coils being arranged and connected as thus described, and the coil B^1 supported in an over-balanced relationship with respect to the primary coil B, whenever an appropriate alternating current is supplied to the primary coil B, a corresponding current will be induced in the secondary coil or coils and through it or them supplied to the lights or other units, with the result that such lights or other units will be brought into operation and through the mutual repulsive action of the primary and secondary coils upon each other and through the unbalancing of the secondary coil such secondary coil will be moved thereby to the proper distance or distances from the primary coil B to supply the required strength of current demanded by the number of lights or other units in operation. Having thus established an equilibrium between the primary and secondary coils, the secondary coil will remain at rest so long as the same number of lights or other units are in operation. With the equilibrium thus existing, whenever one or more of the lights or other units is or are withdrawn from operation the strength of the current in the circuit in which it or they is or are located will be increased thereby, and the equilibrium existing between the primary and secondary coils in consequence thereof will be disturbed, with the result that the secondary coil will, by the increased repulsive action of the two coils engendered by this increase in the strength of the current, cause the secondary coil to move upward away from the primary coil to the extent required to again restore the strength of the current in which the lights or other units are located, and reëstablish the equilibrium between such coils that before existed. When, on the other hand, with the coils in equilibrium, if an additional light or unit is added to the secondary circuit, then the strength of the current flowing through such circuit will be decreased and such equilibrium similarly disturbed, with the consequent effect that the secondary coil will, by the decreased repulsive action between it and the primary coil, permit the secondary coil by its unbalanced condition to approach the primary coil to the proper extent to increase the strength of the current in its circuit to the requisite degree and reëstablish the required equilibrium between the coils as it existed prior thereto. Thus, by the arrangement of the primary and secondary coils above explained, the strength of the current in which the lights or other units are located is automatically equalized and rendered uniform, whether a greater or less number of lights or units are in operation therein.

For supporting the secondary coil in unbalanced relationship with respect to the primary coil, I preferably make use of a column of liquid C, in which the coil is immersed; and, to this end, I arrange the magnetic circuit A, with the primary and secondary coils thereon, in vertical position within an inclosing case D, which is or may be constructed of divers materials and in a variety of forms. In the exemplification of the invention which I have selected for purposes of illustration however, it is shown as cast from metal, with a closed bottom and a cap or cover D^1, which may be detachably secured in place thereon by screws d that extend upward from lugs d^1 on the sides of case, through suitable orifices formed in the cap or cover and receives on their upper ends winged or thumb nuts d^2, suitable packing being interposed between the upper edge of the case and the under surface of the cover when required. As thus constructed the inclosing case D receives the liquid which is supplied thereto, and which in great part or wholly submerges the magnetic circuit with the primary and secondary coils thereon. The liquid thus supplied to the inclosing case may be of various kinds. It is preferred however to employ for the purpose some liquid that will not be affected by the cold, such, for instance, as oil or glycerin. With the parts thus arranged the secondary coil is free to be moved upward and downward within the liquid whereby to carry it toward or away from the primary coil B. In order to overcome in part the gravity of the secondary coil however and increase its buoyancy to the required extent, I provide it with air chambers E on its upper surface,

as shown in the drawings. These air chambers may be of various forms. In the drawings however I have shown them as constructed in the form of closed rectangular vessels, and as secured in proper position upon the upper surface of the secondary coil, by cords or wires e, passed upward over and around each of the vessels in suitable longitudinal grooves or depressions e^1 formed in it, and thence downward around the coil, whereby to permit of these vessels moving up and down in the spaces between the adjacent radiating frames or sections a of the magnetic circuit A, as shown in Figs. 2, 3, 5, and 6. As thus secured in place a buoyant action is imparted to the secondary coil by the air contained in these vessels E; and in order to regulate and control their buoyant action, to the required extent, I find it convenient to provide each of these vessels E with an aperture e^2 in its top, through which liquids or other substance or substances may be supplied to its interior, and which may be hermetically sealed by any appropriate means, such, for instance, as a screw threaded plug e^3.

As thus far described only one secondary coil has been employed and this has been located within the magnetic circuit A above the primary coil B. In some instances, however, I find it desirable to employ two of these secondary coils, and in those cases, instead of locating the primary coil in the magnetic circuit at the lower end of the core a^1, I preferably arrange it mid-way the length of such core, in which relationship it may be firmly secured in any appropriate manner, as, for instance, by cords passing around it and around the core, or otherwise, and locate the secondary coil B^2 below it, as shown in Fig. 6. With the secondary coil B^2 thus arranged, it is connected in circuit with the secondary coil B^1 and is arranged in overbalanced relationship with respect to the primary coil, whereby it may be moved toward and away from it in unison with the secondary coil B^1, as the strength of the current in the circuit in which these secondary coils are arranged may demand, being moved downward away from the primary coil when its companion's secondary coil B^1 is moved upward therefrom, and upward toward such primary coil when the coil B^1 is moved downward toward it. When two secondary coils B^1 and B^2 are thus employed, both coils will be provided on their upper surfaces with air chambers E, and both will be submerged within the liquid column C in the inclosing case D in the same manner as is the case with the coil B^1 when only a single secondary coil is employed.

With the magnetic circuit A and the primary and secondary coils arranged and operated as above described, the conductors b and b^1 through which the primary coil is connected in circuit with the source of electric supply, and the conductors b^2 and b^3 through which the secondary coil or coils is or are connected in circuit with the lights or other units to be operated, enter the inclosing case D and are conducted downward through the column of liquid C therein to their respective coils. To permit of this entrance to the case, I preferably construct it with an outwardly extending flange d^3, which is provided in its under-surface with insulating nipples d^4 and d^5 that are formed with orifices d^6 extending longitudinally through them and connecting with the interior of the case by a suitable passage-way or passage-ways formed in the flange d^3. As thus equipped the conductors b b^1 and b^2 b^3 enter the case D through their respective nipples d^4 and d^5 and, passing downward through suitable insulating tubes d^7 and d^8 secured to the sides of the radially disposed frames or sections a of the magnetic circuit A, are connected at their lower ends to their respective primary coil B and secondary coil or coils B^1, or B^1, and B^2, suitable slack being allowed the conductors b^2 and b^3 to permit of the required upward and downward movement of the secondary coil or coils within the case.

In some instances the magnetic circuit A and the primary and secondary coils may be used without covering, except as may be required to bind the various parts together. I prefer however to wrap the coils and the whole or portions of the magnetic circuits with cords or tapes f and to thoroughly coat this covering and the portions of the magnetic circuit that are not covered thereby with varnish or shellac, but this is not essential and the parts may be left without such covering or coating and operate with efficiency.

For securing the transformer and governor to the cross-bars of a telegraph pole or other appropriate support, various means may be employed. A convenient expedient for this purpose however consists of rods H, which, provided with outer over-turned ends h, are arranged in transverse relationship to the inclosing case in suitable orifices h^1 formed in lugs h^2 which extend outward from the case D, with such rods provided on their inner ends with nuts h^3.

With the various parts constructed and organized as above explained, a transformer and governor is produced, which, while exceedingly simple in construction and efficient in operation, admirably answers all the requirements of a structure of that character.

While in the foregoing I have described the form of the invention which I prefer to employ in practice, I wish it distinctly understood that I do not limit myself strictly thereto, but reserve to myself the right to

modify various of its constituent parts without departing from the spirit of the invention.

Having now described my invention and specified certain of the ways in which it is or may be carried into effect, I claim and desire to secure by Letters Patent of the United States,

1. The combination, with an inclosing case for reception of the operative parts of an electric transformer and governor constructed with a detachable cover, and with an outwardly extending flange that is provided with a passage-way or passage-ways formed therein, of a series of insulating nipples arranged in such flange and connecting with the interior of the case through such passage-way or passage-ways, substantially as described.

2. The combination, with a closed bottom inclosing case provided with a detachable cover and constructed with an outwardly extending flange having a passage-way or passage-ways formed therein, of a series of insulating nipples arranged in such flange and connecting with the interior of such inclosing case through said passage-way or passage-ways, and means by which the case with its contained parts may be secured to an appropriate support, substantially as described.

3. The combination, with an inclosing case constructed with an outwardly extending flange and provided with insulating nipples arranged therein and with a passage-way or passage-ways leading from such nipples to the interior of the case, a magnetic circuit arranged in such inclosing case, and a primary and a secondary coil arranged within such magnetic circuit, of conductors leading from the primary and secondary coils to and through such insulating nipples and respectively adapted for connection in circuit with a source of alternate current electric supply, and in circuit with a series of electrically operated units, substantially as described.

In testimony whereof I have hereunto set my hand, in the presence of two witnesses, this 29th day of February, 1908.

EDWARD R. CLIFF.

Witnesses:
WM. H. APPLETON,
GRACE T. DIXON.