Nov. 29, 1932. E. G. LITTLE 1,889,022

RAILWAY SWITCH OPERATING APPARATUS

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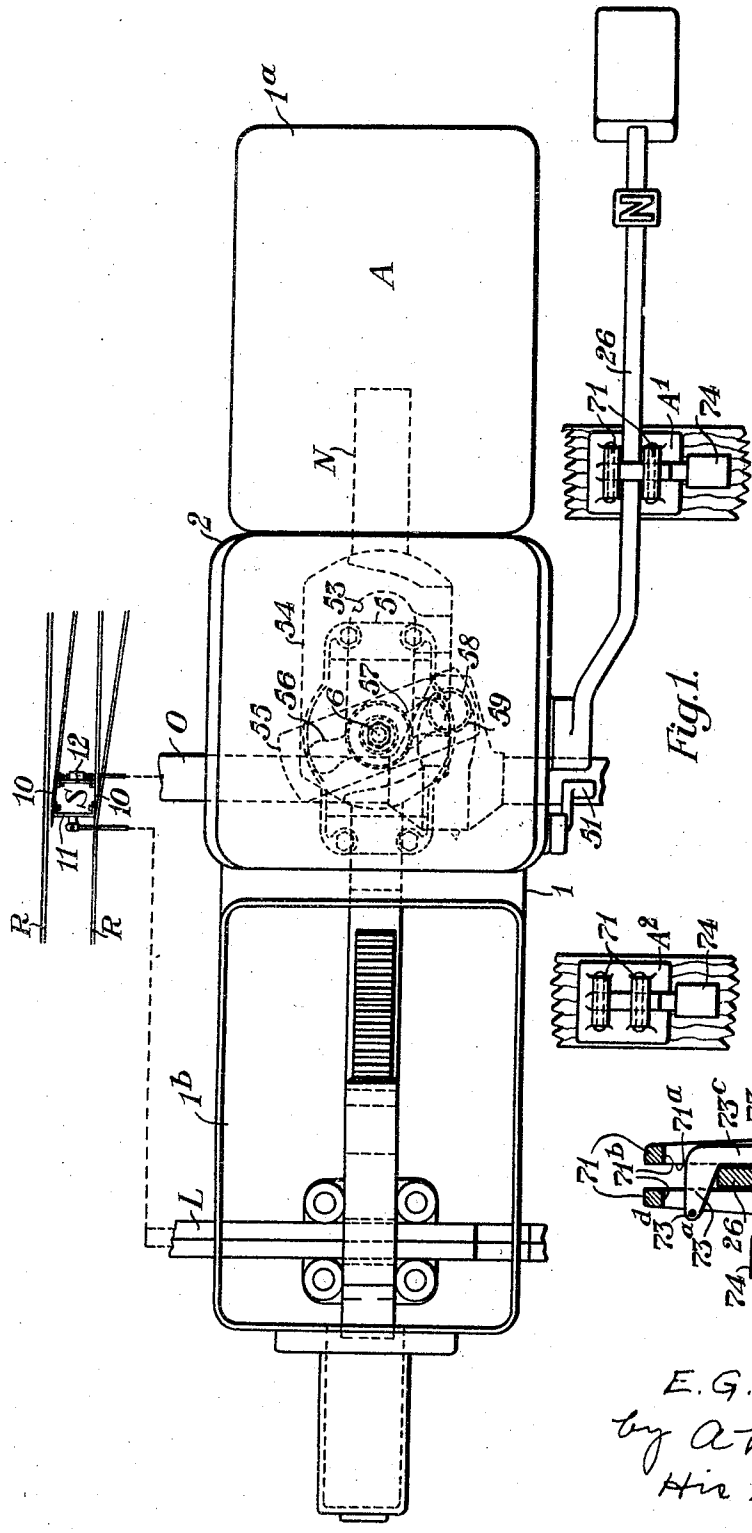


Fig. 1.

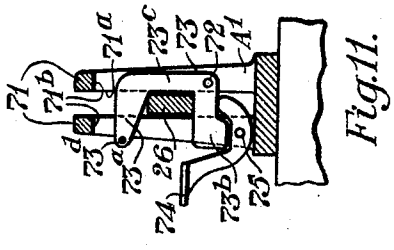


Fig. 11.

INVENTOR:
E. G. Little,
by A R Vincill
His ATTORNEY.

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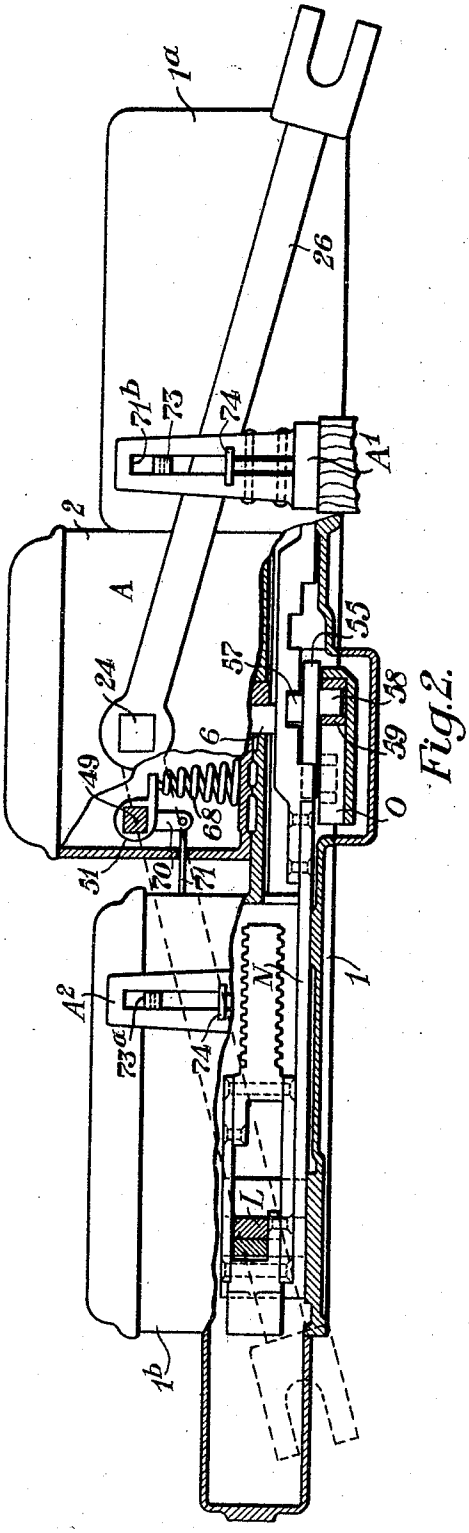


Fig.2.

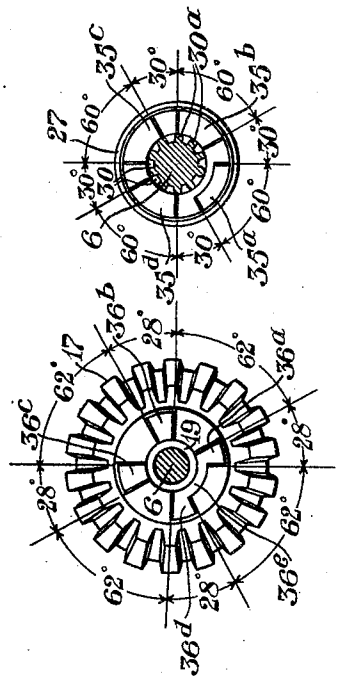


Fig.8.

Fig.7.

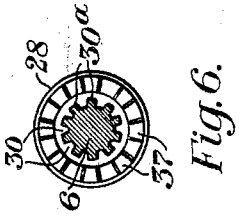


Fig.6.

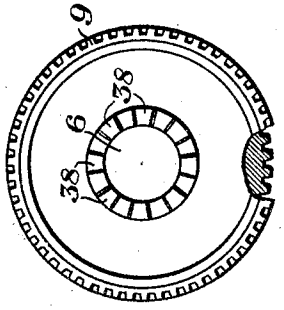


Fig.5.

INVENTOR.
E. G. Little,
BY
A. R. Vinall
His ATTORNEY.

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RAILWAY SWITCH OPERATING APPARATUS

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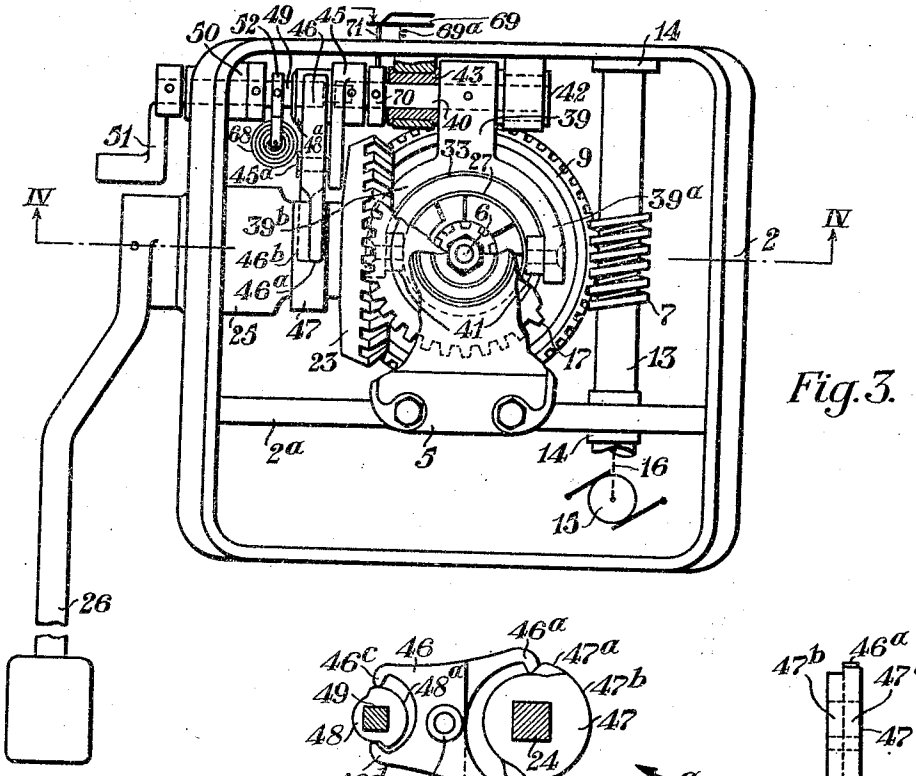


Fig. 3.

Fig. 9.

Fig. 10.

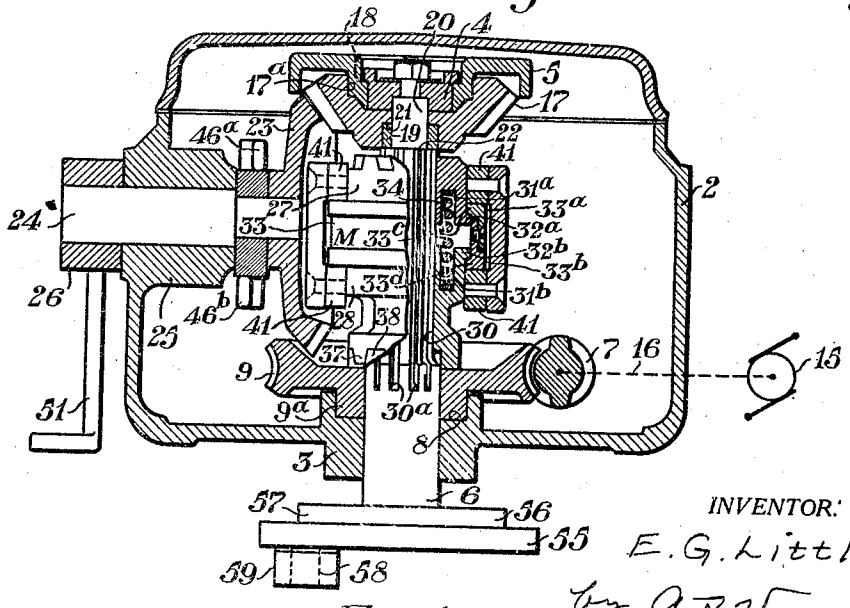


Fig. 4.

INVENTOR:
E. G. Little,
by A R Vincill
His ATTORNEY.

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RAILWAY SWITCH OPERATING APPARATUS

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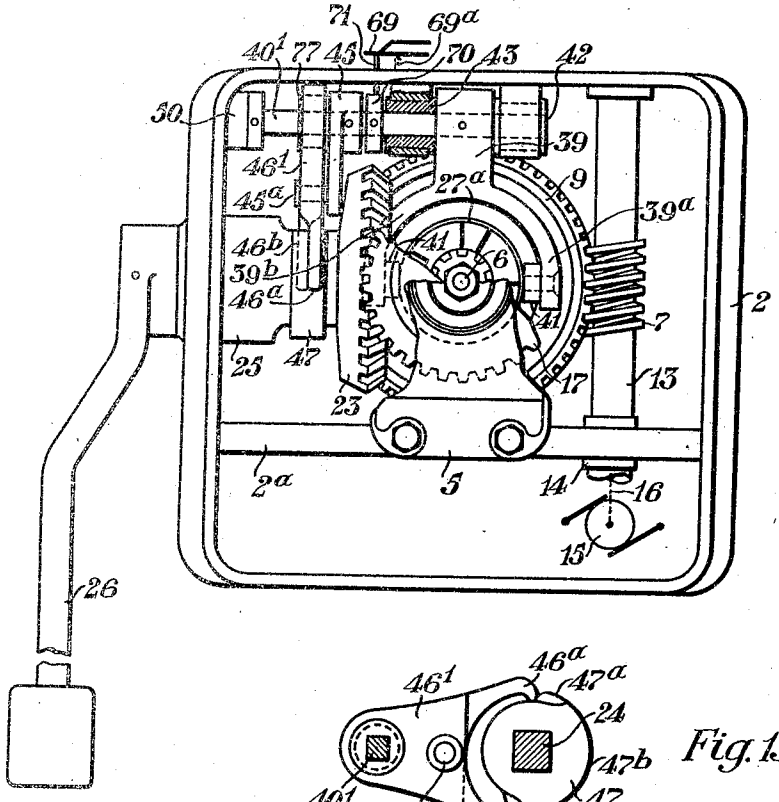


Fig. 12.

Fig. 13.

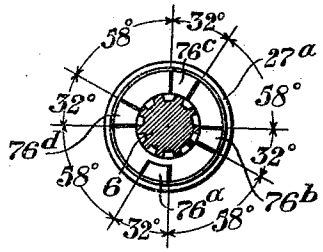


Fig. 14.

INVENTOR.
E. G. Little,
BY A R Vincill
His ATTORNEY.

Patented Nov. 29, 1932 1,889,022

UNITED STATES PATENT OFFICE

EDWIN G. LITTLE, OF WILKINSBURG, PENNSYLVANIA, ASSIGNOR TO THE UNION SWITCH & SIGNAL COMPANY, OF SWISSVALE, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA

RAILWAY SWITCH OPERATING APPARATUS

Application filed August 15, 1931. Serial No. 557,335.

My invention relates to railway switch operating apparatus, and has for an object the provision of novel and improved means for permitting manual operation of a power operated switch.

I will describe two forms of 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 of a railway switch provided with one form of switch operating apparatus embodying my invention, certain of the parts being removed or omitted from the drawings for the sake of clearness. Fig. 2 is a side view of the apparatus shown in Fig. 1 with certain of the parts broken away or removed to better illustrate the construction thereof. Fig. 3 is a top plan view of that portion of the apparatus illustrated in Figs. 1 and 2 which is enclosed in the auxiliary housing 2, the cover of this housing being removed and certain parts being broken away to more clearly illustrate the construction of the apparatus. Fig. 4 is a vertical sectional view taken substantially on the line IV—IV of Fig. 3. Fig. 5 is a detail view illustrating the worm wheel 9 forming a part of the apparatus shown in Figs. 3 and 4. Fig. 6 is a bottom view of the sleeve 28 forming part of the clutch mechanism M for at times connecting the shaft 6 with the worm wheel 9 of the apparatus shown in Figs. 3 and 4. Fig. 7 is a bottom view of the bevel gear 17 forming part of the apparatus shown in Figs. 3 and 4. Fig. 8 is a top view of the sleeve 27 forming a part of the clutch mechanism M for at times connecting the shaft 6 with the bevel gear 17 of the apparatus shown in Figs. 3 and 4. Fig. 9 is a detail view of the cams 47 and 48 and associated cam follower 46 forming part of the apparatus shown in Figs. 3 and 4. Fig. 10 is a view of the cam 47 and cam follower 46 looking in the direction of the arrow *a* in Fig. 9. Fig. 11 is a sectional view of a locking stand forming part of the apparatus illustrated in Figs. 1 and 2. Fig. 12 is a top plan view showing a modified form of a portion of the apparatus illustrated in Figs. 3 and 4, and also embodying my invention, certain of the parts being broken away or removed to more clearly illustrate the construction thereof. Fig. 13 is a detailed view of the cam 47 and cam follower 46^1 forming part of the apparatus illustrated in Fig. 12. Fig. 14 is a top view of the sleeve 27^a forming a part of the clutch mechanism M for at times connecting the shaft 6 with the bevel gear 17 of the apparatus shown in Fig. 12.

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

Referring first to Fig. 1, the reference character S designates a railway switch which is operated by switch actuating mechanism A embodying my invention. For the sake of clearness and convenience, the switch mechanism A has been shown separated from the switch S, and has been drawn to a larger scale than the switch S. The switch S is of the ordinary and well-known construction, and comprises the usual stock rails R R and movable switch points 10—10, the switch points being connected for simultaneous movement by a front rod 11 and a head rod 12.

The switch actuating mechanism A, in the form here shown, consists of a main housing 1 and an auxiliary or transmission housing 2, which latter housing is secured to the top of the main housing 1 between two compartments 1^a and 1^b formed at the opposite ends of the main housing, as best seen in Fig. 2. The compartments 1^a and 1^b of the main housing, and the transmission housing 2, are each provided with removable covers by means of which convenient access to the interior of the respective housings may be had.

Located in the main housing 1 below the transmission housing 2 is a transversely movable operating rod O which projects through the sides of the main housing, and is operatively connected with the head rod 12 of the switch S. A lock rod L, which extends into the compartment 1^b of the main housing 1 through suitable openings in the side walls of the compartment 1^b, is operatively connected with the front rod 11 of the switch S, the connection between the lock rod and the front rod being such that movement of the switch points 10—10 in either direction will cause corresponding longitudinal movement

of the lock rod. Slidably mounted within the casing 1 above the operating rod O, and intersecting the operating rod at right angles, is a slide bar N which cooperates with the lock rod L to lock the switch in either extreme position, as is well understood in the art and as will be described somewhat more fully hereinafter.

Referring now also to Figs. 3 and 4, the transmission housing 2 is formed with a bearing 3 in the bottom thereof, and with a bearing 4 supported by a bracket 5 which is secured to one side wall of the housing 2 and to a partition 2^a formed in the housing 2. A vertically extending shaft 6 is journalled in the bearings 3 and 4, and the lower end thereof extends into the housing 1 and through a slot 53 (see Fig. 1) formed in a cam 54 on the slide bar N, and is provided with a horizontally disposed crank 55. The crank 55 is of substantially rectangular formation, and is rigidly connected to the shaft 6 at its medial portion, its upper side being formed with projections 56 and 57 arranged on opposite sides of the shaft while its underside is provided with a pin 58 carrying a roller 59. The opposite ends of the crank and the projections 56 and 57 cooperate with the slide bar N, and the roller 59 cooperates with the operating rod O, to actuate and lock the switch S in a manner which is described in detail in United States Letters Patent, No. 1,293,290, granted to William Zabel on Feb. 4, 1919, for railway traffic controlling apparatus. In the said patent, the parts which correspond to the parts thus far described in the present application are designated by the same reference characters as the corresponding parts in the present application are designated by. Inasmuch as the manner in which the crank 55 and the projections 56 and 57 cooperate with the slide bar N, and in which the roller 59 cooperates with the operating rod O, is described in detail in the patent referred to, it is believed that for purposes of the present disclosure, it is sufficient to say that when the shaft 6 is rotated in a clockwise direction from the position shown through an angle of approximately 220°, the resulant movement of the crank 55 first moves the slide bar N toward the left, a predetermined distance, which movement releases the lock rod L to permit movement of the switch S. The unlocking movement for the switch having been completed, the crank next moves the operating rod, and consequently the switch, to its reverse position, whereupon the slide bar N is again moved in the same direction to again engage the lock rod, and thereby lock the switch in its reversed position. When the switch is in its reverse position, and the shaft 6 is rotated in a counter-clockwise direction, the resultant movement of the crank 55 first moves the slide bar N toward the right a sufficient distance to unlock the switch, after which it actuates the operating rod O to restore the switch to its normal position in which it is illustrated in the drawings. When the switch has been restored to its normal position, the crank then imparts an additional movement toward the right to the slide bar, thus locking the switch in its normal position.

A worm wheel 9 is mounted for rotation coaxially with the shaft 6, and is formed with a hub 9^a for seating engagement with a suitable step bearing 8 provided at the upper portion of the bearing 3. This gear is driven by a worm 7 fixed to a jackshaft 13 which is journalled in bearings 14, one of which is located in the wall of the casing 2 and the other of which is located in the partition 2^a. The jackshaft 13 is operatively connected with power driving means such as an electric motor 15, through suitable reduction gearing indicated in the drawings by the dash lines 16.

A bevel gear 17 is also mounted for rotation coaxially with the shaft 6 and is provided in its upper face with an annular recess 17^a which cooperates with a thrust bearing 18 formed on the lower side of the bracket 5 to prevent vertical and axial displacement of the bevel gear. Vertical and axial displacement of the bevel gear 17 is also prevented by a bushing 19 which is interposed between the bevel gear and the reduced upper end 20 of the shaft 6, and which cooperates at one end with a circular shoulder 21 formed integral with the bevel gear, and at the other end, with a shoulder 22 formed at the bottom of the reduced upper end 20 of the shaft 6. The bevel gear 17 meshes with a second bevel gear 23 which is fixed to a horizontal shaft 24 mounted in a boss 25 in the wall of the housing 2. This shaft projects through the wall of the housing 2 and carries at its outer end a hand lever 26 which is at times used for manual operation of the switch, as will be described hereinafter.

Means are provided for selectively connecting the worm wheel 9 or the bevel gear 17 with the switch actuating shaft 6, so that the switch may be operated either by the electric motor 15 or by the hand lever 26. As here shown, these means comprise a clutch mechanism M consisting of two sleeves 27 and 28 which are mounted on the shaft 6 for vertical sliding movement, but which are constrained to rotate with the shaft by means of integral internal splines 30 which cooperate with corresponding splines 30^a formed on the shaft, as best seen in Figs. 4, 6 and 8. The confronting ends of the sleeves 27 and 28 are formed with annular recesses 31^a and 31^b, respectively, and with circumferential flanges 32^a and 32^b. A clutch collar 33 comprising two cylindrical members 33^a and 33^b screwed together, surrounds the sleeves 27 and 28 at the flanges 32^a and 32^b with slight clearance, and is provided at its upper end with an inwardly extending cir-

cular shoulder 33e which overlies the circular flange 32a, and at its lower end, with a similar inwardly extending circular shoulder 33d which underlies the circular flange 32b. The sleeves are constantly urged apart by a coil spring 34, the upper and lower ends of which are located in recesses 31a and 31b, respectively.

As best seen in Fig. 8, the upper end of the sleeve 27 is provided with evenly spaced teeth 35a, 35b, 35c and 35d. As here shown, the angular length of each tooth is approximately 60°, while the angular space between each two adjacent teeth is approximately 30°. It will be noted, however, that the radial length of the tooth 35a is less than the radial length of the remaining teeth 35b, 35c and 35d, a portion of this tooth adjacent the shaft 6 being cut away. The lower face of the bevel gear 17 is likewise provided with evenly spaced teeth 36a, 36b, 36c and 36d, as shown in Fig. 7. Each of these latter teeth, as here shown, has an angular length of approximately 28°, while the space between each two adjacent teeth is approximately 62°. The lower face of the bevel gear 17 is further provided with a curved web 36e which connects the teeth 36a and 36d at their inner ends. The radial length of the web 36e is such that it will fit between the inner end of the tooth 35a and the shaft 6 when and only when the space between the teeth 36a and 36d is directly opposite the tooth 35a on the sleeve 27. It follows that the teeth 35 on the sleeve 27 will mesh with the teeth 36 on the bevel gear 17 when and only when the space between the teeth 36a and 36d on the bevel gear 17 is opposite the tooth 35a on the sleeve 27, and the parts are so proportioned that this relation will exist when and only when the hand lever and the switch occupy corresponding relative positions.

Of course, the described arrangement and dimensions of the teeth on the sleeve 27 and bevel gear 17 are not essential, as any other arrangement and proportioning of parts can be employed which will permit mating of the gear and sleeve when and only when the hand lever and the switch occupy corresponding relative positions.

The lower end of the sleeve 28 is also formed with teeth 37. These teeth are evenly spaced about the end of the sleeve, as best seen in Fig. 6, and are arranged to cooperate with similar teeth 38 formed on the upper face of the worm wheel 9, as shown in Fig. 5.

It follows from the foregoing that when the clutch mechanism M is in one longitudinal position on the shaft 6, the teeth on the lower face of the sleeve 28 connect the worm wheel 9 with the shaft 6, whereas, when the clutch mechanism is in another longitudinal position on the shaft, the teeth on the upper end of the sleeve 27 connect the bevel gear 17 with the shaft 6.

The clutch mechanism M is moved longitudinally on the shaft 6 in order to effect the desired driving connection between the bevel gear 17 and the shaft, or between the worm wheel 9 and the shaft, by means of shifting mechanism embodying my present invention, which mechanism I will now describe. This mechanism, in the form here shown, comprises a shifter yoke 39 provided at one end with two curved arms 39a and 39b, as best seen in Fig. 3. The yoke 39 is fastened to a squared horizontally extending main rock shaft 40 which is journalled in bushed bearings 42 and 43 formed in suitable lugs, cast integral with, or otherwise fastened to, the side wall of the housing 2, and the curved arms 39a and 39b of this yoke extend inwardly around the opposite sides of the collar 33 to a position past the vertical axis of the collar, and are each provided at their inner ends with a pair of spaced rollers 41 which engage the upper and lower edges of the collar 33 at both sides of the collar. Also fixed to the rock shaft 40 is a crank 45 provided with a crank pin 45a, and pivotally mounted on the crank pin 45a is a cam follower 46. As best seen in Fig. 9, the one end of the cam follower 46 is provided with an upper finger 46a and with a lower finger 46b. As shown in Figs. 3, 4 and 10, the lower finger 46b is offset from the upper finger 46a, that is to say, the lower finger is located in a different vertical plane from the upper finger. The upper finger 46a cooperates with a cam swell 47a formed on a cam 47, and the lower finger 46b cooperates with another cam swell 47b which is also formed on the cam 47. It will be noted that the two cam swells 47a and 47b are integral, and have the same radial length, but that, the angular length of the swell 47b is shorter than the angular length of the swell 47a. The cam 47 is mounted on the shaft 24, and so will be rotated whenever the hand lever 26 is operated. The opposite end of the cam follower 46 from that which is provided with the fingers 46a and 46b is formed with two vertically spaced fingers 46c and 46d. These fingers are located in the same vertical plane and cooperate with a cam 48 provided with a cam swell 48a. The cam 48 is mounted on an auxiliary rock shaft 49 which is journalled at one end in the end of the rock shaft 40 as shown in Fig. 3, and at the other end, in a boss 50 in the wall of the housing 2. The shaft 49 extends through the housing 2, and is provided at its outer end with suitable operating means, here shown as a foot pedal 51. Also attached to the auxiliary rock shaft 49 is an arm 52, the free end of which is secured to the upper end of a compression spring 68, as shown in Fig. 2. The lower end of the compression spring 68 rests on the bottom of the housing 2, the spring being so designed that the rock shaft 49 is biased to the posi-

tion in which it is illustrated in the drawings, which position I will term its "normal" position.

The reference character 69 designates a circuit controller which may be operated in accordance with the position of the clutch mechanism M in any suitable manner. As here shown, the circuit controller 69 is operated by means of a push rod 71 fastened to the lower end of a vertical arm 70 which is mounted on the main rock shaft 40. This circuit controller may be employed to control the supply of current to the electric motor 15.

Cooperating with the hand lever 26 on opposite sides of the shaft 24 as shown in Figs. 1 and 2, are two lock stands A^1 and A^2. These lock stands are exactly alike, and a description of one will therefore suffice for both. Referring to the lock stand A^1, for example, this lock stand, in the form here shown, comprises a jaw 71 formed on a suitable base which is adapted to be mounted on, and secured to, a railway tie as shown, or to any other convenient foundation or support. The upper part of the jaw 71 is provided with a recess 71^a adapted to receive the lever 26 as best seen in Fig. 11. The jaw 71 also has formed therein a horizontal slot 71^b which extends through the jaw at right angles to the plane in which lever 26 rotates. Mounted to oscillate within the slot 71^b on a pin 72 carried by the jaw 71, and biased by its own weight to the position shown, is a locking member 73 comprising two horizontally extending arms 73^a and 73^b connected together at one end by an integral vertically extending web 73^c. The upper arm 73^a of the locking member 73 normally projects into the path of movement of the lever 26 into and out of the recess 71^a, and is spaced from the lower arm 73^b a sufficient distance so that the lever 26 may fit between the arms as shown. Furthermore, the outer or free end of the upper arm 73^a is provided with an eye 73^d through which a padlock or other suitable locking device may be passed when it is desired to prevent the removal of the lever from the lock stand. The lock stand also comprises a foot controlled detent 74 which is pivotally mounted to oscillate within the slot 71^b below the locking member 73 on a pin 75 carried by the jaw 71, and which is so arranged that when the detent is depressed, the locking member will be moved to a position in which its upper arm 73^a is out of the path of movement of the lever 26.

The operation of the lock stand is as follows: When the parts occupy the positions in which they are illustrated in the drawings, that is, with the hand lever 26 resting on the lower arm 73^b of the locking member 73 and with the eye 73^d of the upper arm 73^a exposed, if a locking device such as a padlock is placed in the eye 73^d, rotation of the locking member 73^c will be prevented, and the lever 26 will therefore be held in the recess 71^a of the jaw 71 by the arm 73^a. When the eye 73^d in the arm 73^a of the locking member 73 is unoccupied by a locking device under the above conditions, however, the locking member is free to rotate, and due to the shape of the lower face of the arm 73^a of the locking member 73, and to the location of the point at which the locking member is pivoted, if the lever 26 is then moved upwardly in the recess 71^a, the lever, upon striking the upper arm 73^a will automatically move the locking member 73 to a position in which the arm 73^a is out of the path of movement of the lever. When the lever has passed the arm 73^a, the locking member will return to the position shown, under the influence of gravity provided that the detent 74 is released. If, after the lever 26 has been removed from the locking stand, the lever is again inserted in the recess 71^a, the movement of the lever will be arrested as soon as the lever engages the upper side of the upper arm 73^a, unless the detent 74 is first operated to move the locking member to the position in which the arm 73^a is out of the path of movement of the lever. If, however, the detent 74 is operated to move the arm 73^a out of the path of movement of the lever, the lever may be restored to the position shown. The parts of the locking stand may be proportioned in any suitable manner, but, as here shown, they are so proportioned, that when the lever is resting on the upper surface of the upper arm 73^a of the locking member 73, the lever will be approximately in a horizontal position, but that, when the lever is resting on the upper surface of the lower arm 73^b of the locking member 73, as shown in Fig. 11, the lever will be some distance below, for example, 15° below, the horizontal, as shown in Fig. 2. It will be noted that the weight of the end of the lever 26 aids in holding the movable parts of the locking stand in the positions in which they are shown in Fig. 2.

The operation of the apparatus thus far described, as a whole, is as follows: As shown in the drawings, the hand lever 26 is at the end of its stroke in a clockwise direction, and the foot pedal 51 is in its upper or normal position. Under these conditions, the cam follower 46 and the cams 47 and 48 occupy the relative positions in which they are shown in Fig. 9. That is to say, the finger 46^c is riding on the swell 48^a of the cam 48, while the finger 46^d is out of engagement with the swell 48^a; and the finger 46^b is riding on the swell 47^b of the cam 47, while the finger 46^a is out of engagement with the swell 47^a. As a result, under the above conditions, the cam follower 46 is rotated to its lowermost position in a clockwise direction, so that the crank 45, and hence the shifter yoke 39, are held in their lowermost positions. When the shifter yoke 39 occupies its lowermost position, the upper

rollers 41 engage the upper edge of collar 33 and exert a downward force on this collar which is transmitted through the shoulder 33c, flange 32a, and coil spring 34 to the lower sleeve 28, thereby holding this sleeve in the position in which the teeth 37 on the sleeve mesh with the teeth 38 on the worm wheel 9. The worm wheel 9 is therefore operatively connected with the switch actuating shaft 6, so that the apparatus is in condition for operation of the switch by the electric motor 15. At such times, the bevel gear 17 is capable of rotating freely with respect to the shaft 6, so that this gear is disconnected from the shaft, with the result that the hand lever is disconnected from the switch.

I will now assume that with the switch in its normal position, and with the parts of the switch mechanism A in the positions just described, it is desired to reverse the switch by means of the hand lever 26. To do this, the operator first moves the hand lever from the full line position shown in Fig. 1 through a sufficient angle to withdraw the lever from the lock stand A^1. This movement of the lever, which movement I will term a "preliminary movement", rotates the cam 47 in a counter-clockwise direction as viewed in Fig. 9, from the position shown in this figure to a position in which the finger 46b of the cam follower 46 is out of engagement with the swell 47b of cam 47 and the finger 46a is riding on the swell 47a. As a result, the cam follower 46 is rotated upwardly about the cam 48 as a fulcrum, thus raising the crank pin 45a, and hence rotating the crank 45 upwardly. This upward rotation of the crank 45, in turn, is transmitted to the collar 33 of the clutch mechanism M by means of the rock shaft 40 and shifter yoke 39, the parts being so proportioned that, as a result of this rotation, the collar is moved to its uppermost position. During this movement of the collar 33 to its uppermost position, its lower shoulder 33d engages the flange 32b on the sleeve 28, thereby positively moving this sleeve upwardly to the position in which the teeth 37 on the sleeve are disengaged from the teeth on the worm wheel 9, so that the worm wheel is then free to rotate with respect to the shaft 6. Furthermore, during the movement of the collar 33 to its uppermost position, the sleeve 27 is moved into engagement with the bevel gear 17 by virtue of the force transmitted through the spring 34, and since the position of the hand lever and the position of the switch correspond under these conditions, the teeth on the sleeve and the teeth on the bevel gear will mesh. The bevel gear will then be connected with the switch. The rotation of the rock shaft 40 during the upward movement of the clutch mechanism permits the spring 69a to open the circuit controller 69, thereby disconnecting the motor from its source of current, and so preventing operation of the worm wheel 9 as long as the hand lever is connected with the switch. The hand lever now being connected with the switch, the operator next moves the hand lever through an angle of approximately 180° to the position in which it engages the arm 73a of the locking member 73 of the lock stand A^2. This movement of the lever, which movement I will term a "main" movement, rotates the shaft 6, and hence the crank 55 on the lower end of the shaft 6, in a clockwise direction as viewed in Fig. 1, from the extreme positions shown in this figure to the opposite extreme positions. As previously pointed out, when the crank 55 is rotated from the extreme position shown, to its opposite extreme position, the first part of this movement unlocks the switch, the next part reverses it, and the final part of the movement locks the switch in its reverse position.

If, after the switch has been reversed by the hand lever in the manner just described, it is desired to restore the switch to its normal position by the hand lever, this may be done by merely operating the hand lever to the position in which it engages the arm 73a of the locking member 73 of the lock stand A^1. This movement of the lever will first unlock the switch, will then operate it from its reverse position to its normal position, and will finally lock it in its normal position.

When it is desired to disconnect the hand lever from the switch, the lever is first operated either to the position in which it engages the arm 73a of the locking member 73 of the lock stand A^1, or to the position in which it engages the arm 73a of the locking member 73 of the lock stand A^2, and the foot pedal 51 is then depressed. When the foot pedal 51 is depressed, the resultant rotation of the cam 48 causes the cam follower 46 to pivot about the cam 47 as a fulcrum in a manner which will be apparent from an inspection of Fig. 9, thereby rotating the crank 45 downwardly, and hence moving the collar 33 of the clutch mechanism M downwardly in a manner which will be apparent from an inspection of the drawings. The downward movement of the collar 33 disengages the sleeve 27 from the bevel gear 17, thereby disengaging the lever 26 from the shaft 6, so that the lever is now free to rotate. The lever is next raised slightly, and the detent 74 of the adjacent lock stand A^1 or A^2 is then depressed to move the arm 73a of the locking member 73 of such lock stand out of the path of movement of the lever, after which the lever is inserted into the adjacent lock stand. During the insertion of the lever into the lock stand, the resultant rotation of the cam 47 lowers the right-hand end of cam follower 46 to its normal position. Furthermore, as soon as the foot pedal 51 is released, spring 68 restores the shaft 49 to its normal position, thus caus-

ing the cam follower 46 to pivot about the pin 45a of the crank 45, so that the cam follower 46 is then restored to its normal or horizontal position in which it is illustrated in Fig. 9.

In order to connect the hand lever with the switch when the switch occupies its reverse position, and the hand lever occupies the dotted position shown in Fig. 2, the hand lever is raised through a sufficient angle to remove the lever from the lock stand A^2. The operation of the mechanism during this "preliminary" movement of the lever is similar to that previously described when the lever was withdrawn from the lock stand A^1, and will be readily understood from an inspection of the drawings without describing it in detail.

If it is desired to connect the hand lever with the switch when the switch and the lever do not occupy corresponding relative positions, this may be done by moving the hand lever to the position which corresponds to the position of the switch. Under these conditions, the preliminary movement of the lever, that is to say, the movement of the lever necessary to remove it from the lock stand A^1 or A^2, raises the collar 33 of the clutch mechanism M to its uppermost position in the manner previously described, but since the position of the switch and the position of the lever do not correspond, the tooth 35a on the sleeve 27 is not opposite the space between the teeth 36a and 36d on the bevel gear 17, and as a result, as soon as the collar has moved upwardly a short distance the flat ends of the teeth on the upper end of the sleeve 27 move into engagement with the flat ends of the teeth 36 on the bevel gear 17, so that during the remainder of the upward movement of the collar, spring 34 becomes compressed. Spring 34 then remains compressed until the lever is moved through the portion of its main movement which is necessary to bring the position of the lever into agreement with the position of the switch. When this is done, the energy stored in the spring 34 completes the upward movement of the sleeve 27, thereby causing the teeth on the sleeve to mesh with the teeth on the bevel gear, and hence permitting manual operation of the switch in the manner previously described.

A switch actuating mechanism constructed in the manner previously described is adapted for use where it is necessary to be able to operate the locking mechanism for the switch by the hand lever in such manner that the switch can be completely locked in either extreme position while the switch is connected with the hand lever. Under some conditions of operation, however, it is unnecessary that the switch should become completely locked after the switch has been reversed by the hand lever, and when this is the case, the foot pedal 51 and associated parts can be eliminated by modifying the apparatus in the manner illustrated in Figs. 12, 13 and 14.

Referring now to Fig. 12, the main rock shaft, which is here designated 40^1, has been lengthened, and is journalled at its left-hand end in the bearing 50. As best seen in Fig. 13, a cam follower 46^1 is pivotally mounted at one end on the shaft 40^1, and is provided at the other end with arms 46a and 46b which cooperate with the cam 47 in the manner previously described. The cam follower 46^1 is also provided intermediate its ends with a suitable hole which receives the crank pin 45a. The upper sleeve of the clutch mechanism M, which in the form shown in Figs. 12 and 14 is designated 27a, is similar to the sleeve 27 previously described except that the evenly spaced teeth 76a, 76b, 76c and 76d formed on the upper end of the sleeve 27a have shorter angular lengths than the teeth 36a, 36b, 36c and 36d, respectively, which are formed on the upper end of the sleeve 27. For example, for purposes of illustration, I will assume that the teeth 76 each have an angular length of approximately 32°, making the space between each two adjacent teeth approximately 58°. It will be apparent, therefore, that when the hand lever is connected with the switch there will be approximately 30° lost motion when the direction of movement of the hand lever is reversed. It should be distinctly understood, however, that in actual practice the amount of lost motion that must be provided will be determined by the proportioning of the parts of the mechanism as a whole. The remainder of the apparatus shown in Fig. 12 is similar to that shown in Figs. 3 and 4 with the exception that the gear ratio of the gears 23 and 17 has been decreased somewhat.

In explaining the operation of the switch actuating mechanism as a whole when modified as shown in Figs. 12, 13 and 14, I will first assume that the lever 26 is moved from one or the other of its extreme positions through a sufficient angle to remove it from the associated lock stand A^1 or A^2. Under these conditions, the resultant rotation of the cam 47 causes the cam follower 46^1 to lift the crank 45 through a sufficient angle so that the collar 33 of the clutch mechanism M is moved to its uppermost position. When the clutch collar 33 is moved to its uppermost position, the motor 15 becomes disconnected from the switch in the manner previously described, and if the switch then occupies a position which corresponds to the position of the lever, the teeth on the bevel gear 17 and the teeth on the sleeve 27a will mesh, so that the hand lever will be connected with the switch. If, however, the switch does not occupy a position which corresponds to the position of the lever when the collar 33 is moved to its uppermost position, the teeth on the collar will not mesh with the teeth on

the bevel gear, and in order to cause the teeth on the collar to mesh with the teeth on the bevel gear, it is necessary to move the lever through a sufficient part of its main movement to bring the position of the lever into agreement with the position of the switch.

I will next assume that after the lever has been connected with the switch in the manner just described, the lever is moved from the position in which it engages the upper surface of the arm 73ª of the locking member 73 of the lock stand A^1 or A^2 through an angle of approximately 180° to the position in which it engages the upper surface of the arm 73ª of the locking member 73 of the other lock stand. The parts are so proportioned that if the switch is locked in either extreme position when this movement of the lever takes place, approximately the first 30° of this movement will operate the locking mechanism to unlock the switch, while the remainder of this movement will reverse the switch but will not completely lock it in its reverse position. If, however, the switch is not locked in an extreme position when this movement takes place, as will be the case if the switch had previously been reversed by the lever in the manner just described, or if the lever had become connected with the switch when the switch occupied an intermediate position, then, due to the construction of the sleeve 27ª previously described, the first 30° of this movement will be lost motion, while the balance of the movement will rotate the shaft 6 through a sufficient angle to reverse the switch but not to lock it in its reverse position.

In order to disconnect the lever from the switch after the lever has been connected with the switch, the lever is rotated nearly to the position in which it engages the upper surface of the arm 73ª of the locking member 73 of one of the lock stands A^1 or A^2, and the detent 74 of the adjacent lock stand is then operated to move the arm 73ª of the locking member out of the path of movement of the lever, after which the lever is inserted into the lock stand. It should be pointed out that this movement of the lever into the adjacent lock stand under these conditions, which movement I will term a "final" movement, is permitted because the switch is not completely locked. During this final movement of the lever into the lock stand, the cam 47 is rotated to a position which causes the cam follower 46^1 to return to its lowermost position thus moving the clutch collar 33 to its lowermost position, and hence disengaging the sleeve 27 from the bevel gear 17, so that the lever is now disconnected from the switch. When the collar 33 is moved to its lowermost position, the teeth 37 on the sleeve 28 will mesh with the teeth 38 on the worm wheel 9 to connect the motor with the switch in the manner previously described. The parts will then be restored to the condition in which they are illustrated in the drawings.

One function of the lock stands A^1 and A^2 is to prevent the lever from dropping to its lowermost position due to its own weight to disconnect the lever from the switch in the manner previously described before it is desired to have the lever become disconnected from the switch. It should be understood, however, that the lock stands A^1 and A^2 are not essential to my invention, and may be replaced by any other suitable device or devices which will perform the same functions.

One advantage of the modified form of switch actuating mechanism just described is that it utilizes a preliminary movement of the hand lever to disconnect the motor from, and connect the lever with, the switch, a main movement of the lever to reverse the switch, and a final movement of the lever for subsequently disconnecting the lever from the switch.

Although I have herein shown and described only two forms of railway 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 apparatus comprising a switch actuating member, two movable elements, means for selectively connecting one of said elements or the other with said member, a manually operable lever movable around only one axis as a center for operating one of said elements, other means for operating the other element, and means responsive to a preliminary movement of said lever around said axis for actuating said connecting means.

2. Railway switch operating apparatus comprising a switch actuating shaft, a manually operable lever movable in a single plane, and means responsive to a preliminary movement of said lever in said plane for connecting said lever with said shaft to permit operation of said shaft by a continued movement of said lever.

3. Railway switch operating apparatus comprising a switch actuating member, a manually operable lever, means responsive to a preliminary movement of said lever for connecting said lever with said switch actuating member to permit operation of said switch actuating member by said lever, a foot operated member, and means controlled by said foot operated member for disconnecting said lever from said switch actuating member.

4. Railway switch operating apparatus comprising a switch actuating member, a

motor normally connected with said member, a manually operable lever movable around only one axis as a center, means responsive to a preliminary movement of said lever around said axis for disconnecting said motor from said switch actuating member and for connecting said lever with said switch actuating member, and means responsive to further movement of said lever around said axis for operating said switch actuating member.

5. Railway switch operating apparatus comprising a switch actuating member, a motor normally connected with said switch actuating member, a manually operable lever, means responsive to a preliminary movement of said lever for disconnecting said motor from said switch actuating member and for connecting said lever with said switch actuating member to permit operation of said switch actuating member by a main movement of said lever, a foot operated member, and means controlled by said foot operated member for disconnecting said lever from said switch actuating member.

6. Railway switch operating apparatus comprising a switch actuating member, a motor normally connected with said member, a manually operable lever movable around only one axis as a center, means responsive to a preliminary movement of said lever around said axis for disconnecting said motor from said switch actuating member and for connecting said lever with said switch actuating member to permit operation of said switch actuating member by a main movement of said lever, and means responsive to a final movement of said lever around said axis for disconnecting said lever from said shaft and for connecting said motor with said shaft.

7. Railway switch operating apparatus comprising a switch actuating member, two movable elements, means for selectively connecting one of said elements or the other with said member, a manually operable lever movable around only one axis as a center for operating one of said elements, an electric motor for operating the other element, and means responsive to a preliminary movement of said lever around said axis for actuating said connecting means and for interrupting the supply of current to said motor.

8. Railway switch operating apparatus comprising a switch actuating member, two movable elements, means for selectively connecting one of said elements or the other with said member, a manually operable lever movable around only one axis as a center for operating one of said elements, other means for operating the other element, and means responsive to a preliminary movement of said lever around said axis for actuating said connecting means to disconnect said other element from said member and to connect said one element with said member.

9. Railway switch operating apparatus comprising a switch actuating member, two movable elements, means for selectively connecting one of said elements or the other with said member, a manually operable lever movable around only one axis as a center for operating one of said elements, a motor for operating the other element, and means responsive to a preliminary movement of said lever around said axis for actuating said connecting means.

10. Railway switch operating apparatus comprising a switch actuating member, two movable elements, means for selectively connecting one of said elements or the other with said member, a motor for operating one of said elements, a manually operable lever movable between two extreme positions, means controlled by said lever for operating the other element, and means responsive to a preliminary movement of said lever from either extreme position for actuating said connecting means to disconnect said one element from said switch actuating member and to connect said other element with said member.

11. Railway switch operating apparatus comprising a switch actuating member, an electric motor, a manually operable lever movable between two extreme positions, means for connecting said motor with said member when said lever occupies either extreme position, and means for disconnecting said motor from said member and for connecting said lever with said member in response to a preliminary movement of said lever from either extreme position.

12. Railway switch operating apparatus comprising a switch actuating member, an electric motor, a manually operable lever movable between two extreme positions, means for connecting said motor with said member when said lever occupies either extreme position, means for disconnecting said motor from said member and for connecting said lever with said member upon a preliminary movement of said lever from either extreme position, and other means for disconnecting said lever from said member and for connecting said motor with said member.

13. Railway switch operating apparatus comprising a switch actuating shaft, a plurality of gear wheels mounted for rotation coaxially with said shaft, a clutch mechanism for selectively connecting said gear wheels with said shaft, an electric motor for rotating one of said gear wheels, means including a manually operable lever movable around only one axis as a center for rotating another one of said gear wheels, and means responsive to a preliminary movement of said lever around said axis for actuating said clutch mechanism.

14. Railway switch operating apparatus comprising a switch actuating shaft, a plurality of gear wheels mounted for rotation

coaxially with said shaft, a clutch mechanism for selectively connecting said gear wheels with said shaft, an electric motor for rotating one of said gear wheels, means including a manually operable lever movable around only one axis as a center for rotating another one of said gear wheels, and means responsive to a preliminary movement of said lever around said axis for actuating said clutch mechanism to disconnect said one gear wheel from said shaft and to connect the other gear wheel with the shaft.

15. Railway switch operating apparatus comprising a switch actuating member, two movable elements, a clutch mechanism for selectively connecting one element or the other with said member, a manually operable lever movable around only one axis as a center for operating one of said elements, other means for operating the other element, and means responsive to a preliminary movement of said lever around said axis for operating said clutch mechanism.

16. Railway switch operating apparatus comprising a switch actuating shaft, a plurality of gear wheels mounted for rotation coaxially with said shaft, clutch mechanism for selectively connecting said gear wheels with said shaft, a manually operable lever movable between two extreme positions, means responsive to a preliminary movement of said lever from either extreme position for operating said clutch mechanism to disconnect one gear wheel from said shaft and to connect another gear wheel with said shaft, a motor for operating said one gear wheel, and means controlled by said lever for operating said other gear wheel.

17. Railway switch operating apparatus comprising a switch actuating shaft, a plurality of gear wheels mounted for rotation coaxially with said shaft, clutch mechanism for selectively connecting said gear wheels with said shaft, a manually operable lever movable between two extreme positions, means responsive to a preliminary movement of said lever from either extreme position for operating said clutch mechanism to disconnect one gear wheel from said shaft and to connect another gear wheel with said shaft, a motor for operating said one gear wheel, and means controlled by said lever and including said other gear wheel for operating said shaft.

18. Railway switch operating apparatus comprising a switch actuating shaft movable between two extreme positions, a plurality of gear wheels mounted for rotation coaxially with said shaft, clutch mechanism for selectively connecting said gear wheels with said shaft, a manually operable lever movable between two extreme positions, means responsive to a preliminary movement of said lever from either extreme position for operating said clutch mechanism to disconnect one gear wheel from said shaft and to connect another gear wheel with said shaft, a motor for operating said one gear wheel, and means responsive to a main movement of said lever and including said other gear wheel for operating said shaft from one extreme position to the other.

19. Railway switch operating apparatus comprising a switch actuating shaft movable between two extreme positions, a plurality of gear wheels mounted for rotation coaxially with said shaft, clutch mechanism for selectively connecting said gear wheels with said shaft, a manually operable lever movable between two extreme positions, means responsive to a preliminary movement of said lever from either extreme position for operating said clutch mechanism to disconnect one gear wheel from said shaft and to connect another gear wheel with said shaft, a motor for operating said one gear wheel, means responsive to a main movement of said lever and including said other gear-wheel for operating said shaft from one extreme position to the other, and means for operating said clutch mechanism to disconnect said other gear wheel from said shaft and for connecting said one gear wheel with said shaft.

20. Railway switch operating apparatus comprising a switch actuating shaft, a plurality of gear wheels mounted for rotation coaxially with said shaft, clutch mechanism for selectively connecting said gear wheels with said shaft, a manually operable lever movable between two extreme positions, means responsive to a preliminary movement of said lever from either extreme position for operating said clutch mechanism to disconnect one gear wheel from said shaft and to connect another gear wheel with said shaft, a motor for at times operating said one gear wheel, means controlled by said lever for at other times operating the other gear wheel, a manually operable member, and means controlled by said manually operable member for operating said clutch mechanism to disconnect said other gear wheel from said shaft and for connecting said one gear wheel with said shaft.

21. In combination, a railway switch movable between two extreme positions, a switch actuating shaft rotatable between two extreme positions, locking mechanism effective when said switch and said shaft occupy corresponding extreme positions for locking said switch in the extreme position which it then occupies; means effective when said switch actuating shaft is rotated from either extreme position to the other extreme position to first operate said locking mechanism to unlock said switch, to next reverse said switch, and finally to again operate said locking mechanism to lock said switch in its reversed position; two gear wheels mounted for ro-

tation coaxially with said shaft, clutch mechanism for selectively connecting said gear wheels with said shaft, a manually operable lever movable between two extreme positions, means responsive to a preliminary movement of said lever from either extreme position for actuating said clutch mechanism to disconnect one gear wheel from said shaft and for at times connecting the other gear wheel with the shaft, means controlled by said lever and effective when said other gear wheel is connected with said shaft for rotating said shaft from either extreme position to the other extreme position, and other means effective when said one gear wheel is connected with said shaft for rotating said shaft from either extreme position to the other extreme position

22. In combination, a railway switch movable between two extreme positions, a switch actuating shaft rotatable between two extreme positions, locking mechanism effective when said switch and said shaft occupy corresponding extreme positions for locking said switch in the extreme position which it then occupies; means effective when said switch actuating shaft is rotated from either extreme position to the other extreme position to first operate said locking mechanism to unlock said switch, to next reverse said switch, and finally to again operate said locking mechanism to lock said switch in its reversed position; two gear wheels mounted for rotation coaxially with said shaft, mechanism for selectively connecting said gear wheels with said shaft, a manually operable lever movable between two extreme positions, means responsive to a preliminary movement of said lever from either extreme position for actuating said clutch mechanism to disconnect one gear wheel from said shaft and for at times connecting the other gear wheel with the shaft, means controlled by said lever and effective when said other gear wheel is connected with said shaft for rotating said shaft from either extreme position to the other extreme position, other means effective when said one gear wheel is connected with said shaft for rotating said shaft from either extreme position to the other extreme position, a foot pedal, and means controlled by said foot pedal for actuating said clutch mechanism to disconnect said other gear wheel from said shaft and to connect said one gear wheel with said shaft.

23. In combination, a railway switch movable between two extreme positions, a switch actuating shaft rotatable between two extreme positions, locking mechanism effective when said switch and said shaft occupy corresponding extreme positions for locking said switch in the extreme position which it then occupies; means effective when said switch actuating shaft is rotated from either extreme position to the other extreme position to first operate said locking mechanism to unlock said switch, to next reverse said switch, and finally to again operate said locking mechanism to lock said switch in its reversed position; two gear wheels mounted for rotation coaxially with said shaft, clutch mechanism for selectively connecting said gear wheels with said shaft, a manually operable lever movable between two extreme positions, means responsive to a preliminary movement of said lever from either extreme position for actuating said clutch mechanism to disconnect one gear wheel from said shaft and for at times connecting the other gear wheel with the shaft, means responsive to a main movement of said lever when said other gear wheel is connected with said shaft for rotating said shaft from one extreme position toward the opposite extreme position through a sufficient angle to reverse said switch but not to completely lock said switch in its reversed position, and means responsive to a final movement of said lever for actuating said clutch mechanism to disconnect said other gear wheel from said shaft and for connecting said one gear wheel with said shaft.

24. In combination, a railway switch movable from a first position to a second position, a switch actuating shaft rotatable from a first position to a second position, locking means effective when said switch occupies its first position and said shaft occupies its first position for locking said switch in its first position; means effective when said switch actuating shaft is rotated from its first position toward its second position to first actuate said locking mechanism to unlock said switch, to next move said switch to its second position, and finally to again actuate said locking mechanism to lock said switch in its second position, two gear wheels, clutch mechanism for selectively connecting said gear wheels with said shaft, means responsive to a preliminary movement of said lever for actuating said clutch mechanism to disconnect one gear wheel from said shaft and to connect the other gear wheel with said shaft, means responsive to a main movement of said lever and including said other gear wheel for moving said shaft from said first position to said second position, and a motor for operating said one gear wheel.

25. In combination, a railway switch movable from a first position to a second position, a switch actuating shaft rotatable from a first position to a second position, locking means effective when said switch occupies its first position and said shaft occupies its first position for locking said switch in its first position; means effective when said switch actuating shaft is rotated from its first position toward its second position to first actuate said locking mechanism to unlock said switch, to next move said switch to its sec-

ond position, and finally to again actuate said locking mechanism to lock said switch in its second position, two gear wheels, clutch mechanism for selectively connecting said gear wheels with said shaft, means responsive to a preliminary movement of said lever for actuating said clutch mechanism to disconnect one gear wheel from said shaft and to connect the other gear wheel with said shaft, means responsive to a main movement of said lever and including said other gear wheel for moving said shaft from said first position to said second position, a foot pedal, means controlled by said foot pedal for actuating said clutch mechanism to disconnect said other gear wheel from said shaft and to connect said one gear wheel with said shaft, and a motor for operating said one gear wheel.

26. In combination, a railway switch movable from a first position to a second position, a switch actuating shaft rotatable from a first position to a second position, locking means effective when said switch occupies its first position and said shaft occupies its first position for locking said switch in its first position; means effective when said switch actuating shaft is rotated from its first position toward its second position to first actuate said locking mechanism to unlock said switch, to next move said switch to its second position, and finally to again actuate said locking mechanism to lock said switch in its second position, two gear wheels, clutch mechanism for selectively connecting said gear wheels with said shaft, means responsive to a preliminary movement of said lever for actuating said clutch mechanism to disconnect one gear wheel from said shaft and to connect the other gear wheel with said shaft, means responsive to a main movement of said lever and including said other gear wheel for moving said shaft from its first position toward its second position just far enough to move said switch to its second position, means responsive to a final movement of said lever for actuating said clutch mechanism to disconnect said other gear wheel from said shaft and to connect said one gear wheel with said shaft, and a motor for operating said one gear wheel.

27. Railway switch operating apparatus comprising a switch actuating shaft, two movable elements, clutch mechanism for selectively connecting said elements with said shaft, power means for actuating one of said elements, a hand lever movable around only one axis as a center for actuating the other element, a cam operated by said lever, and means controlled by said cam for shifting said clutch mechanism in response to a preliminary movement of said lever around said axis in such manner that said one movable element is disconnected from said shaft and said other movable element is connected with said shaft.

28. Railway switch operating apparatus comprising a switch actuating shaft, two gear wheels, clutch mechanism for selectively connecting said gear wheels with said switch actuating shaft, power means for actuating one of said gear wheels, a manually operated shaft, means controlled by said manually operable shaft for actuating the other gear wheel, a main rock shaft, means controlled by said main rock shaft for operating said clutch mechanism, an auxiliary rock shaft, a manually operable member for operating said auxiliary rock shaft, a first cam on said auxiliary rock shaft and a second cam on said manually operated shaft, a crank attached to said main rock shaft and provided with a crank pin, and a cam follower pivoted intermediate its ends on said crank pin and cooperating at one end with said first cam and at the other end with said second cam.

In testimony whereof I affix my signature.

EDWIN G. LITTLE.