July 22, 1952 G. J. JOHANEK 2,604,581

SWITCH CONTROL FOR TRAILABLE TRACK SWITCHES

Filed Aug. 10, 1949 2 SHEETS—SHEET 1

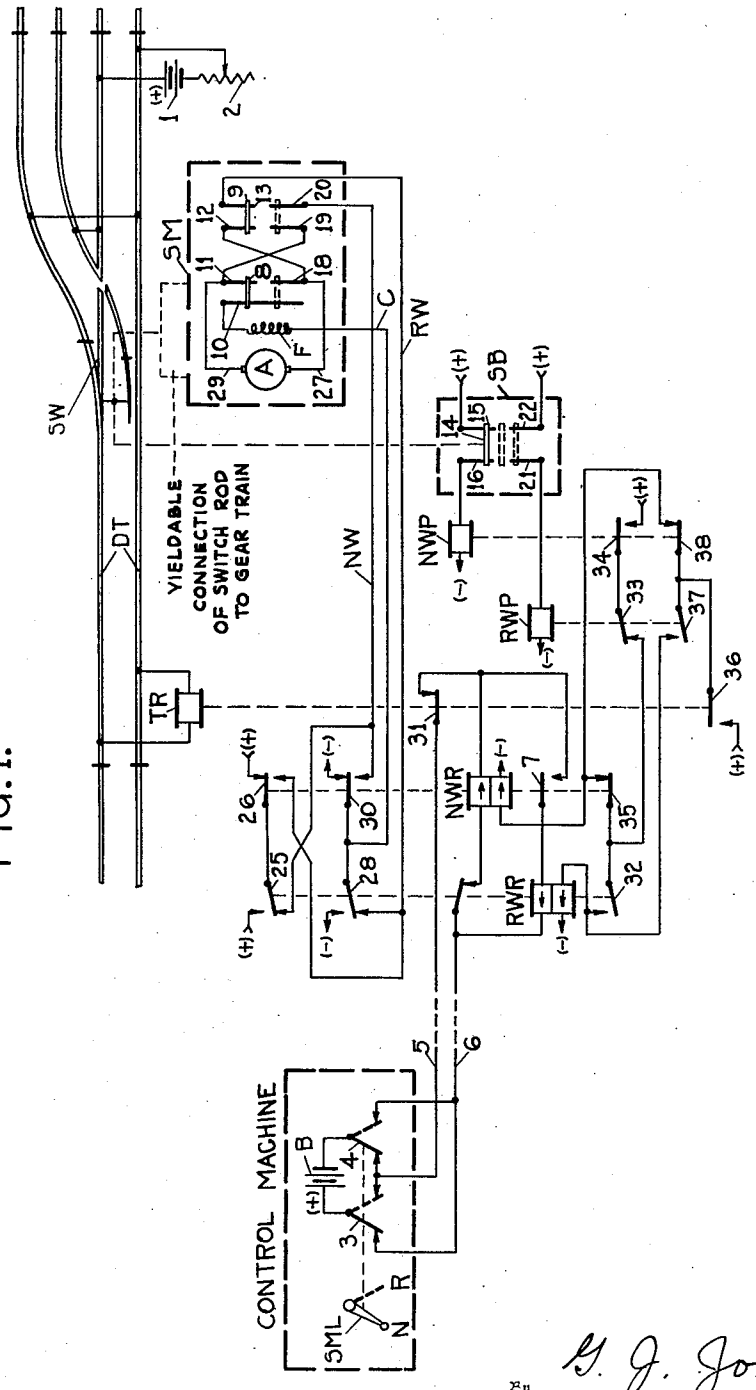


FIG. 1.

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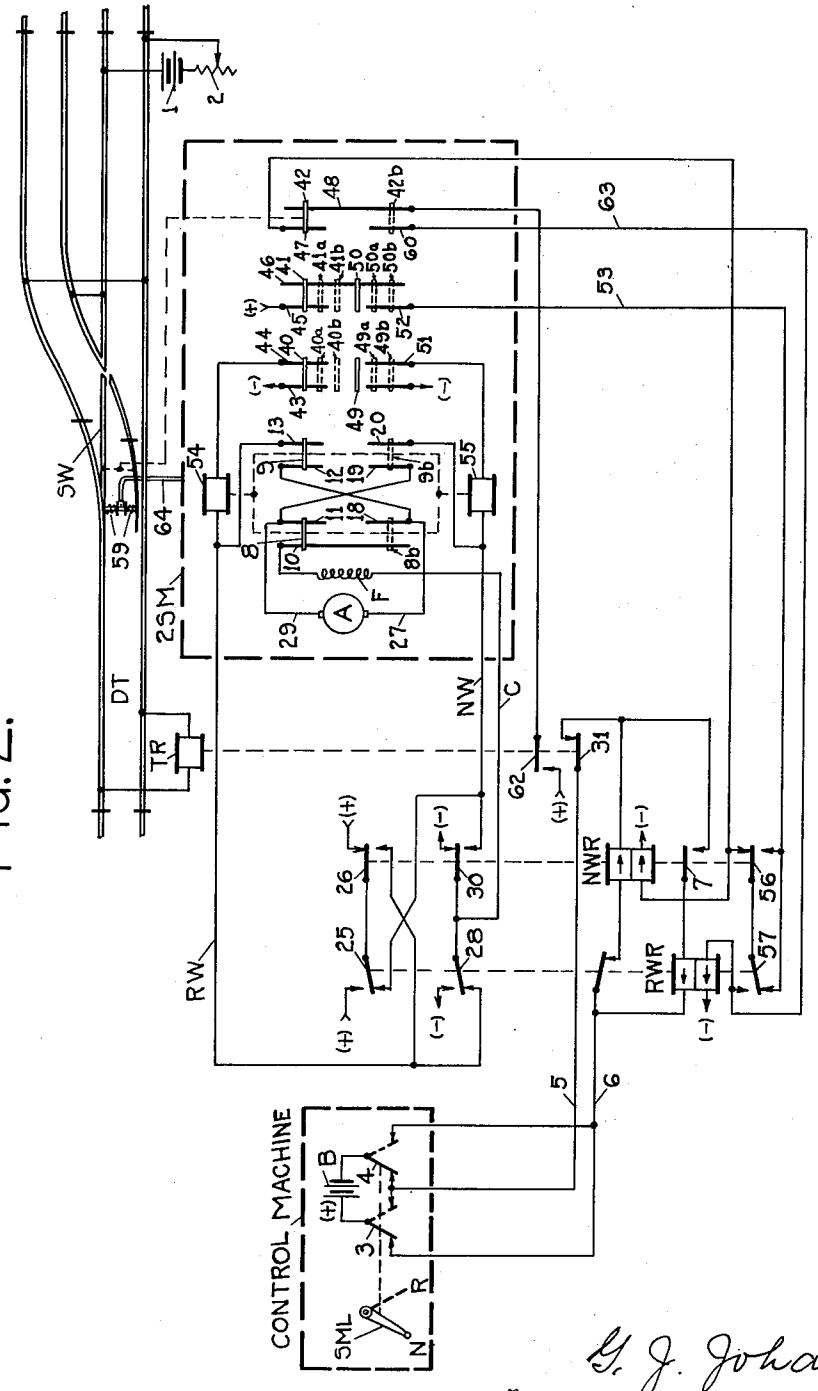


FIG. 2.

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UNITED STATES PATENT OFFICE

2,604,581

SWITCH CONTROL FOR TRAILABLE TRACK SWITCHES

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1 Claim. (Cl. 246—219)

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This invention relates to control circuits, and more particularly pertains to the type of circuits used to control an electrically operated railway switch machine from a remote location.

Modern railway practice requires the use of power operated switch machines and, in addition, the provision of some means for controlling the various switches in a given region from a single, remote location. It has also been found desirable to provide means for preventing damage to switch machines in the event that a trailing point train movement forcibly moves the switch points from their last actuated position. On some prior types of trailable switches, mechanical means, such as a spring connection with dash-pot, are provided to bias the switch points to their last actuated position, but which permit them to be temporarily forced to the opposite position by the wheels of passing cars. This type of switch machine operation has been found to cause a greater than normal amount of wear as the switch points are continually slammed to the trailed position by successive car wheels. In other types of trailable switches, the switch points are immediately moved to their full trailed positions independently of the switch operating mechanism by reason of a yieldable spring biased cam connection. With this type of operation, it generally is required that the switch machine control lever be manually operated to such trailed position after the passage of the train to bring the operating mechanism into correspondence with the switch points in order that the switch points can then be returned by power operation to their original position existing before the trailing point train movement.

The control circuit organization of the present invention avoids the disadvantages of the prior art by providing positive operation of the switch points by the switch operating mechanism immediately following the initial trailing of the switch points by the car wheels. This positive operation of the switch points prevents the slamming of the points against the stock rails upon the passage of successive car wheels, and also provides that the operating mechanism is in correspondence with the switch points at the termination of the trailing point train movement.

Without attempting to describe the present invention in exact detail, it may be said that when the switch points are forcibly moved from either the full normal or full reverse position, the switch operating mechanism is immediately operated to a corresponding position, which position is of course opposite to that to which it was last actuated. This new position of the switch operating mechanism positively holds the switch points in the full operated position in which they are being trailed. Then when the associated track circuit becomes unoccupied, the switch

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points can immediately be restored by power operation to the original position called for by a remotely located control lever without requiring any action on the part of the operator. On the other hand, if the operator has already operated the control lever to the new position in which the switch points are being trailed, then the switch operating mechanism is in a corresponding position and holding the switch points in that position. Thus, no operation is required on the part of the operator subsequent to the associated track section becoming unoccupied.

The features of the present invention may be applied not only to conventional switch machines that are reversible in mid-stroke, but also to switches of the type disclosed in Patent No. 1,854,602 to C. W. Prescott, dated April 19, 1932, which are ordinarily not so constructed as to be reversible in mid-stroke. Switch machines of this latter type employ a yieldable cam connection as shown in the above mentioned patent which not only permits movement of the switch points independently of the switch operating means, but also causes the switch points to be operated fully to the opposite position upon their being moved from their last actuated position by a trailing point train movement, as above described. In order to demonstrate the applicability of the features of the present invention to switches having switch machines of either type, two separate embodiments of this invention are herein disclosed but it should be understood that, although these specific embodiments have been employed in order to permit a specific and complete description of this invention, the features of this invention can readily be applied to other types of switch machines.

Other objects, purposes, and characteristic features of the present invention will be in part obvious from the accompanying drawing and in part pointed out as the description of this invention progresses.

In describing the invention in detail, reference will be made to the accompanying drawings. In these drawings, like reference characters have been used for corresponding parts in the two separate embodiments but distinctive reference characters are used for those parts which are associated with only one or the other of the two embodiments. In these drawings:

Fig. 1 illustrates the switch machine control circuit organization as applied to a switch machine of the type adapted for use in classification yards and having a yieldable cam connection; and

Fig. 2 illustrates the switch machine control circuit organization as applied to a switch machine having a yieldable connection and being reversible in mid-stroke.

For the purpose of simplifying the illustration

and facilitating in the explanation, the various parts and circuits constituting the embodiment of the invention have been shown diagrammatically and certain conventional illustrations have been employed, the drawings having been made more with the purpose of making it easy to understand the principles and mode of operation, than with the idea of illustrating the specific construction and arrangement of parts that would be employed in practice. Thus, the various relays and their contacts are illustrated in a conventional manner, and symbols are used to indicate connections to the terminals of batteries or other sources of electric current instead of showing all of the wiring connections to these terminals.

The accompanying Fig. 1 illustrates that a detector track section DT is provided for a stretch of track adjacent a turn-out switch including a fouling section of this switch. The track relay TR is energized by a track battery 1 which has including in series therewith a current limiting resistor 2. The position of the switch points SW is shown diagrammatically by the dotted lines as being controlled by the switch machine SM, and the position of the switch points, in turn, governs the operation of the switch repeater contacts included in the switch box SB. More specifically, the switch box SB is shown as having a movable contact 14 which is caused to be in a normal position contacting the stationary contacts 15 and 16 when the switch points are in corresponding full normal positions, and which is caused to be in a reverse position contacting stationary contacts 21 and 22 when the switch points are in corresponding full reverse positions. However, when the switch points are out of their full normal or reverse positions, as during their operation from one position to another, the movable contact 14 is in its mid-position shown by dotted lines. This switch box SB may be of the type shown in the Patent No. 2,394,215 to J. E. Stevenson, dated February 5, 1946, or other suitable contacts capable of repeating the position of the switch points can be incorporated within the switch machine, if desired.

A switch machine lever SML located at the control office operates the pole changing contacts 3 and 4 to apply steady energy of either polarity from the battery B to the line wires 5 and 6. Thus, with the lever SML in the normal position N, it is evident that the line wire 6 will be of positive polarity with respect to the line wire 5. The energy thus transmitted over the line wires is applied to the upper windings of the contactors NWR and RWR. These contactors are of the polar-biased neutral type such as shown in the prior Patent No. 2,414,583 granted January 21, 1947, to G. E. Duffy, Sr. Each of these contactors has two independent windings either one of which will, when energized with the proper polarity, pick up its armature and cause the closure of its various front contacts. However, the energization of either one of these windings with the opposite polarity will not cause an actuation of the contacts to their picked up positions. Thus, energization of the line wires 5 and 6 with one polarity causes the actuation of one contactor while energization of the line wires of the opposite polarity causes the actuation of the other contactor. This has been illustrated symbolically by the arrows included within the relay symbols. Since the pick up circuit for the upper winding of each of these contactors includes a back contact of the other contactor, an electrical interlock is provided which will prohibit the simultaneous picking up of both contactors over the control line wires 5 and 6. Thus, with the lever SML in the normal position N, as shown, the contactor NWR will be picked up because the direction of current flow through its upper winding corresponds to the direction of the arrow included within the relay symbol. In order to pick up the contactor RWR, it is necessary to move the lever SML to its reverse position R, in which case the contactor NWR will drop away (because it can not respond to reverse current through its winding) and close its back contact 7, thereby completing a circuit for the energization of the contactor RWR.

With the switch points SW in the normal position shown in Fig. 1, and the switch machine SM in a corresponding position, the movable contacts 8 and 9 of the switch machine are in their upper position so that contact 8 engages the stationary contacts 10 and 11, while the contact 9 engages stationary contacts 12 and 13. Also, the movable contact 14 of the switch box SB is in its upper position and provides an electrical connection between the stationary contact 15 and 16.

When the switch control lever SML is moved to the reverse position R so as to energize the contactor RWR and deenergize the contactor NWR, and if, at that time the switch points are in their normal position as shown in the drawing, a circuit will then be established to energize the switch machine motor and operate the switch points to the reverse position. This circuit may be traced as follows: from (+), including front contact 25 of contactor RWR, back contact 26 of contactor NWR, line RW, stationary contact 13, movable contact 9 in a normal position, stationary contact 12, wire 27, motor armature A, wire 29, stationary contact 11, movable contact 8 in a normal position, stationary contact 10, field winding F, control wire C, and front contact 28 of contactor RWR, to (—). As a result of this circuit being established, the switch machine motor is so energized as to drive the switch points to their reverse positions. As the switch points move from their normal positions, the movable contact 14 in the switch box SB moves to its center position where it cannot make contact with either pair of stationary contacts, i. e. contacts 15 and 16 or contacts 21 and 22. The contact 14 remains in this mid-position until the end of the switch operating stroke when the switch points reach the reverse position, at which time it is moved to a reverse position to make a connection between stationary contacts 21 and 22. The movable contacts 8 and 9 of the switch machine, however, remain in the positions shown during the first part of the operating stroke and move to their dotted line reverse positions only at the end of the operating stroke. When they move to these positions, the above described motor circuit is opened and the motor comes to rest, thereby stopping the switch operation.

If the lever SML is now returned to its normal position N, the contactor RWR will be deenergized and the contactor NWR energized. As a result, a circuit will then be established from (+), through front contact 26 of contactor NWR, back contact 25 of contactor RWR, wire NW, stationary contact 20, movable contact 9 in a reverse position, stationary contact 19, wire 29, motor armature A, wire 27, stationary contact 18, movable contact 8 in a reverse position, stationary contact 10, field winding F, control wire C, and front contact 30 of contactor NWR, to (—). The motor is thus energized and the di-

rection of current flow through its armature A is such as to drive the switch points to their normal positions. It will be noted that in this case, as in the previously described circuit which causes operation of the switch points to the reverse position, the unused control wire is shorted to the common wire C through a back contact of one of the contactors NWR or RWR. Thus, in this latter circuit the control wire RW is shorted to the common wire C through back contact 28 of contactor RWR. This arrangement tends to prevent the inadvertent application of energy to a control wire which might result in erroneous operation.

From the foregoing description, it can be seen that the operation of the switch machine motor shown in Fig. 1 is dependent upon the condition of the contactors NWR and RWR. Thus, if the contactor NWR is picked up and the contactor RWR dropped away, the switch points will be operated from the reverse to the normal position; whereas, if the contactor RWR is picked up and the contactor NWR dropped away, the switch points will be operated from the normal to the reverse position.

As previously noted, the control circuit from the control lever SML to the contactors RWR and NWR includes a front contact 31 of the track relay TR. For this reason, if a train should enter the detector track section DT and cause the track relay TR to drop away, the contactors NWR and RWR would then no longer be subject to control over the line wires 5 and 6. This circuit arrangement precludes the possibility of initiating an operation of the switch points after a train has entered the detector track section.

It is desired, however, that a switch movement, once begun, be completed even though the detector track section becomes occupied and causes the dropping away of the track relay TR. The control circuit of the present invention provides for this contingency by means of the stick circuits for the contactors NWR and RWR. More specifically, the movable contact 14 of the switch box SB does not engage either pair of stationary contacts when the switch points are in mid-stroke. Consequently, both repeater relays NWP and RWP will be dropped away under such circumstances. If the switch is being operated to its reverse position so that front contact 32 of the contactor RWR is closed, a stick circuit will then be completed through this front contact 32 and also back contacts 33 and 34 of the repeater relays RWP and NWP respectively. In this way, the condition of the contactors RWR and NWR as called for by the control lever SML will be maintained through this stick circuit even though the detector track section DT, becomes occupied and opens front contact 31, thereby allowing completion of the operating stroke. If the switch machine SM is being operated to its normal position when the detector track circuit becomes occupied, a similar stick circuit is established including the front contact 35 of contactor NWR.

If the switch SW has been operated to the normal position as shown in the drawing, and is then trailed through by a train or car moving from the siding onto the main track, the switch points will be forced to the reverse position independently of the power operation of the switch machine SM, as has been pointed out. This is because the switch machine SM includes the yieldable cam connection with biasing spring which acts to throw the switch points to their full reverse position when they are trailed reverse without the operation of the switch machine driving motor. As a result, the movable contact 14 in the switch box SB is then immediately moved to its lower dotted line position thereby causing the repeater relay NWP to drop away and the energizing instead of the repeater relay RWP. In making such a trailing point train movement, the track relay TR is, of course, shunted and closes its back contact 36 while opening its front contact 31. The opening of this front contact 31 prevents manual control of the contactors NWR and RWR over the line wires 5 and 6. However, with the front contact 37 of repeater relay RWP now closed, an alternate circuit is completed through this front contact 37 and back contact 36 of relay TR to energize the contactor RWR. The contactor NWR, on the other hand, cannot be held up through its upper winding because of the open front contact 31, nor can it be held up through its lower winding because of the open back contact 33 in its stick circuit and the open front contact 38 of the relay NWP. Thus, with the contactor RWR energized and the contactor NWR dropped away, the switch machine motor will immediately be operated in the direction which will bring its operating mechanism into correspondence with its previously train actuated switch points.

When the train then moves out of the detector track section DT, and allows the track relay TR again to be picked up, the opening of back contact 36 of this track relay opens the alternate circuit to the lower winding of the contactor RWR allowing it to drop away, while the closing of front contact 31 of relay TR restores the control of the contactors NWR and RWR to the manually operable lever SML as effected over the line wires 5 and 6. If the control lever SML has in the meanwhile been left in its normal position, the contactor NWR will then again be energized; and with the contactor RWR dropped away, the switch points SW will be returned to their normal position.

If the switch points SW are originally in their reverse position and are then trailed through by a train passing along the main track, the repeater relay NWP will be energized and a similar circuit established through front contact 38 of this relay NWP and back contact 36 of track relay TR to energize the lower winding of the contactor NWR. In a similar manner, the switch operating mechanism SM will then be operated to correspond with the trailed through switch points.

Modification of Fig. 2

The accompanying Fig. 2 shows a detector track section DT which is associated with the stretch of track adjacent the turn out switch SW and including the fouling section of this switch. The track relay TR is energized by a track battery 1 which has included in series therewith a current limiting resistor 2. The position of the switch points SW is shown diagrammatically as being controlled by the switch machine 2SM, and the position of the switch points SW, in turn, governs the operation of the switch repeater contacts included in the switch machine 2SM.

A switch machine lever SML located at the control office operates the pole changing contacts 3 and 4 to apply steady energy of either polarity from the battery B to the line wires 5 and 6. With the lever SML in the normal po-

sition N, it is clear that the line wire 6 will be of positive polarity with respect to the line wire 5. The energy thus transmitted over the line wires 5 and 6 is applied to the upper windings of the contactors NWR and RWR. These contactors are of the polar biased neutral type such as shown in the prior Patent No. 2,414,583, granted January 21, 1947 to G. E. Duffy, Sr. Each of these contactors has two independent windings either one of which will, when energized with the proper polarity, pick up its armature and cause the closure of its various front contacts. The structure of each contactor is such that the opposite polarity of energization will not cause an actuation of its contacts to picked up positions. Thus, any one polarity of energy on the line wires 5 and 6 causes the picking up of the corresponding contactor. Since the pick up circuit for each of these contactors includes a back contact of the other contactor, an electrical interlock is provided which will positively prohibit the simultaneous picking up of both contactors. Thus, with the lever SML in the normal position N, as shown, the contactor NWR will be picked up because the direction of current flow through its upper winding corresponds to the direction of the arrow included within the relay symbol. In order to pick up the contactor RWR it is necessary to move the lever SML to its reverse position R in which case the normal contactor NWR will drop away because of the reversal of current through its winding and close its back contact 7, thereby completing the circuit for the energization of the reverse contactor RWR.

This form of the invention differs mainly in the fact that the switch machine 2SM is considered to be of the conventional type that is reversible in mid-stroke. For example, this switch machine may be of the type disclosed in the Patent No. 1,466,903, granted September 4, 1923, to W. K. Howe, and includes an operating motor and controlling contacts similar to those shown in the switch machine SM of Fig. 1. For this latter reason corresponding parts have been given the same reference characters. However, in a switch machine of this type the controlling contacts 8 and 9 have magnets 54 and 55 associated therewith so that these contacts can be electromagnetically operated to normal and reverse positions to act as pole changer contacts in mid-stroke of the machine. It should be understood that these contacts 8 and 9 are likewise mechanically operated to their full normal or reverse positions at the end of an operating stroke the same as is described in connection with Fig. 1 so that the machine will stop its operation at an appropriate point and be in readiness for the opposite operation.

In addition, the switch machine 2SM includes other contacts 40, 41, 49 and 50 which are operated to their full normal or full reverse positions in accordance with the operation of the switch machine mechanism to corresponding positions, and which assume mid-stroke positions whenever the track switch is unlocked or in operation. These contacts may be controlled in any suitable way, such as shown, for example, in the above mentioned Howe Patent No. 1,466,903, so as to suitably control the pole change magnets 54 and 55 and also to provide proper holding circuits for normal and reverse contactors NWR and RWR.

Also, a movable contact 42 is provided and is operated independently of the operation of the switch machine mechanism and directly in accordance with the movement of the switch points so as to progressively assume positions in accordance with the actual positions of the switch points, as will be later described in greater detail.

The switch machine 2SM is diagrammatically illustrated as connected with the switch points SW through a suitable spring buffer connection to allow for the trailing operation of the switch points in spite of the locked condition of the switch machine 2SM and its operating rod connected to the switch points through such spring buffer. A suitable dash-pot arrangement may be employed in this connection, if desired. One such spring buffer and dash-pot device has been disclosed in the Pat. No. 2,341,718 granted February 15, 1944 to W. K. Howe. The particular point to be noted in this connection is that the springs 59 of the diagrammatic showing allow the switch points SW to be trailed without movement of the operating rod 64 but such movement is effective through a suitable connection to move the movable contact 42 to a position corresponding to the then existing position of the switch points.

With the switch points SW in their normal positions, as shown in Fig. 1, the movable contacts 8 and 9 are in their upper positions so that contact 8 engages the stationary contacts 10 and 11, while the movable contact 9 engages stationary contacts 12 and 13. Also, the movable contacts 40, 41 and 42 are in their upper positions so that they engage the stationary contacts 43 and 44, 45 and 46, and 47 and 48, respectively. At the same time, the movable contacts 49 and 50 are in their upper positions so that they are not connected across any of the associated stationary contacts. The movable contacts 8 and 9 are so operated by movement of the switch points that they remain in the position shown until the switch points have been operated fully to the opposite position at which time they move to the positions 8*b* and 9*b* and make contact with the stationary contacts 17 and 18, 19 and 20, respectively. The movable contacts 40, 41, 49 and 50, on the other hand, are so operated during operation of the switch points that they remain in the position shown only when the switch points are fully in the normal position. When the switch points are in mid-stroke, the movable contacts 40 and 49 assume the positions 40*a* and 49*a*, respectively, and when the switch points have been operated fully to the reverse position, these contacts 40 and 49 take the position as shown by the reference characters 40*b* and 49*b*. The movable contacts 41 and 50 operate in a manner similar to that just described in connection with movable contacts 40 and 49.

The movable contact 42, however, progressively follows the movement of the switch points SW. Thus, if the switch points have been operated two-thirds of the way from the normal to the reverse positions, for example, the movable contact 42 will also have moved two-thirds of the way to the full reverse position shown as 42*b*. Thus, it can be said that the numeral designating a movable contact indicates, when it is not followed by a letter, the position that contact assumes when the switch points are in the full normal position. However, such a numeral followed by the letters *a* and *b* indicates the position of that contact when the switch points

are in either the mid-stroke or full reverse positions, respectively.

When the switch machine control lever SML is moved to the reverse position R so as to energize the contactor RWR and deenergize the contactor NWR and if, at that time, the switch points are in their normal position as shown in the drawing, a circuit will then be established to energize the switch machine motor and operate the switch points to the reverse position. This circuit may be traced as follows: from (+), including front contact **25** of contactor RWR, back contact **26** of contactor NWR, the line wire RW, stationary contact **13**, movable contact **9**, stationary contact **12**, wire **27**, motor armature A, wire **29**, stationary contact **11**, movable contact **8**, stationary contact **10**, field winding F, control wire C, and front contact **28** of contactor RWR, to (—). As a result of this circuit being established, the switch machine motor is so energized as to drive the switch points to their reverse positions.

In addition to the above described circuit being completed for the energization of the switch machine motor, a circuit is also completed through front contact **25** of contactor RWR, back contact **26** of contactor NWR, wire RW, magnet winding **54**, stationary contact **44**, movable contact **40**, stationary contact **43**, to (—), thereby energizing the magnet **54**. As indicated by the dotted lines, this magnet **54**, when energized, holds the movable contacts **8** and **9** in their upper positions. A similar magnet **55** is provided which, when energized, retains the movable contacts **8** and **9** in their lower positions.

As the switch points SW move from the normal to the reverse position, the movable contacts **8** and **9** remain in their upper positions to keep the motor energized but as the switch points finally reach the full reverse position, the movable contacts **40** and **49** move to the positions **40***b* and **49***b*. With these contacts **40** and **49** in this position, the above described circuit for the energization of magnet winding **54** is interrupted. As a result, the movable contacts **8** and **9** are permitted to be mechanically moved to the positions **8***b* and **9***b*. When this action occurs, the circuit for the energization of the switch machine motor is broken and the motor becomes deenergized, thereby stopping the switch operation.

If the lever SML is now returned to its normal position N, the contactor RWR will be deenergized and the contactor NWR energized. As a result, a circuit will then be established from (+), including front contact **26** of contactor NWR, back contact **25** of contactor RWR, wire NW, stationary contact **20**, movable contact **9***b*, stationary contact **19**, wire **29**, motor armature A, wire **27**, stationary contact **18**, movable contact **8***b*, stationary contact **10**, field winding F, control wire C, and front contact **30** of contactor NWR, to (—). The switch machine motor is thus energized and the direction of current flow through its armature A is now of such a polarity as to drive the switch points from the reverse position to the normal position. It will be noted that in this case, as in the previously described circuit for operation of the switch points to the reverse position, the unused control wire is shorted to the common wire C through a back contact of one or the other of the contactors NWR or RWR. Thus, in this latter circuit the control wire RW is shorted to the common wire C through back contact **28** of contactor RWR. This arrangement tends to prevent the inadvertent application of energy to a control wire which might result in erroneous operation.

From the foregoing description, it can be seen that the operation of the switch machine motor shown in Fig. 2 is dependent upon the condition of the contactors NWR and RWR. Thus, if the contactor NWR is picked up and the contactor RWR dropped away, the switch points SW will be operated from the reverse to the normal position; whereas, if the contactor RWR is picked up and the contactor NWR dropped away, the switch points will be operated from the normal to the reverse position.

As previously noted, the control circuit from the control lever SML to the contactors RWR and NWR includes a front contact **31** of the track relay TR. For this reason, if a train should enter the detector track section DT and cause the track relay TR to drop away, the contactors NWR and RWR will then no longer be subject to control over the line wires **5** and **6**. This circuit arrangement precludes the possibility of initiating movement of the switch points when a train is in the detector track section.

It is desired, however, that, if operation of the switch points has been initiated, it will be completed even though the detector track section DT becomes occupied and causes the dropping away of the track relay TR. The control circuit organization of the present invention provides for this contingency by means of the stick circuits for the contactors NWR and RWR governed by contacts **41** and **50**. For example, if the switch points are operated, as previously described, from the normal to the reverse position, the movable contacts **41** and **50** will assume the positions **41***a* and **50***a* respectively, as soon as the switch points move away from the full normal position and will remain in that position until the switch points have reached the full reverse position at which time the movable contacts **41** and **50** will assume the positions **41***b* and **50***b*. However, while these movable contacts are in the positions **41***a* and **50***a*, a circuit is completed from (+), including stationary contact **45**, movable contact **41**, stationary contact **46**, movable contact **50***a*, stationary contact **52**, wire **53**, back contact **56** of contactor NWR, front contact **57** of contactor RWR, and the lower winding of contactor RWR, to (—). By this means, the contactor RWR will remain energized even though a train has entered the detector track section DT, while the switch machine 2SM was in mid-stroke, and the switch points SW will continue to be operated to the reverse position.

If the detector track section DT becomes occupied when the switch points are being moved from the reverse to the normal position, a similar circuit will be established including the front contact **56** and the back contact **57**; and this circuit will likewise maintain the contactor NWR in an energized condition until the switch points have reached the full normal position. In this way, the condition of the contactors RWR and NWR, as called for by the control lever SML, will be maintained through a stick circuit and the switch machine operating stroke completed even though the detector track section becomes occupied while the switch machine is in mid-stroke.

It will be remembered from the previous description that when the switch points are operated from the normal to the reverse position, the contactor NWR is dropped away and the contactor RWR picked up. If, however, the detector

track section DT should become occupied while the movable contact 42 still forms an electrical connection across stationary contacts 47 and 48, a circuit would be completed through the back contacts 62 of track relay TR, stationary contact 48, movable contact 42, stationary contact 47 and the lower winding of contactor NWR to energize the contactor NWR and pick up its front contacts. Also, the switch machine 2SM would then be in mid-stroke so that a stick circuit, similar to that previously described, would be established to maintain the contactor RWR in an energized condition. Although both contactors RWR and NWR would thus be momentarily picked up, the opening of back contact 56 of contactor NWR would open the stick circuit for contactor RWR so that only the contactor NWR would remain picked up.

According to the previous description, the magnet 54 is energized when the switch machine is being operated to the reverse position. However, with the switch machine in mid-stroke the movable contacts 40 and 49 are in the positions 40*a* and 49*a*, respectively, so that either magnet 54 or 55 can then be energized, provided only that its associated wire RW or NW, respectively, is at that time energized. In the case now under consideration, the reversal of conditions with respect to the contactors RWR and NWR caused by the entrance of a train into the detector track section DT when the switch points are only partially operated will result in the removal of energy from wire RW and at the same time apply energy to the wire NW. As a result, the magnet 54 will become deenergized and the magnet 55 energized. Thus, although the movable contacts 8 and 9 would ordinarily remain in their upper positions until the switch points have reached the full reverse position, the energization of this magnet 55 causes the movable contacts 8 and 9 to be quickly moved to their positions 8*b* and 9*b*. For this reason, the previously described circuit for the energization of the switch machine motor which causes the switch points to be operated to the normal position is now completed and the switch points are immediately returned to that position.

This operation occurs because the movable contact 42 follows the switch points as they are moved between their extreme positions. The fixed contact 47 is preferably constructed to allow the movable contact 42 to make connection between it and the fixed contact 48 for about one-third of the operating travel of the switch points adjacent their normal position; whereas, the fixed contact 60 is adjusted to allow the movable contact 42 to make connection between it and the fixed contact 48 for about one-third of the operating travel of the switch points adjacent their reverse position. Thus, the movable contact 42 does not make any connection during about one-third of the intermediate portion of an operating stroke. It is of course to be understood that these proportions of the operating stroke are selected for convenience in the disclosure and other proportions might well be selected to meet the requirements of practice.

If a train were to enter the detector track section DT when the switch points have travelled more than one-third of the distance to their reverse position, the energy through back contact 62 of the detector track relay TR will not be applied to the lower winding of either contactor NWR or RWR so that the contactor RWR, which has been picked up for the reverse operation of the switch machine, will remain picked up through its stick circuit including movable contact 50 in its position 50*a*. This causes the pole changing magnet 54 to continue to be energized and the contacts 8 and 9 to be maintained in their positions to effect the continued reverse operation of the switch machine in spite of the occupancy of the detector track section. It should be noted, however, that if the track switch has operated sufficiently reverse so as to close a circuit to supply energy through the back contact 62 of the track relay TR and through movable contact 42 in its position *b*, then the lower winding of contactor RWR is merely supplied with an auxiliary energizing circuit in multiple with its stick circuit already energized. This circuit continues to remain closed, even after the switch machine 2SM has completed its operating stroke and has opened the stick circuit, until the detector track section DT becomes unoccupied allowing the track relay TR to pick up and open back contact 62.

A similar operation will occur if the switch machine 2SM is operating the switch points of the track switch SW to their normal positions when the detector track section DT becomes occupied. In brief, it may be said that the entrance of a train into the detector track section DT while the switch SW is being operated, causes the switch machine to continue operation so as to move the switch points to a full normal or reverse locked position, but if such occupancy occurs before the points have been moved more than one-third of the distance to the new position, they will be returned to their original positions.

In other words, the entrance of a train into the detector track section while the switch machine is operating the switch points, results in the switch points being returned to their original positions if they have been moved something less than one-third of the distance to the opposite position, but their movement will be continued to the opposite position if they have moved more than one-third of the operating stroke. In this way the switch points are assured of being operated to a full normal or reverse position for the passage of a car. In this connection, it will be understood that the detector track section extends sufficiently in advance of the switch SW to allow such a completion of the operating stroke for the usual speeds at which cars approach the switch.

If the switch SW is in the normal position as shown in Fig. 2 and is then trailed through by a train or car moving from the siding onto the main track, the switch points will be forced out of the full normal position regardless of the locked condition of the switch machine 2SM which is permitted by reason of the conventional spring switch arrangement associated with the front tie rod and operating bar 64. This yieldable connection has been shown diagrammatically in Fig. 2 by the springs 59. Although a trailing point train movement of this type which forces the switch points from their last actuated position may not necessarily force the switch points fully over to the opposite position, such a train movement is certain to move the switch points at least more than two thirds of the way to the trailed through position. As has been pointed out, movable contact 42 substantially follows the position of the switch points so that when the switch points are forcibly moved from the normal position to approach the reverse position by a trailing point train movement, the movable contact 42 will be operated to a position

where it makes contact between stationary contacts 60 and 48. Then, since the shunting effect of the train in the detector track section DT has caused a dropping away of track relay TR, a circuit will be established from (+), including back contact 62 of track relay TR, stationary contact 48, movable contact 42, stationary contact 60, wire 63, and lower winding of contactor RWR, to (—). As a result, the contactor RWR will become energized.

Since the entrance of the train into the detector track section DT which is now assumed to be trailing the switch points, caused the opening of front contact 31 of track relay TR immediately upon such entrance, the normal contactor NWR is deenergized at the time the reverse contactor RWR is picked up. Thus, the switch machine 2SM is caused to immediately operate to its full reverse locked position which causes the switch points to be held in their reverse positions for continued passage of the train. It can thus be seen that such operation obviates any intermittent movement of the switch points during the trailing point movement of the train after the initial movement of the points by the leading wheels of the train. This saves considerable wear on the switch points.

Upon the passage of the train making such a trailing point train movement out of the detector track section DT, the track relay TR will again be picked up and front contact 31 will become closed while back contact 62 will be opened. The circuit just described for the energization of the lower winding of contactor RWR will then be interrupted and the control of the contactors RWR and NWR will then revert to the polar control transmitted over line wires 5 and 6.

If the lever SML has, in the meanwhile been left in the normal position N, the switch machine will then be immediately operated to return the switch points to the normal position.

Obviously, if the switch points are forced out of their full reverse position by a train making a trailing point move along the main track, a similar circuit will be established through back contact 62 of track relay TR, stationary contact 48, movable contact 42, stationary contact 41, and the lower winding of contactor NWR, to energize this contactor NWR and cause the operation of the switch machine to the full normal position. Then, when the track circuit again becomes unoccupied, the switch machine will automatically be operated to the position called for by the lever SML without any action on the part of the operator.

Thus, the switch machine control circuit of the present invention provides for improved operation in the case of trailing train movements. By using a control circuit of this type, it becomes unnecessary to operate the switch machine control lever to bring the switch operating means into correspondence with the trailed through switch points prior to returning the points to their original position. By means of the present invention not only is the operating mechanism brought into correspondence with the switch points and the switch points instantly brought to the full trailed through position, but the switch points are immediately returned to their last actuated position when the train making the trailing move leaves the associated detector track section. In addition, switch operation is prevented from being initiated after the detector track section becomes occupied.

Having described two forms of a switch machine control circuit organization as specific embodiments of the present invention, it is desired to be understood that these forms are selected to facilitate in the disclosure of the invention rather than to limit the number of forms which it may assume: and, it is to be further understood that various modifications, adaptations, and alterations may be applied to the specific forms shown to meet the requirements of practice, without in any manner departing from the spirit or scope of the present invention.

What I claim is:

A switch control system for the power operation of a track switch comprising in combination, a detector track circuit, manually operable means for designating respective normal and reverse positions for the control of said track switch, an electric switch machine for the power operation of said track switch having a reversible electric motor drive and having a yieldable connection between its driving mechanism and said track switch, whereby said track switch can be operated by the passage of a train when trailed independent of the electric driving mechanism, double wound respective normal and reverse switch machine control contactors, circuit means for selectively energizing a particular one of the windings of said normal and reverse switch control contactors, the contactor selected for energization being in accordance with the normal or reverse switch position designated by said manually operable means, said circuit means being effective only provided that the switch control contactor for the other switch position is dropped away, normal and reverse switch position repeater relays having circuit control means effective to energize each of these relays when in correspondence with the respective full-normal or full-reverse position of the track switch, stick circuit means acting upon the other of said windings of said normal and reverse switch control contactors to maintain the associated contactor energized whenever said normal and reverse switch position repeater relays are both dropped away, auxiliary circuit control means for energizing said other winding of either of said contactors when said switch position repeater relay for the opposite switch position has been picked up by reason of the forcing of the switch points by a trailing train movement, irrespective of the energization of said one winding for the opposite switch position, said auxiliary circuit means being effective only provided said detector track circuit is occupied, and circuit means for energizing said electric motor with one polarity or the other in accordance with the selective energization of said normal and reverse switch machine control contactors.

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