T. BARNARD.

CONTROLLING DEVICE FOR ELECTRIC MOTORS.

APPLICATION FILED MAR. 3, 1910.

1,002,484. **Patented Sept. 5, 1911.**

3 SHEETS—SHEET 1.

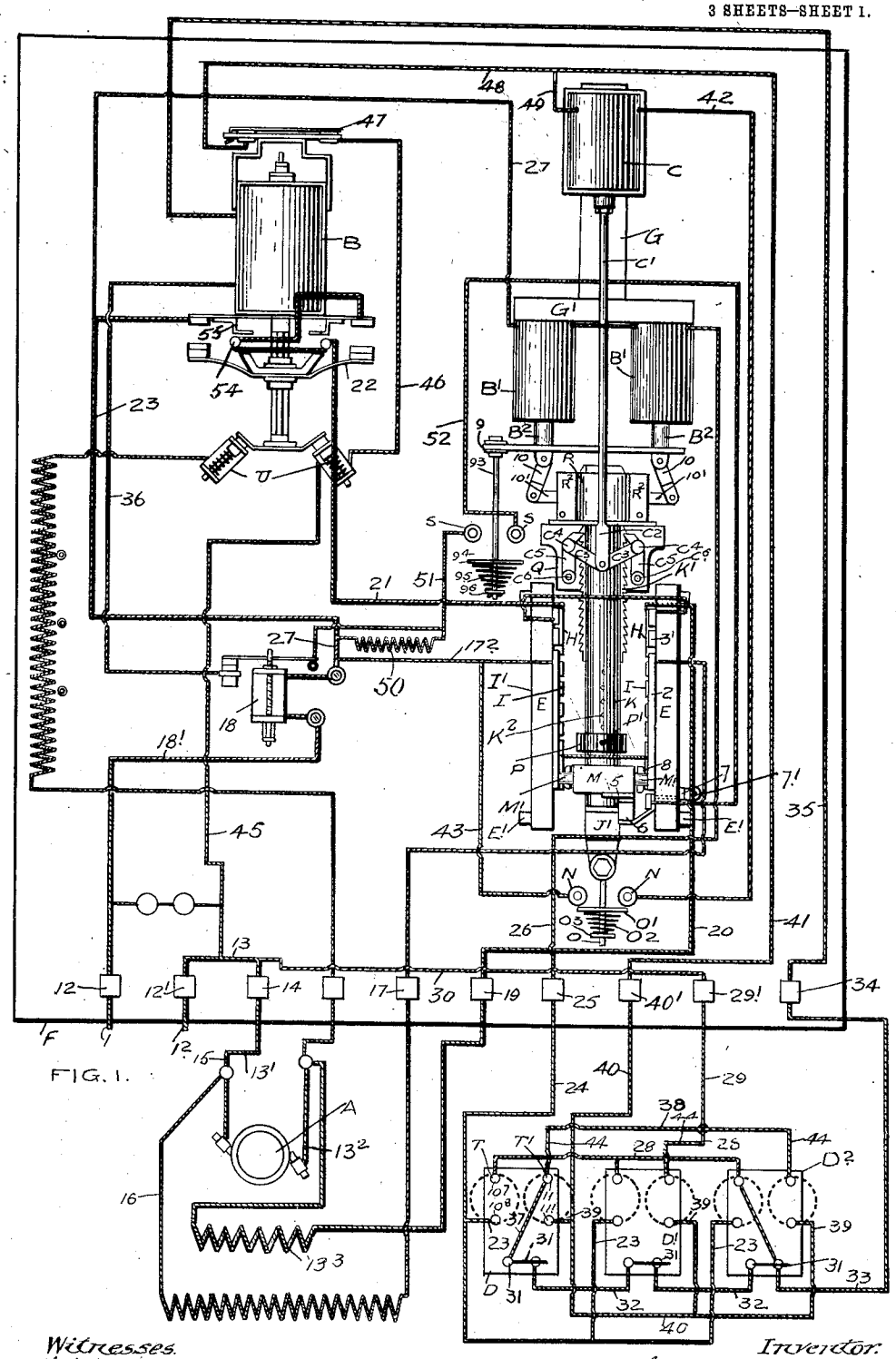

FIG. 1.

Witnesses.
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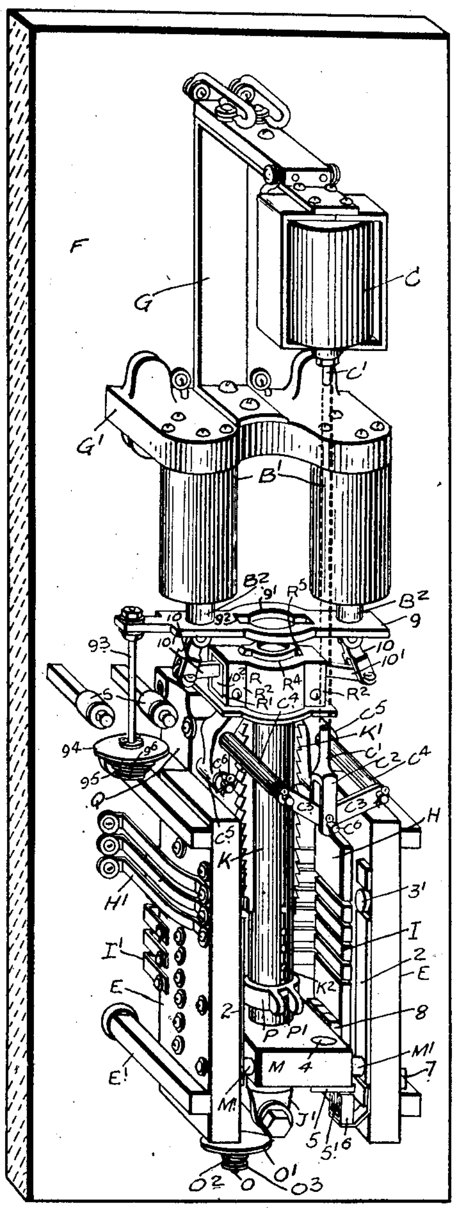

FIG. 2.

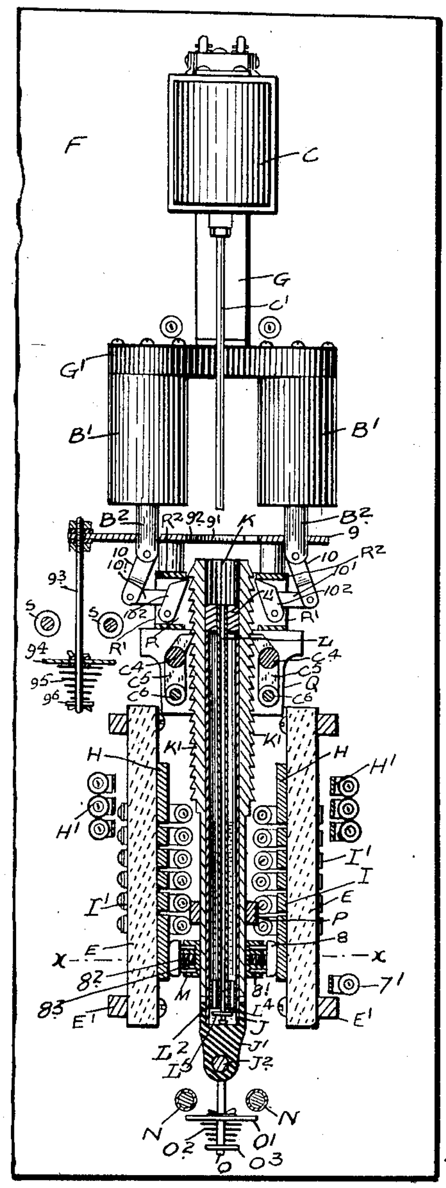

FIG. 3.

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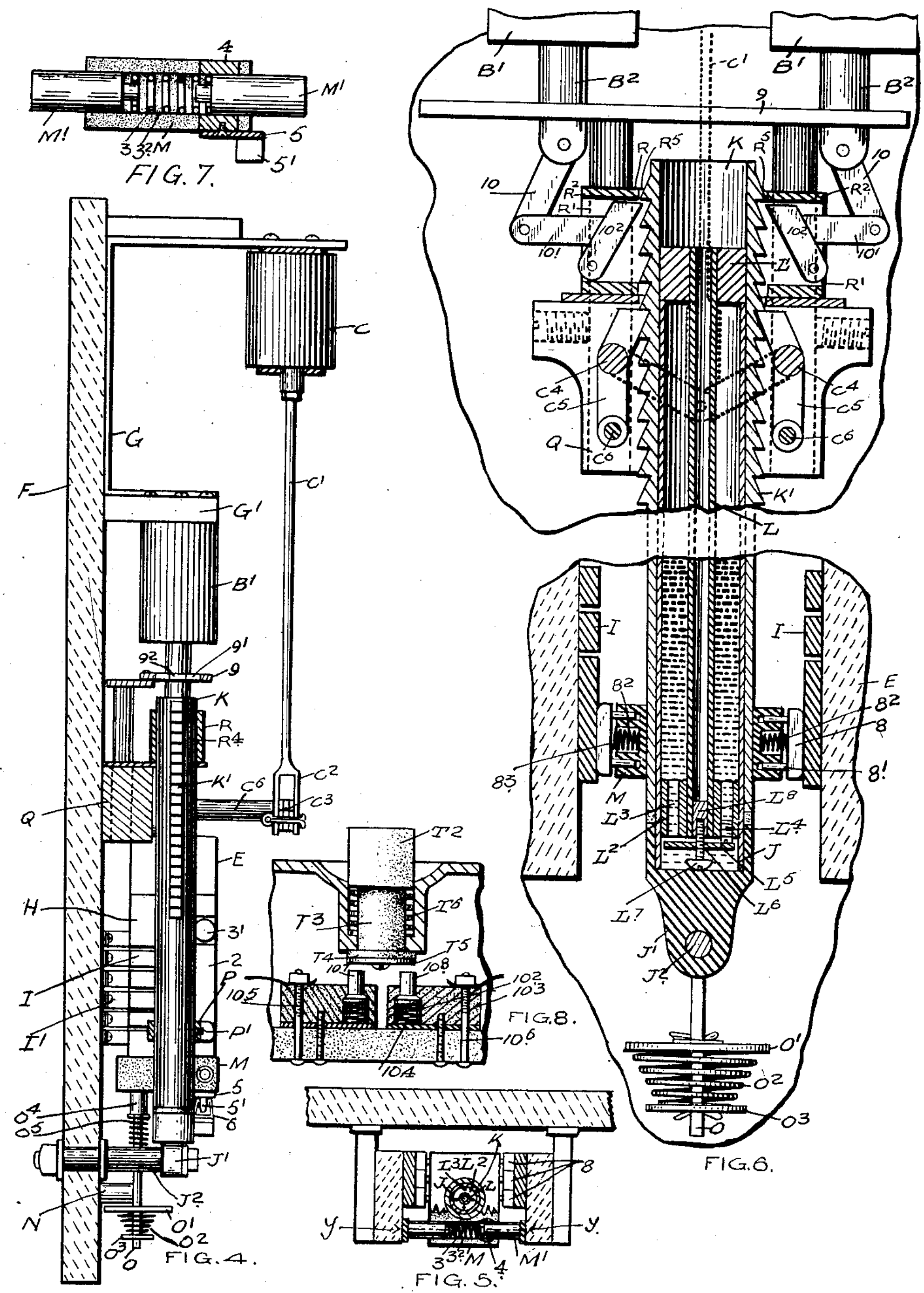

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CONTROLLING DEVICE FOR ELECTRIC MOTORS.

1,002,484. Specification of Letters Patent. Patented Sept. 5, 1911.

Application filed March 3, 1910. Serial No. 547,136.

To all whom it may concern:

Be it known that I, THOMAS BARNARD, of the city of Toronto, in the county of York, in the Province of Ontario, Canada, have invented certain new and useful Improvements in Controlling Devices for Electric Motors, of which the following is the specification.

My invention relates to improvements in controlling devices for electric motors adapted particularly to such machines as printing presses and the like, and other machines in which various speeds are required, and the object of the invention is to devise a form of control in which there will be no liability of the main fuses of the circuit being blown through the instrumentality of the operation of the controlling device.

A further object is to avoid the movement of a sneak current in the main solenoid of the controlling device to hold it raised ready for operation and consequently obviate the liability of rendering the device inoperative by accident to the sneak current circuit as formerly, and especially do away with the continuous waste of current now commonly incident to controllers of this class where the press or machine is standing idle.

A still further object is to provide a construction of panel, which will adapt itself to producing very fine variations in speeds and thus serve to obviate the breaking of the webs of paper in a printing or lithographing press, in short produce such a speed as is commensurate with the proper execution of various classes of work and press work particularly.

Another object is to so construct the device as to operate under a minimum amount of current.

A yet further object is to prevent any liability of the device operating accidentally, the full current being thrown in immediately, and the consequent liability of the press machine attaining full speed instantaneously and the liability of breakage to the machine incident thereto.

A yet further object is to so construct the device that the motor not only starts at the slowest speed but gradually increases to full speed according to the number of operations of the "on" or controlling button, and thereby obviate the motor attaining full speed should a ground circuit develop on the controlling circuit and the attendant danger to life resulting therefrom.

To effect these and other objects and advantages in this class of machine I have constructed my controlling device in the manner, which I shall herein particularly describe.

Figure 1 is a diagrammatic view of my controlling device and the wiring in connection therewith. Fig. 2, is a perspective view of the controlling device complete. Fig. 3, is a front elevation showing the panels and plunger and co-acting parts mostly in section. Fig. 4, is a sectional side elevation. Fig. 5, is a sectional plan on the line *x—x* Fig. 3. Fig. 6, is an enlarged sectional detail of the plunger and portion of the panel in section looking from the front and intermediately broken away. Fig. 7, is an enlarged sectional elevation on the line *y—y* Fig. 5. Fig. 8, is a detail of the contacts of one of the buttons shown in Fig. 1.

In the drawings like letters of reference indicate corresponding parts in each figure.

I shall first describe the construction of the controller proper, and co-acting parts which are common to this class of controller, and then the general scheme of wiring.

A is the motor, B the main solenoid.

B′ B′ are the "on" solenoids, and C the "off" solenoid.

D D′ and D² are the push button stations.

E E are the panels of the controller, which are preferably formed of marble or other suitable insulating material, and are supported on rods E′ extending outwardly from the panels.

The "on" solenoid and "off" solenoid, panels, and co-acting parts are all supported on a board F. The "off" solenoid is supported on the board F by means of a bracket G. The "on" solenoids B′ B′ are supported on a bracket G′ below the bracket G.

H are the armature resistance contact plates located opposite to each other on the opposite panels E E.

I are the field resistance contact plates located opposite each other on the panels E E and comprising a series on each panel.

J is a tube held at the bottom in the socket J′, which is supported on the panel by a pin J² extending therethrough.

K is a hollow plunger provided with

ratchet-shaped racks K′ at each side. The plunger K fits the tube J.

L is a central tube provided at the top with a collar L′, which normally abuts the outer end of the tube J and is secured to the interior of the plunger K.

L^2 is a collar secured to the central tube L fitting the tube J and provided with a plurality of vertical orifices L^3 extending around the same.

L^4 is a set screw, which fits one of the orifices.

L^5 is a disk, which has a central orifice L^6 through which extends a set screw L^7 into a plug L^8 at the bottom of the tube L by means of which the disk L^5 is limited as to its movement. The set screw L^4 serves to limit the upward movement of the disk L^5. The tube J is partially filled with oil. It will now be seen that when the plunger is given an upward movement step-by-step as hereinafter explained that the oil will pass through the orifices L^3 in the collar L^2 down below the collar and disk L^5. When the plunger K is released at the limit of its upward movement the oil will prevent it dropping too rapidly, the rapidity of the drop being determined by the distance that the disk L^5 is away from the bottom of the collar L^2 as determined by the position of the set screw L^4.

M is an insulating block secured to the plunger K and provided at the front with spring-pressed plungers M′, one at each side, which are designed to come in contact with the field contact plates 2 3′ on the panels H. The plungers are held against the plates 2 3′ preferably by the spiral spring 3 extending between the ends of the plungers in the socket 3^2 in which they are located (see Figs. 5 and 7). One plunger extends through a metal block 4 to which is fastened a plate 5 (see Fig. 7) having a depending tongue 5′, which in the normal position shown in Fig. 2 extends between a jaw 6 fastened to the bottom of the panel at one side and connected by a pin to a finger 7 at the opposite side of the panel secured to a binding post 7′.

8 is one of a series of brushes located one on each side of the plunger K and having guiding pins 8′ fitting into corresponding sockets in the insulating block M.

8^2 are spiral springs located in sockets 8^3 and securely pressing against the plates 8, so as to hold them in contact with the contact plates on the panel at each side.

I preferably use three contact plates and their co-acting parts such contact plates being designed to co-act with the field and armature contact plates I and H respectively.

N are cylindrical contacts extending outwardly from the board below the socket J′.

O is a vertically disposed pin extending through the pin J^2 the hole in which forms a guide for the pin O. The lower part of the pin O holds a disk plate O′ designed to be brought into contact with the cylindrical contacts N. The disk O′ is resiliently held in position by a helical spring O^2 extending between the plate O′ and a similar disk O^3.

The top of the rod O is provided with a cap O^4 between which and the pin J^2 extends a spiral spring O^5.

In the normal position the contact plate O′ is held away from the contacts N N by means of the block M pressing against the top of the rod O.

P is a collar through which the plunger K extends and P′ is a set screw, which extends through the front of the collar into one or other of the holes K^2 in the plunger K. The collar P serves to limit the upward movement of the plunger, the collar being designed to abut the bottom of the block Q when it has reached the limit of its upward stroke. By such a collar I am enabled to limit the maximum speed of the motor as will hereinafter appear.

In order to provide for the upward movement of the plunger and the contacts 8 in relation to the armature contact plates I provide the following mechanism in connection with the plungers B^2 of the "on" solenoids B′. 9 is a plate secured to the lower ends of the solenoid B^2 and provided with a central orifice 9′ having laterally extending indentures 9^2 to permit of the passage of the racks K′ of the plunger K.

10 10 are links pivotally connected to the lower ends of the plungers B^2 B^2, and 10′ are supplemental links pivotally connected at the outer ends to the lower ends of the links 10. 10^2 are pawls pivoted in slots R′ oppositely located and made in the outwardly projecting wings R^2 of the sleeve R. The sleeve R has an orifice R^4 having lateral extensions R^5 in order to permit of the ready movement of the racks K′ of the plunger K therethrough.

Upon the "on" button being operated so as to intermittently throw the current through the "on" solenoid B′ the plunger K by means of the pawls 10^2 is given a step-by-step movement only limited by the collar P hereinbefore referred to. This step-by-step movement serves to increase the speed of the motor through the circuit hereinafter described.

9^3 is a rod suitably held in the end of the plate 9 and provided with a disk contact plate 9^4 and a spiral spring 9^5 underneath the same and held in position by a second minor plate 9^6.

It will be seen that the plate 9^4 is resiliently supported. Such plate is designed to come in contact with cylindrical contact ter-

minals S S secured to the board and connected to the electric source of supply as hereinafter described.

C′ is the plunger rod of the "off" solenoid. The plunger rod C′ has located at the lower end a jaw C^2 in the bottom of which are pivoted the links C^3, which are connected at the outer end to one end of the rod C^4, the inner ends of which are secured in pawls C^5, which are pivoted on pins C^6 on the block Q. It will now be seen that when the current is thrown on to the "off" solenoid, so as to raise the rod C′, such rod will immediately disturb the holding pawls C^5 from contact with the ratchet racks K′ of the plunger K and allow the plunger to drop of its own gravity into the off position.

In each push button station the "on" and "off" push buttons are arranged to make contact as shown in Figs. 1 and 8.

T and T′ are the "on" and "off" push buttons of each station shown by dotted line circles in Fig. 1 on the left hand station D. Each button T co-acts with contacts 10^7 and 10^8 and each button T′ co-acts with contacts 11 and 11′. Each button is formed as shown in Fig. 8 and consists of a cylindrical portion T^2, an inner washer T^4 all of insulating material and a metal washer T^5 secured in position on the insulating washer T^4. A spiral spring T^6 surrounds the reduced portion and normally forces the button outwardly in the usual manner.

I shall refer in describing the push buttons of the stations to the plunger contacts 10^7 and 10^8 of the "on" button T. The plunger contacts are held at the top of the recess 10^2 in the block 10^3 by spiral springs 10^4. 10^5 10^6 are binding posts of the blocks 10^3.

Having now described the principal parts of my controller I shall now describe the wiring and the remaining co-acting parts which co-act with the controller to effect the objects I have in view.

12 and 12′ are the line terminals. When the current is turned to the board the shunt field of the motor is the only circuit that is closed, the armature circuit being open at the main solenoid switch and remaining so until that switch is closed by the operating mechanism.

The shunt field circuit is as follows: 13 is the wire leading from the right hand line terminal to the armature and shunt terminal 14. 15 and 16 are wires leading to the shunt field terminal 17 from which it extends to the right hand field contact I and the terminal plates I′ and contact plates I thereof through the contacts 8 on the cross head to the contact plates I on the opposite panel E and connecting terminals I′ thereof, thence by the wire 18′ to the left hand line terminal.

The armature circuit extends from the right hand line terminal 12′ along the wire 13 to the armature shunt terminal 14 along the wire 13′ to and through the armatures of the motor A by the wire 13^2 through the series field 13^3 to the series field terminal 19, thence by the wire 20 to the terminal contacting plates H′ connected to the armature contacts H of the right hand panel E through the contacts 8 and cross head, to the resistance contact H on the left hand panel E, thence by the terminal strips H′ and wire 21 through the blow-outs 22 and main switch B back by the wire 23 to and through the circuit breaker 18 and the wire 18′ to the left hand terminal 12.

Dynamic brake contacts U are placed on the main switch solenoid, which close the armature circuit through a dynamic brake resistance contact, thus assuring a quick stop, although the same is adjustable from an easy to a sudden stop according to the work, which demands it.

The traveling cross head carrying the contacts 8 performs the following function. From the circuits hereinbefore described it will be understood that every time the "on" button is pressed the cross head is raised up a step from the bottom, which is the starting position. The armature resistance is cut out step-by-step until the normal speed is obtained, and then the full resistance is inserted in the shunt field circuit until a maximum speed is attained.

The "on" push button circuits are as follows: When any or all of the push buttons are connecting the contacts 10^7 and 10^8 at any or all of the stations D D′ and D^2 the circuit is completed through the wires 23 and 24 "on" terminal 25 wire 26 "on" solenoids B′ wire 27 circuit breaker 18 wire 18′ to the line terminal 12 and by wires 28 wire 29 board terminal 29′ and wire 30 wire 13 and line terminal 12′.

31 are the run buttons or switches of each station. When all the run buttons or switches are in circuit the current passes in series through the run button 31 of each station by the wires 32 and out by the wires 33 to the stop terminal 34 wire 35 main solenoid B wire 36 circuit breaker 18 wire 18′ and left hand terminal 12 wire 37 in the station D wire 38 wire 29 terminal 29′ and wires 30 and 13 to the right hand terminal 12′.

The "off" button circuits of each station are as follows: The multiple branch wires 39 from each station extend from wire 40 to terminal 40′ wire 41 "off" solenoid C wire 42 contacts N and disk contact O wire 43 wire 17^2 circuit breaker 18 to the left hand terminal 12 and from the contact 11 over the branch wire 44 wires 38 29 terminal 29′ and wire 30 to the right hand terminal.

The automatic cut-off circuit is as follows: From the line terminal 12′ wire 13 wire 45 wire 46 switch 47 wire 48 wire 49 "off" solenoid C wire 42 contacts N and O wire 43 wire 17^2 circuit-breaker 18 wire 18′ to the left hand line terminal.

50 is a resistance tube by which the current passing through the main solenoid B is weakened except when the mechanism is in the off position. Such tube is then short circuited by contacts S and disks 9^4 in order to prevent the solenoid picking up except when the mechanism is in the off position.

The by-path, which short circuits the resistance tube from the main switch solenoid is as follows: wire 51 contacts 9^4 and S wire 52 jaw 6 at the bottom of the right hand panel contact 5 knife 5′ contacts M′ contact plate 2 on the left hand panel, wire 17^2, wire 27 to the other terminal of the resistance tube.

The above circuits are all the circuits directly connected with my invention and are the operating circuits.

To start the motor the line switch, not shown, is closed and the shunt field hereinbefore described being the only completed circuit takes current and magnetizes the field of the motor. I now see that all my line buttons or switches 31 are closed. I then press the "on" button T of any station, which throws in the "on" button circuit hereinbefore described energizing the solenoids B′, thereby closing the contacts 9^4 and S, thus short-circuiting the resistance tube 50, thus allowing the current passing over the circuit into the main switch B to reach the maximum strength, thus effectually closing the armature circuit hereinbefore described by means of the solenoid contacts 55 and 54 shown in Fig. 1, but not hereinbefore particularly referred to as they form no feature of my invention. This closing of the armature circuit puts the motor on the first or slowest speed. Upon each succeeding pressure of the "on" button T the resistance, which is at a maximum when the cross head carrying the contacts 8 and M′ is at the lowest point in reference to the contact plates I and 2 on the panels E the resistance is gradually step-by-step cut out until the motor reaches the normal speed.

The maximum speed, which it is desired that the motor should be run at may be regulated by the collar P on the plunger K hereinbefore referred to.

As the cross head is caused by the repeated pressure of the push button T to ascend, the field resistance plates are contacted by the plungers M′ completing the field circuit and the contacts 8 are simultaneously contacting with the armature resistance plates I. The field on the motor is at the full strength until the contacts M′ leave the contact plates 2 and thus resistance is exerted in the field circuit, thereby weakening the field and thus allowing the speed to increase to a maximum. The armature resistance is necessarily at the same time cut out step-by-step until the contacts 8 rise to the top plate I on the panels E and the normal speed is reached.

When the armature resistance is cut out the field resistance is cut in when the contacts M′ pass from the field contact plate 2 to the field contact plates 3′, thus weakening the field and increasing the speed of the motor.

To slow down the motor it is necessary to press the "off" buttons V at any of the stations, which completes the circuit hereinbefore described through the solenoid C and releases the pawls 10 from the racks K′ allowing the plunger K to drop of its own gravity, the concussion of such drop being relieved by the peculiar construction of the tube L and oil valves therein hereinbefore described.

To stop the motor all it is necessary to do is to throw out the "run" button or switch 31 when the circuit is thrown out of the main solenoid B and the motor is stopped. I may mention, however, that the motor may, of course, be stopped without slowing down as hereinbefore described when throwing out the run push button or switch.

From this description it will be seen that I have produced a controller, which is operated by the push buttons against gravity, so as to start, and thereby insures a safe means, whereby the speed may be gradually increased without any liability of the motor reaching full speed through accident.

I have also as will be readily seen produced a controller in which gravity assists in shutting off the motor instantaneously should accident occur, and thereby there is no liability of any breakage in the machine, which is run by a motor through any fault of the controller as constructed in accordance with my invention.

It will also be understood that by my invention it is not necessary to utilize any sneak current in order to keep the plunger in the off-position, which is a serious defect in other controllers of which I am aware and is, as will be readily understood, a continuance of electric energy when the motor is stopped.

What I claim as my invention is:

1. A controlling device for motors comprising a pair of panels, field and armature contacts located at the inside of the panels and resistances connected thereto, a vertically adjustable plunger suitably supported at the bottom, contacts secured thereto and

designed to co-act directly with both the field and armature resistance contacts, solenoids, and means connected to the solenoid plungers for raising the main plunger, and a solenoid and means connected to this solenoid for releasing the main plunger to allow it to drop by gravity and to stop it at any desired position, and suitable connections and switches for the solenoids and a dash pot cushion at the bottom of the plunger so arranged as to insure the plunger to descend gradually when it is released, as and for the purpose specified.

2. A controlling device for motors comprising a pair of panels, field and armature contacts located at the inside of the panels and resistances connected thereto, a vertically adjustable plunger suitably supported at the bottom, contacts secured thereto and designed to co-act with the field and armature resistance contacts, solenoids and means connected to the solenoid plungers for raising the main plunger, and a solenoid and means connected to the solenoid plunger for releasing the main plunger to allow it to drop by gravity, and suitable connections and switches for the solenoids, and a stop adjustably secured on the main plunger designed to limit its upward movement as and for the purpose specified.

3. A controlling device for motors comprising a pair of panels, field and armature contacts located at the inside of the panels and resistances connected thereto, a vertically adjustable plunger suitably supported at the bottom, and provided with a row of recesses, contacts secured thereto and designed to co-act with the field and armature resistance contacts, solenoids, and means connected to the solenoids, plungers for raising the main plunger, and a solenoid, and means connected to the solenoid plunger for releasing the main plunger to allow it to drop by gravity, and suitable connections and switches for the solenoids, and a collar located on the main plunger and provided with a set screw designed to enter one of the alined recesses in the plunger as and for the purpose specified.

4. In a controlling device for motors, the combination with a pair of panels, field and armature contacts located at the inside of the panels and resistances connected thereto, a vertically adjustable plunger provided with co-acting contacts and suitably supported at the bottom and provided with ratchet racks, of the solenoids, the sleeve through which the main plunger extends provided with hollow wings, pawls pivoted in the wings and designed to engage in the racks, and the links pivotally connected to the lower ends of the solenoid plungers and the supplemental links pivotally connected to the end of the aforesaid links and contacting with the pawls as and for the purpose specified.

5. The combination with the panels and the opposing field and armature resistance contacts thereon, of the vertically adjustable plunger provided with co-acting contacts, and means for supporting the plunger in the down position, electrical means for raising the plunger step-by-step, electrical means for releasing the plunger and means for cushioning the plunger in its descent as and for the purpose specified.

6. In a controlling device such as described, the panels a supporting socket located between the panels, a tube extending upwardly therefrom and designed to contain liquid, a plunger telescopically fitting the tube, an inner tube provided at the upper end with a solid collar, and at the lower end with a collar having orifices therethrough and fitting the tube aforesaid, a set screw fitting one of the orifices and a disk provided with a central adjusting screw as and for the purpose specified.

7. The combination with the panels suitably supported and the field and resistance contacts and resistances connected thereto, of the vertically adjustable plunger and co-acting contact carried thereby, the solenoids for raising the plunger, the cross-bar carried by the solenoids, the plungers, depending stem secured thereto and carrying at the lower end a suitable contact, and a pair of contacts in the resistance tube circuit against which the contact on the stem is designed to be brought upon the raising of the plunger of the solenoid as and for the purpose specified.

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