Sept. 14, 1937. H. L. BONE 2,092,828

RAILWAY SWITCH OPERATING APPARATUS

Filed Sept. 14, 1935 4 Sheets-Sheet 1

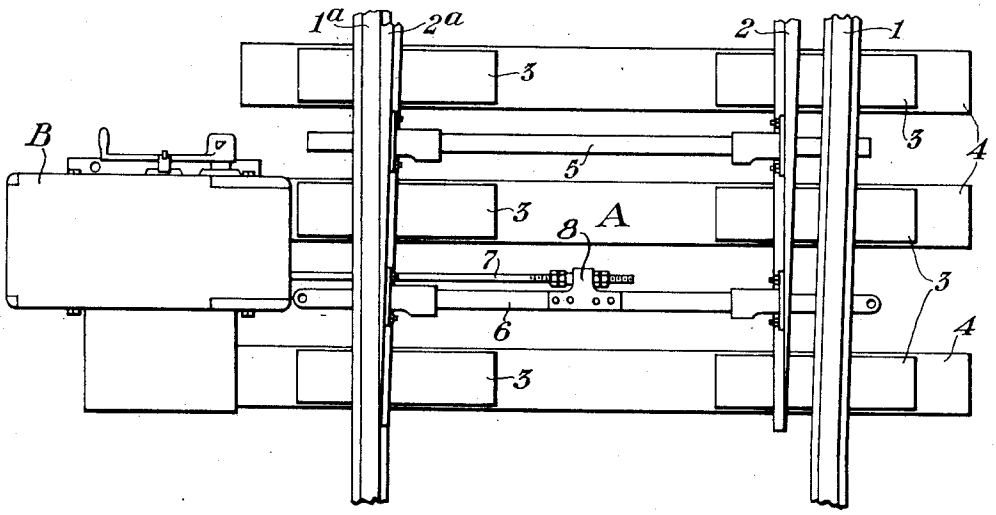

Fig. 1.

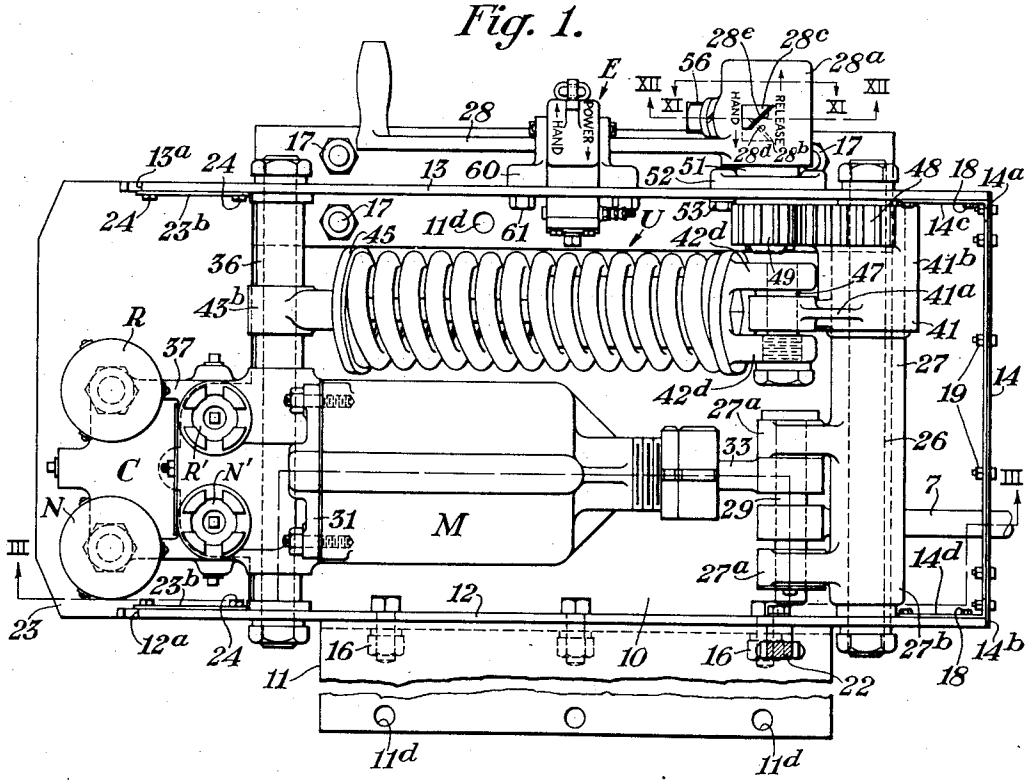

Fig. 2.

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RAILWAY SWITCH OPERATING APPARATUS

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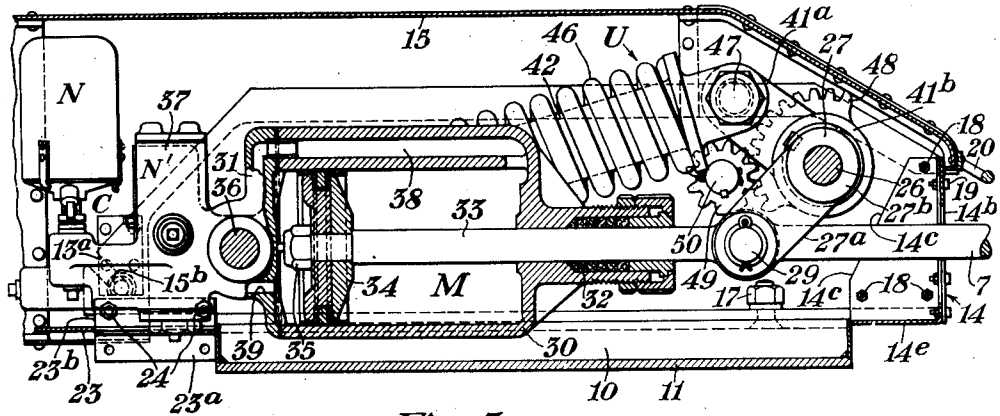

Fig. 3.

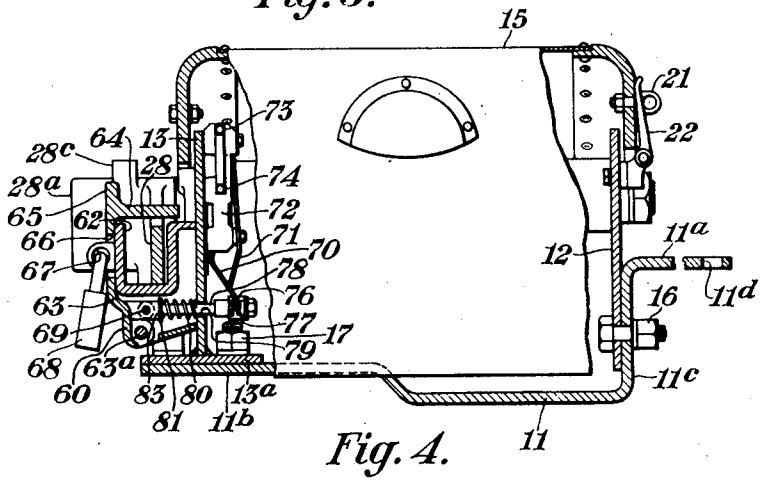

Fig. 4.

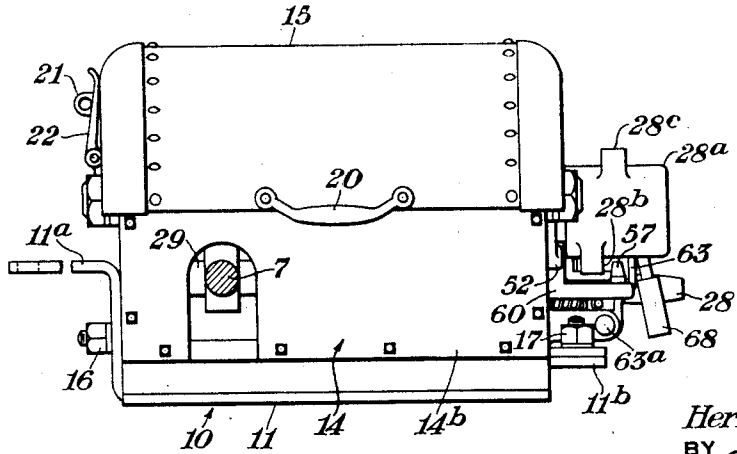

Fig. 5.

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RAILWAY SWITCH OPERATING APPARATUS

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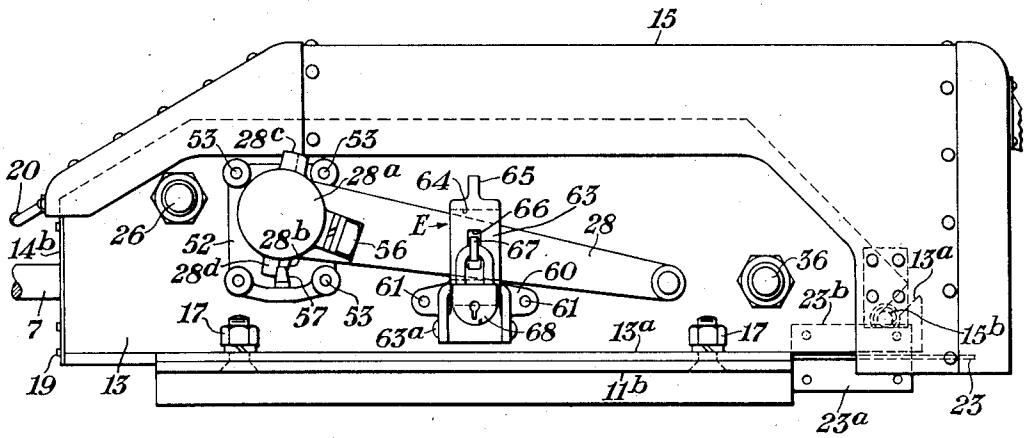

Fig. 6.

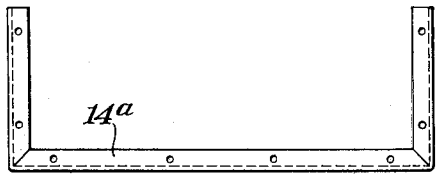

Fig. 7.

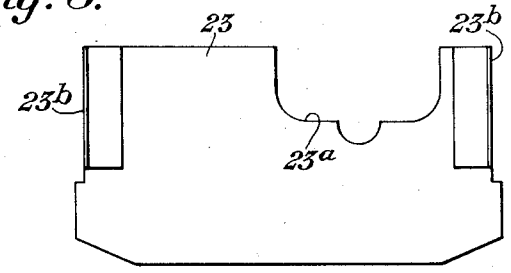

Fig. 8.

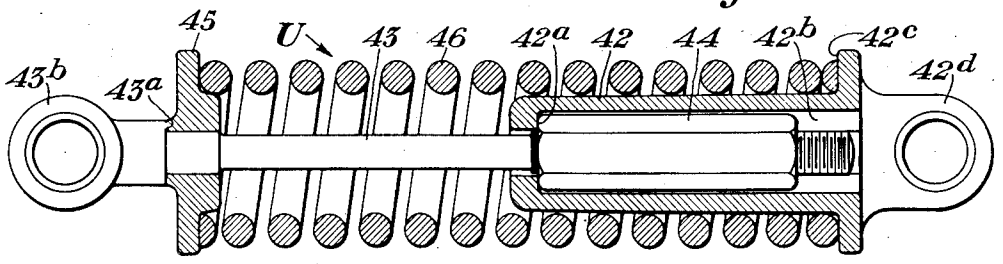

Fig. 9.

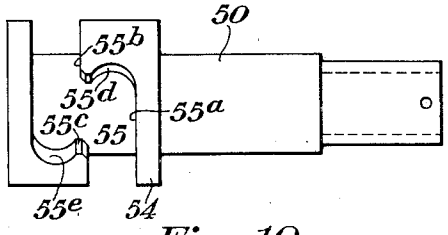

Fig. 10.

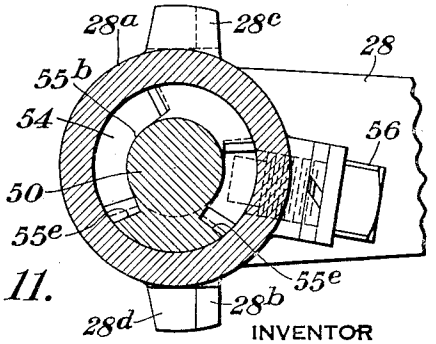

Fig. 11.

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RAILWAY SWITCH OPERATING APPARATUS

Filed Sept. 14, 1935 4 Sheets-Sheet 4

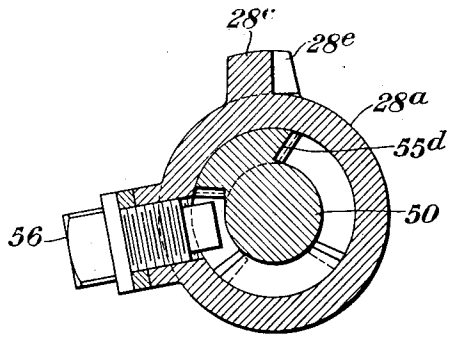

Fig. 12.

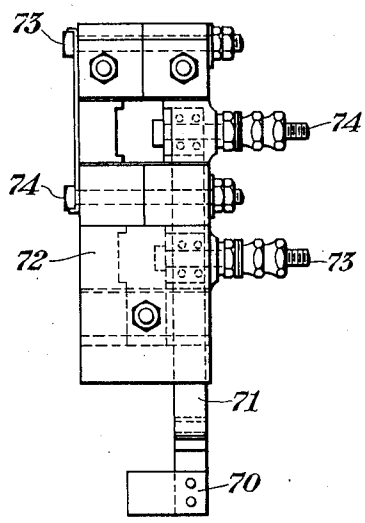

Fig. 13.

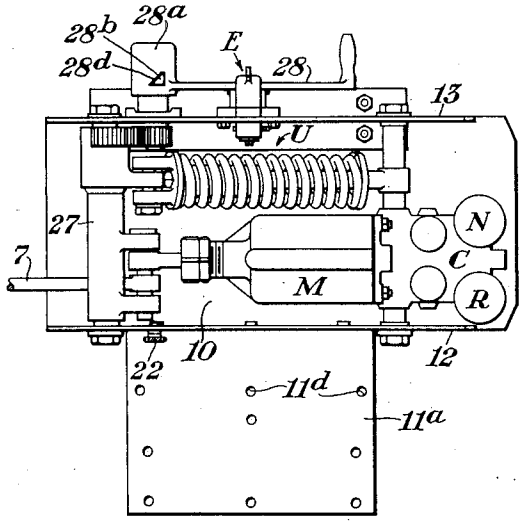

Fig. 14.

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2,092,828

UNITED STATES PATENT OFFICE

2,092,828

RAILWAY SWITCH OPERATING APPARATUS

Herbert L. Bone, Pittsburgh, Pa., assignor to The Union Switch & Signal Company, Swissvale, Pa., a corporation of Pennsylvania

Application September 14, 1935, Serial No. 40,606

15 Claims. (Cl. 246—393)

My invention relates to railway switch operating apparatus, and has for an object the provision of a novel electropneumatic switch operating mechanism which is fast in operation, which permits the switch with which it is connected to be trailed by a train without any danger of derailing the train or damaging the mechanism, which can be manually operated both under normal conditions and in the event of a failure either of the supply of electrical energy or of fluid pressure, and which can be safely provided with valve mechanism which cuts off the supply of fluid pressure to the operating cylinder of the operating mechanism when the switch has been operated to either extreme position by the operating mechanism.

I will describe one form of switch operating apparatus embodying my invention, and will then point out the novel features thereof in claims.

In the accompanying drawings, Fig. 1 is a top plan view showing a railway switch A provided with one form of switch operating mechanism B embodying my invention. Fig. 2 is a top plan view on an enlarged scale of the mechanism B shown in Fig. 1, the cover being removed to better illustrate the construction of the parts. Fig. 3 is a sectional view taken substantially on the line III—III of Fig. 2. Fig. 4 is a left-hand end view, partly in section and partly in elevation of the mechanism B shown in Fig. 2. Fig. 5 is a right-hand end view of the mechanism B shown in Fig. 2. Fig. 6 is a side view, looking downwardly as viewed in Fig. 2, of the mechanism B shown in the preceding views. Fig. 7 is a detail view of the part 14ª of the end closure member forming part of the casing for the mechanism shown in the preceding views. Fig. 8 is a top plan view of the auxiliary closure plate 23 forming part of the casing for the mechanism shown in the preceding views. Fig. 9 is a sectional view of the toggle spring unit U forming part of the mechanism B shown in Figs. 2 and 3. Fig. 10 is a detail view showing, on an enlarged scale, the hand crankshaft 50 forming part of the mechanism illustrated in Figs. 2 and 3. Figs. 11 and 12 are sectional views taken on the lines XI—XI and XII—XII, respectively, of Fig. 2. Fig. 13 is a detail view showing a portion of the cut-out switch which is controlled by the lever latch E. Fig. 14 is a top plan view showing the mechanism described in the preceding views assembled for use in connection with a right-hand switch layout.

Similar reference characters refer to similar parts in each of the several views.

Referring first to Fig. 1, the reference character A designates a railway switch comprising, as usual, two fixed rails 1 and 1ª and two movable rails 2 and 2ª. The fixed rails 1 and 1ª are laid on tie plates 3 and are secured to crossties 4 in the usual and well-known manner. The movable rails 2 and 2ª are fastened together by a tie rod 5 and a head rod 6, and may be moved into normal and reverse positions by means of a throw rod 7 which is connected with the head rod 6 through the medium of the usual switch basket 8. When the switch occupies its normal position, in which position it is shown in the drawings, the movable rail 2ª engages the fixed rail 1ª, and the movable rail 2 is spaced a sufficient distance from the fixed rail 1 to permit the flange of a car wheel which is rolling along the fixed rail 1 to pass freely between the fixed rail 1 and the movable rail 2. When the switch is reversed, the movable rail 2 then engages the fixed rail 1, and the movable rail 2ª is spaced from the fixed rail 1ª.

Associated with the switch A is a switch operating mechanism B embodying my present invention, which mechanism I will now describe. As best seen in Figs. 2 to 6, inclusive, the mechanism is enclosed in a casing 10 which may have any suitable construction, but which in the form here illustrated comprises a base plate 11, two side plates 12 and 13, an end closure member 14, and a removable cover 15. The base plate 11 is constructed of pressed steel and, as best seen in Figs. 4 and 5, is bent to form two vertically offset laterally projecting portions 11ª and 11ᵇ and a vertically disposed portion 11ᶜ. The offset portions 11ª and 11ᵇ are each provided with a plurality of holes 11ᵈ for the reception of lag screws, bolts or the like, to facilitate fastening the base plate to a pair of the adjacent crossties 4 or other suitable foundation. The side plate 12 is bolted to the vertical portion 11ᶜ of the base plate by means of bolts 16 in such manner that this side plate may be turned end for end. The side plate 13 is welded at its lower edge to a horizontal member 13ª which latter member, in turn, is bolted to the laterally projecting portion 11ᵇ of the base plate 11 by means of bolts 17 in such manner that the side plate 13 is parallel to the side plate 12, and that the side plate 13 may also be turned end for end. The base plate 11 is made somewhat shorter in length than the two side plates for reasons which will appear as the description proceeds. The end closure member 14 comprises a frame 14ª and an end plate 14ᵇ. The frame 14ª, which frame is shown on an en-

larged scale in Fig. 7, is constructed of pressed steel, and as will be apparent from an inspection of Figs. 2 and 3 is bent to form two angularly shaped side portions 14c and 14d which are secured to the side plates 12 and 13 by means of studs 18, and a base portion 14e which projects inwardly and engages the adjacent end of the base plate. The end plate 14b is secured to the frame 14a by means of bolts 19 in such manner that this end plate may be turned end for end. The cover 15 is also constructed of pressed steel and is provided adjacent one end with two inwardly projecting trunnions 15b, and at the other end with a handle 20. The trunnions 15b extend into, and cooperate with, inclined aligned slots 12a and 13a (see Figs. 2, 3 and 6) formed in the end plate in such manner that the cover can be rotated about the trunnions 15b between a closed position in which it is shown in Fig. 6 and an open position in which access to the interior of the casing may be had, and that, if desired, the cover can be completely removed by merely lifting it upwardly in a manner to remove the trunnions 15b from the inclined slots 12a and 13a formed in the plates 12 and 13. The cover may be locked in its closed position by placing a padlock through a staple 21 which is secured to the cover, and which cooperates with a hasp 22 which is secured to the side plate 12. The casing 10 further comprises an auxiliary closure plate 23 (see Fig. 8) which is provided at each side with oppositely extending apertured right angle portions 23a and 23b, and which is secured to the side plates 12 and 13 adjacent their left-hand ends as viewed in Fig. 2, by means of bolts 24, in such manner that this auxiliary closure plate may be turned upside down and end for end under certain conditions which will be made clear hereinafter. The auxiliary closure member 23 has a portion 23a cut away to facilitate bringing piping into the casing.

Mounted in the casing 10 adjacent the right-hand end of the casing, as viewed in Figs. 2 and 3 is a transversely extending rod 26, and journaled on this rod is a switch operating crank 27 comprising two laterally spaced arms 27a secured to a hub 27b. The crank 27 is adapted to be moved between two extreme positions either by a double acting fluid pressure motor M, or by a hand crank 28, in a manner which will be described in detail hereinafter, and this crank is operatively connected by means of a pin 29 mounted in the outer ends of the arms 27a, with the previously described operating rod 7 in such manner that movement of this crank between its two extreme positions will move the switch A between its two extreme positions.

As best seen in Fig. 3, the fluid pressure motor M in the form here shown comprises a cylinder 30 which is closed at one end by means of a cylinder head 31, and which is provided at the other end with a stuffing box 32 through which a piston rod 33 extends into the cylinder. The piston rod 33 is attached at its inner end to a reciprocable piston 34 by means of a nut 35, and is operatively connected at its outer end with the crank 27 by means of the pin 29. The cylinder head 31 is pivotally mounted on a transverse rod 36 which extends parallel to the rod 26 adjacent the left-hand end of the casing 10 as viewed in Figs. 2 and 3, and has formed integral therewith a casting 37 comprising part of a valve mechanism C which controls the supply of fluid pressure to the opposite ends of the fluid pressure motor M.

The valve mechanism C forms no part of my present invention, and is essentially the same as that described and claimed in Letters Patent of the United States No. 1,875,853, granted to John P. Coleman, on September 6, 1933, for Railway traffic controlling apparatus, although certain parts of the mechanism shown in the said Coleman patent have been omitted from the valve mechanism C because these parts are unnecessary in the present application of the valve mechanism. Since the valve mechanism C is essentially the same as that shown in the said Coleman patent, it is believed that for purposes of the present application, it is sufficient to state that this valve mechanism comprises a normal magnet valve N and a reverse magnet valve R. When the normal magnet valve N becomes energized, it disconnects the operating cylinder of an associated pneumatically operated relay valve N^1 from atmosphere, and connects it with a source of fluid pressure, thus causing this relay valve to disconnect a passageway 38 (see Fig. 3) which communicates with the right-hand end of cylinder 30 from atmosphere, and to connect this passageway with a source of fluid pressure. When, however, the magnet valve N is deenergized, this magnet valve then disconnects the operating cylinder of the associated relay valve N^1 from the source of fluid pressure and reconnects it with atmosphere, whereupon this valve operates to disconnect the passageway 38 from the source of fluid pressure and to connect it with atmosphere. In a similar manner, when the reverse magnet valve R becomes energized, it disconnects the operating cylinder of an associated relay valve R^1 from atmosphere and connects it with the source of fluid pressure, thus causing this relay valve to disconnect a passageway 39 which communicates with the left-hand end of cylinder 30 from atmosphere, and to connect the passageway with the source of fluid pressure. When, however, the reverse magnet valve R becomes deenergized, it disconnects the operating cylinder of the associated relay valve R^1 from the source of fluid pressure and connects it with atmosphere, whereupon the relay valve disconnects the passageway 39 from the source of fluid pressure and reconnects it with atmosphere. The two relay valves N^1 and R^1 are interconnected by suitable mechanism in such manner that both relay valves cannot be simultaneously operated to admit fluid pressure to both ends of cylinder 30 at the same time, thus preventing the undesirable condition that might result if the magnet valves N and R should accidentally both become energized at the same time.

From the foregoing, it will be obvious that when the magnet valve N becomes energized, fluid pressure will be admitted to the right-hand end of cylinder 30, as viewed in Fig. 3, thus causing the piston 34 to be moved toward the left-hand end of its stroke, whereas, when the magnet valve R is energized, fluid pressure will then be admitted to the left-hand end of cylinder 30 which will cause the piston 34 to move toward the right. The parts are so proportioned that movement of the piston 34 from one end of its stroke to the other will move the switch operating crank 27 from its one extreme position to the other, and it will be apparent, therefore, that by energizing the proper magnet valve N or R the switch may be moved from either extreme position to its other extreme position.

The switch operating crank 27 is biased to its nearest extreme position by means of toggle

mechanism comprising a toggle crank 41 and a toggle spring unit U. The toggle crank 41 comprises an arm 41a formed on a hub 41b which is mounted on, and secured to, the hub 27b of the switch operating crank 27. The toggle spring unit U comprises a spring sleeve 42 (see Fig. 9) which is mounted to slide on one end of a spring rod 43. The spring rod 43 extends into the spring sleeve 42 through an annular flange 42a formed on one end of the sleeve, and carries a nut 44 which cooperates with the flange 42a to limit the position to which the sleeve can slide on the spring rod in one direction. The nut 44 is hexagonal in shape and cooperates with a similarly shaped opening 42b in the sleeve in such manner that the nut is free to slide in the opening, but that, relative rotation of the nut and sleeve is prevented. A spring retainer cap 45 is mounted on the spring rod adjacent a shoulder 43a formed on the rod, and interposed between this cap and an outwardly extending annular flange 42c formed on the spring sleeve is a compressed coil spring 46 which constantly biases the spring sleeve and spring rod to the relative positions in which the nut 44 engages the flange 42a. The spring unit is pivotally mounted at one end on the transverse rod 36 by means of an eye 43b which is formed on the spring rod and which receives the transverse rod 36 with some clearance. The other end of the spring unit is pivotally attached to the arm 41a of the toggle crank 41 by means of a pin 47 which extends through a clearance hole in the arm and through two spaced lugs 42d which are provided on the spring sleeve, and which straddle the arm 41a. The pin 47 is held in place in the lugs 42d in a manner which will be obvious from an inspection of the drawings. The parts are so proportioned that the toggle mechanism will occupy its dead center position when the switch operating crank is in its mid stroke position. The parts are further so proportioned that under normal conditions the nut 44 will remain out of engagement with the flange 42a on the spring sleeve 42, but that, if the parts should get out of adjustment in such manner that the switch operating crank is permitted to rotate beyond the position which it normally occupies when the switch is moved to either of its two extreme positions, the nut will then engage the flange 42a and will thus act as a stop to limit the motion of the operating crank.

A segment gear 48 is formed on the hub of the toggle crank 41, and this segment gear meshes with a gear 49 secured to one end of a hand crankshaft 50 (see Figs. 3 and 10). This hand crankshaft is journaled intermediate its ends in a bearing 51 formed in a bearing plate 52 which is bolted to the side plate 13 by means of bolts 53, and is operatively connected at its outer end with the previously referred to hand crank 28 in the following manner.

As best seen in Figs. 10, 11 and 12, the outer end of the hand crankshaft 50 is provided with an enlarged portion 54 having formed therein a cam slot 55 comprising two axially offset circumferentially disposed portions 55a and 55b connected together at one end by a longitudinally extending portion 55c. The circumferentially disposed portions 55a and 55b extend in opposite directions from the connecting portion 55c and are provided at the ends which adjoin the connecting portion with semicircular recesses 55d and 55e, respectively, the functions of which recesses will be made clear presently. The hub 28a of the hand crank lever 28 is rotatably and slidably mounted on the enlarged portion 54 of the hand crankshaft 50, and is provided with a pin 56 which extends into, and cooperates with, the cam slot 55, as shown in Figs. 11 and 12. The hand crank is adapted to be rotated between two extreme positions corresponding to the two extreme positions of the switch operating crank 27, and the parts are so proportioned that when the hand crank and switch operating crank are displaced by a relatively small angle from their corresponding extreme positions the intermediate connecting portion 55c of the cam slot 55 will align with the pin 56, and the hand crank will then be free to slide axially along the hand crankshaft 50 from a position in which the pin is disposed in the offset portion 55a of the cam slot 55 to a position in which the pin is disposed in the portion 55b, or vice versa. The parts are further so proportioned that when the hand crank is rotated to its normal position and is moved inwardly to the position in which the pin 56 is disposed in the portion 55a of the cam slot, movement of the switch operating crank between its two extreme positions either by the fluid pressure motor M, or by a train trailing the switch, will cause the pin 56 to move idly in the portion 55a, and that, when the hand lever 28 is rotated to its reverse extreme position and is moved outwardly to the position in which the pin 56 is disposed in the offset portion 55b, movement of the switch operating crank between its two extreme positions either by the motor M, or by a train trailing the switch, will cause the pin 56 to move idly in the portion 55b of the cam slot. The parts are still further so proportioned that if, when the hand lever occupies the axial position on the shaft in which the pin 56 is disposed in the portion 55a of the cam slot, the hand lever is rotated from its normal to its reverse position, the pin 56 will engage the cam slot 55a at the semicircular recess 55d shortly after the hand lever has been rotated away from its normal position and will thus cause the shaft to rotate with the hand lever until the parts reach a position in which the toggle mechanism completes the movement of the switch, and that, if when the hand lever occupies the axial position on the shaft in which the pin 56 is disposed in the portion 55b of the cam slot, the hand lever is rotated from its reverse to its normal position, the pin 56 will then engage the cam slot at the semicircular recess 55e when the hand lever has been rotated a short distance away from its reverse position and will thus cause the hand crankshaft to rotate with the hand lever until the parts reach a position in which the toggle mechanism completes the movement of the switch operating crank. It should be noted that the pin 56 in addition to cooperating with the cam slot in the manner described also cooperates with the cam slot to hold the hand crank in place on the hand crankshaft.

The hand crank 28 is further provided with two axially offset diametrically opposite outwardly projecting lugs 28b and 28c. The outer face 28d of the lug 28b is beveled, as shown in Fig. 2, and cooperates with a pin 57 secured to the bearing plate 52 in such manner that if the pin 56 is in the portion 55b of the cam slot 55 when the hand crank is rotated toward its normal position from its reverse position, the beveled face of the lug will engage the pin a short distance away from the full reverse position of the hand crank lever and will, during the balance of the movement of the hand crank, automatically force the

hand crank inwardly along the shaft 50 to the position in which the pin 56 is disposed in the portion 55a of the cam slot. The inner face 28e of the lug 28c is likewise beveled as shown in Fig. 2, and cooperates with the pin 57 in such manner that if the pin 56 is in the portion 55a of the cam slot 55 when the hand lever is moved to its reverse position, the beveled face of this lug will engage the pin 57 a short distance away from the full reverse position of the hand crank, and will, during the balance of the movement of the hand crank automatically force the hand crank outwardly along the hand crankshaft to the position in which the pin 56 is disposed in the portion 55b of the cam slot.

Associated with the hand lever 28 is a lever latch E by means of which the hand lever 28 may at times be locked in its normal position in which it is shown in the drawings. As here illustrated, this lever latch comprises a suitable casting 60 which is secured to the side plate 13 by means of studs 61, and which is provided in its upper side with a jaw 62 (see Fig. 4) which is adapted to receive the hand lever 28 when the hand lever occupies its normal position. A latching member 63 is pivotally supported at its lower end on a pivot pin 63a mounted in the lower part of the casting 60, and this latching member is provided at its upper end with a latch 64 which, when the latching member occupies its latching position in which it is shown in the drawings, projects into the path of movement of the hand throw lever into and out of the jaw 62, but which, when the latching member is rotated to its unlatching position, is then clear of the path of movement of the hand lever. The latching member is also provided at its upper end with a finger piece 65 to facilitate rotating the latching member to its latching position in opposition to the bias of biasing means which will be described presently. The latching member is further provided with a vertical slot 66 which, when the latching member occupies its latching position, receives an eye 67 formed on the casting 60 in such manner that by placing a padlock 68 or other suitable locking device in the eye, the hand lever may be locked in its normal position.

The latching member 63 controls contact mechanism for preventing energization of the magnet valves N and R except when the hand lever 28 occupies its normal position and is locked in this position by the latching member 63. As best seen in Figs. 4 and 13, this contact mechanism comprises a movable contact finger 70 which cooperates with a fixed contact finger 71 to form a contact 70—71. The contact fingers 70 and 71 are secured in spaced relation to a molded insulating member 72 which is bolted to the side plate 13 on the inside of the casting 13 directly opposite the lever latch, and these fingers are electrically connected with terminal posts 73 and 74, respectively, mounted in the insulating member, to facilitate making electrical connections with the contact fingers. The movable contact finger 70 is longer than the fixed contact finger 71, and extends at its lower end into a slot 76 formed in an insulating part 77 which is secured to the inner end of a rod 78. The rod 78 is slidably mounted intermediate its ends in a clearance hole 79 formed in the side plate 13, and is pivotally connected at its outer end with the latching member 63 by means of a pin 69 in such manner that when the latching member occupies its latching position, the movable contact finger will be moved to a position in which the contact 70—71 is closed, but that, when the latching member 63 is moved to its unlatching position, the movable contact finger 70 will then be moved to a position in which the contact 70—71 is open. A compressed coil spring 80 is mounted on the rod 78 between the side plate 13 and a spring retaining washer 81 which is mounted on the rod adjacent a shoulder 83, and this spring constantly biases the latching member 63 to its unlatching position in which the contact 70—71 is open. It will be seen, therefore, that whenever the hand lever is unlocked, the latching member will occupy its unlatching position and the contact 70—71 will be open.

As shown in the drawings, all parts are in their normal positions. That is to say, the switch operating crank 27 is rotated to the end of its stroke in a clockwise direction as viewed in Fig. 3, and is held in this position by the toggle mechanism U, thus causing the switch A to be yieldingly held in its normal position; the piston 34 of the fluid pressure motor M occupies the left-hand end of its stroke as viewed in Fig. 3; the magnet valves N and R are both deenergized so that the supply of fluid pressure to both ends of cylinder 30 of motor M is cut off; the hand throw lever 28 occupies its normal position and is locked in this position by means of the lever latch E and associated padlock 68, and the contact 70—71 is closed.

If, now, with the parts in the positions just described, it is desired to operate the switch to its reverse position by power, the reverse magnet valve R is energized over a circuit which is not shown in the drawings because it forms no part of my present invention, but which circuit includes the contact 70—71. The energization of this magnet valve causes fluid pressure to be admitted to the left-hand end of cylinder 30 of motor M in the manner previously described, and this pressure acts through the piston 34 and piston rod 33 to exert a force on the switch operating crank 27 which force causes the operating crank to rotate from the extreme position shown toward its opposite extreme position. This rotation of the operating crank will, of course, be opposed by the bias of the toggle spring assembly until the operating crank reaches its dead center position, in which position the toggle spring assembly will exert no force on the operating crank. However, as soon as the operating crank passes its dead center position, the bias of the toggle spring assembly will then aid the fluid pressure motor M in moving the operating crank, with the result that at the end of the stroke of the operating crank both the fluid pressure motor and the toggle spring assembly will exert a force on the operating crank which tends to complete the movement of the switch points. In actual practice, the circuit which controls the energization of the magnet valve R will usually be controlled by a circuit controller which is operated by the movement of the switch points, and this circuit will preferably be so arranged that the magnet valve R will become deenergized and will cut off the supply of fluid pressure to the motor M shortly before the switch points have entirely completed their stroke, with the result that only the toggle spring assembly will be effective to hold the switch points closed in their reverse positions. It should be pointed out, however, that although the supply of fluid pressure to the motor M is cut off before the switch points have entirely completed their stroke, the operation of the switch operating mechanism is so rapid that sufficient

fluid pressure will remain in the cylinder 30, after the supply of fluid pressure becomes cut off, to complete the movement of the switch points to their reverse positions. It should also be pointed out that during the movement of the switch points to their reverse positions, the hand crankshaft 50 will be rotated in a clockwise direction as viewed in Fig. 3, through the medium of the segment gear 48 and pinion 49, but this rotation will not exert any force on the hand crankshaft 27 tending to rotate it, because, due to the previously described construction of the cam slot 55, the pin 56 will move idly in the portion 55a of the cam slot under these conditions.

After the switch points have been moved to their reverse positions in the manner just described and it is desired to restore them to their normal positions in which they are shown in the drawings by power, the magnet valve N is energized over a circuit which is not shown in the drawings because it forms no part of my present invention, but which circuit also includes the contact 70—71. The operation of the apparatus under these conditions is similar to that just described, it being noted that in actual practice, the circuit for controlling the magnet valve N will usually be controlled by the same circuit controller which controls the magnet valve R, in such manner that the magnet valve N will become deenergized shortly before the switch points have completed their stroke to their full reverse position. Since the operation of the apparatus under these conditions is similar to that just described, it is believed that this operation will be apparent from the foregoing and from an inspection of the drawings without further description.

I will now assume that the parts are in their normal positions in which they are shown in the drawings and that a train trails the switch. Under these conditions, the force which is exerted on the switch points by the wheels of the train will move the points toward their reverse positions, and this movement of the points, in turn, will act through the operating rod 7 to rotate the operating crank 27 from its normal position to its reverse position. During the rotation of the operating crank to its mid stroke position, the toggle spring assembly will, of course, oppose the movement of the switch points, but as soon as the switch operating crank has passed its mid stroke position, the toggle spring assembly will then become effective to complete the movement of the points to their reverse positions. Furthermore, if the circuit for the control of the normal magnet valve N is arranged to be controlled by a circuit controller in the manner previously referred to, fluid pressure will be admitted to the fluid pressure motor as soon as the points have been forced away from their normal positions a short distance, and the movement of the points will thereafter also be opposed to some extent by the fluid pressure motor. However, in actual practice, means are usually provided for deenergizing the normal magnet valve under these conditions and for energizing the reverse magnet valve as soon as the parts have been moved past their mid stroke positions, and for again deenergizing the reverse magnet valve when the points are within a short distance of their full reverse positions. As a result, as soon as the points have passed their mid stroke positions, the fluid pressure motor will aid the toggle mechanism in completing the movement of the points. After the points have reached their full reverse positions they will then be held in their reverse positions by the toggle mechanism until the points are restored to their normal positions either by operation of the motor M or by a train trailing the switch, or by operation of the hand lever in the manner which will be described presently.

When the parts are in their reverse positions and a train trails the switch, the operation of the apparatus is similar to that just described and will be understood from the foregoing and from an inspection of the drawings without further detailed description.

I will next assume that the parts are in their normal positions and that it is desired to reverse the switch by means of the hand operating crank 28. To do this, the padlock 68 is first removed from the eye 67 of the lever latch E. This allows the latching member 63 of the lever latch to swing to its unlatching position due to the bias of spring 80, thus unlocking the hand crank and also opening the contact 70—71. The opening of the contact 70—71 interrupts all circuits for the magnet valves N and R and thus prevents any operation of the switch operating mechanism by power as long as the hand crank remains unlocked. The operator will next rotate the hand crank from the extreme position shown to its opposite extreme position. This rotation of the hand crank will cause the pin 56 to engage the cam slot 55 at the semi-circular recess 55d as soon as the hand crank has been moved away from its normal position a relatively short distance, and as a result, as the rotation of the hand crank continues, the hand crankshaft will be rotated with the hand crank. This rotation of the hand crankshaft will, of course, be transmitted through the pinion 49 and segment gear 48 to the toggle crank 41 and from the toggle crank 41 to the switch operating crank 27 thus causing the switch operating crank to rotate in a counter-clockwise direction, as viewed in Fig. 3. It will be seen, therefore, that during the first half of the stroke of the hand crank, the toggle spring assembly will oppose the motion of the switch points, but as soon as the hand crank has passed the mid stroke position the toggle spring will begin to assist the movement of the switch points, with the result that as the switch points approach their reverse positions the toggle assembly will cause the points to snap quickly to their reverse positions and will thus cause the hand crankshaft to rotate away from the position in which the pin 56 is engaging the cam slot 55 at the semicircular recess 55d. It should be particularly pointed out that this rotation of the hand crankshaft away from the hand crank will not result in the hand crank being jerked forward out of the hand of the operator because the portion 55a of the cam slot in which the pin is disposed will be open behind the pin 56 during this rotation. As the stroke of the hand crank is completed, however, reverse lug 28c will engage the fixed pin 57 and will thereby slide the hand crank outwardly along the hand crankshaft to the position in which the pin 56 is disposed in the portion 55b of the cam slot.

If, after the switch points have been reversed by the hand crank 27 in the manner just described, it is desired to restore the switch points to their normal positions by means of the hand crank, this may be done by restoring the hand crank to its normal position. Under these conditions, the pin 56 will engage the cam slot 55 at the semicircular recess 55e, and will thus cause the hand crankshaft 50 to rotate with the hand

crank until the switch points have been moved past their mid stroke positions, whereupon the toggle spring assembly will complete the movement of the points. As the hand crank 27 approaches its full normal position, the normal lug 28b will cooperate with the fixed pin 57 to move the hand crank inwardly along the hand crankshaft to the position in which the pin 56 is disposed in the portion 55a of the cam slot.

I will now assume that the switch points are in their reverse positions and the hand crank is in its normal position, and that it is desired to operate the switch points to their normal positions by means of the hand crank. Under these conditions, inasmuch as the position of the hand crank does not correspond to that of the switch, it is necessary to first rotate the hand crank from its normal position to its reverse position, and then rotate the hand crank back to its normal position. During the movement of the hand crank to its reverse position, the pin 56 will move idly along the portion 55a of the cam slot until the reverse lug engages the pin 57, whereupon the resultant outward movement of the hand crank will cause the pin 56 to move out of the portion 55a of the cam slot 55 and into the portion 55b. As a result, when the direction of rotation of the hand crank is then reversed, the operation of the apparatus will be the same as described above during movement of the switch points to their normal positions by the hand crank following their previous movement to their reverse positions by the hand crank.

When the hand crank occupies its reverse position, and the switch occupies its normal position, and it is desired to move the switch to its reverse position by means of the hand crank, the hand crank is first rotated to its normal position, and it is then rotated back to its reverse position. Under these conditions, the pin 56 will move idly along the portion 55b of the cam slot 55 until the hand crank reaches the position in which the normal lug 28b engages the fixed pin 57, whereupon the resultant inward movement of the hand crank will cause the pin 56 to move out of the portion 55b of the cam slot and into the portion 55a. When the direction of rotation of the lever is then reversed, the operation of the apparatus will be the same as that described hereinbefore when the switch was moved from its normal position to its reverse position by means of the hand crank.

I will now assume that the switch has been moved to its reverse position by the hand crank, and that it is desired to release the hand crank and return it to its normal position without restoring the switch to its normal position. To do this, the hand crank must be pushed inwardly when it is started back toward its normal position so that it will retrace the path it takes when the switch is moved from its normal position to its reverse position by the hand crank.

Whenever the switch has been moved to either extreme position by the hand crank, and it is desired to restore the movement to condition for power operation, it is, of course, necessary to restore the hand lever to its normal position and relock it in this position by means of the padlock 68. As soon as this has been done, the movement will then be automatically operated by power to the position corresponding to that which the control apparatus then occupies.

The switch operating mechanism B is so constructed that it may be assembled for either a right-hand or a left-hand switch layout. The preceding views show the mechanism assembled for a left-hand application and Fig. 14 shows the mechanism assembled for a right-hand application.

The mechanism may be changed from a right-hand assembly to a left-hand assembly or vice versa in the following manner: Turn the side plate 12 end for end and reverse the position of the padlock hasp 22. Turn the side plate 13 end for end and reverse the position of the hand crank assembly, the contact assembly and the lever latch E. Turn the end plate 14b end for end with respect to the frame 14a and then turn the whole end closure member assembly end for end and fasten it to the opposite end of the casing. Turn the auxiliary closure plate 23 upside down and secure it to the opposite end of the casing. Remove the toggle crank 41 from the operating crank 27 and reassemble it in a new position corresponding to the desired position of the parts. Remove the pinion 49 from the hand crankshaft 50 and reassemble it on the shaft in a new position spaced 180° from its old position. Reassemble motor M, toggle spring assembly U and operating crank 27. It will be noted that the motor and toggle spring assembly are turned end for end but that the operating crank is moved straight back.

Switch operating mechanisms of the type described are adapted to be used in the same type of service as the well-known forms of direct acting movements have heretofore been used. One advantage of switch operating mechanism embodying my invention over the previous types of direct acting switch operating mechanisms is that since the supply of fluid pressure to the operating motor is cut off before the switch reaches its extreme positions, the fluid which was previously lost in the direct acting type of movement by leakage will be saved. Furthermore, a failure of the fluid pressure supply such as would be caused by breakage of the supply pipe leading to the switch movement will not cause the switch points to open and derail cars which might be passing over the switch at the time. The above features together with the fact that the mechanism may be operated by hand makes it possible to entirely cut off the supply of fluid pressure in classification car retarder yards during the time the yards are not operating and still run an occasional engine or train through the yard, throwing the necessary switches by hand. This arrangement, of course, results in a further saving of fluid which might otherwise be lost by leakage.

Although I have herein shown and described only one form of switch operating apparatus 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. Railway switch operating mechanism comprising a switch operating crank movable between two extreme positions, means for biasing said switch operating crank to its nearest extreme position, power means for at times moving said switch operating crank between its two extreme positions, manually operable means for moving said crank from either extreme position toward its other extreme position in such manner that said manually operable means will become disengaged from said crank as soon as said crank becomes biased toward such other extreme posi-

tion, means for locking said hand crank in one of its extreme positions, and means operated by said locking means for preventing operation of said switch by said power means except when said hand crank is locked in said one extreme position.

2. Railway switch operating apparatus comprising a switch operating crank movable between two extreme positions, means for biasing said crank to its nearest extreme position, electrically controlled means for moving said switch operating crank between its two extreme positions, a hand crank, means for at times operatively connecting said hand crank with said switch operating crank to permit operation of said operating crank by said hand crank, latch mechanism for locking said hand crank in one extreme position, and contact mechanism for controlling said electrically controlled means controlled by said latch mechanism.

3. Railway switch operating apparatus comprising a switch operating crank rotatable between two extreme positions and biased to its nearest extreme position, a hand crankshaft operatively connected with said switch operating crank, a hand crank journaled on said shaft, and means including a cam slot formed in said hand crankshaft and a pin screwed to said hand crank and cooperating with said cam slot for operatively connecting said hand crank with said hand crankshaft.

4. Railway switch operating apparatus comprising a hand crankshaft rotatable between two extreme positions, a hand crank loosely mounted on said hand crankshaft, means including a pin secured to one of said parts and a cam slot formed in the other part for operatively connecting said hand crank with said hand crankshaft in such manner that said shaft may be rotated between its two extreme positions by said hand crank but that said hand crankshaft is free to rotate between its two extreme positions independently of any movement of said hand crank, a switch operating crank operatively connected with said hand crankshaft, and means for biasing said switch operating crank to its nearest extreme position.

5. Railway switch operating apparatus comprising a hand crankshaft rotatable between two extreme positions, a cam slot formed in said hand crankshaft, said slot comprising two axially offset portions extending circumferentially in opposite directions from an intermediate connecting portion and provided at the ends which are adjacent to said connecting portion with semicircular recesses, a hand crank mounted on said shaft in such manner that said crank is free to both rotate relative to said shaft and to slide axially along said shaft, a pin secured to said hand crank and extending into said cam slot, and switch operating means operatively connected with said hand crankshaft.

6. In combination, a hand crankshaft rotatable between two extreme positions, a cam slot formed in said hand crankshaft, said slot comprising two axially offset portions extending circumferentially in opposite directions from an intermediate connecting portion and provided at the ends which are adjacent to said connecting portion with semicircular recesses, a hand crank mounted on said shaft in such manner that said crank is free to rotate about said shaft between two extreme positions and to slide axially along said shaft between two extreme positions, a pin secured to said hand crank and cooperating with said cam slot in such manner that if said shaft is rotated from one extreme position to the other when said hand crank is moved to one axial position on said shaft said pin will move idly in the one offset portion of said cam slot but that if said hand crank is rotated from one extreme position to the other when said hand crank is moved to its one axial position on said shaft said pin will engage said cam slot at one semicircular recess and will thus rotate said hand crankshaft in response to rotation of said hand crank, and that if said hand crank is rotated from said other extreme position to said one extreme position when said hand crank is moved to its other axial position on said shaft said pin will then engage said cam slot at the other semicircular recess and will rotate said hand crankshaft in response to rotation of said hand crank, and means responsive to the rotation of said hand crankshaft.

7. Railway switch operating apparatus comprising a hand crankshaft rotatable between two extreme positions, a cam slot formed in said hand crankshaft, said slot comprising two axially offset portions extending circumferentially in opposite directions from an intermediate connecting portion and provided at the ends which are adjacent to said connecting portion with semicircular recesses, a hand crank mounted on said shaft in such manner that said crank is free to rotate about said shaft between two extreme positions and to slide axially along said shaft between two extreme positions, a pin secured to said hand crank and cooperating with said cam slot in such manner that if said shaft is rotated from one extreme position to the other when said hand crank is moved to one axial position on said shaft said pin will move idly in the one offset portion of said cam slot but that if said hand crank is rotated from one extreme position to the other when said hand crank is moved to its one axial position on said shaft said pin will engage said cam slot at one semicircular recess and will thus rotate said hand crankshaft in response to rotation of said hand crank, and that if said hand crank is rotated from said other extreme position to said one extreme position when said hand crank is moved to its other axial position on said shaft said pin will then engage said cam slot at the other semicircular recess and will rotate said hand crankshaft in response to rotation of said hand crank, and a switch operating crank operatively connected with said hand crankshaft and with means for biasing said switch operating crank to its nearest extreme position.

8. Railway switch operating apparatus comprising a hand crankshaft rotatable between two extreme positions, a cam slot formed in said hand crankshaft, said slot comprising two axially offset portions extending circumferentially in opposite directions from an intermediate connecting portion and provided at the ends which are adjacent to said connecting portion with semicircular recesses, a hand crank mounted on said shaft in such manner that said crank is free to rotate about said shaft between two extreme positions and to slide axially along said shaft between two extreme positions, a pin secured to said hand crank and cooperating with said cam slot in such manner that if said shaft is rotated from one extreme position to the other when said hand crank is moved to one axial position on said shaft said pin will move idly in the one offset portion of said cam slot but that if said

hand crank is rotated from one extreme position to the other when said hand crank is moved to its one axial position on said shaft said pin will engage said cam slot at one semicircular recess and will thus rotate said hand crankshaft in response to rotation of said hand crank, and that if said hand crank is rotated from said other extreme position to said one extreme position when said hand crank is moved to its other axial position on said shaft said pin will then engage said cam slot at the other semicircular recess and will then rotate said hand crankshaft in response to rotation of said hand crank, and a switch operating crank operatively connected with said hand crankshaft and with means for biasing said switch operating crank to its nearest extreme position and with power means for operating said switch operating crank between its two extreme positions.

9. In combination, a hand crankshaft rotatable between two extreme positions, a cam slot formed in said hand crankshaft, said slot comprising two axially offset portions extending circumferentially in opposite directions from an intermediate connecting portion and provided at the ends which are adjacent to said connecting portion with semicircular recesses, a hand crank mounted on said shaft in such manner that said crank is free to rotate about said shaft between two extreme positions and to slide axially along said shaft between two extreme positions, a pin secured to said hand crank and extending into said cam slot, the parts being so proportioned that when said hand crank and said hand crankshaft occupy corresponding extreme positions said connecting portion of said cam slot will align with said pin, and means for automatically sliding said hand crank axially along said hand crankshaft from one axial position to the other as said hand crank approaches an extreme position corresponding to the extreme position which the hand crankshaft then occupies in such manner that if the hand crank is subsequently rotated back to its original position said pin will cooperate with one or the other of said recesses to cause said shaft to rotate in response to the rotation of said hand crank.

10. In combination, a hand crankshaft rotatable between two extreme positions, a cam slot formed in said hand crankshaft, said slot comprising two axially offset portions extending circumferentially in opposite directions from an intermediate connecting portion and provided at the ends which are adjacent to said connecting portion with semicircular recesses, a hand crank mounted on said shaft in such manner that said crank is free to rotate about said shaft between two extreme positions and to slide axially along said shaft between two extreme positions, a pin secured to said hand crank and cooperating with said cam slot in such manner that if said shaft is rotated from one extreme position to the other when said hand crank is moved to one axial position on said shaft said pin will move idly in the one offset portion of said cam slot but that if said hand crank is rotated from one extreme position to the other when said hand crank is moved to its one axial position on said shaft said pin will engage said cam slot at one semicircular recess and will thus rotate said hand crankshaft in response to rotation of said hand crank, and that if said shaft is rotated from its other extreme position to its one extreme position when said hand crank is moved to its other axial position on said shaft said pin will move idly in the other offset portion of said cam slot but that if said hand crank is rotated from said other extreme position to said one extreme position when said hand crank is moved to its other axial position on said shaft said pin will then engage said cam slot at the other semicircular recess and will rotate said hand crankshaft in response to rotation of said hand crank, and means responsive to the rotation of said hand crankshaft.

11. Railway switch operating apparatus comprising a hand crankshaft rotatable between two extreme positions, a cam slot formed in said hand crankshaft, said slot comprising two axially offset portions extending circumferentially in opposite directions from an intermediate connecting portion and provided at the ends which are adjacent to said connecting portion with semicircular recesses, a hand crank mounted on said shaft in such manner that said crank is free to rotate about said shaft between two extreme positions and to slide axially along said shaft between two extreme positions, a pin secured to said hand crank and cooperating with said cam slot in such manner that if said shaft is rotated from one extreme position to the other when said hand crank is moved to one axial position on said shaft said pin will move idly in the one offset portion of said cam slot but that if said hand crank is rotated from one extreme position to the other when said hand crank is moved to its one axial position on said shaft said pin will engage said cam slot at one semicircular recess and will thus rotate said hand crankshaft in response to rotation of said hand crank, and that if said shaft is rotated from its other extreme position to its one extreme position when said hand crank is moved to its other axial position on said shaft said pin will move idly in the other offset portion of said cam slot but that if said hand crank is rotated from said other extreme position to said one extreme position when said hand crank is moved to its other axial position on said shaft said pin will then engage said cam slot at the other semicircular recess and will then rotate said hand crankshaft in response to rotation of said hand crank, and a switch operating crank operatively connected with said hand crankshaft and with means for biasing said switch operating crank to its nearest extreme position.

12. Railway switch operating apparatus comprising a hand crankshaft rotatable between two extreme positions, a cam slot formed in said hand crankshaft, said slot comprising two axially offset portions extending circumferentially in opposite directions from an intermediate connecting portion and provided at the ends which are adjacent to said connecting portion with semicircular recesses, a hand crank mounted on said shaft in such manner that said crank is free to rotate about said shaft between two extreme positions and to slide axially along said shaft between two extreme positions, a pin secured to said hand crank and cooperating with said cam slot in such manner that if said shaft is rotated from one extreme position to the other when said hand crank is moved to one axial position on said shaft said pin will move idly in the one offset portion of said cam slot but that if said hand crank is rotated from one extreme position to the other when said hand crank is moved to its one axial position on said shaft said pin will engage said cam slot at one semicircular recess and will thus rotate said hand crankshaft in response to rotation of said hand

crank, and that if said shaft is rotated from its other extreme position to its one extreme position when said hand crank is moved to its other axial position on said shaft said pin will move idly in the other offset portion of said cam slot but that if said hand crank is rotated from said other extreme position to said one extreme position when said hand crank is moved to its other axial position on said shaft said pin will then engage said cam slot at the other semicircular recess and will then rotate said hand crankshaft in response to rotation of said hand crank, and a switch operating crank operatively connected with said hand crankshaft and with means for biasing said switch operating crank to its nearest extreme position and with power means for operating said switch operating crank between its two extreme positions.

13. Railway switch operating apparatus comprising two spaced parallel rods, a switch operating crank journaled on one of said rods for movement between two extreme positions, a second crank operatively connected with said first crank, spring mechanism journaled on the other rod and operatively connected with said second crank in such manner that said switch operating crank is biased to the nearest one of its two extreme positions, a gear segment formed on said second crank, a shaft, a gear secured to said shaft and meshing with said gear segment, means for at times rotating said shaft between two extreme positions to cause said switch operating crank to rotate between two extreme positions, and a fluid pressure motor journaled on said other rod and having its piston operatively connected with said switch operating crank in such manner that movement of said piston from one end of its stroke to the other will cause said switch operating crank to rotate between its two extreme positions.

14. Railway switch operating apparatus comprising two spaced parallel rods, a switch operating crank journaled on one of said rods for movement between two extreme positions, a second crank operatively connected with said first crank, spring mechanism journaled on the other rod and operatively connected with said second crank in such manner that said switch operating crank is biased to the nearest one of its two extreme positions, a gear segment formed on said second crank, a shaft, a gear secured to said shaft and meshing with said gear segment, manually operable means for at times rotating said shaft between two extreme positions to rotate said switch operating crank, and a fluid pressure motor journaled on said other rod and having its piston operatively connected with said switch operating crank in such manner that movement of said piston from one end of its stroke to the other will cause said switch operating crank to rotate between its two extreme positions.

15. Railway switch operating apparatus comprising two spaced parallel rods, a switch operating crank journaled on one of said rods for movement between two extreme positions, a second crank operatively connected with said first crank, spring mechanism journaled on the other rod and operatively connected with said second crank in such manner that said switch operating crank is biased to the nearest one of its two extreme positions, a gear segment formed on said second crank, a shaft, a gear secured to said shaft and meshing with said gear segment, a manually operable lever, means for operatively connecting said manually operable lever with said shaft in such manner that said switch operating crank may be rotated from either extreme position toward its other extreme position by said lever but that said switch operating crank is free to complete its movement toward such other extreme position in response to the bias of said spring mechanism independently of any movement of said lever, and a fluid pressure motor journaled on said other rod and having its piston operatively connected with said switch operating crank in such manner that movement of said piston from one end of its stroke to the other will cause said switch operating crank to rotate between its two extreme positions.

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