(No Model.)

4 Sheets—Sheet 1.

J. R. HARD.

MEDICO ELECTRICAL APPARATUS.

No. 348,465. Patented Aug. 31, 1886.

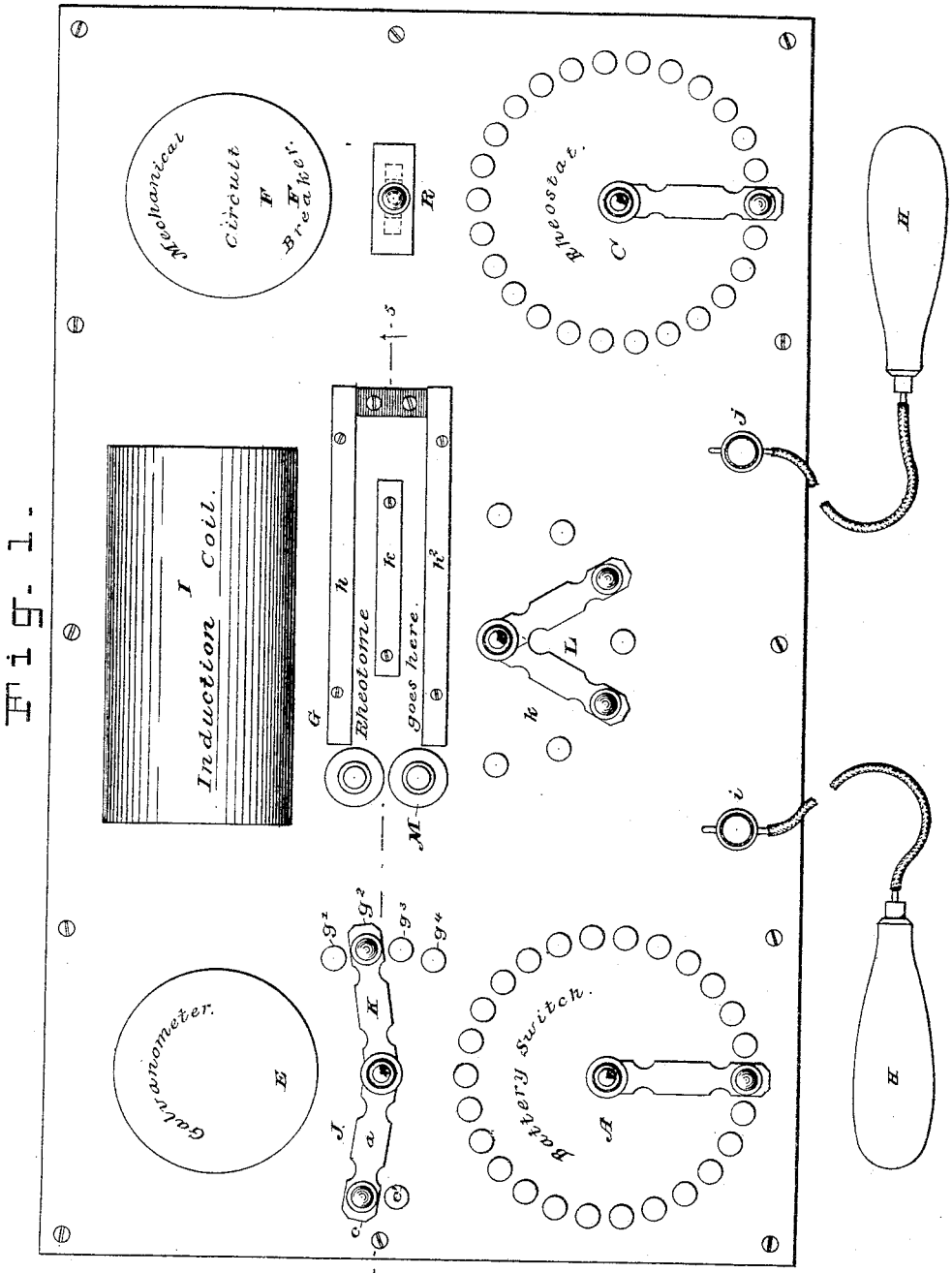

Fig. 1.

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Geo. Baines

INVENTOR:

J. Randolph Hard

By his Attorneys,

Burke Fraser & Connolly

(No Model.) 4 Sheets—Sheet 2.

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MEDICO ELECTRICAL APPARATUS.

No. 348,465. Patented Aug. 31, 1886.

Fig. 2.

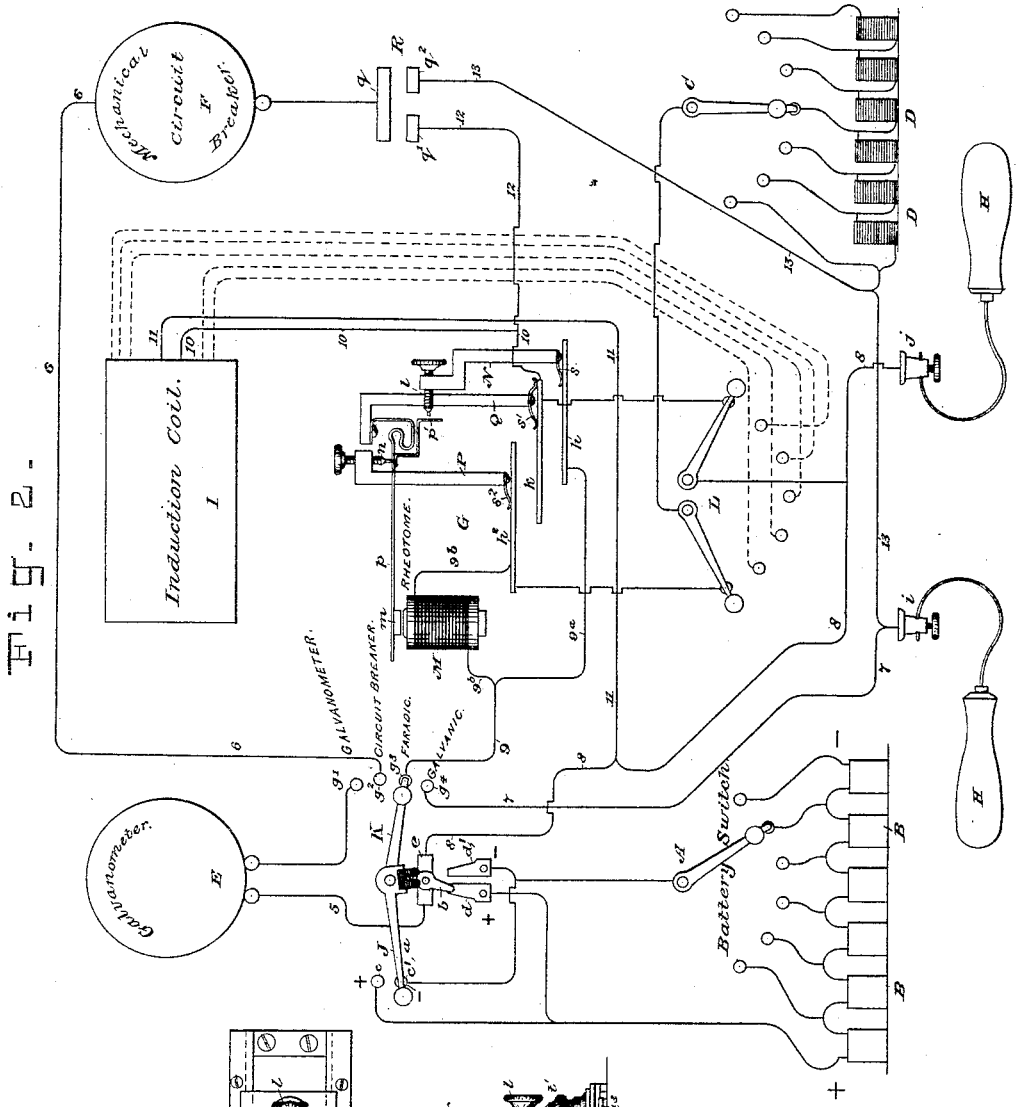


Fig. 3.

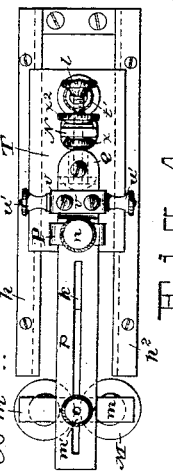
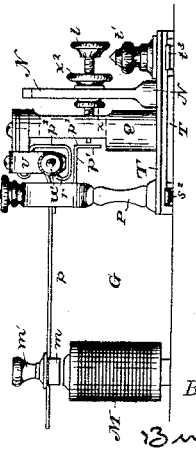


Fig. 4.



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(No Model.) 4 Sheets—Sheet 3.

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MEDICO ELECTRICAL APPARATUS.

No. 348,465. Patented Aug. 31, 1886.

Fig. 6.

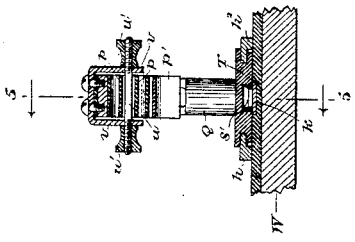


Fig. 10.

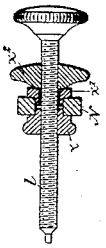


Fig. 11.

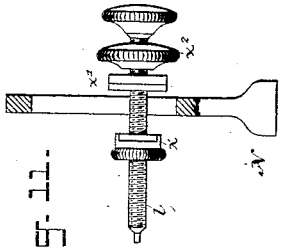


Fig. 5.

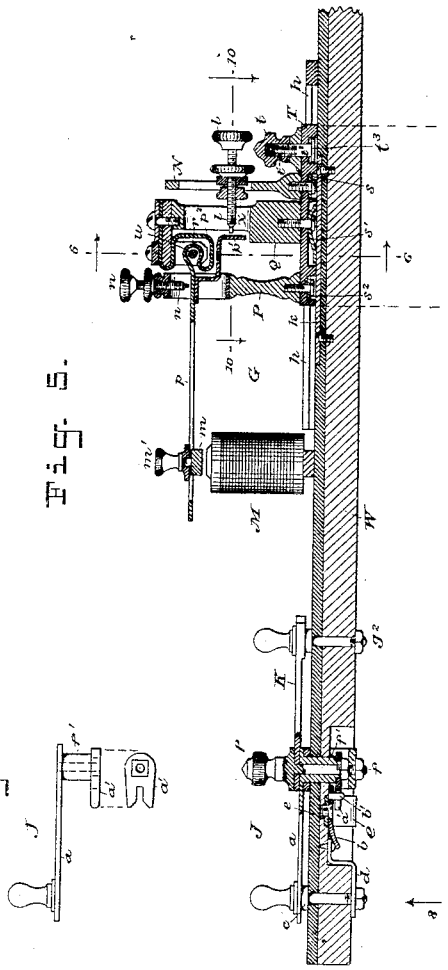
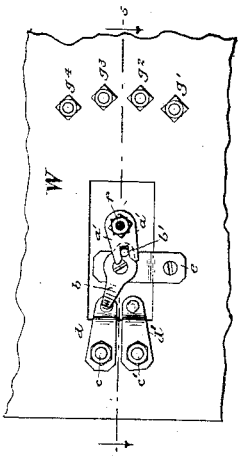


Fig. 7.

Fig. 8.

Fig. 9.



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4 Sheets—Sheet 4.

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MEDICO ELECTRICAL APPARATUS.

No. 348,465. Patented Aug. 31, 1886.

Fig. 14.

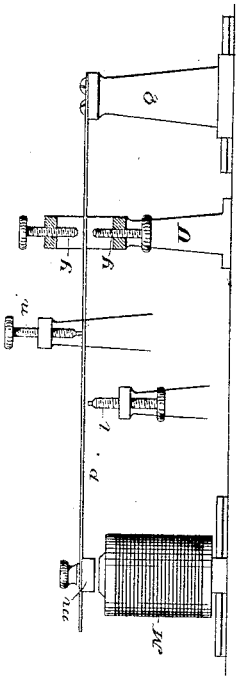


Fig. 15.

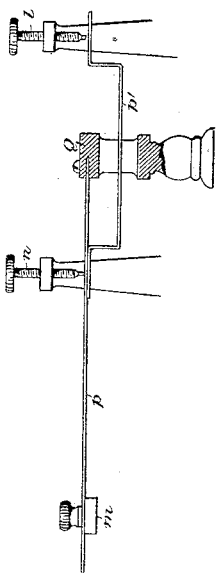


Fig. 12.

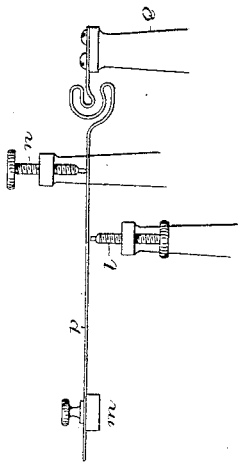
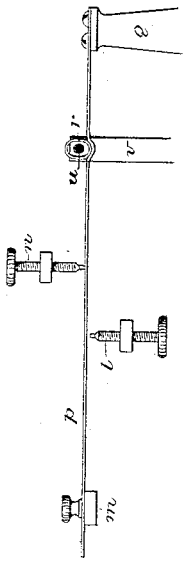


Fig. 13.



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Geo. H. Fraser.

Geo. Baines

INVENTOR:

J. Randolph Hard.

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UNITED STATES PATENT OFFICE.

J. RANDOLPH HARD, OF NEW YORK, N. Y.

MEDICO-ELECTRICAL APPARATUS.

SPECIFICATION forming part of Letters Patent No. 348,465, dated August 31, 1886.

Application filed March 16, 1886. Serial No. 195,421. (No model.)

To all whom it may concern:

Be it known that I, J. RANDOLPH HARD, a citizen of the United States, residing in the city, county, and State of New York, have invented certain new and useful Improvements in Medico-Electrical Apparatus and especially in Rheotomes Therefor, of which the following is a specification.

My invention relates to what are commonly known as "galvano-faradic" electro-medical appliances for use by physicians in treating patients electrically.

The novel features of my invention pertain, chiefly, to the construction of the rheotome or electrical circuit-breaker, and to the pole changing and regulating switches.

Figure 1 of the accompanying drawings is a plan of the switch-board and instruments constituting the medico-electric apparatus when constructed according to my invention. Fig. 2 is a diagram showing the electric circuits. Fig. 3 is a plan of the rheotome. Fig. 4 is a side elevation thereof. Fig. 5 is a vertical longitudinal mid-section through the rheotome, pole-changer, and part of the switch-board cut on the line 5 5 in Fig. 1. Fig. 6 is a transverse section through the rheotome and board on the line 6 6 in Fig. 5. Fig. 7 is an inverted plan of the base-piece of the rheotome. Fig. 8 is an inverted plan of the pole-changer. Fig. 9 is an elevation of one of the detached parts of the pole-changer. Fig. 10 is a horizontal section of one of the contact-screws of the rheotome on the plane of the line 10 10 in Fig. 5; and Fig. 11 is a side elevation of the same parts, the post being shown in section.

The remaining figures show modifications.

Referring first to Figs. 1 and 2, let A designate the battery-switch, and B B the battery-cells; C, the rheostat, and D D the resistance-coils thereof; E, the galvanometer; F, the mechanical circuit-breaker; G, the rheotome; H H, the handles; I, the inductorium or induction-coil; J, the pole-changing switch; K, the switch for directing the battery-current to the different circuits, and L the switch for controlling the induction-coil. These features are all well known as heretofore constructed, and, except in so far as they are otherwise hereinafter explained, they may be understood to be of the usual construction, or of any suitable known construction. The circuit-connections are also in the main essentially the same as in the various galvano-faradic apparatus heretofore made, such differences as exist being plainly traceable in Fig. 2.

My invention relates, chiefly, to the switches J K and the rheotome G.

I will first describe the switches J K. Fig. 2 shows the electrical relations most clearly. The pole-changing lever *a* is connected, through an insulation, with a lever, *b*, which moves oppositely to the lever *a* when the latter is moved. Buttons *c c'* are touched by the lever *a*, and plates *d d'* are touched by the lever *b*. The buttons *c c'* are respectively positive and negative, being connected, respectively, with the pole of battery B and with the lever of switch A, which is in connection with the pole of the battery or of so much of the same as is at any time in use. The plates *d d'* are connected, respectively, with the buttons *c c'*. The connections for taking off the current are made with the levers *a* and *b*, respectively. When the lever *a* is on the positive button *c* and the lever *b* is on the negative plate *d'*, a positive current is taken off. When the lever *a* is turned onto the negative button, it turns the lever *b* onto the positive plate, so that a negative current is taken off. The parts thus described constitute the pole-changing switch J. The current from the lever *a* is taken off by the lever of the switch K, which turns from the same pivot. The current from lever *b* is taken off by wires from the plate *e*, on which it is mounted.

Referring to Figs. 5, 8, and 9, the mechanical construction of these switches J K will be described. The lever *a* is made, as shown in Fig. 9, with a tubular boss, *f'*, and a forked arm, *a'*, beneath. A central screw pin or bolt, *f*, passes down through the board and is held fast by nuts. The sleeve *f'* turns on this pin. The forked end of the arm *a'* engages a pin or projection, *b'*, on the lever *b*, so that as the lever *a* is turned to one side the lever *b* is turned to the other. The arm *a'* is made of insulating material, fitting on a square on the lower end of a sleeve, *f'*. The lever *b* is pivoted on the plate *e*. The buttons *c c'* are made with screw-shanks, which pass down through the board, and the plates *d d'* extend back, receive the ends of the shanks through them, and

are clamped thereto by nuts. Thus the positive button *c* is connected to the positive plate *d*, and the negative button is connected to the negative plate. The lever of the switch K is pivoted in the pin *f*, as shown in Fig. 5. The free end of this lever may be moved over four buttons, g', g^2, g^3, and g^4.

Referring to Fig. 2, the button g' leads to the galvanometer E, from which a wire, 5, leads back to the plate *e*. The button g^2 leads by a wire, 6, to the mechanical circuit-breaker F. The button g^3 leads to the "faradic" circuit, which will be presently explained, and the button g^4 leads to the "galvanic" circuit. The latter circuit follows a wire, 7, from button g^4 to binding-post *i*, passes thence by the flexible cable to one handle H, and from the other handle back to the other post, *j*, and thence by wire 8 to plate *e*. The faradic circuit extends from button g^3 by wires 9, which are branched, one branch, 9^a, leading to the metal bar or strip *h*, and the other branch, 9^b, traversing the coils of the rheotomic electro-magnet M, and then terminating at a metal bar, h^2. The bar *h* is in connection through a spring, *s*, and post N with a contact-screw, *l*. The bar h^2 is in connection, through a spring, s^2, and post P, with a contact-screw, *n*. The armature *m* of the magnet M is mounted on a resilient plate or vibrator, *p*, which is attached to a post or frame, Q, and this post is connected through a spring, s', with a metal strip, *k*. This metal strip connects by a wire, 10, with the primary coil of the inductorium I, and the return-wire 11 therefrom leads to the wire 8, and thence to plate *e*. This completes the primary faradic circuit. The circuits (shown in dotted lines in Fig. 2) from the several secondary or divisions of the secondary coils are connected with the binding-posts *i j*, in the usual manner, through the medium of the switch L, as is well understood. A switch, R, is arranged to make connection from the mechanical circuit-breaker F to either the faradic or galvanic circuits. The circuit-breaker F is electrically connected with a strip, *q*, and opposite to it are two buttons or plates, q' q^2. The switch R is a slide, which when in one position makes electrical connection from *q* to q', and thence by wires 12 and 10 with the induction-coil, and when in the other position the switch makes electrical connection from *q* to q^2, and thence by wires 13 to binding-post *i*. This sliding switch R takes the place of the peg-switch heretofore used for the purpose.

I will now describe the operation of the rheotome G. The magnet M, its armature *m*, the spring plate or vibrator *p*, and the contact-screw *n* are the parts usual to rheotomes for this purpose, the vibrator *p* being a flat plate fastened at one end to a post, Q. When the switch K is turned as shown in Fig. 2, the current from battery B passes through magnet M, and the armature *m* is drawn down, thereby breaking the contact between vibrator *p* and screw *n*, and consequently interrupting the current and permitting the vibrator to fly back into contact again with the screw *n*. This is the usual operation, the circuit being broken once each time the magnet attracts its armature. With my improved rheotome, however, the circuit is broken twice to each excitation of the magnet. This is done by means of the contact-screw *l*, which is touched by a branch, p', of the spring plate or vibrator *p*, after the latter has parted from the screw *n*. The circuit then flows through wire 9^a, bar *h*, spring *s*, post N, screw *l*, spring-plate *p*, post Q, spring s', strip *k*, and wire 10 to the induction-coil, thus cutting out the magnet. This contact continues only until the resilience of the vibrator overcomes the momentum of the armature, when the retractive movement takes place. By this construction the circuit is interrupted with twice the rapidity heretofore possible.

Referring to Figs. 3 to 7, inclusive, the construction of the rheotome will now be explained in detail. The magnet M is fastened immovably to the board W. On the surface of the board are fastened the two metal bars *h* and h^2, which have overhanging or undercut edges, as shown in Fig. 6, and the metal strip *k*, which is arranged between the bars. The three posts P, Q, and N are all mounted on a base-plate, T, of insulating material, the side edges of which are grooved and are engaged by the bars *h* h^2. Thus the plate T can slide toward and from the magnet. A clamp, *t*, is provided to hold it fast in any position. This consists simply of a covered nut, t', engaging a screw, t^2, the head of which is a plate, t^3, Fig. 7, the end of which plate takes under the overhanging edge of either of the bars h^2 or *h*. By turning the nut the screw is drawn up and the end of the plate is caused to press upward against the bar. The post N connects with a spring, *s*, underneath the plate T, (see Fig. 7,) which extends to one side, and its end touches the bar *h*. The post Q connects with a spring, s', Figs. 5 and 7, which touches the strip *k*. The post P connects with a spring, s^2, which touches the bar h^2. Thus the respective connections are maintained, although the plate T may be slid to different positions.

The resilient plate or vibrator *p* is of peculiar construction. Its fixed end is attached by screws to the top of the post Q, (see Fig. 3,) and thence it turns downward, passes underneath and backward, thence downward at p^2, thence forward, thence backward, and around to form an eye or loop, *r*, and thence horizontally forward and over the magnet M. Underneath the plate *p* is attached a branch plate, p', which extends downward far enough to avoid the bends in the plate *p*, thence backward, and thence downward in line with the portion p^2. The horizontal front portion of the plate *p* is slotted, and through the slot passes the clamping-screw m', which secures the armature *m*. By sliding the plate T toward or from the magnet M and then adjusting the armature in position directly over the

magnet the available length of the vibrator can be altered as desired in order to control the rapidity of its vibration.

Through the eye *r* in the vibrator passes a slender rod or pin, *u*, the ends of which pass through ears *v v*, connected to the frame Q. Nuts *u' u'* screw on the threaded ends of the pin *u*. When these nuts are screwed up tight, they force the ears *v v* tight against the ends of the eye *r*, thereby clamping the vibrator fast at this point. The effect of this is to shorten the vibrator, making it vibrate faster. When the nuts are loosened slightly, the ears *v v* are relaxed, and stand free from the vibrator, and as the pin *u* passes through the eye *r* freely, without touching it, the movement of the vibrator is unimpeded, and it vibrates over its whole length, from its point of attachment to the post Q. Thus by means of these nuts *u'* the rate of the vibrations may be quickly altered without impairing any of the adjustments. The screw *l* is adjustable up or down in the post N by means of nuts engaging a vertical slot in the post, as best shown in Figs. 10 and 11. A nut, *x*, has a squared boss entering the slot, which keeps the nut from turning. A washer, *x'*, is placed on the opposite side, and has a square boss entering the slot. A set-nut, x^2, screws against this washer. To set the screw higher or lower, this nut x^2 is released, the screw is slid up or down, and the nut is set fast again. The same set-nut acts to prevent the loosening of the screw after it is adjusted. The screw *l* may be lifted until its end will make contact with the portion p^2 of the vibrator where the vibrations are shorter. When it is set here, the screwing up of the nuts *u'* will throw this contact out of operation, because the portion p^2 of the vibrator will be bound fast, and will cease to vibrate.

The bends or loops formed in the vibrator *p* near its fixed end are a useful feature of my invention, as by their means the vibrator is so far stiffened that a thinner strip or plate may be used, and the rheotome is shortened and rendered more compact without necessarily accelerating its vibration.

Fig. 12 shows a modification, wherein the vibrator is made with return bends or loops near its fixed end, of somewhat different shape, as clearly shown, and the portion *p'* is omitted. The screw *l* is also differently arranged, being placed beneath the vibrator *p*, and somewhat nearer the armature than is the screw *n*.

Fig. 13 shows a modified construction, in which the vibrator is straightened out, or made of a flat strip or plate, with an eye or loop, *r*, applied to it, and a pin, *u*, passing through this loop and through ears *v v*, to clamp the vibrator fast, when desired. The screws *n l* are arranged as in Fig. 12.

Fig. 14 shows a different way of clamping the vibrator fast. A standard, U, carries two clamping-screws, *y y*, which have no electrical function, but which, when screwed toward the vibrator, clamp it between them. The standard U is stationary, but the post Q, to which the vibrator is attached, may be moved toward or from it, and the magnet M may also be moved toward or from the standard U, so that the vibrator may be clamped at any point desired.

Fig. 15 shows another modified construction wherein the screws *n* and *l* both stand above the vibrator. The vibrator *p* is a flat plate fixed at one end to a post, Q. To it on its under side is attached a bent plate, *p'*, which extends rearwardly beyond the part Q and makes contact with the screw *l*. When the armature moves downward, the vibrator breaks contact with screw *n*, and its portion *p'* moves up and touches the screw *l*.

I claim as my invention—

1. In a medico-electrical apparatus, the combination, with the induction-coil, of a faradic circuit connecting with its primary and divided at the rheotome into two branches terminating in opposite contacts, the vibrator arranged to vibrate against said contacts and to touch them alternately and the rheotomic magnet in one of said branches while the other constitutes a shunt around the magnet, substantially as set forth, whereby during the movement of the vibrator toward and from the magnet the faradic circuit is twice broken and closed.

2. In a medico-electrical apparatus, the combination, with the galvanic and the faradic circuits and the battery, of the pole-changer J, consisting of oppositely-moving levers *a* and *b*, positive contact-pieces *c* and *d*, and negative contact-pieces *c'* and *d'*, combined and arranged to operate substantially as described.

3. In a medico-electrical apparatus, the combination, with the galvanic and faradic circuits and the battery, of the pole-changer J, consisting of lever *a* above the board, and arm *a'* beneath, moving together, lever *b*, engaging the arm *a'* and moved thereby, contact-buttons *c c'* above the board, and contact-plates *d d'*, beneath the board, connected together, respectively, substantially as set forth.

4. In a medico-electrical apparatus, the combination, with the galvanic and faradic circuits and the battery, of the pole-changer J, consisting of oppositely-moving levers *a* and *b*, insulated from each other, positive contacts *c* and *d*, connected to the positive pole of the battery, negative contacts *c'* and *d'*, connected to the negative pole of the battery, and circuit-connections with the levers *a* and *b*, respectively, for taking off the current, substantially as set forth.

5. In a medico-electrical apparatus, the combination of the pole-changing switch J, consisting of levers *a* and *b* and their respective contacts, with the battery in connection with said contacts, the distributing-switch K, in connection at its pivot with lever *a*, and sweeping over buttons *g g*, and with the respective circuits, each connecting at one of said buttons and terminating at the lever *b*, substantially as set forth.

6. In a medico-electrical apparatus, a rheo-

tome, G, consisting of a magnet, a vibrator carrying the armature thereof, two contact-screws arranged on opposite sides of said vibrator, to be touched thereby alternately at opposite extremes of its vibration, and a circuit divided into two branches, one of which includes said magnet and terminates at one contact-screw, and the other of which constitutes a shunt around the magnet and terminates at the other contact-screw, substantially as set forth.

7. A rheotome consisting of the combination of magnet M, armature *m*, vibrator *p*, branch portion *p'* thereof, screw *n*, making contact with the vibrator *p*, and screw *l*, making contact with the portion *p'*, substantially as set forth.

8. The combination, to form a rheotome, of magnet M, armature *m*, vibrator *p*, fixed at one end, a contact screw or screws, and a clamp for binding said vibrator fast between its fixed end and said armature, in order to shorten its vibrating portion and accelerate its vibration, substantially as set forth.

9. The combination, to form a rheotome, of magnet M, armature *m*, vibrator *p*, fixed at one end, a contact screw or screws, ears *v v* on opposite edges of said vibrator, and a screw for drawing said ears together against said vibrator, thereby clamping it fast at that point, substantially as set forth.

10. The combination, to form a rheotome, of magnet M, armature *m*, vibrator *p*, fixed at one end and formed with an eye, *r*, a screw-pin, *u*, passing freely through said eye, ears *v v*, on opposite edges of said vibrator, adapted to be drawn together by the said screw against said eye, and thereby to clamp the vibrator fast at that point, and a contact screw or screws, substantially as set forth.

11. The combination, to form a rheotome, of a magnet, M, armature *m*, contact-screw *n*, and vibrator *p*, fastened at one end and formed near that end with return-bends, substantially as described.

12. The combination, to form a rheotome, of magnet M, armature *m*, vibrator *p*, bent near its fixed end to form a vertical portion, p^2, and having a branch, *p'*, connected to it beyond its bent portion and extending back beneath its bent portion and down in line with portion p^2, and a contact-screw, *l*, adjustable vertically to touch either portion *p'* or p^2, substantially as set forth.

13. The combination, to form a rheotome, magnet M, armature *m*, vibrator *p*, post Q, screw *n*, post P, plate T, bearing said posts, and mounted in guides to slide toward and from the magnet M, substantially as set forth.

14. The combination, in a rheotome, of parallel metal bars $h h^2$, insulated plate T, mounted to slide between them, metal strip K, posts N, Q, and P on said plate, and contact-springs $s\ s'\ s^2$, connected to said posts and making sliding contact with said metal bars and strip respectively, substantially as set forth.

15. In a rheotome, the combination of post N, having a vertical slot, with screw *l*, nut *x*, having a squared boss entering said slot, washer *x'*, having a squared boss entering said slot from its opposite side, and set-nut x^2, substantially as set forth, whereby the screw may be set to different heights and may be adjusted longitudinally.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

J. RANDOLPH HARD.

Witnesses:
ARTHUR C. FRASER,
GEORGE H. FRASER.