(No Model.) 3 Sheets—Sheet 1.

A. W. MESTON.

ALTERNATING CURRENT TRANSFORMER.

No. 530,597. Patented Dec. 11, 1894.

Fig. 1.

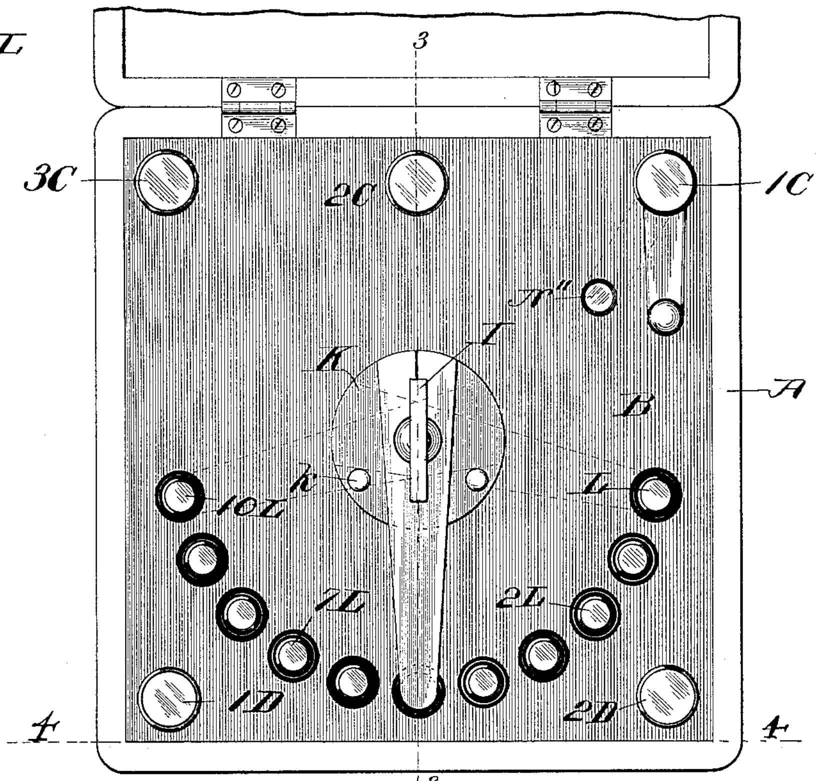
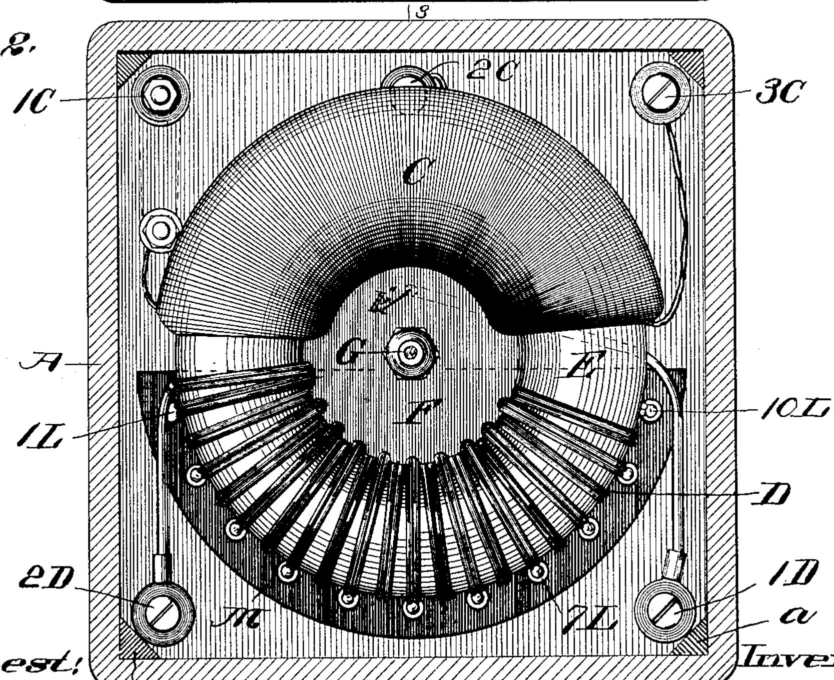


Fig. 2.



Attest:
F. R. Cornwall
A. Ramel.

a

Inventor.
Alexander W. Meston,
By Paul Bakewell
atty.

(No Model.) 3 Sheets—Sheet 2.

A. W. MESTON.

ALTERNATING CURRENT TRANSFORMER.

No. 530,597. Patented Dec. 11, 1894.

Fig. 3.

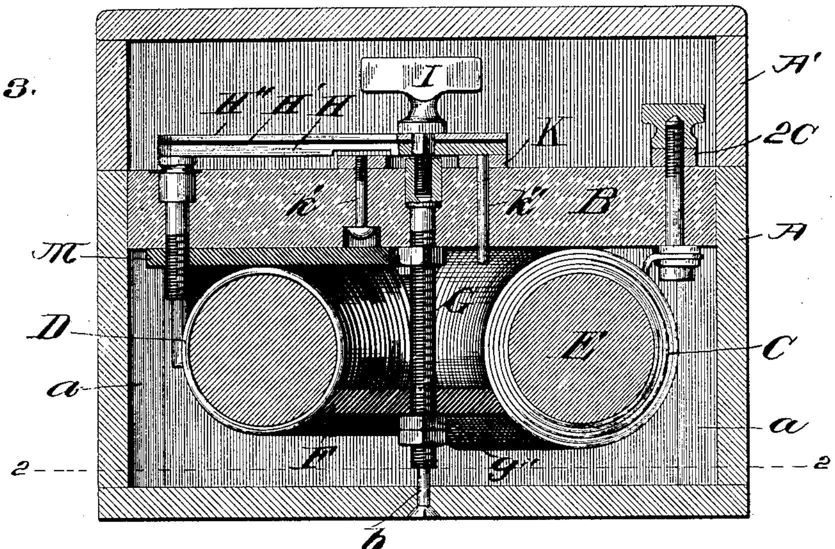


Fig. 4.

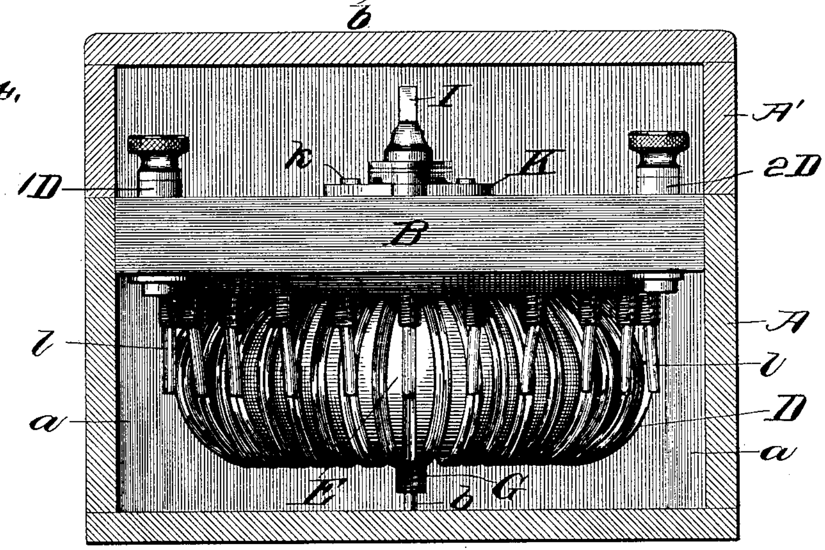
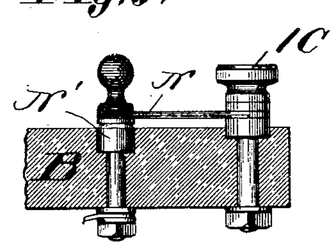


Fig. 5.



Attest:
F. R. Cornwall
A. Ramel.

Inventor:
Alexander W. Meston
By Paul Bakewell
atty.

(No Model.) 3 Sheets—Sheet 3.

A. W. MESTON.

ALTERNATING CURRENT TRANSFORMER.

No. 530,597. Patented Dec. 11, 1894.

Fig. 6.

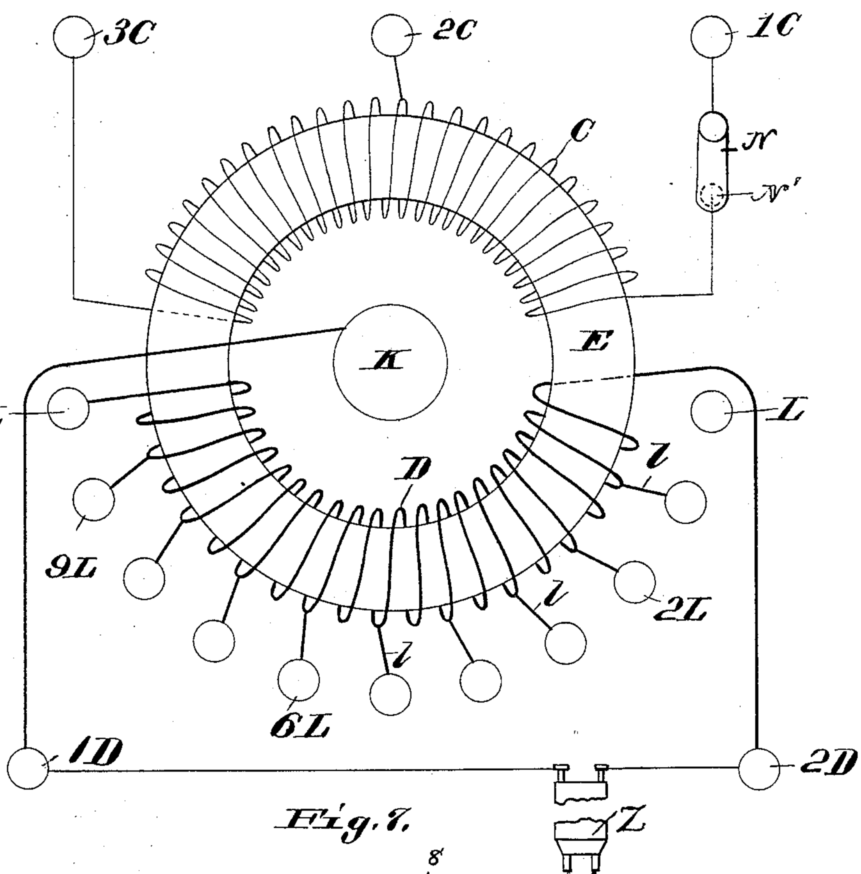


Fig. 7.

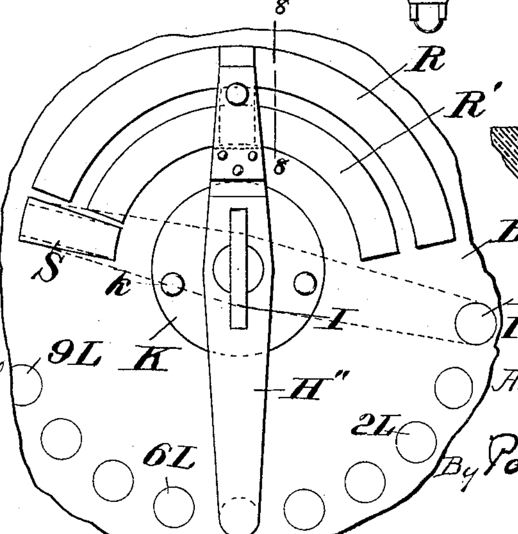


Fig. 8

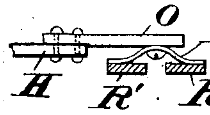
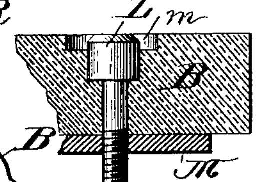


Fig. 9.



Attest;
F. R. Cornwall
A. Ramel.

Inventor;
Alex. W. Meston
By Paul Bakewell
atty.

UNITED STATES PATENT OFFICE.

ALEXANDER W. MESTON, OF ST. LOUIS, MISSOURI, ASSIGNOR TO THE EMERSON ELECTRIC MANUFACTURING COMPANY, OF SAME PLACE.

ALTERNATING-CURRENT TRANSFORMER.

SPECIFICATION forming part of Letters Patent No. 530,597, dated December 11, 1894.

Application filed January 23, 1893. Serial No. 459,342. (No model.)

To all whom it may concern:

Be it known that I, ALEXANDER W. MESTON, a citizen of the United States, residing in the city of St. Louis, State of Missouri, have invented certain new and useful Improvements in Alternating-Current Transformers, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming a part thereof.

My invention relates to means for transforming an alternating current of a comparatively high voltage and low ampèrage to one of low electro-motive force and high ampère strength, or vice versa; and has for its primary object the adaptation, or application, of the alternating current to electro-therapeutics—substantially, the adaptation of the current from the commercial alternating lighting circuits to such purposes.

It consists in the details of improvement, in a transformer, hereinafter described by which the same transformer is adapted to be used on circuits over which are being transmitted, respectively, currents of different voltages, that is, the combination, in the same transformer, of two or more primary coils.

Another feature of invention resides in the means provided whereby the number of turns, in the secondary coil, utilized are variable, thereby effecting an adjustment of the electro-motive force of the current taken from the secondary, as may be desired for different purposes.

Still other features of invention reside in the details of construction, as hereinafter described.

In the accompanying drawings, in which like characters of reference denote like parts in the several figures,—Figure 1 is a top plan view of my improved transformer, showing the lid of the inclosing case thrown back. Fig. 2 is an under side plan view of the same, with the bottom of the inclosing case removed, or a sectional view taken as on the line 2—2 in Fig. 3. Figs. 3 and 4 are vertical cross-sections taken, with the lid of the inclosing case closed, on the lines 3—3 and 4—4, respectively, in Fig. 1. Fig. 5 is a detail view—side elevation—of the switch shown in Fig. 1 for closing the circuit through the primary coil or coils. Fig. 6 is a diagrammatic view of the wiring and connections. Fig. 7 is a plan view of a modified form of the switch for closing the circuit to the primary coil or coils. Fig. 8 is a side elevational detail view of the back end of the main switch, illustrative of the means by which the circuit to the primary coils is closed as illustrated in Fig. 7; and Fig. 9 is an enlarged sectional view of the head of the contact buttons and the countersink in the slab B for the same.

As is well known to those conversant with alternating current appliances, the constituent parts of a transformer are, the iron core—preferably laminated in order to prevent heating from the rapid reversals in the exciting current, &c.; the primary coil, which is connected with the circuit from the generator; and the secondary coil, with which the electro-receptive devices are connected. The function of the iron core is to form a magnetic circuit to intensify and to direct the magnetic lines of force, developed by the primary coil, through the secondary coil. For a given electro-motive force impressed upon the terminals of the primary coil of the transformer, the electro-motive force at the terminals of the secondary coil is dependent on the relative number of turns in the two coils. In an ideal transformer—one in which the small percentage of loss due to transformation may be disregarded—the number of watts produced by the secondary coil corresponds to that taken up by the primary—that is, if the voltage of the current in the primary is higher than that in the secondary, the ampèrage is proportionally lower, and vice versa. Generally speaking, inasmuch as transformers are intended to be used in connection with circuits over which is being transmitted a current of a definite electro-motive force and the electro-motive force of the secondary coil is definitely fixed to be adapted to the electro-receptive devices intended to be used therewith, the relative number of turns in the primary and secondary coils is fixed; but in my improved transformer, which is intended to be used in electro-therapeutic work, making use of electro-receptive devices of different capacities, there is made provision for altering, or adjusting, in the secondary coil, at will, this relation between the number of turns in the primary and secondary coils. In order to adapt the transformer to be used in connection with external circuits of different voltages, as already existing in commercial lighting work, provision is made in the primary coil, to change this relation between the number of turns in the two coils.

In the drawings,—A represents the bottom part and A′ the hinged cover of the inclosing case; B, the slab of slate, marble, or similar insulating material, to which are secured the different parts of my instrument, which is fitted to the interior of the box and supported, so that the upper surface of the slab is flush with the upper edge of the bottom part A of the case, by the four corner blocks *a*, said slab being secured in place by the retaining screw *b* which is screwed into the lower end of the central stem screw, hereinafter described; C, the primary or exciting coil; D, the secondary coil in which the current is induced; E, the iron core, around which the coils C and D are wound; F, a washer of vulcanite, or similar non-conducting material, by which the induction coil, as a whole, is clamped to the slab B by means of the central stem screw G; H, H′ and H″, considered collectively, the tongue of the contact switch; I, the combined pivotal stud and handle of the contact switch; K, an annular plate with which the rear end of the switch makes contact; *k*, stop pins for the switch; *k′*, screws by which the contact plate K is secured to the slab B (see Fig. 3); *k″*, a connection pin extending from the contact plate K to the under side of the slab B (see Fig. 3); L, 1L, 2L, &c., several contact buttons or plates, with which the switch H is adapted to make contact; M, a semi-circular plate of vulcanite, or similar material, on the under side of the slab B, into which the several contact buttons L, 1L, &c., are screwed, and thereby retained in place.

1C, 2C, and 3C are binding posts secured, in convenient position, to the slab B by screws which extend through the slab and act as fixtures with which the terminals of the exciting coil C are connected.

N is a two-point switch, for the pivotal end of which one of the binding posts, 1C, is adapted.

N′ is the contact button for the free end of the switch N (see Fig. 5), N″ being a dead point. (See Fig. 1.)

1D and 2D are binding posts, secured in the same manner as are the binding posts 1C, 2C, and 3C, to which the terminals of the induction circuit, in which the electro-receptive devices are interposed, can be attached.

In Figs. 7 and 8 is illustrated a special form of switch to replace the switch N interposed in the primary coil circuit, for purposes to be described later.

O is a rear end extension of the switch-tongue H, of vulcanite or rubber.

P is a contact spring, secured to the projecting end of the extension piece O, the two free ends of which are adapted to make contact with the two segmental strips R and R′, completing the circuit therebetween. (See Fig. 8.) The two strips R and R′ are interposed in the primary coil circuit in the same manner as the switch N, as illustrated in Fig. 6.

S is a resting block for the contact ends of the spring P, situated, as shown in Fig. 7, beyond the ends of the strips R and R′ (insulated therefrom), at that end at which the rear end of the switch H is resting when the front end is resting on the contact button L, as shown in dotted lines in Fig. 7.

The foregoing description of the several parts, considered in connection with the drawings, will serve to make plain the general features of the method of construction, except, perhaps, in regard to the more specific details, which I will now describe.

The iron core E is preferably formed, as shown, as a closed ring (see Fig. 2), circular in cross-section (see Fig. 3), laminated by being composed, as the most economic method, of fine soft iron wire wound, or reeled, into the desired form.

The primary coil C is wound as a continuous coil around approximately one-half of the core E, the two end terminals being connected with the two outside binding posts 1C and 3C—one end directly with 3C, and the other to the post 1C with a circuit breaking device, corresponding to the switch N, or the device illustrated in Figs. 7 and 8, interposed between them. At some point in the length of wire of the primary coil, a branch connection is made therewith and connected with the binding post 2C. To make a correspondingly efficient transformer, whether the whole of the primary coil or a portion is placed in circuit, it is preferable that the coil is, from beginning to end, wound backward and forward over the full space occupied thereby on the core E, and that the lead-out from the intermediate point in the length of primary wire is made from a point in the winding such that the portion of the coil included in circuit, when connection is made with the middle binding post 2C, with which this terminal is connected, will extend over the full length of iron core E occupied by the primary coil, that is, that the primary coil is not divided into two parts to either side of this intermediate branch connection in the length of the coil as a whole.

The object of what can be considered practically a subdivision of the primary coil, as described above, is to adapt the transformer to be used in connection with exterior circuits carrying currents of different voltages, as, for instance, a fifty and a one-hundred volt circuit, and still retain the proper relation between the number of turns in the primary and secondary coils to adapt the secondary coil to be used, in each instance, with the fixed means of adjustment therefor, to be described; and further, this subdivision of the primary coil, *i. e.* the adaptation enabling the cutting in circuit of a part or of the whole of the primary coil, can also be taken advantage of when using a current of a given voltage, thereby changing the electromotive force at the terminals of the secondary with an exciting current of one and a given voltage, still retaining the same adjustment of the number of turns of the secondary coil included in circuit and of the electromotive force given out at the terminals thereof. It is also evident that this subdivision of the primary coil, for the purposes just described, *i. e.* changing, with the same electromotive force impressed on the terminals of the primary coil, the voltage at the terminals of the secondary coil, might be still further extended—the coil be still further subdivided by branch terminals—and the range of the transformer correspondingly increased.

The secondary coil D is preferably wound on the remaining half of the core E as a continuous coil, one terminal being connected directly to one of the bind-posts, as 2D, and the other end with the last button, as 10L, at that end of the coil. In instances where the transformer is wound for currents of comparatively low electro-motive force and a heavy wire necessitated in the secondary coil, this coil is preferably composed of two wires, or strands, of the proper carrying capacity, wound together. The object, considered from a mechanical or constructional point of view, of using two parallel wires in this coil is two-fold:—first, to render the winding of a wire of a given carrying capacity more easy, and, second, when two wires are laid side by side, it renders the securing, by soldering, of a third wire thereto (as the branch connection *l*) more easily effected and resulting in a more stable joint.

At intervals in the length of the coil D, there are connected "lead-outs" or branches *l*, which are connected to the rear, or under side, ends of the several contact buttons 1L, 2L, &c., respectively. In this manner the secondary coil is subdivided into a number of individual coils, more or fewer of which can be utilized in the manner which I will now describe. The other binding post 1D is electrically connected with the contact plate K. (See Figs. 2 and 6.) When the switch H is turned to make contact with any of the buttons 1L to 10L, electrical circuit is established between the two binding posts 1D and 2D, traversing a number of turns of the coil D depending on which one of the buttons the switch H is in contact with—that is, when the switch H is in contact with the 1L button the circuit will traverse only one-tenth (when the coil is subdivided into ten equal parts and there are ten contact buttons, as shown in the drawings) of the coil D. When on the 10L button it will traverse the complete coil; and on intermediate buttons correspondingly proportionate parts of the coil. See Fig. 6. There is preferably one button, as L, at the 1L end of the series, which is blank—not connected with the coil D—to which the switch H can be turned to open the secondary coil circuit. The means of connecting the wire from the binding post 1D to the contact plate K (the connecting pin k'') is shown in Fig. 3, and in dotted lines in Fig. 2.

As shown in Figs. 2 and 3, the bulk of the primary coil C makes it somewhat thicker than the secondary coil D, so that when laid on a flat surface, as the under side of the slab B (see Fig. 3), there is a space between the slab and the secondary coil. To fill in this space, so as to keep the iron core E parallel with the slab B, I insert the semicircular plate M of vulcanite or corresponding insulating material, making use of the outer circumferential edge of the same plate for securing the ends of the stems of the buttons L, 1L, &c., in place.

In making up the device, I bore holes through the slab B arranging them on the arc of the proper circle, concentric with the pivotal stud of the switch H, and countersink these holes to accommodate the head portion of the contact buttons L, &c., to a depth somewhat less than the length of these head portions, screw the button pieces home into the plate M, and then finally level off the tops of the buttons so that they are flush with the surface of the slab B, thereby offering no obstruction to the free, smooth movement of the contact-end of the switch H.

As shown in Fig. 9, the countersink in the slab B for the reception of the head portions of the contact buttons L, 1L, &c., is somewhat larger diametrically than the buttons L, 1L, &c., leaving an annular space *m* around the buttons. The functional object of this annular space is the following:—In all spring tongue switches which are adapted to be turned from one contact button or plate to another, especially when the contact surface of the buttons is flush with the surface of the mount, as the slab B, the contact surface of the switch is held in contact with the surface of the mount between the contact buttons, thereby, in time, from frictional wear, forming a metallic streak, of more or less efficient electrical conductivity, from one contact button to the other, forming a short circuit therebetween. By surrounding the button, as shown in Fig. 9, with an annular groove *m* the continuity of this short circuit is broken. As shown, the upper circumferential edge of the buttons is beveled off in order to allow the switch to ride easily over the same.

Concentrically with the contact buttons L, 1L, &c., I perforate the slab B for the passage of the stem screw G and countersink the hole to accommodate the relatively enlarged head portion of the stem screw. After the screw G is passed through the slab B, it is held in place by the nut *g* screwed home to the under side of the slab B. See Fig. 3. The screw G extends through and beyond a washer plate F (preferably of some insulating material), which rests, as shown in Figs. 2 and 3, on the inner inclined or curved surface of the coils, and a nut g'' (preferably with a check nut, as shown), screwed on the screw G, retains the plate F in place and firmly holds the coils up against the slab B. Into the lower end of the screw G, I screw the retaining screw *b* from the under side of the bottom of the inclosing case, thereby firmly securing the slab B, with the attached parts described, in the inclosing case. See Figs. 3 and 4. The head portion of the screw G is hollowed out and female screw-threaded to receive the screw-threaded end of the switch pivot piece I. The upper end of the pivot piece, below the upper flanged portion which rests on the upper surface of the switch tongue, is squared to fit a correspondingly shaped perforation in the switch tongue, so that when the handle I is turned it will turn the switch tongue with it. See Fig. 3.

The tongue of the contact switch is composed of three pieces: the contact piece H, which is provided with a flat button-like projection on the under side of its forward end, adapted to make contact with the buttons 1L, 1L, &c., and makes contact at its back end with the contact plate K; the upper spring piece H'' by which the piece H is held in contact at its ends with the buttons L, 1L, &c., and the plate K, respectively; and the interposed piece of insulation H', which prevents the spring piece H'' from carrying any current from the buttons 1L, 2L, &c., to the plate K, and thereby endangering the temper in the spring from the heat generated by the passage of the current. The stop pins, or studs, *k* are used to limit the movement of the switch H, as shown in dotted lines in Figs. 1 and 7, the rear end of the switch striking against the pins as the forward end of the switch rests on the end buttons L and 10L, respectively.

As already stated, the device illustrated in Figs. 7 and 8 is used to close the primary circuit, by means of the sliding contact spring P carried by the rear end extension O of the switch H, which slides in electrical contact with the segmental plates R and R', one of which is connected with the inleading binding post 1C and the other with one terminal of the primary coil. This is true except when the switch H is turned to rest on the blank button L, when the spring P will rest on the block S, which opens the primary coil circuit. This position is shown in dotted lines in Fig. 7.

By means of the switch just described, and illustrated in Figs. 7 and 8, both the primary coil and the secondary coil circuits are necessarily opened at the same time. There are instances, however, when the contact switch H having been turned to the contact button by which the proper current is developed for the electro-receptive device being used, it is desirable to open the primary coil circuit without changing the contact switch H. In this instance I would make use of the switch N shown in Figs. 1 and 5.

In making use of my improved transformer, one of the terminals of the generator circuit is attached to the binding post 1C and the other to either the 2C or the 3C post, depending on whether it is a relatively high or low voltage current, or, when a single current of given voltage only is available, on whether a relatively high or low voltage is desired at the terminals of the secondary coil. When the switch N, or the circuit-closing device illustrated in Figs. 7 and 8, is closed, the circuit is closed through the primary coil, and the primary electro-motive force will develop, by induction, an electro-motive force at the terminals 1D and 2D of the secondary coil, dependent on the position of the switch H, *i. e.* corresponding with the number of turns of the secondary coil included in circuit. When it is desired to open the secondary coil circuit the switch is turned to rest on the blank button L. The terminals of the electro-receptive devices,—such as the small incandescent lamps used to examine the throat, nose, or other internal cavities of the body, in connection with the various forms of surgical and dental appliances; all forms of cautery electrodes, as Z, Fig. 6; small motors, &c.—being connected with the binding posts 1D and 2D, the switch H is revolved until it is evident that the induced current is of the proper electro-motive force for the desired work.

Independent of the apparent general features of advantage in my transformer, there are several features of detail in the construction of the same, with resultant functional advantages, to which attention should be called.

It is evident that, the pivotal stud of the switch H being screw-threaded, the switch will be forced into closer contact with the plate K and the contact buttons 1L, 2L, &c., when the switch is turned to the left, that is, toward the 10L button. This feature is of advantage, inasmuch as the current in the secondary is heavier as the switch is turned in that direction, and, if anything, requires a better and more positive contact of the switch H. This feature of construction also makes the construction of the appliance, as a whole, simpler and cheaper.

The disposition of the contact buttons 1L, 2L, &c., so that they coincide with the points at which it desired to "lead out" the branches from the secondary coil, is of advantage in separating to a maximum degree the parts of the circuit in which there might exist a difference of potential in the current, tending to prevent any short circuiting in the appliance and obviating any crossing of the wires. The functional advantages of this feature are further enhanced by placing the insulating plate M beneath the secondary coil and screwing the stems of the contact buttons into it.

I claim—

1. In a transformer, the combination with

the primary coil, of two strips in the circuit thereof insulated from each other, a secondary coil provided with branch terminals, contact buttons to which said terminals lead, a switch for adjustably cutting the secondary coil in circuit by its contact with the buttons, and a spring contact on the switch for maintaining electrical connection between the strips, substantially as and for the purposes described.

2. In a transformer, the combination with the primary coil, of two segmental strips, insulated from each other, in the circuit thereof, a secondary coil provided with branch terminals, contact buttons arranged in an arc of a circle to which said terminals lead, a centrally pivoted switch for adjustably cutting in the secondary coil by its contact with the buttons, and a spring contact on the switch for maintaining electrical connection between the strips, substantially as and for the purposes described.

3. In a transformer, the combination with the primary and secondary coils, of a switch for maintaining circuit through the primary coil and adjustably cutting the secondary coil in circuit, substantially as described.

4. In a transformer, the combination with a switch and its contact buttons, of a mount therefor, an insulation plate on the reverse side of the mount, said buttons being formed with screw stems which are screwed into the insulation plate, substantially as and for the purposes described.

5. In a transformer, the combination with the inclosing case, of a mount for the several parts of the instrument, corner blocks for supporting the mount, and a screw having a bearing on the under side of the casing for holding the mount, substantially as and for the purposes described.

6. In a transformer, the combination with the inclosing case, of a removable mount for the coils, substantially as and for the purposes described.

7. In a transformer, the combination with the inclosing case, of a removable mount for the coils and means for securing the mount in the case, substantially as and for the purposes described.

8. In a transformer, the combination with the inclosing case, of a removable mount for supporting the coils, a threaded stem projecting from the mount beyond the coils, a disk for holding the coils against the mount, and a nut on the stem for holding the disk and coils in position, substantially as and for the purposes described.

9. In a transformer, the combination with a mount, of a threaded stem projecting therefrom, a coil or coils surrounding the stem, a clamping plate for holding the coils in position against the mount, and means on the stem for securing the clamping plate, substantially as and for the purposes described.

10. In a transformer, the combination with the primary and secondary coils of unequal diameter, of a mount therefor, a plate interposed between the mount and the coil of smaller diameter, and means for securing the coils to the mount, substantially as and for the purposes described.

11. A switch for transformers comprising a conducting portion, a spring metal portion, which does not conduct the current and an interposed insulation, substantially as and for the purposes described.

12. The combination with the pivot stud, and contact buttons, of a switch tongue comprising a strip of conducting material, a spring metal portion, which does not conduct the current and an interposed insulation, substantially as and for the purposes described.

13. The combination with the pivot stud, of a series of concentrically arranged contact buttons, and a yielding tongue on the pivot stud adapted to be forced in closer contact with the contact buttons as the stud is screwed in its seat by the movement of the tongue, substantially as and for the purposes described.

14. In a transformer, the combination with the primary coil, of a secondary coil provided with branch terminals leading to contact buttons, a switch included in the secondary circuit, and a screw-threaded pivot stud upon which said switch is mounted, whereby, when the switch is turned in one direction it is forced into closer contact with the terminal contact buttons, substantially as and for the purposes described.

15. The combination with an insulation block, provided with a cell, of a contact button embedded in the insulation block, and separated from the side walls of the cell, substantially as and for the purposes described.

16. In a transformer, the combination with a switch and its mount formed with cells, of contact buttons embedded in the mount and separated from the side walls of the cells, the face of the buttons being flush with the surface of the mount, substantially as and for the purposes described.

17. The combination with an insulation block, of a switch whose contact point slides thereon in its movement to co-operate with a terminal or terminals, said insulation block being so formed that the path of the switch-contact thereon, is broken.

In testimony whereof I affix my signature, in presence of two witnesses, this 30th day of December, 1892.

ALEXANDER W. MESTON.

Witnesses:

A. RAMEL,

WILLIAM M. BYRNE.