Oct. 2, 1934. J. F. TRITLE ET AL 1,975,564

CIRCUIT CONTROLLER

Filed May 31, 1933

Fig. 1.

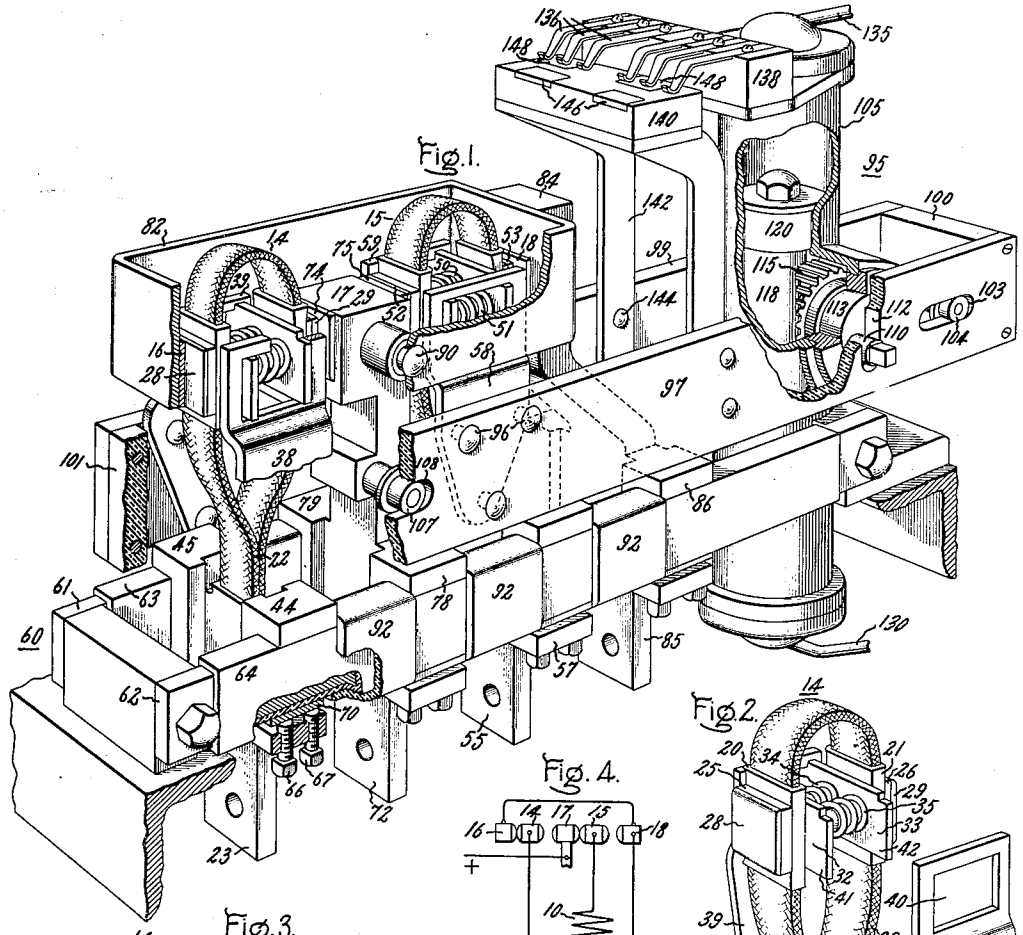


Fig. 2.

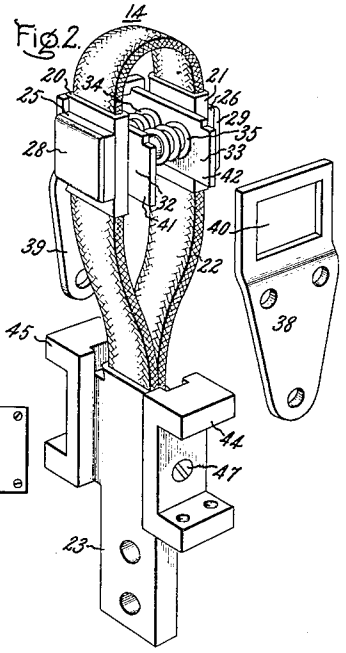


Fig. 4.

Fig. 3.

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Patented Oct. 2, 1934

1,975,564

UNITED STATES PATENT OFFICE

1,975,564

CIRCUIT CONTROLLER

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Application May 31, 1933, Serial No. 673,622

10 Claims. (Cl. 200—16)

Our invention relates to circuit controllers of the type used for reversing the polarity of circuits arranged to carry currents of large magnitude, more particularly to circuit controllers for reversing the polarity of the field windings or armatures of traction motors, and has for an object the provision of an inexpensive, reliable circuit controller capable of carrying very high values of current.

Circuit controllers of the type used for reversing series traction motors are generally designated as reversers. In traction service the overload current of the motors is quite high and in modern practice the current which must be taken care of by the reverser may exceed 5000 amperes. In prior designs much is yet to be desired in providing a reverser which is capable of carrying the maximum overload current, which provides an extremely low contact resistance, and which at the same time is light, compact and rugged in construction.

In carrying out our invention in one form thereof we provide means for locking automatically the controller in one circuit controlling position or the other while a high contact pressure is maintained between the associated movable and stationary contacts. A linear movement is imparted to the movable contact so that its contact surface is maintained parallel to the stationary contact surface, thereby insuring the maximum conducting area between the contacts. The movable contact, however, is flexible enough, even when the maximum pressure is exerted on it by the operating mechanism, to aline itself with an uneven stationary contact.

More specifically, we employ flexible conductors for the movable contacts, each conductor forming a loop, with contact members secured to opposite sides of the loop. A spring assembly is mounted within the loop and between the contact members to provide for a strong contact pressure. Each spring assembly is provided with restraining means for limiting to a predetermined amount the distance between the associated movable contacts. The movable contacts are moved from one circuit-controlling position to another by means of an air engine. The driving connection between the movable contacts and the engine serves first to operate the movable contacts into engagement with the stationary contacts against the bias of the springs and then serves to apply the bias of the springs to the engine to hold the contacts in one circuit-controlling position or the other so as to prevent the displacement of the reverser from its operated position irrespective of failure of the air supply or of vibration or jarring of the reverser.

For a more complete understanding of our invention reference should now be had to the drawing, wherein we have shown in Fig. 1 a perspective view of our invention; Fig. 2 illustrates in perspective one of the movable contact members; Fig. 3 is a sectional elevation of Fig. 1; while Fig. 4 is an elementary diagram of typical circuit connections completed by the reverser.

Referring to the drawing, we have shown our invention in one form as applied to the control of the polarity of a field winding 10 provided on a motor 12. The movable contacts 14 and 15 are respectively shown in engagement with the stationary contacts 16 and 17. In order to reverse the connections of the field winding 10, the movable contacts 14 and 15 are operated respectively into engagement with the stationary contacts 17 and 18.

The specific construction of the movable contacts 14 and 15 as shown does not form a part of the present invention, it being described and claimed in a copending application filed May 31, 1933, Serial No. 673,623, Eaton, "Electric switch", and assigned to the same assignee as the present invention.

In the present application the movable contacts will be described by saying that the movable contact 14, Fig. 2, is constructed by cold forging copper tubes 20 and 21 over a flexible braided conductor 22. It will be observed that the conductor 22 has its ends secured as by welding to a terminal 23. There are attached to the copper tubes 20 and 21 copper spacing blocks 25 and 26, and the silver contact plates 28 and 29 are welded or brazed to the copper space blocks 25 and 26. A pair of spring seats or guides 32 and 33, secured to the blocks by the screws 33*a*, serves to support a pair of compression springs 34 and 35, which springs normally exert a pressure in a direction to separate the contacts 28 and 29. The springs and spring seats are maintained in a position just back of the conducting surfaces 28 and 29 by means of a pair of operating arms 38 and 39. These operating arms are identical in construction. It will be observed that the operating arm 38 is provided with a rectangular opening 40 through which the notched ends 41 and 42 extend. The movable contact 14 is mounted in the reverser by means of the operating arms 38 and 39 and by means of a pair of U-shaped clamps 44 and 45. The clamp 44 is securely attached to the terminal member 23 by means of the set screw 47. The

clamp 45 is similarly connected to the terminal member.

It will be understood that the other movable contact, 15, is identical in construction with the movable contact 14, and is provided with the compression springs 50 and 51 and with silver contact surfaces 52 and 53 electrically connected to a braided conductor 54. The ends of the conductor 54 are secured as by brazing or welding to a stationary conductor, or terminal member 55. A pair of U-shaped clamps are attached to the terminal member 55, only one of which, 57, is shown in the drawing. A pair of operating arms 58 and 59 is also provided for the movable contact member 15.

The movable contacts 14 and 15 have their respective terminal members 23 and 55 supported from a frame 60 by means of the U-shaped clamps. The side members 61 and 62 of the frame 60 are covered with sleeves or wrappings 63 and 64 of insulating material. Each clamp, as for example the clamp 44, is provided with a pair of set screws 66 and 67, the inner ends of which are arranged to bear against a pressure plate 70. The pressure plate 70 prevents damage to the insulation by the set screws. The central stationary contact 17 is formed from a copper bar, the lower end 72 forming a terminal member. At the upper end of the stationary contact 17 there is provided a silver conducting plate 74 arranged to cooperate with the conducting plate 29, and there is also provided a silver conducting plate 75 arranged in cooperative relation with the conducting plate 52. The stationary contact 17 is supported on the frame 60 by means of the U-shaped clamps 78 and 79.

The stationary contacts 16 and 18 are also provided with silver conducting plates and are electrically connected together by means of a copper rectangular bar 82. The rectangular bar 82 is welded or brazed to a second bar of copper 84, the lower end 85 of which forms a terminal member for the stationary contacts 16 and 18. A pair of U-shaped clamps cooperating with the frame 60 is arranged to support the copper bar 84, only one of these clamps, 86, being shown. In addition to the support provided by the copper bar 84 for the stationary contacts 16 and 18, insulated bolts, only one of which, 90 is shown, rigidly secures the rectangular copper bar 82 to the stationary contact member 17.

Between each pair of clamps, as for example the clamps 44 and 78, there are provided spacers 92 of insulating material.

The movable contact members 14 and 15 are operated from one circuit-controlling position to another by means of a cradle 95 constructed of insulating material. The operating arms 38 and 58 are secured as by the rivets 96 to the side member 97 of the cradle 95. Similarly the operating arms 39 and 59 are secured to the side member 99 of the cradle 95. As shown, the side members 97 and 99 are bolted together, the bolts extending through the end pieces 100 and 101. The cradle 95 is provided with a plurality of slots through which extend supporting rollers. For example, the slot 103 has a roller 104 which is supported from the frame of an air engine 105. Similarly a roller 107 supported from the stationary contact 17 extends through a slot 108. The slots provide for the reciprocal longitudinal movement of the cradle 95.

An operating roller 110 secured to a cam 113 extends through a vertical slot 112. A driving gear 115 for the cam 113 is arranged in meshing relation with rack gear 118 provided on the piston 120 of the air engine.

In the operation of our invention the reverser may be operated from the circuit-controlling position shown in Fig. 1 to a second circuit-controlling position by admitting air through the pipe 130 to the lower part of the piston 120. The rack gear 118 will be driven upwardly to rotate the driving gear 115 in a clockwise direction.

It will be observed from Fig. 3 that the operating roller 110 occupies a position slightly below the center of the vertical slot 112. In this position the bias produced by the compression springs 34, 35 and 50, 51 produces a force on the cam 113 and driving gear 115 in a direction which biases the rack gear 118 downwardly. The piston 120 is thereby forced against the lower end of the cylinder. It will therefore be seen that the biasing springs, besides insuring a strong contact pressure, produces a force which locks or secures the rack gear 118 and the piston 120 in the position shown in the drawing, so that the circuit completed by the reverser cannot be interrupted notwithstanding the removal of the air pressure from the engine.

Continuing with the operation of our invention, the driving roller 110 first operates to move the cradle 95 in a direction to increase the contact pressure. This action continues until the roller 110 moves over center and comes into engagement with the right-hand side of the slot. At this point the spring pressure is reduced and the cradle 95 is moved to the right. As the contact surfaces 29 and 53 of the movable contacts 14 and 15 come into engagement with the contact surfaces 74 and 18 of the stationary contacts 17 and 18, the compression springs 34, 35 and 50, 51 are placed under compression. As soon as the operating roller 110 however is moved past center, the biasing force exerted by the springs is reversed with reference to the operating gear 115 and the rack gear, so that this force again serves to secure the movable contacts into engagement with the stationary contacts irrespective of whether or not air is being supplied to the air engine.

It will of course be understood that the reverser can be returned to the position shown in Fig. 1 by admitting air through the pipe 135 to the upper portion of the cylinder 120.

Ordinarily the control of the supply of air to the inlet pipes 130 and 135 is controlled by means of magnet valves. The interlock circuits for these magnet valves, as well as other control devices, may be connected through the contact fingers 136 supported on an insulating block 138. A second insulating block 140 is supported from a bracket 142 secured as by rivets 144 to the cradle 95. The insulating block 140 is provided with conductor plates 146 and 148. As the reverser is operated from one position to the other the circuits completed by the contact fingers may be controlled as desired.

It is to be understood that any number of movable contacts can be employed in accordance with the invention and that the circuit connections can be varied to suit particular applications of the invention. Furthermore the construction of the movable contacts can be modified and other structural changes made without departing from the scope of our invention.

While we have shown a particular embodiment of our invention, it will be understood, of course, that we do not wish to be limited thereto since many modifications may be made, and we, there-

fore, contemplate by the appended claims to cover any such modifications as fall within the true spirit and scope of our invention.

What we claim as new and desire to secure by Letters Patent of the United States is:

1. A circuit controller comprising a pair of stationary contacts, a movable contact, a biasing spring for said movable contact, operating means for moving said movable contact into engagement with either of said stationary contacts, said operating means being operable a predetermined additional distance against the bias of said spring so as to establish a predetermined contact pressure, said operating means including a driving connection for reversing the direction of said bias so as to secure said movable contact into engagement with said stationary contact with said predetermined contact pressure existing between said contacts.

2. A circuit controller comprising a plurality of stationary contacts, a cooperative movable contact formed by a flexible conductor having its ends secured together, contact plates secured to opposite sides of said conductor, resilient means interposed between said contacts for maintaining said contacts in spaced relation one with the other, an operating member associated with said resilient means for moving said movable contact against a selected one of said stationary contacts until a predetermined contact pressure is created, said operating means including a driving connection arranged to secure said movable contact into engagement with said stationary contact.

3. A circuit controller comprising a plurality of stationary contacts, a cooperative movable contact formed by a flexible conductor having its ends secured together to form a loop, contact members secured to opposite sides of said loop, resilient means for biasing said contact members away from each other, restraining means for limiting the movement of said contacts by said resilient means, an operating means operable between predetermined limits of movement for moving said restraining means to operate said movable contact into engagement with a selected one of said stationary contacts and for producing in conjunction with said resilient means a predetermined contact pressure, said operating means being connected with said restraining means so that said resilient means first opposes movement of said operating means and thereafter serves to exert its biasing force against said operating means to hold it in its operative position thereby locking the movable contact member against said stationary contact.

4. A circuit controller comprising a plurality of stationary contacts, a cooperative movable contact formed by flexible conductors secured together at one end, contact members secured to the opposite ends of said conductors, compression springs between said contact members, operating arms operatively connected to said compression springs, operating means connected to said operating arms for imparting a longitudinal movement to said movable contact to operate it into engagement with a selected one of said stationary contacts until a predetermined contact pressure is produced, the connection between said operating arm and said operating means forming a locking means for securing said movable contact into a position against one of said stationary contacts with a predetermined pressure existing between them.

5. A circuit controller comprising a plurality of stationary contacts, a cooperative movable contact formed by a flexible conductor having its ends secured together to form a loop, contact members secured to opposite sides of said loop, a spring guide located within said loop and adjacent each of said contact members, a compression spring between said spring guides for biasing said contact members away from each other, a pair of operating arms connected to said spring guides so as to prevent more than a predetermined spacing of said contact members, an operating arm connected to said operating member, driving means operable between predetermined limits for operating said arm to impart linear movement to said operating members whereby said contact members are moved into engagement with a selected one of said stationary contacts, the connection between said driving means and said arm being arranged to lock said contact member against said stationary contact with a predetermined contact pressure existing therebetween.

6. A circuit controller comprising a plurality of stationary contacts, a cooperative movable contact formed by a flexible conductor having its ends secured together to form a loop, contact members secured to opposite sides of said loop, a compression spring, a spring guide associated with each of said contact members for mounting said spring between them, operating members arranged on opposite sides of said loop and operatively connected to said spring guides, a pair of operating arms connected to said members for imparting linear movement thereto so as to operate said movable contact into engagement with a selected one of said stationary contacts, said operating arms being provided with a pair of vertical slots, a driving gear having projections extending into said slots, a piston operable between predetermined limits to rotate said driving gear through substantially 180 degrees, said projections being associated with said vertical slots so as to operate said movable contact member against said selected stationary contact so as to produce a maximum contact pressure when said projections occupy a position along a horizontal axis taken through said driving gear.

7. A circuit controller comprising a stationary conductor provided with contact surfaces on opposite faces thereof, a stationary contact spaced apart from each of said contact surfaces, a pair of movable contacts formed by flexible conductors having their ends secured together to form loops, contact members secured to opposite sides of said loops, compression springs for each of said loops, spring guides associated with each of said movable contacts for mounting said compression springs between adjacent contact members of said movable contacts, a pair of operating arms provided for each of said spring guides, an operating cradle connected to said operating members, said cradle being provided with a pair of vertical slots, a driving means operable between predetermined limits for said cradle, a driving connection between said operating means and said cradle including a pair of projections extending into said slots and arranged to be driven from one over-center position to another to operate said movable contacts into engagement with said stationary contacts until a maximum contact pressure is produced by said compression springs whereupon said driving connection acts to reverse the bias of said springs to lock said driving means against one or the other of its limits.

8. A circuit controller comprising a stationary conductor provided with contact surfaces on op-

posite faces thereof, stationary contacts spaced apart from said conductor, a pair of movable contacts formed by a pair of flexible conductors having the ends of each conductor secured together to form loops, contact members secured to opposite sides of said loops, a pair of spring guides associated with each of said movable contacts, a pair of compression springs associated with each of said movable contacts, a pair of operating members for mounting said compression springs and said spring guides within said loops and opposite said contact members, an operating cradle, connections for mechanically connecting said operating members to said cradle, a pneumatic driving means for said cradle including a cylinder and a piston operable between predetermined limits within said cylinder, a driving gear arranged to be rotated by said piston through substantially 180 degrees when said piston is moved from one limit to another, said cradle being provided with a pair of vertical slots and projections extending from said driving gear into said slots so as to operate said movable contacts into engagement with selected stationary contacts until a predetermined contact pressure is produced by said compression springs, said projections being so arranged with respect to said vertical slots that said cradle is locked into position by means of the bias of said springs exerted against said driving gear which biases said piston against said cylinder.

9. A circuit controller comprising stationary contacts, a cooperating movable contact provided with a biasing spring, operating means associated with said biasing spring for operating said movable contact against one of said stationary contacts until a predetermined pressure is established between said contacts by said biasing spring and an operating connection between said operating means and said movable contact operable from one overcenter position to a second overcenter position for applying the bias of said spring to create said contact pressure and to reverse the bias of said spring as applied to said operating means so as to secure said contacts together with said predetermined contact pressure existing between them.

10. A circuit controller comprising stationary contacts, a movable contact provided with a biasing spring, an operating cradle for operating said movable contact against one of said stationary contacts until a predetermined pressure is established between said contacts by said biasing spring, said cradle being provided with a pair of vertical slots, driving means operable between predetermined limits for said cradle, a driving connection between said operating means and said cradle including a pair of projections extending into said slots and arranged to be driven from one overcenter position to another to produce said contact pressure and to reverse the bias of said spring to secure said driving means in one or the other of its limits by means of the bias of said spring.

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