

Feb. 11, 1969

P. E. REDELMAN
SWITCHING APPARATUS

3,427,448

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Sheet 1 of 4

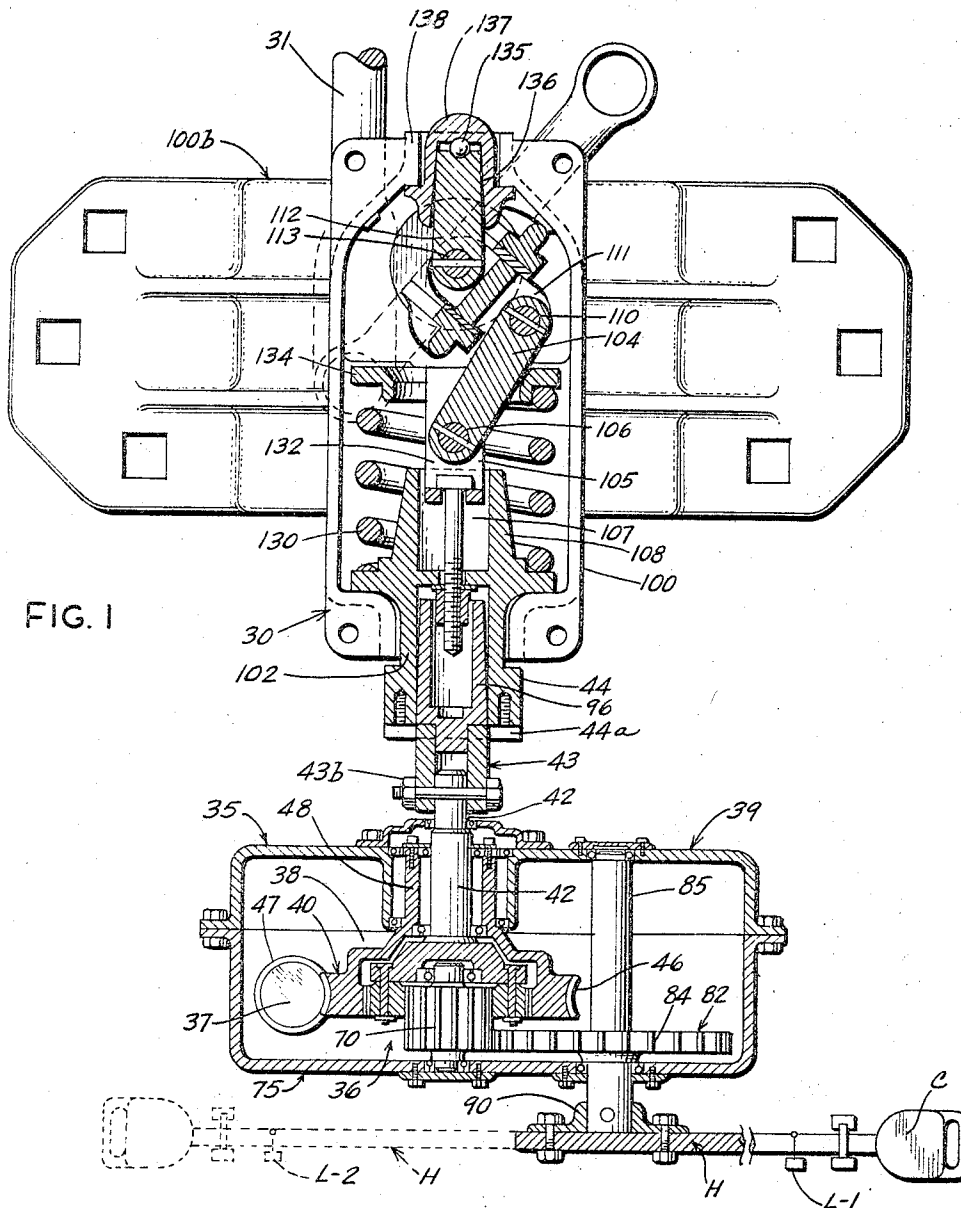


FIG. 1

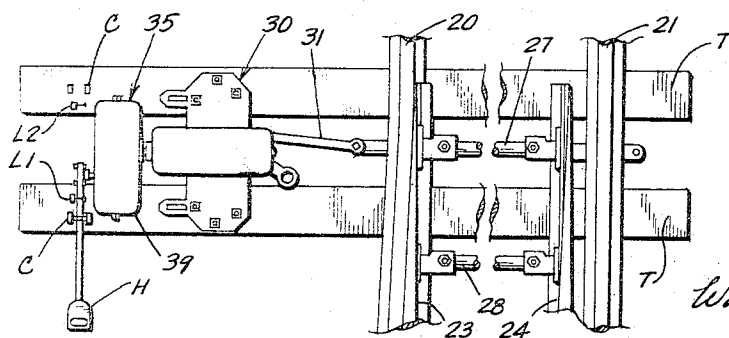


FIG. 1A

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Sheet 2 of 4

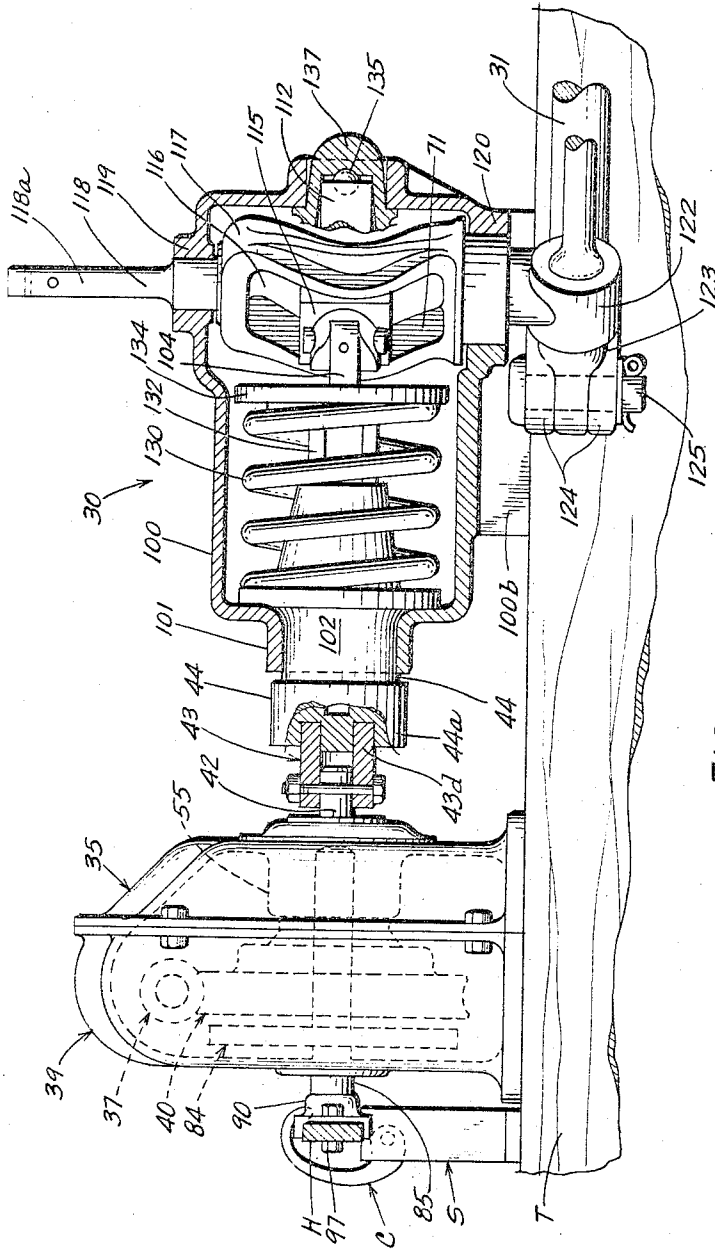


FIG. 2

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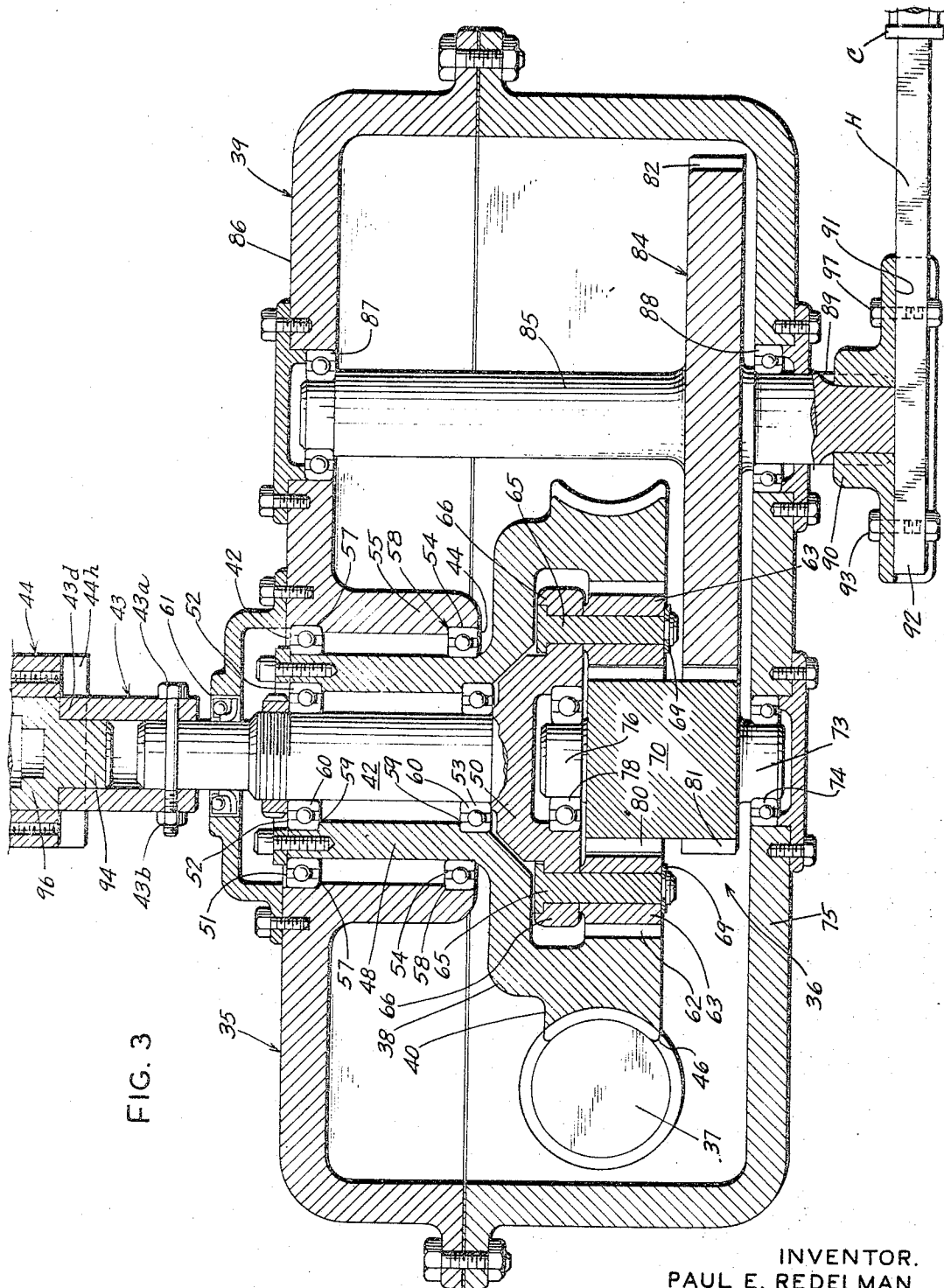
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Sheet 3 of 4



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Sheet 4 of 4

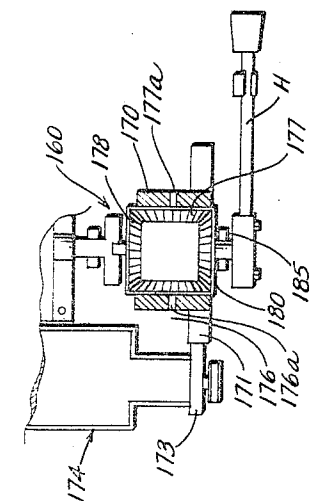


FIG. 5

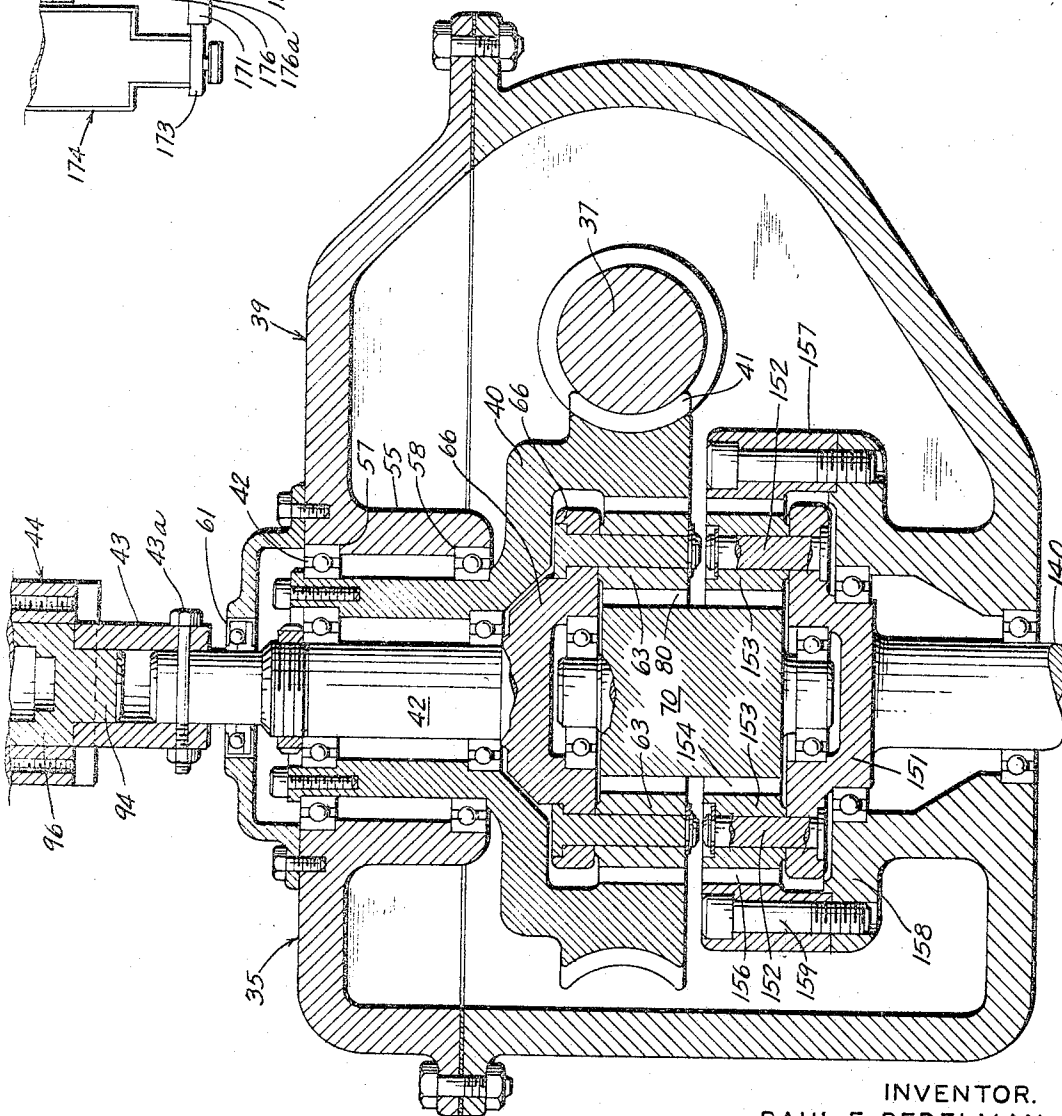


FIG. 4

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3,427,448

SWITCHING APPARATUS

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U.S. Cl. 246—393

9 Claims

Int. Cl. B611 5/02, 11/02

ABSTRACT OF THE DISCLOSURE

A railroad switch stand of the kind which includes a spring base and an overcenter linkage for rotating a spindle effectively coupled to the switch points, and in which the spring base is turned through 180° to operate the spindle, may be operated by a motor or manually through a handle by turning a gear on the spring base through 180°, this being accomplished by a first gear driven by the motor independently of a second gear rotated by the manual throw handle, each mode of operation imparting rotation to the gear on the spring base.

This invention relates to railroad switching apparatus for operating a railroad switch either by hand or by power operation.

A railroad switch includes switch points connected by a throw rod and movable between positions adjacent a pair of stock rails. The movement of the switch points may be effected in a number of ways. For instance, a switch stand may be provided adjacent the switch points having a hand lever for manually operating a mechanical linkage or gear arrangement to move a switch point throw rod to move the switch points to a limit position against the stock rails. Also, power operated devices are provided which may be remotely controlled for moving the switch point throw rod to move the switch points between limit positions. Also, in many installations it is required that the switch also be thrown when a locomotive is trailing the switch.

In a number of installations such as in a railroad classification yard, it is desirable that the switch be capable of being thrown by any of three modes of operation namely, manually, power operation, or by a trailing locomotive. Switching apparatus capable of affording the above three modes of operation has heretofore included a hydraulic mechanism and a switch stand operatively connected to a throw rod of a switch. Although this hydraulic mechanism and switch stand have proved eminently satisfactory, the hydraulic mechanism has required the use of hydraulic pump, cylinders and fluid carrying lines. A need exists for operating a switch by the three different modes without the necessity for hydraulic equipment and accordingly, the primary object of the present invention is to eliminate the necessity for hydraulic equipment in order to achieve the operation of a switch either manually or by powered operation while permitting throwing of a switch by trailing locomotive and without the requirement for specialized conditioning or converting mechanisms between the different modes of operation of the switch.

Another object of the invention is to throw a railroad switch by a switch stand operable by a system of gears actuable by either a motor means or by a manually operated lever to cause movement of the switch points to the opposite limit position irrespective of the last mode of operation and irrespective of the prevailing position of the switch points. A further object of the invention is to operate a switch by a trailing locomotive, by manual throw lever, or by a motor driven mechanism connected to a gear driven switch stand.

A further object of the invention is to operate a switch

2

stand by an epicyclic gear mechanism wherein the input operating force to the gear mechanism may be that of a hand throw lever or that of a motor. Under another object of the invention differential gearing is connected to switch stand and is independently actuated either by a manual throw lever or by a motor to throw the switch.

The present invention is particularly adapted for use with a known switch stand having an overcenter linkage including a strong spring for biasing the switch points when at their closed limit positions. Heretofore, a hydraulic mechanism has been employed to power operate the switch stand by turning the output spindle of the switch stand and compressing the strong biasing spring in the stand. Accordingly, a further object of the invention is to reduce the amount of operating force to throw the switch points of a switch stand, having an overcenter spring, by having a motor and gear means turn the overcenter linkage without compressing the spring to the extent required when turning the spindle.

Other and further objects of the present invention will be apparent from the following description and claims and are illustrated in the accompanying drawings which, by way of illustration, shows preferred embodiments of the present invention and the principles thereof and what is now considered to be the best mode contemplated for applying these principles. Other embodiments of the invention embodying the same or equivalent principles may be used and structural changes may be made as desired by those skilled in the art without departing from the present invention and the purview of the appended claims.

In the drawings:

FIG. 1 is a sectional view showing a switch stand and gear means operable by a motor or a manual throw lever and constructed in accordance with the principles of the present invention;

FIG. 1a is a plan view of an installation of the switching apparatus of FIG. 1 connected to switch points movable between a pair of stock rails;

FIG. 2 is an elevational view, partially in section showing the gear means connected to the switch stand;

FIG. 3 is an enlarged sectional view of the gear means of FIG. 1;

FIG. 4 is a sectional view of a gear means constructed in accordance with another embodiment of the invention; and

FIG. 5 is a diagrammatic view of a differential gear arrangement for operating a switch stand according to the principles of the present invention.

Referring now to the drawings and more particularly to FIG. 1a, there is illustrated a pair of stock rails 20 and 21 secured to a pair of ties T between which rails move the movable switch points 23 and 24 of a railroad switch. The switch points 23 and 24 are connected together by the usual front and rear throw rods 27 and 28. As shown in FIG. 1a, the railroad switch condition is for straight through movement of the locomotive.

The conventional mode of throwing a railroad switch from one of its set or limit positions to the other is by means of a switch stand, which includes an operating handle having a crank connection to an arm which in turn is connected to the throw rod of the switch. In this connection, it will be observed in FIG. 1a, that a switch stand 30 is mounted on the ties T outwardly of the lefthand stock rail 20. One manner of throwing the switch stand 30 is to turn a crank handle H from a position slightly above and generally parallel to one of the ties through 180° to a position slightly above and generally parallel to the other of the ties. Upon the turning of the handle H through 180°, the switch stand 30 causes reciprocation of a connecting rod 31 connected to the front throw rod 27 to move the switch points 23 and 24 to the opposite limit position.

An important aspect of the present invention is that the switch stand 30 may be operable under the control of a motor means 35 to also actuate the switch stand 30 to throw the switch points between the limit positions as an alternative to operating the switch by a trailing locomotive and as an alternative to manual operation by a handle H. The switching apparatus is thus particularly adapted to be remotely controlled by energization of the motor means 35 to cause the switching operation.

In the preferred form of the present invention, the motor means 35 comprises an electric motor 36, FIG. 3, having an output shaft with a worm gear 37 thereon for driving a gear means 38, FIG. 1, disposed within a gear housing 39. The worm gear 37 is meshed with a spider gear 40 to afford a gear reduction of about 30:1 for turning an output shaft 42 connected by an adapter 43 to turn a spring base 44 of the switch stand 30.

The motor 36 and gear means 38 are totally enclosed in a split casting joined together by suitable fasteners to form a housing 39. This gear housing 39 is spiked to the respective ties T, FIG. 2, and the output shaft 42 from the housing 39 is axially aligned with the spring base 44 of the switch stand. The motor 36 is disposed generally vertically with the worm gear 37 extending downwardly and tangentially to the worm wheel 40.

The gear means 38 includes an epicyclic gear train, which in one form of the invention, may be a differential gear train, as seen in FIG. 5.

As can best be seen in FIG. 3, the gear means 38 includes the spider 40 with an outer worm wheel having circumferentially disposed teeth 46 for engagement with the teeth of the worm gear 37. The spider 40 is mounted for rotation by its integrally formed, cylindrical portion 48 extending forwardly to be journaled for rotation in the gear housing 39. More specifically, the cylindrical portion 48 is mounted for rotation within gear housing 39 by means of a pair of forward bearings 51 and 52 and a pair of rearward bearings 53 and 54. The gear housing 39 is formed with an interiorly directed cylindrical portion 55 with spaced, annular grooves 57 and 58 into which the respective outer bearings 52 and 54 are seated.

The smaller pair of bearings 51 and 53 have their outer races 59 secured in grooves of the cylindrical portion 48 of the spider 40 and have their inner races 60 secured to the output shaft 42. A suitable bearing seal 61, FIG. 3, is in sealing engagement with an end 42 of the shaft to seal the interior of the housing 39.

The spider 40 has an open ended central portion or chamber within which is formed, along its inner wall, an inner, ring gear having teeth 62 in meshed engagement with the teeth of at least three planetary gears 63.

The planetary gears 63 are rotatably mounted on individual shafts 65 extending rearwardly from a circular plate 66 integrally formed on the rearward end of the output shaft 42. The stub shafts 65 have enlarged heads 66 fitted and secured within suitable grooves formed in the outer flange 66 of the output shaft 42. Retainers 69 are secured at the opposite ends of the stub shafts 65 to hold the planetary gears 63 in alignment and in tooth engagement with the ring gear 62. The shafts 65 are fixed to flange 66 and the planetary gears are free to rotate on their respective supporting shafts 65.

The planetary gears 63 are disposed for rolling movement about a central sun gear 70 which is journaled for rotation at its rearward end by a stub shaft 73 in a bearing 74 disposed in a rearward wall 75 of the gear housing 39. At its forward end the sun gear 70 has a stub shaft 76 disposed for rotation in a ball bearing means 78 seated in a groove in the inner portion of the annular flange 66 of the output shaft 42. The sun gear 70 has a forward ring of teeth 80 integrally formed thereon and which are in meshed engagement with the teeth of the respective planetary gears 63.

The sun gear 70 also has a ring of rearward teeth 81

which are in meshed engagement with teeth 82 of an input drive gear 84 attached to an input shaft 85. The input shaft 85 is journaled for rotation within a bearing means 87 in a forward wall 86 of the bearing housing 39 and is journaled by a bearing means 88 in the rearward housing wall 75. The rearward end of the manual input shaft 85 is splined at 89 to receive an interfitted splined connecting casting 90 which has a groove 91 for receiving a portion 92 of the handle H. Bolt and nut fasteners 93 releasably secure the handle H to the casting 90.

When throwing the switch manually, the handle H is rotated through 180° causing the shaft 85 and input drive gear 84 to rotate therewith. The drive gear 84 through its teeth 82 drives the sun gear 70 to rotate about its stub shafts 73 and 76. As the sun gear 70 rotates, its teeth 80 rotate the respective output planetary gears 63 which travel about the teeth of the ring gear 62 which is being held stationary by the spider 40, the spider 40 being locked against reverse rotation by the worm gear 37. As the planetary gears 63 roll about the now stationary ring gear 62, the flange 66 and the drive shaft 42 are forced to move therewith thereby rotating the output shaft 42 to turn the adapter 43 and spring base 44 of the switch stand 30.

As will be brought out in greater detail hereinafter, it is necessary that the handle and the spring base casting 44 rotated thereby receive only 180° of rotation. For this purpose, a suitable pair of angle-shaped members S are secured to the ties T, to engage and stop rotation of the handle H at a horizontal position with the handle being spaced above the ties T and disposed generally parallel to the ties T. Pivotaly mounted on the stops S are arcuate clamp members C which serve to clamp the handle H against the top of the stop S to hold the handle H when the motor 36 is energized to throw the switch.

With the handle H locked in position by the clamping means C, the motor means 35 may be energized to rotate the worm gear 37 to cause the throwing of the switch. The worm gear 37 rotates and drives the worm teeth 46 as an input thereby turning the spider 40 about the shaft 42. Since the locked handle H holds the drive gear 84 against turning movement, the sun gear 70 having its teeth 81 meshed with the teeth 82 of the drive gear 84 is also held stationary. Thus, the turning of the ring gear 62 with the spider 40 forces the planetary gears 63 to move around the stationary sun gear 70. The planetary gears 63, in turn, cause the flange 66 of the output shaft 42 to turn and through the adapter 43 drive the switch stand 30. The adapter 43 is a cylindrical sleeve through which extends a bolt 43a and a nut 43b to couple the drive shaft 42 to the adapter sleeve. The opposite end of the adapter sleeve 43 has a rectangular shoulder 43d fitted in a rectangular slot 44a at the end of spring base 44. The adapter sleeve 43 loosely receives a square shaped projection 94 of a spring tightener element 96 of the switch stand 30.

The switch stand 30 is a conventional switch stand of the type previously disclosed in U.S. Patent Nos. 2,575,037 and 3,127,138. The operation of this switch stand will be described briefly herein as an aid to understanding the present invention. A more detailed understanding of the construction and operation of the switch stand 30 may be had by resort to the aforementioned patents.

Referring now to FIGS. 1 and 2, it will be seen that the switch stand 30 includes an outer housing 100 having a lower portion with a wide base 100b for spanning the ties to which it is spiked. The switch stand housing 100 has at its rearward end a sleeve 101 in which is mounted a cylindrical portion 102 of the spring base 44. The adapter 43 connects the output shaft 42 of the gear means 38 to the input spring base 44 of the switch stand. The turning of the spring base 44 by the output shaft 42 causes the spring base 44 to rotate a cross head link 105 and a rear link or cross arm 104 in an arcuate path, either clockwise or counterclockwise depending upon the rotation of the in-

put shaft 42. The crank arm 104 is secured to a cross head 105 by a pin 106. The cross head 105 is disposed within a rectangular slot 107 in the forward end 108 of the spring base casting 44. Thus, it will be seen that turning of the spring base casting 44 and its forward portion 108 causes the cross head 105 to also turn, and turn therewith the crank arm link 104.

The crank arm link 104 is pivotally connected by a pin 110 at its forward end to an intermediate or crank pin link 111. The intermediate or crank pin link 111 is pinned to a link 112 by a pin 113. The intermediate link 111 extends through a spindle block 115, FIG. 2, which is disposed for reciprocatory movement within a rectangular shaped opening 116, FIG. 2, in a spindle box 117. The links 104, 111 and 112 constitute an overcenter toggle linkage which will be explained more fully hereinafter.

The spindle box 117 is the central portion of a vertical spindle 118 which is journaled in an upper bearing sleeve 119 of the switch stand housing 100. A lower bearing sleeve 120 is formed on the lower portion of the switch stand housing 100 for journaling the lower portion of the spindle 118 which ends in a turnbuckle 122. The turnbuckle 122 has threaded therein a crank arm 123 which has its outer end secured to a clevis portion 124 of the connecting rod 31. A clevis pin 125 extends through apertures in the clevis portion 124 of the connecting rod 31 and through an aperture in the outer end of the crank rod 123. Thus, as the spindle 118 turns its turnbuckle 122, crank arm 123 reciprocates the connecting rod 31 thereby moving the switch points between their respective limit positions. A signal light or flag is secured to upper portion 118a of the spindle 118 to rotate with the spindle 118 to indicate the position of the switch points.

The turning of the spring base casting 44 thus rotates its crank arm link 104, the cross head 105 and the intermediate link 111 to cause the spindle block 115 to move in an arcuate path while moving vertically in the rectangular opening 116 and thereby causing the spindle 118 to turn. The turning of the spindle 118 turns its turnbuckle 122 to pivot its connecting arm 123 to reciprocate the connecting rod 31.

The switch stand 30 is so constructed that rotation of the spring base 44 results in a movement of the spindle 118 and reciprocating of the rod 31 to move the switch points to their opposite limit position, irrespective of the direction of rotation of the spring base 44. The only difference caused by a change in direction of rotation of the spring base casting 44 is whether or not the spindle block 115 moves in an upper or lower arcuate path from the horizontal plane. The moving of spindle block 115 through its arcuate path turns the spindle 118 and the turnbuckle 122 rotates to reciprocate the connecting rod 31 to move the switch points to the opposite limit position.

The manner of operation of the switch stand 30 by the trailing locomotive is considerably different in that there is no rotation of the spring base 44 as hereinbefore described. More specifically, the wheel flange of a locomotive trailing the switch exerts a force on the switch point 23, FIG. 1a, pulling on the connecting rod 31 which causes the crank arm 123 and the spindle 118 to rotate. Because the spindle block 115 is in a horizontal plane at the end of each throwing operation, a subsequent turning of spindle 118 does not move the spindle block 115 in an arcuate path; but the spindle block 115 moves into a generally straight line, toggle relationship with links 104, 111 and 112. The straightening of toggle link 104 forces its pin 106 rearwardly, as viewed in FIG. 1, forcing the cross head 105, to which the pin 106 is secured, to force an attached spring cap 134 rearwardly while compressing the strong compression spring 130.

The toggle linkage formed from links 104, 111 and 112, is deliberately made loose with the toggle link 112 pivoted in a ball 135 within a tapered socket 136 in a thrust bushing 137 carried in a forward sleeve 138. When the connecting rod 31 moves this toggle linkage to a substantially

straight line position, the looseness of the toggle linkage causes the toggle linkage to shift through-center whereby the spring 130 is again permitted to expand to move the spring base 134 and cross head 105 forwardly thereby driving the links 104, 111 and 112 to their angled position with the consequent driving of the cross block 115 to its fully turned position at which time the switch points 23 and 24 will be biased tightly against the traffic rails 20 and 21 in a limit position. The spring 130 serves to bias the switch points 23 and 24 to a completely closed position preventing the switch stopping in a partially closed condition.

It will be realized that the operation of the switch stand by the trailing locomotive requires considerably more operating force because of the considerable compression of the spring 130 necessary to straighten the toggle linkage and move the toggle linkage. It has been found that the amount of force applied to throw the switch points to straighten the toggle linkage by a trailing locomotive or by turning the turnbuckle 122 by a fluid applicator attached to the turnbuckle 122, as disclosed in U.S. Patent No. 3,127,138, is significantly greater than the force required for turning the spring base casting 44 either by a handle H or by an electric motor means 34. It is pointed out that the terminal portion of the 180° of turning of the spindle 118, by each of the three respective operating modes, causes compression of the spring 130 to bias the switch points 23 and 24 to a limit position against a traffic rail. The amount of compression of the spring 130 at the end of the turning of the spindle is much less than the compression of the spring 130 when the toggle linkage is straightened by a locomotive trailing the switch.

It will be appreciated from the foregoing that the spindle block 115 must be positioned in a horizontal plane to permit the toggle linkage to move through its straight-line position during the trailing of the switch by a locomotive. The spindle block 115 is assured of its horizontal position when the switch is thrown manually by the handle H due to the limiting of the 180° rotational movement of the handle H between the respective stop members S.

The reversible, electric motor 36 is provided with suitable limit switches (not shown) and also with a brake to stop the motor from driving the spindle block 115 past a 180° position of rotation. Other suitable mechanical mechanisms can be employed with the motor to limit the rotation of gear means 38 to stop the rotation of the spindle block 115 in the horizontal plane.

It will be appreciated that the motor means 35 may be a kind of motor other than an electric motor for causing operation of the gear means 38. For instance, the rotary electric motor 36 could be replaced by a fluid motor controlled by a suitable valve to operate the fluid motor which in turn would rotate the spider 40 of the gear means 38.

Another embodiment of the epicyclic gear means is illustrated in FIG. 4, which includes a spider 40 and output shaft 42 similar to those hereinbefore described by the same reference numerals in conjunction with FIG. 3. In the embodiment of the invention illustrated in FIG. 4, an input shaft 140 connected at one end to a manual throw lever (not shown) terminates at its opposite end in an integral, interior flange 151. The flange 151 carries a series of spaced, fixed shafts 152 on which are supported planetary input pinion drive gears 153 which are in engagement with the teeth 154 of a sun gear 139. The sun gear 139 of FIG. 4 functions similar to sun gear 70 of FIG. 3. The pinion planetary gears 153, FIG. 4, are also in meshed engagement with the teeth 156 on an outer ring gear 157 secured to an interior, housing flange 158 by suitable fasteners 159. The remaining elements of gear means of FIG. 4 are similar to the elements of the gear means 38 of FIG. 3 and hence are not described again in detail.

As the manual input shaft 140 is rotated, its integral flange 151 moves the planetary gears 153 forcing them to travel on the teeth 156 of the outer ring gear 157 thereby turning the teeth 154 of the sun gear 139 causing the sun gear 139 to rotate. Through its sun gear 139 forward teeth 80 drives the output pinions 63, hereinbefore described as being attached to the integral flange 66 of the output shaft 37. The spider 40 is locked by worm gear 42 from rotating while the input planetary pinions 153 are driving the sun gear 139 and the planetary gears 63 to rotate the output shaft 42.

During a power operation, worm gear 37 turns spider 40 to turn pinions 63, which roll about now stationary sun gear 139, to cause flange 66 and output shaft 42 to rotate the spring base 44 of the switch stand 30. The latched manual throw handle (not shown) in FIG. 4 holds stationary shaft 140, pinion gears 153, and sun gear 139 during power operation by the motor driving worm gear 37, FIG. 4.

According to another embodiment of the invention, illustrated in FIG. 5, a differential gearing arrangement 160 such as that commonly employed in an automobile is substituted for the gearing of FIGS. 3 and 4. In this form of the invention, it is preferred that an outer cylindrical, differential cage 170 have secured thereto an outer ring gear 171. A pinion or worm gear 173 turned by a motor means 174 turns the cage 170. The bevel gears 176 and 177 are journaled for rotation about stub shafts 176a and 177a fixed to the cage 170. Thus, as the cage 170 turns, the bevel gears 176 and 177 roll about bevel gear 180 and turn output gear 178. The bevel gear 180 is, of course, held stationary by being attached to the handle which is latched against rotation. The output gear 178 and the gear 180 driven by the handle are mounted in a support 185 which remains stationary while the cage 170 is turned.

To manually throw the switch points through the switch stand 30 with the differential gear train of FIG. 5, the handle H is turned through 180° and bevel gear 180 rotates the two bevel gears 176 and 177 carried on the housing cage 170. The two bevel gears 176 and 177 rotate the output gear 178. The housing cage 170, is of course, being held stationary by the motor 174 and worm gear 173 during the rotation of the output gear 178 by the manual handle H. The differential gear means affords a 2:1 rotation advantage when the cage 170 is rotated by the motor 174. Hence, the motor 174 rotates the cage through only 90°, as contrasted with the 180° rotation of the handle H.

In the foregoing embodiments of the invention, the motor means is always stopped after 180° of movement of the spring base 44 and spindle 118 so that the cross block 115 remains in the centered orientation shown in FIG. 2. It is pointed out that the switch points are moved to a limit position against one of the stock rails prior to the complete movement of the spindle block 115 to the horizontal position of FIG. 2, so that the latter part of the movement of the spindle block 111 into its horizontal position causes the compression of the spring 130 to hold the switch points tightly in their limit position.

It is preferred that limit switches L1 and L2, FIG. 1, be supported on ties T and be disposed for engagement by the handle H when the handle H is locked in its respective horizontal positions by the clamps C. When the clamps C are released and the operator begins to move the handle H, the associated limit switch L1 or L2 opens the circuit for the electric motor means preventing remote operation of the motor 36 which might injure a person, who would be unsuspecting of the automatic powered operation, while he is in the process of throwing the switch manually.

From the foregoing, it will be seen that the present invention affords a switching apparatus for operating a railroad switch between its opposite limit positions by rotation of gear means either manually or by power operation. The manual throwing of the switch and the

powered operation of the switch may take place alternatively without the requirement for any special setting or checking of the last mode of operation or to the prevailing position of the switch points. Also, a third operation of the switch by a trailing locomotive may be made at any time without disrupting the gearing means or the subsequent throw of the switch by either the motor means or by the manual operation of the handle H.

Hence, while preferred embodiments of the invention have been described and illustrated, it is to be understood that they are capable of variation and modification, and I therefore do not wish to be limited to the precise details set forth, but desire to avail myself of such changes and alterations as fall within the purview of the following claims.

I claim:

1. Apparatus for shifting points of a railroad switch between two limit positions comprising a switch stand having operating means adapted to be connected to the switch points for shifting said switch points between said two limit positions and including a spring for exerting a biasing force for maintaining the switch points in each limit position, said operating means further including a 180° rotatable spring base for said spring, a cross head keyed to the spring base to rotate therewith, an off-center crank arm link connected to the cross head to rotate therewith, a crank pin link connected to the crank arm link to rotate therewith, and a rotatable spindle rotatable with and upon rotation of the crank pin link, means joined to the spindle to move the switch points upon rotation of said spindle, a gear means connected to said spring base of said operating means to rotate the spring base 180° and to rotate therewith the other of the rotatable parts which shift said switch points, a manually operable lever connected by a first gear to said gear means and movable through 180° for actuating said gear means to operate said operating means to shift said switch points, and motor means connected by a second gear to said gear means to operate said operating means to shift said switch points.

2. The apparatus of claim 1 wherein said gear means includes an epicycle gear arrangement including an output gear means connected to said operating means, first input gear means connected to said motor means for rotation thereby, second input gear means connected to said manually operable lever for rotation thereby, and gear means operable by said first or said second input gear means to rotate said output gear means to operate said operating means to shift said switch points.

3. The apparatus of claim 1 wherein said motor means includes an electric motor and a worm gear, said worm gear being connected to said gear means and preventing rotation of said motor means when said manually operable lever is operating said gear means, and means to lock said manually operable lever in position to prevent rotation thereof by said gear means when said gear means is operated by said motor means.

4. The apparatus of claim 1 wherein said gear means includes a differential gear means with opposed pairs of bevel gears enmeshed with each other, one of said bevel gears being an output gear, said output gear connected to said operating means, rotatable cage means supporting a pair of said bevel gears enmeshed with said first-mentioned bevel gears, said motor means being connected by gears to said cage means to rotate said cage means, said manually operable lever being connected to the other of said bevel gears, turning of said cage means by said motor means turning said output gear and said operating means to shift said switch points and turning of said manually operable lever turning said output gear and said operating means to shift said switch points.

5. Apparatus for operating a switch stand manually or by power operation and permitting a trailing operation of a related railroad switch by a locomotive, said switch stand having operating connections to a switch for throwing said switch between two limit positions, said

apparatus comprising: epicyclic gear means connected to said switch stand and turnable to operate the same to throw said switch between limit positions, manual lever means connected to said epicyclic gears to turn said gear means to operate said switch stand to throw said switch, and electric motor means connected to said epicyclic gears means to turn said gear means independently of said manual lever means to operate said switch stand to throw said switch between limit positions, said manual lever means being operable to turn said epicyclic gear means independently of said electric motor means whereby said switch may be thrown independently by said manual lever means or said electric motor means.

6. In a switching apparatus for switching switch points interchangeably by a hand mode, a power mode, and locomotive trailing mode, said switching apparatus comprising: a switch stand including a rotatable spindle adapted to be connected to said switch points and over-center linkage means for turning said spindle, a biasing spring for biasing said overcenter linkage, spindle and switch points to a closed switch position, gear means connected to said linkage means to turn said spindle to throw said switch points and to compress said biasing spring, hand lever means connected by a first gear to said gear means and operable through a single 180° stroke to turn said gear means and spindle to throw said switch points, means to lock said hand lever means against turning by said gear means when said switch points are operated by one of the other modes, motor means connected by a second gear to said gear means to turn said gear means to throw said switch points, and means to lock said motor means against rotation by said gear means when said switch points are thrown by one of the other modes.

7. A switching apparatus for shifting switch points of a railroad switch between limit positions, a switch stand including a turnable spindle and a rotatable overcenter toggle linkage for turning the spindle, a biasing spring in said switch stand for exerting a biasing force on said switch points when said turnable spindle is turned to a position corresponding to a limit position of said switch points, a 180° rotatable spring base for turning said linkage, connecting means for connecting said switch points to said spindle, rotation of said spindle by rotating the spring base through 180° actuating said connecting means for moving said switch points between limit positions, trailing of the switch points by a locomotive adapted to actuate said connecting means to turn said spindle, gear means connected to said spring base and operable to turn said spring base, a manual throw lever connected by a first gear to said gear means to operate said gear means through 180° to turn said spring base,

linkage and spindle to shift said switch points, and motor means connected by a second gear to said gear means to operate said gear means to turn said spindle to shift said switch points.

8. In combination, a switch stand for throwing switch points between limit positions, said switch stand including a vertical spindle mounted for turning movements, linkage means connected to said spindle to turn said spindle when said linkage means is turned arcuately over-center or straightened and moved through a center position, strong biasing spring means connected to said over-center linkage means and compressed thereby to bias said spindle and said switch points when in a limit position, connecting means for connecting said switch points to said spindle, trailing movement of a locomotive through said switch points adapted to actuate said connecting means to turn said spindle and said spindle straightening said toggle linkage means which moves through a center position to compress said strong biasing spring, epicyclic gear means having a plurality of gears and connected to said linkage means to turn the same arcuately overcenter and thereby to turn said spindle to throw said switch points, motor means connected to a first gear of said epicyclic gear means to turn said linkage means arcuately overcenter thereby turning said spindle and throwing said switch points, and hand throw lever means connected to a second gear of epicyclic gear means to turn said linkage means arcuately overcenter thereby turning said spindle and throwing said switch points, means to lock said motor means while said hand throw lever means is being operated, and means to lock said hand throw lever means against turning while said motor means is being operated.

9. The combination of claim 8 wherein said epicyclic gear means includes a differential train having four bevel gears enmeshed, housing means carrying an opposite two of said bevel gears, said housing means being turnable by said motor means, another of said beveled gears being said second gear which is connected to said hand lever means for turning movement thereby, and a fourth of said bevel gears being connected to said over-center linkage means.

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