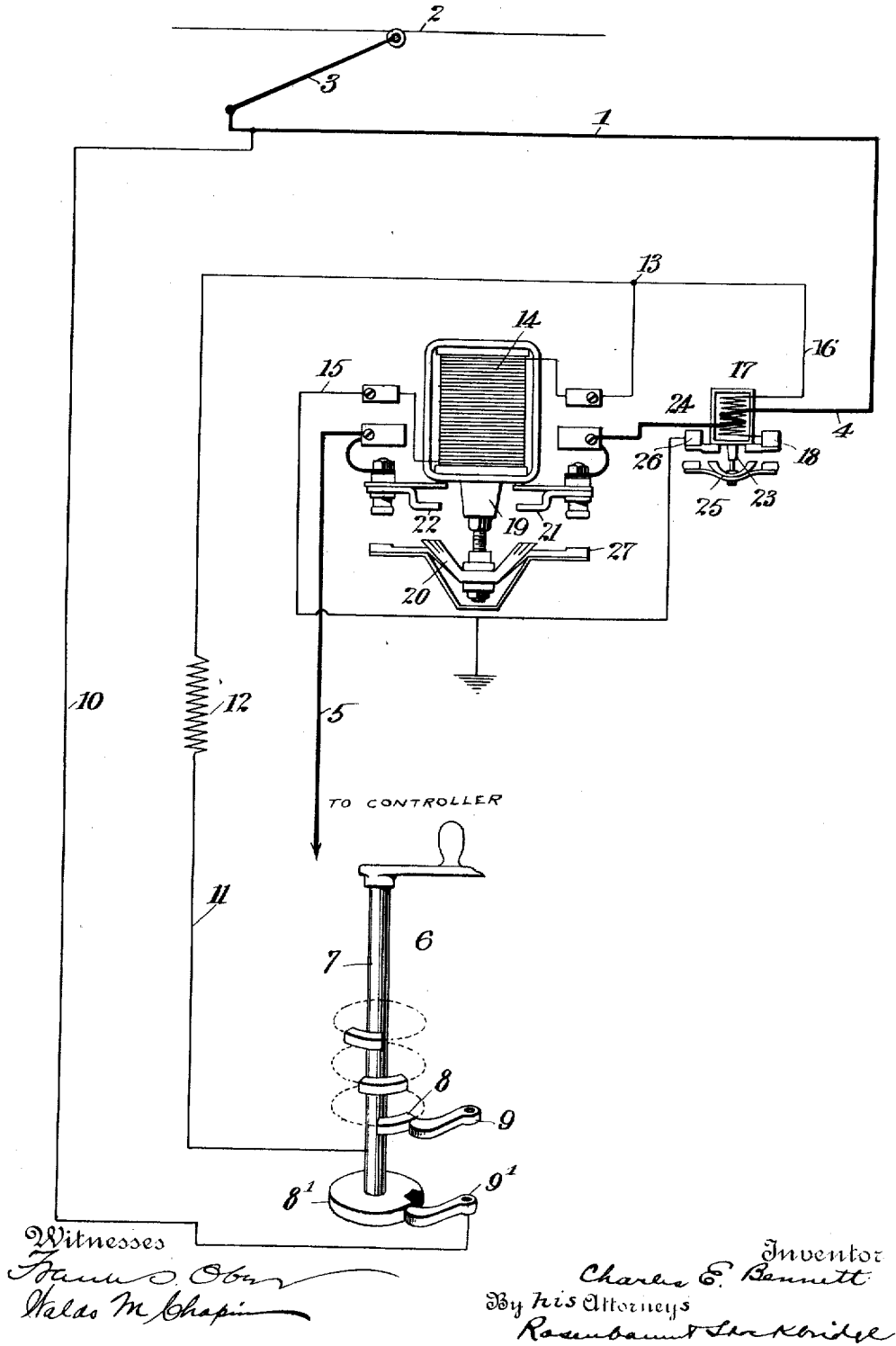


No. 829,135.

PATENTED AUG. 21, 1906.

C. E. BENNETT.
MOTOR CONTROL SYSTEM.
APPLICATION FILED DEC. 28, 1905.



UNITED STATES PATENT OFFICE.

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MOTOR-CONTROL SYSTEM.

No. 829,135.

Specification of Letters Patent.

Patented Aug. 21, 1906.

Application filed December 28, 1905. Serial No. 293,607.

To all whom it may concern:

Be it known that I, CHARLES E. BENNETT, a citizen of the United States, residing at the city of New York, in the borough of Manhattan and State of New York, have invented certain new and useful Improvements in Motor-Control Systems, of which the following is a full, clear, and exact description.

My invention relates to a system for controlling electric motors, and has particular reference to use with street-cars and similar installations where heavy currents are handled.

Trolley-cars are constantly being made larger and heavier and are called upon to run at greater speeds, so that the method of handling the necessary heavy currents upon the street-car platform is dangerous and accidents frequently occur. For heavy trains the difficulty is overcome by the multiple-unit system in which only an operating-circuit is handled on the car-platform, the heavy currents being controlled wholly beneath the cars, where there is plenty of room and where the unavoidable arcing can be so provided for as not to be disastrous. This serves to render the train control entirely safe; but it is evident that the expensive multiple-unit system cannot be practically applied to simple street-cars, the complexity and expense being quite prohibitive.

By the present invention I aim to secure all the advantages of a multiple-unit system in which the heavy currents are broken at specially-constructed contactors beneath the car-platform and at the same time retain practically all the present valuable features of the platform-controller now used, with its attendant cheapness and simplicity.

A further object of the invention is to secure an automatically-operating magnetic cut-out which is also automatically restored to its normal condition by the return of the controller-arm.

With these and other objects in view my invention consists in the construction, combination, location, and arrangement of parts, as hereinafter set forth and shown and finally particularly pointed out in the appended claims.

The drawing illustrates the system of street-car control embodying the principles of my invention.

In order that my invention may be fully

understood, it is necessary to consider the action of a controller when used to regulate a motor-circuit. The ordinary controller comprises a revoluble shaft with copper segments which contact with fingers, so as to cut out successive resistances within the armature-circuit. In shutting off the controller the resistances are again successively cut into the circuit until the latter is finally broken as the controller-arm passes from the first notch to the off position. As long as the circuit continues there is no great danger of excessive sparking, because a path is always provided for the inductive extra current of the motors; but when the arm leaves the first notch and opens the motor-circuits entirely the inductive current has no path open to it and rises to an uncertain potential, which may be enormously high if the break is made abruptly. All the practical danger therefore occurs at the first notch of the controller at which the motor acts as a gigantic spark-coil; but in practice the difficulties from arcing at this notch are very great and are the cause of a great many controllers being burned up. In carrying out my invention I make use of a device which takes the place of the ordinary circuit-breaker on the trolley-car and in addition to this function serves as a contactor for the first notch of the controller. The remaining notches do not need contactors, but will take care of themselves for the reason above stated.

Referring now to the drawing, in which like parts are designated by the same reference-sign, 1 indicates the motor-circuit of a trolley-car receiving current from the usual trolley-conductor 2, pole 3, and wire 4. At this point are interposed special devices embodying the principles of my invention and which will be later described. This motor-circuit is continued at 5 to the usual controller and motor by connections. (Not shown.)

6 designates the controller of usual or any desired form, having the operating-shaft therein with the usual segments, of which 8 designates the first and the one through which the circuit is finally broken when the controller is shut off.

9 designates the usual contact-finger spring pressed from the frame, so as to engage the segment 8 in any desired way. I make the finger 9 and the segment 8 or pref-

erably special contacts 9' 8' within the controller and adapted to operate simultaneously therewith part of a shunt or pilot circuit, including a wire 10, from the trolley-wheel and through contacts 9' 8', as above stated, wire 11, resistance 12, up to point 13, where this shunt-circuit divides, a part going through a large circuit breaker or contactor magnet 14, which I shall term the "circuit-breaking magnet," wire 15, to ground, and the other part passing through a wire 16 to a magnet-winding 17, to block 18, where this circuit normally terminates. The coils 14 and 17 are wound with a large number of turns of fine wire, so that the pilot-current in the wire 10 is merely a light operating-current. It is evident that this circuit remains open for the off position of the controller-arm, but that whenever the controller is moved to the first notch the circuit is completed and the magnet 14 energized. As a result of the completion of this pilot-circuit and the energization of the magnet 14 the following actions take place: The magnet-coil 14 is energized and attracts its armature 19, so that the brushes 20 close a circuit between points 21 and 22, and establish a connection for the motor-current which up to this time has been broken at this point. This motor-current then passes into the controller in the usual way. The motor is therefore operating at its proper speed, depending on the position of the controller-arm. In the meantime the magnet 17 is not energized, so that its armature 23 remains in the position shown. The main motor-circuit 1 has a few turns around this magnet, which I term the "supplemental magnet," and these serve to exert a certain amount of attraction on the armature 23, but not sufficient to draw it upward. Conditions remain as above described during the normal operation of the car, unless for some reason an abnormally heavy current passes through the motor-circuit. Should this occur, the effect of the turns 24 becomes enough strengthened to pull upward the armature 23, and bridge the brush 25 across the contact 18, above mentioned, and a ground connection 26, and thus completes the shunt-circuit 16 through the magnet-winding 17, above mentioned. The effect of completing the circuit 16 through the coil 17 is to divert almost all of the shunt or pilot current through the magnet 17 and away from the coil 14 of the circuit-breaking magnet which becomes so much deenergized as to release its armature 19 and break the main motor-circuit at points 21 and 22. This is the desired result, since it is customary to break the motor-circuit at a circuit-breaker when the current becomes excessive for any reason. The brush 25, however, continues to short-circuit the contacts 18 and 26 on account of the magnetizing effect of the coil 17, which serves

the dual purpose of short-circuiting the circuit-breaking magnet 14 and providing the magnetism for holding the armature 23 raised in spite of the breaking of the main motor-circuit. The main motor-circuit is therefore kept broken until the controller-arm is again moved to its off position, whereupon the shunt or pilot circuit 10 is broken at this point, so that everything falls to the normal position.

The above apparatus takes care of all conditions which arise in practice and in addition virtually serves as a contactor for the first notch of the controller. The latter effect is secured, since the circuit-breaker always operates when the controller passes off of the first notch by breaking the circuit through the magnet 14. The heavy arcing due to the extra current is therefore borne by the circuit-breaking magnet, which may have special carbon-brushes 27 for this purpose. If an arc should occur at any later segment, the motorman is always able to destroy it promptly by moving his controller to off position, which automatically throws the circuit-breaker, as above. The circuit-breaker is always also automatically operated in case of an abnormally heavy current. Thus I provide for all conditions which arise in practice and secure the control of a trolley-car or any other machinery by a simple system.

What I claim is—

1. In a controller system, a circuit-breaking magnet located in a separate circuit between the potential sources or terminals, means whereby said circuit is broken whenever the controller-arm is moved to zero or off position, and a supplemental magnet arranged to short-circuit said circuit-breaking magnet whenever the current through the motors exceeds a predetermined value, said supplemental magnet having an additional winding acting to maintain such short-circuiting relation.

2. In a controller system, a circuit-breaking magnet located in a separate circuit between the potential sources or terminals, means whereby said circuit is broken whenever the controller-arm is moved to zero or off position, a supplemental compound-wound magnet arranged to short-circuit said circuit-breaking magnet whenever the current through the motors exceeds a predetermined value, and means whereby said supplemental magnet continues in its attracted relation after an actuation until the controller-arm is moved to zero or off position.

3. In a controller system, a circuit-breaking magnet entirely separate from the usual controller and adapted to be located at any convenient point as for example beneath the floor of the car, and connections entirely electrical and including a supplemental magnet for actuating said circuit-breaking mag-

net whenever the controller is moved to zero or off position, and whenever the current in the motors exceeds a predetermined value, said supplemental magnet having a shunt-coil for holding the circuit-breaking magnet in actuated relation.

15 4. In a controller system, a circuit-breaking magnet included in a separate circuit across the potential sources, a supplemental magnet having a winding in series with the motors, and arranged to short-circuit said circuit-breaking magnet in case of excessive current in the motors, and a shunt-winding on said supplemental magnet for maintaining it in attracting relation after each actuation until the controller-arm is moved to zero or off position.

5. In a controller system, a circuit-breaking magnet entirely separate from the usual controller, a supplemental magnet having a 20 shunt-winding across the winding of said circuit-breaking magnet, said shunt-winding being normally open circuited, and a series winding on said supplemental magnet for closing said shunt-winding in case of excessive current in the motor-circuit, and means 25 for breaking all of the said circuits whenever the controller is moved to zero or off position.

In witness whereof I subscribe my signature in the presence of two witnesses.

CHARLES E. BENNETT.

Witnesses:

ALFRED W. PROCTOR,
WALDO M. CHAPIN.