(No Model.) 2 Sheets—Sheet 1.

A. G. McKEE.

PEDAL GOVERNOR FOR ELECTRIC MOTORS.

No. 520,072. Patented May 22, 1894.

Fig. 1.

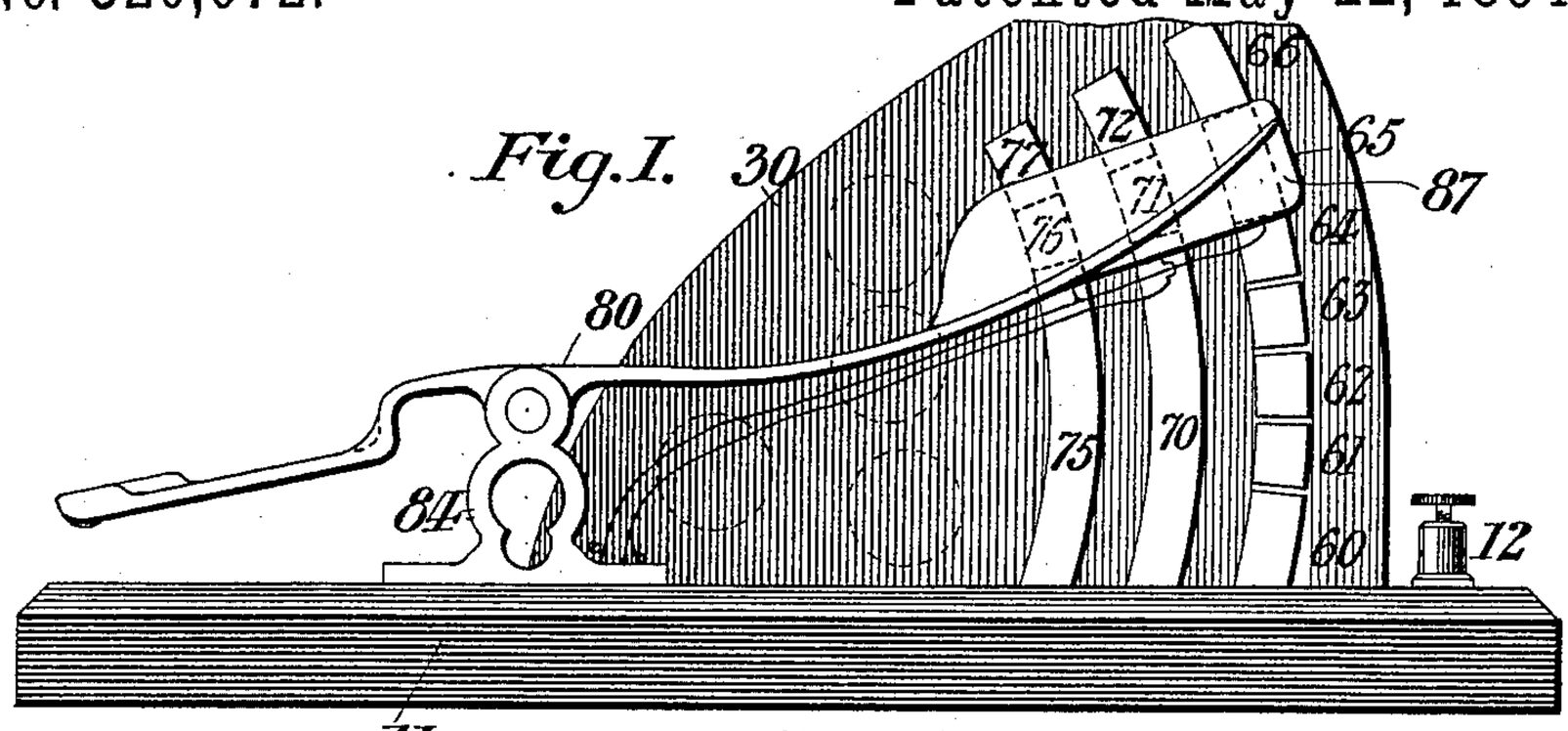


Fig. 2.

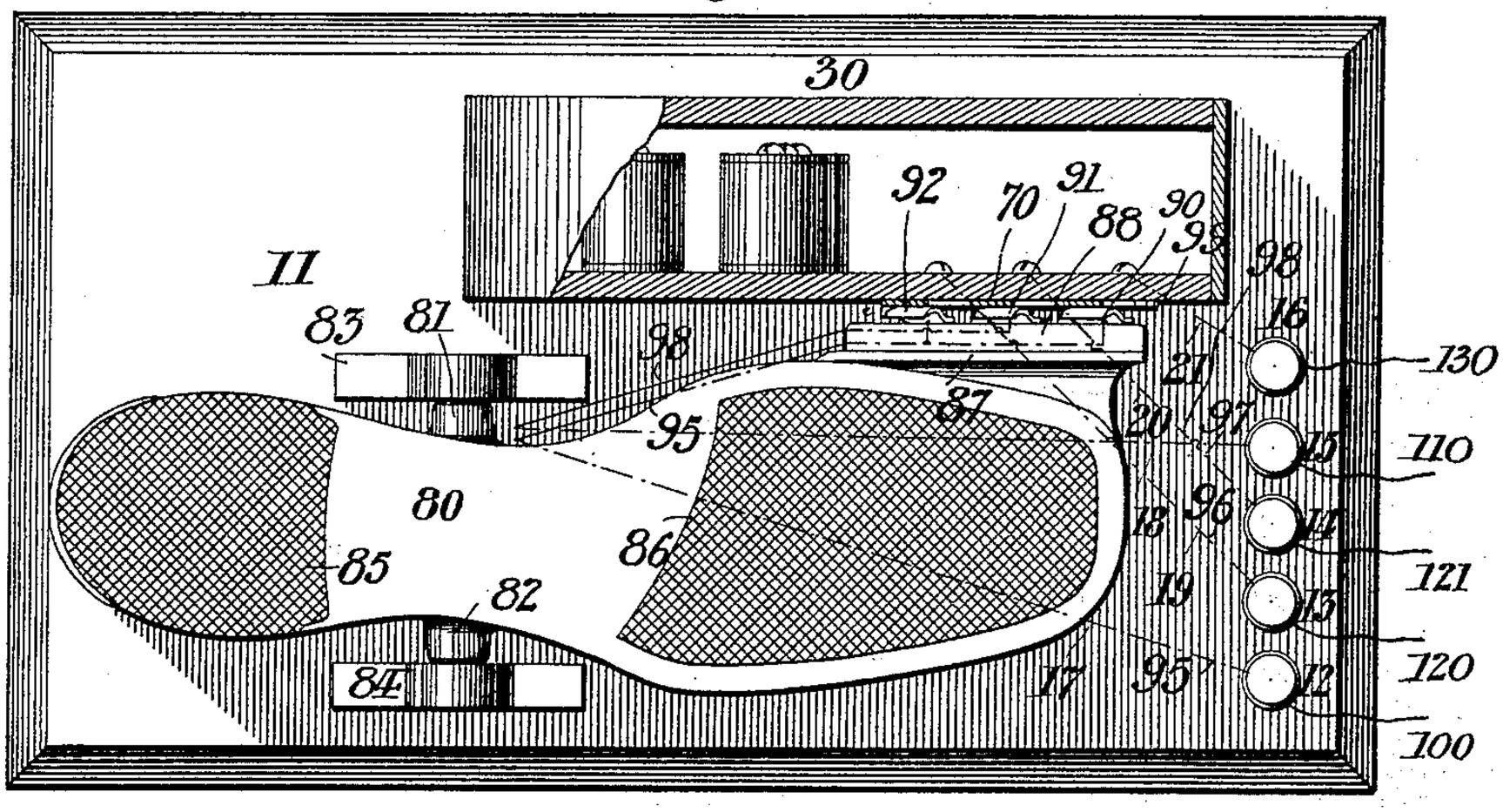
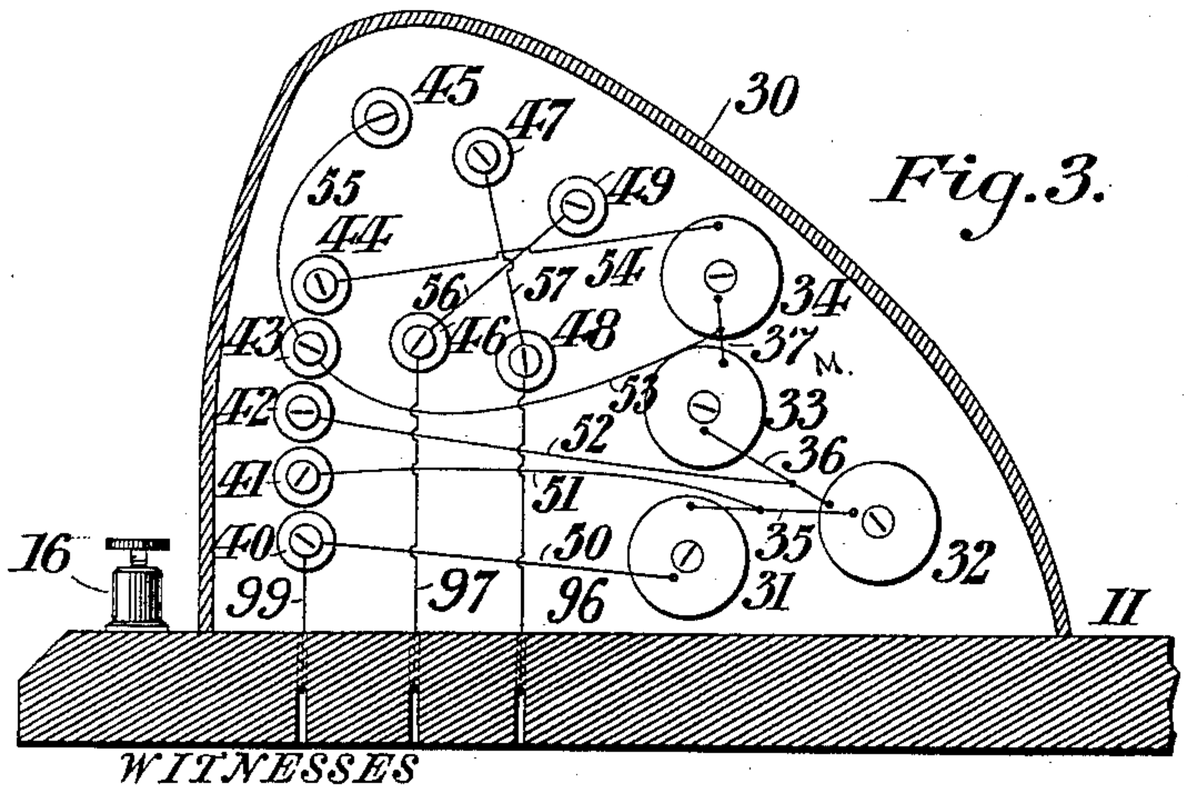


Fig. 3.



WITNESSES

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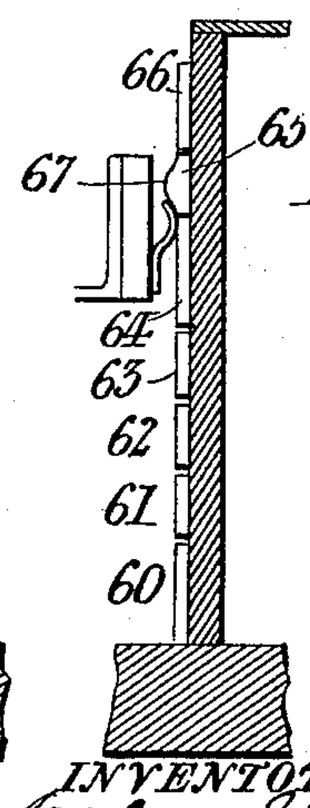
Fig. 5.



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(No Model.) 2 Sheets—Sheet 2.

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PEDAL GOVERNOR FOR ELECTRIC MOTORS.

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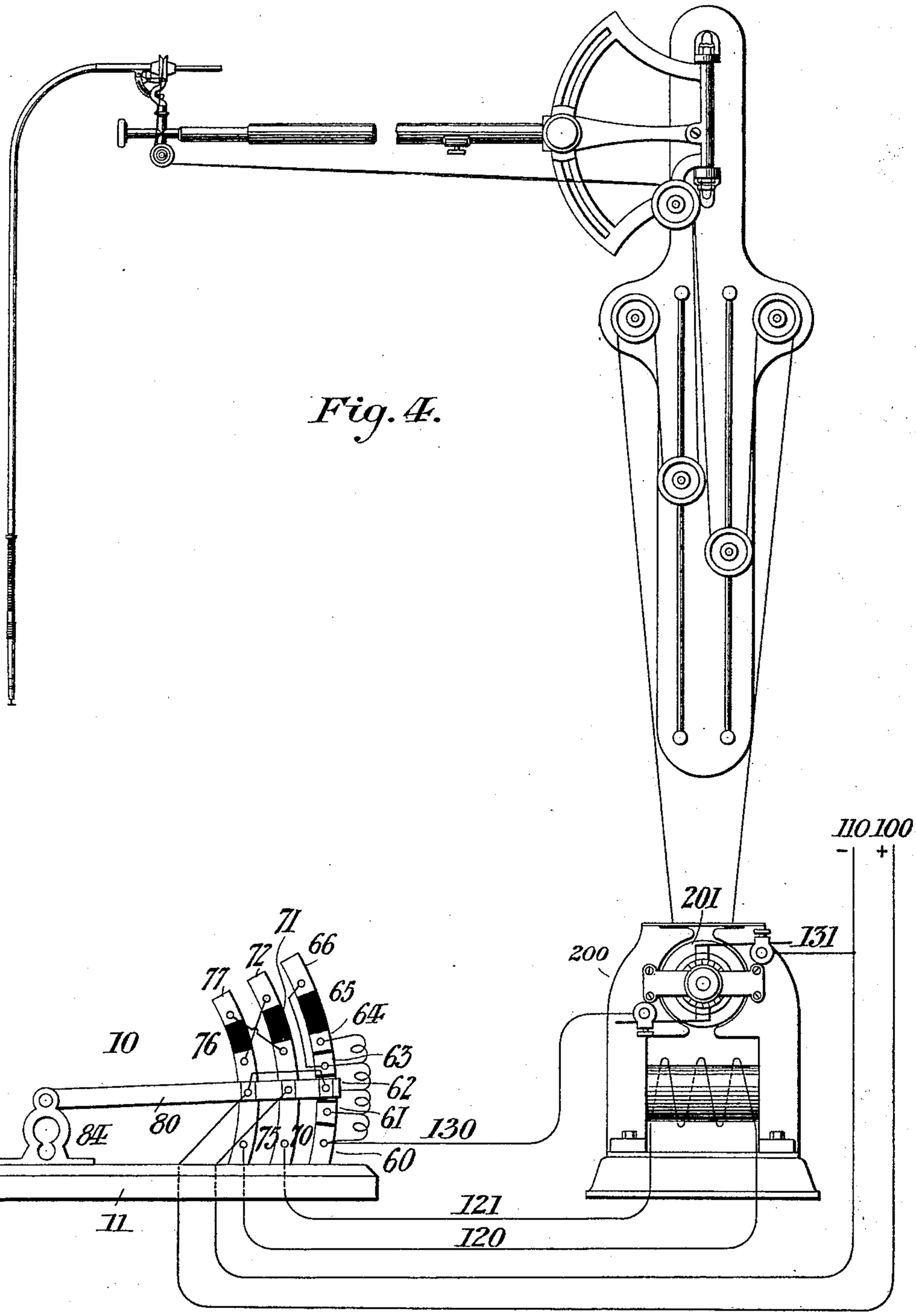

Fig. 4.

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UNITED STATES PATENT OFFICE.

ARTHUR GLENN McKEE, OF STATE COLLEGE, PENNSYLVANIA.

PEDAL-GOVERNOR FOR ELECTRIC MOTORS.

SPECIFICATION forming part of Letters Patent No. 520,072, dated May 22, 1894.

Application filed July 13, 1893. Serial No. 480,409. (No model.)

To all whom it may concern:

Be it known that I, ARTHUR GLENN McKEE, a citizen of the United States of America, residing at State College, in the county of Centre, in the State of Pennsylvania, have invented certain new and useful Improvements in Pedal-Governors for Electric Motors, of which the following is a specification.

This invention relates to means for starting, stopping and reversing an electric motor and for varying the speed thereof.

The device is especially designed for use in the circuit of an electric motor used for driving a dental engine, but it may be used in the circuit of an electric motor used for other purposes. In the use of the dental engine, it becomes necessary in the operations upon the teeth of the patient to vary the speed of rotation and power of the dental tool driven thereby; the lowest speed being about one hundred and fifty rotations a minute for cleaning the thread-like cavities at the roots of the teeth; the highest about eighteen hundred revolutions a minute for polishing the teeth; and between these extremes various speeds are used for different operations and upon teeth in different conditions. It is desirable that the dentist be able to vary the speed and power of the tool as required, and also to stop, start and reverse it instantly without changing his position and without withdrawing either hand from his work.

The object of this invention is to provide means under the control of the foot of the operator for instantly stopping, starting, varying the speed of, and reversing the motor, and consequently the dental or other instrument.

Figure 1 of the accompanying drawings represents a side elevation of this pedal governor. Fig. 2 represents a plan view thereof, the box containing the resistance coils being partly in horizontal section. Fig. 3 represents a longitudinal section of the resistance box constituting a part of this governor. Fig. 4 represents diagrammatically an electric motor, a dental engine driven thereby, and this pedal governor in the motor circuit. Fig. 5 represents a plan of the bottom of the base plate. Fig. 6 represents a vertical transverse section on line 7—7 of Fig. 1 of the vertical plate carrying the several contact studs for varying the speed and reversing.

The same reference numbers indicate the same parts in all the figures.

The drawings represent this pedal actuated governor 10 disposed in the supply current of an electric motor 200 used for driving a dental engine 300.

The dental engine 300 herein illustrated is that shown and described in United States Patent No. 492,432, granted to Charles E. Rhone February 28, 1893, to which reference is made for a detailed description, but the motor and its governor may be used in connection with any other dental engine or other machine where change of speed is desirable.

The electric motor 100 herein illustrated is shunt-wound and the speed thereof is changed by varying the current through the armature, but it may be so connected with the circuit as to vary the speed by changing the current through the field magnets.

The rheostatic pedal governor 10 comprises a base plate 11, a resistance box 30 preferably mounted on said base plate, and a pedal 80 also mounted on said base plate. This base plate 11 is provided at one end with a number of binding posts as 12, 13, 14, 15 and 16, which extend through holes in said plate, and on its under side with grooves 17 and 18 leading from the binding posts 12 and 15 to points under the pedal 70 and with grooves 19, 20 and 21 extending from the binding posts 13, 14 and 16 to points under the resistance box 30, a number of holes being made opposite the said terminals of the grooves through which the wires disposed in said grooves and connected with said binding posts may pass through the base plate. The resistance box 30 is disposed at any convenient point either on or off the base-plate 11. In the latter case, it may be placed under the pedal, or at one side thereof as shown. This box is provided with any desired number of resistance coils as 31, 32, 33 and 34 disposed on spools fastened to one side thereof. The coils 31 and 32 are connected with each other by a wire 35, the coils 32 and 33 by a wire 36 and the coils 33 and 34 by a wire 37. A series of binding posts 40, 41, 42, 43, 44 and 45 are disposed in a row on the arc of a circle on the inner face of a vertical plate which may constitute one of the side walls of the resistance box 30, a considerable space being

left between the posts 44 and 45. Two similar binding posts 46 and 47 are disposed at considerable distance apart on a corresponding arc concentric with that just described; and two binding posts 48 and 49 are disposed at considerable distance apart on a third arc concentric with those on which the other binding posts are arranged. A wire 50 connects the binding post 40 with the outer terminal of the coil 31, a wire 51 connects the binding post 41 with the outer terminal of the coil 32 through the medium of the wire 35, a wire 52 connects the binding post 42 with the outer terminal of the coil 33 through the wire 36, the wire 53 connects the binding post 43 with the outer terminal of the coil 34 through the wire 37 and the wire 54 connects the binding post 44 with the inner terminal of the coil 34, said coil being cut out when the current passes through this connection. A wire 55 connects the binding post 45 of the outer arc-shaped row with the binding post 43 of the same row. Wires 56 and 57 cross each other, the former connecting the binding post 46 of the middle row with the binding post 49 of the innermost row and the latter connecting the binding post 47 of the middle row with the binding post 48 of the innermost row. Conductive studs 60, 61, 62, 63, 64 and 66 are disposed in an arc-shaped row on the outer face of said vertical plate opposite respectively the binding post 40, 41, 42, 43, 44 and 45, the studs 60, 61, 62, 63 and 64 being insulated from each other and connected respectively with said binding posts. An insulating stud 65 is disposed between the studs 64 and 66 and provided at its upper edge with a rib 67. A conductive strip 70 is disposed on said plate concentric with the row of studs just described, its upper end being opposite the binding post 46 and connected therewith. A conductive stud 72 is disposed in the same arc as the strip 70 opposite to and connected with the uppermost binding post 47, and an insulating stud 71 is disposed between said strip 70 and said conductive stud 72. A similar conductive strip 75 is disposed on the outer face of said plate concentric with the strip 70, its upper end being opposite to and connected with the binding post 48, and a conductive stud 77 is disposed in the same arc and separated from said strip by an insulating stud 76, said contact stud 77 being opposite to and connected with the binding post 49.

The pedal 80 is provided with trunnions 81 and 82 which are journaled in pedestal brackets 83 and 84, mounted on the plate 11. This pedal is preferably constructed of metal and provided at the heel and toe portions with corrugated soft rubber mats 85 and 86, which by frictional contact with the sole of the boot of the operator, tend to hold his foot in position on the pedal. A vertical flange 87 extends from the ball to the toe of the pedal and is preferably cast integral therewith. A hard rubber insulating plate 88 is attached to said vertical flange 87. Three spring contacts 90, 91, and 92 are disposed on the insulating plate 88. The spring contact 90, which is nearest the toe, touches the series of contact studs 60 to 66 opposite the binding posts 40 to 46; the middle spring contact 91 being adapted to move in a path corresponding to the middle contact strip 70 and the conductive and insulating studs 71 and 72 for contact with said strip or studs; and the innermost spring contact 92 being adapted to move in a path in which the strip 75, conductive stud 77 and insulating stud 76 are disposed.

A positive wire 100 and negative wire 110 connect the pedal governor with the main supply circuit or with any source of electricity and serve to supply the current for driving the motor 200. The positive wire 100 is connected with the exterior binding post 12 and the negative wire 110 with the exterior post 15. Wires 120 and 121 constitute the terminals of the shunt field circuit of the motor and are connected respectively with the exterior binding posts 13 and 14. A wire 130 connects the exterior binding post 16 with one of the commutator brushes of the motor and a wire 131 connects the other commutator brush with the negative supply wire 110. A wire 95 connected with the exterior binding post 12, to which the positive supply wire 100 is connected, extends along the base plate 11, preferably in a groove therein, to a point opposite or nearly opposite to the pivot of the pedal 80; thence passes upward through a hole in said plate; then extends along the pedal on the under side thereof to the inner and outer spring contacts 90 and 92, being connected with both of said spring contacts and serving to supply current to the armature 201 of the motor and also to the shunt circuit passing through the field magnets thereof. For connection with the shunt field circuit of the motor, a wire 96 extends from the interior binding post 48, which is connected with the inner strip 75 on which the spring contact 92 bears, downward through a hole in the base-plate 11; thence along a groove in the under side thereof to the exterior binding post 13, with which one terminal of the shunt circuit is connected; and a return wire 97 connects the interior binding post 14 to which the other terminal of the shunt circuit is attached, with the interior binding post 46 which is connected with the intermediate strip 70, on which the spring contact 91 plays. A wire 98 connected with the spring contact 91, passes along the under side of the pedal 80 to a point opposite the pivot thereof; thence through a hole in the base plate 11 and along the under side of said base to the exterior binding post 15 to which the negative wire 110 of the supply circuit is connected. For the armature current a wire 99 extends down from the binding post 40 opposite the conductive stud 60 of the outer series of studs over which the spring contact 92 plays, through the base-plate 11

and along a groove therein, to the binding post 16, from which the current passes to the armature through the wire 130.

If the motor is not in use, the pedal is in such position that its conductive spring contacts 90, 91, and 92 rest upon the insulating studs 66, 72, and 77, whereby the circuit is broken. These several insulating studs 66, 72 and 77 may all be formed in one piece if desired. The rib or ribs as 67 at the upper edge of one or all of them serve as stops to arrest the upward movement of the pedal unless special force is used to move the pedal over said stops into contact with the reversing studs 66, 71 and 76 above said insulating studs.

The contact studs hereinbefore referred to and hereinafter included in the claims may be any suitable form of contact terminals, and the stop stud may be any suitable insulating point.

In the use of this pedal governor in connection with a motor for driving a dental engine, the pedal 80 is depressed until its outermost contact spring 90 bears upon either of the conductive studs 64, 63, 62, 61, or 60 and the spring contacts 91 and 92 bear against the conductive strips 70 and 75. The current then passes from the positive wire 100 connected with the supply circuit to the exterior binding post 12; thence along the wire 95 to the toe flange of the pedal, where it divides, one part passing through the spring contact 90 and the other part through the spring contact 92. That part of the current which passes through the spring contact 92 forms the shunt circuit for exciting the field magnets of the motor. It passes from the spring contact 92 into the conductive strip 75, thence to the interior binding post 48, thence through the wire 96 to the exterior binding post 13, thence through the wire 120 of the shunt circuit to the field magnets, thence through the wire 121 of the shunt circuit from said magnet to the exterior binding post 14, thence through the wire 97 to the interior binding post 46 of the resistance box, thence to the conductive strip 70, thence to the spring contact 91 on the toe flange of the pedal, thence through the wire 98 to the exterior binding post 15, where it connects with the negative wire 110 of the supply circuit. That part of the current which passes into the contact spring 90, goes thence into one of the conductive studs 66, 64, 63, 62, 61, or 60 according to the position of the pedal. When the pedal is in the position illustrated in Fig. 4, where its spring 90 is in contact with a conducting stud 62, the current passes from said spring to said stud, thence to the interior binding post 42, through the wire 52 to the coil 32, thence through the coil 31 and wire 50 to the interior binding post 40, and thence through the wire 99 to the exterior binding post 16. From the binding post 16 it passes through the wire 130 to the commutator brush 220, thence to the armature 201 of the motor, thence through the other commutator brush 221 and thence through the wire 131 to the negative wire 110 connected with the source of supply. When the contact spring 90 is in contact with the conductive stud 64, the current for the armature passes through all the resistance coils, and the motor and dental drill run at the minimum speed; when the contact spring 90 rests on the contact stud 60, the motor and machine driven thereby run at the maximum speed. The speed may be varied by adjusting the pedal so as to bring the spring 90 into contact with any of the conductive studs referred to, and any desired number of studs and resistance coils may be employed.

When it is desired to reverse the motor for stopping it and consequently the drill or other tool driven thereby, the pedal 80 is thrown up beyond the insulating studs 65, 71 and 76 and its spring contacts 90, 91 and 92 ride over the rib or ribs thereon into contact with the reversing conductive studs 66, 72 and 77. The current of the field circuit is thus reversed by means of the cross wires 56 and 57 connecting the binding posts 47 and and 49, opposite said studs, with the binding posts 56 and 48 opposite the strips 70 and 75. The armature current then passes through the wire 55 connecting the conductive studs 66 with the conductive stud 63. This reversal of the current tends to reverse the motor and instantly stops it preparatory to a reversal. The operator then depresses the pedal until the spring contacts 90, 91 and 92 rest on the insulating studs or blocks and the motor and the tool remain stationary.

For reversing the motor for the purpose of changing the direction of rotation of the dental or other tool, the pedal is swung upward in the same manner as for stopping, and the spring contacts 90, 91 and 92 are permitted to rest on the uppermost conductive studs 66, 72 and 77. The motor is thus instantly reversed and the tool rotated in the opposite direction as long as desired.

The reversing mechanism is very useful to effect a quick stoppage of the tool. It is also useful in reversing the direction of rotation of a tool; especially for polishing, as by turning the polishing disk in reverse direction, it will be quickly unscrewed and released from its holder and can be removed and another put in its place instantly, without the neces sity of resorting to the use of a screw driver, which causes annoyance to the operator and interruption of the work. By this means the operator can stop the motor in one half second by the watch when running at the highest speed, and can reverse the direction of rotation in still less time.

A variety of reverse speeds may be obtained by increasing the number of reversing studs, but for practical purposes a single reversal is ordinarily sufficient, that which gives a speed of about four hundred revolutions a minute being preferable in dental work. The regulation of the speed may be

effected by placing the resistance coils in the field circuit instead of in the armature circuit, but the arrangement hereinbefore described is regarded as preferable as it avoids dangerous reaction of a strong armature on a weak field, which might sometimes unexpectedly change the direction of rotation. It will be observed that the reversal is effected by reversing the current through the field magnets. This has a slight advantage over reversing the current in the armature, which latter method might be adopted. Owing to the retentivity of the iron in the field of the motor, the heavy current induced by the reversal is distributed over a greater period of time and so has a lower potential, and burning out of the armature is avoided.

I claim as my invention—

1. In an electric governor, the combination of a pedal having a spring contact, a vertical series of contact studs for varying the current, a stop stud, and a reversing stud disposed adjacent to the stop stud.

2. In an electric governor, the combination of a stop stud, a vertical series of contact studs for varying the current, disposed on one side of said stop stud, a reversing stud disposed adjacent to the stop stud on the other side thereof, and a pedal having a spring contact.

3. In an electric governor, the combination of a contact stud, a reversing stud, a stop stud provided with an arresting rib, and a pivoted bar carrying a spring contact for engaging said studs.

4. In an electric governor, the combination of a series of contact studs, a reversing stud, a stop stud disposed between said contact studs and reversing stud, and provided with an arresting rib, and a pivoted bar carrying a spring contact for engaging said stud.

5. In an electric governor, the combination of a pedal having a spring contact, a vertical series of contact studs for varying the current, a stop stud, and a reversing stud disposed adjacent to said stop stud, the studs admitting least direct current to the armature being disposed nearest the reversing stud.

6. In an electric governor, the combination of a series of contact studs diposed in a vertical plane, and a pedal disposed adjacent to said studs, said pedal being provided with a contact spring for establishing an electric connection along said studs, said spring having a frictional contact with said studs which holds the pedal in adjusted position at any point in its path of motion.

7. In an electric governor, the combination of a vertical plate provided with two conductive strips and with a series of contact studs, said studs and strips being disposed side by side in a vertical plane, and a pedal provided with different yielding plates adapted to bear upon said strips and studs.

8. In a rheostatic pedal governor for an electric motor, the combination of a vertical plate provided with arc-shaped conductive strips and an arc-shaped set of conductive studs, resistances connected with said studs, a pedal provided with spring contacts engaging said strips and studs, and circuit wires connected with said strips, studs and pedal.

9. In a rheostatic pedal governor for an electric motor, the combination of a vertical plate provided with arc-shaped conductive strips and an arc-shaped set of conductive studs, resistances connected with said studs, a pedal provided with spring contacts engaging said strips and studs, circuit wires connected with said strips, studs and pedal and reversing conductive studs in the path of said contacts.

10. In a pedal governor for an electric motor, the combination of a vertical set of conductive studs, resistances connected therewith, a pedal, provided with contacts wires connected with said studs and pedal, and means operated by said pedal for reversing the current.

11. In a pedal governor for an electric motor the combination of two conductive strips, reversing studs above said strips, crossing wires connecting said reversing studs with said strips, a set of conductive studs, a set of resistances connected with said studs, a separate conductive stud in arc with said set, a wire connecting said separate stud with one of the set of studs, and a pedal provided with spring contacts for engaging said strips and studs.

12. The combination of electric conductors, a series of contact terminals disposed in a vertical plane and connected to said conductors, and an oscillating pedal for closing the circuit through any of said contact terminals, said pedal having a vertical flange disposed on one side, said flange carrying a spring contact for electric connection with said terminals.

13. The combination of electric conductors, two vertically disposed conductive strips, connected with said conductors, a vertical series of contact studs also connected with said conductors, and a pedal having a vertical flange disposed on one side, said flange carrying spring contacts adapted to bear upon said strips and studs.

14. The combination of electric conductors, a series of contact terminals disposed in a vertical plane and connected with said conductors, and an oscillating contact pedal for closing the circuit through any of said contact terminals, said pedal having a frictional contact which holds it in adjusted position in electric connection with either contact terminal.

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