June 1, 1937. N. D. PRESTON, 2,082,462

TRAIN DISPATCHING SYSTEM FOR RAILROADS

Filed June 16, 1927 7 Sheets-Sheet 1

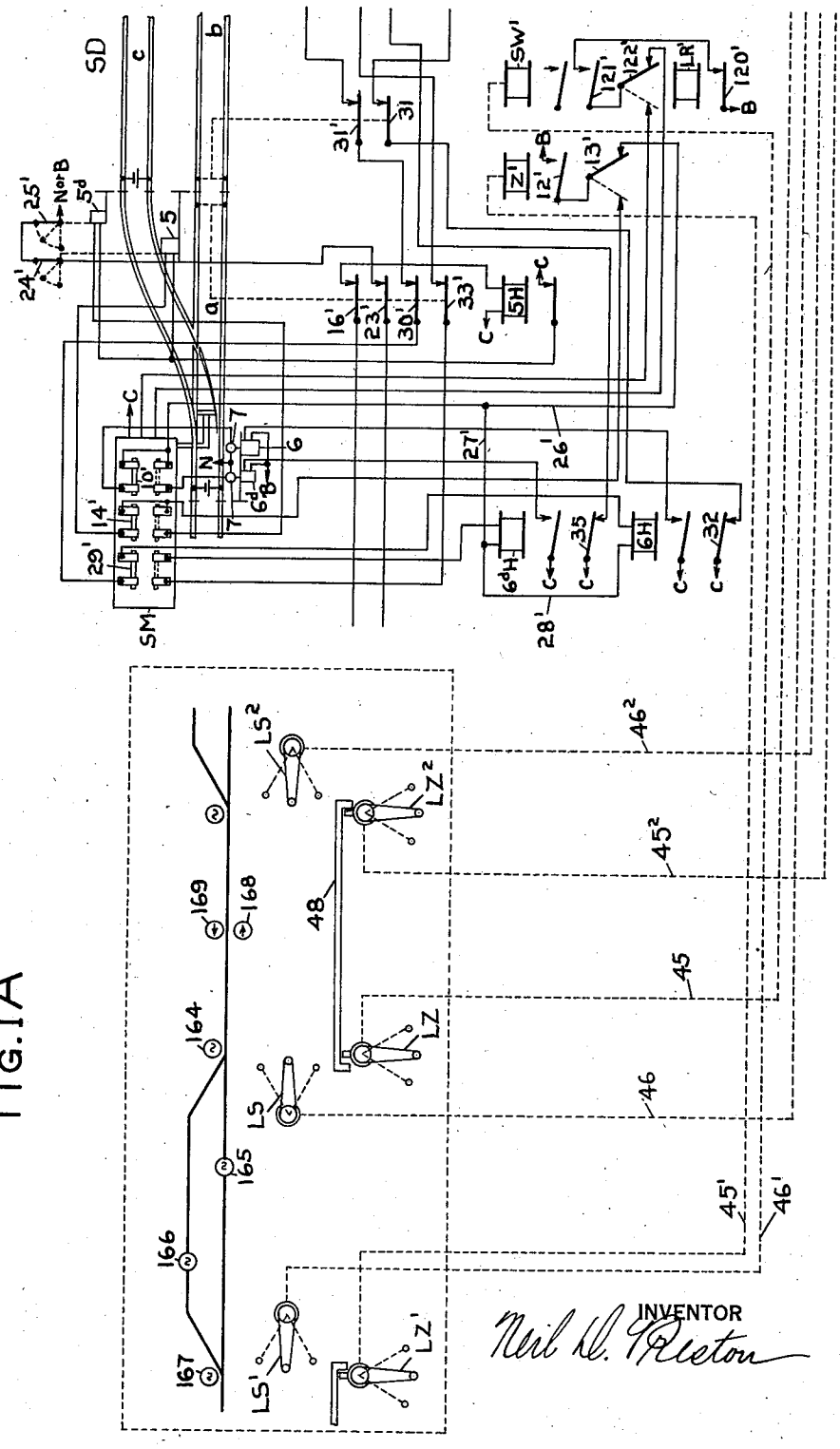


FIG. 1A

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TRAIN DISPATCHING SYSTEM FOR RAILROADS

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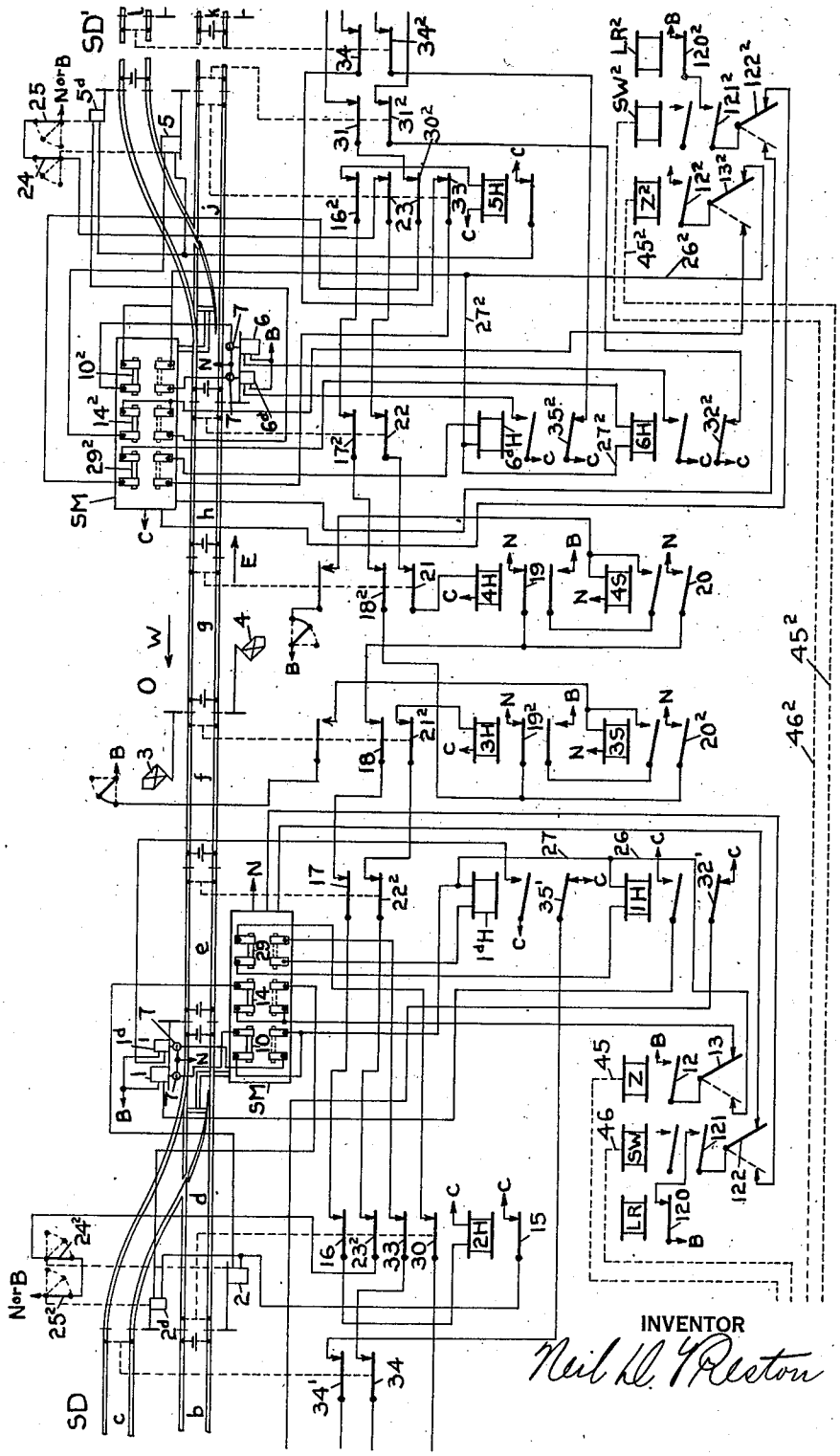


FIG. 1B

June 1, 1937. N. D. PRESTON 2,082,462

TRAIN DISPATCHING SYSTEM FOR RAILROADS

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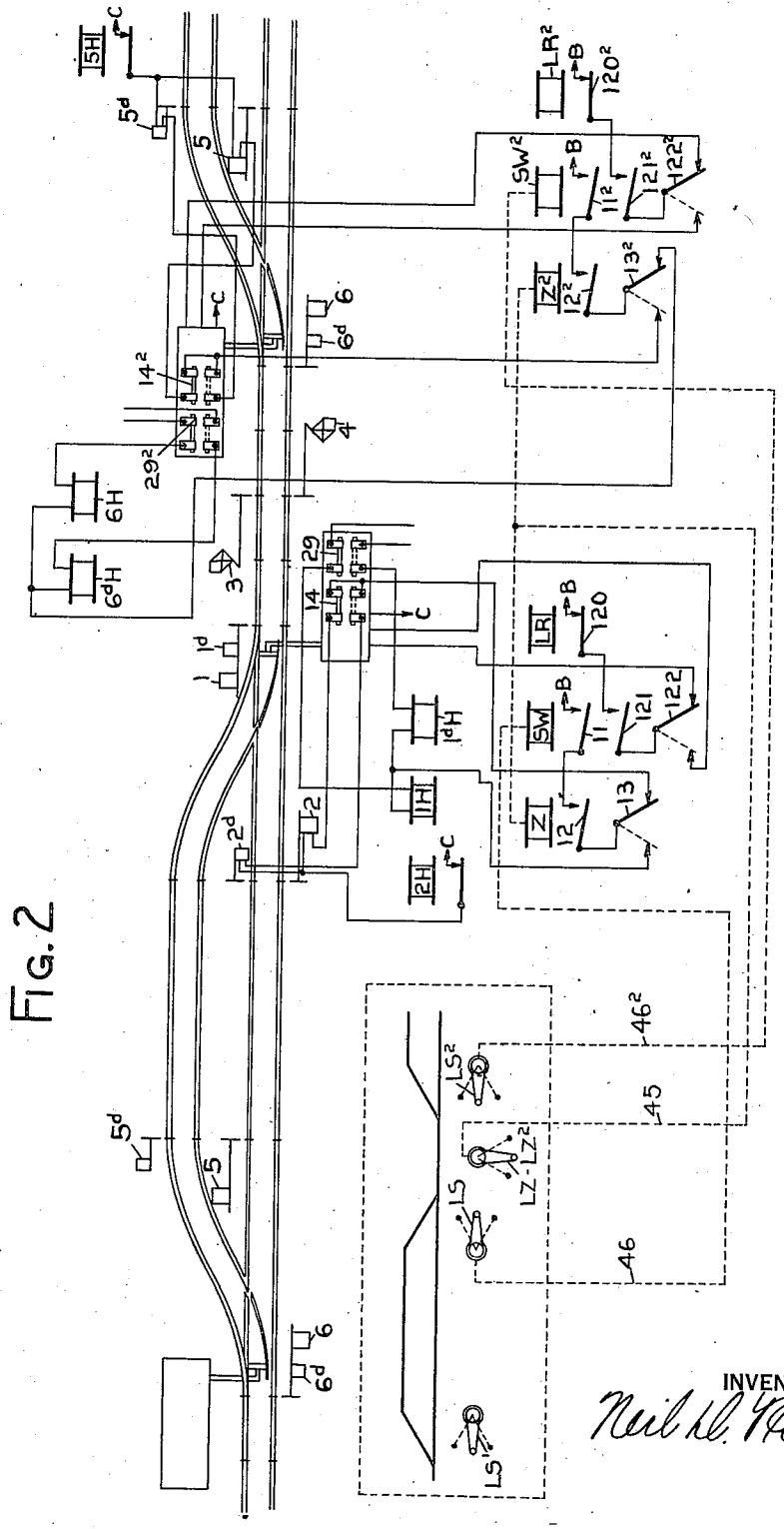


FIG. 2

INVENTOR

Neil D. Preston

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TRAIN DISPATCHING SYSTEM FOR RAILROADS

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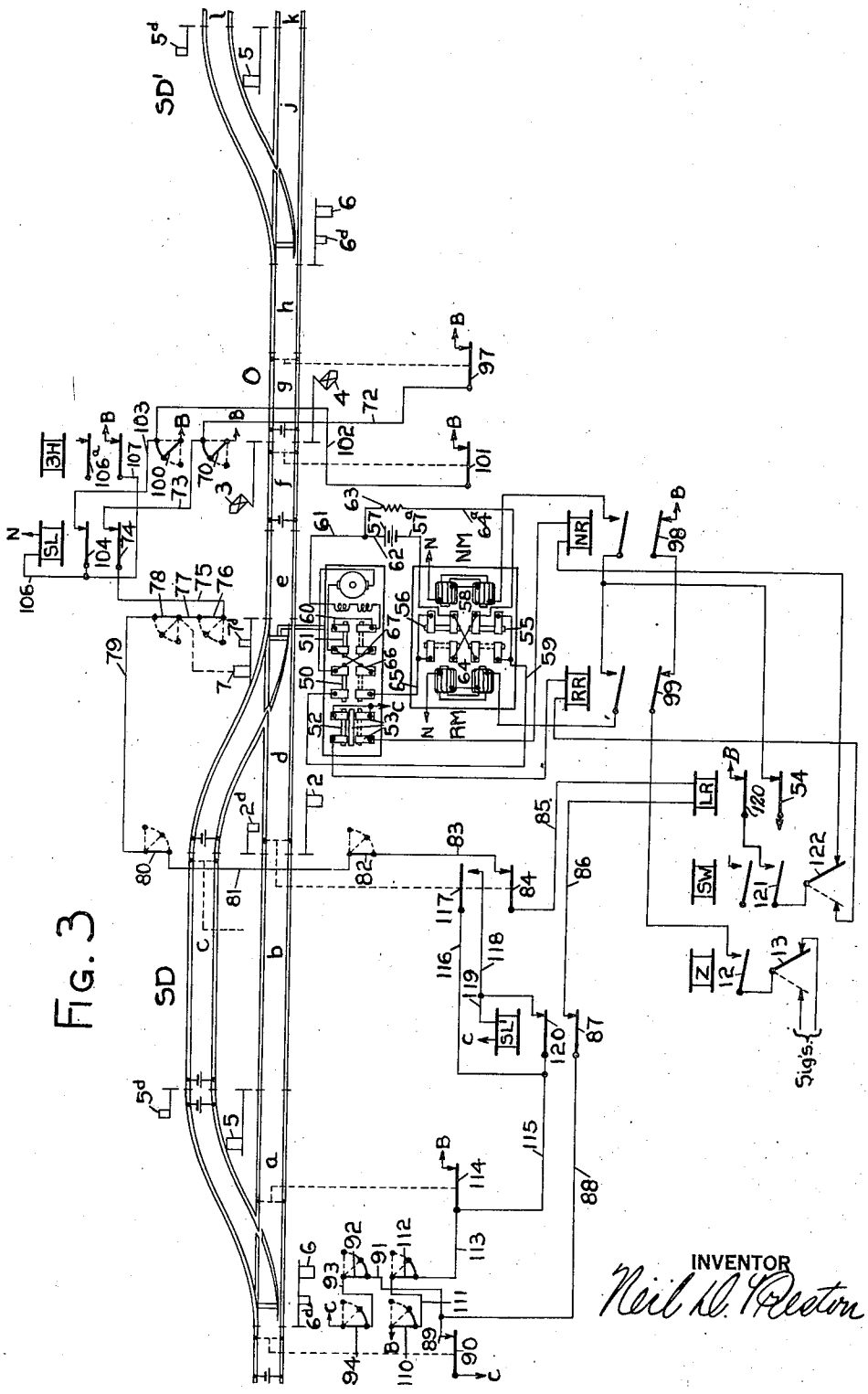


FIG. 3

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TRAIN DISPATCHING SYSTEM FOR RAILROADS

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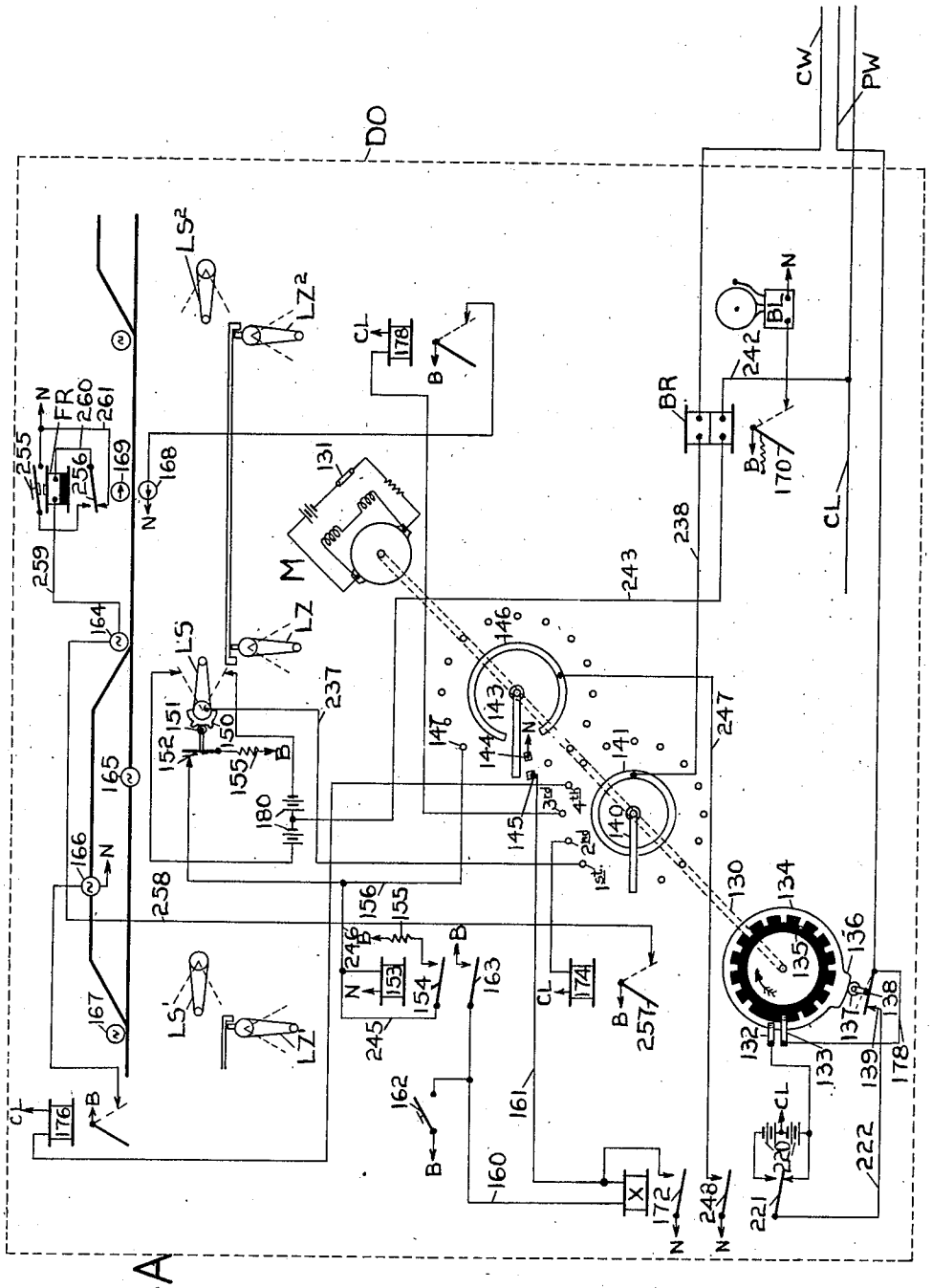


FIG. 4A

INVENTOR

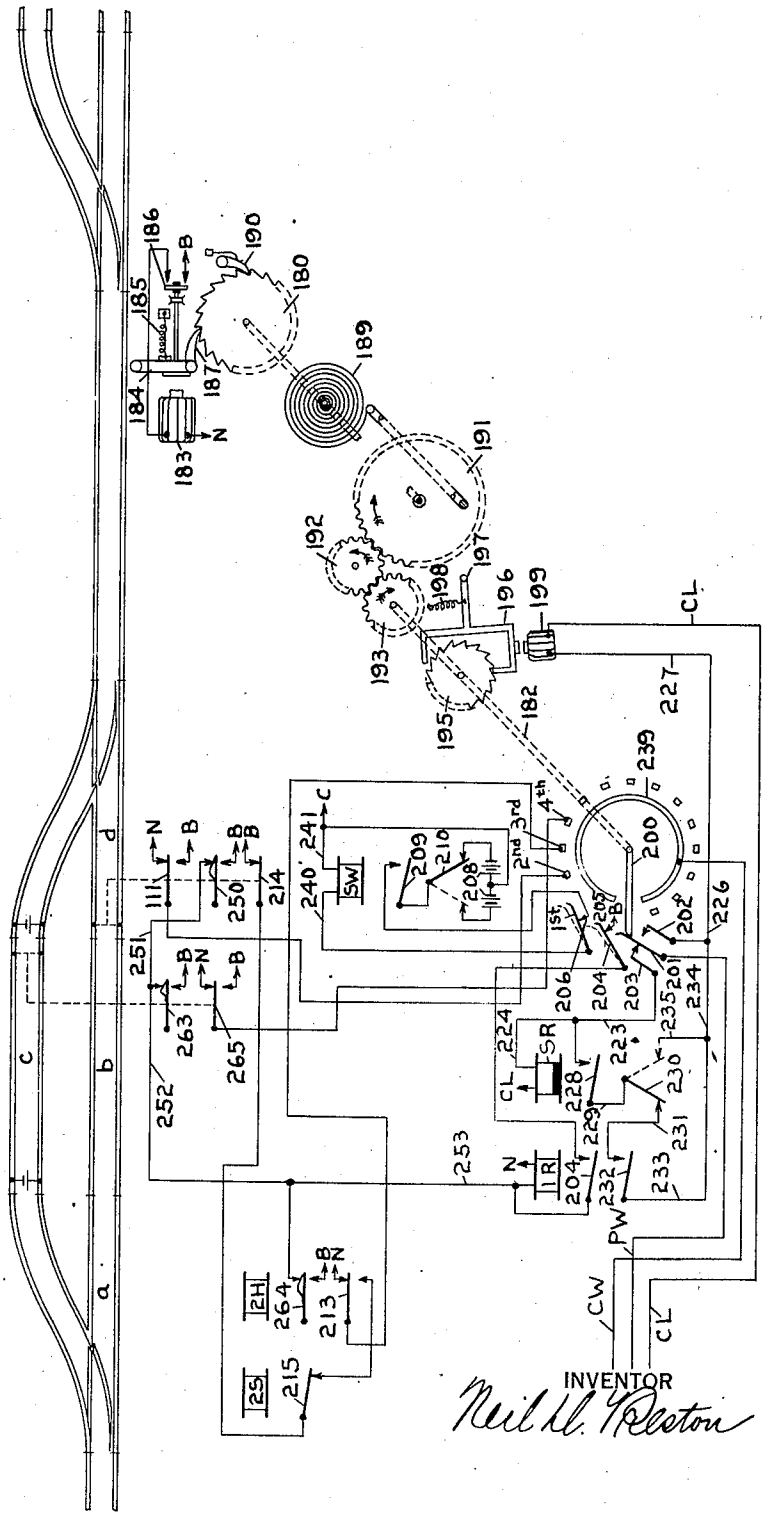
Neil D. Preston

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FIG. 4B



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TRAIN DISPATCHING SYSTEM FOR RAILROADS

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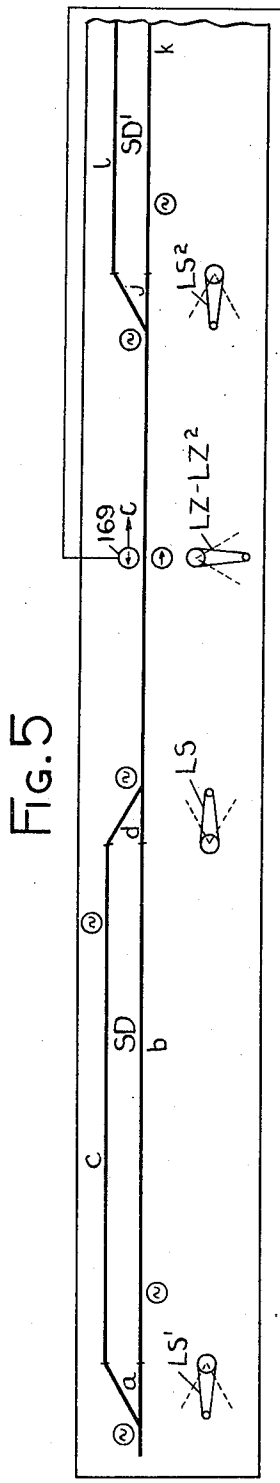


FIG. 5

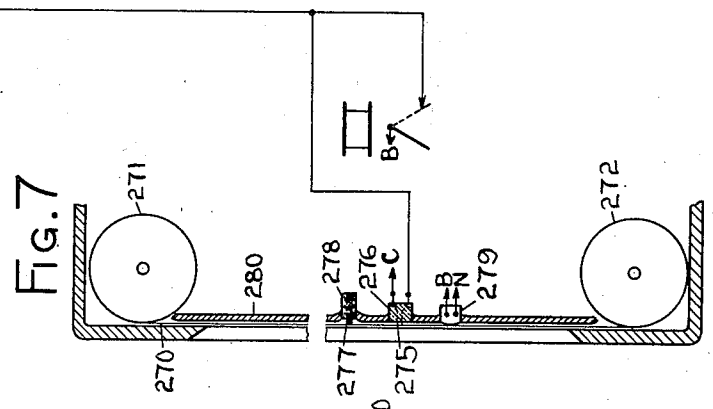


FIG. 7

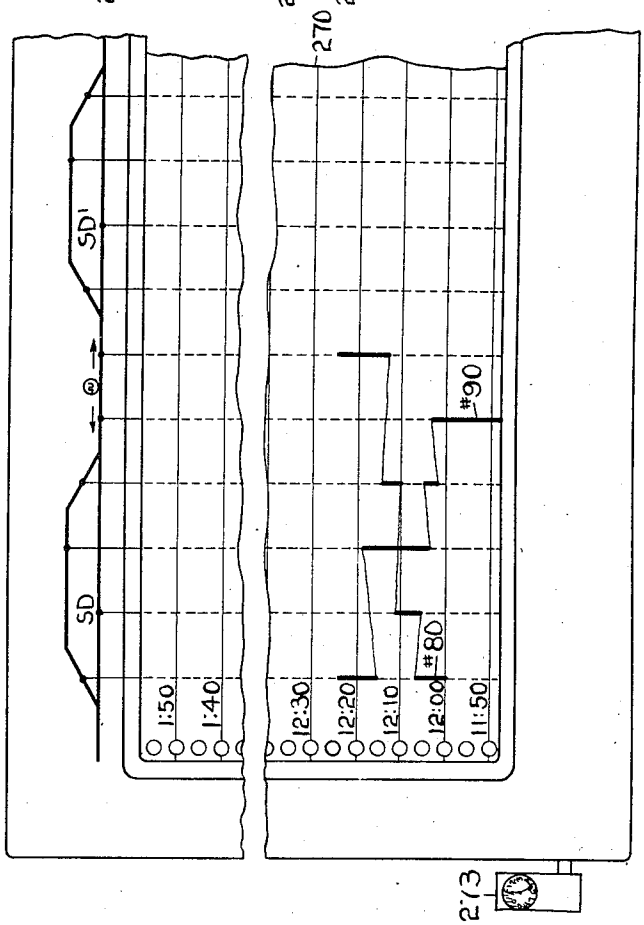


FIG. 6

INVENTOR

Neil D. Preston

Patented June 1, 1937

2,082,462

UNITED STATES PATENT OFFICE

2,082,462

TRAIN DISPATCHING SYSTEM FOR RAILROADS

Neil D. Preston, Rochester, N. Y., assignor to General Railway Signal Company, Rochester, N. Y.

Application June 16, 1927, Serial No. 199,325

83 Claims. (Cl. 246—3)

This invention relates to systems for dispatching trains on railroads by signal indications under the control of an operator or dispatcher at a central station.

One object of the invention is to provide for the control of the wayside signals of a single track railroad so that the direction of traffic is determined by the position of levers, or similar manually controlled devices, independently of the sequence in which these levers are operated, or how quickly they are operated one after another.

Another object is to provide a power-operated switch, under the control of the operator, with the necessary approach locking protection, which is controlled by levers or the like, separate from the levers determining the direction of traffic.

A further object of the invention is to provide the necessary control for the operation of the signals and switches by selectors, preferably of the synchronous type as distinguished from the code type, thereby economizing in line wire and facilitating the economical extension of the system.

A still further object is to provide means for indicating at all times at the central station the location of trains, and their direction of movement, synchronous type selectors being employed for this purpose in such a way that several indications of train location may be transmitted successively within such a limited time as to be substantially simultaneous.

The invention further contemplates an automatically operated recorder providing a graphic chart which constitutes a complete record of train operation, and which in conjunction with the track diagram indicating at any time the existing status of train location provides the necessary information to the operator to enable him to handle the traffic expeditiously. The chart thus automatically made is also arranged so that the operator may make various notations thereon, such as forecasts of meets, which will materially assist him in manipulating the system.

The indication of train location, or direction of movement, is preferably provided by an illuminated track diagram, which automatically changes as trains move. In connection with this track diagram, an audible signal is preferably provided to call attention to a change in train location; and there is also preferably provided means for enabling the operator to distinguish the particular lamp or indicator that has just responded.

In connection with the selector system for control of train indication, special means are provided so that the various selectors at the different way stations along the track are operating only when required to receive a control indication or transmit a change in the indication of train location.

Various other objects, characteristic features, and advantages of the system and its various modifications herein disclosed will be in part obvious, and in part pointed out as the description progresses.

Figs. 1A and 1B illustrate the essential circuits of an A. P. B. signaling system having superimposed thereon means for controlling the switch of such system and dispatch trains over such system by remote controlled wayside signals in accordance with the present invention, of which many of the novel features are shown conventionally herein and are shown specifically in the remaining figures of the drawings, and more particularly showing the control circuits of the system;

Fig. 2 shows modified control circuits for the system of Figs. 1A and 1B;

Fig. 3 shows the switch machine control and the approach locking circuits for the systems shown in Figs. 1A, 1B and 2.

Figs. 4A and 4B illustrate the control and indication selector system conventionally shown in the systems of Figs. 1A, 1B and 2.

Fig. 5 shows the miniature track layout and control board at the dispatcher's office, and

Figs. 6 and 7 show on a larger scale than Fig. 5 a portion of a recorder for recording entirely automatically the movement of all trains.

Signal control circuits

While various features of this invention are applicable to the control of switches and signals at isolated locations, either on single or double track, the invention has been shown applied to a single track railroad, which is to be equipped with some suitable form of block signaling system, preferably of the well known absolute-permissive-block type. Figs. 1A and 1B show in a simplified and diagrammatic manner one embodiment of the control circuits for the signals of an A. P. B. system as modified and adapted in accordance with this invention.

Referring to Figs. 1A and 1B, in which the portion of track shown comprises one siding SD, one end of another siding SD[1], and a stretch of single track O between these sidings. The track, including the siding, is provided with insulated track sections *a*, *b*, etc. in a manner

obvious to those skilled in the art. The track batteries have been shown, conventionally, and the track relays for these various track sections are indicated conventionally by dotted lines. The track sections *a*, *d*, and *j* are short detector track circuits at the ends of the sidings, the switch points being suitably cross-bonded in a well known way.

The signals, which may be of any suitable type, shown conventionally as of the semaphore type, for the siding SD and single track stretch O shown in Figs. 1A and 1B, are designated **1**, **1d** **2**, **2d**, **3**, **4**, **5**, **5d**, **6** and **6d**. The signals **6** and **6d** govern traffic in one direction (conveniently termed eastbound traffic as indicated by the arrow E) onto the main track opposite the siding, and into the siding, respectively. These signals **6** and **6d** are conveniently called entering signals. The signals **1** and **1d** are likewise entering signals for westbound traffic at the siding SD or SD1. The signals **5** and **5d**, conveniently termed starting signals, govern westbound traffic from the main track opposite the siding, and from the siding, respectively, into the single track stretch O. The signals **2** and **2d** are similar starting signals for eastbound traffic from the siding SD; and the signals **5** and **5d** are also starting signals for westbound traffic from the siding SD1. The stretch of single track O between the sidings SD and SD1 is preferably provided with one or more pairs of intermediate signals, arranged opposite or in staggered relation, in accordance with the well known practice in the A. P. B. system. Two intermediate signals **3** and **4** are shown. The intermediate signals **3** and **4** are permissive automatic block signals; but the starting signals, **2**, **2d**, **5** and **5d** are absolute stop-and-stay signals. When these absolute signals are at stop, they can not be passed except under special order and with suitable flagging protection in accordance with the rules. For reasons hereinafter explained, the entering signals, as **1**, **1d**, **6** and **6d**, are preferably provided with auxiliary arms or lights **7**, as shown, for the purpose of giving these signals either an absolute stop-and-stay indication, or a permissive stop indication, under the control of the operator.

In order to simplify the drawings, the control circuits are shown only for the clear and stop indications of the signals; but it should be understood that three-position signals, or their home and distant equivalent, are employed in practice, the caution indication or distant signal being controlled in the well known way by additional line circuits or a polarized line circuit.

The switches are preferably power-operated by an electric switch machine, shown conventionally at SM in Figs. 1A and 1B. Each switch is provided with contacts, either as a separate switch circuit controller, or as a part of the switch machine, which are closed when the switch is in a corresponding extreme position and locked. These switch controller contacts are shown conventionally at **10**, **14** and **29**.

At each end of each siding is a signal control relay Z, operatively connected in some suitable way, indicated conventionally by dash lines **45**, as by a line circuit or a system of selectors, as hereinafter described, to a lever LZ, or a corresponding manually operable control device, located in the dispatcher's office at the central control point. At each end of each siding is also a switch control relay SW, similarly connected by dotted line **46** to a lever LS. These relays and levers for the other siding ends shown in Figs. 1A and 1B are connected by suitable means conventionally shown by similar dotted lines and are given the same reference characters with distinctive exponents. The signal control levers for the opposite ends of each single track section between sidings, as the levers LZ and LZ2, are preferably provided with a mechanical interlock, so that they can not be simultaneously shifted to extreme positions to set up conflicting directions of traffic for the single track stretch. As shown, these levers LZ, LZ2 which are movable to the right or to the left from the middle position shown, are provided with extensions cooperating with a sliding bar **48** with stops thereon in such a way that these levers can not be moved towards each other at the same time. If the lever LZ is shifted to the right, for example, the lever LZ2 can not be shifted to the left. The switch control levers LS and LS2 are preferably arranged to move up and down between two extreme positions corresponding to the switch points normal or reverse.

The control for the corresponding signals of the various passing sidings are identical and therefore have been given like reference characters. The control for signals **1** and **1d** is the same as that of signals **6** and **6d**, except an opposite direction of traffic is involved. Similarly, the control circuits for the pairs of starting signals **2**—**2d**, and **5**—**5d** are substantially the same. Consequently, an explanation of the control of the entering signals **6** and **6d** and the starting signals **2** and **2d** is enough to make clear the complete organization of circuits.

In order to avoid complication of the drawings by necessary circuit wires some of the circuits have been shown terminating at the end of a source of current or a mid-point of such source. In the particular arrangement shown direct current is to be used, although alternating current can be used if desired, and the positive side of the source or battery is designated B, the negative terminal is designated N and the mid-point, if such is used or the terminal connected to common wire is designated C.

Referring first to the starting signals **2** and **2d**, their control circuits as shown in the simplified diagram may be readily traced from the positive B of the battery, through the neutral armature **12** of signal control relay Z, polar armature **13** to the right or left, through the switch circuit controller contacts **14** normal or reverse, through the mechanism signals **2** or **2d**, and through the front contact **15** of the line relay 2H, to negative battery marked C.

The line circuit for this line relay 2H (starting at common C) includes the front contact **16** of the detector track section *d*, front contacts **17** and **18** of the track sections *e* and *f* intervening between the signals **2** and the next eastbound intermediate signal **4**, and through a front contact **19** of the relay 4H controlling said signal **4**, in multiple with the front contact **20** of the directional stick relay 4S at said signal **4**, to negative battery N. This directional stick relay 4S is characteristic of the A. P. B. system, such as is disclosed, for example, in the U. S. patent to S. N. Wight No. 1,294,736, dated Feb. 18, 1919, and is picked up only by an eastbound train traveling past the signal **4**, and is stuck up so long as the relay 4H is de-energized.

The line circuit for the relay 4H includes the front contacts **21**, **22** and **23** of the track relays for sections *g*, *h* and *j*, and circuit controllers **24** and **25** on the opposing starting signals **5** and

5d closed only if these signals are at stop to a battery, and in the event the caution control is added to N or B depending on the indicating condition of signals 6 and 6d.

Since the control circuits for the home or line relays 5H and 3H are exactly the same as those of the line relays 2H and 4H, respectively, just traced except that they extend in the opposite direction in the single track stretch like parts thereof are given like reference characters with a distinctive exponent two.

Referring now to the control of the entering signals 6 and 6d, these signals are controlled respectively by relays 6H and 6dH. The energizing circuit for the relay 6H may be traced as follows:—commencing at positive terminal B of a battery, through the neutral contact 121 of the relay Z1, its polar armature 131 to the right, wires 261, 271 and 281, relay 6H, switch circuit controller contact 291 closed in the normal position of the switch, through the front contacts 301 and 311 of the track relays for the detector track circuit *a*, and the track circuit *b* in the main track opposite the siding, and through a back contact 321 of the relay 1H controlling the opposing signal 1 to C. The energizing circuit for the relay 6dH is much the same, passing through switch circuit controller contact 291 closed in the reverse position of the switch, a front contact 331 of the track relay for the detector track circuit *a*, front contact 341 of the siding track circuit *c*, and back contact 351 of the relay 1dH controlling the opposing take-siding signal 1d to C. The circuits for the relays 1 and 1d are exactly the same as those just traced except governed by the opposite direction of traffic and therefore like parts have been given like reference characters with the exponent one omitted.

The manner in which the signals 1, 1d, 6 and 6d are controlled by relays 1H, 1dH, 6H and 6dH is obvious from the circuits shown in the drawings.

From a consideration of these circuits, it can be seen that the signal control lever LZ, for example, in one operated position (to the right in the arrangement shown) tends to clear the eastbound starting signals 2 and 2d, one or the other of these signals clearing, depending upon the position of the switch, providing the opposing starting signals 5 and 5d are at stop, that there is no opposing westbound train in the stretch of single track, and no eastbound train between signal 2 and the signal 4. In short, the lever LZ, when moved to the right, will set up eastbound traffic (to the right) from the east end of the siding SD to the entering signals 6 and 6d at the west end of the siding SD1, that is, over the stretch of single track O. For westbound traffic over this stretch of single track O, the other lever LZ2 is moved to the left. The mechanical interlock between the levers LZ and LZ2 prevents moving them accidentally to the right and left respectively at the same time, which would tend to allow eastbound and westbound trains to enter the same stretch of single track. On account of the electrical interlock between the opposing starting signals 2—2d and 5—5d through the contacts 24 and 25, however, conflicting signal indications could not be given in spite of the omission of the mechanical interlock, the direction of traffic set up in the event of failure or omission of a mechanical interlock being that corresponding to the lever first moved and first effective through the line relays and their control circuits in holding the opposing starting signals at stop.

If the signal control lever LZ is moved to the left, westbound traffic for the siding and main track opposite the siding is set up, and the signal 1 or 1d may clear, depending upon the position of the switch, providing the corresponding track section *b* or *c* is not then occupied, and further providing that the corresponding opposing signal 6 or 6d is in the stop position. Eastbound traffic through the siding is controlled by moving the signal control lever LZ1 to the right.

Since the electrical interlock is between the upper arms 1 and 6 and between the lower arms 1d and 6d, trains traveling in opposite directions may be allowed to enter respectively either the siding or the main track opposite the siding; but the two signals 1 and 6, and likewise 1d and 6d, governing traffic in opposite directions into the same pieces of track can not be cleared simultaneously, thereby affording ample protection for opposing train movements both into the siding and into the main track opposite the siding, without the use of an overlap.

Occasionally in practice it may be desirable to allow two trains, particularly one train and a light engine, traveling either in the same direction or in opposite directions, to enter the same piece of track either on the siding, or on the main track opposite the siding; and to enable this to be done with a high degree of protection, the entering signals 1, 1d, 6 and 6d are preferably provided with auxiliary permissive indications. Referring to the signals 1 and 1d, for each signal there is an additional indicating means, such as a lamp, call-on arm, or the like, which may be energized to give a permissive aspect to the corresponding signal when the relay Z is energized by the operator, and the switch points are in the corresponding position and locked.

Considering the permissive aspect signal 7 of the signal 1 for instance, this lamp is energized through contact 13, swung to the left, of the relay Z, and the contact 10 of the switch machine when in its normal position, and therefore is lighted to indicate permissive proceed in the event there is a train directly ahead on the main track of the passing siding holding the signal 1 at stop when such signal 1 is otherwise in a condition to clear, namely, with the relay Z and the corresponding track switch in the main track position.

By virtue of this arrangement the operator can, if he wishes, permit two trains to enter the same portion of track, under the restrictions characteristic of a permissive stop indication, provided the switch points are safe. For example, assuming the operator wishes to put a westbound train, followed by a light engine, on the siding SD, he operates the lever LS to set the switch in the reverse position for the siding, then shifts the signal control lever LZ to the left, energizing the relay Z, and permitting the lower arm signal 1d to clear. After this train arrives and enters the siding, it of course holds the signal 1d at stop; but since the operator maintains his lever LZ shifted to the left and the relay Z energized, the signal 1d is given a permissive aspect by the lighting of its call on signal lamp 7 the energizing circuit of which is readily traced, permitting the following light engine to pass on the siding, knowing that the switch points may be safely run over and that the signal is held at stop because of a train ahead or other obstruction. The following light engine, of course, proceeds at low speed prepared to stop short of any obstruction. It will be evident that the operator

can permit two trains to follow one another into the stretch of main track opposite the siding in the same way. Likewise, he can permit two trains, traveling in opposite directions, to enter either the stretch of main track opposite the siding, or move on the siding. In such a case, the operator would preferably keep both entering signals at stop, and issue his instructions to the first train arriving and calling up over the telephone (which in practice would be installed at each siding end), in order that the first train arriving may leave room for the second. Also, if desired, the rules may provide that the permissive indications of the entering signals shall not be accepted without specific information from the operator over the telephone.

Modified signal control circuits

Fig. 2 illustrates how the signal control circuits of Figs. 1A and 1B may be governed by relays Z and SW, controlled by the operator, in a different way. In this modified arrangement, there is one lever, designated LZ—LZ² for controlling the direction of traffic over the single track stretch O. The switch control lever LS has a neutral or intermediate position, as well as two extreme positions. The relays Z and Z² at the opposite ends of the stretch of single track are operated simultaneously with the same polarity, by being connected to the same control circuit from the tower, or to like points on the controlling selectors, or by any other suitable arrangement. Thus, when the operator throws the signal control lever LZ—LZ² to the right, to set up eastbound traffic, both the relays Z and Z² are operated to move their polar armatures to the right, tending to clear signals **2** and **2**ᵈ, and signals **6** and **6**ᵈ. In other words, the operator selects the direction of traffic from one end of the passing siding through the adjacent single track stretch, and through the next adjacent siding, up to the leaving signals for that adjacent siding. With a given direction of traffic through the siding set up, the train takes either the siding or the main track depending on the position of the switch. The clearing of the starting and entering signals at each end of each siding, however, is dependent upon the energization of the corresponding switch relay SW, as well as the relay Z, the neutral armature **12** of the relay Z being connected to battery through a front neutral contact **11** of the neutral polar relay SW. Consequently, the operator, by manipulation of the switch lever LS, is able to hold one train, while letting another proceed, or perform various other movements to take care of the different conditions that may occur in practice. In other words the relays Z and Z² in this embodiment primarily determine the direction of traffic for the single track section O, although they may also be used to stop traffic, whereas the switch machine relays may be used to hold the signals at one end of said section at stop without interfering with the movement of traffic at the other end of such section.

Switch control and approach locking

Fig. 3 illustrates the preferred arrangement of control circuits for the switch machine and approach locking. Although the switch machine control circuit and the approach locking control mechanism associated therewith for the switch at the east end of siding SD only has been shown, it is deemed that this is sufficient since all switch machines are controlled in the same way and the approach locking relay circuits are the same considering their relation to the passing siding. The switch is operated to the normal or reverse position by energizing the relay SW with one polarity or another. It is contemplated that the switch operating mechanism will be of the electric motor type, such as disclosed for example in the U. S. patent to W. K. Howe, No. 1,288,897 dated Dec. 24, 1918. This machine includes contacts **50** and **51** shifted from one extreme position (normal as shown) to the other extreme position, if the switch machine has completed its cycle of operation and the points are locked. Another pair of contacts **52** and **53** are alternately closed when the switch machine is in the full normal or full reverse condition and are both closed while the switch is in midstroke. Magnets NM and RM electrically operate contacts to either of two extreme positions; and these magnets are energized over circuits controlled by relays NR and RR in series with a front contact **54** of an approach locking relay LR.

Assuming the switch to be in the normal position as shown, when the operator energizes the relay SW with current of opposite polarity the relay RR is energized, through a circuit readily traced on the drawings and including the contact **52** closed with the switch machine in the normal position. Assuming there is no approaching train and the approach locking relay LR is energized and its front contact **54** is closed, then the reverse operating magnet RM is energized, shifting the contacts **55** and **56** and closing a reverse operating circuit for the motor from battery **57** through wires **57**ᵃ and **58**, contact **55** (shifted to dotted position), wire **59**, contact **50**, motor armature, contact **51** normal, wire **60**, motor field and wires **61** and **62** back to the battery.

When the switch machine starts operating, it shifts contacts **52** and **53** to the middle position; and when the switch machine completes its operation, the contacts **50** and **51** are shifted to the reverse dotted position, thus closing a snubbing circuit through the resistance **63**, including the motor armature and field reversely connected. This snubbing circuit comprises the following:— resistance **63**, wire **64**, contact **56** reversed, wire **65**, contact **50** reversed, wire **66**, armature, wire **67**, contact **51** reversed, field winding, and wire **61** back to resistance **63**.

While the switch is in mid-stroke, both pairs of contacts **52** and **53** are closed, permitting energization of either relay NR or RR (assuming the approach locking relay LR to be energized), so that the switch machine may be reversed in mid-stroke by the operator. Such reversibility in mid-stroke is desirable because it sometimes permits the switch to be thrown by repeated operations when it could not otherwise be thrown on account of snow, lumps of coal, or other obstructions in the points.

Referring now to the approach locking protection, current can not be applied to either of the operating magnets NM or RM to cause operation of the switch from its then existing position, unless the approach locking relay LR is energized. If desired, the approached locking relay LR, if de-energized, may be used to cut off the switch machine battery, or short-circuit the armature and field of the motor, or the like, as additional protection.

The energizing or control circuit for the approach locking relay LR may be traced as follows:— Commencing at B, (near signal **3**) through circuit controller contact **70** on said signal **3** closed between zero and 45 degrees, in multiple

with wire 72 and the front contact 97 of the relay of the track section *g* next in the rear of signal 3, wire 73, front contact 74 of the stick relay SL, wire 75, circuit controller contact 76 on signal 1d closed in the zero degree position, wire 77, circuit controller 78 on signal 1 closed only in the zero degree position, wire 79, circuit controller 80 of signal 2d closed in the zero degree position, wire 81, circuit controller 82 on the signal 2 closed in the zero degree position, wire 83, front contact 84, of track relay of detector track section *d*, wire 85, relay LR, wire 86, front contact 87 of stick relay SL1, wire 88, and then either through wire 89 and front contact 90 of the track relay of track section next in rear of signals 6 and 6d, or along wire 91 through circuit controller 92 on signal 6 closed from zero to 45 degrees, wire 93, through a similar circuit controller 94 of the signal 6d, to common wire C.

It will be observed that the relay LR is de-energized if the detector track section *d* is occupied; and hence the switch can not be thrown under the train. Also, the relay LR is not energized unless all of the signals at the switch 1, 1d, 2 and 2d are in the stop position, blocking train movement in either direction over the switch. The other control for the relay LR is intended to de-energize the relay LR and prevent operation of the switch in case there is a train approaching the switch under a proceed indication. If the train is approaching the switch under a caution indication, it will be slowing down and will be brought to a stop at the signals 1, 1d, 2 and 2d. In other words, if a train, approaching the switch from either direction, has received and accepted a signal indication permitting it to approach the switch at speed and pass over it, then the relay LR is de-energized and the switch can not be operated.

Referring to the control circuit for the relay LR at the signal 3, if this signal 3 is in the 90 degree or clear position, the energization of the relay LR depends for its current upon the front contact 97 of the track relay of the section *g* next in the rear of said signal 3, so that when a west-bound train enters the track section *g*, with the signal 3 in the clear position, the relay LR is de-energized. This, of course, means that the signals 1 and 1d indicate caution or proceed.

Whenever the operator energizes the switch control relay SW in a direction to operate the switch from its then existing position, the resultant energization of either of the relays NR or RR interrupts at their back contacts 98 or 99 the circuits for clearing the signals 1, 1d, 2 and 2d, so that these signals assume the stop position.

If the signal 3 reaches its 45 degree or caution position, and the signal circuit controller 70 is closed before a west-bound approaching train passes it, then the relay LR is energized, notwithstanding the opening of the front contact 97 of the track relay of section *g*, because with the signal 3 at caution, the current controller 70 is closed and shunts the front contact 97.

If, however, the train passes the signal 3, while in its clear position, the opening of the front contact 101 of the track relay for section *f* breaks the stick circuit for the stick relay SL, which may be traced as follows:—terminal battery B through front contact 101 of track relay for section *f*, wires 102 and 103, contact 104 of relay SL, wire 105, relay SL to the other side N of the battery. The pick-up circuit for the relay SL from terminal B through the front contact 106a of the signal relay 3H and wires 107 and 106 is also broken when the train passes the signal 3, since the energizing circuit for the relay 3H includes a front contact of the track relay for section *f* (see Fig. 1B). If signal 3 is in the caution position when the westbound train in question passes it, and opens the front contact 101 of track relay for section *f*, the stick relay SL is maintained energized through the circuit controller 100 on the signal 3 closed from zero to 45 degrees. The stick relay SL, when once de-energized by a westbound train passing the signal 3 in the clear position, is automatically again energized by its pick-up circuit if that train has advanced beyond the signals 1 and 1d and out of the detector track section *d*, so that the relay 3H may pick up.

In the same way the stick relay SL affords approach locking protection for a west bound train approaching the switch under consideration when such train accepts the signal 3 in the rear at proceed, the stick relay SL1 affords such protection for east bound trains. The problem for east bound trains is, however, more difficult, because of the additional signals and possible train movements involved. The pick-up circuit for the relay SL1 may be traced as follows:—From either B, signal contact 110 closed when the signal 6d is in the caution or stop position, wire 111, signal contact 112 closed when the signal 6 is in the caution or stop position, wire 113, or B, contact 114 of the relay of detector track circuit *a*, then along wires 115 and 116, back contact 117 of detector track relay of section *d*, wires 118 and 119, through winding of relay SL1 to C. The stick circuit for this relay is exactly the same as the pick up circuit just traced except that the stick contact 120 is substituted for the relay contact 117.

From the consideration of these circuits it is noted that a through east bound train accepting either the signal 6 or 6d at clear, the relay SL1 is de-energized, irrespective of whether such train moves over the main track or the siding, and that such train restores relay SL1 to its normal condition when it passes over detector track section *d*. Dropping of the relay SL1 in response to a train accepting signal 6 or 6d at clear is assured in the same way as is dropping of relay SL under similar conditions.

The arrangement shown is thus one which prevents switch machine operation when trains are approaching the switch in either direction in response to a clear indication of a distant signal, but does not cause such locking for departing trains or for approaching trains accepting the distant signals at caution or stop. Also, if there is a train standing on the detector track circuit (such as *d*) at such switch, the switch machine control apparatus is such that, if the switch machine has once been started and lock relay LR is immediately thereafter de-energized for any reason, this will not prevent the completion of the operating stroke, although both magnets RM and NM are de-energized, by opening of contact 54, since the contacts 55 and 56 operated by said magnets remain where put.

Since there may be times when, on account of peculiar train movements, derangements of circuits, or some other reason, the approach locking is effective when the switch should be thrown, or for any other reason the switch machine can not be operated as desired, I prefer to use with the switch a dual selector with a hand-throw

mechanism, such as disclosed, for example, in the application of W. K. Howe, Ser. No. 160,679, filed Jan. 12, 1927.

One characteristic feature of this scheme of approach locking is that the indications of the signals accepted by a train approaching the switch determine whether or not the approach locking shall be effective, rather than the presence of a train within certain approach locking limits. In this connection, the front contacts **90** and **97** of the track relays for the track sections next in the rear of the signals **3** and **6**—**6**[d] may be omitted, if it is desired to rely on the circuit controllers on these signals. The circuit controllers corresponding to **70** and **100** of signal **3** should be made slow-acting, if light signals are used, so as assure that the relay LR will not be energized in case a train passes the signals **3** and **6**—**6**[d] just at the time their indication is being changed to caution.

Selector system

The electrical intercontrol between the central station of the operator or dispatcher and the various sidings has to provide for selective energization of the signal control relays Z and the switch machine relays SW at the several sidings, and also has to provide for the transmission of a sufficient number of indications of train movement to enable the dispatcher to know enough about the location and direction of movements of trains to operate the switches and permit clearing of the signals. The various relays Z and SW may be controlled through a suitable selector system of the usual code type, the transmission of a particular code over a pair of wires acting through a code responsive selector to energize a particular Z relay with one polarity of current, another code with another polarity of current, and another code to de-energize that relay, and so on. With the code type of selector, however, each controlling function must be performed separately by a distinctive code, and enough time must elapse between the transmission of each code to avoid improper operation. While the operator may be relied upon to avoid confusion of codes by attempting to operate the relays Z and SW too quickly one after another, or automatic means may be employed to assure absolute segregation of code impulses, it is preferred to use a code transmission system of what is conventionally termed the "synchronous type," in which a single line circuit is used successively at frequent intervals to establish a segregated control circuit between the central station and each relay or other device to be controlled in turn.

The indications of train location, that is, repeating in the central station or dispatcher's office the de-energization of detector track relays, or the track relays of other track sections, can not be readily handled by selectors of the usual code type, since two or more track relays may be operated at exactly the same time and confusion of the code impulses results. The synchronous type of code system, however, permits the transmission of indications from the different track sections in succession so quickly one after another that the indications from the several track sections are sufficiently simultaneous for the purposes of dispatching trains.

While the code system for transmission of relay control and for the transmission of train indications may be carried over separate line wires, and with different types of selectors, with certain advantages, economy of apparatus and line wire makes it desirable to handle both control and train indication with the same selector, so that the apparatus is adaptable for both control and train indication functions. A preferred form of this invention employs this arrangement. Also, in accordance with this invention, special provision is made so that the selectors at the sidings are normally at rest, and are operated only where it is necessary to transmit an indication of change of train location, or when a control code is transmitted to change the energized condition of one of the control relays Z or SW.

Figs. 4A and 4B illustrate diagrammatically and conventionally one specific embodiment of novel means for performing both the signal control and train indication functions by synchronous selectors over a single line wire and the common return wire.

Referring to Figs. 4A and 4B the apparatus at the central station or dispatcher's office, shown at the left hand side of these figures, that is on Fig. 4A, is enclosed within the dotted square DO. A shaft **130** indicated by a dash line, is continuously rotated by a motor M of any suitable type, preferably a direct current compound wound motor with reasonably good speed regulation, although the speed of the shaft may vary through wide margins without affecting the operation of the system. A switch **131** may be used to stop the motor when the system is not in use. Fixed to the shaft is a make-and-break device, shown as a pair of brushes **132** and **133** cooperating with a toothed conducting rim **134** and insulation **135** to momentarily make and break electrical connection between these brushes **132** and **133** in an obvious manner. This wheel **134**—**135** also carries a cam **136** engaging a roller **137** forcing a spring contact **138** finger insulated therefrom against a stationary contact **139**. A selector arm **140** fastened to the shaft **130** bears on the contact ring **141** and contacts successively with a plurality of contact buttons 1st, 2nd, 3rd, 4th, etc. as the shaft rotates. Another arm **143** on said shaft engages a pair of contacts **144**—**145** in the initial or zero degree position of the shaft, and establishes electrical connection between an interrupted ring **146** and a plurality of contact points, such as **147**, as the shaft rotates through another portion of its revolution.

Each lever, only one lever LS being shown connected, is provided with a cam **150** engaging the roller **151** of the spring contact **152**, so as to momentarily close the circuit as the lever LS is shifted from any operated position to another position. For each lever there is a small initiating relay **153**, energized by a pick-up circuit, readily traced from B to N on the drawings, each time the lever is shifted to a different operating position. This lever relay **153** is stuck up through a circuit including its own front contact **154** and a limiting resistance **155** and the heel of its front contact **154** is connected by wires **245**, **246** and **156** to a corresponding contact point **147** for the arm **143**, this same limiting resistance **155** preferably being also included in the pick-up circuit of this relay, as shown. When any one of the several lever relays (such as **153**) are energized to apply a battery having a terminal B through a front contact, such as **163**, to a bus line **160** leading to a starting relay X, the other terminal of which is connected by a wire **161** through the contacts **144**—**145** and

the arm 143 to the other side of the battery N, such starting relay X is picked up and is then stuck up through a stick circuit including the contact 163 and the stick contact 172 of this relay X, readily traced. In other words, whenever any lever is shifted to a different position, the starting relay X is energized as soon as the shaft of a master selector reaches its initial or zero position, if not already there, and if this relay X has once been picked up and stuck up it will remain up so long as one of the lever relays (153) is up, even though contacts 144—143—145 are open. The purpose of this arrangement is more conveniently explained hereinafter. A push button 162 is also provided whereby the dispatcher may himself pick up the relay X at the beginning of the next revolution of the master selector.

The location of trains is indicated by repeating at the central station or dispatcher's office the operation of selected track relays. If desired, each track relay on the whole stretch of track may be repeated, and the presence of a train occupying each track section may be manifested in the dispatcher's office by lighting a lamp at the place on the track diagram corresponding to that particular track section. For the sake of simplicity, I have shown provisions for indicating the presence of a train on a siding, on the main track opposite the siding, on the detector track circuit, and at any point in the stretch of single track between sidings, the direction of the train as well as its presence being indicated in the last case. It is contemplated that a track diagram of the railroad under the operator's jurisdiction will be displayed in a convenient place before him, and on this track diagram will have small lamps 164, 165, 166, 167, etc., as shown in Fig. 4A which when lighted indicate that a train is occupying a corresponding portion of the track. In the case of a stretch of single track between sidings, two lamps 168 and 169 are provided, with arrows or other designation, as shown in Fig. 4A to indicate the direction of train movement, one lamp being automatically lighted, as hereinafter explained, when the train is traveling in the direction indicated by its arrow at any place along the stretch of single track. The lamps 164, 166 and 168 are controlled by small deadbeat polar relays 174, 176 and 178, respectively, these relays being connected to the 2nd, 4th, and 3rd contact points for the selector arm respectively. For reasons explained hereinafter, the lamp for the detector track circuit at least, and if desired all of the lamps, has in series in its lighting circuit a slow-acting flashing relay FR, with a push button arranged to be held in its actuated position when once depressed but not attracted by the relay to such position.

Extending from the tower along the track are three wires, conveniently called the control wire CW, stepping wire PW, and the common wire CL. The control wire CW is connected to the contact ring 141 of the selector arm 140 in series with the upper winding of a differential bell-ringing relay BR, having a biased polarized armature 170 which closes the circuit to a single stroke bell, or other audible signal, when attracted in opposition to the bias of spring 171. The stepping line PW is connected to the contact finger 138 and also by wire 178 to the brush 133. The common line CL is connected in series with the other winding of the bell-ringing relay BR through wires 242 and 243 to the neutral point of the main battery 180 connected to the lever contacts. The common line CL is also connected, by wire (not specifically shown) to the polar lamp relays 174, 176 and 178.

Referring now to the selector at the sidings, the shaft 182, indicated diagrammatically by a dash line, is biased to turn in a clockwise direction by a suitable means. As shown, the magnet 183 energized from a local battery is arranged to attract an arm 184 against the opposition of the spring 185, breaking its own energizing circuit at the contacts 186 in so doing. A pawl, 187, reciprocated as the arm 184 is intermittently attracted and retracted by the magnet 183, drives a ratchet wheel 188 clockwise and tensions the torsion spiral spring 189, said ratchet wheel 188 being held by a spring pressed pawl 190. The other end of the spring 189 drives a gear 191 meshing through the intervening pinion 192 with the pinion 193 on the shaft 182. It will be readily understood, without further explanation, that the magnet 183 automatically reciprocates the pawl 187 and turns the ratchet wheel 188 until the back pressure of the torsion spiral spring 189 balances or exceeds that of the tension spring 185, whereupon the pawl arm 184 fails to complete its stroke, leaving the magnet 183 de-energized. Other means, such as a small motor and friction clutch, or clock winding mechanism of the usual construction, may of course be used for giving the desired bias for turning to the shaft 182.

Fixed to the shaft is an escapement wheel 195 cooperating with a movable pallet 196 pivoted at 197, and biased in one direction by a spring 198 and at times attracted in the other direction by a stepping magnet 199. As the stepping magnet is alternately energized and de-energized, the pallet 196 is reciprocated, and the escapement wheel 195 allows the shaft 182 to turn step by step positively from one position to another.

Also fixed to the shaft is an arm 200 cooperating with a spring contact finger 201 in the initial or zero position to move that contact finger 201 from engagement with one fixed contact 202, and hold it in engagement with another fixed contact 203. Another spring finger 204 is arranged to be moved out of contact with its stationary contact 205 when the arm has made one step beyond its initial position. Spaced around the shaft, with the same spacing as the make and break points on a master selector and also the contact points for the arms of said master selector, are a plurality of contact points and spring fingers, these fingers and contact points, together with their connections, corresponding with those for the selector arm 140, have also been designated 1st, 2nd, 3rd, 4th, etc. In the particular arrangement shown in the first position 1st of each selector, a circuit connection is made at the master selector in the dispatcher's office from the lever LS. On the selector for the siding end corresponding to the lever LS, the first contact point has a spring finger 1st, normally engaging the fixed contact 206 and also connected to one terminal of the relay SW corresponding to said lever SL, the other terminal of said relay being connected to the common line CL. The relay SW whenever energized, is stuck up through a local battery 208 and neutral and polar contacts 209 and 210 in series with the spring finger 1st and its stationary contact 206. As shown, the way station selector in Fig. 4B, which is assumed to correspond with the particular end of the miniature siding shown in Fig. 4A, has its second contact point 2nd connected to the contact finger 111 of the detector track relay of section *d*; and simi-

larly the second contact point also marked 2nd of the selector arm 140 is connected to the polar light relay 174 controlling the light 164 corresponding to that detector track circuit. In a similar way, the corresponding control of contact points on the master selector are connected to corresponding control points on the various selectors through the system. While the master selector has a complete equipment of contact points around the shaft, each selector will have only the necessary contact points for the control of the relays Z and SW at that point, and for the indications of train location to be reported at the vicinity of that point.

In the same way as the second contact 2nd of the wayside selector is connected through contact 111 to the negative N or positive B of a suitable battery having its neutral point connected to the common wire CL, the third contact 3rd is connected to N when the contact 213 of home relay 2H is up and is connected to B when the contact 214 of the detector track relay of section *d* is up and the contact 215 of relay 2S and contact 213 of relay 2H are down. This circuit arrangement as more clearly explained hereinafter applies positive potential to the third contact point 3rd when there is a west bound train in the stretch of single track O and applies negative potential thereto when there is no train in this section or there is an east bound train therein. As a result of this energization of the third contact point the lamp 168 at the dispatcher's office is lighted only when there is a west bound train in the single track stretch O.

Operation of selecting system

The operation of the selecting system is more conveniently described by starting with the master selector in the station DO in its initial or zero degree position, and assuming that all of the station selectors are at that time in the same positions. While the shaft 130 of the master selector is continuously rotating, the shafts 182 of the outlying station selectors are normally at rest, assuming that the system is not at that time being used for the transmission of either control or train location indications. Passing for the present explanation of the reasons why the way station selectors are thus normally at rest, when the master selector reaches its zero degree position, as shown, the brush 133 rides on insulation 135 and disconnects the battery 220 from the stepping line PW. The cam 136 forces over the finger 138 and connects the stepping line PW to the contact finger 221 of the local starting relay X. Assuming that no lever has just been operated, the relay X is de-energized and its finger is in the lower position as shown, energizing the stepping wire PW with current of negative polarity which passes over wire 222 through contacts 139—138, wire PW, contacts 201—203, wires 223 and 224 through the polar starting relay SR to the common line. This impulse moves the armature of this polar relay SR to the left hand position as shown. Although the neutral contact 228 of this slow acting polar starting relay SR is picked up for a time, the stepping magnet 199 is nevertheless disconnected from the stepping line PW, each of its three multiple circuits being broken. The starting relay SR is made sufficiently slow acting that it will not respond to the short stepping impulses, that is, so that it cannot pick up its neutral contact 228 in response to a stepping impulse and will pick up only while the contacts 138—139 are closed. One of the three multiple circuits for the stepping magnet 199 may be traced, from the stepping lines PW to the finger 201, through contact 202 (now open because selector is in its initial position) and wires 226 and 227 to magnet 199 and to common line CL. Another circuit is from contacts 201—203 along wire 223 through neutral contact 228 and wire 229 to the polar armature 230 in the left hand position, wire 231 through front contact 232 of initiating relay IR and wires 233, 234 and 227 to the stepping magnet. A similar circuit is through the polar armature 230 in the right hand position through the wires 235, 234 and 227 to the stepping magnet 199. All of these circuits being open under the conditions assumed, the stepping magnet 199 is not energized, and the shaft 182 and the arm 200 remain stationary. As the master wheel advances from the zero position shown, the cam 136 releases the roller 137 which opens contacts 138—139 and the stepping wire PW is de-energized long enough for the relays SR to drop. Then, the brushes 132—133 intermittently connect the battery to the stepping wire, but since the stepping wire PW is not connected to the stepping magnet 199, the wayside selectors will remain at rest.

Transmitting a control code.—Assume now that one of the levers, as LS is operated. This operation of a lever LS, from any position to another, momentarily closes the contacts 152 and energizes the relay 153, which is then stuck up through its stick contact 154 in series with the limiting resistance 155. With this lever relay 153 up, the relay X is picked up and stuck up by completion of its energizing circuit at the beginning of the next revolution of the master selector, namely when contacts 144—145 are bridged by arm 143. Also, when the master selector approaches its initial or zero degree position, the brush 133 rides on the insulation 135, de-energizing the stepping wire PW and the stepping magnets 199 of any selectors then in operation, producing the final movement of the selectors in operation to the initial or zero position, in which the arm 200 engages the spring finger 201 and shifts it to the position shown. When the arm 143 which remains in motion engages the contacts 144 and 145 the starting relay X is energized, one of the levers having been operated, which relay X then remains stuck up through the stick circuit 163, 160, X and 172. The cam 136 then shifts the spring finger 138 to its circuit closing position; and the relay X being energized the stepping wire PW is energized with an impulse of opposite polarity to normal, conveniently called positive. This impulse energizes the polar relays SR of all of the wayside selectors, in each case shifting the armature of the polar relay to the right dotted position, whereupon current flows from the stepping wire PW through contacts 201—203, wire 223, neutral contact 228, wire 229, polar armature 230 to the right, wires 235, 234 and 227 through the stepping magnet 199 to the common line CL and back to the tower battery 220, thereby operating the escapement and advancing the shaft 182 a half step. The spring finger 201 is now released and engages the contact 202, connecting the stepping magnet of the selector directly across the stepping wire and the common line. This explanation applies to all of the wayside selectors because a positive impulse over the stepping wire PW starts all of the selectors, which selectors if once started establish the stepping circuit as just explained. Then when the master selector advances, the cam releases the spring contact arm

138, de-energizing the stepping wire PW and stepping magnets 199, allowing the escapement wheel to make another half step. Continued movement of the master selector intermittently makes and breaks the circuit at the brushes, alternately energizing with negative polarity and de-energizing the stepping magnets 199 of the selector and causing their shafts 182 to rotate step by step in synchronism with the shaft 130 of the master selector, so that when the arm 140 of the master selector is in the position corresponding to the lever just operated assumed to be first position marked 1st, corresponding to the lever LS, the arm 200 of one of the selectors is in the same corresponding position engaging a spring finger 1st and establishing at that particular selector a partial circuit from the control wire CW to the common line CL through the particular relay SW or Z, in this case SW, which corresponds to the lever in question. Thus when the selector arm 140 of the master controller is in its first position, the arm 200 of the selector shown is in position to engage the finger 1st, thereby completing the circuit from the main tower battery 180, from the positive or negative terminal, depending upon the position of the lever LS itself, through the lever LS, wire 237, through selector arm 140, contact ring 141, wire 238, upper winding of the differential bell relay BR, control wire CW, contact ring 239, selector arm 200 of the selector of the siding corresponding to the lever LS, spring finger 1st, wire 240, relay SW, and wire 241 to common line CL thence along wire 242 to the lower winding of the differential bell relay BR and wire 243 to the neutral or middle terminal of the main battery 180. The relay SW is thus energized, either positively or negatively depending on the direction in which the lever LS was moved; and as the arm of the way station selector advances, in synchronism with the master selector, the spring finger 1st is released and closes a stick circuit for the relay SW, readily traced on the drawings, and which has heretofore been specifically traced. While the master selector is in this position corresponding to the lever LS operated, the arm 143 engages the contact 147 and establishes a circuit for shunting out and de-energizing the lever relay 153 starting at the positive side B of the battery, through the limiting resistance 155, front contacts 154 of the lever relay 153, wires 245, 246 and 156, contact point 147, arm 143, contact ring 146, wire 247, through front contact 248 of relay X to the negative N of the battery. The shunting circuit just traced shunts the current, which flowed through the relay 153 and resistance 155 in series, away from the winding of this relay 153, thus causing de-energization thereof. With the relay 153 assuming its de-energized condition the relay X is de-energized thus opening its stick contact 172 and the shunting contact 248. With the stick contact 172 once open the relay X will not again assume its energized condition until the first return of the master selector to its starting position after a lever relay, such as 153, has been energized. Obviously, the lever relay 153 could be de-energized by opening a stick circuit, as well as by shunting its winding, but this modified construction is for convenience omitted from the drawings. De-energization of the relay X, by dropping of its contact 221, causes a negative starting impulse to be transmitted at the beginning of the next revolution of the master selector, which negative impulse will only start those way station selectors from which an indication is to be transmitted to the dispatcher's office.

When the master selector, and also each of the way station selectors, again reaches its initial or zero position, the arms 200 of each of the station selectors shift the spring contact 201, disconnecting the stepping magnet 199 from the stepping wire PW and connecting it to the polar starting relay SR. When the cam 136 shifts the contact finger 138, a starting impulse of a normal or negative polarity is transmitted, because the relay X is de-energized, assuming that no other lever has been operated in the meantime. This starting impulse of normal negative polarity operates the polar armature of the polar relay SR to the left as shown, so that when the short stepping impulses are applied to the stepping wire PW, the stepping magnets 199 of the various selectors are not energized. Thus, each selector remains at rest in the initial or zero position.

The levers may be operated at any time simultaneously, or in rapid sequence, or in any order without interfering with the operation of the system. Each time the lever is operated, all of the selectors are started when the master selector reaches its zero position. If another lever is moved immediately after the first, the lever relay corresponding to that lever will be energized during the same revolution of the master controller, if the contact arm has not passed by the position corresponding to that second lever by the time it is shifted. If the contact arm has passed by the selecting position corresponding to the second lever pulled, then the lever relay for that lever is not shunted out because the relay X is still down and the shunting circuit is open at contact 248, this relay X however picks up at the beginning of the next revolution of the master selector, whereupon the selectors at the way station complete a second revolution, during which revolution the lever relay is shunted out and caused to drop; and the same operation is repeated until all of the levers operated have had a chance to energize their corresponding relay, after which the relay X is de-energized and the selectors at the way stations automatically stop and remain at rest until again started by operation of a lever, or by the operation of a track relay, as about to be described.

In the case of control impulses for energizing the relays Z or SW, current is supplied from the main battery in the tower, and the same current traverses the upper and lower windings of the bell relays BR. The windings of this relay BR are so wound and connected that the flow of this control current, of either polarity, out the control wire CW and back through the common line CL, 242, 243, produces opposing fluxes and consequently these fluxes do not actuate the biased polar armature. Consequently, the bell is not sounded when control impulses are transmitted. This bell BL on the other hand is sounded in response to operation of the relay BR when an indication impulse is received from a way station selector because this current impulse does not pass through wires 242—243 including the lower winding of this relay BR, thus leaving only one of these fluxes effective.

Transmitting a train indication code.—Referring now to the operation of transmitting indications in response to the operation of track relays, the system is so arranged that the selector at the particular place where a track relay operates is automatically started in synchronism with the master selector, makes one revolution, and then

automatically stops. By providing enough contacts on the selectors, as many track circuits may be repeated as desired. As shown, provision is made for indicating at the central station on the miniature track layout the energized or de-energized condition of the track relay for the detector track section *d*, which indicates the arrival and departure of trains at the east end of the siding SD and shows when trains have cleared the fouling points. It is also considered desirable to repeat in the tower the condition of the track relays for the track sections of the siding as indicated by the indicating light **166**, and of the main track opposite the siding as shown by light **165**. Since there is preferably a selector for each end of the siding, in order to economize in wire, the selector at one end of the siding takes care of the track circuit of the siding, as shown, and the selector for the other end of the siding takes care of the track circuit for the main track opposite the siding, as well as for the detector track circuit at that end. These indications tell the operator what sidings are occupied and keep him informed of trains waiting to make meets. In order that the operator may be kept fully advised of the location of all trains, two indicating lamps **168** and **169** with arrows or the like signifying direction, are provided for each stretch of single track between sidings, and these lights **168** and **169** are lighted whenever a train occupies any portion of this single track stretch according to the direction of movement of that train. This is accomplished by taking advantage of a feature of the A. P. B. system which causes de-energization of the line relay **2H** with a westbound train in any portion of the single track (see Fig. 1) and the line relay **5H** for eastbound trains. The line relay **2H** is also de-energized while an eastbound train is between the signals **2** and **4**; but the relay 2S, controlled in the same way as the relay 4S, and located at the signal **2**, will be energized by such an eastbound train, and will be maintained energized until this train has passed the signal **4**. In other words, a westbound train in the stretch of single track between the sidings SD and SD[1] (see Fig. 1) will de-energize the line relay **2H**, and at that time the stick relay **2S** will also be de-energized; whereas an eastbound train will energize the stick relay **2S** during the time that the line relay **2H** is de-energized. A circuit including the back contacts **213** and **215** of the relay **2H** and 2S, respectively, will be closed therefore only if a westbound train is at some point in the stretch of single track. This circuit also preferably includes the front contact of the track relay for the detector track section *d*, as shown in Fig. 4B to assure that the indicating circuit in question will not be momentarily established by an eastbound train because of dropping of the line relay **2H** before picking up of the stick relay **2S**.

Assuming a way station selector at rest as shown in Fig. 4B (no control impulses being transmitted), when the detector track relay of section *d* for instance drops, the make-before-break contacts **250** momentarily close an energizing circuit from B, through contact **250**, wires **251**, **252** and **253**, relay IR to N, for a quick-acting initiating stick relay IR, which is stuck up through the contacts **204—205** of the selector. When the master selector next comes to its initial or zero position, and a long starting impulse either positive or negative is transmitted, the neutral contact of relay SR is picked up. If the starting impulse is a negative one and the starting polar relay is energized to the left and with the relay IR energized establishes a circuit heretofore traced to the stepping magnet, permitting that selector to operate. If the starting impulse is a positive one the way station selector will start in synchronism for reasons already described under "transmitting a control code." As the arm of that selector moves, it breaks the stick circuit for the relay IR, so that the selector makes only one revolution and stops. The detector track relay of section *d* being de-energized, one of the contact points, shown in this case as the second point 2nd, is connected to the positive terminal B of the battery, the middle terminal of which leads to the common line CL thereby energizing the polar light relay **174** with opposite, that is positive, polarity, which reverses the light relay **174** and closes a circuit through the lamp **164** in series with the flashing relay FR. The flashing relay FR intermittently opens and closes the circuit through the lamp **164**, thereby flashing the lamp. This circuit may be traced as follows:—B, contact **257** to the right, wire **258**, lamp **164**, wire **259**, winding of FR, wire **260**, contact **256** down, wire **261**, to the negative terminal N. When the operator pushes down the switch **255**, the flashing relay contacts **255** and **256** are stuck closed and the light **164** is steady, said switches **255** and **256** being held in their attracted position magnetically. This flashing relay FR is so constructed that its magnetism due to its normal current is sufficient to attract armature **256** but not armature **255**, but is of sufficient magnitude to hold the armature **255** attracted if once closed. The impulse transmitted over the control wire through the lamp relay **174** passes only through the upper winding of the bell relay BR, and not also through the lower winding as is the case when a control code is transmitted, and consequently operates its armature. The armature of the bell relay BR is preferably made polarized, in order that the bell BL may ring when the track relays drop, sending a negative impulse, and not when track relays pick up and send a positive impulse. This feature is provided in contemplation that the operator wishes to be promptly informed of the entrance of a train into a particular portion of track, but is not interested in the picking up of track relays by trains, except as may be readily determined by inspection of the diagram.

The flashing relay arrangement is provided in order to enable the operator to readily determine, upon sounding of the bell BL, which light has just been lighted. It will be evident that, with several trains on the railroad, there will be many lights displayed on the track diagram at the same time; and it would be difficult for the operator to determine what light has just responded to a train movement. With the flashing light, however, the operator can instantly pick out the particular track location where a train has just entered, and having noted this condition, may stop the flashing light and make ready for the next indication by pushing in the switch **255**. Although only one flashing relay FR has been shown, there is preferably provided one for each indicating lamp for the detector track circuits.

When the detector track relay of section *d* picks up, its make-before-break contact **250** momentarily energizes the initiating stick relay IR, the selector is started, and the indicating impulse of the other or negative polarity is transmitted, reversing the armature of the lamp relay

174 and extinguishing the lamp 164 and releasing the switch 255 of the corresponding flashing relay FR.

The same explanation applies to the dropping and picking up of the track relay of section *c* for the siding. Whenever the line relay 2H is energized or de-energized, the selector is started in response to momentary closure of contact 264; and if when this relay is de-energized the stick relay 2S has its back contact closed, then an impulse of the positive indicating polarity is transmitted to the corresponding lamp relay 178, lighting the lamp 168 having the arrow signifying westbound traffic in the stretch of single track in question. With respect to the side track of the passing siding, the make-before-break contacts 263 serves a purpose similar to that of contact 250, and the contact 265 applies B or N to the fourth contact the same as contact 111 applies energy to the second contact point.

This selector system described provides distinct circuits at different times between the central station and the way stations, and these circuits may be advantageously utilized to transmit a plurality of controls or indications. The relays, as SW and Z to be controlled are made quick-acting, as are like-wise the lamp relays, so that the selector arms do not have to remain in their different contacting positions so long as to unduly lengthen the time of one revolution or cycle. If desired, two quick-acting polar relays, leading to separate contact points, may be employed instead of the neutral polar relays SW and Z, the spring arms controlling the stick circuits likewise being omitted. It is of course understood that the same or even a greater number of controls may be given by two two-position polar relays as by one three-position polar neutral relay. The number of contacting positions of the selector arm required to give the desired number of controls and indications for a length of railroad that an operator can conveniently handle, together with a speed of rotation of the master selector shaft possible with ordinarily quick-operating relays, enables a change in control or indicating to become effective so quickly that the maximum delay is something less than three or four seconds, and this is quick enough for this type of work. If more indicating points are desired, an additional selector arm may be carried on the master selector shaft and an additional control wire employed with the same type of way station selector.

Reviewing briefly the selector system of which one embodiment has been illustrated in Figs. 4A and 4B, this system is based on the underlying principle of transmitting distinctive codes wherein each code constitutes a single electric impulse of which the distinctiveness depends on the time that this electric impulse is transmitted in a cycle of operation of the synchronous selector system. Since each code is characterized by a single impulse having a definite relation in time to the last initiation of a revolution of the master and way-station selectors it is readily appreciated that a large number of these selective codes or impulses may be transmitted substantially simultaneously, that is, may all be transmitted during a single revolution of the various selectors, of which the time of one revolution may be, say, from one to five seconds. As heretofore pointed out, the master selector located in the tower DO is constantly operating and its contact arms 140 and 143 are continuously operated at a fixed speed, whereas all of the way-station selectors are normally at rest. It readily appears that if an indication is to be transmitted from a way station selector to the dispatcher's office, for instance, to indicate the arrival of a train, it is only necessary for that particular way station selector to operate. On the other hand, if it is desired to pick up a control relay at one of the way stations it is necessary that all of the way station selectors be in operation in order that the distinctive code may have an opportunity to reach the particular way station selector and relay which it is to control in response to the operation of a lever in the dispatcher's office. By reason of the fact that all of the way station selectors must operate when a control code is to be transmitted, and only a single way station selector needs to operate when a train indication is to be transmitted to the dispatcher's office, the present invention has provided means for transmitting two different kinds of starting impulses from the master selector to the way station selectors. One of these starting impulses resides in the transmission of a negative impulse of sufficient duration to pick up the slow acting polar relay SR, and the other distinctive starting impulse consists in the transmission of a positive impulse over the stepping wire PW of sufficient duration to pick up this same starting relay SR to its right hand position. Normally, that is when no code impulses are to be transmitted, each revolution of the master selector during the transmission of its stepping impulses first transmits a negative starting impulse which holds the polar contact 230 of the slow acting polar relay SR to the left and picks up the neutral contact 228 of this relay and again drops this neutral contact. This negative starting impulse may be considered to be a synchronizing impulse because it is transmitted at each revolution of the master selector so that when a train indication is to be transmitted from a way station selector this way station selector may start in response to energization of the initiating relay IR but may start in synchronism in response to the lifting of the neutral contact 228 of the starting relay SR. The net result is that if the initiating relay IR is picked up and stuck up, as for instance in response to dropping of the detector track relay of section *d*, the way station selector associated therewith is started upon the transmission of the first negative starting impulse thereafter, and this way station selector is again stopped the first time it reaches its zero degree position after the stick circuit for initiating relay IR is broken. On the other hand, when a control code is to be transmitted from the dispatcher's office DO to a particular control relay located at a wayside station the picking up of the relay X in response to the operation of the lever at the dispatcher's office will cause a positive starting impulse of sufficient duration to pick up the neutral armature 228 of the relay SR at each of the various way station selectors to be transmitted so that all of the way station selectors are started in synchronism with the master selector and will continue in operation for at least one revolution.

Bearing in mind this broad underlying principle of transmitting starting impulses of two distinct kinds, one of which is primarily used for conditioning apparatus at all of the way station selectors so that any one particular selector may be initiated because an indication is to be transmitted from that selector to the dispatcher's office, and will operate through at least one

revolution, and the other distinctive starting impulse of which is used for starting all of the selectors when a control impulse is to be transmitted from the dispatcher's office, it readily appears that many different types of apparatus might be used to carry out this theory of operation wherein only a master selector is continually operated and the way station selectors are only in operation when necessary to transmit or receive a distinctive code. For instance, instead of operating all of the various way station selectors in response to stepping impulses transmitted from a way station selector each of these various way station selectors might be operated solely by local power and local constant speed mechanism, such as a motor driving a normally locked shaft through a slip friction clutch which shaft is released by a starting impulse, suitable clockwork mechanism, or the like, so long as the selector operating mechanism functions properly to keep its rotating contact arm in synchronism with the master selector arm after having started in response to a starting impulse transmitted by such master selector.

The local starting relay X located in the dispatcher's office is primarily provided to insure that all of the way-station selectors operate through at least one revolution after each change in lever positions of the equipment. Attention is particularly directed to the fact that the relay X is not picked up until the way station selector arm **143** has reached its zero degree or starting position in which it bridges the contacts **144—145**; and that the relay X will remain energized through its stick circuit including the stick contact **172** until all of the lever relays, such as relay **153**, have again assumed their de-energized condition. From this it readily appears that should the arm **143** have passed a particular contact, the lever of which is operated immediately after this rotating arm **143** has passed such contact, the lever relay for that contact, such as **153**, will remain stuck up even though all of the way station selectors have operated during the preceding revolution of the master selector, that is they will be operated through a second revolution, so that the code transmitted from such lever may reach the proper way station selector and control relay. During this second revolution the wiping of the contact arm **143** over this contact, such as **147**, shunts the winding of this lever relay and causes it to assume its de-energized position. In connection with this subject of starting and stopping the various way station selectors, it is desired to point out that the relation between the spacing of the various contacts in the circumference about the selector shafts **130** and **182**, the time required for picking up and dropping of the various relays, the inductance and capacity of the various circuits, battery voltage, and the like, will be so chosen that the various way station selectors will always start in synchronism with the master selector, will remain in synchronism during the revolution or revolutions through which they are to operate, and will be brought to stop when they again reach their zero degree position. In this conection it should be noted that if a lever is operated in coincidence with the transmission of a starting impulse the relay X will not pick up until the master selector has completed that revolution, in which event the control code will not be transmitted until during the following revolution of the master selector. In other words the relay cannot pick up during the time contacts **138—139** are closed and further it cannot drop while these contacts are closed, and therefore it is not possible for the relay X to change either a positive or a negative starting impulse into two short impulses one of which is positive and the other of which is negative.

Referring now to the way station selectors, of which only one has been illustrated in Fig. 4B, it is desired to point out that the control relay SR is sufficiently slow acting so that it will not pick up during the transmission of one or a series of stepping impulses, but will pick up its neutral contact **228** upon the transmission of either a positive starting impulse or a negative starting impulse. Further, since the initiating relay IR if in its energized condition through its front contact **232** may start the associated way station selector and since this initiating relay IR will have its stick circuit broken at the zero position and before the shaft reaches the position marked 1st, it appears that the way station selector will operate through at least one complete revolution after each track relay change, and will therefore assure transmission of an indicating code from such way station selector to the master selector.

Automatic recorder

In order for the operator to handle the traffic expeditiously, it is necessary for him to have complete information of the location of each train. The existing location of trains on the railroads is very clearly exhibited to the operator by the lighted lamps on the track diagram, as already described. These lighted lamps do not, however, tell what particular train is at that point on the track, nor do these lamps show how long the train has been at that place, nor the direction it is headed, with the exception of the direction lamps for the single track portions.

While the position of the levers LS and LZ show what are the existing positions of the switches and directions of traffic, and the lights on the track diagram indicate the location of trains, the operator frequently has occasion to make various notations of train movement forecasts, train delays, time allotted to work trains, and the like. It is also necessary to have a complete record of train performance. Although the operator may keep a regular train sheet, making such notations thereon as he wishes, and operate the the system with a high degree of efficiency, it is proposed to make an automatic record of train operation on the graphic chart from and in such a way that the operator can use this record for convenient reference, and make his notes on the same chart.

Fig. 5 shows a track diagram with the levers LS and LZ—LZ^2 conveniently disposed with relation to this diagram. Below this track diagram and lever board, which is preferably disposed vertically or on an inclined panel, and on the table in front of the operator, is a miniature track diagram (see Fig. 6 of the drawings). This still smaller miniature track diagram is disposed directly above an opening exposing a recorder sheet **270** ruled horizontally to indicate increments of time, and vertically to indicate track locations. This recorder sheet is fed from a drag roller **271** over a flat surface **280** affording a backing to the sheet so that it may be marked upon; and is wound up on a roller **272**, moved continuously gradually or step by step by suitable clockwork mechanism **273**, this driving roller preferably having teeth (not shown) engaging holes in the

edge of the paper **270**. While any suitable marking means, operated from the lamp relays **174**, **176** and **178** may be employed, it is preferred to make marks on chemically prepared paper by the direct flow of electric current. As shown, in multiple with each lamp such as **169**, for instance, are a pair of contact points **275**, preferably imbedded in a bar **276** of insulating material to afford a smooth marking contact surface for the paper, which contacts **275** bear on the underside of the paper and allow current to flow through the paper between these points when and so long as the corresponding lamp relay is energized with one polarity of current. Any suitable chemically prepared paper may be employed to produce a colored mark, due to the electrolytic action, or the like, by the flow of current. For example, the paper may be moistened by a wick or pad **277** bearing on its underside, this wick containing a mixture of starch paste and solution of potassium iodide which mixture is contained in the tank **278**, the moistened paper in turn being dried by ironing, as by an electrically heated bar **279**; or, if desired, the paper may be impregnated with the desired chemicals and the wick **277** be used for moistening purposes only for reducing the resistance to electric current flow. Obviously, the current may be caused to flow between the contacts bearing on opposite sides of the paper, or electrically operated pencils or pens may be employed, or various other expedients employed in the art of recording may be employed.

So long as a train occupies the portion of track controlling one of the lamp relays, a mark is made on the chart along the vertical line corresponding to that place on the railroad. The ends of this mark show the time when the train entered and left the track section. These marks when manually connected up by sloped lines provide a step-like time distance curve for each train, as indicated on the chart in Fig. 6; and it will be evident that by reference to this chart, the operator can conveniently ascertain the number of the train then occupying a given track section. For example, if the lamp for the siding SD is lighted, and the operator wishes to know which train this is, reference to the chart shows the number of this train and also how long that train has been on the siding. The operator can also make such notations or marks on the chart as necessary to record forecasts of meets, train delays, and the like, so that when it is time to manipulate the levers, in view of a certain train having reported in, he can determine from these notes what he had planned to do.

As an example of how the recorder makes a record, lines have been shown on the chart **270** indicating that an east bound train #80 met a west bound train #90 at the passing siding SD, the train numbers in practice of course being entered upon the chart by the dispatcher from his knowledge through other channels. It is noted that at 12 o'clock east bound train #80 entered the fouling section *a* at the west end of siding SD and train #90 occupied the single track stretch O, moving westward. At 12:02 train #90 entered the detector track section *d*, entered the siding *c* at 12:03, cleared the single track section O at 12:03, cleared the fouling section *d* at 12:05, and occupied the siding until 12:19. Also, train #80 entered the main track *b* at 12:06, cleared the fouling section *a* at 12:07, entered the fouling section *d* at 12:10, cleared the main track *b* at 12:11, entered the single track section O at 12:13, left the section *d* at 12:14, left the single track section (going eastward) at 12:24 etc. The west bound train #90 entered the fouling section *a* at 12:15 and passed off of the same and out of the territory of the dispatcher at 12:24.

One marked advantage of making an automatic record in this way is that it leaves the operator free to devote his attention to handling the levers and planning train movements. His attention is not distracted at difficult times by the necessity of recording the time of arrival or departure of some train. Another very important feature of this method of making a record, is that it is easily read and is more reliable than a hand made record, because it is not subject to false and mistaken entries as is the case with handmade records.

Since the recorder shown accurately records the entrance and departure of the front and rear end, respectively, of trains moving into and out of successive track sections, this recorder also records the speed of the train providing its length is known, as is usually the case in railroading. For instance, the overlap as to time during which a train occupies two successive track sections indicates that during this time the train occupied both of these sections, and therefore if its length and time of transfer from one section to the next is known its speed is readily calculated. In the same way, if the length of certain track sections is known, as will be the case in practice, it is a very simple problem to determine the speed of a train regardless of its length by the record available; and after its speed is known it is an easy matter to determine its length for reasons already given.

The particular embodiments of the invention shown and described are merely illustrative; and various additions, adaptations, and modifications may be made in the particular construction and arrangement of parts and circuits shown and described to meet the exigencies of a particular installation without departing from the invention.

What I claim is:—

1. In an animated train diagram, the combination with a plurality of indicating lamps for indicating train movements, a circuit for each lamp including a source of current, the winding of an electro-responsive device and a back contact of this same device; whereby said lamp is intermittently energized when said circuit is closed; and manually operable means for each lamp which if operated allows such lamp to be lighted continuously so long as its circuit is otherwise complete.

2. In an animated train diagram, the combination with a plurality of indicating lamps for indicating train movements; a circuit for each lamp including a source of current, the winding and a back contact of an electro-responsive device; whereby said lamp is intermittently energized when said circuit is closed; and manually operable means for each lamp which if operated allows such lamp to be lighted continuously so long as its circuit is otherwise complete, and which means is restored to its normal condition when the energizing circuit for such lamp is broken.

3. In a system for transmitting a plurality of distinctive indications over the same line circuit wires, the combination with a master circuit selector and a plurality of way station circuit selectors, means governed by said master selector for transmitting a starting impulse for starting a way station selector only if such way station selector has been conditioned for starting, and means for conditioning for starting a way station

selector when an indication is to be transmitted therefrom to said master selector.

4. Means for indicating the direction of train travel in a single track stretch of a single track railway system equipped with absolute-permissive-block signaling comprising, the usual tumble down circuit including a series of line relays each of which except the first is controlled through the front contact of the line relay next in advance, the last line relay of which series is in its de-energized condition when there is a train at any point in the single track stretch moving in one direction or there is a train moving in the opposite direction in the first block of such single track stretch, a directional stick relay which is normally de-energized but which assumes its energized condition when there is a train moving in said first block in said opposite direction, and indication transmission means rendered active only when said line relay and said directional stick relay both assume their de-energized condition.

5. In a train dispatching system of the single circuit synchronous selector type, the combination with a continuously operated master circuit selector at the dispatcher's office and a plurality of way station circuit selectors normally at rest, means associated with said master selector for transmitting to all of said way station selectors a synchronizing impulse which is capable of starting such way station selectors in synchronous operation with said master selector only if they have been conditioned for starting, and means associated with each way station selector for conditioning such selector for starting and operation in response to said synchronizing impulse.

6. In a train dispatching system of the single circuit synchronous selector type in which the movement of trains are dispatched in accordance with wayside signal indications, the combination with a continuously operated master circuit selector located in a train dispatcher's office and a plurality of way station circuit selectors, means for maintaining said selectors operating in synchronism when operating and intermittently completing circuits over a line wire and a common wire for transmitting both control and train indication impulses, said common wire being divided into two branches one of which carries the control impulses and the other of which carries the indication impulses, and means for giving an audible signal indication in response to train indication impulses flowing in one of said branches only.

7. In a train dispatching system of the synchronous selector type, the combination with a railway system having a plurality of way stations, a selector contact mechanism at a local train dispatcher's office and at each of said way stations, a dispatcher's board including a plurality of control levers for transmitting distinctive control influences to said way stations, train occupancy responsive means at each of said way stations, and means for effecting synchronous operation of the selector contact mechanisms at a particular way station and at said dispatcher's office upon response of the train occupancy means at said particular way station and for effecting synchronous operation of all of said selector contact mechanisms upon operation of one of said levers.

8. In a train dispatching system of the synchronous selector type, the combination with a railway system having a plurality of way stations, a selector contact mechanism at a local train dispatcher's office and at each of said way stations, a dispatcher's board including a plurality of control levers for transmitting distinctive control influences to said way stations, train occupancy responsive means at each of said way stations, and means for effecting synchronous operation of the selector contact mechanisms in said dispatcher's office and at a particular way station only upon response of the train occupancy means at said particular way station and for effecting synchronous operation of all of said selector contact mechanisms upon operation of one of said levers, and means closing instantaneous control and indication circuits at the proper time during operation of said selector contact mechanisms.

9. In a synchronous selector type train dispatching system, the combination with a railway system having a dispatcher's office and a plurality of way stations, a continuously operated master selector normally transmitting to said way stations series of impulses of which the first impulse of each series is an impulse of a particular polarity, a lever at said dispatcher's office for each way station, a stick relay which if energized causes the first impulse of a series to be of reverse polarity, a contact associated with each lever and closed momentarily upon movement of such lever toward an operating position which if closed completes a pick-up circuit for said stick relay, and means for again dropping said stick relay effective to allow at least one series of impulses to be transmitted of which the first impulse is of reverse polarity.

10. A way station selector mechanism for train dispatching systems of the synchronous selector type wherein the dispatcher's office equipment includes a continuously operated master selector and each way station equipment includes a selector normally at rest and which will operate in synchronism with the master selector in the event the first impulse of a series of impulses transmitted by said master selector to such way station selector is of a particular polarity comprising, a rotatable contact arm normally held at rest by suitable stop means, means responsive to the first impulse of a series of impulses providing it is of a particular polarity for rendering said stop means inactive and allowing said arm to rotate in response to the following series of impulses, and other means for rendering said stop means inactive and allowing said arm to rotate in response to the following series of impulses rendered active upon passage of a train by such way station.

11. In an animated train diagram, the combination with a miniature track layout, an indicating lamp therein for each of a plurality of track circuits the occupancy of which is to be indicated, an indicating circuit for each indicating lamp energized when the track circuit it represents is occupied, means included in a particular indicating circuit for intermittently opening the same to effect flashing of the lamp included therein, and manually operable means for rendering said last mentioned means ineffective.

12. In a train dispatching system of the single circuit synchronous selector type in which the movement of trains is dispatched in accordance with wayside signal indications, the combination with a master circuit selector at the dispatcher's office, a plurality of way station circuit selectors normally at rest, of a message wire sequentially included in different branch circuits selected by said circuit selectors, and means associated with

said master selector for transmitting to all of said way station selectors synchronizing impulses which are capable of starting such way station selectors in synchronous operation with said master selector.

13. A train dispatching system of the synchronous selector type comprising, a dispatcher's office, a distant way station at which a train crew receives dispatching instructions, a synchronous dispatcher's selector at said dispatcher's office, a synchronous way station selector operable step by step at said way station, a stepping line circuit, said dispatcher's selector transmitting a starting impulse and a plurality of stepping impulses to said way station over said stepping line circuit to effect synchronous starting and synchronous step-by-step operation of said way station selector with respect to said dispatcher's office selector, said starting impulse and said stepping impulse being of distinctive character, a message line wire, message branch circuits associated with said dispatcher's selector closed by said dispatcher's selector, corresponding message branch circuits for said way station selector closed by said way station selector, corresponding pairs of message branches being connected to said message line wire simultaneously when said selectors operate in synchronism, means for indicating in the dispatcher's office conditions of track occupancy over such temporarily established message circuit, and means at said way station initiated in response to a change in track occupancy for rendering said way station selector responsive to said distinctive starting impulse.

14. A train dispatching system of the synchronous selector type comprising, a dispatcher's office, a distant way station at which a train crew receives dispatching instructions, a synchronous dispatcher's selector at said dispatcher's office, a synchronous way station selector operated step by step at said way station, said dispatcher's selector transmitting a starting impulse and a plurality of stepping impulses to said way station to effect synchronous starting and synchronous step-by-step operation of said way station selector with respect to said dispatcher's office selector, a message line wire, message branch circuits associated with said dispatcher's selector closed by said dispatcher's selector, corresponding message branch circuits for said way station selector closed by said way station selector, corresponding pairs of message branches being connected to said message line wire simultaneously when said selectors operate in synchronism, a lever in said dispatcher's office for controlling the character of dispatching information transmitted over such temporarily established message circuit, and means associated with said lever for starting said way station selector from rest effective when said lever is moved from one to another of its active positions.

15. In a selector type train control system, the combination with a central office and a plurality of stations along the track of a railway system, a traffic controlling device at each of said stations, a lever at said central office for each of said devices, selector apparatus at said central office and at each of said stations for controlling said traffic controlling devices in accordance with the positions of their corresponding levers, and means for initiating said selector apparatus including two stick relays, a manually operable contact included in the pick-up circuit of one of said stick relays, a stick circuit for said one stick relay, a pick-up circuit for said other stick relay including a front contact of said one stick relay, and another contact in the pick-up circuit of said other stick relay closed only at the beginning of a cycle of operation of said selector apparatus.

16. Means for the control from an office of traffic over a remotely located track switch, comprising signals for governing train movements over said switch, switch control and signal control relays adjacent said switch manually operable from the office independently of traffic conditions at said switch; circuits for the control of said switch and signals by said control relays arranged to be closed only when the track section containing said switch is unoccupied, said switch control circuit being also arranged so that it may be closed only when said signal circuits are open, and said signal circuits being arranged so that they may be closed only when said switch control circuits are open.

17. A traffic controlling system comprising a distant track switch, a signal for controlling traffic over said switch, a switch control relay controlled from a local office, a signal control relay also controlled from said local office, a switch machine for operating said track switch, another relay, a control circuit for said switch machine controlled by said switch control relay which can be closed only if said another relay is energized, and a control circuit for said signal controlled by said signal control relay which can be closed only if said another relay is deenergized.

18. In a traffic controlling system, the combination with a track switch, two signals governing traffic toward said track switch, a switch machine for operating said track switch and controlled from a distant point, a lock relay which if deenergized prevents control of said switch machine, a stick relay, a stick circuit for said stick relay including a contact open if one of said two signals assumes the clear position, and an energizing circuit for said lock relay including a front contact of said stick relay and a contact closed only if the other of said two signals is at stop.

19. In a traffic controlling system, the combination with a track switch, two signals governing traffic toward said track switch, a switch machine for operating said track switch and controlled from a distant point, a lock relay which if deenergized prevents control of said switch machine, a stick relay, a stick circuit for said stick relay including a contact open if one of said two signals assumes the clear position, an energizing circuit for said lock relay including a front contact of said stick relay and a contact open if the other of said two signals assumes the clear position, and a contact for shunting the said contact of said other signal and closed only if there is no train approaching such other signal.

20. In a centralized traffic controlling system for railroads, a control office, a field station, a normally inactive selector type communication system connecting said control office and said field station, a plurality of traffic controlling devices at said field station, a plurality of control levers in said control office each corresponding to one of said traffic controlling devices, means for transmitting controls to said traffic controlling devices in accordance with the existing positions of said levers through the medium of said communication system when said system is in effective operation, and means associated with said levers for starting said communication system into effective operation effective each time any one of said levers is moved from either one to the other of its active positions and irrespective

of the condition of the corresponding traffic controlling device.

21. In a normally inactive selector type communication system, a plurality of control levers each having a plurality of active positions, a starting button, and means for initiating the communication system into operation either upon the actuation of any one of said control levers from any one to another of its active positions or upon the actuation of said starting button.

22. In a normally inactive selector type communication system, a plurality of control levers, a starting button, a stick relay associated with said control levers and said starting button, said relay being effective to initiate said communication system when up, a pick-up circuit for said stick relay closed upon the actuation of any of said control levers to a new position or upon the actuation of said starting button, and a stick circuit for said relay momentarily opened when the system has been effectively initiated to transmit the controls.

23. In a centralized traffic controlling system for controlling signals and switches on a railroad and transmitting indications of traffic conditions at such signals, a plurality of field stations, a line circuit connecting said field stations, an indication transmitting apparatus at each field station normally inactive, means for applying a plurality of series of impulses of distinctive character to said line circuit, and means at each field station controlled in accordance with the character of the first impulse of each series for governing the initiation of said transmitting apparatus at said stations.

24. In a centralized traffic controlling system for controlling signals and switches on a railroad and transmitting indications of traffic conditions at such signals, a plurality of field stations, a line circuit connecting said field stations, an indication transmitting apparatus at each field station normally at rest, means for applying a plurality of series of impulses of distinctive character to said line circuit, and means at each field station controlled in accordance with the polarity of the first impulse of each series for governing the initiation of said transmitting apparatus at said stations.

25. In a centralized traffic controlling system for railroads, a line circuit connecting a control office and a field station, automatic means in the control office for impressing a series of impulses on said line circuit with the first impulse of the series of a distinctive particular character, and step-by-step means at said field station operated to take one step for each of said impulses only when the first impulse of said series is of a particular character.

26. In a centralized traffic controlling system for railroads, a line circuit connecting a control office and a field station, means in the control office for impressing a series of impulses on said line circuit, step-by-step means at said field station normally at rest but capable of being initiated, initiating means at said field station for rendering said step-by-step means responsive to take one step for each of said impulses of said series, a traffic controlling device at said field station, change means automatically actuating said initiating means upon a change in the condition of said traffic controlling device, means actuating said initiating means when the first impulse of said series is of one character but rendering said initiating means subject only to said automatic change means when said first impulse of said series is of another character.

27. In a selector type communication system which must be initiated in order to transmit a selective control to a distant station, including a control lever which may assume a plurality of control positions; and of means for initiating said system comprising, a stick relay which if energized initiates said system, a pick-up circuit for said relay including a contact closed during the movement of said lever from one to another of its control positions, a stick circuit including its own front contact, and means for deenergizing said stick relay upon effective initiation of said system to transmit a control in accordance with said lever.

28. In a centralized traffic controlling system for railroads; a field station having a code receiving and a code transmitting apparatus; a line circuit extending to said field station, said line circuit having a plurality of series of impulses impressed thereon with the first impulse of each series distinctive from the remaining impulses of that series; and cycle demarking means at said station responsive to said first impulse of each series for governing the code receiving an code transmitted apparatus.

29. In a centralized traffic controlling system for railroads; a line circuit extending to a plurality of field stations and having a plurality of series of impulses impressed thereon with the first impulse of each series of longer duration than the remaining impulses of that series, a slow acting relay at each field station picked up at the beginning of each of said series of impulses in response to the first impulse of that series, and communication apparatus at each field station rendered effective to the remaining impulses of a series only after the response of said slow acting relay at that station.

30. In a centralized traffic controlling system for railroads, a field station, a line circuit extending to said field station, means impressing a series of impulses on said line circuit with the first impulse of said series of prolonged duration, step-by-step means at said field station, and means responsive only during said prolonged first impulse of said series to render said step-by-step means selectively initiated in accordance with the character of said first impulse, whereby said step-by-step means may or may not respond to the remaining impulses of said series.

31. In combination, a normally inactive indication transmitting apparatus, a plurality of devices, a stick relay effective when picked up to cause operation of said indication transmitting apparatus to thereby transmit indications in accordance with the conditions of all of said plurality of devices, a pick-up circuit for said stick relay momentarily energized upon a change in any one or all of said plurality of devices, and a stick circuit for said stick relay including its own front contact, and means opening said stick circuit upon effective initiation of said indication transmitting apparatus.

32. In combination, a plurality of two-position devices; a make-before-break contact on each of said devices; an initiating relay; a plurality of multiple pick-up circuits for said initiating relay, each of said pick-up circuits including its respective one of said make-before-break contacts, whereby said initiating relay is momentarily energized each time one or more of said plurality of two-position devices changes positions; a code transmitting means initiated to transmit code

impulses in accordance with said two-position devices when initiated by said initiating relay, and a stick circuit for said initiating relay including its own front contact and contacts momentarily opening said stick circuit only once for each complete operation of said code transmitting means.

33. In an animated track diagram for railroads, an electro-responsive device controlled to either of two conditions in accordance with a corresponding traffic controlling device, means giving one distinctive indication on a track diagram when said electro-responsive device is automatically controlled to one of its two conditions, and a stick relay picked up in response to a manual acknowledgment of said one distinctive indication for giving another distinctive indication so long as said stick relay is energized.

34. A system for operating traffic controlling devices on railroads comprising, a local office and a distant way station, normally inactive selector apparatus connecting said office and way station and which when initiated operates through a cycle of operation, a plurality of traffic controlling devices at said way station, a lever for each traffic controlling device, a stick relay associated with each lever and having a pick-up circuit including a contact closed only during movement of such lever from one to another active position and closable irrespective of the condition of said selector apparatus and an initiating relay controllable by any one of said stick relays and which may be picked up only between cycles of operation of said selector apparatus.

35. Railway traffic controlling apparatus comprising a plurality of traffic governing devices located at intervals along the trackway, a pair of line wires, a plurality of relays one for each such device all located at a control point and each responsive to the polarity of the current supplied thereto, means set into operation when the condition of any such device is changed for successively connecting said relays with said line wires for a brief interval, and means controlled by each device and effective during the interval that the corresponding one of such relays is connected with the line wires to supply the line wires with an impulse of energy of one polarity or the other depending upon the condition of the device.

36. Apparatus for the remote control of a movable device, comprising a control lever having at least two operative positions and including a control contact for each of said positions each adapted to be closed when said lever is moved to the corresponding position, and means including said control contacts effective when said lever is moved from one to another operative position to complete a circuit to effect an intermittent control of said device, and to then open said circuit, said last named means being effective when said lever is moved to another position to reestablish said circuit.

37. In combination with a line circuit, a manually operable switching device, a master relay, means effective when said switching device is operated to reverse said master relay, coding apparatus set into operation when said master relay is reversed to initiate the delivery of a code to said line circuit, means for holding said master relay in its reverse position until the completion of said code, and means operating at the conclusion of said code to restore the master relay to its normal position.

38. In combination, a line circuit connecting a control station with a remote station, two devices at said remote station, two levers at said control station, means effective when either of said levers is operated to deliver a distinctive code to said line circuit, means at said remote station for operating said devices selectively in accordance with the code supplied to the line circuit, and mechanical linkage connecting said two levers for at times preventing operation of one lever to one position if the other lever has been operated to a conflicting position.

39. In combination, a line circuit, a movable lever, a code transmitter, a selector controlled by a code delivered by said line circuit, a relay responsive to conditions adjacent said selector, means controlled by said lever and by said relay for completing said line circuit through said transmitter, and a device controlled by said selector.

40. In combination, a railway signal, a relay responsive to conditions adjacent said signal, a movable lever, a code transmitter, a circuit including said code transmitter and controlled by said lever and by said relay, and means controlled by said circuit for operating said signal.

41. In a train dispatching system for railroads, means for transmitting distinctive signals comprising different sequences of current impulses of different characters from an office to a station comprising a group of control levers located at the office and each having a plurality of control positions in each of which a distinctive control contact is closed, and initiating means associated with said group of levers and rendered effective when a lever is actuated from one control position to another to initiate the transmission of a distinctive sequence of impulses from said office to said station, said sequence being determined in part by the position of each of said levers.

42. A centralized traffic controlling system for railroads comprising an office and a station connected by line circuits, selector transmitting means connecting said office and station for transmitting distinctive momentary controls to said station, a railway switch at the station, a two position switch relay located at the station and having a control contact arranged to remain in the position to which it was last operated after the relay is deenergized, means selectively responsive to a particular one of said momentary controls to operate said control contact to one position, means selectively responsive to another particular one of said momentary controls to operate said control contact to its other position, a second two-position switch relay, a lock relay which when de-energized prevents control of said second switch relay, and means effective when said lock relay is energized for moving said second two-position switch relay to a position corresponding with the position of said first relay.

43. In a train dispatching system of the wayside signal indicating type, a railway track having a passing siding, a track switch at one end of said passing siding, a switch machine controlled from a distant train dispatcher's office for operating said track switch, a combined permissive and stop-and-stay signal located adjacent said track switch and governed in accordance with traffic conditions and the position of said track switch, said combined permissive and stop-and-stay signal tending to display only a permissive aspect of proceed or stop, and a single means manually controllable from said distant dispatcher's office for preventing said signal displaying a permissive

aspect and causing said signal to display only a stop-and-stay indication.

44. In a centralized traffic control system for railways, a track switch, a signal to govern traffic over the switch, a first circuit to control the operation of the switch, a second circuit to govern the signal, a third circuit to control said first and second circuits and arranged to render said second circuit effective to clear the signal only when said third circuit is open and to render said first circuit effective to move the switch only when said third circuit is closed, means controlled from a central office to open said third circuit, and traffic controlled means responsive to the movement of a train past the signal to close said third circuit.

45. In combination, a detector section of railway track including a track switch, signals for governing the movement of traffic over each route over the switch; switch control means for controlling the switch, signal control means for governing the signals; means for operating said switch and signal control means from a remote point to successively operate the switch and to clear the signal for the route rendered available by the movement of the switch in a single sequence of operations, and means effective if said control means is operated when the signal for a different route in the same direction over said switch is at clear, for initiating said sequence of operations automatically when a train having accepted such signal passes out of said detector section.

46. In combination, a track lay-out including a track switch for establishing any one of a plurality of routes, a switch machine for operating said track switch, a normal and a reverse control circuit for respectively controlling said switch machine to operate to a normal position and to a reverse position, a relay having front contacts included in one of said circuits, whereby said switch machine cannot be operated to one position unless said relay is energized, a signal for governing traffic over one of said routes, and a circuit for clearing said signal including back contacts of said relay closed only if said relay is deenergized.

47. In combination, a track lay-out including a track switch for establishing any one of a plurality of routes, a switch machine for operating said track switch, a normal and a reverse control circuit for respectively controlling said switch machine to operate to a normal position and to a reverse position, a lock relay having a front contact included in a common portion of said normal and said reverse control circuits to prevent operation of said switch machine when such lock relay is deenergized, a signal for governing traffic over one of said routes, and a circuit for clearing said signal including a back contact controlled by said lock relay and closed if said lock relay is deenergized.

48. In an interlocking system, a track lay-out including a track switch, a switch machine for operating said track switch, a switch control relay for controlling said switch machine, a signal for governing traffic over said track switch, a signal control relay for when energized clearing said signal, means for preventing clearing of said signal in response to energization of said signal control relay if said switch control relay and said switch machine assume non-corresponding positions but permitting clearing of said signal when said switch machine operates into correspondence with said switch control relay, and means responsive to clearing of said signal for rendering said last mentioned means ineffective and permitting said switch control relay to be operated out of correspondence with said switch machine without disturbing the clear condition of said signal.

49. In combination, a railway switch, signals for governing traffic over the switch, control means for controlling the switch and signal control means for governing the signals, remote control means for simultaneously operating said switch control and signal control means to effect a movement of the switch and the clearing of a signal in a single sequence of operations, and means for preventing the initiation of such sequence in response to the operation of the remote control means provided the signal control means is then energized.

50. Remote controlling apparatus comprising a railway switch, signals for governing traffic over said switch in different directions and routes, means for transmitting over a single circuit during one period of transmission a series of time spaced current impulses providing a plurality of elements each changeable in its characteristics and constituting a distinctive code, means for controlling the character of one element to determine a route over said switch, means for controlling the character of another element of said code to determine the traffic direction over such switch, means selectively controlled in accordance with the characteristics of said one element for governing said switch, and means selectively controlled in accordance with the characteristics of said other element for selectively controlling said signals.

51. In combination with a plurality of contacts at one point and a plurality of relays at another point, means for continuously controlling each relay in accordance with the position of a corresponding contact comprising a pick-up circuit and a stick circuit for each relay, means responsive to a change in a position of any contact for briefly and successively interrupting all of said stick circuits, and means effective when each stick circuit is interrupted by the last-mentioned means for closing the pick-up circuit for the corresponding relay provided only the associated contact occupied a predetermined position.

52. In combination with a line circuit, a manually operable switching device, a master relay, means effective when said switching device is operated to reverse said master relay, coding apparatus set into operation when said master relay is reversed to initiate the delivery of a code to said line circuit, means for holding said master relay in its reverse position until the completion of said code, means operating at the conclusion of said code to restore the master relay to its normal position, a device in the field at the remote end of said line circuit which may assume one or another condition, and means for setting said coding apparatus into operation when said device is changed from said one to said another condition.

53. In combination with a local office and a distant field station connected by line wires, a manually operable switching device at said office, a master relay at said office, means effective when said switching device is operated to reverse said master relay, selector apparatus normally at rest which must be initiated to transmit control impulses from said office to said field station or to transmit indication impulses from said field station to said office set into operation when said master relay is reversed, said selector apparatus

transmitting a control impulse dependent on the position of said switching device to said station, a traffic controlling device at said field station the position of which may be indicated at said office by transmitting impulses over said line wires through the medium of said selector apparatus, and means for setting said selector apparatus into operation in response to a change in the position of said traffic controlling device.

54. In a system for electrically interlocking railway traffic controlling devices controlling traffic movements over a track switch, a switch machine connected to operate said track switch, a signal governing traffic over said track switch, a control circuit for said switch machine including manually operable contacts, circuit means effective to interrupt said switch control circuit when said signal displays a proceed indication, a control circuit for said signal including manually operable contacts, circuit means effective to permit the completion of said signal control circuit when said switch machine corresponds in position to that of said manually operable switch machine control contacts, and circuit means whereby a clear signal is undisturbed by operation of said manually operable switch control contacts out of correspondence with said switch machine.

55. In an interlocking system; a track switch included in a plurality of routes; manually governable power operating means for operating said track switch; a signal for each of said routes capable of giving clear or stop indications; means preventing power operation of said track switch when included in any of said routes having its respective signal therefor cleared, but allowing the manual act for the governing thereof to take place; and means causing said track switch to be operated by its power operated means in response to such manual act executed while the signal governing a route over the track switch was cleared, if said signal governing that route over said track switch is caused to indicate stop.

56. In an interlocking system; a track switch included in a plurality of routes; power operating means for said track switch; control means for said power operating means, whereby any of said routes may be set up, said control means being permitted to be operated to set up a route conflicting with a first route already set up over said track switch; other means for at times preventing the response of said power operating means to its control means; and means initiated by a train moving over said first route to render said other means ineffective to prevent the response of said power operated means to its control means to set up said conflicting route.

57. In combination, a control office and a way station spaced therefrom, a track switch and a switch machine for operating said track switch both located at said station, a switch machine control relay for controlling said switch machine and controlled from said control office, a signal for governing traffic over said track switch, a signal control relay for controlling said signal and controlled from said office, and a circuit for when energized clearing said signal and energized in response to operation of said switch machine into correspondence with said switch machine control relay.

58. In combination, a track switch, two starting signals and two entering signals governing respectively the movement of traffic away from and toward the points and over said track switch, a starting signal branch wire, an entering signal branch wire, a double throw contactor controlled in accordance with the position of said track switch for connecting said starting signal branch wire to one or the other of said starting signals, a second double throw contactor controlled in accordance with the position of said track switch for rendering said entering signal branch wire effective to control one or the other of said entering signals, a third double throw contactor for applying electrical energy to one or the other of said two branch wires, and a fourth contactor for cutting energy off said third contact and controlled from a remote point.

59. In combination, a track switch connecting the end of a passing siding to a single track section, two starting signals and two entering signals governing respectively the movement of traffic into and out of said single track section, a starting signal branch connection, an entering signal branch connection, a double throw contactor controlled in accordance with the position of said track switch for connecting said starting signal branch connection to one or the other of said starting signals, a second double throw contactor controlled in accordance with the position of said track switch for rendering said entering signal branch connection effective to control one or the other of said entering signals, a third double throw contactor for applying electrical energy to one or the other of said two branch connections, and a fourth contactor for cutting off said electrical energy, a fifth contactor for controlling said track switch to either of its two extreme positions; and means for controlling said third, said fourth and said fifth contactors from a remote point.

60. In combination, a power operated switch machine for operating a railroad track switch, signals for governing traffic over said track switch, a polar neutral relay for governing the operation of said switch machine, means for manually controlling said polar neutral relay, means for manually controlling the clearing of said signals, and means for checking the complete response of said polar neutral relay to its control means before said signals can respond to their said control means.

61. A railway traffic controlling system of the type described for transmitting code messages from a control office to a remote station for the establishment of selected traffic routes over a railway switch at said station by related sequence of operations of devices in response to the particular code message received during a single transmission period; a switch; a plurality of signals for governing traffic over said switch; a first means controlled by a code message for blocking an existing route by causing the signal governing traffic over said existing route to go to stop, if clear; a second means controlled by a code message for operating said switch to establish an alternate route only when all said signals governing traffic over said switch are at stop; and a third means including a circuit having contacts actuated when said track switch completes its stroke included in series with contacts controlled by said second means for preventing the clearing of the signal governing over said alternate route from the time said second means is effective to control said track switch to establish such alternate route until said alternate route has been established.

62. A railway traffic controlling system for transmitting a single code message from an office to a remote station and effective when received

at the remote station to establish a traffic route over a railway switch at said station in a related sequence of operations comprising; a railway track switch for establishing a plurality of routes; a signal for each route; a first means controlled by a code message for blocking an existing route by causing the signal governing traffic over said route to go to stop, if clear, provided the route identified by said message is for a different traffic direction over a different position of said switch; a second means for operating said switch only when all signals governing movements over said switch are at stop, and provided the route identified by said message is over a switch position differing from an existing position of said switch; and a third means for clearing the signal corresponding to the particular route identified by said message only when said switch is in a position in agreement with the route identified by said message.

63. A route signaling system for controlling the four signals governing the four routes over a railway switch, determined by the two positions of said switch and by the two traffic directions over said switch, by means of a multiple element code transmitted from a remote point comprising; a track switch; a signal for each of four routes over said switch; a series of stick relays; means responsive to a transmitted code to cause said relays to assume one position or another according to the character of selected elements of said code; and means for controlling the circuits for said signals individually and selectively by said relays.

64. In a centralized traffic control system, the combination with a power-operated track switch and its associated signals governing traffic over said switch in both directions, relay means for governing the operation of said switch, other relay means for governing the clearing of said signals, line wires extending from a distant control office to the switch location, step-by-step means at the switch location for first rendering said switch relay means and then the said signal relay means independently and successively responsive to the condition of energization of said line wires during one operation of said step-by-step means, circuit means for clearing each of said signals controlled by said signal governing relay means, and means for preventing energization of said circuit means while said switch is being controlled to a different position by said switch relay means.

65. A centralized traffic control system comprising, switch and signal control levers at a control office, line wires extending from the control office to a field location, means governed by said levers for distinctively energizing said line wires at successive time intervals during one operating cycle to form code elements each variable in character to conform with the existing position of said control levers, separate switch and signal control means at the field location responsive to said successive code elements for governing first the operation of said switch and then the clearing of one of said signals during the same operating cycle, a clearing circuit for each signal governed by said signal control means, and means for preventing closure of said clearing circuit while said switch is being controlled by said switch control means to assume a position different from its existing position.

66. In a centralized traffic control system including a control office and a field location connected by line wires, a manually operable switch lever in the control office freely movable at any time, a switch machine at the field location including a motor for operating and locking the switch points, a contactor device at the field location operable to either of two positions to supply current to said motor and cause operation of said switch machine to either its normal or its reverse position, normal and reverse relays at the field location for governing said contactor device, switch control means at the field location for selectively energizing said relays, normally inactive communication means including said line wires and adapted to be manually set into operation at the control office for conditioning said switch control means temporarily to conform with the existing position of said switch lever, and means at the field location for retaining said switch control means in its actuated condition after each operation of said communication means until subsequently changed by another operation.

67. A system of centralized traffic control governing the operation of power-operated track switches over line wires extending from a control office to a switch location comprising, a freely movable and manually operable control lever in the control office, switch control means at the switch for governing the operation thereof to the normal or the reverse position, normally inactive communication means including said line wires and adapted to be manually set into operation at the control office for temporarily conditioning said switch control means by current impulses of distinctive character to conform with the existing position of said control lever, and means for retaining said switch control means in its actuated condition after each operation of said communication means until subsequently changed by another operation.

68. In a system of centralized traffic control for railroads, the combination with a switch control lever in a control office manually operable and freely movable at all times, of a power-operated track switch and associated signals at a distant field location, a communication system of the multiple impulse type including line wires extending from the control office to the field location, and switch control means at the field location comprising, normal and reverse relays for governing the operation of said switch to its normal and reverse positions, code responsive means governed by said communication system in accordance with the existing position of said control lever for selectively energizing said relays, and approach locking means effective only if a train approaches within a predetermined distance of said switch under a proceed signal for preventing energization of said relays in response to said code responsive means.

69. In a system of centralized traffic control for railroads, the combination with a switch control lever in a control office manually operable and freely movable at all times, of a power-operated track switch and associated signals at a distant field location, a communication system of the multiple impulse type including line wires extending from the control office to the field location comprising, a normal relay and a reverse relay for governing the operation of said switch to its normal and reverse positions, code responsive switch control means at the field location temporarily governed by said communication system in conformity with the existing position of said switch lever, means for retaining said code responsive means in its actuated condition after each operation of the communication system until subsequently changed, and locking means for at times

preventing operation of said switch machine by said code responsive means.

70. A centralized traffic control system comprising, a control office, a plurality of traffic controlling devices at a distant field location, track circuits at the field location automatically controlling said devices, a plurality of freely movable manually operable control devices in the control office, a normally inactive communication system including line wires extending between said control office and the field location and step-by-step means at the control office and at the field location operated synchronously in response to the energization of said line wires, control means at the field location for governing the operation of said traffic controlling devices subject to the automatic control of said track circuits, and manually operable means at the control office freely movable at any time for rendering said communication system active to condition each of said control devices during a single cycle of operation and regardless of the condition of said track circuits to conform with the then existing position of said manually operable control devices.

71. A centralized traffic control system for railroads including a control office and a field station, a three-position signal control lever at the office, electro-responsive means at the field station which may assume any one of three conditions, opposing signals at the field station governing traffic in opposite directions over the same track, operating circuits for said signals including contacts of said electro-responsive means closed selectively in certain ones of its different operated conditions, means for momentarily conditioning said electro-responsive means by momentary current impulses under the control of said lever, thereby clearing a selected one of said signals or placing said signals at stop dependent upon the existing position of said control lever, and means for maintaining said electro-responsive means in its operated condition until subsequently changed.

72. A centralized traffic control system including a control office, a field station, a three-position manually operable signal lever, a separate switch lever at the control office, a power-operated track switch at the field station, signals for governing traffic over said switch in opposite directions, separate switch control means and signal control means at the field station respectively governing the operation of said switch and signals, manually operable starting means at the control office, a communication system partly at the control office and partly at the field station and including line wires extending from the control office to the field station, said communication system being normally inactive and being responsive to momentary operation of said starting means to cause first said switch control means to assume a condition in accordance with the existing position of said switch lever and then said signal control means to assume a condition to conform with the existing position of said signal control lever during the same operating cycle.

73. In a centralized traffic control system for railroads, the combination with a number of signals at different field locations along the railroad track and each controlled in accordance with traffic conditions ahead, of means for controlling said signals separately and distinctively from a distant control office over the same line wires comprising, step-by-step means in the control office and at each field location, said line wires including a stepping line circuit for operating all of said step-by-step means in synchronism to close a series of contacts successively at corresponding times, a manually operable lever in the control office for each signal, control means in the field for each signal, partial circuits selectively controlled by said contacts for rendering each lever effective to control its own corresponding control means over said line wires at a particular time interval, and holding means for maintaining each control means in its last operated condition, except during its particular time interval.

74. In a centralized traffic control system of the character described, in combination with a control office and line wires connecting said control office and a field station, of apparatus at the field station including electro-responsive means energized over said line wires for closing a series of contacts consecutively in response to the repeated short periods of energization and deenergization of said line wires, and a slow-acting relay not responsive to said repeated short energizations of said line wires by reason of their short duration but responsive only to a relatively long energization of said line wires and acting only if thus actuated to render said electro-responsive means operable to respond to such energization and de-energization of said line wires.

75. A centralized traffic control system for railroads comprising, a control office, a plurality of distant field stations, step-by-step means at each field station normally inactive in a predetermined initial condition, a stepping line circuit extending from the control office to the several field stations for operating said step-by-step means in synchronism, manually controllable means in the control office for distinctively controlling said stepping circuit to render said step-by-step means at all of the several stations operable to respond to subsequent energizations and de-energizations of the stepping line circuit, a track circuit at each of said field stations, and means local to each station operated by a change in the condition of said track circuit and effective only when said step-by-step means is in its initial condition for rendering the step-by-step means at that particular station only responsive to subsequent energizations and de-energizations of said stepping line circuit.

76. A centralized traffic control system for railroads comprising, in combination with a control office and a plurality of field stations and line wires connecting said control office with the several stations, means for intermittently energizing and de-energizing said line wires, of normally inactive step-by-step means at each field station operable only if conditioned for such operation to respond to repeated energizations and de-energizations of said line wires, a plurality of track circuits at each field station, and means responsive to a change in the condition of any one of said track circuits at any time for conditioning the step-by-step means at the corresponding station for such operation.

77. In a centralized traffic control system for railroads of the character described, the combination with a portion of track at a field location equipped with a plurality of track circuits and a distant control office, of a communication system for transmitting indications to the control office of the condition of said track circuits comprising, line wires connecting the control office and the field location, means for intermittently energizing and de-energizing said line wires, normally inactive step-by-step means at

the field location having an initial condition, a starting relay automatically actuated by a change in the condition of any one of said track circuits at any time, means wholly at the field location controlled by said starting relay for rendering said step-by-step means responsive to successive energizations and de-energizations of said line wires, and means for maintaining said starting relay in its actuated condition until said step-by-step means has operated from its initial condition.

78. In a centralized traffic control system for railroads, in combination with a track circuited section of track at a field location over which trains may move in opposite directions, of a control machine at a distant control office having a miniature diagram of the track and lamps thereon to show the presence and direction of movement of trains on said track section, a normally inactive communication system including step-by-step means and line wires extending from the control office to said field location and automatically initiated by the entrance of a train into said track section for selectively controlling the lighting of said lamps in accordance with the direction of train movement into said track section.

79. A centralized traffic control system for railroads comprising, in combination with a normally inactive communication system including line wires extending from a control office to a distant field location and operable to transmit code signals having plurality of code elements each variable to have any one of three distinctive characters, of manually operable levers in the control office for determining the character of two particular code elements, manually operable means in the control office associated with said levers for initiating operation of said communication system, separate switch and signal control means at the field location distinctively responsive to the character of said particular code elements, a power-operated track switch governed by said switch control means, and signals for governing traffic over said switch in opposite directions in its different positions having clearing circuits selectively controlled by said signal control means.

80. A system of centralized traffic control for governing from a control office the clearing of signals at a distant field location which govern traffic in opposite directions over a portion of track, comprising, in combination with a normally inactive communication system including line wires connecting the control office and the field location and operable to transmit time-spaced code elements each variable to have any one of three distinctive characters, a signal control lever in the control office for determining the character of a particular one of said code elements, manually operable means in the control office associated with said lever for initiating operation of said communication system, relay means in the field momentarily conditioned to any one of three different conditions in response to the character of said particular code element, means for maintaining said relay means in its last operated condition until subsequently changed, and clearing circuits for said signals selectively closed by said relay means in two of its conditions and both opened by said relay means in its third condition.

81. A system of centralized traffic control for governing from a control office the operation of a power-operated track switch at a distant field station and signals governing traffic over said switch in its different positions comprising, manually operable control means in the control office adapted to be positioned to conform with the position of the track switch and control of the signals desired, line wires connecting said control office and switch location, means for impressing a code signal on said line wires having a plurality of code elements each changeable in character, means for changing the character of certain of said code elements in accordance with the existing position of said manually operable means, code receiving means at the field station including switch control means and signal control means respectively conditioned temporarily in conformity with the character of said certain code elements in the code signal then being transmitted, said switch control means being conditioned prior to the conditioning of said signal control means, means for retaining said switch and signal control means in their actuated conditions after each code signal until changed by a subsequent code signal, and means controlled by said signal control means for clearing each traffic signal and effective when said switch has operated to a position corresponding with the existing condition of said switch control means.

82. In combination, a local office, a distant way station, a track switch at said station, a signal associated with said track switch, two line circuits each at times connecting said local office and said way station, means for controlling operation of said track switch from one extreme position to the other over one only of said line circuits, means for controlling said signal over said one switch control line circuit without changing the position of said switch, and means for independently controlling said signal over the other line circuit.

83. A centralized traffic control system for railroads including a control office and a field station connected by line wires comprising, manually controlled means at the control office for applying to said line wires at times a relatively long current impulse and thereafter a series of shorter impulses, normally inactive step-by-step means at the field station, a slow-acting relay at the field station constructed to respond to said relatively long current impulse by reason of its duration but not said series of shorter impulses by reason of their shorter duration, and means effective only if said slow-acting relay has responded for operating said step-by-step means in response to said series of shorter impulses.

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