March 26, 1929. W. K. HOWE 1,706,851

HUMP YARD INTERLOCKING

Filed July 23, 1923 2 Sheets-Sheet 1

FIG. 1.

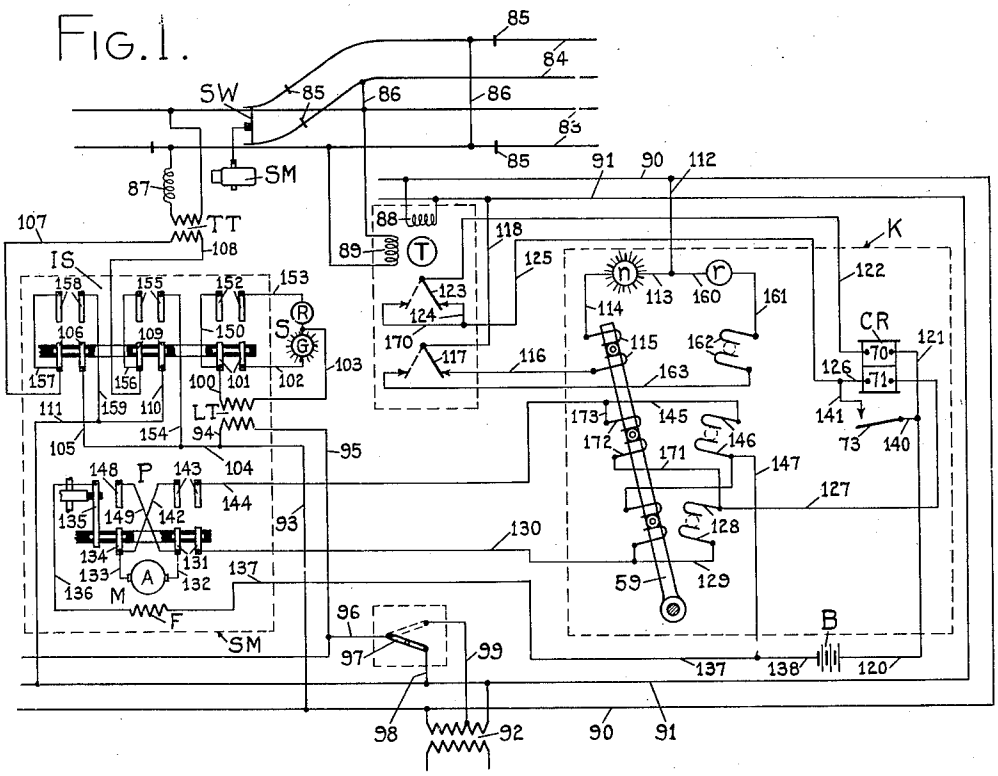
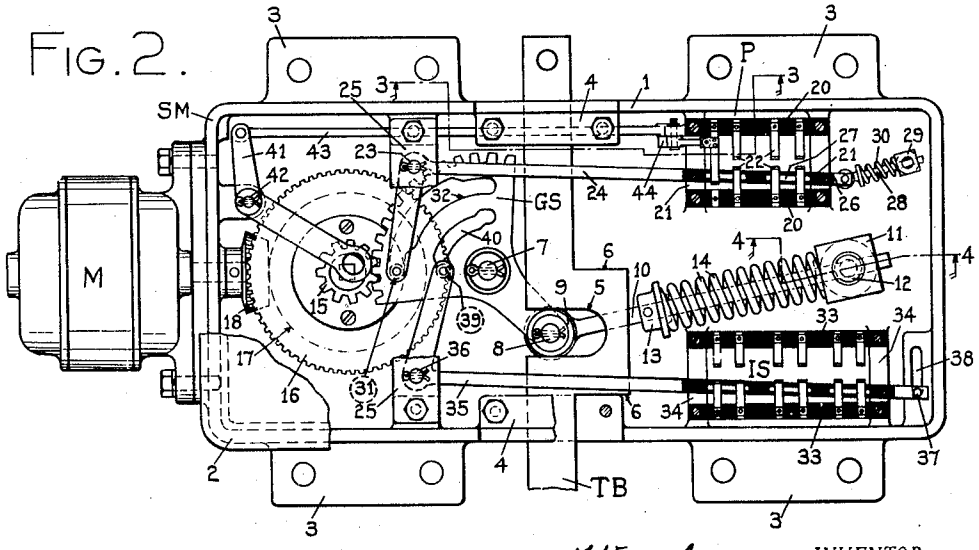


FIG. 2.



INVENTOR.
Winthrop K. Howe,
BY Neil D. Preston,
his ATTORNEY

March 26, 1929. W. K. HOWE 1,706,851

HUMP YARD INTERLOCKING

Filed July 23, 1923 2 Sheets-Sheet 2

FIG. 3.

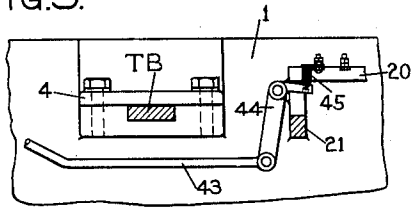


FIG. 4.

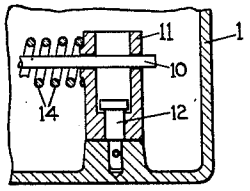


FIG. 5.

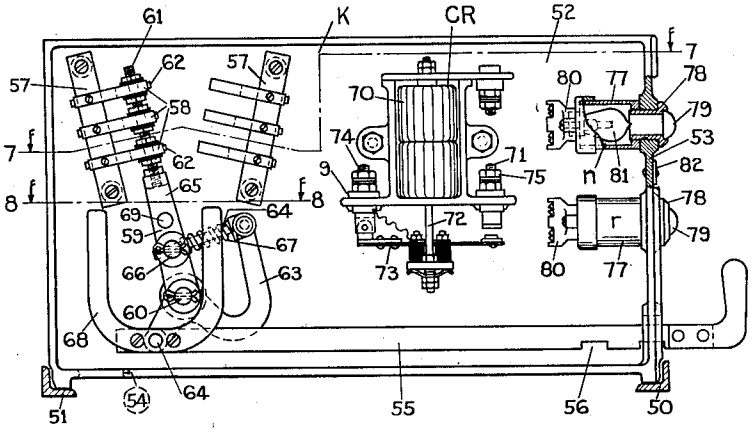


FIG. 6.

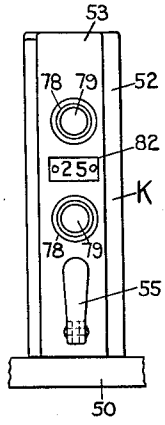


FIG. 7.

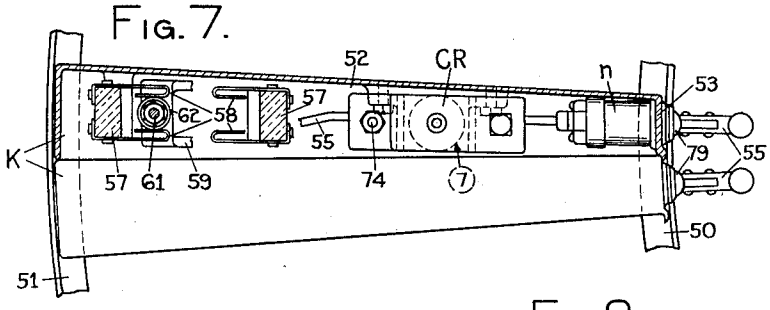


FIG. 8.

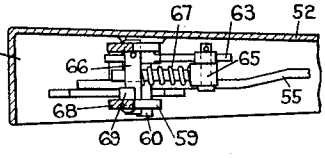


FIG. 9.

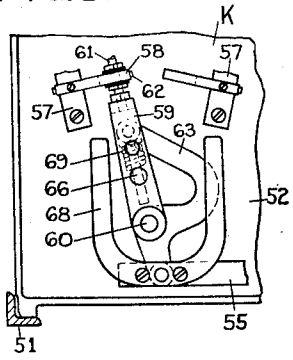
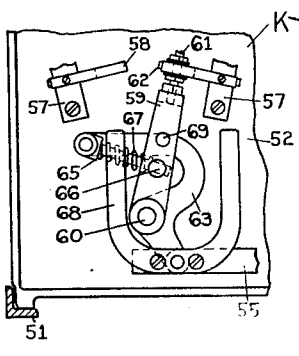


FIG. 10.



INVENTOR.
Winthrop K. Howe,
BY Neil D. Preston
his ATTORNEY

Patented Mar. 26, 1929. 1,706,851

UNITED STATES PATENT OFFICE.

WINTHROP K. HOWE, OF ROCHESTER, NEW YORK, ASSIGNOR TO GENERAL RAILWAY SIGNAL COMPANY, OF ROCHESTER, NEW YORK.

HUMP-YARD INTERLOCKING.

Application filed July 23, 1923. Serial No. 653,220.

This invention relates to a system for operating by power the switches of classification or "hump" yards of railroads.

In sorting cars, making up trains, and handling freight cars in general, it is common practice to employ a special arrangement of tracks and switches, usually on a grade, which is well known in the art and commonly known as a hump, gravity or classification yard. Ordinarily, the switches of such a classification yard are thrown by hand by the switch men; but, for various well known reasons, it is desirable to be able to operate all or the more important switches of a classification yard from a central point by power under the control of one operator. On account of the slow speeds and active supervision, such a system of power operation of switches does not need necessarily all of the safeguards and refinements required in a power interlocking system for terminals, crossings, and the like; and on account of the size of these yards and the number of switches involved, it is desirable to make the system of power operation as cheap and simple as the practical requirements and working conditions permit.

Generally speaking, the primary object of this invention is to provide a simple and efficient scheme for the power operation of a large number of switches from a central control point, with such indications and safeguards as are considered to be necessary for practical use. More specifically, this invention contemplates the provision of a cheap and efficient quick acting machine for throwing a switch by electric power from a central supply under the control of an operator; a simple arrangement for cutting off supply of power to a switch machine and preventing its operation while a detector track circuit adjacent thereto is occupied, so that the switch can not be thrown under a car, this protective arrangement at the same time permitting the switch machine to complete the stroke of the switch if once started prior to the occupancy of the detector track circuit; the provision of a switch machine which permits the switch points to be trailed and which keeps switch points in their shifted position until the car or train has passed, whereupon the switch is automatically returned to its former position in correspondence with the position of its controlling lever; provision of facilities for operating any switch by hand whenever required and with safety; the provision of suitable indications at the switch and at the central control point or tower corresponding to the existing position of the switch points; the incorporation of a dynamic braking or snubbing arrangement for the motor operating the switch machine so that, in spite of its quick operation, the parts of the mechanism are not injured by shock or jar at the end of each stroke; and the arrangement of the control devices or levers in the tower in such a fashion that they are readily accessible to one operator, can be easily and quickly manipulated, and can not be accidently displaced.

Various other characteristic features and specific objects of the invention will appear hereinafter as the description progresses.

In the accompanying drawings, Figure 1 shows diagrammatically and in accordance with established conventions a simple typical single switch layout, together with the devices at the switch and the control tower constituting the system of this invention, and including the various control circuits of this system;

Fig. 2 is a plan view of the switch machine diagrammatically illustrated in Fig. 1, having its cover partly broken away;

Fig. 3 is a detail section taken on the line 3—3, Fig. 2, and shows means for lifting a contact finger from a movable contact block for cutting energy off of the switch machine;

Fig. 4 is a detail section taken on the line 4—4, Fig. 2;

Fig. 5 is a side elevation of a lever and its casing for controlling the switch machine shown in Fig. 2;

Fig. 6 is a front elevation of the lever shown in Fig. 5;

Fig. 7 is a plan view of two of the switch levers shown in Fig. 5, illustrating how they may be assembled to form an arc of a circle;

Fig. 8 is a sectional view taken on the line 8—8, Fig. 5, as viewed in the direction of the arrows;

Fig. 9 shows a portion of the switch lever illustrated in Fig. 5, with the lever in an intermediate position, and with the snap switch arm just on a point of throwing over to the reverse position; and

Fig. 10 is a view similar to that of Fig. 9 with both the lever and the switch arm in the reverse position.

Generally stated, the system of this inven-

tion consists of a number of control devices, conveniently termed levers, arranged together in a convenient manner in a machine located in a tower or other desired point of central control. Differing from ordinary interlocking practice, there is no mechanical interlocking between the several levers. In addition to the levers, and their associated circuit controllers, there are indicators for each lever, a safety or control relay, and perhaps a track relay or repeater, these various parts being preferably assembly in unit form in separate casings and connected together in the arc of a circle with such radius that all of the levers may be easily reached by the operator at the center. In the tower, or adjacent thereto, is preferably located the source of operating current assumed in this instance to be a storage battery of, say, 110 volts, with the necessary recharging equipment, control panel, and the like. In addition to this operating source, there is preferably used in this invention a source of alternating current which is distributed throughout the yard by suitable power lines.

At each switch is a detector track circuit and track relay, the small "pot" light signal, and a switch machine for operating the switch points, the casing of this switch machine also housing a transformer for the pot signal and the track transformer. The switch machine comprises, in addition to an automatically operated circuit controller for controlling its own operating motor, a circuit controller shifted to correspond with the position of the switch points for controlling the indication of the pot signal and the indicators of the corresponding lever in the tower.

Switch machine.—The specific construction of mechanism embodying this invention for shifting switch points and performing the other desired functions may take various forms, and the specific design illustrated in Fig. 2 is intended to be merely typical. Referring to Fig. 2, a switch machine and associated parts are supported and housed in a box-like casing 1 having the usual tightly fitting and detachable cover 2, said casing having two pairs of projecting feet 3 extending from opposite sides thereof and facilitating the attachment of the switch machine casing to a pair of ties with the usual spacing. The switch points are shifted and held in their extreme positions by a single throw-bar TB, which extends transversely of the casing and is guided by recesses in the side walls thereof, detachable cover plates 4 facilitating the removal of this throw-bar. The end of this throw-bar is connected by a throw-rod and adjustable switch connection to the switch points in the usual way, as indicated diagrammatically in Fig. 1. This construction, being well known, needs no particular illustration or description.

As clearly shown in Fig. 2, the throw-bar TB is formed with a laterally opening U-shape jaw 5 between its ends, the sides of this jaw forming shoulders 6 which engage sides of the casing and accurately determine the extreme position of said throw-bar, it being understood in this connection that variation in the throw of the switch points is taken care of by the adjustable connection between the throw-bar and said points. The throw-bar TB is reciprocated by a lever or gear sector GS, which is pivotally supported upon a pin 7 securely fixed in the base of the casing 1, said sector GS being held in place by the usual washer and cotter pin. Fixed in the end of the sector GS is a pin 8 carrying a revolvable roller 9 adapted to cooperate with the jaw 5 of the throw-bar TB and cause reciprocation thereof when said sector is rocked back and forth. On the same pin 8 is journaled the end of a thrust-rod 10, the other end of which slides in a block 11 swiveled on a pin 12 fixed in the base of the casing 1 (see Fig. 4). Between the block 11 and a collar 13 fixed to the rod 10 is a strong compression coil spring 14.

The sector or lever GS is rocked or oscillated by the rotation of a pinion 15 meshing with the teeth on said sector GS. This pinion 15 is driven from a bevel gear 16 through a friction slip clutch of suitable construction, such as disclosed, for example, in my prior application Ser. No. 304,816, filed June 17, 1919, this clutch being indicated by dotted lines 17. The bevel gear 16 meshes with a bevel pinion 18 pinned to the armature shaft of the operating motor M. This motor M is of the series direct current type, with the usual field and armature; and is preferably wholly enclosed, as shown, and bolted directly to the end of the casing 1.

In connection with the operation of the switch machine SM, it is necessary to provide circuit controlling contacts automatically opened and closed during the cycle of operation of the machine. Also, it is desirable to provide a circuit controller which is actuated in correspondence with the position of the switch points and may be used to control the signal at the switch and the indicators in the tower. These two circuit controllers are both operated by the movement of the gear sector GS. The circuit controller governing the operation of the switch machine, conveniently termed pole changer P, consists of two parallel blocks 20 of insulating material fastened to brackets 21 integral with one wall of the casing 1. Fastened to these insulating blocks 20 are spring contact fingers, as 22, specific designation of these fingers and their inter-connection into the operating circuits being taken up hereinafter in the description of the operation. An angle or bell crank lever 24 is pivotally supported on a pin 23 in a plate 25 fixed to a side wall of the casing 1. The longer end of this angle lever

24 has fixed thereto a block 26 of insulating material, in which are embedded or secured short contact pieces or strips 27 adapted to bridge pairs of the contact fingers 22. Also connected to this longer end of the lever 24 is an over-center throwing spring device, which comprises a plunger 28 pivotally secured to said lever and guided in a swiveled block 29, similar in construction to the block 11 hereinbefore described, and a spring 30 interposed between said block and an enlarged head on said plunger. The other or shorter end of the angle lever 24 carries a freely revolvable roller 31 engaging in a cam slot 32 formed in the gear sector GS.

The other circuit controlling unit IS, governing the switch signal and the lever indicators, comprises pairs of fingers supported upon insulating blocks 33 secured to shelves or brackets 34, similar to the pole changer P. An angle lever 35 is pivotally supported on a stationary pin 36 and carries at its free end insulated contact pieces cooperating with the contact springs, in much the same way as already described in connection with the pole changer P. The outer end of this angle lever 35 is guided by a pin 37 traveling in a slot formed in a bracket 38 integral with the casing 1. The shorter end of the angle lever 35 is provided with a roller 39 engaging in a cam slot 40 in the gear sector GS.

To facilitate manual operation of the switch machine, the hub of the pinion 15 is formed with a square socket to receive a crank or similar tool, by means of which said pinion may be turned by hand. Such manual operation of the switch machine is necessary in case the mechanism is for some reason out of order, the circuits broken, or the power supply cut off; and while under such conditions it is ordinarily not possible for the machine to be operated by power, it is considered expedient to assure that all power shall be cut off and disconnected from the switch machine before it can be moved by hand. Otherwise, on account of the automatic restoring features of this type of machine, as hereinafter more fully explained, the switch man might be seriously injured in attempting to operate by hand a switch which had not had its power cut off. For this purpose, a movable guard for the crank socket in the pinion 15 is used in such a way that, before the crank can be inserted, this guard must be moved and in so doing the switch man cuts off the power of the switch machine.

In the particular arrangement shown, a swinging lever 41 is pivotally supported on a pin 42, and one end of this lever has a hole through which the crank must pass in order to enter the socket in the pinion 15. The other end of the lever 41 is connected by a link 43 to a crank 44 (see Fig. 3), the shorter end of said crank 44 carrying a striking piece 45 of insulating material adapted to engage an extension on a long contact finger of a pole changer P and raise that finger out of engagement with a contact piece on the lever 24, thereby cutting off the supply of current to the motor M. The parts are so proportioned that the lever 41 partly covers the crank socket for the pinion 15, and when displaced to permit the insertion of a crank, raises the long contact finger and cuts off the supply of power.

Lever unit.—As already explained, the so-called levers for controlling the switch machines of the several switches are made up in units of like construction and are assembled together, preferably in a curved tier. The description of one of these lever units will suffice for all.

Every lever unit K comprises a casing of cast iron or sheet metal, which is wider at one end than at the other (see Fig. 7) and is secured to inner and outer curved angle bars 50 and 51 of the main framework for the machine. Each of these casings is made up of one side wall 52, a front wall 53, and back and bottom walls, one side of the casing being open. When these casings of the lever units K are secured to the angle bars 50 and 51 side by side, as shown in Fig. 7, the side wall 52 of one casing serves to close the open side of the adjacent casing. Any one of these lever units may be separately removed; and it is evident that when taken out, all parts of the unit are accessible to inspection and repair through the open side. The connecting wires of the lever units are taken up through a hole 54 in the bottom of the casing.

The lever itself is a slidable bar 55, which projects at one end through the front wall 53 of the casing, this projecting end being formed with a handle to facilitate the reciprocation of this bar or lever. In the lower edge of the lever 55 are two notches 56 which engage the front wall 53 when the lever is in its extreme position and drops down by its own weight. In this simple way, the lever 55 is held against accidental movement either in or out from its extreme positions, so that there is no chance of its accidental displacement by one leaning against it or by one catching a coat sleeve or the like over the handle. It will be obvious that the lever may be released by simply raising the handle to free the notches 56.

As the lever 55 is shifted from one extreme position to the other, it controls the operation of the corresponding switch machine by opening and closing certain circuits. According to this invention, the circuit controller operated by the lever 55 is of the quick acting or snap type and is always closed in one extreme position or the other. This circuit controller comprises, generally speak-

ing, two rows or tiers of contact fingers arranged in pairs and a swinging contact arm which carries insulated contact rings bridging said pairs of fingers. More specifically, referring to Figs. 5 and 7, two contact carrying blocks 57 of suitable insulating material are secured to the back wall 52 of the casing; and to these insulating blocks are fastened contact fingers, as 58, arranged, as best shown in Fig. 7, in pairs. The contact arm 59 is preferably constructed, for the purposes of clearance, in an inverted U-shape form or bifurcated; and this arm is pivotally supported at its lower end on a fixed stud 60, being held in place by the usual washer and cotter pin.

To this contact arm 59 is attached a threaded member 61 on which are secured a number of insulated contact rings 62 adapted to engage and bridge pairs of contact fingers 58 as said arm is swung from one extreme position to the other. Pivotally supported upon the same fixed stud 60 is a lever 63 of peculiar angle shape, as shown in Fig. 5. The shorter and downwardly projecting end of this lever 63 is pivotally connected by a pin 64 to the lever 55, so that the lever 64 is rocked from one extreme position shown in Fig. 5 to the other extreme position shown in Fig. 10 as the lever 55 is reciprocated. The other and upwardly projecting end of the lever 63 is pivotally connected to a plunger 65 which slides through the transverse hole in a pin 66 secured between the two bifurcations of the contact arm 59. On this plunger 65, between the head thereof and the pin 66, is a compression coil spring 67. A U-shaped member, conveniently called the hammer or striker 68, is rigidly fastened to the lever 55; and fixed in one of the bifurcations of the contact arm 59 is a pin 69 positioned so as to be engaged by the striker 68.

The operation of this snap or quick acting circuit controller is best understood from consideration of Figs. 5, 9 and 10. Fig. 5 shows the parts in one extreme position, the lever 55 being pushed all the way in, and the contact arm 59 being in the lefthand position. As the lever 55 is pulled outward, the lever 63 is rocked about the pin 60, and the upper end of this lever is carried up and to the left with respect to the pin 66 of the contact arm 59. After a certain distance of movement of the lever 55, the parts assume the position as shown in Fig. 9, in which the spring 67 has been compressed and is acting substantially on a line with the pivotal axis of the contact arm 59.

Upon movement of the lever beyond the position just discussed, the lever 63 is moved still further to a point where the spring 67 acts on the opposite side of the pivotal axis of the contact arm 59 and tends to throw said contact arm from the lefthand position toward the right. Ordinarily, on account of the friction of the engagement of the contact rings 62 with the contact fingers 58, the spring 67 may not be strong enough to move the contact arm 59; but by referring to Fig. 9, it can be seen that after the lever 55 has been moved part way the lefthand side of the striker 58 is brought in position to engage the pin 69 on the contact arm 59, thereby positively connecting the lever with said contact arm and pulling it free irrespective of the frictional engagement of its contacts. As soon as the contact arm 59 is free to be moved by the spring 67, it is thrown over quickly with a snap action to the other right-hand position shown in Fig. 10.

It will be observed that the circuit controller of the lever, according to this invention, must always be closed in one position or the other. Aside from producing quick break and make of circuits and avoiding injury to the contacts due to arcing, this snap circuit controller has another important feature in connection with the use of detector track circuits controlling the supply of electric current to the switch machine, this advantageous feature being more conveniently discussed hereinafter.

In connection with the safety provisions for preventing operation of a switch under a car, there is employed in this invention a safety or control relay for each switch and lever unit, this relay being preferably located at the tower and in the casing of the lever unit. Referring to Fig. 5, this safety relay as shown, is of the iron-clad type with a high resistance coil 70 and a low resistance coil 71, both surrounding a vertical movable core 72. The core 72 is connected by insulated blocks to a contact finger 73, which is hinged at one end to an insulated binding post 74, and which carries a contact (preferably of carbon) at the other end movable into engagement with a cooperating carbon contact carried by an insulating binding post 75. Contact finger 73 is biased to the open position by its weight and the weight of the core 72. When the coils 70 or 71 are effectively energized in the manner hereinafter explained, core 72 is raised, closing the circuit controlled by this contact finger.

For the purpose of indicating to the tower man or operator the position of the several switches under his control, small indicator lamps *n* and *r* are provided for each lever unit one for each position of the switch. These indicators may have distinctive color, letter or sign significance. As illustrated each of these indicator lights or signals comprises a cylindrical casing 77 having a threaded hole in the bottom which is fastened to the front wall 53 of the lever unit casing by a flanged sleeve 78. A small lens or bull's eye 79 is suitably secured in the outer end of the sleeve 78. A lamp socket 80 of suitable construction and containing a lamp 81, is fastened

to the other end of the casing 77, preferably by a spring flange frictionally engaging the outer end of said casing. Each of the levers is preferably identified in the usual way by a number plate 82.

Organization of the system.—In Figure 1 is shown in a simplified and diagrammatic manner a track layout and control circuits for a single switch SW. In this particular layout, the track rails of the main track or superior route are designated 83, and the track rails of the siding, branch track, or turnout are designated 84. These track rails 83 and 84, for a portion of their length at least near the switch SW, are bonded in the usual way and provided with insulated joints 85 and cross bonds 86 to give the usual detector track circuit and fouling point protection.

In the particular embodiment of the invention illustrated, this detector track circuit is energized with alternating current derived from the secondary of a track transformer TT, the usual current limiting impedance or resistance 87 being interposed in the connections so as to avoid excessive current flow when the train is standing on the track section. The circuits by which current is supplied to the primary of this track transformer TT are more conveniently considered hereinafter.

The track relay T for the detector track circuit since the use of alternating current is assumed, is of the well known two-element alternating current type having a local phase field winding 88 and a track phase field winding 89. As well known by those skilled in the art of railway signaling, such a two element A. C. relay is responsive to both the existence and phase relation of the currents in its field windings, this relay being in effect a three-position device. The contact fingers and cooperating stationary contacts of this relay are shown in accordance with established convention as single switch arms and arrows. This track relay (part shown in dash rectangle) may be located near the switch and the circuit controlled thereby taken to the tower, or at the tower and the connections to its track phase winding carried out to the switch, as may be most convenient or suitable.

For the information of the switch men and train crews, there is preferably employed a small "pot" color light signal at the switch giving the usual color indications corresponding to the positions of the switch points, such as green and red. The specific construction of this signal S, which may be of any one of the well known types modified in proportions for the purpose, has not been shown, but in the wiring diagram of Fig. 1 there are indicated two lamps G and R of this signal. As shown, the lamps of the signal S are supplied with alternating current from the small transformer LT. Running throughout the yard is a pair of alternating current br wires or mains 90 and 91, supplied from a suitable source, shown as a step-down transformer 92 connected to a high voltage supply. The lighting transformer LT has its primary connected by wires 93 and 94 to one of these supply mains 90 and by wires 95 and 96 to a dimming switch 97, said switch 97 being shiftable from the position shown in connection with the other energy main 91 by wire 98 to the other position where connection is made by a wire 99 to a lower voltage tap on the secondary of the main supply transformer 92. The dimming switch 97, which is preferably located in the tower or at some other central control point and which preferably controls the light transformers LT for all switches or for large groups thereof, is employed in practice to change the voltage supplied to the lamp signals S to give a strong indication for day time and a weaker indication for night time.

The pole changer circuit controller P and the indication circuit controller IS of the switch machine have been shown conventionally and diagrammatically; and similarly the snap circuit controller of the lever has been shown in a simplified and diagrammatic manner.

Operation.—The operation of the complete system may be readily comprehended by consideration of the operation of a single unit in detail. Referring to Fig. 1, the various parts and circuits are shown in positions corresponding to what may be called the normal position of the switch SW. In this normal position, the green lamp G of the pot signal S is lighted by a circuit:—Starting at one terminal of the lighting transformer LT, wire 100, contact springs 101 and cooperating contact piece of the indication circuit controller IS, wire 102, lamp G, wire 103 back to the other terminal of said secondary.

The primary of the track transformer TT is supplied with current by a circuit controlled by the contacts of the indication circuit controller IS, this circuit being traced as follows:—Commencing at the energy main 90, wires 93, 104 and 105, contact springs 106 of the circuit controller IS, wire 107, primary of transformer TT, wire 108, contact fingers 109 and wires 110 and 111 to the other energy main 91. With the primary of the track transformer TT energized by this circuit just traced, the phase relation or instantaneous polarity of the currents flowing in the track phase field 89 and the line phase field 88 of the track relay T are such as to cause the contact fingers of said relay to assume the righthand extreme position indicated, this position being conveniently termed the normal position.

With the contact fingers of the track relay T in the normal position, and with the contact arm 59 of the lever in the normal position shown, the indicator *n* is lighted by a circuit

which may be traced as follows:—Commencing at the energy main 90, wires 112 and 113, indicator *n*, wire 114, contacts 115 of the lever, wire 116, contact finger 117 of the relay T normal, and wire 118 to the other energy main 91.

The pot signal S serves to inform train men near the switch that this switch is in the normal position. The indicator *n* in the tower serves to inform the operator or lever man that the particular switch corresponding thereto is in the normal position, and further that the detector track circuit associated with that switch is not occupied.

Assume now that the lever man desires to reverse the switch SW and put it in the reverse position to divert a car or number of cars on to the siding or turnout. Observing that the indicator *n* is lighted, the lever man knows that the detector track circuit of the switch SW is clear and that the switch may be properly thrown. To throw the switch, the lever man pulls out the bar or lever 55, first raising its outer end to free the notch 56. The contact arm 59 is thrown from the left-hand or normal position shown to the right-hand or reverse position with a snap action in the manner previously explained. Referring to Fig. 1, and imagining the contact arm 59 to be in the reverse position opposite to that shown, there is established a circuit for energizing the safety or control relay CR, provided the indicator track circuit is not occupied, which is the condition assumed to exist, this circuit being traced on the drawings as follows:—Commencing at the battery B, wires 120 and 121, high resistance winding 70 of the relay CR, wire 122, contact finger 123 of the track relay T normal, wires 124, 125 and 126, low resistance winding 71 of the relay CR, wire 127, contact spring 128 of the lever, contact arm 59 being now reversed, wires 129 and 130, contact springs 131 of the pole changer P, wire 132, armature A of the switch machine motor, wire 133, contact spring 134 and its cooperating contact piece, long contact spring 135 (assumed to be closed because no crank is in place in the switch machine), wire 136, field F of the motor and wires 137 and 138 back to the battery B.

It will be noted that this circuit includes the high resistance winding 70 and the low resistance winding 71 of the relay CR in series; and the resistances of these windings are so proportioned, with due regard to the voltage of the battery B, and resistance of the motor, such that there will not be sufficient current flowing in this circuit to start the motor but enough current to raise the core 72 (Fig. 5) and lift contact finger 73 of the relay CR into engagement with its cooperating front contact. When the front contact of the relay CR is closed, current from the battery B may then flow directly through wire 140, said front contact 73, wires 141 and 126, through the low resistance winding 71 of the relay CR direct to the motor M of the switch machine. In other words, closing of the front contact of the relay CR shunts out its high resistance winding and also the track relay contacts. By excluding the high resistance winding 70 of the relay CR from the motor circuit, the resistance is reduced so that sufficient current for operating the motor M is supplied. The motor M now rotates the pinion 15 through the friction clutch 17 in a direction to rock the gear sector GS counter-clockwise; and this movement of the gear sector GS causes reciprocation of the throw-bar TB in an obvious manner. Upon the first movement of the gear sector GS, and preferably as quick as mechanical clearances will permit, the lever 35 of the indication circuit controller is shifted to its intermediate or middle position, in which all contact springs of said circuit controller are disconnected or unbridged.

Referring now to Fig. 1 and assuming the movable contact carrier of the indication circuit controller IS to be in the middle or intermediate position, it will be noted that both of the lamps of the pot signal S are extinguished, thereby signifying that the switch is operating or in mid-stroke. Also, the supply of current to the track transformer TT is cut off by the opening of contact springs 106 and 109, whereupon contact fingers 117 and 123 of the track relay T assume the neutral or middle position due to the biasing force common in relays of this character. The dropping of the track relay T at this time breaks the circuit for the indicators *n* and *r* extinguishing both indicators and signifying to the operator in the tower that the switch is operating or is in mid-stroke. When the contact finger 123 assumes its neutral position, under the conditions considered, no effect is produced upon the operation of the switch machine, since the front contact 73 of the control relay CR is closed and current may be supplied to the motor of the switch machine independently of the dropping of the track relay, it being understood that the front contact 73 of the control relay is retained in its upper or closed position due to the flow of operating current for the motor through the low resistance winding 71.

Thus, as soon as the switch machine starts its operation, the indications of the pot signal S and the lever indicators *n* and *r* are extinguished, but the supply of current to the operating motor of the switch machine is maintained by the action of the control relay CR, irrespective of the dropping of the track relay T.

As the switch machine continues its operation, the spring 14 is compressed and after the gear sector has moved beyond its middle position, this spring tends to expand and force the throw-bar TB to the other extreme posi-

tion. At the appropriate point in the movement of the gear sector GS, say about three-fourths of its stroke, the lever 24 of the pole changer P is shifted to the other extreme position by the action of the cam slot 32, said lever 24 having been held in its normal extreme position shown in Fig. 2, independently of the cam slot, by the action of the spring 30.

When the contact carrier of the pole changer P is shifted to the opposite extreme position, the supply of current to the operating motor is interrupted at the contact springs 131 and 134–135. Current now ceases to flow through the low resistance winding 71 of the relay CR and the contact finger 73 drops by gravity to the lower open position. Although the operating current of the motor is cut off, the stroke of the switch is completed by the spring 14, so that eventually the contact carrier of the indication circuit controller is shifted from its middle position to the opposite extreme position. This results in closing energizing circuit for the red lamp R of the pot signal S as follows:—Commencing at the secondary of the transformer LT, wires 100 and 150, contact spring 152, wire 153, lamp R, and wire 103 back to said secondary.

Also the primary of the track transformer TT is again connected across the energy mains 90–91, but with its polarity reversed. This new or reverse energizing circuit of the primary of the track transformer TT may be traced as follows:—Commencing at the energy main 90, wires 93, 104 and 154, contact springs 155, wires 156 and 108, primary of transformer TT, wires 107 and 157, contact springs 158, and wires 159 and 111 back to the other energy main 91.

By comparing the circuit just traced with the circuit previously described for energizing track transformer TT under the normal conditions, it will be noted that the terminals of the primary of this transformer have been oppositely connected to the energy mains. For example, the energy main 90 is connected to the lefthand terminal of the primary of the transformer TT with the switch normal and to the righthand terminal with the switch reversed. This change in polarity or reversal of circuit connections results in reversing the phase relation of the currents in the field windings 88 and 89 of the track relay T, thereby causing its contact fingers to assume the other extreme or reverse position. Such reversal of the track relay T, remembering that the contact arm 59 of the lever is now in the reverse position, results in the energization of the reverse indicator *r* over a circuit that may be traced as follows:—Starting with the energy main 90, wires 112 and 160, indicator *r*, wire 161, contact springs 162, wire 163, contact finger 117 of the track relay T reversed, and wire 118 back to the other energy main 91. The lighting of the indicator *r* signifies that the switch has properly completed its operation in the reverse position and that the track circuit is not occupied. When the car or train for which the switch has been reversed enters the detector track circuit, the indicator lamp *r* then goes out, since the track relay T is de-energized; and in this way the lever man is advised that the car or train is taking the switch. When a car or cars have passed beyond the fouling point, track relay T is again energized and the indicator *r* lighted, whereupon the lever man knows that he may return the switch back to the normal position if he so desires.

In order to handle the cars expeditiously in the classification yards, it is important that the switches should be thrown quickly. It will be evident, however, that the switch points and their operating mechanism necessarily involve relatively heavy parts having considerable inertia; and consequently, when these parts are moved quickly, there is a dendency to produce severe shocks and jars at the extremes of movement. To avoid this, there is provided in accordance with this invention, a dynamic braking or snubbing which serves to slow down the movement of the parts of the switch machine at the end of the stroke and cause them to come to rest without objectionable shock and jar.

As previously explained, the operating current of the motor is cut off at some intermediate point before the throw-bar has reached its extreme position, the final movement of said throw bar and the completion of the stroke of the switch points being accomplished by the action of the spring 14. When the pole changer P is shifted to cut off operating current to the motor M, it is thrown from one extreme position to the other; and when in the other extreme position, the armature and field of the motor, with their connections reversed, are connected in a closed circuit of low resistance. On account of the reversal of the armature and field connections, the residual magnetism in the field and armature cores acts with the armature rotating, to generate dynamically a current in this closed circuit; but since the generation of this current requires power, it is obvious that the rotation of the armature is retarded or braked, this action being similar to that occurring in various systems of dynamic braking.

Assuming that the switch has just been thrown to the reverse position, as previously explained, with the lever in the reverse position and the contacts of the pole changer P shifted to the reverse position, opposite to that shown in Fig. 1, the dynamic or snubbing circuit may be readily traced as follows:—Commencing at, say, lefthand brush of the armature A, wires 133 and 142, contact

springs 143, wires 144 and 145, contact springs 146 of the lever, now in the reverse position, wires 147 and 137, field F of the motor, wire 136, long contact spring 135 and contact spring 148, wires 149 and 132 back to the other brush of the armature.

By comparison of the circuit just traced with the circuit over which current for operating switch machines flows, it will be observed that the connections between the armature A and the field F have been reversed. Explaining more in detail, with the contacts of the pole changer P in the normal position shown in Fig. 1, it will be noted that the lefthand brush of the armature A is connected to the lefthand terminal of the field F; whereas with the contacts of the pole changer P reversed, the righthand brush of the armature A is now the one connected to the lefthand terminal of the field F.

This dynamic braking not only serves to absorb the momentum of the rotating armature of the motor, and the gearing operated thereby, but also cushions the action of the spring 14, so that the throw-bar TB is brought to rest in its extreme positions without a severe shock. On account of the use of the spring 14 for completing the stroke of the switch points, it is possible to cut off the current of the motor M and begin dynamic braking some time before the throw-bar reaches its extreme position, and makes it possible to utilize to any desired extent the snubbing action of the motor to cushion the movement of the parts at the extreme positions.

As already stated, it is not possible to operate the switch while its detector track circuit is occupied, because under these conditions the track relay T is deenergized and cuts off the supply of current to the switch machine irrespective of the position of the lever. Although the switch machine is preferably made quick in its operation, taking perhaps a second and a half, it may happen, particularly in a busy yard, that after the operation of the switch machine has been initiated but before it has completed its stroke, a car may enter the detector track circuit and deenergize the track relay. Under these conditions, if these were no provision other than the track relay for the control of the supply of current to the switch machine, current would be instantly cut off and the switch might stop in an intermediate position. On account of the spring 14, however, it is very unlikely that the switch points will stop in a middle position, said spring acting to throw them one way or another, unless the throw-bar should happen to stop with the spring 14 acting on a line with the pin 8 and the pivotal axis of the sector GS. All possibility of stopping the switch points in mid-stroke is avoided, however, by the provision of the safety or control relay CR.

As previously explained, before the motor can start, the front contact of the relay CR must close; and when this has happened, operating current is maintained on the motor wholly irrespective of the operation of the track relay, and this current is maintained until the switch machine has completed its cycle of operation and the operating current is broken at the switch machine itself, whereupon the contact finger 73 of the relay CR drops. In short, by the incorporation of the safety relay CR in the system, it is assured that a cycle of operation of the switch machine, once started, will be completed in spite of the entrance of a car in the detector track circuit.

Another important feature of this invention relates to the provision made to permit switches to be trailed through, that is, run through by a car although not set in the proper position. For example, referring to Fig. 1, the switch S may be set in the normal position shown and a car move from the siding or turnout track on to the main track, it being evident that in so doing the car must force the switch points over. Referring to Fig. 2, it can be seen that the switch machine is so constructed that the switch may be trailed and the points forced over without injury to the mechanism. The throw-bar is not positively locked, as in some switch machines, but is merely held in its existing extreme position by the spring 14. Accordingly, when the switch is trailed, the throw-bar may be forced to the other extreme position by merely compressing the spring 14. Such movement of the throw-bar is, of course, accompanied by the forced movement of the gear sector, pinion 15, and armature of the motor; but if this movement is too abrupt for the armature of the motor to follow, injury to the parts is avoided by the slipping of the friction clutch 16.

In addition to permitting switch points to be forced over without injury when the switch is trailed, it is desirable to return the switch points automatically to their former position in correspondence with the control lever; but this should not be done until after the cars trailing the switch have all passed, otherwise there would be a reciprocation of the switch points, with resultant wear and tear, as each pair of wheels or truck passes over the switch points. All this is taken care of by the action of the track relay T by cutting off the supply of power to the switch machine, and by the fact that, whenever the switch machine has been forced into a position out of correspondence with the controlling lever, conditions are set up supplying current to the switch machine and restoring it to its former position in correspondence with the lever.

Explaining in detail, assume that the switch machine and lever are in the normal

position shown in Fig. 1. When the switch is trailed and the points forced over, the contacts of the pole changer P are shifted to the other extreme position. So long as a car is present on the detector track circuit, the track relay T is deenergized so that no current can be supplied to the switch machine. As soon as the car or train trailing the switch, however, has left the detector track circuit and the track relay T picks up, current is supplied to the motor M of the switch machine to restore the switch points back to their former normal position. Remembering that the lever is in the normal position shown, and that the contacts of the pole changer P are reversed, this operating circuit may be readily traced as follows:—Commencing at the battery B, wires 120 and 121, high resistance winding 70 of relay CR, wire 122, contact finger 123, track relay T reversed, wires 170, 125 and 126, low resistance winding 71, wires 127 and 171, contact fingers 172 of the lever now normal, wires 173 and 144, contact springs 143, pole changer contacts being reversed, wires 142 and 133, armature A, wires 132 and 149, contact springs 148 and 135, wire 136, field F, and wires 137 and 138 back to the battery B.

Thus, regardless of the length of the train trailing the switch, the switch points may be forced or thrown over without injury, held there until the train has entirely passed, and are then automatically returned to their former position in correspondence with the lever, assuming of course that the lever has not been changed in the meantime. Incidentally, the indications of the pot signal S are automatically changed as the switch is trailed; but since the track circuit is occupied and also because the switch is out of correspondence with the lever, neither of the indicator lights *n* or *r* is lighted.

Manual operation.—It is extremely important for classification yards that there should be no interruptions; and if there is any failure of power, or other trouble with any switch, it should be possible to operate that switch by hand. As previously explained, a switch machine of this invention includes provisions for its operation by a suitable hand crank or the like. However, before a hand crank can be inserted, the angle lever 41 (Fig. 2) must be shifted to allow the crank to be inserted, and in so doing the long contact finger 135 is lifted to break the common return connection to the battery B through the field F, thereby preventing current from reaching the switch machine in any manner. This safety device assures that the person manually cranking a machine will not be injured in case power should be unexpectedly applied to the switch machine for any reason, and also makes it certain that a switch machine once manually placed in a given position will remain there and will not be displaced until, by removal of the crank and re-positioning of the angle lever 41, the switch has been deliberately put back under power operation.

From the foregoing explanation, it can be seen that this invention provides a simple and efficient system for operating by power from a central control point any desired number of distant switches in a classification or hump yard. For simplicity of explanation and description, no attempt has been made to show or explain the various well known expedients of the art that might be used in practice in addition to and in conjunction with the particular devices hereinbefore described. For instance, various signals, in addition to the pot signals S, may be located throughout the yard and their indications controlled from the tower for the guidance of the engineers and the train crew. Such signals, and other expedients, may be applied to and used in connection with a system of this invention without modifying its functions or operation. Similarly, the particular devices and the circuit organization herein disclosed is susceptible of modification and adaptation in practice without altering the functions or scheme of operation. I desire to have it understood, therefore, that my invention is not limited to the particular embodiment shown and described, but embraces all equivalent means and various sub-combinations and re-organizations, coming within the scope of the appended claims.

What I claim is:—

1. In an interlocking system, the combination with a main track and a branch track of a switch whereby traffic may be directed to said branch track or directly ahead on said main track, and power operated means for operating said switch including a switch point operating bar having a transverse slot therein, a pivotally mounted gear sector and a pivotally and slidably mounted rod engaging said sector, means movable with said rod and said sector engaging said slot, and a spring engaging said rod, whereby said switch is biased toward either of its extreme positions.

2. In an interlocking system, the combination with a main and a branch track, a track switch whereby traffic may be directed to said branch track or directly ahead to said main track, and power operated means for operating said track switch to either the open or the closed position, said power operated means including a gear sector, for operating said track switch, a pivotally mounted rod engaging said gear sector and biased toward said gear sector for urging said gear sector in either of two extreme positions from an intermediate position, and means for indicating the position of said gear sector.

3. In an interlocking system, the combina-

tion with a main track and a siding, of a switch connecting said main track and siding, and power operated means for operating said switch which will allow said switch to be trailed by a train and if so trailed will complete the stroke of the switch to the trailed position and will hold it there, said last mentioned means also including means for returning the switch points to their previous position only effective if said train has passed completely off of said switch.

4. Means for operating switches for railroads comprising, a switch machine having a switch bar biased toward each extreme position from points on the corresponding side of its neutral position, a motor for operating said bar having an armature and a field winding, and means for connecting the field winding and the armature of said motor in a circuit of low resistance during a portion of the stroke of said bar for electro-dynamically braking said motor.

5. Means for operating switches for railways comprising, a switch machine having a switch bar biased toward each extreme position from points on the corresponding side of its neutral position, a motor for operating said bar, and a manually operable double-throw switch of the quick-acting snap type for controlling said motor, said manually operable double-throw switch being so constructed that it cannot be manually held in an intermediate position, in which power is cut off of said motor, thereby preventing the operator accidently leaving the switch machine in the neutral position.

6. Means for operating switches for railways comprising, a switch machine having a switch bar biased toward each extreme position from points on the corresponding side of its neutral position, a motor for operating said bar, and a quick acting manually operable double-throw switch for controlling said motor, said manually operable switch being constructed so that it can not be held in an intermediate position.

7. Traffic controlling apparatus for railways comprising, a track switch, a switch bar operatively connected to said track switch and biased toward one or the other extreme position from points on the corresponding side of the neutral position depending on whether it is on one or the other side of such neutral position, a motor for operating said bar in either direction, and a friction slip clutch between said motor and said bar for allowing relative movement between said motor and said bar for extreme forces existing therebetween, whereby said track switch may be operated by a train trailing the track switch without operation of said motor and whereby the bias of said switch bar maintains the track switch in the trailed position until again operated by said motor.

8. A switch system comprising, the usual main and branch track and a detector track circuit therefor, a three position indicating means controlled by said detector track circuit for giving an indication depending on the presence and the polarity of potential across the detector track circuit, a switch connecting said main track and branch track, a power operated switch machine for operating said switch, means for initiating operation of said switch machine only operative if said detector track circuit is unoccupied, and means for applying energy to said detector track circuit having a relative polarity depending on the position of said switch.

9. A switching system comprising, the usual main track and branch track and a detector track circuit therefor, a switch adapted to connect said main track and branch track, a switch machine for operating said switch constructed so that if said switch is thrown over beyond the intermediate position by a trailing train said switch will assume the extreme position, and means for initiating operation of said switch machine only operable if said detector track circuit is unoccupied, said switch machine being constructed so that it will only be operated to a position corresponding to that of a suitable manually controllable lever providing said track circuit is unoccupied, whereby if said switch is trailed by a train it will be thrown over and maintained in such position until the detector track circuit is again cleared, after which it will automatically be returned to a position corresponding to that of the control lever.

10. A switch machine comprising, a casing, a gear sector having an extending arm pivotally supported in said casing, means comprising a rod having one end slidably and pivotally supported in said casing and having the other end pivotally connected to said arm, a coiled compression spring on said rod for biasing said rod toward said gear sector, a switch bar operatively connected to said gear sector, and a motor operatively connected to said sector.

11. In a switch machine, the combination with a switch bar movable to two extreme positions for operating a railway track switch to two extreme positions, a motor for operating said switch bar, a normal circuit which if closed operates said motor in one direction, a reverse circuit which if closed operates said motor in the reverse direction, a double-throw switch which if in one extreme position closes said normal circuit and which if in the other extreme position closes said reverse circuit, spring actuated toggle means for holding said double-throw switch in the extreme position to which it was last operated, and means operated synchronously with said switch bar for operating said double-throw switch to one extreme position when the switch bar assumes one extreme position

and operating it to the other extreme position when the switch bar assumes the other extreme position, whereby said double-throw switch is firmly held into the proper extreme position during the main portion of the operating stroke when the switch bar is operated by the motor.

12. A switch machine system comprising, a suitable track layout including a switch, a track circuit associated with said track layout, a switch machine for controlling said switch from a distant tower, means for applying energy to said track circuit having a relative polarity depending on the position of said switch, and indicating means in said tower controlled by said track circuit for indicating the position of said switch and whether or not said track circuit is occupied.

13. Means for operating switches for railways comprising, a throw bar connected to the points of a track switch, an electric motor for operating said throw bar, compression spring means for biasing said throw bar toward each of its extreme positions from points on corresponding sides of its neutral position, and an electric switch, operated in accordance with the position of said throw bar and acting to de-energize said motor and to connect its windings in a circuit of low resistance after said throw bar has been moved past its neutral position, whereby the motion of said throw bar due to the action of said compression spring means may be gradually opposed and reduced.

14. In an interlocking system, in combination with a main track, a branch track, a track switch for directing traffic along the main track or to the branch track, a power operated means for operating the track switch including a motor, and a track relay, a double wound relay having a high resistance coil and a low resistance coil, and means for completing a motor circuit with the track relay contact and the high and low resistance coils of the double wound relay in series.

15. In an interlocking system, in combination with a main track, a branch track, a track switch for directing traffic along the main track or to the branch track, a power operated means for operating the track switch including a motor, and a track relay, a double wound relay having a high resistance coil and a low resistance coil, and means for completing a motor circuit with the track relay contact and the high and low resistance coils of the double wound relay in series, for picking up the contact finger of the double wound relay and thereby shunting the high resistance coil and track relay contact out of said circuit.

In testimony whereof I hereby affix my signature.

WINTHROP K. HOWE.