Jan. 9, 1968 J. R. WILHELM ET AL 3,363,097

RAILWAY SWITCH MECHANISM

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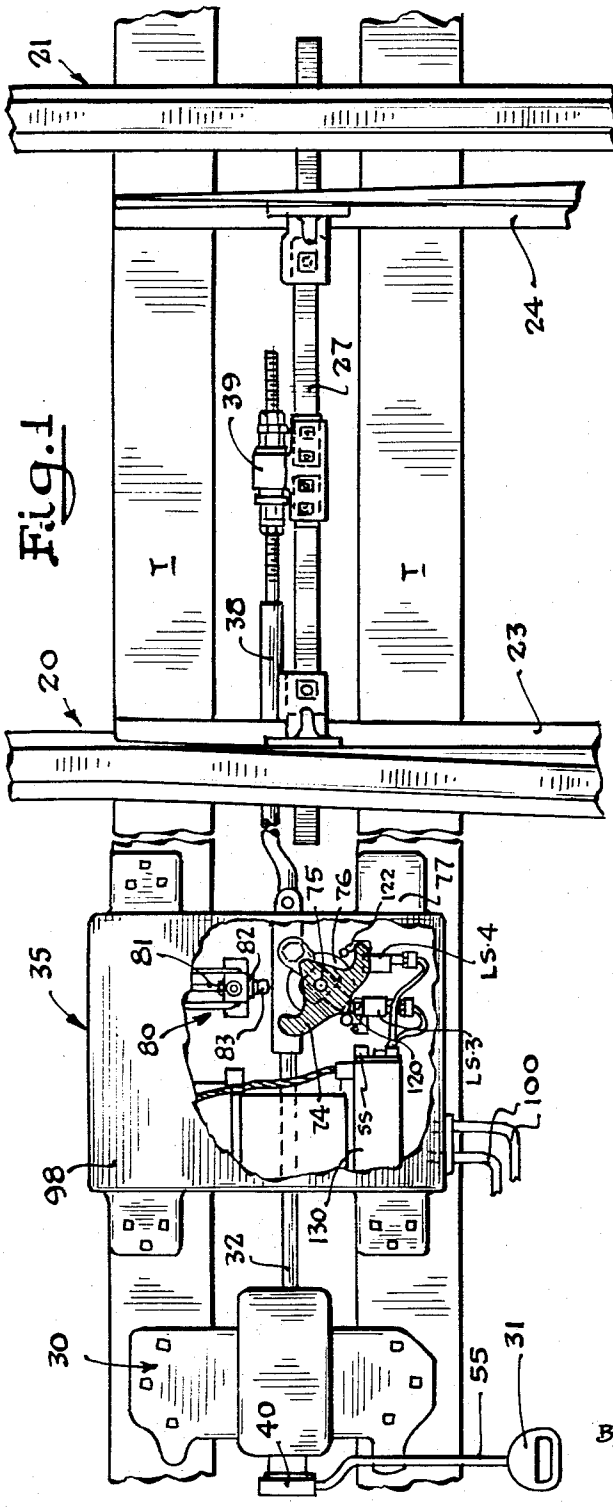

Fig. 1

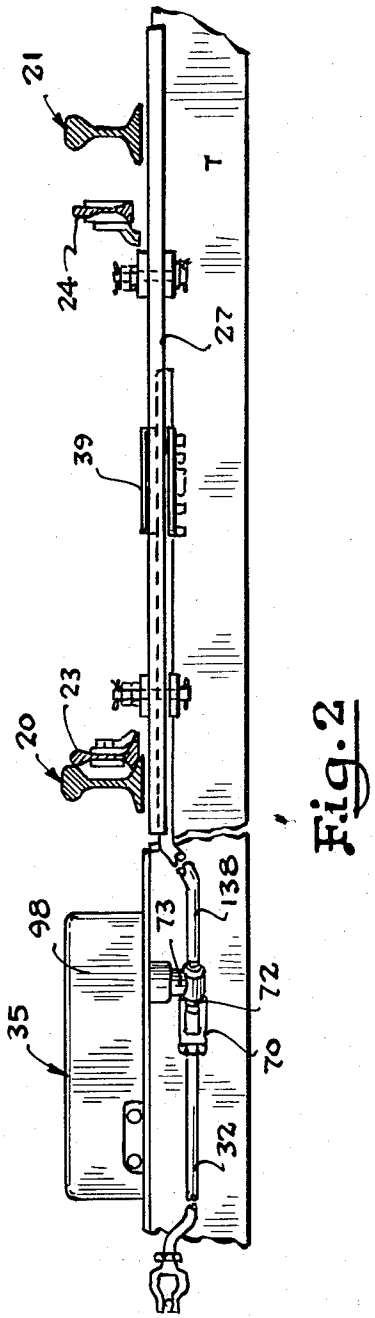

Fig. 2

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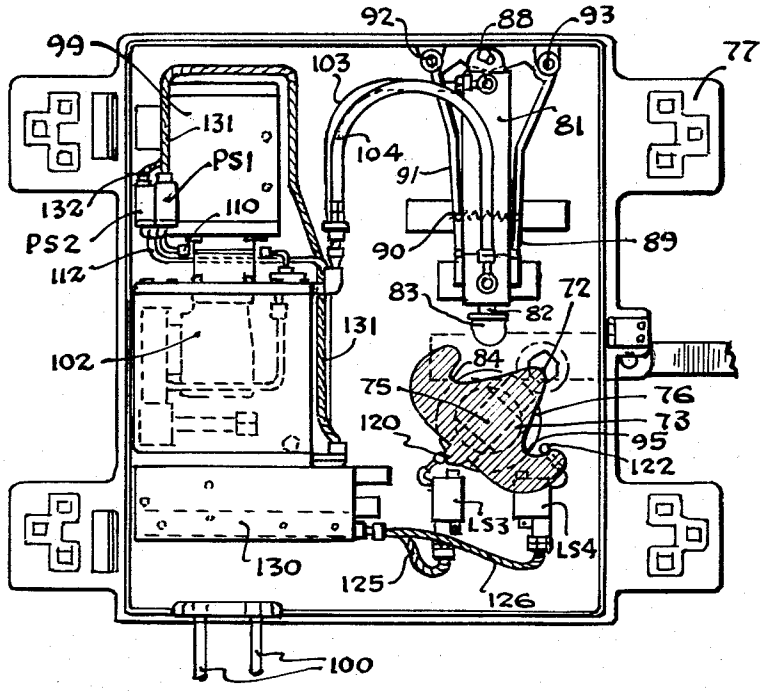
Fig.3



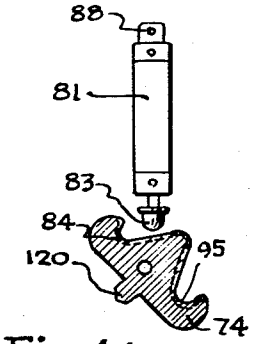


Fig.4A

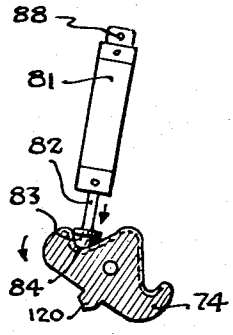


Fig.4B

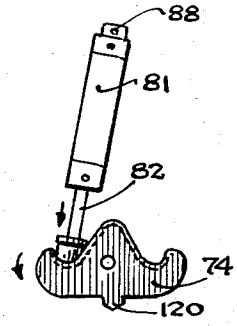


Fig.4C

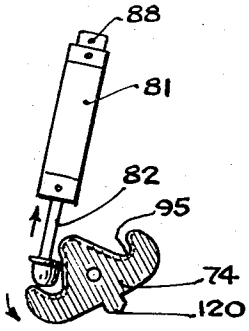


Fig.4D

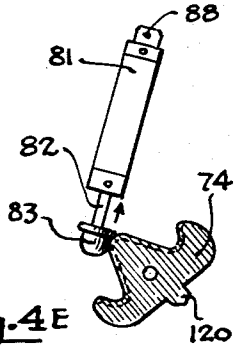


Fig.4E

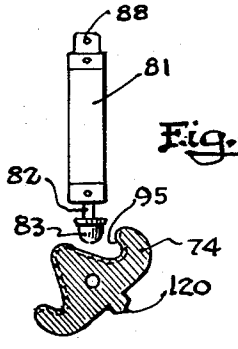


Fig.4F

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Fig.5

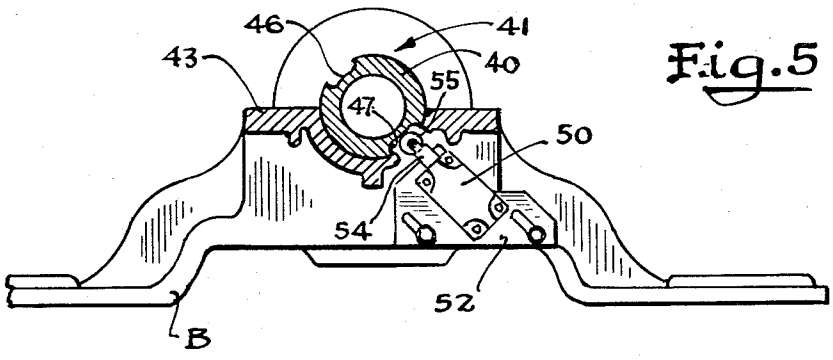


Fig.6

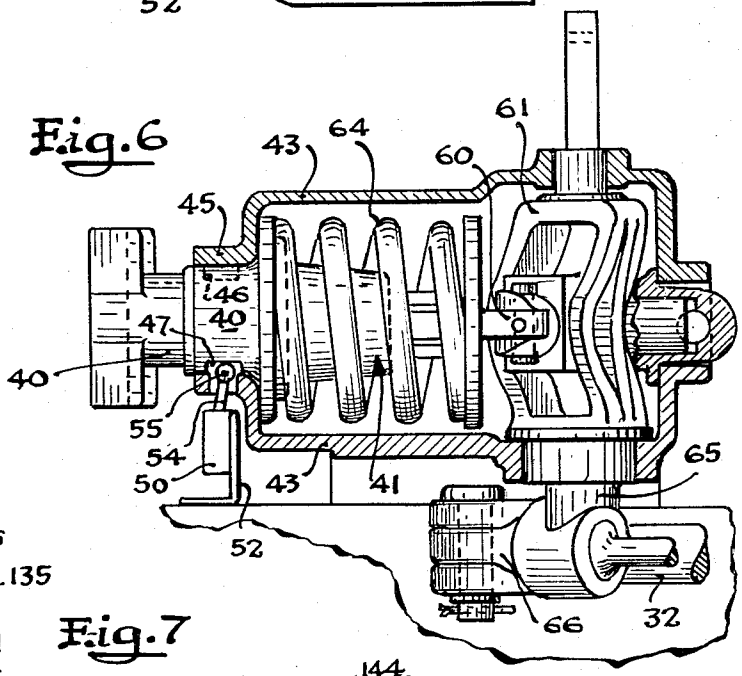
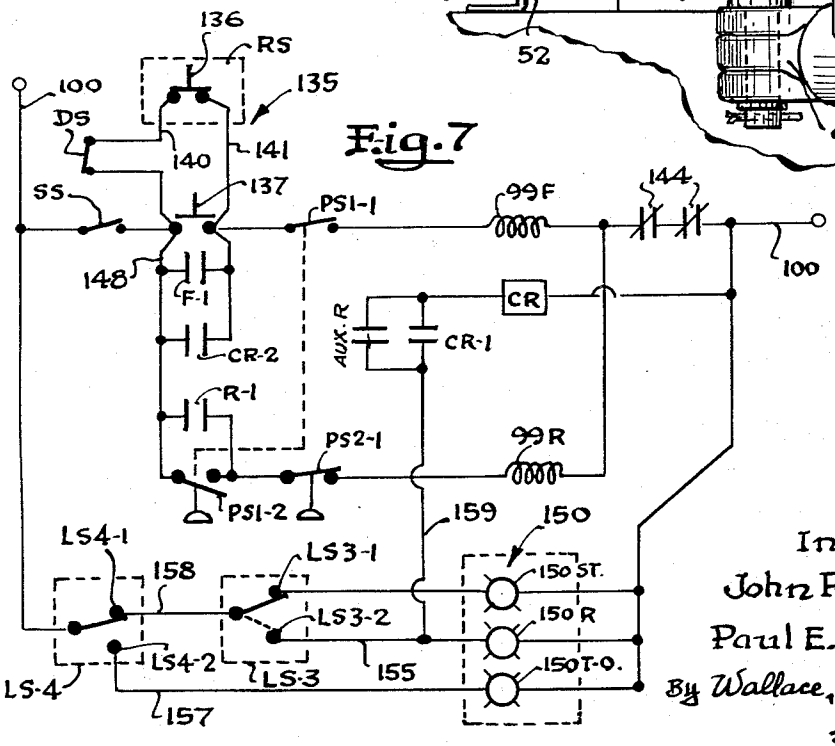


Fig.7



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RAILWAY SWITCH MECHANISM

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4 Claims. (Cl. 246—393)

This invention relates to a railroad switch stand.

The present invention is directed to a railroad switch mechanism for throwing switch points from limit positions between stock rails. It sometimes occurs that the switch points are prevented from being completely thrown to an opposite limit position because of some obstruction. When such obstruction to complete switching occurs, the switch points are, in effect, in an open position so that a locomotive passing therethrough is derailed. When the switch machine is being controlled from a remote tower, the operator may fail to observe the open switch condition; or the operator may be too slow to institute remedial action to prevent a derailment.

Manifestly, such an open switch condition is a safety hazard, and accordingly an object of the present invention is to eliminate an open switch condition caused by the failure of switch points to complete their movement from an original limit position to an opposite limit position. More particularly, a further object of the invention is to return automatically the switch points to their original limit position after they have been stopped short of the other limit position by an obstruction or the like. Thus, the locomotive or train moving over the switch points will move down a track rather than through an open switch and being derailed.

A further object of the invention is to prevent an open switch condition in a switch machine, which is capable of both manual and power operation. Another object of the invention is to disable power operation of a switch machine while the switch points are being thrown manually thereby preventing the operator from personal injury by a simultaneous manual and power operation of the switch machine.

Another object of the invention is to eliminate the directional valve control by means of a unique fluid operated switch machine capable of alternative operation with a manually operable switch stand.

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 plan view of a switch machine and its connection to the switch points and constructed in accordance with the preferred embodiment of the invention;

FIG. 2 is an elevational view of the switch machine of FIG. 1;

FIG. 3 is a plan view of the power switch machine with its cover removed to show its internal operating mechanisms;

FIGS. 4A through 4F are partial detailed views illustrating operating sequences when actuating the cam during the throw of the switch points.

FIG. 5 is a sectional view showing a switch for disabling the power switch machine;

FIG. 6 is a partial sectional view of a manual switch machine; and

FIG. 7 is a schematic electrical diagram of a control circuit for controlling the power switch machine of FIG. 3.

Referring now to the drawings and more particularly to FIG. 1, there is illustrated part of a railroad switch including two stock rails **20** and **21**, which are spiked in the usual fashion to the tie T, and two movable switch points **23** and **24**, which are connected together by a conventional throw rod **27**. The railroad switch is conditioned for "straight through" movement for the locomotive when in the position illustrated in FIG. 1.

The conventional mode of throwing a railroad switch from one of its set or limit positions to the other set or limit positions is by means of a mechanical switch stand **30**, FIG. 1, which includes an operating or throw handle **31** for throwing the internal mechanism of the switch stand to operate a connecting rod **32** to operate the throw rod **27** to move the switch points **23** and **24**. The switch stand **30** is spiked to a pair of ties T in the conventional manner and is shown positioned outwardly of a power switch machine **35**.

The railroad switch in the present instance is arranged for dual operation either by the manual switch stand **30** or by the power switch machine **35**, each of which is adapted to reciprocate a connecting rod **38** attached by an adjustable bracket means **39** to the throw rod **27** for the switch points **23** and **24**. The manual switch stand **30** may thus be thrown by an operator who turns the handle **31** through approximately 180° from a position overlying the top surface of one tie T to a position generally overlying the top surface of the opposite tie T, in the conventional manner. On the other hand, the power switch machine **35** may be remotely operated by incoming signals that are part of an electrical control circuit from a remote operating station such as a control tower (not shown).

Heretofore, it has been possible that an operator will begin to throw the switch by turning movement of the handle **31** of manual switch stand **30** at a time when the tower operator may institute power actuation of the power switch machine **35**. The attempt of simultaneous operation of the switch by the manual switch stand **30** and the power switch machine **35** results in unexpected forces which may cause personal injury to the operator, except for the disabling of the power switch machine **35**, as practiced in accordance with the present invention.

The preferred form of the manual switch stand is best understood from FIG. 5, which is generally similar to FIG. 6 of U.S. Patent No. 3,136,509, wherein the preferred form of the manual switch stand is described in detail. The disclosure of the manual switch stand disclosed in U.S. Patent No. 3,136,509, is hereby incorporated by reference as if fully reproduced herein.

Briefly, the throw handle **31** of the manual switch stand **30** is connected to a hub portion **40**, FIG. 5, of a spring base element **41** which is journaled for rotation within a loosely fitted bearing portion **45** on a two-piece housing sleeve **43**.

For the purpose of detection of the beginning of the manual operation of the manual switch stand **30** by turning movement of the throw handle **31**, a limit switch **50**, which is mounted on the base B of the manual switch stand **30** detects turning movement of the hub portion **40** with the throw handle **31**. More particularly, the hub portion **40** is provided with a pair of cutouts **46** and **47** spaced 180° apart on the exterior surface of the hub **40**.

The limit switch **50**, FIGS. 5 and 6, is secured to the base casting B by a suitable bracket **52** and has a sensing element or plunger **54** with a cam follower or roller **55** on the terminal and outward end of the plunger **54** for

cam following engagement with the outer peripheral surface of the hub **40**. As the hub **40** begins to rotate with the turning of the throw handle **31**, the plunger **54** is cammed inwardly into the limit switch **50** to operate contacts which disable the power operation of the power switch machine **35**, as will be explained hereinafter in greater detail.

The limit switch **50** is held in its inward disabling position throughout the greater portion of the 180° rotation of the hub **40** with the throw handle **31**, until the opposite cutout **46** of the hub **40** is reached at which time the plunger **54** under biasing force again moves outwardly to bring the cam following roller **55** into the cut-out **46**. Thus, the contacts in the limit switch **50** are again operated to permit completion of a control circuit for operation of the power switch machine **35** by an operator at a remote location.

The illustrated location of the detection limit switch **50** and its cooperation with the hub **40** is only one of a number of other locations which could be employed to detect movement of the manual switch handle **31** by an operator. For instance, a pair of limit switches may be provided to engage the arm portion **55** of the throw arm **31** in each of its opposite limit positions; therefore, when the throw arm **31** is moved from each of its respective limit positions, a limit switch is actuated.

Moreover, a sensing means like the switch **50** may be located to detect movement of the crank arm or other movable portions of the switch stand **30** from its at-rest position and still fall within the purview of the present invention. During the rotation of the throw arm **31**, such other movable portions such as a toggle link mechanism **60**, move through approximately 180° of movement as does the vertical spindle **61**. Either of these could be sensed by a sensing means such as a switch **50**. The rotation of the throw arm **31** causes the spring base **41** to turn and move the toggle link **60** which turns the vertical spindle **61**.

As explained in greater detail in U.S. Patent No. 3,136,509, the spring **64** is a strong spring which is compressed during initial rotation of the spindle **61** by the power switch machine and which thereafter expands to complete rotation of the vertical spindle **61** and thereby movement of the switch points **23** and **24** to bring the points into firm engagement with one of the stock rails **20** and **21**. That is, the power switch stand **35** is so constructed that the centered or half way turning of spindle rotation is an unstable position so that the spring **64** acts as an overcentering spring to assure that the switch points and the vertical spindle **61** are not left on a dead center position which would constitute an open switch position for the switch points **23** and **24**.

Rotation of the vertical spindle **61** by operation of the throw handle **31** causes rotation of the spindle **61** and its lower hub **65** connected by an eye bolt **66** in turn connected to the first connecting rod **32**. The lower end of the spindle **61** functions as a crank to reciprocate the connecting rod **32** which is in turn connected to the connecting rod **38**, FIG. 1, for reciprocation of the throw rod **27** to move the switch points **23** and **24** between their home or limit positions.

As best seen in FIG. 2, the connecting rods **32** and **38** are joined by a bracket **70** which in turn is connected by an eye bolt **72**. The latter is connected to a crankboss **73**, FIG. 2. The crankboss **73** is formed on the bottom of a spindle cam **74** within the power switch machine **35**.

The spindle cam **74**, FIG. 3, is journaled for rotation about a vertical axis **75** in a hub **76** of a base casting **77**, FIG. 1, for the power switch machine **35**. As will be explained in greater detail hereinafter, the spindle cam **74** is adapted to be turned in clockwise and counterclockwise directions by a fluid operating means **80** which includes a double acting hydraulic cylinder **81** with an extendible piston rod **82** having a cam ball **83** secured on the outer end thereof.

The turning of the spindle cam **74** and thereby its crank portion **73** reciprocates the connecting rod **38** and causes a switching operation, which can best be understood from a consideration of FIGS. *4a–4f*. The leftmost position shown in FIG. 4 corresponds to the at-rest position for the spindle cam **74** with the switch points **23** and **24** in the limit position shown in FIG. 1. Operation of the hydraulic cylinder **81** to move the piston rod **82** outwardly of the cylinder **81** causes the cam ball **83** to slide downwardly into a cam pocket **84**, FIG. *4b*, and to pivot the cylinder **81** about its pin connection **88** to the base **77**.

Further outward movement of the piston rod **82**, as seen in FIG. *4c*, causes pivoting of the spindle cam **74** in the counterclockwise direction to bring the cam and cylinder into its half-thrown position, or slightly therepast, at which time the crank portion **73** of the spindle cam **74** has pulled the connecting rod **32** sufficiently to turn the vertical spindle **61** in the manual switch stand **30** to compress the spring **64** and to move past its center position, whereupon the overcentering spring **64** becomes operative to complete the counterclockwise rotation of the spindle cam **74**. Upon completion of the counterclockwise rotation of the spindle cam **74** by the spring **64**, the switch points **23** and **24** are moved rightwardly, as viewed in FIG. 1, to bring the switch point **24** into firm engagement with the stock rail **21** whereby the approaching locomotive is "turned out," that is, switched onto a side track.

The complete extension of the piston rod **82** is followed by an automatic withdrawal of the piston rod **82** by reversing the flow of hydraulic fluid within the double acting hydraulic cylinder **81**. During return of the piston rod **82**, the spindle cam **74** remains in its "turn out" limit position and the switch points **23** and **24** remain thrown to this "turn out" limit position. When the cam ball **83** moves past the apex **85** of the spindle cam **74**, as seen in FIG. *4e* and *4f*, the cylinder **81** pivots to its generally centered position, as seen in FIG. *4f*.

More particularly, the cylinder **81** is centered by means of a pair of right and left centering arms **89** and **91**, FIG. 3, which are interconnected by a tension spring **90**. The arms **89** and **91** are respectively pivoted at **92** and **93** to the base casting **77**.

To rotate the spindle cam **74** in the clockwise direction from the position of FIG. 4, it is necessary to institute a second cycle of operation of the hydraulic cylinder **81** to force the ball cam **83** into an opposite cam pocket **95** on the cam **74**. Such further extension of the piston rod **82** rotates the spindle cam **74** in a clockwise position to at least a half-thrown position whereupon biasing spring **64** of the manual switch stand **30** is again operative to complete the throw to the switch points **23** and **24** and movement of the spindle cam **74** to its full clockwise or limit position, as shown in FIG. *4a*.

For the purpose of operating the hydraulic cylinder **81**, there is disposed beneath the housing cover **98** for the power switch machine **35** and an electric, reversible motor **99**, which is suitably connected to power inlet cables **100**. The reversible motor **99** is directly connected to a hydraulic pump **102**, which in turn is connected to flexible hydraulic hoses **103** and **104**, leading to opposite ends of the hydraulic cylinder **81**.

When the piston rod **82** is being driven outwardly of the cylinder **81**, fluid is pumped from the pump **102** through the hydraulic hose **103** to the rearward end of the hydraulic cylinder **81** to force the piston rod **82** outwardly. Conversely, when retracting the piston rod **82**, the motor **99** is reversed in its direction of rotation, as is the pump **102**. Thus, fluid is pumped under high pressure through the hydraulic hose **104** to the forward end of the cylinder **81** to drive the piston rod **82** inwardly into the hydraulic cylinder **81**.

The preferred manner of detecting when the piston rod **82** has moved to its external and extended position is by

means of a first pressure switch PS1, FIG. 3, which is connected by a line 110 to the hydraulic line 103 so as to detect the build up of pressure of the hydraulic fluid when the piston has moved to its maximum extended movement within the hydraulic cylinder 81. In the preferred embodiment of the invention, the usual operating pressure is approximately 500 pounds p.s.i. and the pressure switch PS1 is actuated when the fluid pressure builds up to approximately 1,000 pounds p.s.i., which event occurs after the piston rod 82 is fully extended. The pressure switch PS1 controls a pair of contacts in the control circuit for the reversible motor 99 to cause reversal of the rotation of the motor M and thereby the return of the piston rod 82.

In a similar manner, a pressure switch PS2, FIG. 3, disposed adjacent the pressure switch PS1 is connected by a line 112 to the hydraulic line 104 to the forward end of the hydraulic cylinder 81 to detect the build up of the fluid pressure to approximately 1,000 pounds p.s.i. indicating that the piston and piston rod 82 have been driven in the return direction to their full retraction. The pressure switch PS2 is adapted to shut off the reversible motor 99 in a manner to be explained hereinafter in conjunction with the control circuit shown in FIG. 7.

An important aspect of the present invention is the detection of the movement of the switch points 23 and 24 to their limit positions so that there is assurance that the switch is fully thrown. An open switch condition may result in the locomotive or train running onto the ground and thereby it is to be avoided as a safety hazard. It is preferred to protect the sensing means for detecting the movement of the switch points to their full extent, from adverse environmental conditions such as snow and ice.

Thus, the sensing means which includes limit switches LS3 and LS4, FIG. 3, are disposed beneath the cover 98 within the power switch machine 35. The limit switch LS3 is adapted to be operated by a nose 120 on the spindle cam 74 when the spindle cam 74 is in its furthermost clockwise position, that is, limit position, which corresponds to the switch points 23 and 24 being in their "straight through" limit position illustrated in FIG. 1. Conversely, counterclockwise rotation of the spindle cam 74 moves the nose 120 in a counterclockwise direction to actuate a lever arm 122 for the limit switch LS4 to actuate limit switch LS4 when the switch points 23 and 24 are in their opposite, "turn out," limit positions.

When the spindle cam 74 is moving between its opposite limit positions or when it is obstructed from moving to its fullest extent, the limit switches LS3 and LS4 detect such a condition and cause automatic reversal of the switch points to their original limit position, which may be either the "straight through" or "turn out" limit position, as will be explained hereinafter in greater detail.

The limit switches LS3 and LS4 are connected by cables 125 and 126, FIGS. 1 and 3, to an electrical control box assembly 130. The electrical control box assembly 130 is also connected by appropriate cables 131 and 132 to the pressure switches PS1 and PS2. The internal components of the electrical assembly 130 are best explained hereinafter in conjunction with FIG. 7.

The control circuit 135 illustrated in schematic form in FIG. 7, controls operation of the power switch machine 35 either by operation of a push button switch 136 located at a remote control station RS or a push button switch 137 located on the outside of the control box 130, FIG. 1. The usual manner of operation of the power switch machine 35 is by the operator in a control tower, which constitutes the remote station RS, having the push button switch 136.

For purposes of installation and servicing, it is preferred to have a local push button switch 137 and an on-off switch SS secured adjacent to one another on the switch box 130 within the housing cover 98. Local operation of the switch is by means of the manual switch machine 30 except during times of repair or servicing when the cover 98 is removed. Suitable power and signal wire are brought in by cables 100 to the control box 130; and upon closure of the remote switch button 136, a circuit is completed for driving the reversible motor M through either its forward driving coils 99F or its reversible coils 99R, FIG. 7. Closure of the switch 136 will complete the circuit for the forward coil 99F over the following path: from lead 100; switch SS; disconnect contacts DS; lead 140; now closed, push button 136; lead 141; now closed, pressure switch contacts PS1–1; motor coil 99F; normally closed, overload contacts 144, to the opposite power lead 100.

Thus, the motor coil 99F is energized to start rotation of the motor 99 to drive the pump 102 to pump fluid through the hose 103 to drive the piston rod 82 outwardly of the cylinder 81. The motor starting circuits of coils 99F and 99R (not shown) each have holding contacts F–1 and R–1 to hold circuits for motor coils F and R when the push button 136 is released. Consequently, with release of the push button 136, the hydraulic cylinder 81 continues to extend its piston rod 82 to drive cam 74 through the leftmost, sequential operations in FIGS. 4*a*, 4*b* and 4*c*.

When the piston rod 82 is fully extended as in FIG. 4*c*, the pressure begins to build up with continued rotation of the pump 102 until the pressure switch PS1 is operated to open its contacts PS1–1 breaking the previously described circuit through the motor coil 99F. As the pressure switch PS1 opens its pressure contacts PS1–1, it closes its contacts PS1–2, FIG. 7, to complete a circuit for the reverse coil 99R of the motor 99 through a circuit including: lead 100; selector switch SS; lead 148; now closed, pressure contacts PS1–2; now closed, contacts PS2–1, coil 99R and normally closed overload contacts 144 to the opposite power lead 100.

Energization of the reverse coils 99R of the motor 99 causes the motor M and the pump 102 to reverse their directions of rotation. The higher pressure of fluid from the pump 102 is forced through the hose 104 and into the forward portion of the cylinder 81 to drive the piston and piston rod 82 toward the rear of the cylinder, as shown in FIGS. 4*d* and 4*e*. When the piston and piston rod 82 are fully retracted, the operating pressure begins to build up within the hose 104 and pump 102 from about 500 pounds p.s.i. to about 1,000 pounds p.s.i. This increased pressure actuates the pressure switch PS2 to open its contacts PS2–1, FIG. 7, thereby breaking the immediately above traced circuit for operating the reverse motor coil 99R. Thus, the motor 99 is de-energized.

The limit switches LS3 and LS4, which are operated by the spindle cam 74 also were activated during the movement of the switch points from the position of FIG. 1. According to FIG. 7, signal lights 150, FIG. 7, are provided to indicate the switch condition. Such signal lights may at the switch location only, however, have additional signal lights that are usually provided in the control tower to indicate the condition of the switch to the remotely located operator. The upper signal light 150 ST indicates that the switch points are in the "straight through" condition of FIG. 1. The light 150 ST is usually a green light. A middle light 150 R is a red light, which indicates that the switch points are open, and the "turn out" light is an amber light 150 T which indicates that the switch points are switched to cause a turning movement of a railroad locomotive moving through the switch.

The signal lights 150 are controlled by the position of the switches LS3 and LS4, as will be hereinafter explained. With the switch points 23 and 24 in the position illustrated in FIG. 1, the "straight through" green light 150 ST is lighted over a circuit from: lead 100; now closed, upper contacts LS4–1 and LS3–1 of the limit switches LS4 and LS3, lamp coil of the green light 150 ST to the opposite power lead 100. Immediately upon movement of the spindle cam 74, as illustrated in FIG. 4*b*, the

limit switch LS3 is operated and moves from its upper contact to break the circuit for the green, "straight through" light 150 ST; and the limit switch LS3 closes its contacts LS3–2 to complete a path: through lead 155 to the red (open) light 150 R.

If the switch points are unobstructed in their movement to their opposite limit position, the "turn out" position, the spindle cam 74 rotates to its fullest extent to operate the limit switch LS4. Operation of limit switch LS4 by arrival of the switch points 23 and 24, in the "turn out" position extinguishes red light 150 R by opening contacts LS4–1. Closing of contacts LS4–2 completes the circuit path for the lamp 150 T from lead 100; through now closed contact LS4–2; lead 157 and lamp coil of the light 150 T to the opposite power lead 100.

On the other hand, if the switch points were not completely closed, that is in the limit position, the spindle cam 74 would not have operated the limit switch LS4 to complete its lower contacts and the lamp 150 R would have remained red and a circuit would have been completed to a control relay CR, FIG. 7, to cause reverse movement of the switch points back to their original "straight through" position of FIG. 1.

The limit switches LS3 and LS4 could be located at the respective stock rails 23 and 24 and would function in the same manner to indicate the movement of the switch points to their limit positions. Alternatively, the limit switches could be situated to detect the full reciprocation of the connecting rods 32 or 38.

For purposes of description, let it be assumed that the switch points have started their movement from the "straight through" position; and have become obstructed while the switch points are in their open position. That is the switch points 23 and 24 are being held against complete movement to the "turn out" position. A pair of contacts AUX–R, FIG. 7, in the starter circuit for the motor are closed with each energization of the reverse coil 99R.

With the switch points obstructed, the continued operation of the pump 102 builds up sufficient pressure to open the contacts PS1–2 to complete the circuit for the reverse motor coil 99R to retract the piston rod 82. With the piston rod 82 retracted, pressure builds up and actuates switch PS2 to open its contacts PS2–1. This completes a first cycle of operation of the motor M.

During the retraction of the piston rod 82 and reverse rotation of the motor 99, the auxiliary contacts AUX–R are closed and complete a path for operating the control relay CR to initiate a second cycle of operation of the motor M and the hydraulic cylinder 81 to cause the switch points to return to their "straight through" positions. The circuit for the control relay CR remains completed because of the open switch condition; this circuit for the control relay CR extends from: lead 100; now closed, contacts LS4–1; lead 158; now closed, contacts LS3–2; lead 155; lead 159; now closed contacts AUX–R; coil of relay CR to opposite power lead 100. As the control relay CR is operated, it closed its normally open holding contacts CR–1 to hold relay CR energized as the contacts PS2–1 were opened to break the circuit for the reverse motor coil 99R.

The control circuit means including control relay CR at this time, causes an automatic reversal of the switch points to their "straight through" position by completing a circuit for the forward motor coil 99F through its normally opened, relay contacts CR–2; this circuit being through power lead 100; selector switch SS; lead 148; now closed contacts CR–2; now closed pressure switch contacts PS1–1; coil 99F and overload contacts 144 to power lead 100. Thus, the piston rod 82 moves outwardly into the cam pocket 95 to afford a clockwise rotation for the spindle cam 74 to return the switch points to their "straight through" position.

As the piston rod 82 moves to its fully extended position and the pressure builds up, the pressure switch contacts PS1–1 are opened to break the forward motor coil circuit and to establish the reverse motor coil circuit in the hereinbefore traced circuit. The return of the switch points to their "straight through" position causes the cam nose 120 on the spindle cam 74 to operate the limit switch LS3 to move its swinger into engagement with the upper contact LS3–1 thereby breaking the circuit for the control relay CR through the limit switch contacts LS3–2. De-energization of the control relay CR opens its holding contact CR–1 and its contacts CR–2 thereby preventing another operation of the forward motor coil circuit as hereinbefore stated. Thus, a locomotive or railroad cars will not be derailed by an open switch condition; the locomotive being switched "straight through" rather than moving in the "turn out" direction as originally desired.

The control relay CR will function generally in the same manner to return the switch points 23 and 24 to the "turn out" position if the switch points are obstructed from moving to the "straight through" position. With the switch points 23 and 24 in the "turn out" position, the positions of the limit switch contacts LS3 and LS4 are reversed from that shown in FIG. 7. That is, the swingers of the respective limit switches LS3 and LS4 are engaging their lower contacts, LS3–2 and LS4–2.

Upon closure of the switch 136, the forward motor coil 99F is energized and the spindle cam 74 rotates in a clockwise direction. Also, the limit switch contacts LS4–2 are closed to complete a circuit over lead 158; now closed, lower contacts LS3–2 of limit switch LS3 and lead 155 to the red light 150R. If the switch points fail to reach the "straight through" limit switch position and hence fail to reverse the positiiton of limit switch LS3 from contact LS3–2 to LS3–1, the control relay CR is energized over a path from lead 100; now closed contacts LS4–1; lead 158, now closed, contact LS3–2; lead 155; auxiliary return contacts AUX–R; and coil of relay CR to the opposite lead 100.

Operation of the control relay CR closes its holding contacts CR–1 and its contact CR–2 to complete another energization cycle of the motor 99 through its forward coils 99F and 99R to cause reciprocation of the piston rod 82 to return the spindle cam 74 to its counterclockwise position. Return of the spindle cam 74 to its counterclockwise position, moves cam nose 120 to actuate limit switch LS4 to open contact LS3–1 thereby breaking the circuit for the control relay CR. Relay CR opens its contacts CR–2 and breaks the motor cycle with the switch points returned to their "turn out" position and the motor 99 de-energized.

The control circuit means, as exemplified in FIG. 7, also contains the manual, disconnect switch contacts DS for disabling operation of the power switch machine 35 from operation by closure of the push button switch 136 at the remote station RS. It will be remembered that disconnect contacts DS of the limit switch 50 remain open through approximately 180° rotation of the throw handle 31. With the handle 31 in either one of its extreme throw positions, the limit switch plunger 54 is extended and the limit switch contacts DS are closed to permit completion of the operating circuits for either the motor coils 99F and 99R by closure of the remote switch 136.

From the foregoing, it will be seen that the present invention affords a unique inter-relationship of a manual switch machine and a power switch machine so as to disconnect the operation of the power switch machine upon beginning to throw the switch points by the manual switch stand.

It will also be recognized that the present invention affords a novel manner of controlling the return of the switch points to their initial position when the switch points are obstructed or prevented from moving to the opposite limit position thereby preventing the occur-

rence of an open switch position which might be the cause of a train derailment.

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 we therefore do not wish to be limited to the precise details set forth, but desire to avail ourselves of such changes and alterations as fall within the purview of the following claims.

We claim:

1. In a power operated switch machine for throwing switch points between initial and second limit positions and operable, upon failure of the switch points to complete a throw to the second limit position, to return the switch points to their initial limit position; a reversible electric motor, a hydraulic pump driven by said motor, a hydraulic piston adapted to be driven in opposite extending and retracting directions by hydraulic fluid from said pump, rotary cam means engageable by said piston and adapted to be turned in opposite directions by successive extension strokes of said piston, connecting means operatively connecting said cam means with the switch points to move the switch points between either limit position upon a predetermined amount of turning movement of said cam means in one direction or the other; electrical circuitry for said motor including a starting circuit, detecting means in said circuitry to detect arrival of the switch points at the second limit position during an intended throw of the switch points and effective thereupon to reverse the motor to cause retraction of the piston thereby conditioning the piston for the next extension stroke thereof which will reverse the switch points from the second to the initial limit position; said detecting means also being effective to reverse the motor to cause retraction of the piston in the event the switch points encounter an obstruction and fail to reach the second limit position during an attempted throw of the switch; and recycling means in the circuitry for said motor to cause a second cycle of the motor when the obstructing event is encountered, to thereby produce re-extension of the piston and return of the switch points to the initial limit position when there is failure to reach the second limit position because of an obstruction.

2. A switch machine according to claim 1 including manually operable means for throwing said switch points between said limit positions, and sensing means in the circuitry for said motor to disable the motor circuit thereby safeguarding the operator during manual operation of the switch.

3. A switch machine according to claim 2 wherein said manually operable means includes a throw handle and said sensing means is a limit switch.

4. A switch machine according to claim 3 wherein the manually operable means includes a linkage means and a spring means urging said switch points to a limit position, operation of said switch points through said motor compressing and releasing said spring means to urge said linkage means to assist in throwing said switch points.

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