

No. 793,454.

PATENTED JUNE 27, 1905.

F. MACKINTOSH.
MULTIPLE SWITCH RHEOSTAT.

APPLICATION FILED DEC. 5, 1903.

2 SHEETS—SHEET 1.

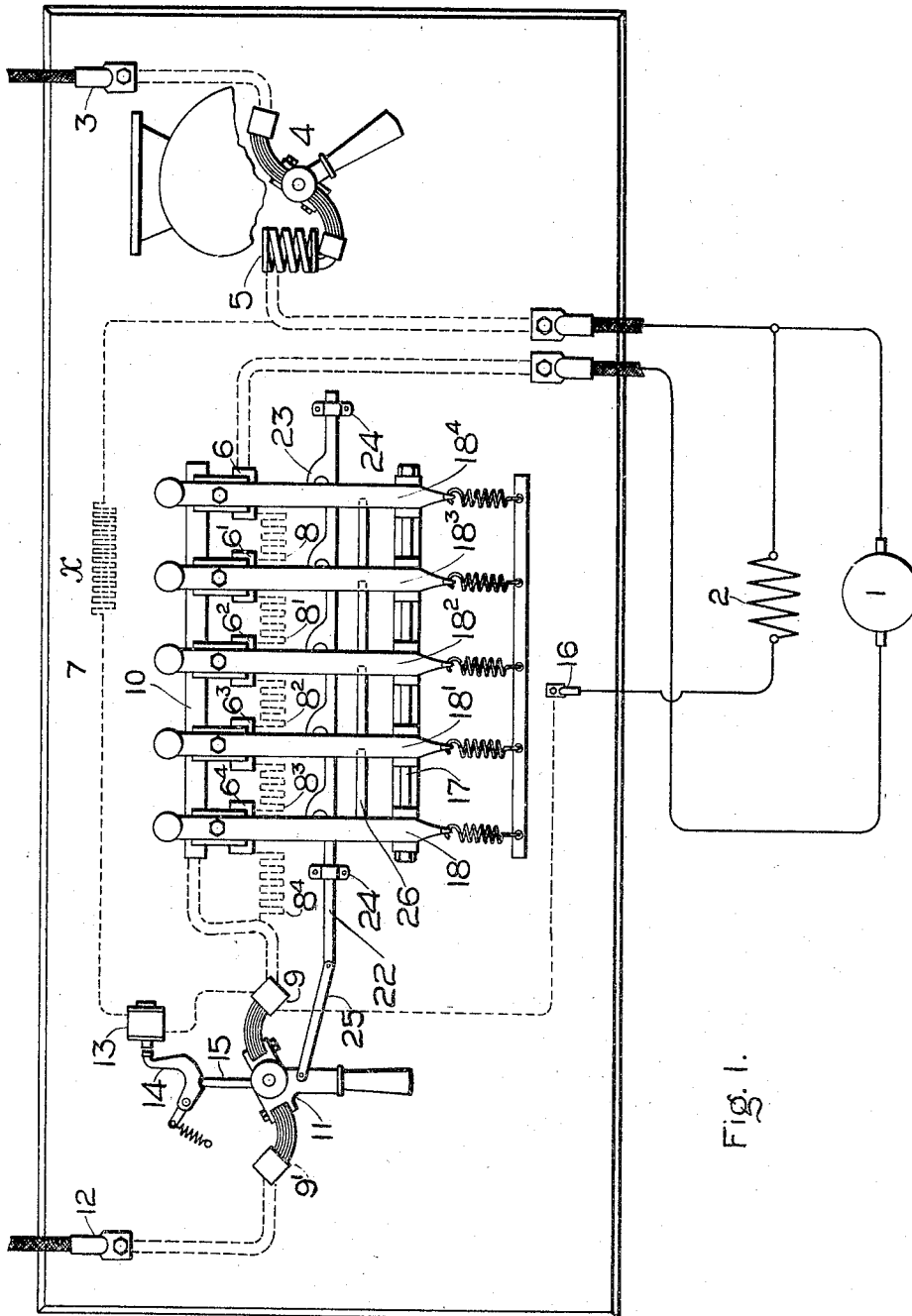


Fig. 1.

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by *Albert S. Davis*
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2 SHEETS—SHEET 2.

Fig. 2.

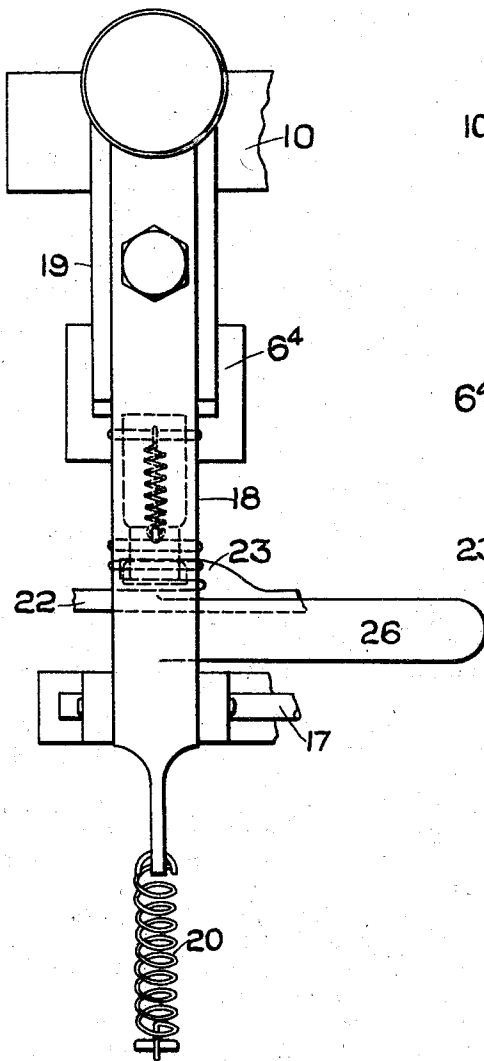
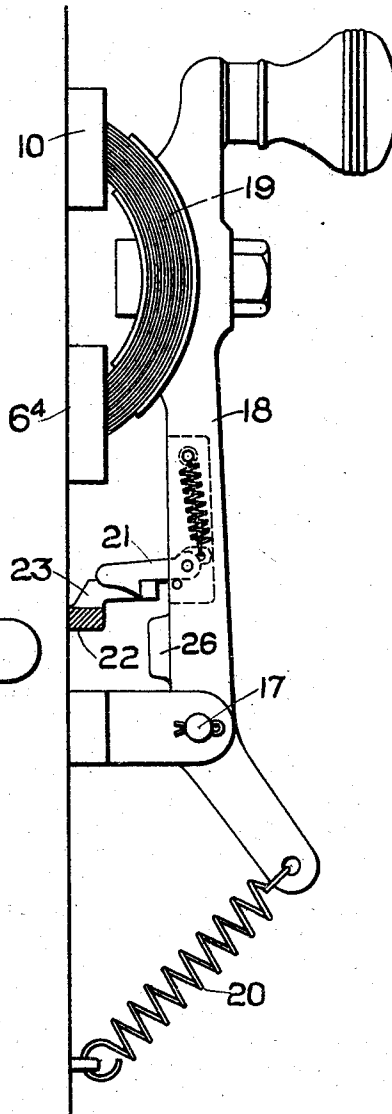


Fig. 3.



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UNITED STATES PATENT OFFICE.

FREDERICK MACKINTOSH, OF SCHENECTADY, NEW YORK, ASSIGNOR TO
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MULTIPLE-SWITCH RHEOSTAT.

SPECIFICATION forming part of Letters Patent No. 793,454, dated June 27, 1905.

Application filed December 5, 1903. Serial No. 183,878.

To all whom it may concern:

Be it known that I, FREDERICK MACKINTOSH, a citizen of the United States, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Multiple-Switch Rheostats, of which the following is a specification.

This invention relates to switches for starting electric motors; and its object is to furnish a starting-rheostat of the multiple-switch type.

It has not been until quite recently that electric motors of more than one-hundred-horse power have been frequently used on consumers' premises. Motor-generator sets of larger than one-hundred-horse power have been used; but since the starting-load on them has been comparatively small it has been the custom to start them with a single-blade multiple-contact switch. Inasmuch, however, as motors for distribution-circuits are now being built of two-hundred-and-fifty-horse power and upward, it is not only desirable but necessary to provide suitable starting-switches capable of handling the currents supplied to motors of this size. The difficulty in making a rheostat of so large a capacity does not lie in the resistance, which is very easily constructed, but in the switch device, which for large motors has to carry a very large current. In order to avoid the cost of a single switch of such large dimensions as would be necessary for this purpose, it has been proposed to make switches of a multiple-bladed type, in which the several blades can be successively closed. Each blade as it is closed cuts out a certain section of the rheostat, and as an appreciable time is required to close all the switches, and thus cut out the resistance from the motor-circuit, the motor is enabled to speed up as the switches are successively closed. In this way the switches are required to carry only a small proportion of the line-current, and so comparatively small switches can be used. In switches of this type it is desirable to use laminated contacts pressing against stationary surfaces, since any other construction involves too much friction to render the opera-

tion of the switch feasible for hand operation. Moreover, by using several single-pole switches in series large currents can be successively handled, because each switch when closed makes good contact immediately, which is not the case in switches where the blade has to enter clips, since one corner of the clip makes contact first and the large rush of current is very liable to fuse the clips to the switch-blade. Another point in favor of using separate switches is that since they are closed by hand the movement of each switch can be made rapid, so that the interval from leaving its open position to being fully closed is almost instantaneous, as it is well known that by the hand operation of a switch it can be so quickly opened or closed that but little arcing occurs. In the switch which I have devised to meet these conditions of service a plurality of independently-actuated manual switch-levers are so arranged that they can only be closed in a certain definite order, the closing of one lever permitting the closing of the next one in the series. As each lever is closed it engages with a locking device, whereby it is held in the closed position against the tension of a spring. The locking device is mechanically connected with a circuit-breaker, so that when the breaker opens the switch-levers are all released and will be automatically opened by their springs. I prefer to include in series with the switch two circuit-breakers, one of which controls the locking device as just stated and is responsive to an under-load, while the other is responsive to an overload.

In the accompanying drawings, Figure 1 is an elevation of a switch embodying my invention, the circuit connections being shown in diagram. Fig. 2 is a front elevation of one of the switch-blades on a much larger scale, and Fig. 3 is a side elevation of the same.

In the drawings the several parts are not shown in the position in which they would be arranged for commercial service, but the relative position of the parts has been selected for the sake of clear illustration. The

motor-armature is shown at 1 and the shunt-field coil therefor at 2. The line-current enters through a suitable binding-post 3 and passes thence through the automatic circuit-breaker 4, which is provided with an overload-coil 5, as usual. This circuit-breaker is in series with one terminal of the motor, the other terminal of the armature being connected with a stationary contact-segment 6, forming one of a series of similar segments 6, 6', 6'', 6''', and 6⁴, suitably mounted upon the insulating-panel 7, on which the circuit-breaker motor is mounted. Between these segments are interposed several sections of the rheostat 8, 8', 8'', and 8'''. Between the last segment 6⁴ and a suitable stationary contact 9 is interposed a section 8⁴ of the rheostat. Parallel with the segments 6, 6', 6'', 6''', and 6⁴ is a stationary contact-bar 10, connected at one end with the contact-block 9. This block forms one of the two stationary terminals of the automatic circuit-breaker 11, the other stationary block 9' being connected with the binding-post 12, to which the other line conductor is connected. The circuit-breaker 11 is tripped by means of a no-voltage coil 13 and a pivoted latch 14, which engages with a suitable projection 15 on the circuit-breaker and is held in this position by the attraction of the coil 13 so long as current is flowing, said coil being in circuit between the contact-block 9 and the opposite side of the line 2.

Suitably pivoted on the rod 17 is a series of switch-levers 18, 18', 18'', 18''', and 18⁴, each of which carries an arched and laminated contact 19, adapted to bridge the space between one of the contact-segments and the contact-bar 10 when the switch-lever is closed. A spring 20 normally holds the switch-lever open and serves to automatically open said lever when released. Each lever can be locked in the closed position by means of a catch 21, suitably pivoted to the lever and engaging with a locking-bar 22, which passes adjacent to all of said levers and is preferably provided with a series of projections or fingers 23 corresponding in number and location with the switch-levers and with which the spring-catches 21 engage. This bar is capable of movement, preferably longitudinal, in suitable guides or bearings 24, secured to the panel 7. One end of said bar is operatively connected, as by means of a connecting-rod 25, with the handle of the circuit-breaker 11, so that when said circuit-breaker is closed the bar will be moved in order to bring the fingers 23 into operative position with reference to the catches 21. On each switch-lever is a laterally-projecting arm 26, extending into the path of the adjacent switch-lever, so that until the first lever in the series has been closed the other levers cannot be actuated and until the second lever has been closed the remaining levers cannot be actuated, and so

on through the series, each lever preventing the closing of the next succeeding one in the series until it has itself been closed.

The operation of the device has been somewhat indicated in the foregoing description, but it may be desirable to briefly recapitulate it. The switch-levers are normally in open position, and in order to start the motor it is necessary first to close the circuit-breakers 4 11. This completes the circuit through the several sections of the rheostat 8, 8', 8'', 8''', and 8⁴. In order to cut out these several sections, the switch-levers must be closed in a certain order, beginning with the lever 18 and ending with lever 18⁴. As each switch-lever is closed its catch engages with the corresponding finger 23 of the locking-bar 22, said bar having been moved longitudinally by the closing of the circuit-breaker 11, so as to bring said fingers into line with the levers. The closing of the first lever 18 carries its arm 26 away from the lever 18' and leaves said lever 18' free to be closed. This movement carries the arm 26 on said lever 18' away from the lever 18'', and therefore permits said third lever to be closed in turn. In this manner the levers can be closed in order, thereby successively cutting out the sections of the rheostat and speeding up the motor. The last switch-lever in the series must be of sufficient capacity to carry the full-load current of the motor, but the other switches need not be of full-current capacity size, since they only carry the current of the motor through the period of starting. The motor is now supposed to be running at full speed. If an overload takes place, the circuit-breaker 4 opens, which of course disconnects the motor from the line. This demagnetizes the magnet 13, and the circuit-breaker 11 being thereby tripped will open, and in doing so will push the locking-bar 22 to the right in Fig. 1, so that its fingers 23 will no longer engage the catches 21, and therefore all of the switch-levers will be simultaneously unlocked and will be pulled open by their springs 20. The device is then in the safety position for the starting of the motor. If instead of an overload the current should be cut off from the supply-line to the motor, the magnet 13 will thus be demagnetized and the circuit-breaker 11 will open and release all the switches, and the device is again brought to the safety position for starting, with the exception that the circuit-breaker 4 remains closed. If the motor is running at full speed and it is desired to stop it by hand, it is simply necessary to trip the circuit-breaker 4, when the rest of the device will automatically operate in the manner above described, and the motor will come to rest in the safety position.

I prefer to place the no-voltage release-magnet 13 in a shunt across the line, interposing a standard ohmic resistance X. The advantage of this arrangement is that one

magnet-winding and resistance is suitable for motors of different capacities and for variable-speed motors which are regulated by changes of field strength, a result difficult to accomplish when the magnet is in the field-circuit, as common.

In accordance with the patent statutes I have described the principle of operation of my invention, together with the apparatus which I now consider to represent the best embodiment thereof; but I desire to have it understood that the apparatus shown is only illustrative and that the invention can be carried out by other means.

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

1. The combination with a series of independently-actuated manual switches, of means for preventing the closure of the same except in a definite order, and means for automatically opening them simultaneously.

2. The combination with a rheostat, of a plurality of independently-actuated manual switches for controlling the resistance thereof, means for preventing the closure of said switches except in a definite order, and means for automatically opening said switches simultaneously.

3. The combination with a series of manual switches, a rheostat the steps of which are governed by the switches, means for holding the switches in a closed position, and means for releasing all of them simultaneously.

4. The combination with a series of manual switches, a rheostat the steps of which are governed by the switches, means for holding the switches in a closed position, and means responsive to line conditions for releasing all of them simultaneously.

5. The combination with a series of manual switches, of means for preventing the closure of the same except in a definite order, means for holding said switches in the closed position, and means for automatically releasing them simultaneously.

6. The combination with a series of switches, of interlocking mechanism whereby each switch controls the closing of the next succeeding switch, and a device for unlocking all of said switches simultaneously.

7. The combination with a series of switches, of a locking-bar, means for engaging each switch with said bar, and means for actuating said bar to automatically release all the switches simultaneously.

8. The combination with a series of switches, of a bar provided with a corresponding series of projections, catches on said switches to en-

gage with said projections, and means for moving said bar lengthwise to release all the switches simultaneously.

9. The combination with a series of switches, of a movable bar for locking and unlocking the same, a circuit-breaker in circuit with said switches, and connections whereby said breaker can actuate said bar.

10. The combination with a series of switches, of a movable bar for locking and unlocking the same, and an automatic circuit-breaker in circuit with the switches and operatively connected with said bar.

11. The combination with a series of switches, of a catch on each switch, a longitudinally-movable locking and unlocking bar with which said catches cooperate, and an automatic circuit-breaker operatively connected with said bar.

12. The combination with a series of switches, of a movable bar for locking and unlocking the same, an electromagnet in circuit with said switches, and operative connections with said bar, whereby the switches will be simultaneously unlocked when said electromagnet is deenergized.

13. The combination with a series of switches, of a movable bar for locking and unlocking the same, mechanical means for moving said bar to the locking position, and electroresponsive means for causing said bar to unlock said switches.

14. The combination with a series of switches, of an arm on each switch-lever projecting into the path of the next succeeding lever.

15. The combination with a series of switches, of an arm on each switch-lever, a spring-catch pivoted on each lever, a bar extending adjacent to all the levers and having fingers cooperating with said catches, and means for moving said bar to disengage said catches.

16. The combination with an electric motor, of a rheostat, a series of self-opening switches controlling the sections of said rheostat, an arm on each switch projecting into the path of the next succeeding switch, a catch on each switch, a locking-bar cooperating with the catches, and a no-voltage coil in circuit with the motor and arranged to cause the bar to release the catches.

In witness whereof I have hereunto set my hand this 1st day of December, 1903.

FREDERICK MACKINTOSH.

Witnesses:

BENJAMIN B. HULL,
HELEN ORFORD.