No. 613,869. Patented Nov. 8, 1898.

F. J. RUSSELL.

CONTROLLING DEVICE FOR ELECTRIC MOTORS.

(Application filed May 25, 1898.)

(No Model.) 2 Sheets—Sheet 1.

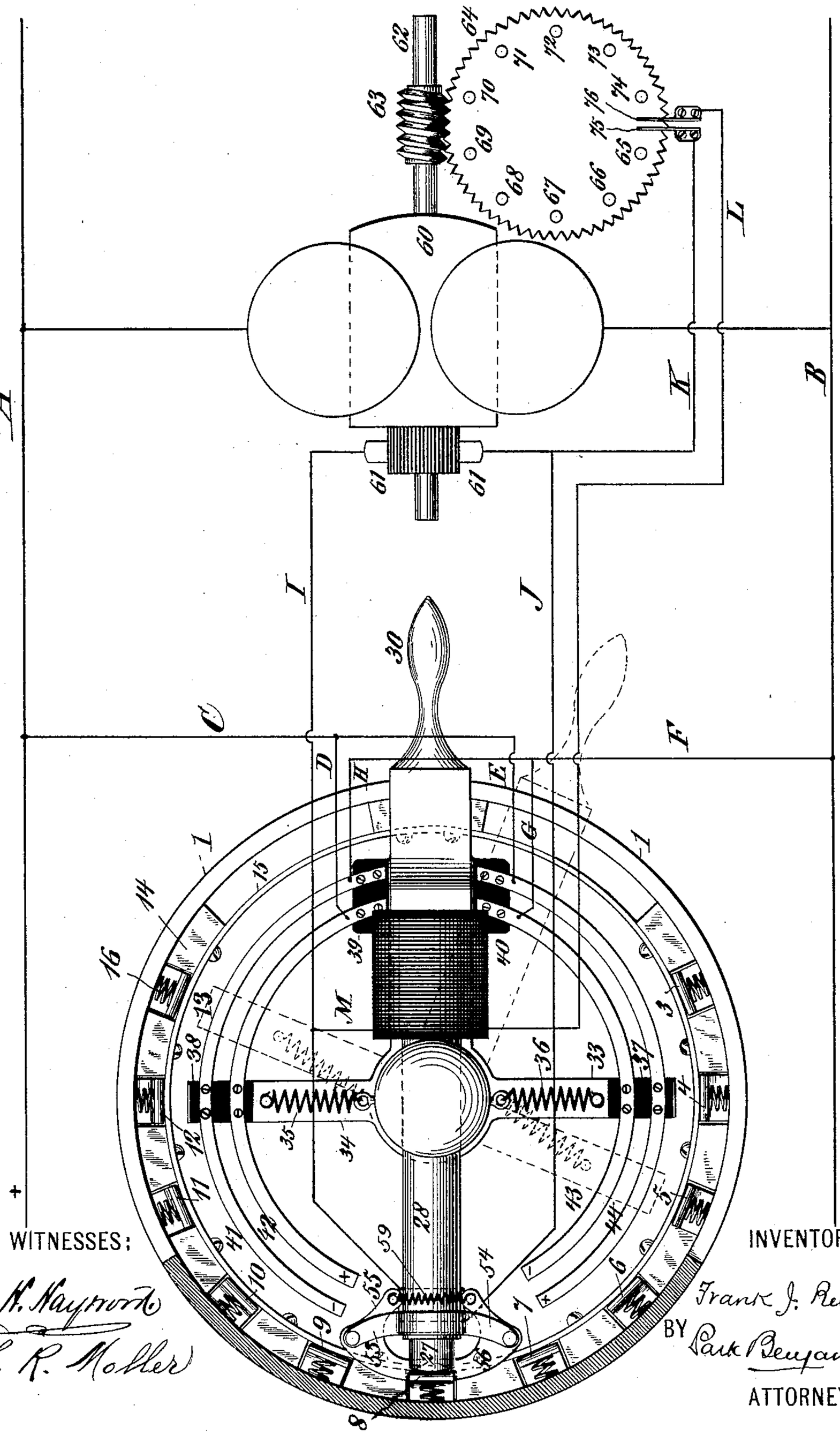

Fig. 1.

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Fig. 3,

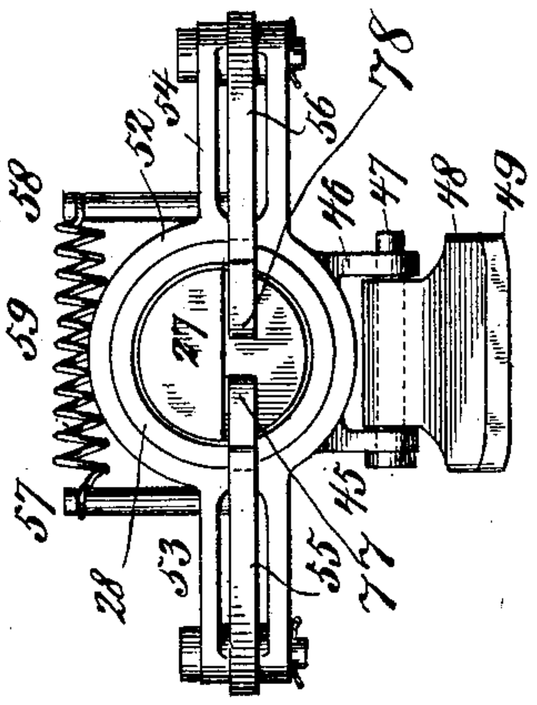


Fig. 4,

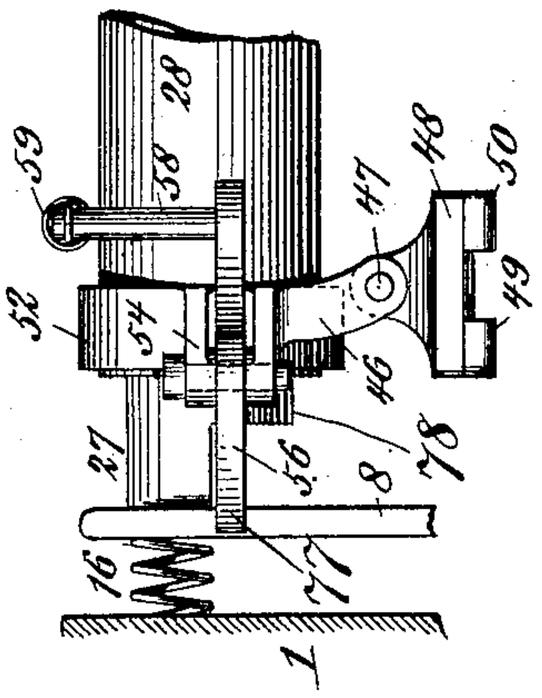
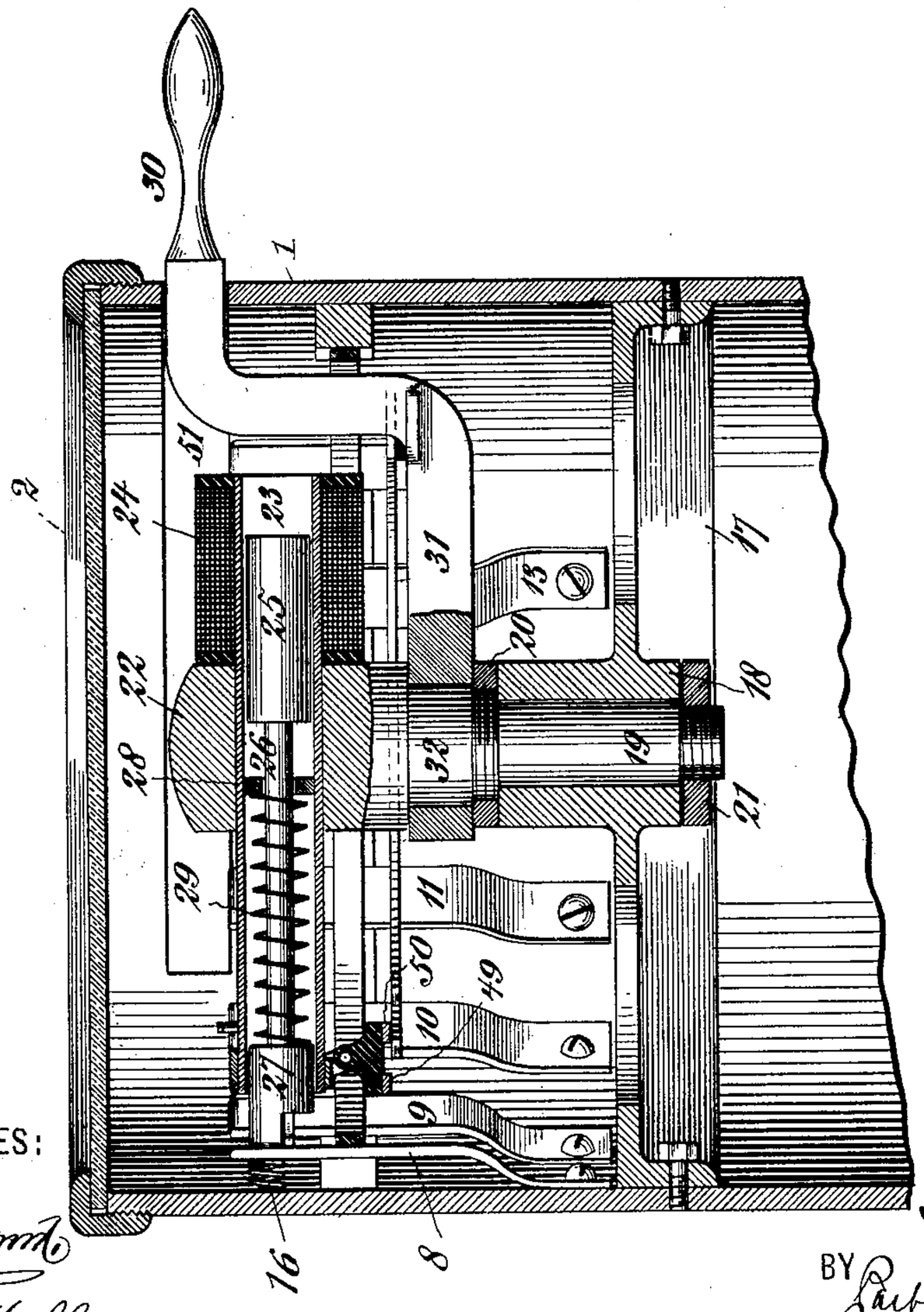


Fig. 2,



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CONTROLLING DEVICE FOR ELECTRIC MOTORS.

SPECIFICATION forming part of Letters Patent No. 613,869, dated November 8, 1898.

Application filed May 25, 1898. Serial No. 681,684. (No model.)

To all whom it may concern:

Be it known that I, FRANK J. RUSSELL, of the city, county, and State of New York, have invented a new and useful Improvement in Controlling Devices for Electric Motors, of which the following is a specification.

The object of my invention is to provide a manually-operated controlling device for an electric motor so constructed and arranged that the motor-armature shall be caused to rotate in a direction corresponding to the direction of movement of the controlling hand-lever and for a period corresponding to the extent of said movement.

My invention consists, first, in the construction and arrangement of the controlling device, and, second, in the combination of controlling device and motor and in the various subcombinations and instrumentalities, as hereinafter pointed out in the claims.

In the accompanying drawings, Figure 1 is a plan view of the controlling device, the motor, and the connecting-circuit. Fig. 2 is a vertical section of the controlling device. Fig. 3 is an end view of the hollow pivoted arm, showing the contact-plates carried thereby and the locking-dogs. Fig. 4 is a side view of the same, showing also the engagement of the dogs with one of the spring-stops. Both Figs. 3 and 4 show the various parts in detail and on a larger scale than appears in Figs. 1 and 2.

Similar numbers and letters of reference indicate like parts.

I will first describe the mechanism of the controlling device.

1 is a cylindrical case, which may be of metal, open on its upper side, where a glass plate 2 may be provided, so as to allow inspection of the mechanism within. Around the inner periphery of the case 1 are secured vertical stops, which may be in any desired number and spaced at regular intervals. In the drawings I show eleven of these stops, (marked 3 to 13, inclusive.) Between these stops are spacing-blocks 14, secured to the inner walls of the case, which spacing-blocks carry a ring 15, against which the stops 3 to 13 are pressed by the action of the spiral springs 16, interposed between said stops and the wall of the case. Also secured within the case 1 and below the stops 3 to 13 is a spider 17, which has a central bearing 18 for the pivot 19. This pivot is threaded above and below the bearing 18, and is provided with nuts 20 and 21, by which it is held in place. The upper part of the pivot 19 forms a hub 22, through which is an opening in which is inserted the hollow cylindrical arm 23. This arm fits tightly in the hub 22 and turns with its pivot 19. Secured upon this arm 23 upon one side of the hub is an electromagnetic coil 24. Within the arm 23 and entering within the magnet-coil is a plunger 25, which carries a spindle 26, which extends longitudinally through the hollow arm 23 and terminates in a head 27, which normally, as shown in Fig. 2, protrudes beyond the end of the arm and has a bearing upon whichever one of the stops 3 to 13 may be in front of it. Between the head 27 and a perforated fixed partition 28 in the arm, through which partition the spindle 26 freely passes, there is interposed a spiral spring 29, the ends of the spring bearing, respectively, upon the head 27 and upon the partition 28. The expansive effect of this spring is to hold the outer end of the head 27 against the stop, as 8, Fig. 2, opposite to it with some pressure, which is counteracted by the spiral spring 6, between the stop and the wall of the case.

30 is the operating-handle of the device, which is fast upon the end of the lever 31, which turns freely upon the enlarged portion 32 of the pivot 19 and lies between the nut 20 and the hub 22. The lever 31 has two arms 33 and 34 fast upon it and extending at right angles thereto. To these arms are fastened the ends of spiral springs 35 and 36, the other ends of which are attached to eyes fast upon the hub 22. To the ends of the arms 33 and 34 are secured blocks of insulating material 37 and 38, and on each side of the lever 31 are secured similar blocks of insulating material 39 and 40. To the insulating-blocks are attached arc-shaped contact-plates 41, 42, 43, and 44—that is to say, the ends of plates 41 and 42 are connected to the block 39 and their middle portions are supported by the block 38 and their opposite ends are free. The ends of the plates 43 and 44 are connected to the block 40. Their middle portions are supported by the block 37 and their opposite ends are free.

Near the outer end of the hollow arm 23 and on its under side are two downward projections 45 and 46, Fig. 3, between which is pivoted, by the pin 47, a shoe of insulating

material 48. This shoe carries two contact-plates 49 and 50. These plates 49 and 50 are placed in circumferential line with the curved plates 41, 42, 43, and 44. The lever 31 passes through a slot 51 in the case 1, and when said lever is turned, by means of the handle 30, in one direction or the other the curved plates 41 and 42 or 43 and 44, as the case may be, run under, and so come in contact with the plates 49 and 50.

Secured upon the outer end of the arm 23 is a collar 52, which carries brackets 53 and 54, and in which brackets are pivoted dogs 55 and 56. On the inner ends of these dogs are upwardly-projecting pins 57 and 58, Fig. 3, to which pins are secured the ends of a spiral spring 59, which tends to draw said ends together. The other ends of the dogs are of substantially the shape shown in plan in Fig. 1, and the dogs have also a curved outer contour, as represented in said figure.

When the head 27 rests against a stop, as 8, the shouldered outer portion of the dogs bears against the sides of said stop, and so normally prevents the arm 23 from being turned on its pivot.

60 represents an electric motor the armature of which is supplied with current from the usual brushes 61 and the field of which is energized by current from the mains A and B, the main A being plus and the main B being minus. On the shaft 62 of the armature of this motor is a worm-wheel 63, engaging with and rotating the pinion 64. Protruding from the face of the pinion 64 are pins 65 to 74, inclusive.

75 and 76 are contact-springs normally separated, but capable of being brought into contact by any one of the pins 65 to 74 pressing against them as the pinion 64 is rotated.

I will now trace the circuits in the apparatus.

From the plus main A extends a wire C, which connects by branch D with the plus contact-plate 42 and by branch E with the plus contact-plate 44. From the minus main B extends a wire F, which connects by branch G with the minus contact-plate 43 and by branch H with the minus contact-plate 41. The brush 61 of the motor connects by wire I with contact-plate 50, which is supported by the shoe 48 on the under side of the arm 23. A similarly-supported block 49 connects by wire J with the other brush 61 of the motor and also by branch K to the spring contact-plate 75, which is in proximity to the pins on the pinion 64. The other contact-plate 76, similarly located, connects by wire L with one terminal of the electromagnet-coil 24. The other terminal of that coil connects by wire M with wire I.

I will now describe the operation of the entire apparatus.

When the parts are in the position shown in Fig. 1, it will be apparent that the contact-plates 75 and 76, adjacent to the pinion 64, are separated. Hence no current passes through the magnet-coil 24, which is thus deënergized. It will also be obvious that the contact-plates 49 and 50, carried by arm 23, are not in contact with either pair of plates 41 42 or 43 44, and hence no current goes to the motor, which is at rest. It will also be apparent that the dogs 55 and 56 engage with each side of the stop 8, and that the spiral spring 29 is forcing the head 27 outward against that stop. It is now desired to set the motor in operation, so that it will turn in a definite direction for a given length of time to produce some desired result, depending upon its direction and the time during which it operates. Assume the handle 30 to be moved to the left in the drawings, Fig. 1, or, in other words, into the position shown in dotted lines and over such an angle as that a line passing through the pivot-center will also pass through the middle of the next stop 9, secured on the inner side of the case. It will be obvious that when the handle is so displaced it will carry the curved contact-plates 43 and 44 underneath and into contact with the plates 49 and 50, carried by arm 23, thus establishing circuit from the mains A and B, through contact-plates 49 and 50, contact-plates 43 and 44, through the wires I and J, to the motor-brushes. The motor will then be set in operation, turning in a definite direction, and through the rotation of its shaft 62 and worm-wheel 63 it will also rotate the pinion 64 until a pin on said pinion—as, for example, 74—meets contact-plates 75 and 76 and forces them together, thus establishing circuit between said plates and the wires K and L. The effect of this establishment of circuit is to close circuit through the electromagnet 24, which, acting as a sucking-solenoid, draws in the plunger 25 against the action of the spring 29, thus removing the head 27 from contact with the stop 8 and holding it so removed from such contact as long as the current in the magnet is maintained. When, however, the pin on the pinion 64 shall have passed over the plates 75 and 76, they will spring apart again, thus breaking circuit through the magnet and allowing head 27 to be thrown violently outward by the action of the spiral spring 29. The combined momentum of the head, spindle, and plunger is sufficient to force the stop 8 back against the opposition of its springs 16, and thus release dogs 55 and 56 from engagement with the edges of said stop. It will be observed that when the arms 33 and 34 on the lever 31 are displaced to the position shown in dotted lines the spiral springs 35 and 36 thereon are also displaced and have a tendency to turn the hub 22 of the hollow arm 23 into such position as to bring that arm 23 again in line with the lever 31. This they can now do, because the dogs have been released from the stop. As the hollow arm 23 thus moves into its new position—namely, in line with the lever 31—the curved outer edge of dog 55 runs over the edge and face of the next stop 9, but the shoulder of the opposite

dog 56 engages with the edge of said stop and arrests any further motion of the arm 23. Both dogs then fall into the same position with respect to stop 9 as they are shown to have with respect to stop 8. At the end of each dog is a tooth 77, and the face of the head 27 is recessed on its under side 78. As the curved outer edge of dog 55 runs over the edge and face of stop 9 this tooth 77 bears against the recessed portion of head 27 and forces said head inwardly, thus bringing the face of the head in proper position in front of stop 9 and preventing the side of the head from meeting the edge of said stop. Meanwhile the arm 23, in moving in the manner described carries its contact-plates 49 and 50 off of the contact-plates 43 and 44, thus breaking circuit through and stopping the motor. It will be seen, therefore, that the effect of moving the lever 31 by handle 30 to the extent described is to set the motor in operation in a given direction, depending upon the polarity of plates 43 and 44, and to permit that motor to continue operating until one pin on the pinion 64 shall have temporarily closed and passed the spring contact-plates 75 and 76. Suppose now it be desired to have the motor operate twice as long while running in the same direction. Then the handle 30 is carried over so as to bring the lever in line with stop 10, for example, the next in succession. Then a similar action to that already stated will be repeated twice. If it be desired that the motor shall run a still longer period in the same direction, the handle 30 may be carried over to bring the lever into line with stop 11, and then the motor will run three times as long, and so on for each and every plate. Now, supposing that it be desired that the motor shall turn in the opposite direction, then instead of moving the handle 30 to the left, as above described, it is moved to the right, so bringing the curved plates 41 and 42 under contact-plates 49 and 50, carried by the arm 23, and as these contact-plates 41 and 42 are of reverse polarity to the plates 43 44 the motor turns in the opposite direction for a period of time, as already explained, depending upon how many contact-plates are passed over.

It will be observed that it is not necessary in order to cause a reversal of the moter to carry the handle 30 back to its central position, as represented in Fig. 1—that is, so that it will be opposite the stop 8—but that no matter from what position it may start, the motor always operates in the direction in which the lever is carried. The net result is complete control of the motor in accordance with the movement of the lever-handle. It will always run in a direction corresponding to the direction of motion of that handle and will run for a period of time corresponding to the angular extent of movement of that handle. It may also be observed, and this is an important point, that although the initial movement of the handle starts the motor the action of the motor in the direction and to the extent desired finally permits the arm 23 to assume its new position and locks it therein, so that, in other words, the movement of the handle indicates, so to speak, to the motor what work it has to do, and the motor after it has done that work places the controlling apparatus to show that it has done it and also prevents further movement of the controlling device.

Another point of importance is the locating of all the controlling apparatus, excepting the worm-wheel 63 and pinion 64, within the case 1 at the transmitting-station, and as the pinion 64 and associate parts are placed directly at the motor it will be seen that there is nothing between the controlling apparatus and the motor itself except the ordinary leading-wires and that the control of the motor is direct and not made through the interposition of translating devices which automatically throw in or out switches or resistances or work of that kind. The operation of the device therefore requires no skill, nor, in fact, need the operator know what the mechanism within the case 1 may be. All he has to do is to put the handle in one way or the other and as far over in either direction as he may desire, with the certainty that the motor will respond by turning in the desired direction for as long a period as may correspond to the extent of angular movement of the handle.

A device of this kind is susceptible to many useful applications, among which may be especially noted the control of the helm of a vessel, the training of guns from a distance, the turning of turrets on war-ships, the manipulation of signals of all kinds, whether on railways or elsewhere, from points distant therefrom, the governing of elevators or hoists, and, in brief, the control of electric motors under all conditions which it may be desirable to govern their time and direction of movement.

I claim—

1. The combination with an electric motor and a controlling device therefor, of a pivoted actuating-lever in said device, a pivoted arm normally not in circuit with said lever, a locking device retaining said arm in normal position, a retracting-spring between said arm and said lever, means controlled by the motor-armature for unlocking said arm and permitting its retraction by said spring, and circuit connections substantially as set forth; the aforesaid parts being constructed and arranged so that when said lever is moved in predetermined direction the line of tension of said retracting-spring on said arm shall be altered, and circuit shall be established between said lever and said arm and the motor-armature to cause said armature to rotate in corresponding direction, and thereafter at the end of a predetermined period said armature shall control said locking device to unlock the same and permit said arm to be retracted by its spring into position to break circuit with said lever, substantially as described.

2. The combination with an electric motor and a controlling device therefor, of a pivoted actuating-lever in said device, a pivoted arm normally not in circuit with said lever, a locking device on said arm, two fixed stops supported in position to be successively engaged by said locking device as said pivoted arm is turned on its pivot, a retracting-spring between said pivoted arm and said lever, means controlled by the motor-armature for unlocking said pivoted arm and permitting its retraction by said spring, and circuit connections substantially as set forth; the aforesaid parts being constructed and arranged so that when said lever is moved into line with a stop other than that one with which said pivoted arm is normally locked, circuit shall be established between said lever and said pivoted arm and the motor-armature to cause said armature to rotate in corresponding direction, and thereafter at the end of a predetermined period said armature shall control said locking device to unlock the same from the stop with which it is normally engaged, and permit said arm to be retracted by its spring to break circuit with said lever, and to allow said locking device to engage with said stop, substantially as described.

3. The combination with an electric motor and a controlling device, of a pivoted actuating-lever in said device, an arm concentrically pivoted therewith and movable independently thereof, a spring between said arm and said lever, a locking device for said arm, means for electrically governing said locking device controlled by said motor, and circuit connections substantially as set forth; whereby when said lever and said arm are parallel said arm being locked in place, circuit is broken between them and to the motor-armature, and when placed relatively at an angle circuit is closed through them and to said armature until by operation of said motor said locking device is released to allow said arm to be drawn by said spring again into parallelism with said lever, substantially as described.

4. The combination in a controlling device of a pivoted actuating-lever, an arm concentrically pivoted therewith and movable independently thereof, a spring between said arm and lever, a locking device for said arm, and circuit connections; whereby when said lever and arm are parallel, said arm being locked in place, circuit is broken between them, and when placed relatively at an angle circuit is closed, until said locking device is released to allow said arm to be drawn by said spring again into parallelism with said lever, substantially as described.

5. The combination in a controlling device of a pivoted actuating-lever, an arm concentrically pivoted therewith and movable independently thereof, a spring between said arm and lever, an electrically-governed locking device for said arm and circuit connections; whereby when said lever and arm are parallel, said arm being locked in place, circuit is broken between them, and when placed relatively at an angle circuit is closed until said locking device is released to allow said arm to be drawn by said spring again into parallelism with said lever, substantially as described.

6. The combination in a controlling device of the pivoted lever 31, concentrically-pivoted arm 23, contact-plates 49, 50 carried by said arm, contact-plates 41, 42 and arm 34 carried by said lever, and a spring 35 extending between said arm 34 and said arm 23, substantially as described.

7. The combination in a controlling device of the cylinder 1, the pivoted lever 31, concentrically-pivoted arm 23, stops 8, 9, 10, &c. supported within said cylinder, a locking device on the end of arm 23 constructed to engage with said stops 8, 9, 10, &c., contact-plates 49, 50 carried by arm 23, contact-plates 43, 44, and arm 34 carried by lever 31, and a spring 35 between said arm 23 and arm 34, substantially as described.

8. The combination in a controlling device with a spring-stop 8, of the hollow pivoted arm 23, electromagnet-coil 24 thereon, plunger 25 within said arm, head 27 connected to said plunger, retracting-spring 29, and pivoted spring-dogs 56 and 55 on the end of said arm 23 and constructed to engage with said stop 8; the aforesaid parts being constructed and arranged so that when said electromagnet is energized it retracts plunger 25 and when deëngerized allows said plunger to be retracted by said spring 29 to strike said stop 8 and move it out of engagement with said dogs, substantially as described.

9. The combination of the spring-stop 8, pivoted arm 23, brackets 53 and 54 on arm 23, dogs 56 and 55 pivoted in said brackets and having their outer faces curved and their ends shouldered, and a spring 59 connecting said dogs, substantially as described.

10. The combination of an electric motor, a circuit-breaker in the armature-circuit thereof, an electromagnet controlling said circuit-breaker, and means actuated by said motor to energize said magnet and so actuate said circuit-breaker to open the armature-circuit after the motor shall have operated for a predetermined period, substantially as described.

11. The combination with an electric motor and a controlling device therefor, the said device containing a means for establishing current on the motor-armature, a circuit-breaker for interrupting said current, and an electromagnet controlling said circuit-breaker, of means governing said electromagnet and actuated by said motor after said motor shall have operated for a predetermined period, substantially as described.

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