

F. T. TAYLOR.
CONTROLLER FOR ELECTRIC MOTORS.
APPLICATION FILED JULY 10, 1909.

991,181.

Patented May 2, 1911.

2 SHEETS—SHEET 1.

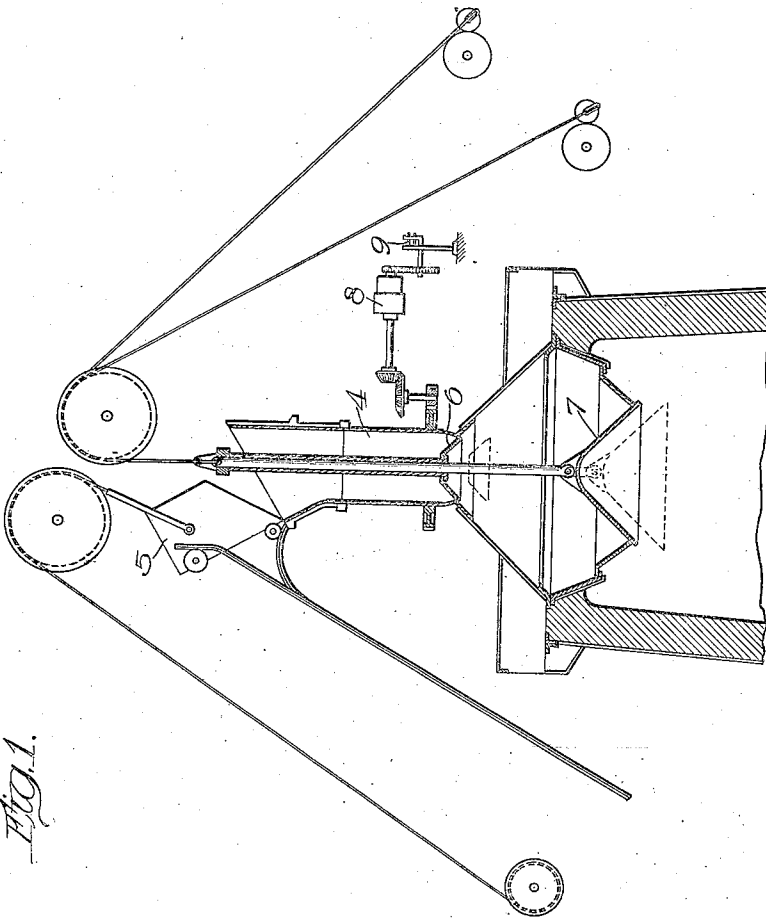


Fig. 1.

Witnesses:
Robert H. Mc
George Haynes

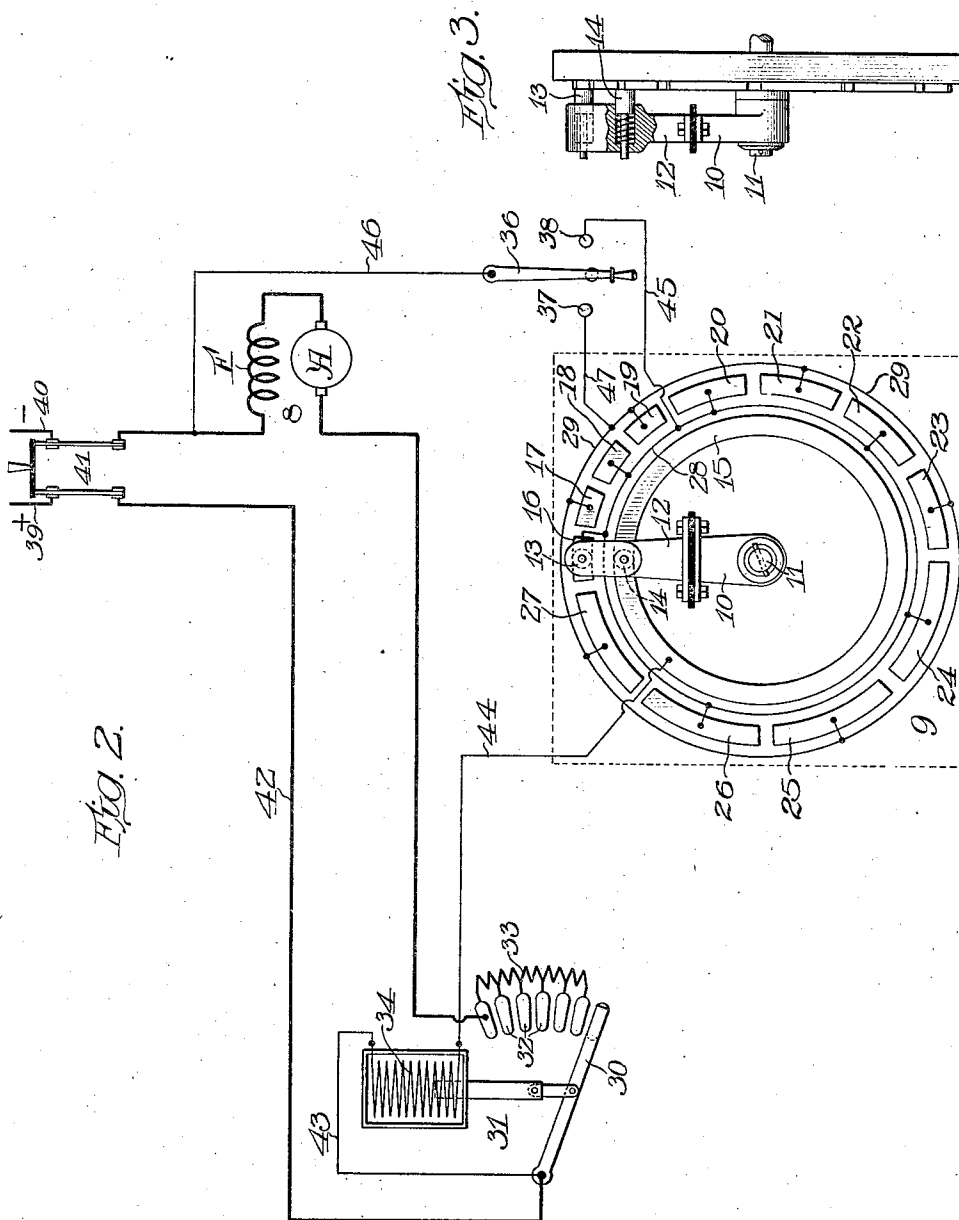
Inventor:
Floyd T. Taylor.
By: Edwin P. H. Tower, Jr.
Attorney

F. T. TAYLOR.
 CONTROLLER FOR ELECTRIC MOTORS.
 APPLICATION FILED JULY 10, 1909.

991,181.

Patented May 2, 1911.

2 SHEETS—SHEET 2.



Witnesses:
 Robert A. Weir
 George Hayner.

Inventor:
 Floyd T. Taylor.
 BY: Edwin B. Tower, Jr.
 Attorney.

UNITED STATES PATENT OFFICE.

FLOYD T. TAYLOR, OF NEW YORK, N. Y., ASSIGNOR TO THE CUTLER-HAMMER MFG. CO., OF MILWAUKEE, WISCONSIN, A CORPORATION OF WISCONSIN.

CONTROLLER FOR ELECTRIC MOTORS.

991,181.

Specification of Letters Patent.

Patented May 2, 1911.

Application filed July 10, 1909. Serial No. 506,941.

To all whom it may concern:

Be it known that I, FLOYD T. TAYLOR, a citizen of the United States, residing at New York, in the county of New York and State of New York, have invented new and useful Improvements in Controllers for Electric Motors, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawing, forming a part of this specification.

My invention relates to improvements in controllers for electric motors.

With certain classes of motor operated machinery it is necessary to operate the same in stages, and, in some instances, to vary the range of operation thereof during successive stages. For instance, in charging a blast furnace, it is necessary to operate the hopper in stages and to vary the range of operation thereof during successive stages in order to obtain an even distribution of the charges on the large bell of the furnace. This may be accomplished in various ways. For instance, the hopper may be revolved a certain number of degrees after each charge is dumped therein until a predetermined number of charges have been deposited at the same point on the large bell and then operated a greater number of degrees each time a charge is dumped therein until an equal number of charges have been deposited at a different point on the large bell, and so on. This method obviously necessitates the operation of the hopper for varying distances, and further necessitates successive operations of the hopper for the same distance.

Another method of distributing the charges consists in revolving the hopper so that the first charge will be deposited on the large bell at a given point, the next charge deposited on the large bell at a predetermined distance from the previous charge, and so on. This operation may be continued until a predetermined number of charges have been deposited upon the large bell and then the same cycle of operation repeated, until a plurality of charges have been deposited on top of the first charges. Of course, where it is desired to insure the deposit of the charges as above set forth, or in a similar manner, it is impractical to leave the operation of the hopper to the discretion of an attendant.

It is, therefore, the object of my invention

to provide a simple and efficient device for necessitating the operation of a motor in stages and for varying the range of operation of the motor during successive stages as desired.

A further object of my invention is to provide a controller which may be readily constructed to meet different conditions.

For the purpose of more clearly disclosing the nature of my invention, I shall describe the embodiment thereof illustrated in the accompanying drawing, in which I have shown my invention as applied to the control of a blast furnace hopper. It should be understood, however, that my invention is not limited in its application to any particular class of motor operated machinery, but may be used in various different relations. It should also be understood that the drawing merely illustrates one embodiment of my invention and that the same is capable of various modifications.

Figure 1 shows schematically a revolving hopper and other moving parts of a blast furnace. Fig. 2 illustrates one form of my controller as it may be constructed in practice and also diagrammatically illustrates one arrangement of circuit connections therefor; and Fig. 3 is a side elevation of the controller shown in Fig. 2.

The mechanism shown in Fig. 1 includes a revolving hopper 4, a skip car 5, a small bell 6 and a large bell 7, each of which is provided with suitable operating means.

My invention relates particularly to the control of the revolving hopper, and, therefore, I shall not describe the operation of the other moving parts in detail as the operation thereof is well understood by those skilled in the art. However, briefly set forth, the sequence of operation of the parts is as follows. The skip car 5 is operated to dump suitable charges into the hopper 4 which is revolved to insure proper distribution of the charges. At predetermined times, in each cycle of operation the small bell is lowered to deposit the charges onto the large bell. When a predetermined number of charges have been deposited on the large bell, the same is lowered to distribute the charges in the furnace. As illustrated, the hopper 4 is arranged to be revolved by a motor 8 which is connected thereto by suitable gearing. The motor 8 is also geared, or otherwise operatively connected, to a

suitable controller or limit switch 9, the construction of which I shall now describe, reference being had to Fig. 2.

The limit switch 9 is provided with a movable member 10 preferably rigidly mounted on a revoluble shaft 11. Instead of the member 10 being operatively connected to the motor, the same might be operated directly from the revolving hopper if preferred. The member 10 is preferably formed in two parts, the upper part 12 thereof being insulated from the lower portion and the shaft 11. The portion 12 carries, at its outer end, two contact brushes 13 and 14. The brush 14 is adapted to engage and sweep over a contact ring 15 when the arm 10 is rotated, while the brush 13 is adapted to sweep over a series of contact segments 16 to 27 inclusive. The portion 12 of the arm 10 forms an electrical connection between the brushes 13 and 14, and, hence, said brushes are adapted to electrically connect any one of the contact segments to the contact ring 15.

For the purpose hereinafter set forth, I prefer to divide the contact segments 16 to 27 into two sets, the contacts of each set being electrically connected and at the same time insulated from all of the contacts of the other set. In practice, I prefer to arrange the sets of contacts so that each contact of one set will be disposed between two contacts of the other set. In other words, alternate contact segments are electrically connected. In the diagrammatic view, Fig. 2, it will be seen that all of the contact segments bearing even reference numerals are electrically connected to a conductor 28, while those bearing odd reference numerals are connected to conductor 29.

The motor 8 for operating the hopper is diagrammatically illustrated as being provided with an armature A and a series field winding F. Of course, other forms of motors might be used if preferred. The continuity of the motor circuit is controlled by means of a switch 30 which forms the movable element of an electromagnetically operated starting rheostat 31. Of course, if preferred, a separate main switch might be provided. The member 30 is adapted to sweep over a series of contacts 32, the first of which is dead, while the remainder are connected to a suitable armature resistance 33. Hence, when the arm 30 is in its initial position, it will engage the dead contact 32, thereby interrupting the motor circuit. The member 30 is adapted to be moved over the contacts 32 to close the motor circuit and then remove the resistance 33 from circuit by a suitable electromagnetic winding 34. As will be hereinafter set forth, the circuit of the operating winding 34 is controlled by the limit switch previously described in conjunction with a suitable master switch 36,

which may, in practice, be of any preferred type. As illustrated, the switch 36 merely comprises a pivoted switch arm adapted to be moved from a central position into engagement either with contact 37 or contact 38.

I shall now describe the operation of the controller. Current is supplied to the motor and to the operating winding of the main switch from main lines 39 and 40 through a double pole switch 41. Assuming the movable element of the rheostat 31 to be in the position illustrated, the motor circuit will be opened. To close the motor circuit with the member 10 of the limit switch in the position illustrated, it is necessary to throw the switch 36 into engagement with the contact 38. This closes a circuit from main line 39 by conductors 42 and 43, through the operating winding 34 of the rheostat, by conductor 44 to ring 15 of the limit switch, thence by brushes 14 and 13 to contact segment 16, to conductor 28, by conductor 45, through the switch 36, and by conductor 46 to the negative side of the main line. The winding 34 being thus energized, operates the element 30 to first close the motor circuit with all of the resistance 33 included therein, and then to gradually remove said resistance from circuit. This starts the motor and then gradually brings the same up to speed.

Operation of the motor causes the hopper of the blast furnace to revolve, and at the same time causes the arm 10 to revolve about its pivot. When the hopper has revolved a certain number of degrees, the brush 13 of the limit switch will disengage the contact segment 16, thereby interrupting the circuit of the winding 34 of the rheostat 31. The member 30 of the rheostat then descends to reinsert the resistance 33 in circuit and to finally open the motor circuit. This, of course, stops the motor and brings the hopper to rest, and, during this time, the arm of the limit switch moves onto the next contact. To again start the motor, it is necessary to move the switch 36 into engagement with the contact 37. This completes the circuit of the winding 34 from the main line 39 to ring 15 of the limit switch as already traced, thence by brushes 14 and 13 to contact segment 17, by conductors 29 and 47, through the switch 36 and back to the negative line as already traced. The motor is then again started and brought up to speed in the manner previously set forth. The hopper is thus again set in operation and will continue to operate until the brush 13 of the limit switch leaves contact segment 17, whereupon the circuit of the starting rheostat will again be interrupted, thereby stopping the motor and hopper in the manner previously set forth. To again start the motor, the switch 36 must be thrown into engagement with contact 38. During the remainder of the revolution of the mem-

ber 10 of the limit switch, the same operates in the manner previously set forth to periodically stop the motor, thereby necessitating operation of the master switch before the motor can be again started.

In the particular controller illustrated, it will be noted that the contacts 16 to 27 are of three different lengths. Contacts 16 to 19 inclusive are of one length, contacts 20 to 23 of a greater length and contacts 24 to 27 of a still greater length. For the purpose of illustration, it may be assumed that the first set of contacts provide for 90 degrees of rotation of the hopper, while the second and third sets provide for 180 and 270 degrees of rotation thereof respectively. With this arrangement, during one complete cycle of operation of the controller, the hopper would be started and stopped four times in succession after rotating 90 degrees each, then started and stopped four times in succession after rotating 180 degrees each time, and then started and stopped four times in succession after rotating 270 degrees each time. Such an arrangement provides for the following distribution of charges on the large bell. The first charge is deposited onto the large bell without operating the hopper. This operation is repeated until four charges have been deposited on the large bell one on top of the other. Thus four charges are deposited at zero point on the large bell. Before depositing the next charge on the large bell, the hopper is revolved 90 degrees, thus depositing the same on the large bell at 90 degrees from the first charges. This operation is repeated until three more charges have been deposited at the same point. In depositing the next four charges, the hopper is revolved 180 degrees each time, thereby depositing said charges at 180 degrees from the first four charges and 90 degrees from the second four charges. The last four charges are each carried 270 degrees by the hopper before being deposited on the large bell, and, consequently, are deposited at a point 90 degrees from the next preceding charges. In brief, the foregoing operation results in depositing each group of charges at a point 90 degrees from the next preceding group, which obviously results in an even distribution of the charges on the large bell. The large bell may then be dumped or the previous cycle of operation repeated until any desired number of charges have been deposited thereon and then the same dumped.

While I have shown the controller as constructed to cause the distribution of the charges in the manner above set forth, it should be understood that all of the contacts of the limit switch might be varied in length to cause successive charges to be deposited at different points on the large bell. Such an arrangement would merely necessitate repetition of the cycle of opera-

tion to obtain practically the same result as that obtained by the arrangement illustrated.

I claim.—

1. In a controller for electric motors, in combination, a plurality of contacts and an automatically operated member adapted to successively engage and disengage said contacts and to stop the motor upon disengaging each of said contacts, thereby necessitating operation of the motor in stages but permitting an indefinite number of operations of the motor in the same direction.

2. In a controller for electric motors, in combination, a plurality of contacts and an automatically operated member adapted to successively engage and disengage said contacts and to stop the motor upon disengaging each contact, thereby necessitating the operation of the motor in stages, said contacts being of varying sizes to vary the range of operation of the motor during successive stages.

3. In a controller for electric motors, in combination, a plurality of contacts and an automatically operated member adapted to successively engage and disengage said contacts and to stop the motor upon disengaging each contact, thereby necessitating operation of the motor in stages, said contacts being arranged in groups, the contacts of each group being of substantially the same length and differing in length from the contacts of another group.

4. In a controller for electric motors, in combination, a plurality of contacts, an automatically operated member adapted to successively engage and disengage said contacts and to stop the motor upon disengaging each contact, thereby necessitating operation of the motor in stages, and means for starting the motor when said member is in engagement with any of said contacts, said contacts being of varying sizes to vary the range of operation of the motor during successive stages.

5. In a controller for electric motors, in combination, electroresponsive means controlling the motor circuit and a switch controlling said electroresponsive means, comprising a plurality of contacts, and an automatically movable member adapted to successively engage and disengage said contacts, said member being adapted to cause the deenergization of said controlling means upon leaving each of said contacts, and said contacts being of varying lengths to maintain said means energized for different lengths of time.

6. In a controller for electric motors, in combination, electroresponsive means for controlling the motor circuit, a switch comprising a plurality of contacts, and an automatically movable member adapted to successively engage and disengage said con-

tacts and to deenergize said means upon leaving each contact, and means for energizing said controlling means when said member is in engagement with any one of
5 said contacts to cause the motor to operate in stages, said contacts being of varying lengths to vary the range of operation of the motor during successive stages.

7. In a controller for electric motors, in
10 combination, electroresponsive means for controlling the motor circuit, said means having parallel energizing circuits and means movable in unison with the motor to alternately open said parallel circuits to de-
15 energize said controlling means, thereby necessitating operation of the motor in stages.

8. In a controller for electric motors, in
20 combination, electroresponsive means for controlling the motor circuit, said means having parallel energizing circuits and a switch common to said circuits and adapted to be automatically operated in unison with the motor to alternately open said parallel
25 circuits to deenergize said means to stop the motor, thereby necessitating operation of the motor by stages.

9. In a controller for electric motors, in
30 combination, electroresponsive means for controlling the motor circuit, said means having parallel energizing circuits and a switch common to said circuits and adapted to be automatically operated in unison with the motor to alternately open said parallel
35 circuits to deenergize said means to stop the motor, thereby necessitating operation of the motor by stages, said switch being provided with contacts of varying sizes to necessitate the same being moved different
40 predetermined distances prior to stopping the motor.

10. In a controller for electric motors, in
combination, electroresponsive means for
45 controlling the motor circuit, said means having parallel control circuits, a series of contacts, said control circuits including alternate contacts of said series, and a movable contact member common to said control circuits and arranged to be moved in
50 unison with the motor to successively engage and disengage said contacts to alternately open said control circuits, thereby necessitating closure of said control circuits

alternately to cause the motor to operate in stages. 55

11. In a controller for electric motors, in combination, electroresponsive means for controlling the motor circuit, said means having parallel control circuits, a series of contacts, said control circuits including alternate contacts of said series, and a movable contact member common to said control circuits and arranged to be moved in unison with the motor to successively engage and disengage said contacts to alternately open said control circuits, thereby necessitating closure of said control circuits
65 alternately to cause the motor to operate in stages, said contacts being of different sizes to maintain said means energized for different predetermined periods to vary the range of operation of the motor during successive periods. 70

12. In an electric switch, in combination, a movable contact member and contacts co-
75 operating therewith to alternately connect said member in one of two parallel circuits as the same is moved in a single direction, said member, upon leaving each of said contacts, being arranged to open one of the parallel circuits. 80

13. In an electric switch, in combination, a series of contacts, alternate contacts of said series being electrically connected in sets and said sets of contacts being connected in different parallel circuits, and a movable contact member common to the parallel circuits and arranged to be moved to successively engage and disengage said
90 contacts. 95

14. In an electric switch, in combination, a series of circumferentially arranged contacts, alternate contacts of said series being electrically connected in sets, said sets of contacts being connected in parallel circuits, and a switch member common to said parallel circuits and adapted to be moved to successively engage and disengage said contacts. 95

In witness whereof, I have hereunto subscribed my name in the presence of two witnesses. 100

FLOYD T. TAYLOR.

Witnesses:

LAURA E. SMITH,
M. GOLDSTEIN.