No. 675,294. Patented May 28, 1901.

O. H. & A. F. PIEPER.

ELECTRICAL CONTROLLING APPARATUS.

(Application filed Feb. 2, 1900.)

(No Model.) 3 Sheets—Sheet 1.

Fig. 1.

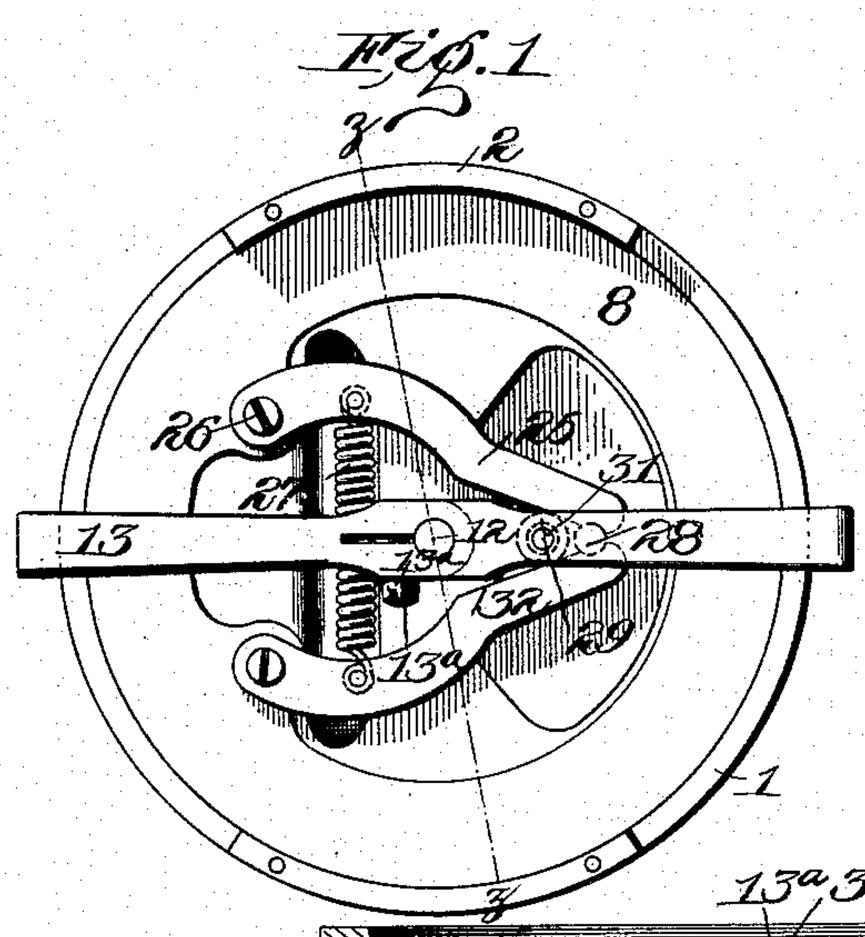
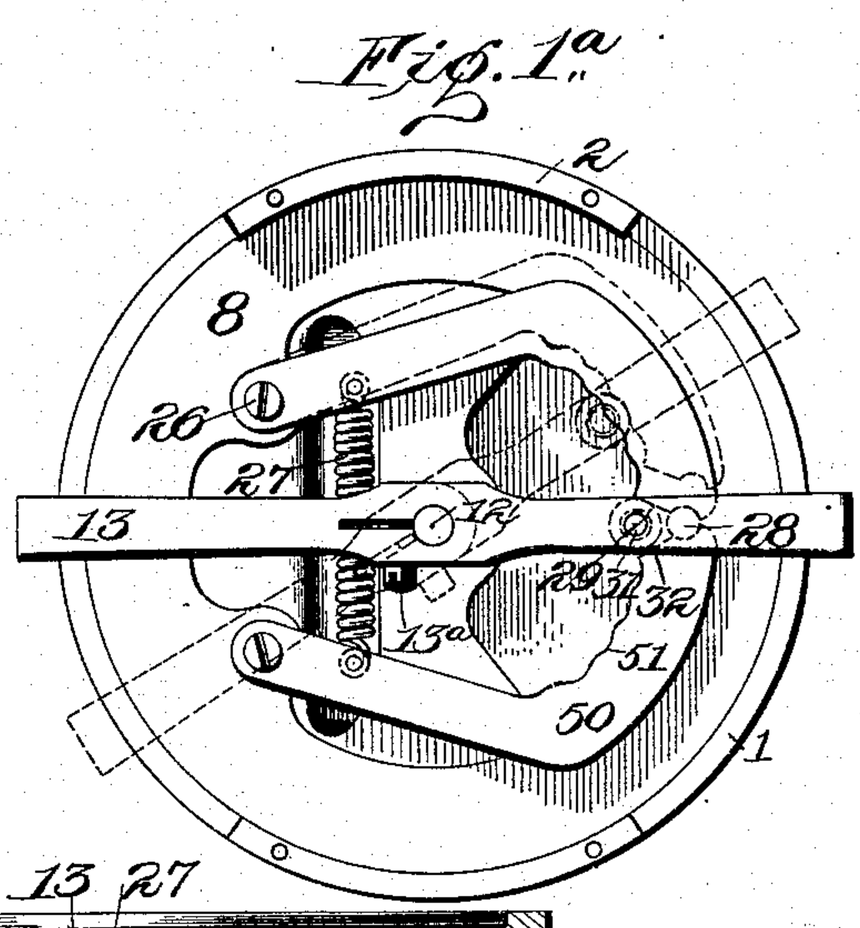


Fig. 1a.



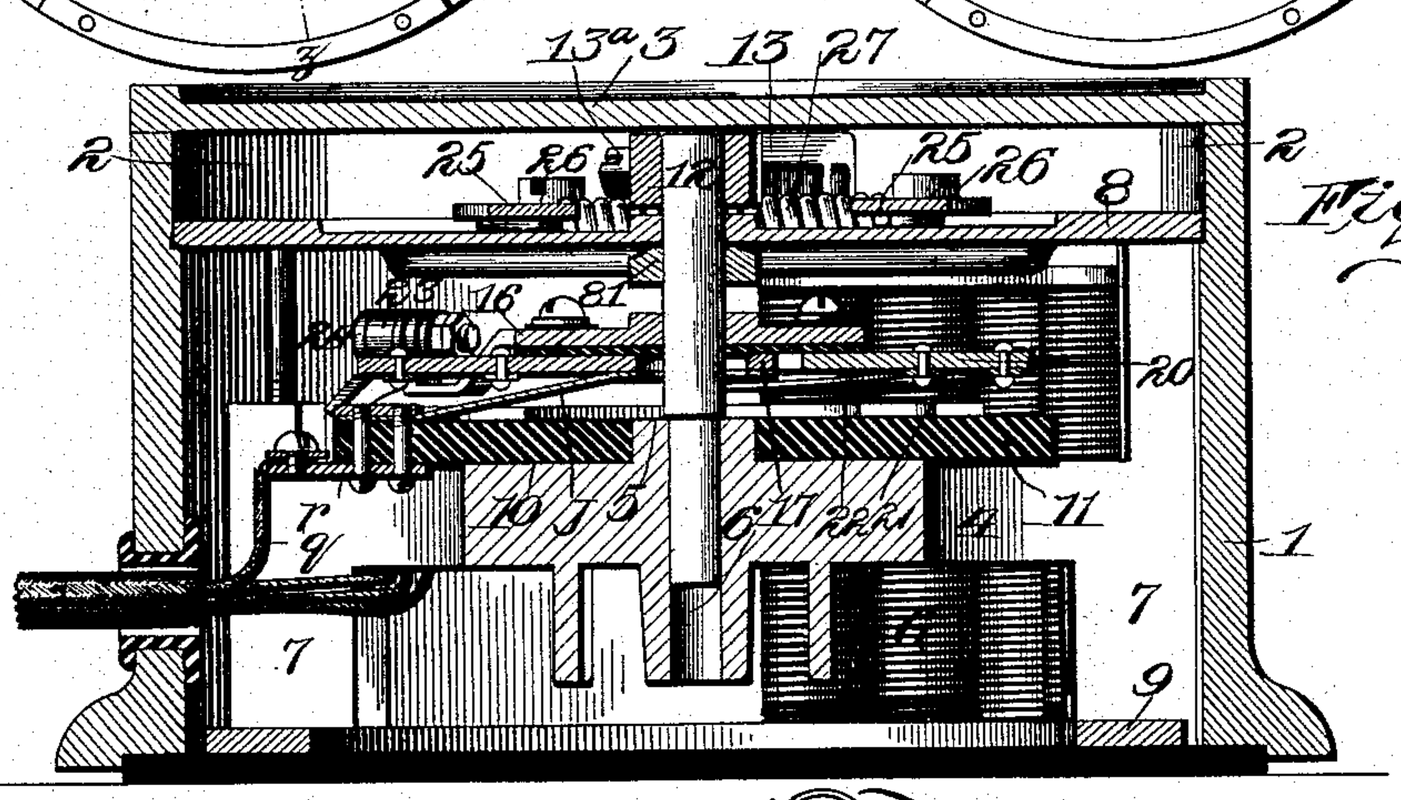


Fig. 2.

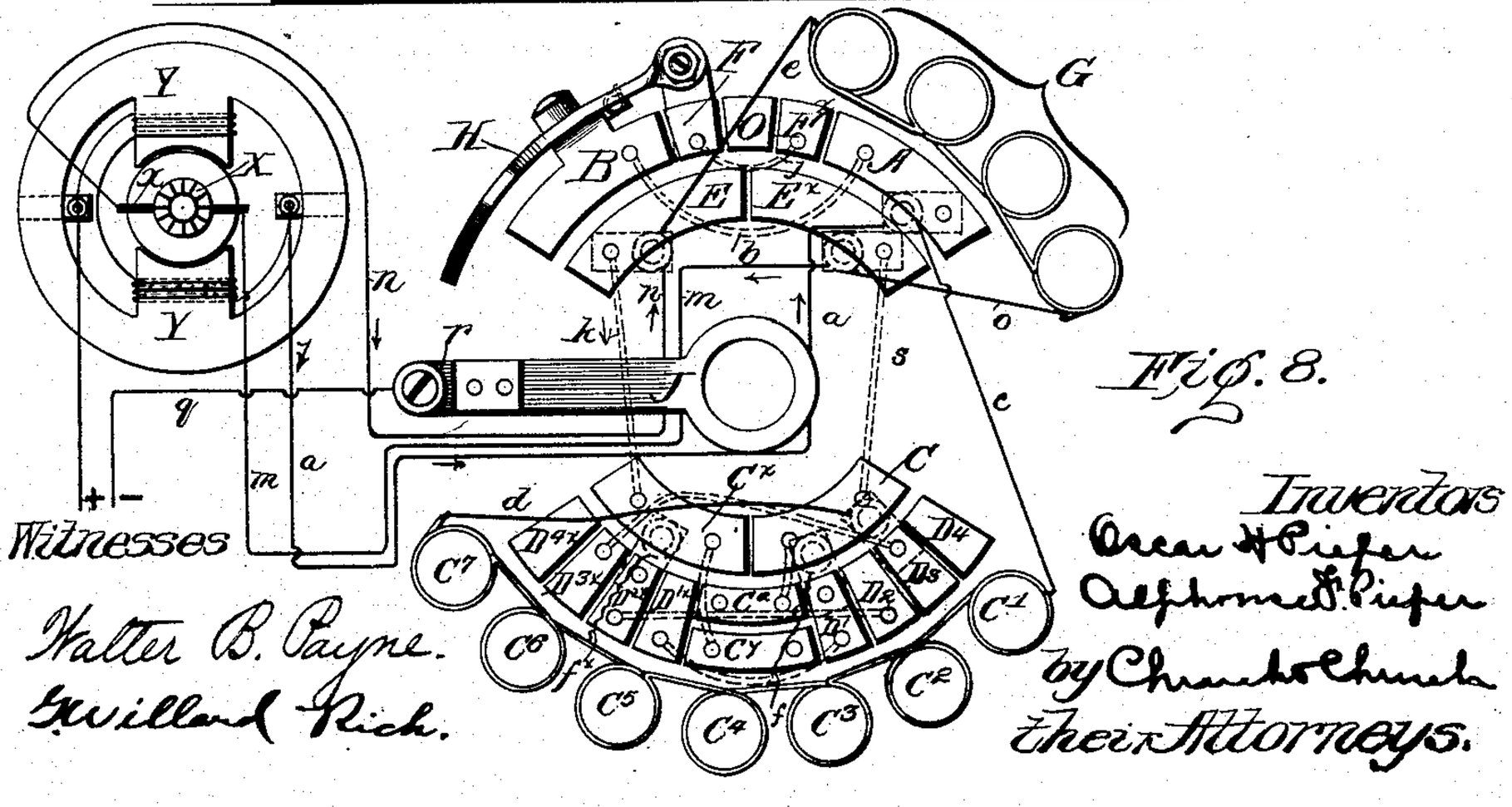


Fig. 8.

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Fig. 3

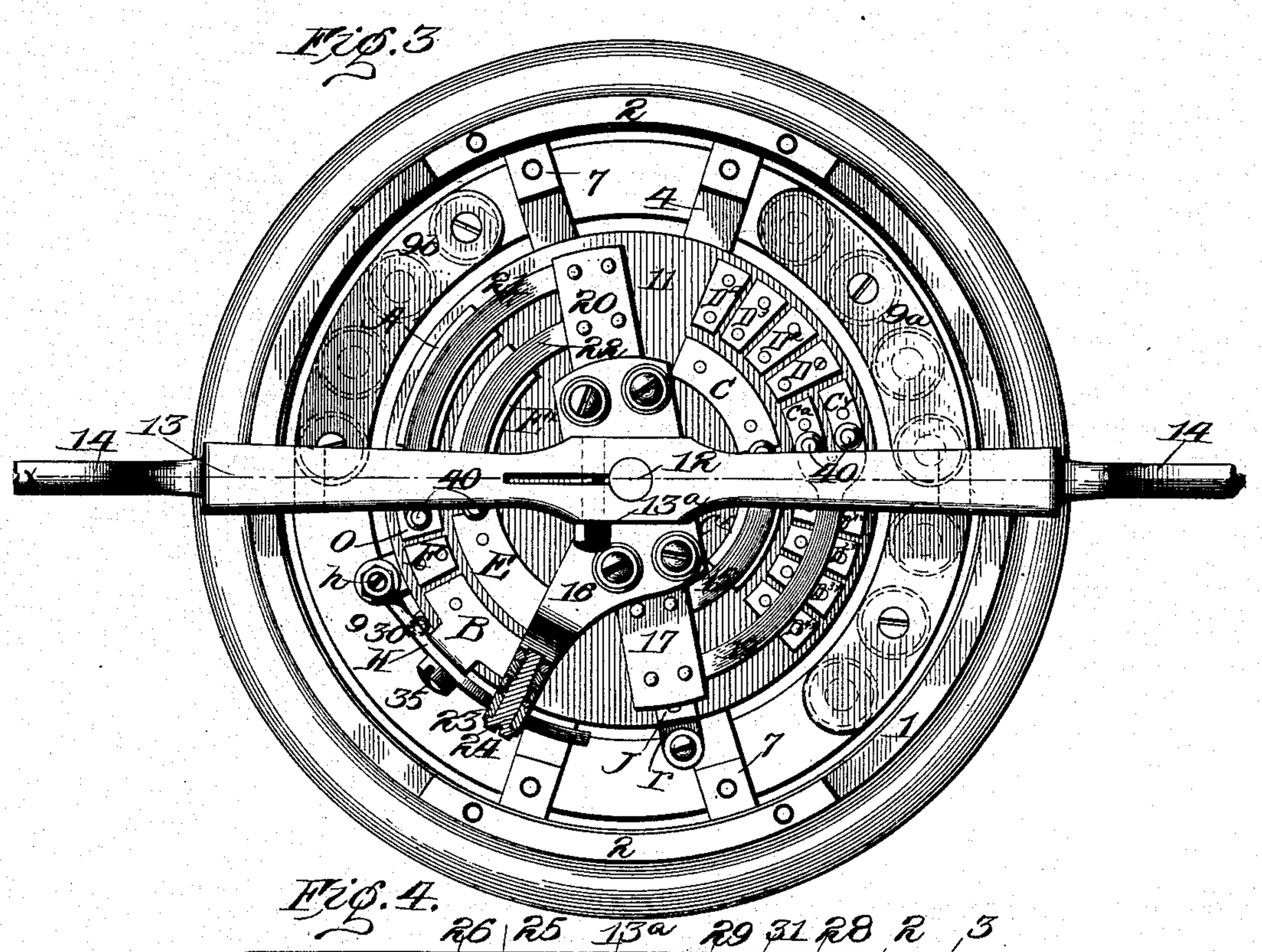

Fig. 4.

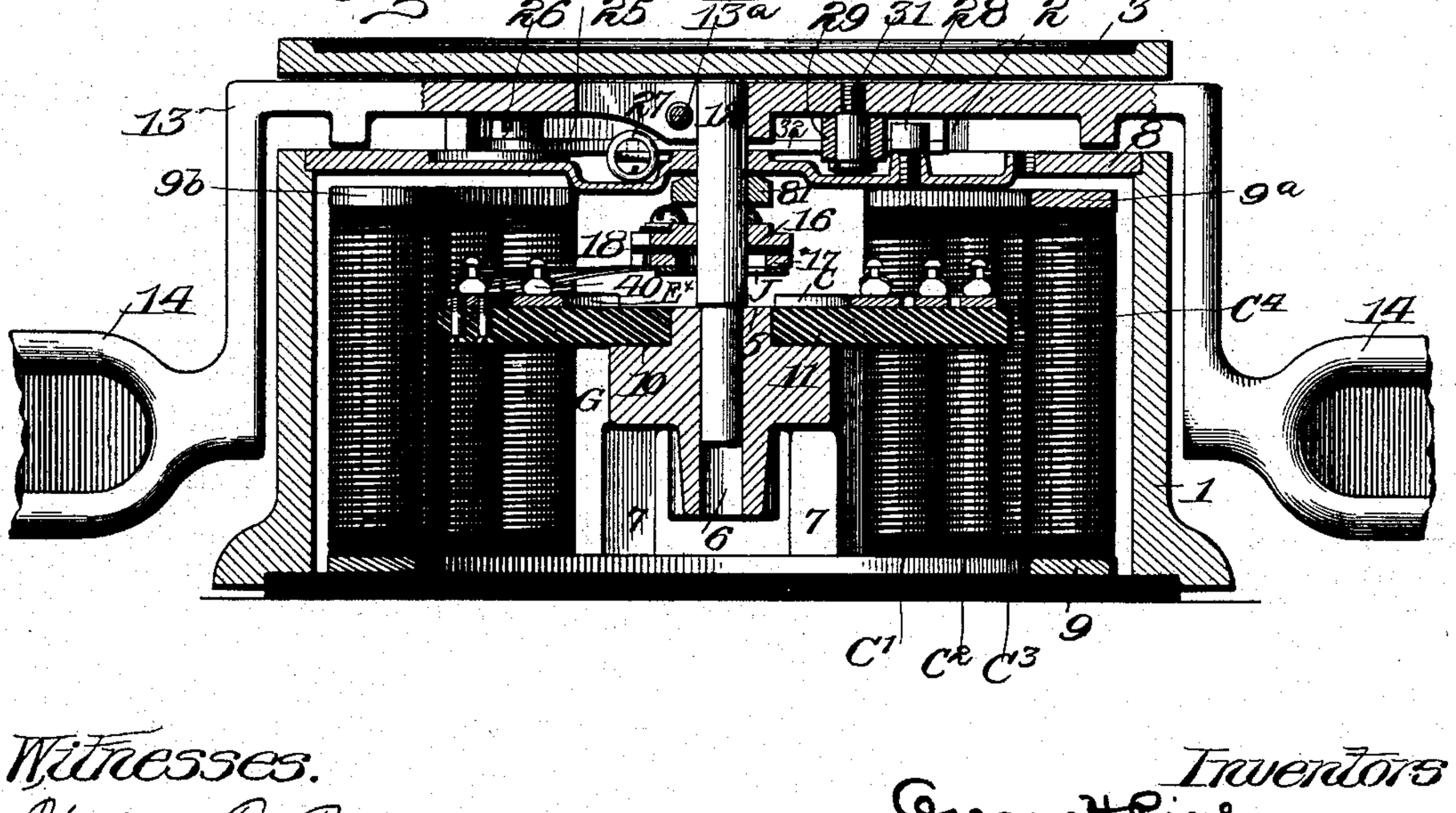

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Fig. 5.

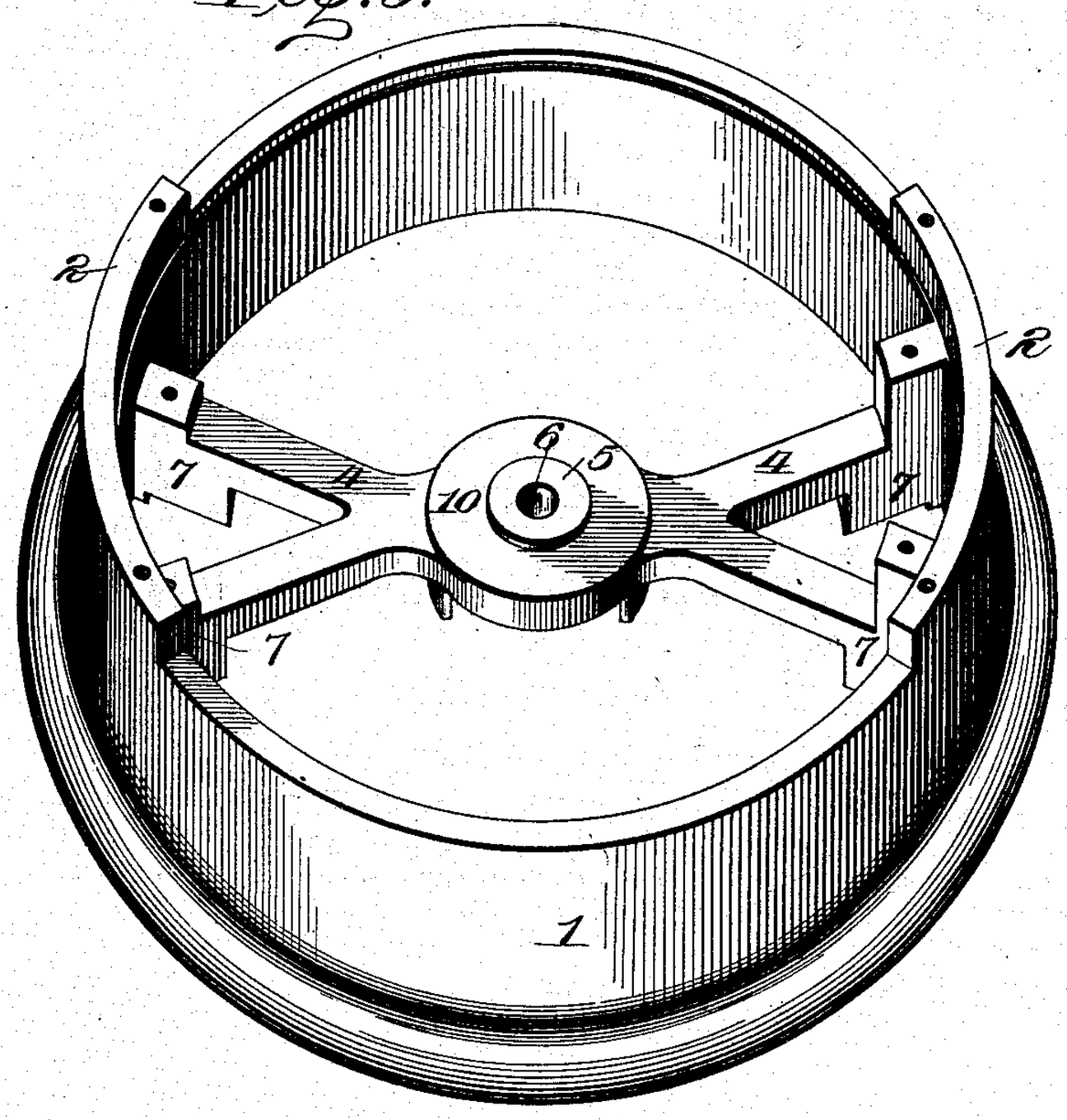


Fig. 6.

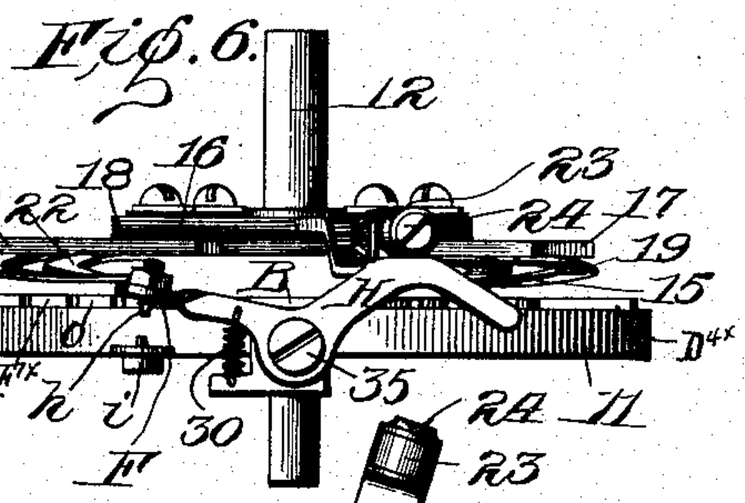
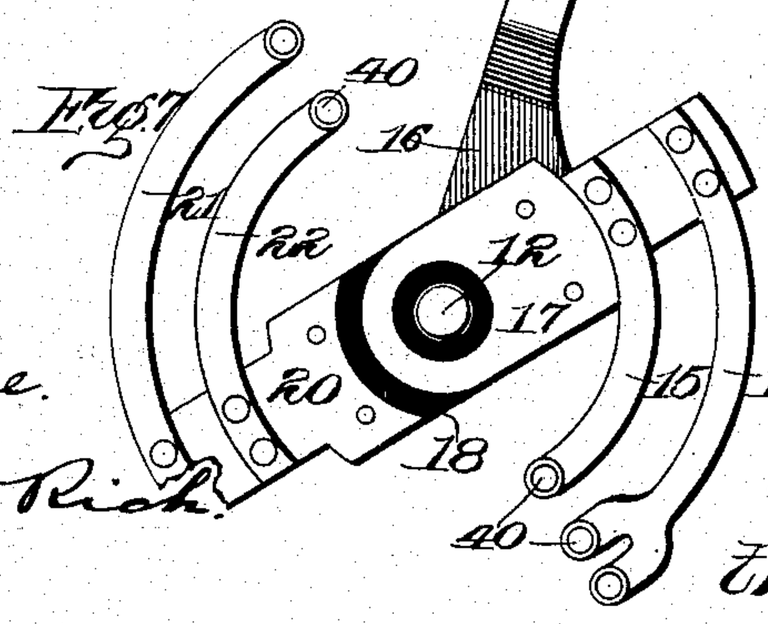


Fig. 7



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UNITED STATES PATENT OFFICE.

OSCAR H. PIEPER AND ALPHONSE F. PIEPER, OF ROCHESTER, NEW YORK.

ELECTRICAL CONTROLLING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 675,294, dated May 28, 1901.

Application filed February 2, 1900. Serial No. 3,729. (No model.)

To all whom it may concern:

Be it known that we, OSCAR H. PIEPER and ALPHONSE F. PIEPER, of Rochester, in the county of Monroe and State of New York, have invented certain new and useful Improvements in Electrical Controlling Apparatus; and we do hereby declare the following to be a full, clear, and exact description of the same, reference being had to the accompanying drawings, forming a part of this specification, and to the reference characters marked thereon.

Our invention relates to devices for controlling electric motors, especially those employed to operate dental apparatus, though capable of other uses, and to the starting, stopping, reversing, and controlling the speed of such motors by means of an oscillating switch-arm actuated by the operator.

In the accompanying drawings, Figure 1 is a plan view of a controller with the cover-plate removed and showing the operating-lever and its controlling devices; Fig. 1ª, a similar view showing a modification of the device adapted to hold the switch mechanism in adjusted position; Fig. 2, a vertical sectional view on the line *z z* of Fig. 1; Fig. 3, a plan view of the device with the cover-plates removed and showing the switch mechanism; Fig. 4, a vertical sectional view on the line *x x* of Fig. 3, with the cover-plates in position; Fig. 5, a perspective view of the casing; Fig. 6, a side view of the circuit-breaking switch and its operating device; Fig. 7, a bottom plan view showing the movable contacts and brushes; Fig. 8, a plan view of the stationary contacts in the controller, showing diagrammatically the circuit connections of the motor.

Similar reference characters in the several figures indicate similar parts.

The main frame or casing of the controller embodies a metallic frame or ring 1, having at its upper end and on opposite sides the shoulders 2, upon which is fastened the top plate 3, allowing spaces at the sides for the controlling-lever 13, which latter is provided at its ends with the pedals or operating portions 14. Arranged within the frame 1 and preferably integral therewith is a spider having the central boss 5, a vertically-extending aperture or bearing 6, and the shoulder 10; the latter adapted to support a plate 11 of insulating material, such as porcelain, on which the segments or contacts of the switch or controlling mechanism are located. At the ends of the spider 4 and near the frame 1 are provided the vertically-extending standards or arms 7, to the upper end of which and to the casing is attached the annular plate 8. To the lower ends of these pillars 7 is attached an annular plate 9, upon which, on one side, are mounted resistance-coils C′ to C⁷ and on the other side resistance-coils G, the upper ends of the first-mentioned set of coils being secured by plate 9ª and the upper ends of the coils G being attached to a plate 9ᵇ, said coils being secured by bolts or pins extending through them and fastening to the plates in any approved manner. By making the coils long and the casing rather deep, as shown, we are enabled to form the coils easily and to assemble the parts and are also able to increase the number, if desired.

The controller-operating lever 13 is secured by a screw 13ª to the upper end of an arbor or spindle 12, having a shoulder near its lower portion and journaled in the central aperture 6 of the spider 4, and secured to this arbor is a plate 16, to the under side of which are attached plates 17 and 20, said last-mentioned plates being separated from the plate 16 by a plate of insulating material 18 and are separated and out of electrical contact with each other, as shown in Fig. 7. Secured to the plate 17 are two spring contact arms or brushes 15 and 19, the outer end of the latter being bifurcated. The plate 20 is provided with the curved spring brush-arms 21 and 22, as shown particularly in Figs. 3 and 7, and the ends of these arms and also the contact arms or brushes 15 and 19 are provided with contact-pieces 40, having ball-and-socket connections with said arms, so that they may accommodate themselves to the surface of the contact-segments with which they coöperate and still maintain good electrical contact with the spring-arms by which they are carried. This construction of contacts is shown in a pending application, and we do not therefore claim it herein. The plate 16 is provided at one side with an extension, upon the end of which is secured a small roller 23, mounted upon a screw 24 and adapted to coöperate

with the upper end of a lever H, pivoted at 35 to the segment-plate B, carried by the insulating-plate 11 and having the contact *h*, adapted to make point contact with a point *i*, electrically connected with the contact-segment F, as will be described. The points *h* and *i* are of platinum and are normally kept in contact by a small spring 30, (see Fig. 6,) but are separated when during the rotation of the arbor 12 the roller or projection 23 engages the lever, so as to break the main circuit in such manner as to prevent sparking, as will be presently described.

J indicates a spring contact-arm secured to the insulating-plate 11 and having its free end perforated for the passage of the arbor and bearing upon the under side of the plate 17 evenly to prevent a tendency to tilt the arbor and connected by a plate *r*, Fig. 2, with the wire *q*, leading from the main generator-circuit. The tendency of the spring to lift the arbor and connected parts is counteracted by the plate 8, with the under side of which a nut 81 on the arbor engages, said nut having a relatively small bearing-surface on the plate to prevent undue friction.

Referring particularly to Fig. 8, which shows in plan the segmental contact-plates upon the support 11 and circuit connections, it will be noted that the contact-plates are practically duplicated on each side of a line drawn from the neutral plate or segment O through the center of the arbor to which the operating-lever is connected, the various movable contact arms or brushes carried by the operating-lever occupying central position on such divisional line when the current is cut off and the motor is at rest, so that when the lever is moved on one side of this central line the motor will be operated in one direction, and when moved to the other side will be operated in the other direction and at different speeds, depending upon the extent of movement of the lever. The stationary contacts upon the plate 11 embody the plates C $C^{\times}$, with which the contact-arm 15 coöperates, the plates D $D'^{\times}$ D^2 $D^{2\times}$ D^3 $D^{3\times}$, the idle segments D^4 $D^{4\times}$, the plates C^a and C^y, with all of which the contacts on the brush-arm 19 are adapted to separately coöperate. On the other side of the arbor 12 are arranged the interior plates E $E^{\times}$, with which the contact-brush 22 coöperates, and the outer segments or plates A, B, F, $F^{\times}$, and O, with which the brush-contact 21 coöperates. The plates A and B are connected by the conductor *b* and the plates F and $F^{\times}$ by the conductor *j*. The plate E is connected by a conductor *e* with one terminal of the resistance-coils G, the other terminal being connected by a conductor *o* with the plate $E^{\times}$. The plate $E^{\times}$ is also connected with the plate C by the conductor *s*. The plate E is connected by the conductor *k* with the plate $C^{\times}$. Plate $C^{\times}$ is connected with the plate C^y and plate C with the plate C^a. The corresponding plates on opposite sides of the central or neutral line are connected with each other—that is, D^3 is connected with $D^{3\times}$, D^2 with $D^{2\times}$, D′ with $D'^{\times}$. The resistance-coils C′ to C^7 are connected with each other, and the conductor *f* taps into these resistance-coils between coils C^3 and C^4 and is connected with the plates D′ and $D'^{\times}$, and conductor $f^{\times}$ connects the plates D^2 and $D^{2\times}$ between coils C^5 and C^6. The motor illustrated diagrammatically at the left of Fig. 8 is preferably somewhat similar in construction, though not in winding, to that shown in our prior patent, No. 619,217, embodying the ring field-magnets having pole-pieces on which are located the field-coils Y Y, X indicating the armature, and *x* the commutator-brushes, the motor being preferably a series-wound alternating-current motor. The main conductors from the main or generator circuit are indicated by the signs + and —, the latter being connected to the conductor *q*, leading to the spring contact-arm J.

a, *m*, *n*, and *q* indicate the conductors leading from the motor to the controller, and assuming that the motor is to be operated in one direction and at the first or lowest speed the current will pass from the positive pole + of the line through the field-coils Y and then by conductor *a* to contact-plate A. Here the current divides, part passing through resistance-coils C′ C^2 C^3, conductor *f* to plate D′, thence to plate $D'^{\times}$, then through brushes or contacts 19 on plate 17 to spring J, and from thence to the negative pole by conductor *q*. From the plate A the current also passes to plate $E^{\times}$ through contact-brushes 21 and 22, thence by conductor *m* to one commutator-brush *x* of the armature, through the armature-winding and by conductor *n* to plate E, from thence by conductor *k* to plate $C^{\times}$, thence to spring J and by conductor *q* to the negative pole. At plate $E^{\times}$ the current is also divided and part is passed through the resistance-coils G to plate E and from there by conductor *k*, plate $C^{\times}$, and contact-brush 15 to spring J and to the negative pole of the generator-circuit. On the second speed the current will pass in the same manner, excepting that resistance-coils C^4 and C^5 will now be included in series with C′ C^2 C^3. On third speed all resistance-coils C′ to C^7 will be in series and in shunt with the armature. On fourth speed only the coils G constituting the permanent resistance will be included in said shunt.

To reverse the direction of rotation of the armature, the contact-brushes 21 and 22 must be moved to coöperate with the plates B and E and the corresponding brushes on the opposite side with plates C and C′ to D^3. Then the current after reaching plate A passes to plate B, then to E, and by conductor *n* through the armature-windings and conductor *m* to $E^{\times}$, then to C and from C to J, and by conductor *q* to the negative pole. The current passes through the resistance-coils G and C′ to C^7, the same as in the other direction of rotation. The provision of the platinum-point contacts

h and *i* between the plates F and B avoids the sparking at the brushes, as the projection on the oscillating brush-bar comes into contact with the lever H and breaks the circuit between these platinum points before the brush or contact 21 passes off the contact-plate F or $F^{\times}$, as the case may be, onto the neutral plate or support O. To avoid any possibility of the shunt to the armature being broken, we connect the coils G at the plate E and $E^{\times}$, making a permanent shunt to the armature, regardless of what contact-plates the brushes may be resting upon. Then on the first, second, and third speeds the coils C′ to C^{7} will act in parallel with coils G, and on fourth speed the coil G will be in shunt alone. Of course, if desired, any appropriate number of coils and contacts could be employed; but we find that for practical purposes four speeds are quite sufficient. This switch embodying the circuit arrangements shown provides a convenient controlling mechanism for regulating direct or alternating current series-wound motors, in which a shunt to the armature is employed to regulate the speed of the motor, such a motor and the general circuit arrangements for accomplishing this being shown in a pending application, and we do not therefore claim this arrangement broadly herein.

The means which we employ for centering the switch-arm and maintaining the main circuit broken embodies the two arms 25, pivoted at 26 upon the plate 8, said arms being connected by a tension-spring 27, tending to draw their free ends together into contact with a stop or pin 28. Also on the plate 8 and upon the under side of the pedal-lever 13 is arranged a projection 29, preferably in the form of a roller, mounted upon a stud 31 and adapted to coöperate with the inner proximate sides of the ends of the arms 25. In the normal position of rest the ends of the levers are in contact with the projection 28; but when the pedal-lever is moved in either direction the roller 29 thereon will operate upon the inclined surface 32 of one of the levers and move the latter outward against the tension of its spring, these inclined surfaces 32 converging in a direction away from the lever-pivot, being so arranged relatively to the pivotal point of the lever 25 and to the arc of rotation of the projection 29 that the pressure of the spring tending to return the pedal-lever to normal central position does not increase in proportion to the extent of movement; but the leverage against the spring is gradually increased as the pedal-lever turns, so that the movement of the pedal by the operator is substantially uniform, and the switch may be operated in either direction to the full extent of its movement without the exercise of any great amount of force, although the spring is sufficiently strong to return the pedal-lever when released to central position with the projection 29 between the inclined surfaces on said lever. In some instances it is desirable that the pedal-lever be maintained yieldingly in position to keep the motor running at a certain speed without requiring the pressure of the operator's foot upon it, and to provide for this and at the same time preserve the advantageous features of the compensating or differentially-acting construction just described we prefer to employ the slightly-modified form of spring-operated lever shown in Fig. 1ª. The levers indicated by 50 in this construction are provided with the inclined portions 32 near their outer ends and are then curved outwardly from the pedal-lever and provided on their inner sides with slight corrugations or indentations 51, with which the roller or projection 29 coöperates successively when the contacts carried by the pedal-lever coöperate with the stationary contacts to insure the operation of the motor at different speeds determined by the amount of resistance in the circuits, as previously described. The arcs on which the inner surfaces of the spring-operated arms 50 are described are not precisely coincident with the arc through which the projection 29 on the pedal-lever moves, the difference being just sufficient so that by reason of the indentations or corrugations an amount of frictional resistance will be provided which will hold the pedal-lever and the contacts carried thereby in position to give the required speed to the motor, but not sufficient to hold the pedal-lever against the positive movement by the operator when he desires to return the latter to central position with the current cut off from the motor.

On the arms 50 shown the surfaces 32 could be increased in length, if desired, so that the return of the lever would be caused automatically from the first or second speeds and retained only at the third and fourth in the manner described, or the relations of the inclined and corrugated surfaces could be otherwise altered to suit the required conditions.

While we prefer the use of the contacts *h* and *i*, which abut to make the main circuit and being of platinum are not damaged by sparking when the circuit is broken, it is not absolutely necessary that these parts abut squarely, as shown, as a knife-switch would accomplish the same purpose. It will also be understood that if it is desired to make a switch which controls the movement of the motor in but one direction it would only be necessary to dispense with the contacts and brushes on one side of the so-called "central" or "median" line.

We claim as our invention—

1. The combination with a series-wound electric motor and a resistance permanently in shunt with the armature, of a controlling-switch embodying stationary contacts arranged in sets on opposite sides of a median line, each including variable resistances, a movable member carrying contacts coöperating with the stationary contacts and operat-

ing to reverse the current through the motor and control the variable resistance when moved to either side of the median line.

2. The combination with a series-wound electric motor and a resistance permanently in shunt with the armature, of a controlling-switch embodying stationary contacts arranged in sets on opposite sides of a median line, each set including variable-resistance contacts, a movable member carrying contacts coöperating with the stationary contacts successively and operating to reverse the current through the motor and control the variable resistance when moved to either side of the median line and relatively movable contacts controlled by the movable member and operating to break the main circuit through the machine before said circuit is broken by the contacts carried by the movable member.

3. The combination with a series-wound electric motor and a resistance permanently in shunt with the armature, of a controlling-switch embodying stationary contacts arranged in sets on opposite sides of a central line, each set including variable-resistance contacts, a movable member carrying contact-brushes sliding over the stationary contacts successively and operating to reverse the current through the motor and control the variable resistance when moved to either side of the central line or position, and spring-separated contacts in the main circuit controlled by the movable member and operating to break the main circuit before the circuit is broken by the separation of the sliding contacts carried by the movable member.

4. The combination with a series-wound electric motor, and the conductors a, n, m and q, of a controller embodying a resistance G, a variable resistance having two sets of contacts on opposite sides of a central line, contact-plates A and B, E and $E^{\times}$, F and $F^{\times}$, a movable member having brushes coöperating with the variable-resistance contacts, and brushes coöperating with all of the last-mentioned contacts, and a separate switch between plates B and F operated by the movable member.

5. The combination with a series-wound electric motor and a resistance permanently in shunt with the armature, and a variable resistance also in shunt with the armature and in parallel with the permanent shunt, of a movable switch member operating to control the variable resistance and also the main circuit.

6. In a controller, the combination with the casing, the spider therein, the resistance-coils extending above and below the spider, the insulating-plate, contacts thereon, and an oscillatory arbor having brushes coöperating with the contacts.

7. In a controller, the combination with the casing having the spider, the plate 9, the coils mounted thereon, and the insulating-plate having contacts thereon, of the oscillatory arbor mounted in the spider, the brushes carried thereby, and means for oscillating the arbor.

8. In a controller, the combination with the casing and contacts therein, of the oscillatory arbor, the plate 16 thereon having the projection, the plates carried by the plate 16 having the brushes and insulated from said plate 16 and from each other, the contacts with which the brushes coöperate, and a spring-operated switch with which the projection on the plate 16 coöperates.

9. In a controller, the combination with the casing having the central bearing, of the arbor, the top plate 8 engaging the arbor, the contact-plate carried on the arbor, and the spring contact-arm J engaging the last-mentioned plate.

10. In a controller, the combination with the operating pivoted lever having the projection thereon and electrical contacts controlled by the movement of the lever, of the two pivoted spring-operated arms having opposing surfaces with each of which the projection on the lever is adapted to coöperate, said surfaces relatively converging in a direction away from the pivot of the lever.

11. In a controller, the combination with the pivoted lever and electrical contacts controlled by the movement thereof, of the two pivoted spring-operated arms in contact with the lever to return it to normal central position between them, the coöperating surfaces of the lever and arms being inclined relatively to the arc through which the lever moves, so that the spring resistance to the movement of the lever is not increased in direct proportion to the extent of said movement.

12. In a controller, the combination with the pivoted lever and electrical contacts controlled by the movement thereof, of the two arms pivoted in rear of the lever-pivot having the opposing converging surfaces at their ends coöperating with the lever, and the single spring connecting said arms, the surfaces of the arms being inclined relatively to the arc described by the lever to prevent undue increase in spring resistance during the movement of the lever in either direction.

13. In a controller, the combination with the pivoted lever having the projection, and the contacts controlled by the lever, of the pivoted opposing spring-operated arms having the opposing inclined surfaces, and the curved and corrugated surfaces, both adapted to be engaged by the projection on the lever.

14. In a controller, the combination with the pivoted lever having the projection thereon and contacts controlled by the lever, of the pivoted, opposing spring-operated arms having the notched and curved surfaces with which the projection on the lever coöperates to retain the lever in adjusted position.

15. In a controller, the combination with the pivoted lever having the projection thereon, and contacts and circuit connections involving a variable resistance controlled thereby, of a pivoted spring-operated arm having the

curved and notched surface arranged slightly tangentially of the arc described by the projection on the lever to retain the lever in adjusted position.

16. In a controller, the combination with the pivoted lever having the projection thereon and contacts and circuit connections involving two variable resistances controlled by the movement of the lever in opposite directions from the center, of the two opposing pivoted spring-operated arms having the curved and notched surfaces arranged slightly tangentially of the arc described by the projection on the lever, to retain the lever in adjusted position when moved in either direction from central position.

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