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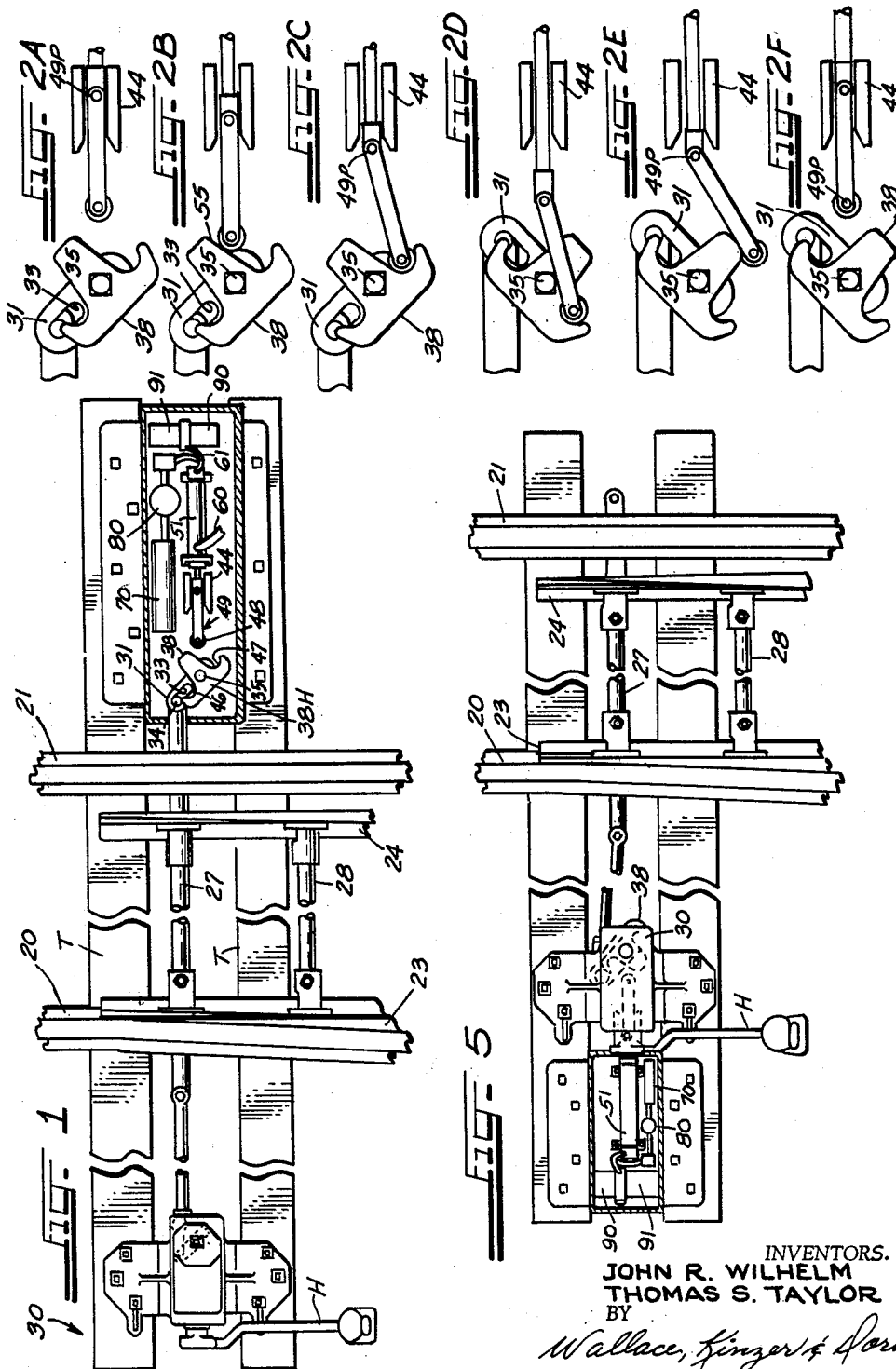
J. R. WILHELM ETAL

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RAILWAY SWITCH ACTUATING MECHANISM

Filed Sept. 19, 1961

3 Sheets-Sheet 1



INVENTORS.
JOHN R. WILHELM
THOMAS S. TAYLOR
BY

Wallace, Finger & Horn
ATTORNEYS.

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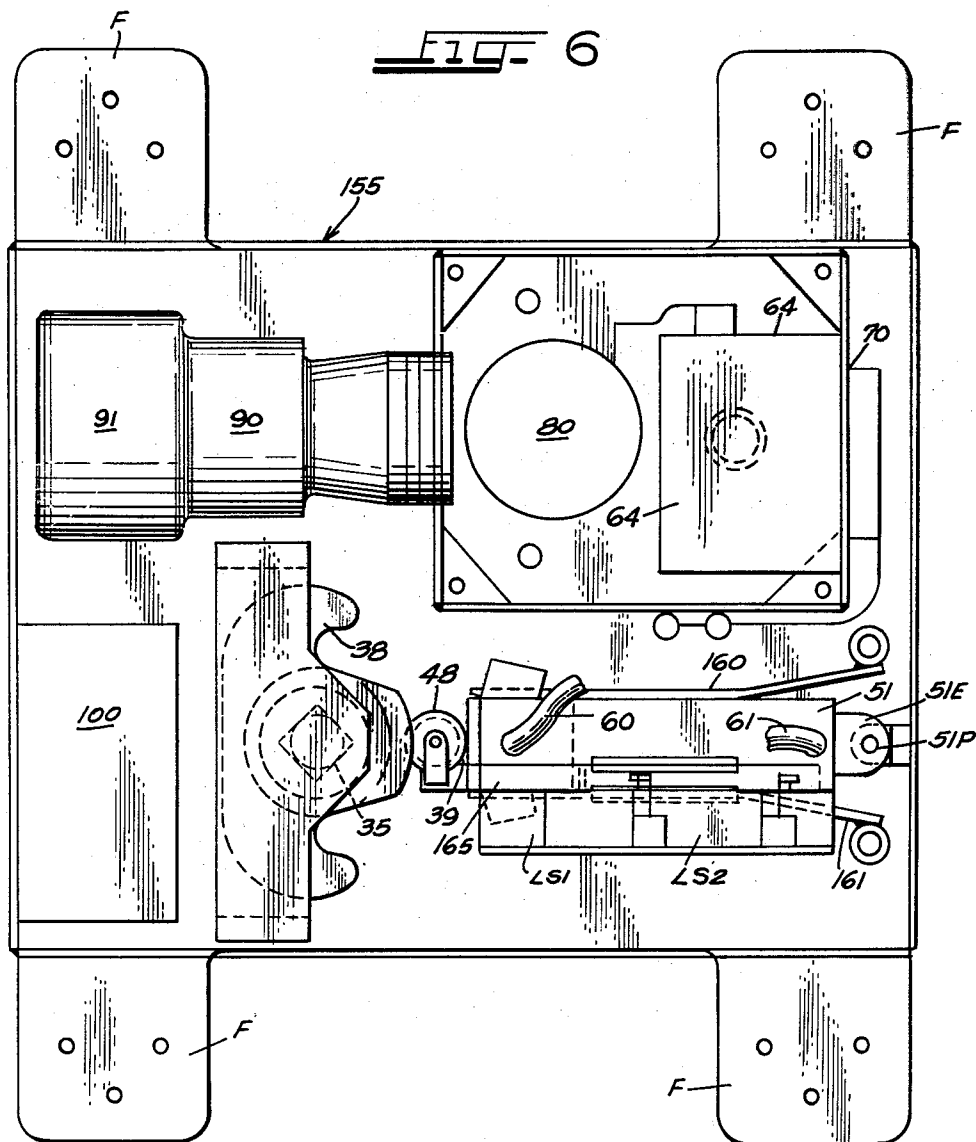
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ATTYS.

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RAILWAY SWITCH ACTUATING MECHANISM
John R. Wilhelm, Chicago, Ill., and Thomas S. Taylor,
Suffern, N.Y., assignors to American Brake Shoe Com-
pany, New York, N.Y., a corporation of Delaware
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This invention relates to a railroad switch and in particular to control apparatus specifically adapted to be used in conjunction with a reversing cam which is to be engaged by the operating end of a hydraulic piston each time the switch is to be thrown.

The railroad switch contemplated by the present invention is one wherein the throw rod is connected by a link to a rotary cam which has a pair of pockets on opposite sides of a fixed axis of rotation for the cam. When the switch is to be thrown, the operating end of a fluid operated piston is thrust into one of the pockets of the cam, rotating the cam the extent required, and then the piston is retracted. The linkage means is secured for movement with the cam and is effective to translate rotary motion of the cam into linear motion of the throw rod. Thus, a complete cycle of operation of the piston includes a forward as well as a reverse stroke of the piston.

The switch has been thrown when the cam turns through an angle determined by the geometry involved, and this determines the required extent of the forward stroke of the piston. At the same time, the cam is set for throwing the switch in the opposite direction on the next cycle of operation of the piston, and this is manifest in the cam pocket that was not engaged during the forward stroke of the piston being disposed in position to be engaged on the next forward stroke of the piston. A railroad switch stand operating on this principle is disclosed in co-pending application Serial No. 25,297, filed April 28, 1960.

The present invention as noted above is concerned with control apparatus for a railroad switch operating on the foregoing principle. Control mechanism of this kind is to be such that it will create an in and out stroke of the piston for each switch throwing operation, and this is made possible by the fact that the switch reversing cam, once the switch has been thrown, is already set for effecting a reverse movement of the throw rod when the railroad switch is next to be operated.

Specifically, the object of the present invention is to arrange hydraulic and electrical circuitry for a railroad switch operating on the above principle to be inclusive of control elements which will automatically reverse the stroke of the piston at the end of its required forward-most stroke, that is, after it has rotated the cam to throw the railroad switch. Another object of the present invention is to use an accumulator effectively in such a system. Another object of the present invention is to construct a railroad switch with relatively few parts operating on an automatic hydraulic principle.

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, show a preferred embodiment 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.

In the drawings:

FIG. 1 is a plan view of a railroad switch of the kind that may be constructed under the present invention, and

wherein the hydraulic apparatus is simplified in detail for clarity;

FIGS. 2A and 2F are fragmentary views illustrating various stages of the disposition of parts when operating the switch shown in FIG. 1;

FIG. 3 is a schematic drawing of the hydraulic circuit for the switch;

FIG. 4 is a wiring diagram;

FIG. 4A is a diagrammatic view showing the manner in which certain limit switches are operated;

FIG. 5 is a view illustrating another way in which the apparatus of the present invention can be arranged along a railroad track; and

FIG. 6 is a plan view showing an alternative arrangement of parts.

In FIG. 1 of the present drawing there is illustrated part of a railroad switch including two stock rails 20 and 21 secured to ties T, and the associated movable switch points 23 and 24 which are joined by the usual front and rear throw rods 27 and 28.

The switch construction illustrated in FIG. 1 hereof, as well as in FIG. 5 to which reference is hereinafter made, is of the general kind disclosed in application Serial No. 25,297, filed April 28, 1960. This particular switch can be operated by means of a switch stand 30 having a handle H enabling the same to be manually operated, or by a trailing locomotive, or the switch can be operated automatically by the apparatus hereinafter described. The switch stand 30 is explained in detail in the co-pending application, including an over-center spring toggle, and reference can be made to the co-pending application for the disclosure of the spring toggle included in the switch stand 30 hereof.

The throw rod 27 has one end projecting outward of the stock rail 21, and a link 31 is formed with an elongated slot 33 which at one end embraces a pin 34 carried in a bifurcation at the outer free end of the throw rod 27 as explained in the aforesaid co-pending application.

The opposite end of the link 31 is keyed to a vertically extending spindle 35, the axis of which is parallel to and spaced a predetermined distance from the pin 34. A generally T-shaped cam member 38 is secured to the spindle 35, which represents a fixed axis of rotation for the cam member, and the cam is rotated as the result of imparting forward or left-hand motion to a piston 39 that is disposed between a pair of guides 44.

The cam member 38 includes a cross-head 38H having concave pockets 46 and 47 formed at the free ends thereof. Each such cam pocket is adapted to be engaged by a roller 48 carried by an arm 49 that is pivotally connected to the piston 39 operating in a cylinder 51, the relationship of parts being such that the piston 39 reciprocates substantially parallel to the path of movement of the throw rod 27. The arm 49 is articulated by being pivotally connected at 49P to the free end of the piston 39 for reasons now to be explained.

The sequence of movements entailed in a switch throwing operation based on the principle of the cam 38 are illustrated in FIGS. 2A to 2F. The piston 39 is illustrated in its retracted position in FIG. 2A, and it will be noted that the ends of the guides 44 adjacent the cam 38 are tapered or relieved at 44B to permit free swinging action of the arm 49. In FIG. 2A, the cam 38 is shown in the disposition characterizing its ability, when operated, to move the switch points 23 in a right-hand direction as viewed in FIG. 1.

The operating end of the piston 39 represented by the roller 48 is spaced from the cam 38. When the piston 39 is actuated in a cycle of operation in the manner herein-after described, it is driven from its initial or fully retracted position, FIG. 1, forward or to the left as viewed in FIGS. 1 and 2B until the roller 48 strikes the slope 55

3

on one side of the shank 56 of the cam 38, there being a like slope on the other side of the cam shank which will be the effective slope when the cam is next operated. The slope 55 is effective to guide the roller 48 toward the pocket 47 of the cam, and such action is now manifest in the arm 49 swinging about its pivot 49P during continuation of the forward stroke of the piston 39.

Eventually, the roller 48 is disposed in the pocket 47 as shown in FIG. 2C, and continued forward movement of the piston is now manifest in a clockwise oscillation of the cam 38 as shown in FIG. 2D. This in turn is manifest in a clockwise oscillation of the link 31 which is secured to the spindle for rotary movement with the cam 38. Rotary movement of the cam 38 is translated into linear motion of the throw rod 27 to the right as viewed in FIG. 1, and FIG. 2D illustrates the disposition of parts at the completion of a switch throw. In this connection, it will be noted that the cam pocket 46, FIG. 2D, is now the one that will be nearer the roller 48 when the piston 39 is retracted to the initial starting position illustrated in FIG. 2F.

Thus, after the switch has been thrown, the piston 39 is retracted, FIGS. 2E and 2F, and eventually the parts are restored to the relationship illustrated in FIG. 2F at the end of the cycle of hydraulic operation discussed above.

It will be recognized from the foregoing that cam 38 is an oscillating member and is provided with two cam pockets that are disposed on opposite sides of the axis of rotation of the cam so that one will be nearer the operating end of the piston 39. Furthermore, the axis of the cam 38 is spaced from the path of movement of the throw rod 27, and the distance separating the spindle 35, which is the axis of rotation of the cam, is spanned by the link 31 which in effect connects the spindle to the throw rod. The link 31 being secured to the spindle 35 will, therefore, translate rotary motion of the cam into linear motion of the throw rod when the piston is actuated to engage and drive the cam, and as this is occurring, the pocket of the cam that is farthest removed from the piston gradually becomes the nearer one. Hence, at the end of movement of the switch, the cam is set for the next or reversing switch movement, and the piston 39 can be retracted or restored in the same cycle of operation in which it was effective to throw the switch, as from left to right as viewed in FIG. 1.

The hydraulic circuit for the piston 39 and its associated cylinder 51 is illustrated in FIG. 3. Thus, a pair of conduits 60 and 61 are connected to the opposite ends of the cylinder 51 so that hydraulic fluid can be directed into that end of the cylinder 51 required for a corresponding in or out stroke of the piston as the case may be. The opposite ends of the conduits 60 and 61 are connected to a four-way valve 64.

The two conduits 60 and 61 are interconnected by a conduit 65, and a pair of check valves 66 and 67 are interposed therein. These check valves operate in opposite senses to enable trapped air in either conduit 60 and 61 to be by-passed to the oil reservoir 70 by way of a conduit 71 which has an air bleed valve 75 interposed therein.

Fluid under pressure is obtained from an accumulator 80 which is adapted to be supplied with hydraulic fluid through a main conduit 81. To this end, the accumulator 80 is connected to the conduit 81 by a conduit 83, and a pressure switch 84 is used to sense the line pressure. The pressure switch has a pre-set condition for controlling energization of a motor, as will be described hereinafter, for charging the accumulator. A relief valve 86 is connected to the main line 81 and will open at excessive hydraulic pressures, as for instance the pressure built up when the railroad switch has been thrown all the way home without an instantaneous cessation of operative hydraulic pressure.

4

The main line 81 is charged by a pump 90 through a check valve 87, and the pump 90 in turn is driven by a motor 91. As will be explained hereinafter in connection with the wiring diagram, the pressure switch 84 is set to bring the motor 91 into operation in the event that pressure in the accumulator 80 drops below a predetermined level determined by the setting of the pressure switch 84.

The directional valve 64 is a four-way, closed center, solenoid-operated valve, and until the railway switch is to be operated, the valve 64 is spring-biased to its center position. Thus, valve 64 includes a spool under control of a solenoid 93. When solenoid 93 is energized, the spool in valve 64 is set so that the accumulator will discharge to conduit 61, driving the piston to the right or in its forward direction as viewed in FIG. 3, and at the same time conduit 60 is connected to the reservoir through the four-way valve. On the other hand, if solenoid 94 of valve 64 is energized, then the reverse condition prevails, that is, conduit 60 is connected to the accumulator and conduit 61 is connected to the reservoir.

The electrical control circuit is illustrated in FIG. 4 where, it will be noted, the motor 91 is a single phase motor having a starter circuit indicated in its entirety by the block diagram 100, such being inclusive of a starter relay SR for controlling a set of associated normally open relay contacts SR-1, SR-2 and SR-3 which close when the relay SR is energized. This starts the motor to drive the pump, charging the accumulator if the motor switch 110 is closed. The motor starter circuit also includes fuses as indicated and safety thermostat switches 106 and 107.

The switch 110 for the motor can be closed at any time, since the motor 91 is started and stopped through the pressure switch 84 which determines the pressure to which the accumulator is to be charged. In the description which immediately follows, it will be assumed that the pressure switch 84 is open as the result of the accumulator having had sufficient pressure established therein for normal operation of the railway switch.

The control circuit includes a momentary start switch 115. When the start switch is closed, wires 116 and 117 associated therewith are bridged. Wire 117 is connected to the normally open contacts LS2-1 associated with a limit switch LS2 interposed in wire 117. Wire 117 is also connected to one side of a relay RB, and the other side of this relay is connected by a wire 121 to a wire 122 in turn connected to lead L3 associated with the motor circuit.

The normally open contacts of the switch LS2 are shunted by a wire 123 in which are interposed normally closed contacts RA-1 under control of a relay RA.

Wire 116 is connected to lead L1, and a momentary stop safety switch 126 is interposed in the wire 116.

The pressure switch 84 (normally open) is interposed in a wire 128 connected on one side to the wire 116 and connected on the other side to the motor start relay SR. The other side of the start relay SR is connected to a wire 129 in which the thermostat switches 106 and 107 are arranged, and it will be noted that wire 129 is connected to lead L3 of the motor 91. Assuming that the main switch 110 is closed, it will be recognized that the motor circuit will be energized in the event that the pressure switch 84 closes due to insufficient pressure build-up in the accumulator 80.

A wire 130 is connected at one end to wire 122 and at the other end is connected to solenoid 93. A wire 131 leads from the other side of solenoid 93 and is connected to a wire 132 in turn connected to wire 117. The normally closed contacts RA-2 of relay RA are interposed in wire 131.

The limit switch LS1 is located to correspond to what would be the outermost position of the piston 39, FIG. 4A (see also FIG. 6) effective to move the railway switch to its new position. A cam 39C for operating the limit switch LS1 as well as the limit switch LS2 is arranged to

5

move the piston 39. As shown in FIG. 4A, the cam element 39C in the fully retracted position of the piston 39 engages the actuator arm of switch LS2, and under such circumstances the contacts LS2-1 of the limit switch LS2 are held open as shown in FIG. 4.

When the start switch 115 is actuated to bridge wires 116 and 117, this establishes a circuit to solenoid 93 through the normally closed relay controlled contacts RA-2. At the same time, relay RB is energized, and a pair of normally open contacts RB-1 controlled thereby are closed to establish a holding circuit around the start switch 115. Hence, when the latter is released, relay RB is held energized and solenoid 93 is held energized. Therefore, valve 64 is positioned so that the accumulator discharges fluid under pressure into conduit 61 forcing piston 39 outward of cylinder 51. This movement of piston 39 continues until the cam 39C strikes the actuator arm associated with limit switch LS1. This closes a set of normally open contacts LS1-1 included in limit switch LS1, and of course limit switch LS2 closed when cam 39C passed therefrom.

The contacts LS1-1 of switch LS1 are interposed in a wire 142 connected at one end to wire 132 and connected at the other end of a wire 145 in turn connected to solenoid 94, solenoid 94 at the other side being connected to wire 122.

Relay RA is interposed in a wire 146 connected at one end to wire 122 and connected at the other end to wire 145. A wire 150 is connected to wire 146 and to wire 142 to shunt switch LS1, and a set of normally open contacts RA-3 under control of relay RA are interposed in wire 150.

When the limit switch LS1 is actuated, a circuit is completed to solenoid 94, recalling that the contacts RB-1 under control of relay RB are closed. Additionally, when switch LS1 is closed a circuit is completed to relay RA which becomes energized. When relay RA energizes, the contacts RA-1 and RA-2 open. This drops out solenoid 93 and opens the shunt circuit around limit switch LS2, although it is to be borne in mind that the contacts LS2-1 of switch LS2 are still closed at this time to maintain a circuit to relay 120.

When relay RA energizes, its contacts RA-3 are closed so that a holding circuit is established for solenoid 94 and relay RA around limit switch LS1.

When solenoid 94 is energized, this reverses the flow of fluid under pressure in cylinder 51, and as a consequence the piston 39 commences its return movement after the railroad switch has been actuated. Eventually, cam 39C rides off the actuator of switch LS1 and the contacts LS1-2 thereof revert to their normally open state. This, however, has no effect on solenoid 94 or relay RA which are held energized through the relay contacts RA-3 which are closed at this time. However, when cam 39C strikes the actuator of limit switch LS2, the contacts LS2-1 of switch LS2 are opened, and as a consequence relay RB is de-energized, contacts RB-1 controlled thereby open, and this breaks the holding circuit for solenoid 94 and relay RA. This completes a cycle of operation and the various electrical components revert to the state illustrated in FIG. 4. Thus, both solenoids 93 and 94 have dropped out, and the four-way valve 64 re-centers itself for the start of the next cycle of operation initiated by engaging the start switch 115.

In the event that pressure in the accumulator drops below the predetermined level, pressure switch 84 will close, and this establishes an immediate circuit for energizing relay SR, closing the motor controlled contacts SR-1, SR-2 and SR-3 so that the pump will be driven until the pressure switch 84 opens, breaking circuit to the motor.

In the form of the apparatus above described, the hand stand 30 is on the side of the track opposite the hydraulic apparatus that is used to actuate the reversing cam 38, but both can be on the same side as shown in FIG. 5 where-

6

in the cam 38 as above described has an exact counterpart on the same side of the track as the hand apparatus. Operation is the same for the cam as described in connection with FIGS. 1 through 4A.

Of primary importance is the fact that the accumulator furnishes instantaneous power for operating the railroad switch in the manner above described since the pump does not have to build the system up to pressure at the time when the railroad switch is to be reversed. This enables a low horsepower motor to be used to drive the pump for charging the accumulator in between cycles of operation when the accumulator may be under-charged. While the over-all power consumption is not less than in the instance where the accumulator is not used, the rate of power consumption is less and this in turn allows a lower demand charge, smaller size lines and the like.

FIG. 6 is illustrative of the compact arrangement possible under the present invention, including the hydraulic and electrical parts above described, nested within a housing 155 having flanges F to be secured to the railroad ties. The cam 38 and the associated spindle 35 are illustrated in FIG. 6 immediately adjacent the roller 48 carried at the operating end of the piston 39. The articulation 49, FIG. 1, is unnecessary with this arrangement for reasons to be explained.

The cylinder 51 is provided with an ear 51E attached to a pivot pin 51P supported within the housing 155. This enables the cylinder as a whole to shift to follow the contour of the cam 38, and is an alternative arrangement to the articulated arm 49 above described. The cylinder is, however, constrained to the centered position illustrated in FIG. 6 by a pair of leaf springs 160 and 161 anchored within the housing 155 and which flex depending upon the direction in which the cylinder shifts at the time when the roller 48 is moving along the surfaces of the cam 38.

The limit switches LS1 and LS2 are located adjacent one side of the cylinder 51. A slide 165 is arranged to move with piston 39, and it is this slide that carries the equivalent of the cam 39C above described for engaging the actuator arms of the limit switches LS1 and LS2.

It will be recognized from FIG. 6 that the hydraulic and electrical components are capable of being arranged as a quite compact unit, and this is made possible in part by the fact that the accumulator 80, which itself is not very large, permits a motor 91 of relatively small capacity to be used.

We claim:

1. In a railroad switch of the kind wherein a pair of switch points are movable between two limit positions with respect to stock rails by a throw rod interconnecting the switch points, means for moving said switch points between said two limit positions comprising, a cam member mounted for rotation in opposite directions about a fixed pivot, link means secured for rotation with the cam member and connected to the throw rod to translate rotary movement of the cam member into linear movement of the throw rod, and means to rotate the cam member to throw the switch, the last-named means including: an hydraulically operated piston in a cylinder to be moved from a retracted position in a forward direction to engage and rotate the cam as aforesaid in an advanced position and thereafter to be moved from the advanced position immediately in a reverse direction back to said retracted position in a single cycle of operation, conduits connected to the opposite ends of the cylinder and alternately effective in said cycle of operation to direct fluid under pressure into one end of the cylinder while connecting the opposite end of the cylinder to the hydraulic reservoir for piston movement in a forward direction, and vice versa for piston movement in the reverse direction, said conduits being connected to a solenoid-type directional valve having a first solenoid which, when energized, determines one operative position of the valve corresponding to the forward direction of the piston and a second sole-

noid which, when energized, determines another operative position of the valve corresponding to the reverse direction of the piston, and electrical control means for initiating a cycle of operation of the hydraulic apparatus which cycle is inclusive of movement of the piston from its initial position to its advanced position followed by immediate reversal, said control means including a manually operable normally open start switch, a first control switch adapted to be closed when the piston is in its initial retracted position to complete a circuit to the first solenoid when the start switch is closed causing the piston to advance, a first limit switch adapted to be closed when the piston is in its advanced position to complete a circuit to the second solenoid causing the piston to retract to its initial position, holding circuits for the first and second solenoids and means operable upon closure of said first limit switch to break the holding circuit for the first solenoid at the time the second solenoid is energized, a second limit switch for breaking the holding circuit for the second solenoid when the piston arrives at its fully retracted position, said limit switches being spaced one from another by a distance corresponding to the length of the stroke of the piston, and cam means carried by the piston for operating said limit switches.

2. An arrangement according to claim 1 including an accumulator for furnishing hydraulic fluid under pressure for piston movement as aforesaid, a pressure switch for sensing the condition of the accumulator, and a motor and pump for charging the accumulator in response to the demand of the pressure switch.

3. In a control circuit for an hydraulically operated piston in a cylinder, to be moved from a retracted position in a forward direction and thereafter to be moved from the advanced position immediately in a reverse direction back to said retracted position in a single cycle of operation, conduits connected to the opposite ends of the cylinder and alternately effective in said cycle of operation to direct fluid under pressure into one end of the cylinder while connecting the opposite end of the cylinder to the hydraulic reservoir for piston movement in a

forward direction, and vice versa for piston movement in the reverse direction, said conduits being connected to a solenoid-type directional valve having a first solenoid which when energized determines one operative position of the valve corresponding to the forward direction of the piston and a second solenoid which when energized determines another operative position of the valve corresponding to the reverse direction of the piston, electrical control means for initiating a cycle of operation of the hydraulic apparatus which cycle is inclusive of movement of the piston from its initial position through its forward direction followed by immediate reversal, said control means including a normally open manually controlled start switch, a first control switch adapted to be closed when the piston is in its initial retracted position to complete a circuit to the first solenoid when the start switch is closed, thereby causing the piston to advance, a first limit switch adapted to be closed when the piston is in its advanced position to complete a circuit to the second solenoid causing the piston to retract to its initial position, holding circuits for the first and second solenoids and means operable upon closure of said first limit switch to break the holding circuit for the first solenoid at the time the second solenoid is energized, a second limit switch for breaking the holding circuit for the second solenoid when the piston arrives at its fully retracted position, said limit switches being spaced one from another by a distance corresponding to the length of the stroke of the piston, and cam means carried by the piston for operating said limit switches.

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