Aug. 18, 1925. 1,550,611

W. K. HOWE

POWER OPERATED INTERLOCKING SYSTEM

Filed Jan. 21, 1922 2 Sheets-Sheet 1

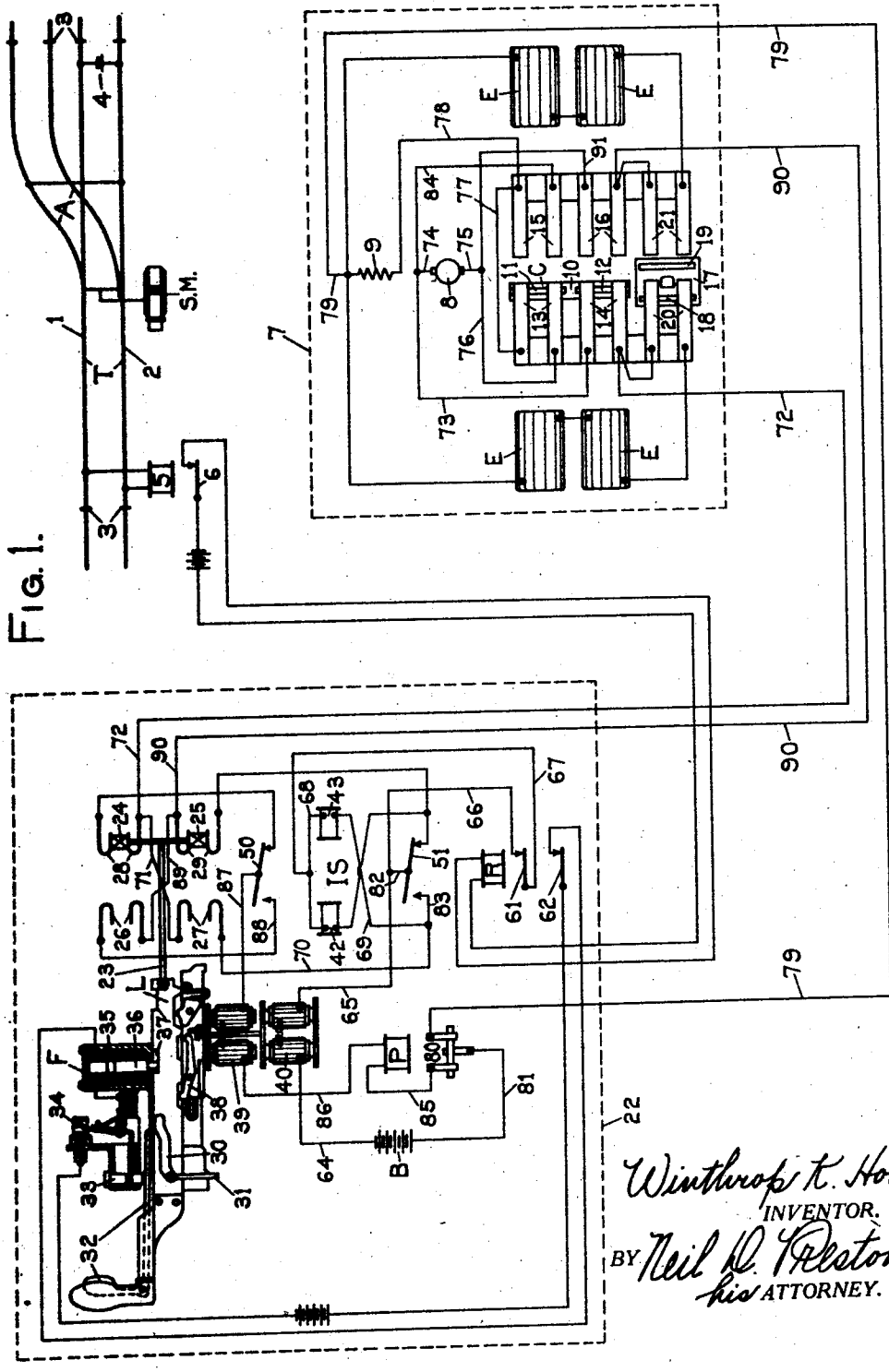


FIG. 1.

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FIG. 2.

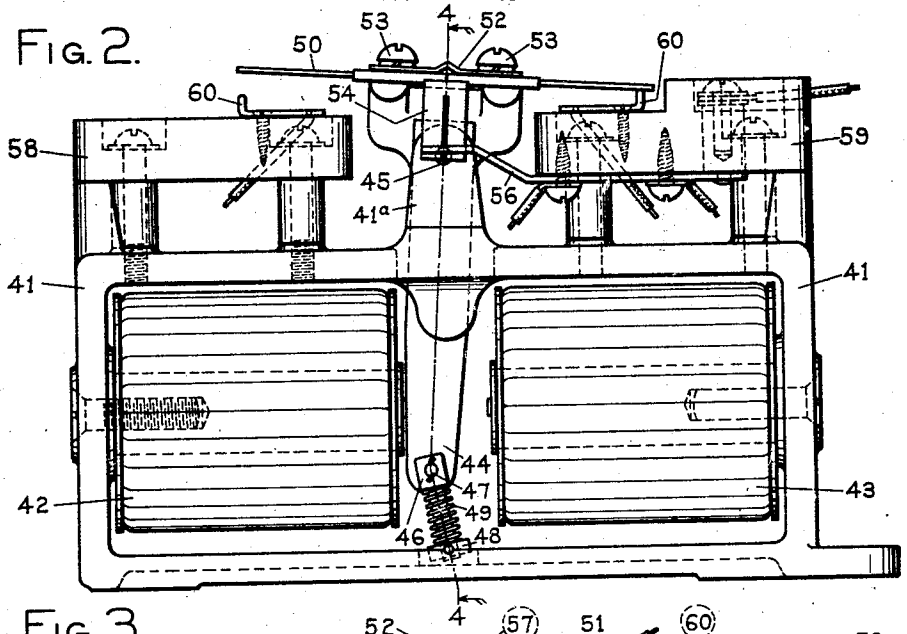


FIG. 3.

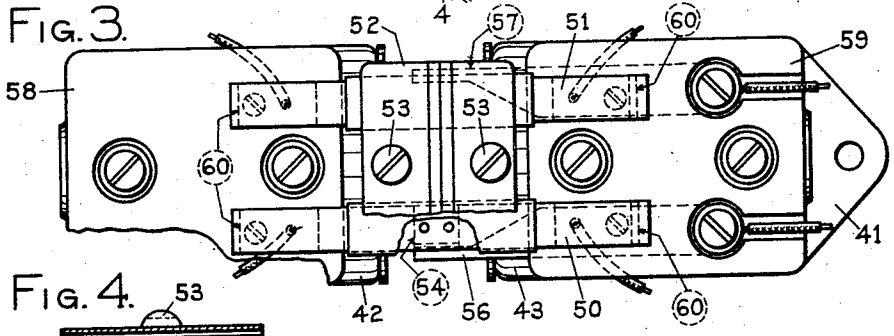
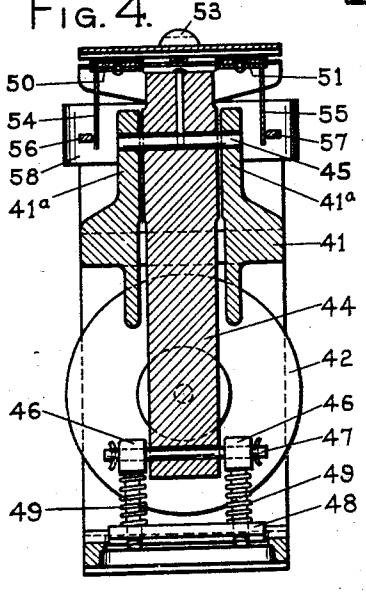


FIG. 4.



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Patented Aug. 18, 1925. 1,550,611

UNITED STATES PATENT OFFICE.

WINTHROP KEITH HOWE, OF ROCHESTER, NEW YORK, ASSIGNOR TO GENERAL RAILWAY SIGNAL COMPANY, OF GATES, NEW YORK, A CORPORATION OF NEW YORK.

POWER-OPERATED INTERLOCKING SYSTEM.

Application filed January 21, 1922. Serial No. 530,847.

To all whom it may concern:

Be it known that I, WINTHROP KEITH HOWE, a citizen of the United States of America, residing at Rochester, in the county of Monroe and State of New York, have invented certain new and useful Improvements in Power-Operated Interlocking Systems, of which the following is a specification.

This invention relates to power operated interlocking systems for railroads, and more particularly to a scheme of detector locking for preventing the throwing of switches under trains.

In order to safe guard the movement of switches, or derails, and assure safe movement of trains through terminals, yards, and the like, where a power operated interlocking system is employed, it is desirable for reasons well recognized in the art to provide suitable automatic means for preventing a switch being shifted by power under a train or directly in front of an approaching train. Lever locks, commonly employed for this purpose, have the disadvantage that the operator may sometimes release them by hand, or with the aid of the manual release ordinarily provided; thus obtaining control of the switch machine, and then thoughtlessly or carelessly manipulate the lever so as to apply power to the switch machine at the wrong time. Instead of such lever locks, or preferably in addition thereto, it is proposed in accordance with this invention to provide automatic means for directly controlling the application of power to the switch operating mechanism in accordance with the condition of the detector track circuit, so that when this detector track circuit is occupied, power is cut off from the switch machine, and the machine can not be operated irrespective of the position of the lever.

In a restricted sense, the present invention deals more particularly with a well-known type of an all-electric interlocking system employing dynamic indication and supplying the operating current, subject to the control of the lever, from a central source at the tower over operating wires to the respective switch machines. In this type of system, as well as other types of systems characterized by a similar method of operation, if a train should happen to enter the detector track circuit just after the lever has been shifted and before the corresponding switch machine has had time to operate, the interruption of operating current to this switch machine would, without anything else, stop the switch machine at an intermediate point in its operation and leave the switch in mid-stroke or unlocked. The possible occurrence of such a condition, even though it can exist only under exceptional circumstances, is of course objectionable and dangerous; and rather than have a switch in mid-stroke or unlocked, it is generally better to allow it to complete whatever cycle of operation may have been started before the entrance of a train into its controlling track circuit. Accordingly, this invention contemplates an organization of parts and circuits for influencing the desired control of the switch machine from a track circuit, but always permitting the switch machine to complete a cycle of operation under way regardless of a subsequent entrance of a train into the track circuit, no operation being possible, however, if the train enters the track circuit before the operation of the switch machine is started. In this connection it is further considered desirable to take away the operator's control over the switch machine as soon as a train enters the detector track circuit, and while permitting the switch machine to complete an operation it may have started, prevent the operator from stopping or changing this cycle of operation, more especially manipulating the lever so as to work the switch machine back and forth between the ends of its stroke.

Various other features and advantages of the invention will be pointed out, and others will be apparent, as a detail description progresses.

In describing the invention, reference will be made to the accompanying drawings, in which—

Figure 1 illustrates in a simplified and diagrammatic manner the parts and circuits of a well-known type of an all-electric interlocking system employing dynamic indication and showing the organization of parts and circuits constituting the invention;

Fig. 2 is a side elevation of one specific form of indication selector employed in connection with this invention;

Fig. 3 is a top plan view of this indication selector, parts being broken away for the sake of clearness; and

Fig. 4 is a vertical transverse section through the indication selector on the line 4—4 in Fig. 2.

For the purpose of more clearly illustrating the nature of this invention and facilitating explanation of the construction and mode of operation, there is shown in the accompanying drawings in a simplified and conventional way the significant parts and circuits of one particular type of a power operated interlocking system, employing a switch operating mechanism disclosed, for example, in my prior Patent, No. 1,288,595, Dec. 24, 1918. It should be understood that this specific type of interlocking system is merely illustrative of the nature and utility of the present invention, and that the invention may be applied to analogous types of system by making appropriate change in mechanical and electrical details.

Referring to Fig. 1, a stretch of track T, with a switch A is shown conventionally. The track rails 1 and 2 are divided by insulated joints 3 and bonded in the usual way to provide a detector track circuit, having a track battery 4 and a track relay 5 with a contact finger or armature 6. The movable points of the switch A are locked and shifted back and forth by a switch machine SM connected thereto in the usual way; and since the detail construction of this switch machine is fully disclosed in my prior patent above mentioned, only those parts directly involved in consideration and explanation of the present invention are illustrated, these parts being inclosed within the dotted rectangle 7. These parts include the operating motor, which comprises armature 8 and field 9, a circuit controller C for governing the operating and indication circuits, pole changer coils E for operating the circuit controller C, and a similar circuit controller D for governing the circuits for these pole changer coils.

The circuit controller C comprises a contact block 10 of suitable insulating material, carrying conducting bars or strips 11 and 12 which are adapted to bridge pairs of contact springs 13 to 16. This block 10 is operated mechanically from an extreme position shown to its other opposite extreme position by the final locking movement of the locking plunger of the switch machine, in the manner fully explained in my prior patent. In other words, this contact block is shifted mechanically from one extreme position to the other upon the completion of the cycle of operation of the switch machine. Also, this block 10 may be shifted to one extreme position or the other by energization of the corresponding pairs of pole changer coils E, said block being disengaged from its mechanical operating means at intermediate points in the cycle of operation of the machine.

The circuit controller D comprises an insulating block 17 shiftable back and forth and carries two conducting bars 18 and 19 adapted to be bridged and electrically connected by said bars. This block 17 is shifted mechanically in concurrence with the operation of the switch machine, and is moved from its existing extreme position during the unlocking movement of the switch machine to an intermediate position, connecting both pairs of contact springs 20—21, until the switch machine has completed its cycle of operation and is again locked, whereupon said block is automatically shifted to its opposite extreme position.

The parts of the interlocking system located at the tower or central control point are enclosed in a dotted rectangle 22, and in general comprises the usual lever L, which is slidable back and forth and is connected to a rod 23 working insulated contact blocks 24 and 25 into and out of engagement with pairs of contact springs 26 to 29. A cam slot 30 in this lever L drives a roller on the upper end of a tappet bar 31 which is connected to the usual mechanical interlocking between this lever and other levers making up the complete machine. The lever L is provided with a handle for facilitating its movement, and associated with this handle is a latch operating angle lever 32. When this latch lever 32 is pressed inward, it raises a button 33 of insulating material which operates a latch contact 34, which controls the energizing circuit for an electric lever lock F. This lock F comprises an iron clad solenoid 35, the core 36 of which carries a lock dog adapted to engage shoulders of notches 37 formed on the upper edge of the lever L. The indication latch for the lever L is designated 38, the indication magnet 39, the safety magnet 40, polarized cross protection relay P, and the main battery B, these parts being of the usual well-known construction and those commonly employed in a direct current dynamic indication type of system illustrated. The indication selector IS, however, in order to carry out the present invention, is modified somewhat in construction as compared with that ordinarily employed, this modified construction being shown in detail in Figs. 2 to 4.

Referring to Figs. 2 to 4, the indication selector comprises a rectangular open frame 41 of iron, to the ends of which are fastened coils 42 and 43. Disposed between these coils is an armature 44 which is pivotally supported near its upper end by a shaft 45 (see Fig. 4) fastened therein by a small transverse pin and journaled in holes in upstanding ears or lugs 41[a] integral with the

upper longitudinal member of the frame 41. The armature 44 is provided at its lower end with a spring locking or over-center throwing device. As shown, this device comprises a pair of plungers 46 which have their heads pivotally mounted on a pin 47 fixed in the lower end of the armature 44, and which slide in holes in a rocking member 48 supported by end trunnions resting in notches in the base of the frame 41, compression springs 49 being interposed between the rocking member 48 and the heads of the plunger 46. It will be evident that the tension of the springs 49 tends to hold the armature 44 in the extreme position in which it may be placed, thereby maintaining the desired contact pressure between the contacts associated with the armature and hereinafter described, and also preventing displacement of the armature by jar and vibration when its controlling coils 42 or 43 are deenergized. Also, the springs 49 act to force the armature 44 to its extreme position as soon as it is shifted slightly beyond its middle position in one direction or the other.

The armature 44 opens and closes certain contacts as it is shifted back and forth. In the construction shown, two contact fingers 50 and 51 are clamped to the bifurcated upper end of the armature 44 by a plate 52 and screws 53, these fingers being insulated from the armature and from each other by interposed pieces of fiber or other suitable insulating material in the way shown. To the fingers 50 and 51 are riveted side downwardly extending split arms 54 and 55 respectively, which rub against the edge of stationary springs 56 and 57 respectively. To the ends of the frame 41 are fastened terminal blocks 58 and 59 of suitable insulating material, one of which supports the springs 56—57, and each carrying contact pieces 60 arranged to be engaged by the ends of the fingers 50 and 51. The circuit connections are made between the springs 56—57, to the fingers 50—51, and thence to the contact pieces 60 with which said fingers are in engagement, as shown in a simplified and diagrammatic manner in Fig. 1.

One characteristic of this specific construction of indication selector IS which adapts it for use in connection with the present invention is, that its coils 42—43 are of a relatively high resistance, in practice usually 250 ohms, so that when one of these coils is connected in series with the switch machine operating motor, the current is limited to an amount below the value necessary to start the motor and operate the switch machine.

Another element of the combination of circuits and devices constituting the invention comprises a suitable relay R which is controlled by the track relay 5. The particular circuit shown for the relay R, comprising a separate battery at the switch, is merely illustrative, various other arrangements of circuits for rendering the energization of the relay R dependent upon the track relay 5 being familiar to those skilled in the art. The relay R is essentially a repeating relay for the detector track circuit, and in practice may be an indicating or control relay commonly located at the tower in interlocking systems for exerting the desired control for various schemes of approach and route locking, operation of indicators, track diagrams, etc. This relay R is shown as provided with two contact fingers 61—62 and associated front contacts. The front contact 62 of the relay R controls the energizing circuit for the lever lock F and the front contact 61 controls the energization of the coils 42 and 43 of the indication selector IS in a manner more fully explained hereinafter. It is noted here that the relay R may be controlled by a number of track circuits, or the two circuits taken through the front contacts of this relay R may be taken through the front contacts of a number of relays governed by track circuits, according-ly as the varying operating conditions for different installations may require.

Operation.—Referring to Fig. 1, assume that the parts and circuits of the system are in the normal condition shown. When the operator desires to reverse the switch A, he presses the latch releasing lever 32, thereby closing the latch contacts 34 and energizing the locking solenoid 35, providing the detector track circuit is not occupied so that relay R is energized. After releasing the electric lever lock, the operator may then pull the lever L out (to the left as shown) to its reverse indication position, where the contact blocks 24—25 are moved to electrically connect the pairs of contact springs 26—27, thereby establishing a reverse operating circuit which may be traced as follows: commencing at the battery B, wire 64, safety magnet 40, wires 65 and 66, front contact 61 of relay R, wires 67 and 68, coil 43 of indication selector, wires 69 and 70, contact springs 27, wire 71 to reverse operating wire 72, through springs 14 and bar 12, wires 73 and 74, armature 8, wires 75 and 76, springs 13 and bar 11, wires 77 and 78, field 9, its common wire 79, through contacts 80 of the polarized relay P and wire 81 back to the battery B.

On account of the resistance of indication selector coil 43 included in this circuit, the current flowing through the armature and field of the switch machine motor is not sufficient to operate the switch machine; but the current flowing in said coil 43 attracts armature 44 of the indication selector and rocks its contact fingers 50—51 to the other extreme position, thereby establishing a shunt around corresponding coil 43 and also

the front contact 61 of relay R, this shunt being traced as follows: commencing at wire 65, wire 82, finger 51 in the other extreme position and wire 83 to wire 70, and thence through contact springs 27, etc., as in the circuit previously traced. Sufficient current now flows to the operating motor to cause operation of the switch machine, reverse the switch points, and lock them in their new position. At the completion of the cycle of operation of the switch machine, contact block 10 of the circuit controller C is shifted to the extreme position opposite to that shown, breaking the operating circuit hereinafter traced at the contact springs 13—14, and electrically connecting the contact springs 15—16 to establish the reverse indication circuit. This indication circuit includes the armature 8 and field 9 of the motor, with their connections reversed, the indication magnet 39, and contact finger 50 of the indication selector, this circuit being conveniently traced as follows: Starting at the upper brush of armature 8, wires 74 and 84, springs 15 and bar 11, wire 78, field 9, common wire 79, contacts 80 of polarized relay P, wire 85, winding of relay P, wire 86, indication magnet 39, wire 87, finger 50 of indication selector (previously shifted to its other extreme position), wire 88, springs 26, and block 24, wire 89, normal operating wire 90, springs 16, and bar 12, and wires 91 and 75 back to the lower brush of the armature 8.

Indication current which is generated dynamically by the operating motor in the usual way, energizes indication magnet 39, releases indication latch 38, and permits the operator to complete the movement of the lever L to its full reverse position and release the mechanical interlocking associated with conflicting levers, all in the usual way characteristic of this type of system. The operation of returning the switch A back to the position shown, is the same as described, and analogous circuits, which can be readily traced, are involved.

In the foregoing operation it has been assumed that the relay R is energized, a condition existing only when the detector track circuit or circuits are unoccupied. Assume then that a train is present on the detector track circuit protecting the switch A at the time the operator desires to reverse the switch. In the first place, the electric lever lock can not be released, since the relay R is deenergized; but in addition to this protection commonly provided, the present invention also prevents the application of current to the switch machine, so that even if the operator should "plug" the lever lock, or obtain its release by a push button or other manual release, the switch machine can not be operated. This additional protection is afforded by the fact that the next operating circuit is broken at the front contact 61 of relay R. To explain more fully, suppose the switch machine is in the normal position shown in Fig. 1, and that front contact 61 of relay R is open, due to the presence of a train on the detector track circuit. If the operator should succeed in getting the lever to the reverse indication position, no current can be supplied to the operating motor, because the connection between battery B and the reverse operating wire 72 is broken at the finger 51 of the indication selector, and because the energizing circuit for coil 43 of the indication selector, capable of closing this break, is broken at the front contact 61 of relay R. Consequently, independently of the protection provided by the electric lever lock, the switch can not be changed from its existing position when there is a train present on its associated detector track circuit.

Under exceptional circumstances, it may happen that the operator releases the electric lock, shifts the lever L, and starts the operation of the switch machine just before the train enters the detector track circuit, or at least just before the relay R is operated by the entrance of such a train. Under these circumstances it is preferable to complete the cycle of operation of the switch machine that has been started, rather than stop the switch machine in mid-stroke and leave the switch points partly open or unlocked. This desirable function is accomplished by this invention, because once the indication selector has responded, the front contact 61 of relay R, as well as the corresponding coil 42 or 43, is shunted, so that current may continue to flow to the operating motor in spite of the deenergization of relay R.

It may happen that the operator for some reason desires to reverse the switch machine in mid-stroke, and to do this he restores the lever L to the former position, thereby energizing the other operating wire and sending current through one of the pairs of pole changer coils E, contact block 17 of circuit controller D having been mechanically placed in its middle position; and these pole changer coils shift the block 10 of the circuit controller C from its existing extreme position to the other extreme position, thereby supplying current to the operating motor, with its field and armature connections reversed, and causing the motor to operate in the other direction and return the switch points to their former position. During such operation of reversal in mid-stroke, the indication selector is shifted in the same way as at the beginning of a normal or reverse operation. The possibility of the operator causing reversal of the switch machine in mid-stroke is characteristic of this particular type of system, and is a feature taken into account in con-

nection with the detector locking scheme embodying the present invention, provisions being made for the reasons hereinafter explained to prevent such reversal when the detector track circuit is occupied. This end is accomplished because the indication selector must respond, in the case of such reversal in mid-stroke, the same as in the case of initial operation from a normal or reverse position, before current is supplied to the operating motor sufficient to operate the switch machine, and since the indication selector can not respond when the relay R is deenergized, due to the presence of a train in the detector track circuit, it is evident that the operator can not reverse the switch in mid-stroke after a train has entered the track circuit.

While the detector locking provided by this invention in a sense affords the same protection as the usual lever lock, and consequently may be used instead of such lever lock, it is considered to be preferable under ordinary conditions to retain the lever lock. For one thing, such lever locks, when the locking notches are cut in the lever accordingly, will prevent return of the lever from an indication position, when a train occupies the detector track circuit, so that the operator can not carelessly or thoughtlessly push back his lever, after having initiated a cycle of operation of the switch machine, and interrupt the supply of current to the operating motor at the lever contacts before the switch has had chance to complete its operation. In other words, the lever lock can be used to prevent the operator from stopping a switch machine in mid-stroke when there is a train on the detector track circuit.

While one specific construction of devices and arrangement of circuits, designed for use in connection with one particular type of electric interlocking system, has been selected for disclosure of the nature and scope of this invention, it will be evident that various modifications and adaptations of this specific embodiment shown and described may be made in practice, without departing from the invention; and I desire to have it understood that the specific disclosure is merely illustrative, and does not exhaust the various forms of means constituting the invention.

What I claim is:—

1. In an electric interlocking system, a switch machine having two wires over which operating current is conducted, a detector track circuit, an electro-magnetic device having two high resistance coils alternately included in circuit with said wires, said device including circuit controlling means operated upon energization of either of said coils to establish a low resistance shunt around the energized coil, and automatic means governed by said track circuit for controlling the operation of said device.

2. In an electric interlocking system, the combination with a detector track circuit, a switch machine having normal and reverse operating wires, a dead-beat armature controlling the supply of operating current over said wires alternately, and electro-magnetic means responsive to the condition of said detector track circuit for actuating said armature.

3. In an electric interlocking system, the combination with a detector track circuit, a switch machine having normal and reverse operating circuits, a circuit controller for alternately controlling the supply of current over said circuits and adapted to continue in the existing condition until forcibly changed, electro-magnetic means for operating said circuit controller, and an energizing circuit for said electro-magnetic means governed by said track circuit.

4. In an electric interlocking system, the combination with a detector track circuit, a switch machine having normal and reverse operating circuits, a circuit controller alternately controlling the supply of current over said circuits, high resistance coils for operating said circuit controller included one in each of said operating circuits, and limiting the flow of current therein below that required to operate the switch machine, said operating circuits having their initial energization controlled by the detector track circuit, and a dead-beat armature operated by said coils and establishing a low resistance shunt for each coil in turn as the armature is shifted by that coil.

5. In an electric interlocking system, the combination with a detector track circuit, an electrically operable switch machine, a source of current and a lever for governing the operation of said switch machine, indication mechanism for the lever, two control wires between the lever and the switch machine and used alternately for conducting operating current and indication current, an indication selector having high resistance coils included in circuit with said control wires respectively, said indication selector having a dead-beat armature, circuit controlling means governed by the detector track circuit for controlling the current through the coils of the indication selector, and means actuated by said armature for closing a low resistance shunt for said circuit controlling means and the coil shifting the armature.

6. In an electric interlocking system, the combination with a detector track circuit, a switch machine, a source of current and a lever at a central control point for governing the operation of the switch machine, means at said control point governed by the detector track circuit for preventing the

application of power to the switch machine while said track circuit is occupied, and electro-magnetic means comprising a dead-beat armature and two coils alternately energized from said source as the lever is shifted for continuing the supply of power to the switch machine independently of the track circuit after the switch machine has once commenced a cycle of operation.

7. In an electric interlocking system, the combination with a detector track circuit, a switch machine, and means comprising a dead-beat armature and two high resistance coils and governed by the detector track circuit for controlling the supply of operating current to the switch machine.

8. In an electric interlocking system of the type described, the combination with a detector track circuit and a switch machine, of an indication selector having high resistance coils, circuit controlling means governed by the track circuit for controlling the operation of said indication selector, and means actuated by said selector for determining the supply of effective operating current to the switch machine.

9. In an electric interlocking system of the dynamic indication type, the combination with a detector track circuit, of an electrically operable switch machine adapted to generate an indication current dynamically after each operation, a source of current and a lever for controlling the operation of the switch machine, indication mechanism for the lever, an indication selector having high resistance coils and adapted to control the continuity of the indication circuits over which said indication current flows to the indication mechanism of the lever, circuit controlling means governed by the detector track circuit for controlling the operation of the indication selector, and means actuated by said selector for establishing a low resistance shunt for said circuit controlling means and the coil of the selector then acting.

10. In an electric interlocking system of the type described having an indication selector with high resistance coils limiting the flow of operating current below that required to operate the switch machine of the system, the combination with a detector track circuit, of circuit controlling means governed by said track circuit and included in circuit with the coils of said selector, and means governed by said selector for establishing a low resistance shunt for said circuit controlling means and its corresponding coil.

11. In an electric interlocking system of the type described having an indication selector with high resistance coils and in which the operation of said selector is necessary after each movement of the switch machine in order to obtain an indication, the combination with a detector track circuit, of a relay governed by said track circuit and controlling the operation of said indication selector, and automatic means actuated by said selector for maintaining the supply of operating current to the switch machine independently of the condition of the detector track circuit.

12. In an electric interlocking system, a switch machine, a lever controlling the operation of said machine, a detector track circuit, an electric lock for said lever governed by said track circuit, an indication selector, and means governed by the indication selector and by said detector track circuit for controlling the supply of operating current to the switch machine.

13. In an electric interlocking system, a switch machine, a lever controlling the operation of the switch machine, a detector track circuit, an electric lock for said lever governed by said track circuit, and means governed by the track circuit and acting independently of said lock for preventing the application of effective operating current to the switch machine while said track circuit is occupied.

14. In an electric interlocking system, a switch machine, a lever controlling the operation of the switch machine, a detector track circuit, an electric lock for said lever governed by said track circuit, and means governed by said track circuit and acting automatically and independently of said lock to prevent application of operating current to the switch machine while said track circuit is occupied but permitting the switch machine to complete a cycle of operation once started prior to the occupancy of the track circuit.

15. In an electric interlocking system, a switch machine, a lever controlling the operation of the switch machine, a detector track circuit, an electric lock for said lever governed by said track circuit, normal and reverse control circuits for the switch machine governed by said lever and used alternately for conducting operating and indication currents, and an indication selector controlling the supply of operating current and also the continuity of each indication circuit in turn, said indication selector having its operation governed by said track circuit and acting automatically to prevent the application of effective operating current to the switch machine while the track circuit is occupied but continuing such supply of current independently of said track circuit after the switch machine has commenced a cycle of operation.

16. In an electric interlocking system, a switch machine, a source of current and a lever at a central control point for governing the operation of the switch machine, a detector track circuit, automatic means in-

cluding a relay at said control point for preventing the supply of operating current to the switch machine while the track circuit is occupied, said means permitting the switch machine to complete a cycle of operation once started prior to the occupancy of the track circuit, and an electric lock governed by said track circuit for preventing reversal of the lever while the track circuit is occupied.

17. In an electric interlocking system, the combination with a switch machine, its control lever, and an indication selector having high resistance coils, of an electric lock for the lever, and track circuit control means for governing the operation of the indication selector and also said electric lock.

18. In an electric interlocking system, the combination with a detector track circuit, a switch machine having a normal and a reverse control circuit, a manually operable lever for alternately closing said circuits at one point, and automatic means for alternately closing said circuits at another point, said automatic means being rendered effective by the movement of the lever to close the same circuit closed by said lever only if said detector track circuit is not then occupied.

19. In an electric interlocking system, the combination with a detector track circuit having the usual track relay, a switch machine, a normal and a reverse control circuit for said switch machine each of which may be open at two points, a manually operable lever for alternately closing said circuits at one point, and automatic means depending for its operation on the energization of said track relay for alternately and separately closing at the other point the same circuit closed at the lever.

20. In an electric interlocking system, the combination with a detector track circuit having the usual track relay, a switch machine, a normal and a reverse control circuit for said switch machine each of which may be open at two points, a manually operable lever for alternately closing said circuits at one point, and automatic means depending for its operation on the position of said lever and the energization of said track relay for closing at the other point the same circuit closed by the lever provided the track circuit is then not occupied, said automatic means if once actuated remaining in its actuated position until again changed irrespective of the occupancy of the track circuit.

In testimony whereof I hereby affix my signature.

WINTHROP KEITH HOWE.