Feb. 8, 1955 W. R. GRACEY, JR 2,701,825

ELECTRIC CIRCUIT CONTROLLER

Original Filed Dec. 28, 1948 3 Sheets-Sheet 1

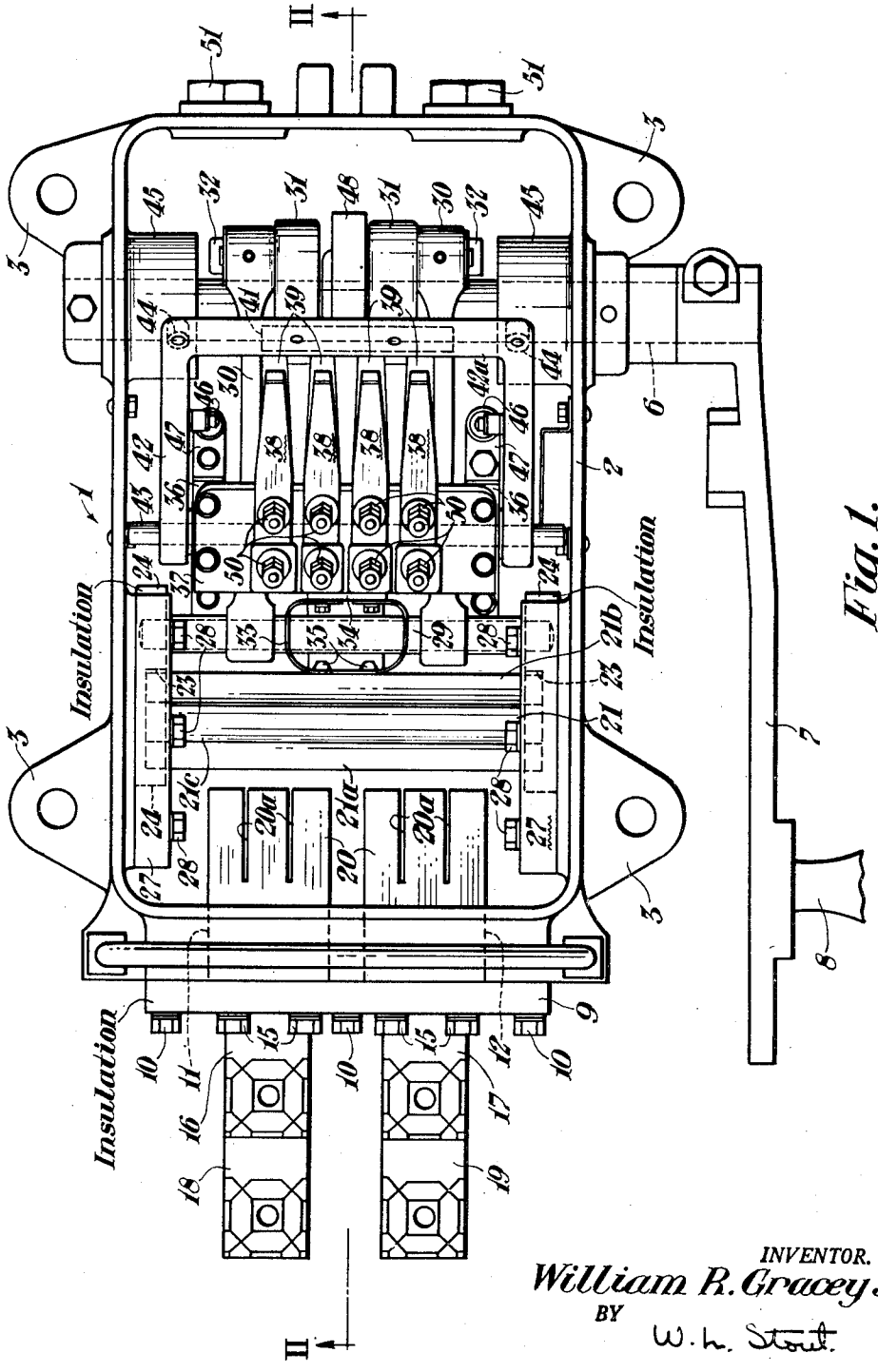


Fig. 1.

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Original Filed Dec. 28, 1948 3 Sheets-Sheet 2

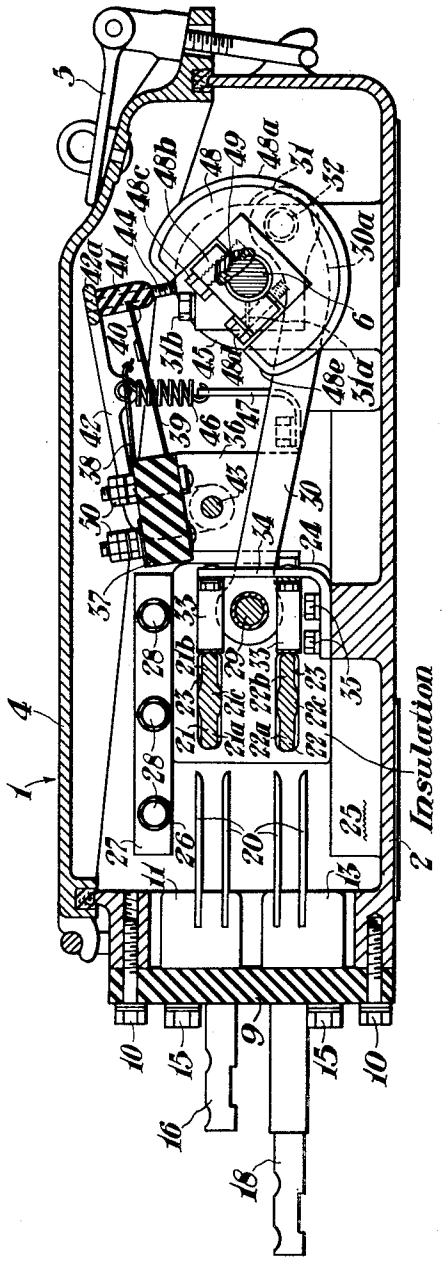


Fig. 2.

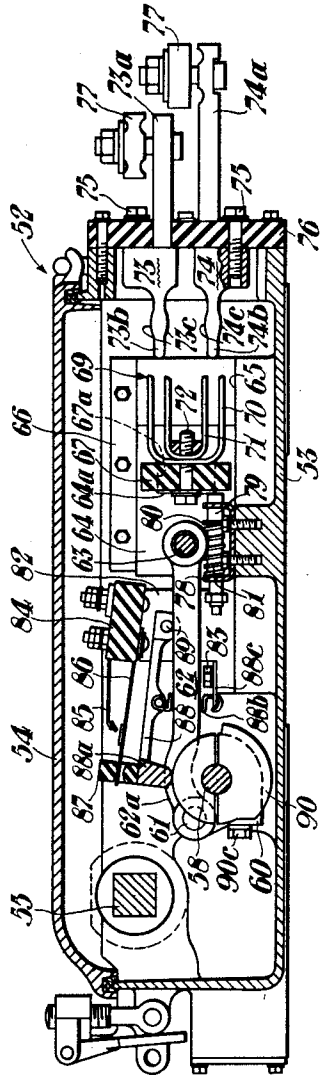


Fig. 4.

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Original Filed Dec. 28, 1948 3 Sheets-Sheet 3

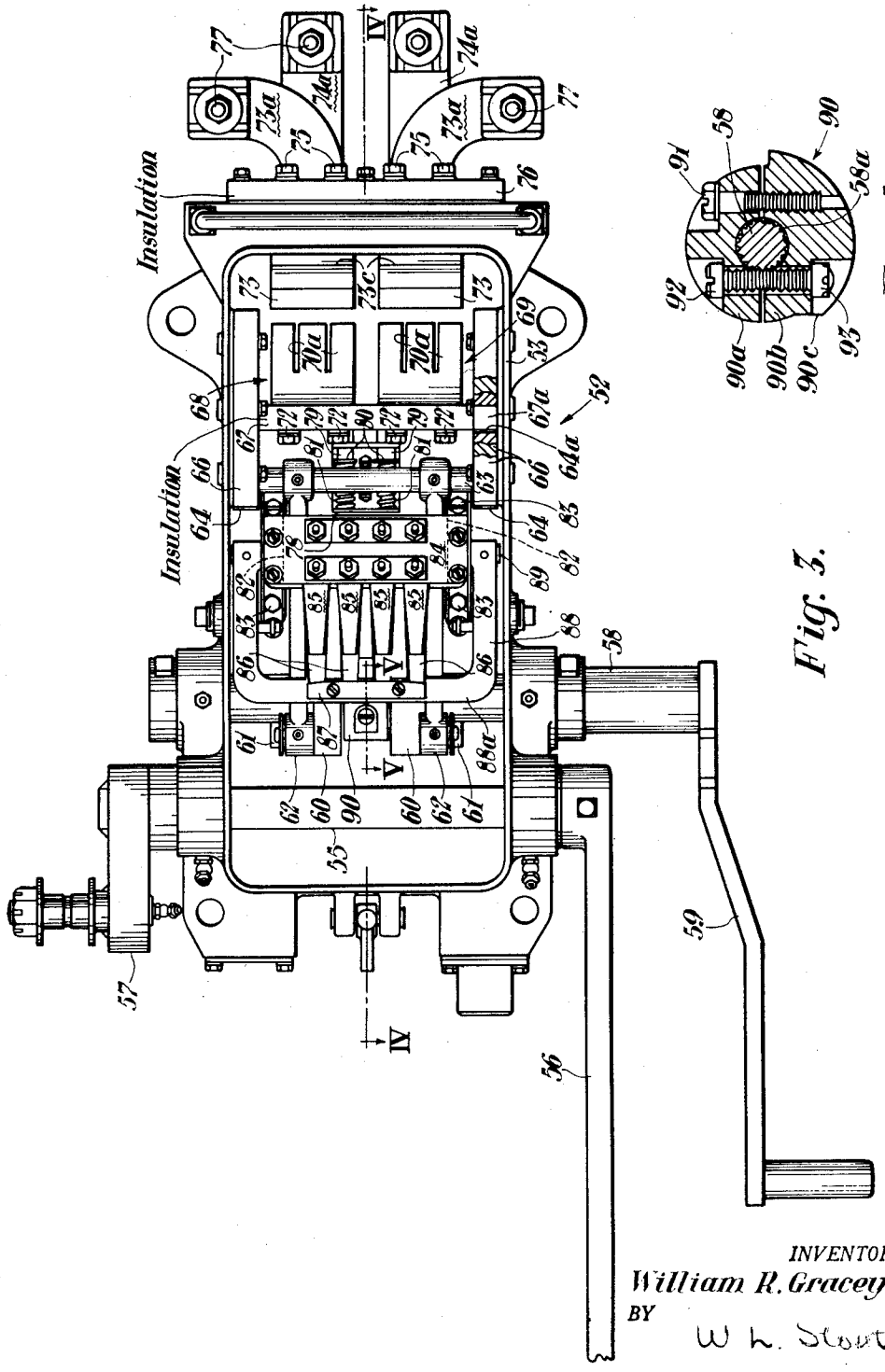


Fig. 1.

Fig. 5.

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Patented Feb. 8, 1955

2,701,825

ELECTRIC CIRCUIT CONTROLLER

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Original application December 27, 1948, Serial No. 67,264, now Patent No. 2,651,698, dated September 8, 1953. Divided and this application July 16, 1952, Serial No. 299,270

6 Claims. (Cl. 200—5)

My invention relates to an electric circuit controller, and particularly to a controller for shunting a track circuit and for controlling other circuits in a railway signal or control system.

The present application is a division of my copending application, Serial No. 67,264, filed on December 27, 1948, now U. S. Patent 2,651,698 granted September 8, 1953, for Electric Circuit Controllers.

It is sometimes necessary or convenient to provide a manually operable track switch in a section of a railway in which the signals are automatically controlled. In order to protect trains approaching such a switch, it is desirable to prevent manual operation of the switch until the signals have been set to stop for an adequate warning period. This may be done by providing a switch lock controlled by a manually movable member and a timer. The manual member may be operated at any time to set the signals governing the track approaching the switch to display a stop aspect, and start the timing mechanism running. After a predetermined time has expired, the timing mechanism releases the lock to permit manual actuation of the track switch.

The Letters Patent of the United States No. 2,539,937 issued to Howard A. Thompson, on January 30, 1951, for Traffic Protection Apparatus, illustrates a switch locking system of this type. Thompson shows a track switch operable by means of an electrically locked hand-throw lever, and a circuit controller operated by an auxiliary lever movable between normal and reverse positions. When this auxiliary lever is first moved away from its normal position, the circuit controller shunts the track circuit, thereby setting the signals governing trains approaching the switch to stop. As the motion of the manual auxiliary lever to its reverse position is completed, it actuates additional contacts to initiate the operation of a timing mechanism which eventually releases the electric lock on the hand-throw lever of the track switch.

The present invention relates to a circuit controller for use in a system of the type described in the Thompson patent.

An electric circuit controller for shunting a railway track circuit and for controlling additional circuits, if mounted on the railway ties, is subject to severe conditions of vibration. This vibration will cause undue wear between the parts if relative motion of the parts is not prevented.

Where such a controller is used to shunt a track circuit on an electric railway, it must have high current carrying capacity. On electrified railways, the rails are commonly used as a current flow path, and unbalanced resistance conditions in the opposite rails may cause high current flow through track shunting contacts. Such a controller must therefore have heavy duty contacts. If the controller is required to additionally control other circuits, for example, signal or control circuits, then additional light duty contacts must be provided in the controller.

Where a controller is to be mounted on the ties of a railway, it is desirable that its overall height be low enough so that it may be mounted between the rails of a track without projecting sufficiently above the track to foul any portion of the equipment passing over it.

An object of my invention is therefore to provide an improved electric circuit controller of high current carrying capacity.

Another object is to provide an electrical circuit controller which may be subjected to severe vibration without producing undue wear between the moving parts of the controller.

A further object is to provide an improved controller including a set of heavy duty contacts and a set of light duty contacts in the same casing and operated by movement of the same control member.

A further object is to provide an improved controller of the type described in a compact structure so arranged that it may be mounted between the rails of a railway track without projecting far enough above the track rails to foul rolling stock passing over it.

According to my invention, I achieve these objects by using elongated fixed and movable contacts mounted horizontally, and support the movable contact so that it is moved horizontally to open and close the circuit. This construction aids in keeping the overall height of my controller at a minimum. In order to provide high current carrying capacity, one of the contacts is made in the form of a flat bar having convex upper and lower surfaces. This bar moves between a pair of flat spring contacts which, in their disengaged condition, are spaced apart by a distance somewhat less than the distance between the opposite convex surfaces on the bar contacts. In this way, a line contact is maintained between the bar and the flat springs.

The controller is operated by an external manual lever which rotates a shaft through an angle of 180°. This shaft is connected to the movable contact supporting structure through a crank and pitman to provide a linear movement of the movable contact upon rotation of the shaft.

The movable contact is loosely mounted on its support so that minor misalignments between the fixed and movable contacts may be accommodated. The spring contact structure is effective when the contacts are closed to take up all lost motion in the contact supporting operating mechanism, so as to prevent wear in the operating parts due to vibration. A stationarily supported spring is provided in the path of movement of the movable contacts so as to engage those contacts as soon as they separate from the stationary contact. This spring device places the movable contact and the contact operating element under tension, and thereby is effective when the contacts are open to take up all lost motion in either the loose mounting of the movable contact or in the bearings of the shaft, crank, and pitman.

The light duty contact assembly is mounted on a bridge structure above the pitman and is operated by a cam adjustably fixed on the crank shaft.

Other objects and advantages of my invention will become apparent as the description proceeds.

I shall describe two forms of circuit controllers embodying my invention, and shall then point out the novel features thereof in claims.

In the drawings,

Fig. 1 is a plan view of one form of electric circuit controller constructed in accordance with my invention, with the cover removed.

Fig. 2 is a cross-sectional view of the controller taken along the line II—II of Fig. 1.

Fig. 3 is a plan view of a modified form of controller built in accordance with my invention, with the cover removed.

Fig. 4 is a cross-sectional view of the controller taken along the line IV—IV of Fig. 3, while

Fig. 5 is a detail cross-sectional view taken along the line V—V of Fig. 3.

Referring to the drawings, there is shown in Figs. 1 and 2 a controller generally indicated at **1**. The controller **1** includes a casing **2** having mounting feet **3** and a removable cover **4**. A latch **5**, of known construction, is provided to hold the cover in place. A squared shaft **6** projects outside the casing and carries an operating lever **7** having a handle **8**.

One end of the casing **4** is open, and is closed by means of an insulating plate **9** attached to the casing by means of bolts **10**. Four contact supporting blocks are secured to the insulating plate **9**, in spaced pairs, only three of the blocks **11**, **12** and **13** being illustrated in the drawings. The blocks are secured to the plate **9** by means of bolts

15, the blocks carrying the electrical terminals 16, 17 and 18, respectively, and the terminal 19 for the block not illustrated. The electrical terminals extend outwardly through the insulating plate 9. The outside ends of these terminals are adapted for the attachment of suitable heavy current conductors for shunting the rails of a track circuit. Inside the casing 4, each of the contact supporting blocks carries a pair of spaced spring contact blades 20. These blades 20 are elongated in the horizontal plane and are slotted, as at 20*a*, to permit independent movement of the portions between the slots, so as to accommodate misalignment of the contacts.

It should be noted that the blades 20 on the upper contact supporting blocks 11 and 12 are horizontally aligned with each other and that the blades 20 on the lower contact supporting blocks are likewise horizontally aligned with each other. The upper set of blades 20 is adapted to be bridged by a movable contact bar 21, and the lower set of blades 20 may be bridged by a movable contact bar 22.

The bars 21 and 22 are formed with relatively narrow edge portions 21*a*, 21*b*, 22*a*, and 22*b* and wider central portions 21*c* and 22*c* having convex surfaces. The convex surfaces 21*c* and 22*c* are made wider than the distance between the spring blades 20, so that when the contact bars 21 and 22 move between the blades 20, those blades ride on the convex surfaces, thereby producing substantially a line contact between the blades and the contact bars.

The advantage of a line contact is that it provides high current carrying capacity while the force necessary to operate the movable contacts is held at a minimum. This advantage is gained by arranging the parts to produce high contact pressures so that correspondingly high current densities may be used.

A line contact could alternatively be obtained through the use of a flat bar contact and a contoured spring contact. The construction shown is greatly to be preferred, however, since it is much easier to maintain accurate dimensions in a solid bar with a convex contour than it is in a relatively thin flexible spring with a corresponding contour. The dimensions of the bar and spring contacts are very important in this construction, because these dimensions are major factors in determining the contact pressure and hence the allowable current density.

The opposite ends of the contact bars 21 and 22 are loosely received in recesses 23 formed in a pair of movable contact supporting slide blocks 24, of insulating material. Each of the slide blocks 24 moves between a lower guiding surface 25 formed in the casing 2 and an upper guiding surface 26 formed on the lower side of a rail 27 attached to the side of casing 2 by means of bolts 28.

The slide blocks 24 are connected by means of a crosshead rod 29, which is in turn connected by two pitmans 30 to crank arms 31 attached to the shaft 6. Each pitman 30 is connected to its associated crank arm 31 by means of a pin 32. Each pitman 30 is curved, as indicated at 30*a* in Fig. 2 to permit rotation of the shaft 6 further in a counterclockwise direction (as viewed in Fig. 2) than would otherwise be possible. The crank arms 31 are rigidly attached to the shaft 6 by any suitable means, as for example by using a split crank arm as indicated at 31*a*, and a bolt 31*b* to tighten the opposite parts of the crank arm together.

At all bearings, such as the bearings of shaft 6, the pins 32, and the crosshead rod 29, a certain small clearance must be allowed so that the relatively rotatable members can turn freely and without binding. A controller intended to be mounted on a railway track is likely to be subjected to very severe conditions of vibration. The vibration tends to cause the relatively rotatable parts to move relative to each other, because of the clearances between them, thereby causing friction and wear of the parts. Also, the vibration might cause movement and wear of the contact bars 21 and 22 in their sockets 23 unless some means is provided to prevent it.

I prevent wear due to such vibration conditions by the provision of two springs 33 mounted on a bracket 34 so that they are aligned with the contact bars 21 and 22. The bracket 34 is attached as by bolts 35 to the bottom of the casing 4. The springs 33 are so arranged that as the contact bars 21 and 22 move to their normal open circuit position, as shown in the drawings, they engage the springs 33. The springs 33 thereby hold the contact bars 21 and 22 tightly against the left-hand ends of their supporting

recesses 23, as viewed in Fig. 2. At the same time, the springs 33 place all the bearings associated with the pitman 30, crank 31, and shaft 6 under tension, so that all lost motion due to clearances between these parts is taken up. Since the parts are held firmly against each other, they cannot rub or pound so as to cause excessive wear.

The stationary contact assembly, including the mounting plate 9, the contact supporting blocks 11, 12, and 13, the connectors 16, 17, 18, and 19, and the contact blades 19 is removable as a unit from the casing by taking out the attaching bolts 10.

The light duty contacts of my controller are mounted on a pair of supports 36 which are removably attached to the bottom of the casing adjacent the opposite sides thereof. An insulating plate 37 is attached to the tops of the supports 36, and bridges the pitmans 30. The plate 37 carries a row of fixed contacts 38, and a row of movable contacts 39, all of the leaf spring type. The movable contacts 39 are longer than the fixed contacts 38, and their ends project into suitable notches 40 formed in an insulating member 41. The member 41 is carried by a yoke 42, whose ends are pivotally attached to a shaft 43 journaled in the supports 36.

The insulating member 41 is carried on a crossbar 42*a* of yoke 42. At the ends of the crossbar 42*a* the yoke is provided with bolts 44 which engage hubs 45 formed in the casing 2, in which hubs the shaft 6 turns. A pair of biasing springs 46 have their upper ends connected to the yoke 42 and their lower ends connected to brackets 47, which are attached to the casing 2 by certain of the bolts which hold the supports 36. The biasing springs 46 hold the yoke 42 down so that screws 44 engage the hubs 45. The insulating support 41 is then in the path of movement of an adjustable cam 48 mounted on the shaft 6. With this construction, the entire light duty contact assembly including supports 36, plate 37, contacts 38—39, yoke 42, and springs 46 may be removed as a unit for inspection or repair without disturbing the heavy duty contacts or their operating mechanism.

Cam 48 comprises an operating portion 48*a* and a clamping portion 48*b* secured together by means of an adjusting screw 48*c* and a clamping bolt 48*d*. The adjusting screw 48*c* cooperates intermediate its ends with an annular threaded groove 49 formed in the shaft 6 in such manner that by first backing off the clamping bolt 48*d* and then rotating the adjusting screw 48*c* the cam can be readily rotated to any desired angular position relative to the shaft. After the desired adjustment has been made, the clamping bolt is again tightened and the cam will then be securely held in its adjusted position.

The lower end of insulator 41 lies in the path of the operating surface of cam 48. When cam 48 engages the insulator 41, it moves upwardly, carrying with it the movable contacts 39 into engagement with their associated stationary contacts 38.

By means of adjustable cam 48, any desired relationship may be established between the angular position of shaft 6 at which the heavy duty contacts are operated and the angular position of shaft 6 at which the light duty contacts are operated. For example, where the heavy duty contacts are used to shunt a track circuit, then it is desired to have the light duty contacts set so that their circuit is not completed until the motion of the hand operating lever 7 to its reverse position is substantially complete. This mode of operation will be secured with the cam adjusted as shown in the drawings. With the cam in this position, the light duty contacts are not operated until the shoulder 48*e* of the cam moves around and engages the insulator 41.

The insulating block 37 is provided with suitable terminals 50 connected to each of the contacts 38 and 39. The casing is provided with conduit outlets 51 for permitting the passage of wires leading to the terminals.

It may be seen that upon clockwise rotation of the shaft 6 by the manual lever 7, the contact bars 21 and 22 will be moved to the left to engage their respective stationary contact blades 20. After this engagement has been made, the cam 48 will thereafter operate the light duty contacts 38 and 39 to their closed positions.

Both the fixed and movable heavy duty contacts are elongated horizontally to obtain the required size and current carrying capacity. This construction of the contacts and the mounting of the movable contacts for horizontal movement allow my circuit controller to be

constructed with a low overall height so that it may be readily mounted between the rails of a railway track.

There is shown in Figs. 3–5 another form of electric circuit controller, generally indicated by the reference character **52**, which is adapted for use in an installation to be described hereinafter and which includes a modified form of heavy duty contact mechanism.

The circuit controller **52** includes a casing **53** having a cover **54**. Near the left end of casing **53**, as it appears in the drawings, a shaft **55** extends transversely through the casing and outwardly beyond both sides of the casing. One one end of the shaft **55** is fixed a hand-throw lever **56** and on the opposite end of the shaft **55** is fixed a crank arm **57**.

A circuit controller operating shaft **58** also extends through the casing transversely and has one end projecting outside the casing and carrying a hand operating lever **59**.

Inside the casing **53**, the shaft **58** is arranged to operate a set of heavy duty contacts and a set of light duty contacts. The mechanism for operating the heavy duty contacts includes a pair of crank arms **60** fixed on the shaft **58** by suitable means and connected by crank pins **61** to a pair of pitmans **62**.

The pitmans **62** are provided with lateral curves **62***a* to permit rotation of the crankshaft **58** farther in a counterclockwise direction without fouling the shaft than would otherwise be the case. The opposite ends of the pitmans **62** are pivotally connected to a crosshead rod **63** journaled at its ends in a pair of slide blocks **64**. Each of the slide blocks **64** moves between a lower guiding surface **65** cast integrally with the casing **53** and an upper guide rail **66** bolted to the side of the casing **53**.

The slide blocks **64** support the opposite ends of an insulating plate **67**, which carries the movable contacts of the heavy duty circuit controller. These slide blocks **64** are provided with apertures **64***a* which loosely receive projections **67***a* on the ends of the insulating plate **67**, so that the latter is loosely mounted at its ends in the slide blocks **64**.

Mounted on the insulating plate **67** are two sets of heavy duty contacts, the sets being generally indicated respectively by the reference characters **68** and **69**. Each set comprises two channel-shaped spring members **70** and **71** (see Fig. 4) of different widths. These channel-shaped members are held together in nested relation on the insulating plate **67** by means of bolts **72**. The spring members **70** and **71** are slotted, as shown at **70***a* in Fig. 3, so as to accommodate misalignment of the contacts.

Each set of movable heavy duty contacts **68** and **69** cooperates with a pair of upper and lower stationary contact bars **73** and **74**. The contact bars **73** and **74** are mounted by means of bolts **75** on an insulating terminal board **76** which closes an open end of the casing **53**. The contact bars **73** and **74** are provided with integral extensions **73***a* and **74***a* which pass through the insulating board **76** and are provided outside the casing **53** with terminal lugs **77**.

The contact bars **73** and **74** are provided with relatively thin edge portions **73***b* and **74***b* narrower than the space between the spring contact members **70** and **71**, and relatively thick central portions having convex surfaces **73***c* and **74***c*. These convex surfaces are made wider than the distance between the spring blades **70** and **71**, so that when the blades engage the contact bars, a line contact is produced.

A spring loading mechanism is provided for the heavy duty movable contact structure to prevent rattling and wear due to vibration. This mechanism includes a U-shaped bracket **78** mounted on the bottom of the casing **53**. Two spring rods **79** extend through apertures in the opposite sides of the bracket **78**. Each spring rod **79** carries a spring retaining washer **80**. A spring **81** encircles each spring rod between the left side of the U-shaped bracket **78** and the spring retaining washer **80**. The springs **81** bias the spring rods **79** to a position in which the washers **80** engage the inner surface of the right-hand side of the U-shaped bracket **78**. When the movable heavy duty contact structure is in its normal position, as shown, the insulating plate **67** is moved against the ends of the spring rods **79** so as to compress the springs **81**. The springs **81** are thereby effective to take up all lost motion between the plate **67** and the slide blocks **64**, and are also effective to take up the lost motion in the bearings of the mechanism which drives the slide blocks **64**.

The light duty contact structure of my controller is mounted on a pair of supports **82** which are attached to the bottom of the casing **53** adjacent the opposite sides thereof by means of bolts **83**. An insulating plate **84** is mounted on the supports **82**, spanning the pitmans **62**. The plate **84** carries a row of fixed contacts **85** and a row of movable contacts **86**, all of the leaf spring type. The movable contacts **86** are longer than the fixed contacts **85**, and their ends project into suitable notches formed in an insulating member **87**. The member **87** is carried by a yoke **88**, whose ends are pivotally mounted on pins **89** set in the supports **82**. The yoke **88** has a crossbar **88***a* which carries the insulating member **87**. The lower edge of crossbar **88***a* is contoured to provide a cam follower which cooperates with a cam **90** attached to the shaft **58**. A spring **88***b*, connected between yoke **88** and a bracket **88***c* held in place by one of the bolts **83**, biases the follower into engagement with cam **90**. As in the case of the controller of Figs. 1 and 2, the entire light duty contact assembly may be removed for inspection or repair without disturbing the heavy duty contacts.

Cam **90** (see Fig. 5) comprises two portions **90***a* and **90***b* secured together on the shaft **58** by means of a clamping bolt **91**. An adjusting screw **92** passes freely through openings in the cam portions **90***a* and **90**b and is held against longitudinal movement with respect to those cam portions by its head and by a lock nut **93**, respectively. The adjusting screw **92** cooperates intermediate its ends with an annular threaded groove **58***a* formed in the shaft **58**. By loosening the clamping bolt **91** and rotating the adjusting screw **92**, the cam may be readily moved to any desired angular position relative to the shaft. If the clamping bolt is again tightened, the cam will then be securely held in its adjusted position.

By adjustment of cam **90**, any desired relationship may be established between the angular position of shaft **58** at which the heavy duty contacts close and the angular position at which the light duty contacts close.

When the circuit controller shaft **58** is operated by the lever **59** through 180° clockwise from the position shown in the drawings, then, with the cam adjustment illustrated, the heavy duty contacts will close first, and the light duty contacts will close later when the shoulder **90***c* of cam **90** engages the cam follower **88***a*.

Although I have herein shown and described only two forms of circuit controllers embodying my invention, it is understood that various changes and modifications may be made therein within the scope of the appended claims without departing from the spirit and scope of my invention.

Having thus described my invention, what I claim is:

1. An electric circuit controller comprising fixed and movable heavy duty contacts at least one of said contacts including a heavy spring which is deflected upon engagement of said contacts, fixed and movable light duty contacts at least one of said contacts including a light spring which is deflected upon engagement of said contacts, common operating mechanism for both the heavy duty and light duty contacts including a shaft, means for rotating the shaft, a crank on the shaft, a pitman connecting the crank to the movable heavy duty contacts, a cam on the shaft, and a follower for the cam connected to the movable light duty contacts.

2. An electric circuit controller as in claim 1, including a support for said light duty contacts, means on the support for mounting said cam follower, a spring connecting the support and the follower and biasing the follower into engagement with the cam, a casing for enclosing all the contacts and their operating mechanism, and means for removably attaching the support to the casing so that the support, light duty contacts, spring and follower may be removed therefrom without disturbing the heavy duty contacts or their operating mechanism.

3. An electric circuit controller comprising fixed and movable heavy duty contacts, fixed and movable light duty contacts, common operating mechanism for the movable heavy duty and light duty contacts including a shaft, a crank on the shaft, means for supporting the movable heavy duty contacts, means guiding said supporting means for linear movement, a pitman connecting the crank to said supporting means, a terminal board for supporting said light duty contacts, means for mounting said terminal board spanning said pitman, a cam on the shaft, a cam follower pivoted on said mounting means and operatively connected to the movable light duty contacts, and means

for rotating said shaft to cause engagement and disengagement of said fixed and movable contacts.

4. An electric circuit controller comprising fixed and movable heavy duty contacts, fixed and movable light duty contacts, common operating mechanism for the movable heavy duty and light duty contacts including a shaft, a crank on the shaft, means for supporting the movable heavy duty contacts, means guiding said supporting means for linear movement, a pitman connecting the crank to said supporting means, a terminal board for supporting said light duty contacts, means for mounting said terminal board spanning said pitman, a cam on the shaft, a yoke pivoted on said mounting means and operatively connected to the movable light duty contacts, a cam follower on said yoke cooperating with said cam, and means for rotating said shaft to move said supporting means linearly and said yoke angularly to engage and disengage the heavy and light duty contacts respectively.

5. A circuit controller comprising an enclosure, an insulating member at one end, fixed heavy duty contacts secured to said insulating member, a linearly movable support within said enclosure adjacent the one end thereof, movable heavy duty contacts secured to said support and adapted to engage the fixed heavy duty contacts, a shaft journaled at the other end of said enclosure, a crank on said shaft, a pitman interconnecting said crank and the movable support, a terminal board within said enclosure and spanning said pitman, fixed and movable light duty contacts supported by said terminal board, a yoke pivoted in said enclosure between said shaft and said movable support and operatively connected with the light duty contacts, a cam on said shaft, a cam follower on said yoke

cooperating with said cam, and means for rotating said shaft to move said movable support linearly and said yoke angularly to engage and disengage the heavy and light duty contacts respectively.

6. A circuit controller comprising an enclosure, an insulating member at one end, fixed heavy duty contacts secured to said insulating member, a linearly movable support within said enclosure adjacent the one end thereof, movable heavy duty contacts secured to said support and adapted to engage the fixed heavy duty contacts, a shaft journaled at the other end of said enclosure, a crank on said shaft, a pitman interconnecting said crank and the movable support, a terminal board within said enclosure and spanning said pitman, fixed and movable light duty contacts supported by said terminal board, a yoke pivoted in said enclosure between said shaft and said movable support, an insulating member carried by said yoke and operatively connected with the movable light duty contacts, a cam on said shaft, a cam follower on said yoke cooperating with said cam, and means for rotating said shaft to move said movable support linearly and said yoke angularly to engage and disengage the heavy and light duty contacts respectively.

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