No. 868,381. PATENTED OCT. 15, 1907.

H. E. WHITE.

MOTOR CONTROL SYSTEM.

APPLICATION FILED FEB. 27, 1906.

Fig. 1.

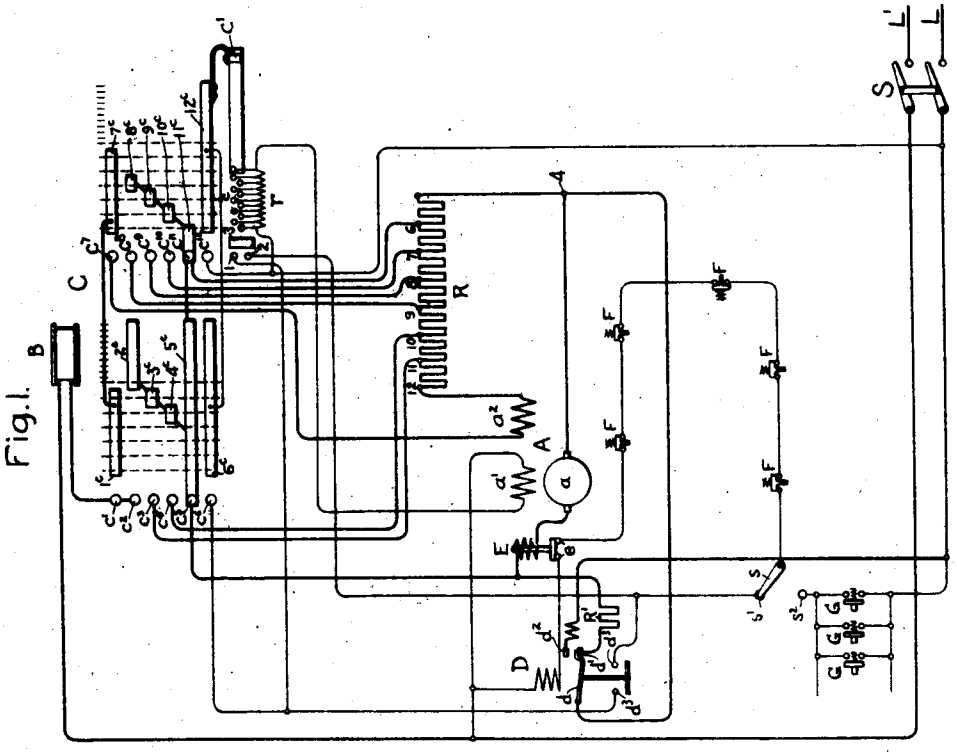


Fig. 2.

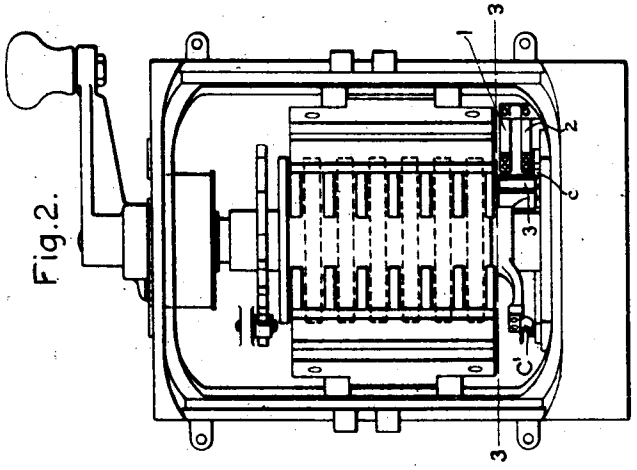
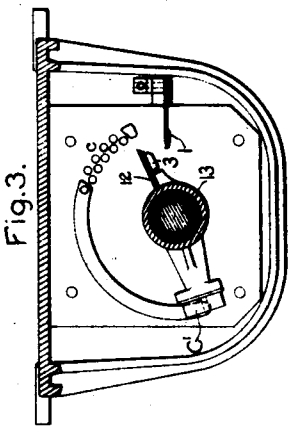


Fig. 3.



Witnesses:
Irving E. Steers.
Helen Orford

Inventor:
Harold E. White.
by Albert G. Davis
Atty.

UNITED STATES PATENT OFFICE.

HAROLD E. WHITE, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

MOTOR-CONTROL SYSTEM.

No. 868,381. Specification of Letters Patent. Patented Oct. 15, 1907.

Application filed February 27, 1906. Serial No. 303,218.

To all whom it may concern:

Be it known that I, HAROLD E. WHITE, a citizen of the United States, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Motor-Control Systems, of which the following is a specification.

The present invention relates to means for controlling electric motors and particularly motors adapted to operate printing presses, or other machines which it may be desired to start and stop quickly from a plurality of points and to operate slowly under the control of the operator while near the machine and at a distance from the main controller.

The present invention has for its object an improved control apparatus of the character specified and to this end comprises the novel construction and arrangement of parts to be hereinafter described and particularly pointed out in the claims.

In the accompanying drawing, Figure 1 indicates diagrammatically a complete control system arranged in accordance with the present invention; Fig. 2 is a side elevation of the main controller having its inclosing casing removed; and Fig. 3 is a section taken on line 3, 3, of Fig. 2.

Referring to the drawings, A represents a motor having an armature a, a shunt field winding a^1, and a series field winding a^2.

L and L^1 indicate a source of current supply.

R is a resistance across variable portions of which the motor armature is adapted to be connected in starting.

r is a variable resistance in the shunt field, and R^1 is a braking resistance.

C is a controller adapted to connect the motor to the source of supply in proper relation to the resistance R and r.

D is a relay governed by the controller C and serving to make and interrupt the armature circuit and to short-circuit the motor armature through braking resistance R^1.

E is an overload relay, and F, F, F, are normally closed push buttons in series with the contacts e of the overload relay and the actuating coil of the relay D.

The controller is illustrated as comprising two sets of fixed contacts c^1 to c^6 and c^7 to c^{12}, and two sets of movable contacts 1^c to 6^c, and 7^c to 12^c; together with a series of stationary contacts c connected to the resistance r and a movable brush C^1 electrically connected to the contact segments 6^c and 12^c for coöperating with the stationary contacts c. Additional contact fingers, 1 and 2, coöperating with a movable contact piece 3, are provided for controlling the relay D.

When the controller is in its "off" position, as illustrated, the contact segments 5^c and 11^c engage, respectively, with contact fingers c^5 and c^{11}, so that a circuit may be traced from the right-hand terminal of the motor armature, through one section of resistance R, through contacts c^{11}, 11^c, 5^c, and c^5, to the left-hand terminal of the motor armature, and another circuit through contacts d and d^1 of the relay and resistance R^1. Upon closing switch S, current flows from line L, through resistance r, through the shunt field winding, back to line L^1. Thus, if the motor is in operation and the controller is returned to the "off" position, the armature is short-circuited upon itself and produces a dynamic braking action. In moving to the first running position, engagement is made between contacts 1 and 2 and contact 3, as will hereinafter be described, and during this period of contact, current flows from line L^1, through the actuating coil of relay D, through the contacts e of the overload relay, through the push buttons F, through contacts s and s^1, through controller contacts 2, 3 and 1, contacts c^6, 6^c, 12^c and c^{12}, to line L. This energizes the relay D and the contact member d is lifted into engagement with the fixed contact d^2. At the same time auxiliary contacts d^3 are closed and a maintaining circuit is established through these auxiliary contacts of the relay D independently of the contacts 1, 2 and 3 of the controller. Therefore, when the controller has fully reached its first running position the contact 3 may leave contacts 1 and 2 without causing the relay D to drop. With the relay energized, a circuit may be traced from line L through the contacts d^2 and d of the relay, to point 4, from which one branch passes through the resistance R, to series field coil a^2, contacts c^7, 7^c, 1^c and c^1, through blow-out coil B, to line L^1. A second branch from point 4, passes through the motor armature, through the coil of the overload relay, through contacts c^5, 5^c, 11^c and c^{11}, to point 6 on resistance R. Thus it will be seen that the motor armature is connected in parallel with a portion of the resistance. In the second position of the controller, the circuits remain the same, except that the armature circuit, after reaching contact c^{11}, flows through contacts 10^c and c^{10} to point 7 on the resistance; the armature being now shunted across an increased resistance. In the same way, in succeeding positions, including the fifth running position, the connection with one motor terminal and the resistance passes successively through points 8, 9, 10 and 11. Segment 1^c reaches only through the fifth position so that in the sixth position, and thereafter, current flows directly from line L, through the contacts of the relay D, through the motor armature, through contacts c^5, 5^c, 2^c and c^2, through blow-out coil B, to line L^1, the resistance R and the series field winding being entirely eliminated. The motor is now connected to the line as a shunt motor and further increase in speed may be obtained by continuing the rotation of the controller so that the brush C^1 sweeps

over the contacts c of the field rheostat cutting resistance into the shunt field and thus weakening it. Thus, in starting, a very strong field is provided, enabling the motor to readily start under load.

In order to stop the motor from a point adjacent to the machine and at a distance from the controller, one of the buttons F may be pressed, interrupting the circuit of the coil of the relay D and causing the contact member *d* to drop. The motor armature is thus short-circuited while the shunt field is still excited, and the motor operates as a braking generator, bringing the machine to rest smoothly. After the relay has once dropped it cannot be again energized until the controller is returned to the "off" position, in order to enable the contact 3 to again engage contacts 1 and 2 and thus complete the actuating circuit for the relay. By this means it becomes impossible for the motor to be stopped through the operation of one of the push buttons and then inadvisably permitted to start up again without sufficient resistance protection.

It is sometimes desirable to be able to operate a machine, such as a printing press, through small steps while adjusting the paper or testing the machine, without requiring the operator to use the main controller which may be inconveniently situated for this purpose. Therefore I have provided an additional circuit for the actuating coil of the relay whereby, when the switch arm *s* is brought into engagement with contact s^2, current may flow from line L^1, through the actuating coil of the relay D, through switch members *s* and s^2, through any one of a number of normally open push buttons G, G, G, arranged in parallel, to line L. The push buttons G, G, G, are arranged about the machine at points from which it may be convenient to control the motor to operate the machine intermittently. In adjusting the paper, or when it is desired to otherwise run the machine slowly and intermittently while the operator is watching it, the switch-arm *s* is moved into engagement with contact s^2, the main controller is then moved to a position giving the proper speed for such operation, and the nearest one of the push buttons G, G, G, is pressed and held down as long as it is desired to have the machine run, whereupon the push button is released and the machine immediately comes to rest. This operation may of course be repeated indefinitely. When the machine is ready to be set in continuous operation, the switch-arm *s* is moved into engagement with contact s^1 and the controller must then be returned to its "off" position in order to energize the relay *d*. The motor is then controlled in the usual way from the main controller.

In Figs. 2 and 3 I have illustrated the contacts 1, 2 and 3; 1 and 2 comprising spring fingers fixed in position within the controller, and the contact 3 being an elongated strip adapted to bridge the fingers 1 and 2 and carried upon a block of insulation 12, suitably mounted upon the controller shaft 13. In Fig. 3 the parts are shown in the "off" position. When the shaft 13 is turned in a clockwise direction contact 3 comes into engagement with the fingers 1 and 2 and deflects the outer ends thereof until finally, when the controller is in its first running position, the fingers snap past the edge of the contact 3 and the electrical connection between them is interrupted. Upon returning the controller to its "off" position the block of insulation 12 strikes the ends of the fingers and they are deflected in the reverse direction until just before the "off" position is reached they are released and resume their normal positions. During this operation, however, the fingers do not come into engagement with the contact piece 3, so that the relay-actuating circuit is not completed except during the rotation of the controller from the "off" position toward the first running position.

It will now be seen that the present invention provides means whereby an electrically-operated machine may be started easily and brought to rest quickly and smoothly, together with a safe and convenient system of auxiliary control whereby the machine may be stopped in case of emergency or otherwise and operated intermittently without making it necessary for the operator to manipulate the main controller.

What I claim as new and desire to secure by Letters Patent of the United States, is,—

1. In a system of control, a motor, a controller for said motor, a switch in the motor circuit, electromagnetic-controlling means for said switch, a control circuit extending from said controller, a second control circuit provided with one or more normally-open switches, and means for connecting said electromagnetic-controlling means in either of said control circuits and disconnecting it from the other control circuit.

2. In a system of control, a motor, a controller for said motor, a switch in the motor circuit, an electromagnet controlling said switch, one or more normally-closed switches in series with said electromagnet, a control circuit extending from said controller, a second control circuit provided with one or more normally-open switches, and means for connecting said electromagnet and said normally-closed switches in either of said control circuits and disconnecting them from the other control circuit.

3. In a system of control, a motor, a controller for said motor, a normally-open switch in the motor circuit, an electromagnet adapted to close said switch when energized, one or more normally-closed switches in series with said electromagnet, a control circuit governed by said controller, a second control circuit having a plurality of normally-open switches arranged therein in parallel with each other, and a switch arranged to connect said electromagnet and said normally-closed switches in either of said control circuits and disconnect them from the other control circuit.

4. In a system of control, a motor, a controller, a two-position switch in the motor circuit and coöperating with the controller to connect the motor to a source of current supply in one of its positions and to short-circuit the motor armature in its other position, electromagnetic actuating means for said switch, a control circuit governed by said controller, a second control circuit provided with a plurality of switches, and means for connecting said actuating means in either control circuit and disconnecting it from the other control circuit.

5. In a system of control, a motor, a controller having "off" and running positions, a switch in the motor circuit, electromagnetic-controlling means for said switch, a control circuit for energizing said controlling means, contacts in the controller adapted to complete said control circuit in turning the controller from the "off" position to the first running position, means associated with said switch controlling-means for completing a maintaining circuit for itself independent of the controller contacts, and one or more normally-closed switches in said maintaining circuit for deënergizing said controlling means.

6. In a system of control, a motor, a controller having "off" and running positions, a switch in the motor circuit, electromagnetic-actuating means for said switch, one or more switches for deënergizing said actuating means, a control circuit and contacts therein adapted to be closed in moving the controller from the "off" position to the first running position, means associated with said actuat-

ing means for completing a maintaining circuit independent of said circuits, a second control circuit provided with one or more switches, and means for connecting said actuating means in either control circuit and disconnecting it from the other control circuit.

7. In combination, a source of current supply, a motor having an armature and a shunt field winding, a main resistance, a field resistance, and means for connecting said main resistance to the source of supply with the motor armature in shunt to variable portions thereof and then connecting the armature directly to said source of supply and inserting resistance in the shunt field.

8. In combination, a source of current supply, a motor having a series field winding and a shunt field winding, a resistance, and means for connecting said series field winding to said source of supply in series with said resistance with the motor armature in shunt to variable portions of said resistance and then cutting out the resistance and series field and connecting the armature directly to the source of supply.

9. In combination, a source of current supply, a motor having a series field winding and a shunt field winding, a resistance, and means for connecting said series field winding to said source of supply in series with said resistance and with the motor armature in shunt to variable portions of said resistance and then cutting out the resistance and series field, connecting the armature directly to said source of supply and varying the strength of the shunt field.

In witness whereof, I have hereunto set my hand this 26th day of February, 1906.

HAROLD E. WHITE.

Witnesses:

BENJAMIN B. HULL,

HELEN ORFORD.