G. S. PFLASTERER.

BLOCK SIGNAL SYSTEM.

APPLICATION FILED JUNE 9, 1908.

913,557.

Patented Feb. 23, 1909.

3 SHEETS—SHEET 1.

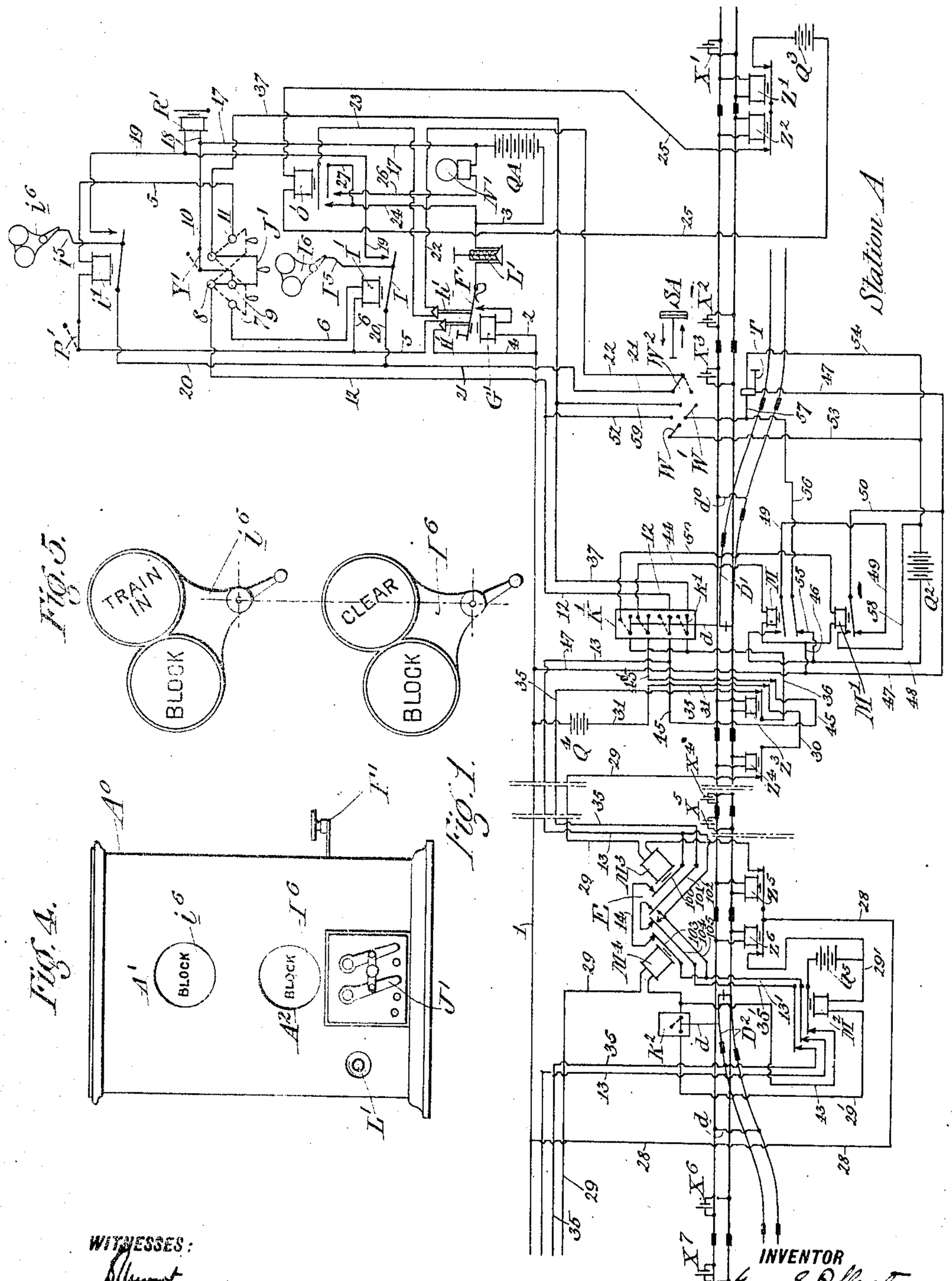

Fig. 1.

Fig. 3.

Fig. 4.

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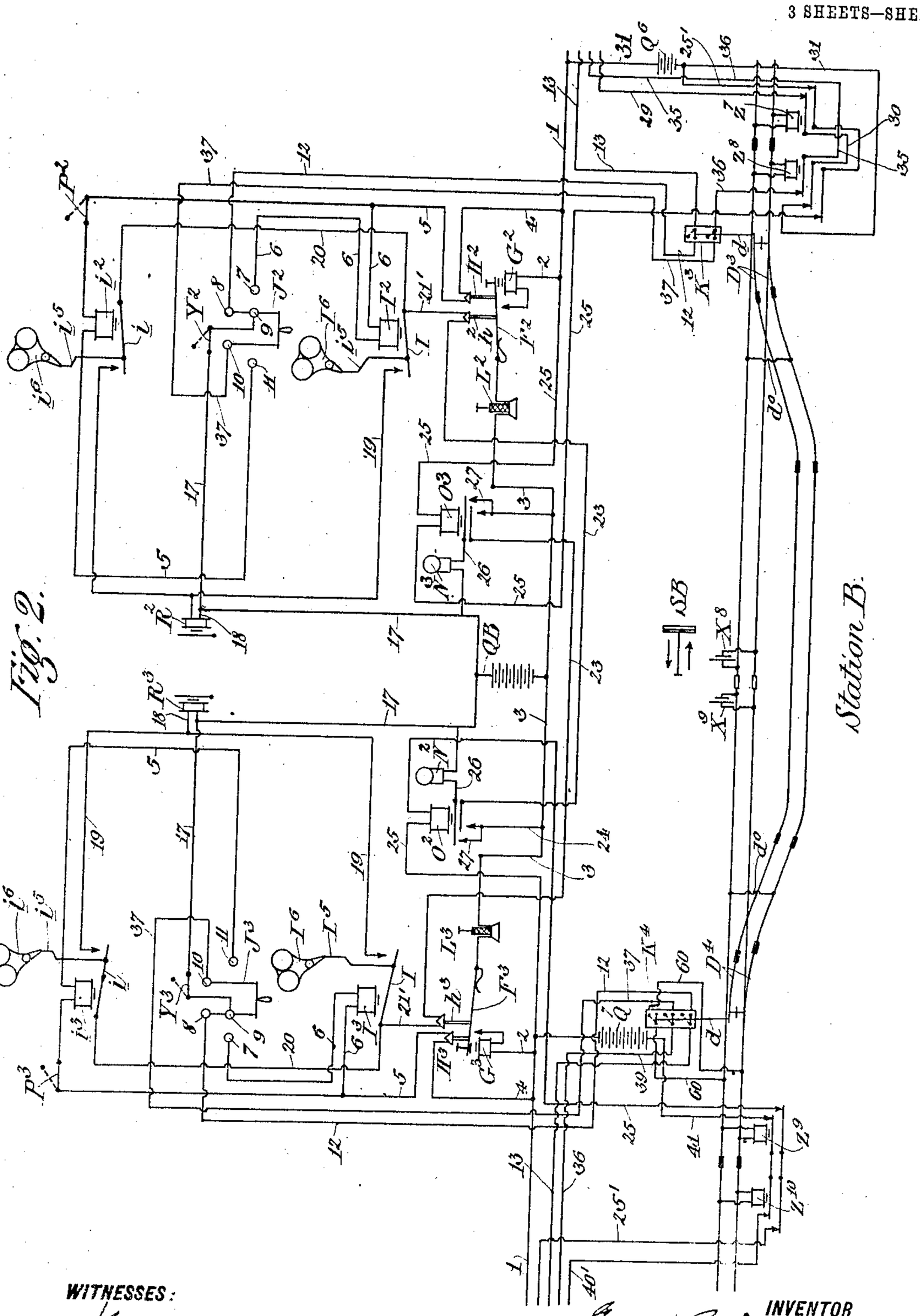

Fig. 2.

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[illegible]

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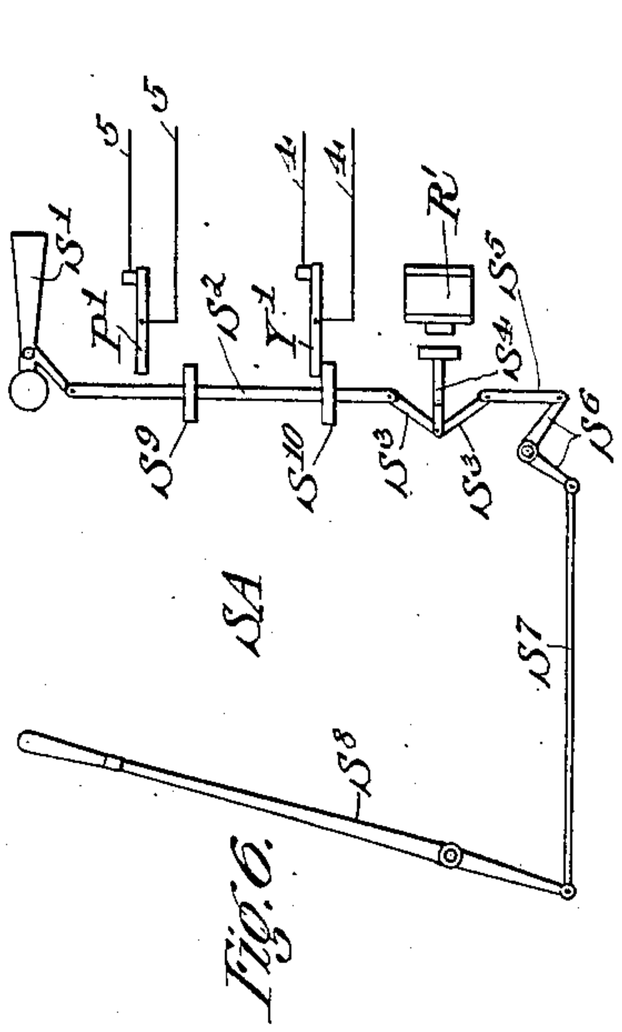

Fig. 6.

Station C.

Fig. 3.

Fig. 7.

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BLOCK-SIGNAL SYSTEM.

No. 913,557. Specification of Letters Patent. Patented Feb. 23, 1909.

Application filed June 9, 1908. Serial No. 437,542.

To all whom it may concern:

Be it known that I, GEORGE S. PFLASTERER, a citizen of the United States of America, residing in Nashville, in the county of Davidson and State of Tennessee, have invented a certain new and useful Improvement in Block-Signal Systems, of which the following is a true and exact description, reference being had to the accompanying drawings, which form a part thereof.

The present invention relates to railway block signal systems and particularly to block signal systems for single track railways.

One main object of the invention is to provide a reliable, effective and relatively simple block signal system of the kind described which can be cheaply installed and is inexpensive to maintain.

The preferred form of the system which I have devised is electrically controlled and manually operated and resembles the well known telegraph block signal system and one of the objects of the invention is to provide a system into which an existing telephone block system may be readily and inexpensively converted.

By preference the system is arranged to permit an absolute clear signal indication to be given a train about to enter the block if the latter is unoccupied and while not permitting such an indication when the block is occupied, to permit a permissive signal indication to be given to admit a train to the block following a previously admitted train, provided the latter has proceeded a predetermined distance from the end of the block at which it entered. The invention however is not limited in all of its aspects to a system having provisions for permissive signaling. The signal circuit may be controlled by trains in the block either through short insulated track sections or a continuous track circuit, though the latter alone is disclosed herein. By preference also, as illustrated herein, each signal proper is actuated through an electric slot controlled mechanism arranged to return the signal to danger whenever either the front end or the rear end of a train entering the block passes by the signal.

In the particular system disclosed in detail herein front end control of the slot magnets is had.

One important feature of the particular form of apparatus disclosed is found in the fact that every signal clearing operation whether absolute or permissive requires the permission and coöperation of the operators at both ends of the block and another important feature of this apparatus is found in the arrangement for preventing any signal from being cleared until a train is in proximity thereto preventing the operator from carelessly anticipating train movements.

The invention also comprises arrangements by which the opening of the switches or sidings joining the main track of the blocks automatically brings to danger if cleared and regulates the clearance of the main signals at the block ends, and by which train movements from the station switches or intermediate switches may be controlled as through special signals for the sidings, by the operators at the ends of the block.

An advantageous feature of the system disclosed is due to the fact that it readily permits the use of an automatic signal or signals between the ends of a block when necessary or desirable as where the block is of considerable length. These signals have the effect of giving space permissive signaling. With these automatic signals each of the portions into which the block is divided may be operated as an absolute block or one portion may be operated as an absolute block and the other as a permissive block.

The various features of novelty which characterize my invention are pointed out in the claims annexed to and forming a part of this specification. For a better understanding of the invention, however, and the advantages possessed by it, reference may be had to the accompanying drawings and descriptive matter in which I have illustrated and described forms in which the invention may be embodied.

Of the drawings: Figures 1, 2 and 3 are diagrams which, taken together, show two adjacent blocks equipped with my invention, the form of the invention employed in one block differing slightly from that in the other. Fig. 4 is an elevation of the case holding certain of the block instruments at one station. Fig. 5 is an elevation of the indicators employed in the case shown in Fig. 4. Fig. 6 is a diagrammatic representation of one form of signal and actuating mechanism proper which may be employed, and Fig. 7 is an elevation of a portion of one of the interlocking relays.

Of the two adjacent blocks, AB and BC shown by Figs. 1, 2 and 3, Fig. 1 shows one

station which I have marked station A and most of the track and circuits running from station A to station B. Fig. 3 similarly shows the apparatus at the remote end of block BC, while Fig. 2 shows the duplicate set of parts at station B, one set coöperating with those of Fig. 1 to form the complete equipment for block AB and the other set with those shown by Fig. 3 to form the complete equipment for the block BC.

It will be understood of course that the apparatus at stations A and C may or may not be duplicated to coöperate with apparatus at stations more remote from station B to protect other portions of the track than are shown in Figs 1, 2 and 3. The signal-apparatus for the two blocks shown differ somewhat though having many features in common. The four sets of station instruments and circuits are in general alike, and corresponding ones of these and other parts of the apparatus are indicated by the same reference symbols, exponents being employed where necessary to avoid confusion.

The main rails are divided into sections of suitable length by insulated joints, track relays Z^1—Z^{16} are connected across the rails one for each section, and each section is provided with a battery or other source of signal current X^1—X^{16}. Sidings or branches D^1—D^5 join the main track at various points along the two blocks shown. Adjacent the switch points of each of the sidings D^1—D^5 is one of a set of contact boxes K^1—K^5, the contacts in each of which are connected to the corresponding switch points by a link d so that as the switch points are moved from the normal closed position shown, the contacts are moved from the full line position shown into the dotted line position. A short section of each outside siding track rail adjacent the switch points is connected to the opposite rail of the main track so that a train on this section of the siding deënergizes the track relay for the adjacent main track section.

For each adjacent block end at each station there is a set of instruments which is duplicated at the other block ends. These instruments comprise keys F^1, F^2, F^3, F^4 normally spring held in the position shown, but each adapted when depressed to be held down by the corresponding one of a set of magnets G^1, G^2, G^3, G^4, if the latter be energized; indicator magnets I^1, I^2, I^3, I^4, indicator magnets i^1, i^2, i^3, i^4, magnets O^1, O^2, O^3, O^4, bells or other annunciators N^1, N^2, N^3, N^4, slot magnets R^1, R^2, R^3, R^4, emergency push button, circuit breakers, L^1, L^2, L^3, L^4, and signal-controlling hand switches J^1, J^2, J^3, J^4.

Each of the magnets I^1, I^2, I^3, I^4 has a pivoted armature i to which is connected by link I^5, a pivoted indicator or target I^6. Similarly each of the magnets i^1, i^2, i^3, i^4 has an armature i connected by a link i^5 to an indicator or target i^6. Each of the keys F^1, F^2, F^3, F^4 carries two circuit closing contacts H^1, H^2, H^3 or H^4 and h^1, h^2, h^3 or h^4.

In Fig. 4 I have shown a construction in which the magnets I^1 and i^1, hand switch J^1, key F^1 and push button L^1 for station A are all mounted in a single case A^0, suitable for mounting on a telegraph table. The case A^0 is provided with upper and lower openings A^1 and A^2 in front of the indicators i^6 and I^6 different portions of which are exposed accordingly as magnets i^1 and I^1 are energized or are deënergized, the latter condition being the normal one, which is illustrated in Fig. 4. Preferably these targets bear legends as indicated, target i^6 the legend Block, exposed when i^1 is deënergized, and the legend Train in, exposed when i^1 is energized, while target I^6 bears legend Clear, exposed when I^1 is energized, and legend Block, exposed when magnet I^1 is deënergized. By this arrangement the following readings are obtained at each instrument according to the condition of the block: Block block, Block clear, Train in block. At each of the stations A, B and C there are sources of current, as batteries, QA, QB and QC, respectively, and a signaling mechanism proper, SA, SB and SC, respectively. The signaling mechanism at each block end for controlling train movements into the block may comprise a three position signal or two two-position signals of any preferred form.

In Fig. 6, I have shown a signal mechanism proper which may be used at station A. In this figure S^1 represents the pivoted three-position signal blade, S^2 the signal rod, S^3, S^3 the jointed links of the electric slot, S^4 the armature for holding these links rigid, when slot magnet R^1 is energized and S^5 and S^7 links, and S^6 a bell crank lever connecting the lower end of the slot links to the operating handle S^8. Collars S^{10} and S^9 throw circuit controllers Y^1 and P^1 respectively, when the signal blade is moved into the 45° and vertical positions, respectively, these positions corresponding to permissive and full clear positions respectively.

The apparatus shown in Figs. 4, 5 and 6 for the right-hand end of block BA may be duplicated at station C (once) and at station B (twice) for the other block ends. The apparatus shown in Figs. 4 and 5 is simple, compact and reliable, and possesses among other advantages the important one that while the station instruments through the slot magnets, etc., as we shall see, effectually control the signals the parts are not locked against movement but may be freely moved at all times without likelihood of injuring the delicate parts of the mechanism.

In addition to the instruments referred to above, there are interlocking relays E and E^1 in blocks AB and BC respectively, and in

connection with relay E^1 there are automatic signals V and U, and in connection with intermediate switch D^1 there is an automatic signal T and circuit control mechanism, the purposes and operation of which will be hereinafter explained in detail.

An understanding of the general operation of the signal system will be facilitated by a consideration of the sequence of events occurring when the operator at one station, say A, desires to admit a train, moving toward B, into the adjacent end of block AB. It should be explained that in the drawings the parts are shown with the switches closed, tracks free from trains and signals at danger.

Assuming that block AB is empty and operator at A wishes to admit a train to block AB, to move toward B, his first step is to communicate his desire to station B, preferably by telephone. If the conditions permit, then operator at A moves hand switch J^1 toward B and operator at B depresses key F^2, which is held down by magnet G^2, energized by current flow from battery QB through the following circuit; line 3, contacts controlled by L^2; key F^2; line 2, which includes magnet G^2; line 1 to station A; then through line 4; contacts closed by H^1 line 5; line 6, including magnet I^1; contacts 7 and 8 closed by switch J^1; line 12 to switch box K^1, and through normally closed contacts therein; line 13; contacts 100 and 103 and line 14 of relay E; line 13^1; contacts controlled by magnet M^2; line 13 running to B, normally closed contacts in box K^3, line 12; contacts 8 and 9, closed by switch J^2, normally closed switch Y^2, and line 17 to battery QB. The current flow through the circuit described in addition to energizing stick magnet G^2 energizes magnet I^1 and causes it to attract its armature I and shift target I^6 at A so that targets at A now read from top to bottom "Block clear." The energization of magnet I^1 also connects lines 19 and 20, which form part of the energizing circuit for slot magnet R^1.

The circuit just described forms the absolute signal clearing circuit and a substantially similar circuit must be closed to fully clear the signal at any other block end, though in block BC the connections at relay E^1 between the two lines 13 are slightly different from those at E. In each case the switch J^1, J^2, J^3 or J^4 at the station where signal is to be cleared must be moved toward the other end of block.

It will be obvious that the absolute clear circuit cannot be completed unless the two hand switches J^1 J^2 are in the positions described, and the switches D^1, D^2 and D^3 are closed, and the magnets M^3 and M^4 of interlocking relay E are energized, and that if the circuit is established it will be broken on any change in these elements. Furthermore the signal SB, at B for block AB must be at danger or switch y^2 will be open. Magnets M^3 and M^4 will not both be energized unless block AB is free from trains as will be explained. It is apparent also that operators at A and B cannot now proceed to establish the absolute clear circuit for B without breaking the absolute clear circuit for A, since at each station the circuit breaker H^1 or H^2 and hand switch J^1 or J^2 must be each in one position to clear the signal at one station and in another position to clear the signal at the other station.

The operation of the signal SA at station A requires the energization of slot magnet R^1. R^1 is energized by battery QA through the following circuit: lines 17, 18, 19, armature I; lines 20, 21, normally closed contact W^2, line 22, circuit breaker h^1, line 23, upper armature of magnet O^1 when the latter is deenergized; lines 24 and 3, and battery QA. Magnet O^1 is normally energized by a circuit which includes the winding of magnet O^1 battery Q^3, armatures of track relays Z^1 and Z^2 and lines 25. This circuit is broken by deënergization of track relays Z^1 or Z^2, when a train is in either of the track sections to which they are connected. This arrangement results in preventing the signal at A from being cleared until a train arrives at track section to which relay Z^1 belongs, thus preventing the signal operators from anticipating train movements and clearing the signals before such clearance is necessary.

The presence of a train in sections to which relay Z^1 and Z^2 are connected is indicated by an electric bell or other annunciator N^1 energized when magnet O^1 is deënergized, through battery QA and lines 26, lower armature of magnet O^1, lines 27, 24 and 3. The length of the annunciator sections is optional with the user.

The operation of energizing slot magnets R^2, R^3 or R^4 is substantially similar to that for R^1 though the circuit arrangements are slightly different. In the case of each of slot magnets R^2, R^3 and R^4 there is no circuit controller W^2 and lines 21 and 22 are replaced by lines 21′ running from line 20 to corresponding circuit breaker h^2, h^3 or h^4. The control of the energization of magnet O^4 by relays Z^{15} and Z^{16} and battery Q^{11} is through circuit arrangements exactly like those for magnet O^1. Magnet O^3 is controlled by track relays Z^8 and Z^7 through a circuit including these armatures, line 25′, line 31 and battery Q^6 to line 1, line 1 to junction of line 2, and line 25 to magnet O^3 and back to armature of relay Z^8. Magnet O^2 is controlled by track relays Z^9, Z^{10} and Z^{11}, line 25′ running from armature of relay Z^{10} to armature of relay M^5, the energization of which depends on Z^{11} as will be explained later. Current for energizing magnet O^2 is furnished by battery Q^8 at E^1, one terminal of the battery being connected to line 25′

when relay M^5 is energized and the other terminal by line 40 to line 1.

When the operator at A is notified by annunciator N^1 of the presence of a train moving to enter block AB and after he has had his slot relay R^1 energized as described, he next clears signal SA. This opens switch Y^1 and thus prevents the signal SB at the other end of the block from being cleared regardless of the other circuit conditions.

As soon as the train entering the block AB at A, comes on track section to which relay Z^3 is connected, magnet M^3 of interlocking relay E is deënergized, as the armature of relay Z^3 as well as the armatures of relays Z^4 and Z^5 are included in the energizing circuit of relay M^3. This circuit includes in addition to these relay armatures the following: battery Q^4, lines 31, 30, 29 and 28 to line 1, to which one terminal of battery Q^4 is connected. When magnet M^3 is deënergized and armature 100 drops, the absolute clear circuit for signal SA is broken and magnets I^1 and G^2 are both deënergized. This breaks circuit for magnet R^1 and returns signal SA to danger and by allowing key F^2 to resume its normal position, notifies operator at B that train has entered block at A. A bell may be arranged either within or without the box A^0 to be actuated by key F^2 when released.

While signal SA cannot be fully cleared again so long as the train is in the block, it can be moved into the cautionary or permissive position as soon as a train entering at A has passed beyond the track section to which relay Z^3 is connected. To establish the permissive signal clearing circuit operator at A communicates with operator at B and the latter, if willing, again depresses his key F^2. Operator at A must also throw switch J^1 to the right of normal. The following circuit is then established: battery QB line 3, L^2, key F^2, line 2, line 1, line 4 at A, line 5 including switch P^1 and magnet i^1, contacts 11 and 10 and switch J^1, line 37, normally closed contact in box K^1, line 36, armature of relay Z^3, line 35, interlocking armatures 101 and 105 of E which are now in contact and from thence back to battery QB through lines 13^1, 13, 12 and 17, and switches, etc., as in the case of the absolute clear circuit. The energization of magnet i^1 shifts target i^6 so that the target reading at A is now Train in block. When magnet i^1 is energized its armature connects lines 19 and 20. This permits magnet R^1 to be energized and signal SA to be cleared, as in the case of the absolute clear circuit, before described. In this case, however the signal SA can only be moved to the cautionary position since further movement of the signal opens switch P^1. When the train now enters the block and moves by signal SA onto track section to which Z^3 is connected, signal SA again goes to danger. As soon as relay Z^3 is again energized the signal SA can be again moved into the permissive position by proceeding as before, but it is to be noted that in all cases the movement of a train into block, returns signal to danger, and the signal cannot again be cleared either absolutely or permissively, except by the coöperation of the operators at the two ends of the block.

Magnet M^4 of relay E is energized by battery Q^6 through a circuit analogous to that for energizing magnet M^3, the only material difference being that in the case of magnet M^3 one terminal of the magnet runs directly to the armature of relay Z^5, while in the case of magnet M^4 a conductor 29^1 runs from armature of relay Z^6 to one contact in switch box K^2, the corresponding contact being connected to one terminal of magnet M^4. Conductor 29^1 includes winding of magnet M^2, the purpose of which will be explained later. As soon as a train moving from A toward B enters section to which relay Z^6 is connected, the latter is deënergized and thus opens the circuit through M^4. Since magnet M^3 is already deënergized, however, armatures 104 and 101 mechanically interlock and the latter is held by the former in engagement with armature 105 until magnet M^4 is again energized, regardless of whether magnet M^3 is energized or not. In consequence, the permissive circuit for signal SA can be established regardless of the number or location of trains in block AB moving toward B, provided only that relay Z^3 is energized. The purpose of the emergency push button circuit breakers L^1, L^2, L^3 and L^4 is to permit an operator who has previously actuated his operating key F^1, F^2, F^3 or F^4, as the case may be, to close the signal circuit permitting the clearance of a signal at the opposite end of a block from that at which the operator is located, to break the signal circuit closed, in case of emergency, by actuating the one of the push button devices L^1, L^2, L^3 or L^4 located at his station.

The control of train movements from B to A is the same as in the opposite direction, except as already indicated.

The operation of block BC is generally like that of block AB, except as it is modified by the provisions had for the control of train movements through automatic signals V and U. These provisions do not affect the operation of the main signals at the end of the block when the absolute or permissive signal clearing circuits are established, nor do they affect the establishment of the absolute signal clearing circuits, but they do affect the establishment of the permissive signal clearing circuits. In the arrangement shown for block BC the permissive signal clearing circuit for signal SB or SC cannot be established

until after a train entering the block at B or C has moved past signal V or U, as the case may be.

The magnet M^6 of interlocking relay BC is energized by battery Q^8 through a circuit including a portion of line 43 and one armature of relay M^5 and a portion of line 42. Similarly, magnet M^7 is energized from battery Q^9 by a circuit including a portion of line 42, line 43 and armature of relay M^8. Signals U and V are also energized by batteries Q^8 and Q^9, respectively, through circuits comprising lines 42 and contacts controlled by the energization of magnets M^5 and M^8, respectively. Magnet M^8 is energized when track relays Z^{12}, Z^{13} and Z^{14} are energized, by circuit including in addition to the armatures of these relays, battery Q^{10}, lines 41^1, 40^1, 40 and a portion of line 1. Magnet M^5 is energized from battery Q^7 through a similar circuit controlled by track relays Z^9, Z^{10} and Z^{11}.

When a train enters one end of block BC, for instance at C, magnet M^8 is at once deenergized and remains in this condition until the train passes out of the section to which relay Z^{12} is connected. The deënergization of magnet M^8, in addition to deënergizing magnet M^7, causes normally clear signal V to fall into the danger or cautionary position, either being optional with the user.

When magnet M^7 is deënergized, contact 107 engages contact 111 and as contacts 107 and 110 interlock, when magnets M^7 and M^6 are deënergized, contacts 107 and 111 remain in engagement until the train moving from B to C has passed out of the block. With contacts 107 and 111 in engagement and magnet M^7 energized, the following permissive signal clearing circuits for signal SC may be established, assuming that operators at B and C coöperate as described for block AB. Battery QB, line 3, L^3 F^3, lines 2, 1, 4 at C, H^4, lines 5 through switch P^4 and winding of magnet i^4, contacts 11 and 10 and switch J^4, line 37, normally closed contacts in box K^5, line 36, contacts 106 and 111, line 13^1, contacts controlled by magnet M^8, line 13, normally closed contacts in box K^4, line 12, contacts 8 and 9 and switch J^3, and line 17 to battery QB. This circuit may be established whenever the block is unoccupied between E^1 and C, regardless of the presence of a train or trains moving toward B in the block portion between E^1 and C. Signal U is at clear or danger position accordingly as the block portion last mentioned is occupied or not, and this signal determines accordingly whether or not a train arriving at E^1 from C may proceed freely or with caution through the remainder of the block. The train movements from B to C are controlled in the same manner as movements from C to B.

In the case of each of the switches D^1, D^2, D^3, D^4 and D^5 the opening of the switch causes certain changes in the contacts or electrical switches located in the corresponding one of switch boxes K^1, K^2, K^3, K^4 and K^5. In the case of switches D^4 and D^5 the opening of the switches causes the normally open contacts in the switch box K^4 and K^5 to close low resistance shunts 60 across the rails of the track sections to which the track relays Z^9 and Z^{14} are connected, so that those relays are deënergized and when switches are opened. This produces the same effect upon the automatic signals and interlocking relays E^1 that would be produced by the entrance of a train onto these track sections. Moreover, since both the permissive and absolute clearing circuits are broken at the boxes K^4 and K^5 when the corresponding switches D^4 and D^5 are operated, main signals at the end of the block cannot be moved out of the danger position until the switches are again closed, and if these signals are clear when the switch is open the breaking of these circuits immediately returns the signals to danger. The presence of a train on a switch portion connected to the track circuit proper by bond d^0 of course has the same effect upon the signal circuits as the presence of a train on the track section to which the bond d^0 runs. In consequence of this arrangement a train moving onto the main track from siding D^4 or D^5 prevents the clearance of any signal until after the train moving toward B or C respectively has left the block, or moving toward C or B respectively, has passed beyond the corresponding automatic signal at E^1. Similarly the presence of a train on the section of switch D^3 connected to the adjacent track section by bond d^0 makes it impossible to give a signal at either end of the station until the train has passed beyond relay Z^8 going toward A or until after it has passed out of the block at B when going toward C. In the case of switches in block AB, the shunts 60 are obviously not needed. In the case of switches D^3, D^4 and D^5 train crews are instructed not to leave the siding until permission has been received from the adjacent signal operator who gives the permission only after consulting the other operator. This permission is given preferably by telephone. For intermediate switches in block A—B, that is, for sidings or branches joining the main track at points between the track sections to which relays Z^3 and Z^8 are connected, *i. e.* at points where the presence of a train does not prevent the giving of a cautionary indication by the appropriate main signal, means should be provided for obtaining better protection than is had at switches D^3, D^4 and D^5. One of the arrangements which I propose to employ is shown in block AB for switch D^2.

This arrangement is such that main line train movements have no effect on the switch protecting mechanism.

As already explained, relay M^2 is provided adjacent interlocking relay E. This relay is initially energized by the circuit which energizes interlocking relay magnet M^4. The energization of relay M^2 closes a local energizing circuit through M^2 including battery Q^5, contacts controlled by armature of M^2, line 43, contact in box K^2 and a portion of line 29^1 back to battery Q^5. It will thus be seen that so long as switch D^2 is closed, magnet M^2 will be energized from its battery Q^5 regardless of whether or not the circuit through magnet M^4 is maintained. Permission to open the switch is given the crew of the train on the siding by the operator at B, if the train is to move toward B; and by the operator at A, if the train is to move toward A, after a conference between the two operators in either case.

When the switch D^2 is opened, the relay M^2, as well as magnet M^4 is deënergized by the breaking of the circuit in box K^2. The deënergization of magnet M^2 breaks the absolute and permissive signal clearing circuits through the consequent movement of the armatures connecting lines 13 and 13^1 and lines 35 and 35^1. This prevents signals at A and B from being cleared absolutely or permissively and if one of these is clear the opening of the switch returns it to danger. So long as the train moving out of the siding D^2 is between B and E magnet M^4 remains deenergized and consequently relay M^2 does also. The result of this is that if the train coming out of the siding moves toward B, no signal at the end of the block can be cleared until the train leaves the block. If, however, the train moves toward A, a cautionary signal indication can be given at B in the usual manner, as soon as the train moves off the track section to which track relay Z^6 is connected, provided, of course, that switch D^2 is closed.

With the switch or siding D^1 there is provided an automatic three-position dwarf signal T by means of which the crew of a train on the siding D^1 may be informed that the block from A to B is free to them and is clear, so that they may enter the block, but that the latter is occupied by a train moving from A toward B. The dwarf signal T is electrically interlocked with the signal SA at A so that only one of these signals may be cleared at a time and the clearance of the signal T requires the coöperation of the signal operators at stations A and B.

The signal T comprises an electrical actuating device which sets the signal to the full clear position when current flow through the signal between lines 47 and 54 is had and to the permissive position when the current flow through the signal is between lines 57 and 47. Normally closed contact W^2 and normally open contacts W and W^1 are connected to switch D^1, so that when the latter is opened contact W^2 is opened and contacts W and W^1 are closed.

When the operator at A becomes aware that a train on the siding at D^1 wishes to enter the main track and proceed toward B, the operator at A confers with the operator at B and in case permission for the movement is given the operator at A then notifies the crew of the siding train to open the switch D^1. This opens the normally closed contacts in switch box K^1 and closes the normally opened contacts in the box. It also opens normally closed contact W^2 thus preventing completion of the energizing circuit for the slot magnet K^1 and closes normally open contacts W and W^1. Operator at A then notifies the operator at B that the train on the siding is ready to move and the latter then depresses key F^2. This establishes a signal clearing circuit which if the block is free from trains is like the absolute signal clearing circuit previously described for block AB, with the exception that the circuit instead of leading directly through the box K^1 from the line 13, continues through line 45, contact controlled by relay Z^3, line 45^1 to contact normally open (but now closed) in box K^1, thence through line 44 and winding of magnet M, line 46 and line 47 to line 1 and thence back to battery QB.

The energization of winding M does two things: It causes signal T to go to the full clear position and it energizes the indicator magnet I^1 at station A. The circuit by which signal T is cleared is as follows: battery Q^2, line 48, contacts controlled by magnet M, line 49, contacts controlled by deënergized magnet M^1, lines 50 and 47, actuating coil for signal T and line 54 to battery.

The circuit by which magnet I^1 is energized is as follows: Battery Q^2, lines 48, upper contacts controlled by magnet M, line 49, contacts controlled by magnet M^1, lines 50, 47, 1 and 4, contact breaker H^1, lines 5 and 6 including winding of magnet I^1, contacts 7 and 8 and switch J' which must be to the left, lines 12 and 52, contact W, lines 53 and 54 back to battery Q^2. The energization of magnet I^1 shifts the indicator I^6 so that the instruments at A now read "Block clear" and this indication serves to inform the operator at A that the signal T has been cleared.

As a train moves out of the siding and relay Z^3 is deënergized the various circuits just described are all broken and the dwarf signal T drops to danger and the indicator controlled by the magnet I^1 drops back to its normal position, the latter notifying the operator at A that the train on the siding has accepted the signal. After this train so

moves that the track relay Z^3 is again energized, a train may be admitted to the block by signal SA with caution signal as before described, or a train on the siding D^1 may be admitted to the block with a caution indication by dwarf signal T. In either case the coöperation of the two operators at A and B is required; B to depress key F^2, and A to throw switch J^1 to the left.

The circuit by which the dwarf signal T is set to indicate "Proceed with caution" differs from the permissive signal circuit for signal SA in that the circuit instead of running from line 36 through box K^1 to the line 37 is connected through the upper normally opened contact in the box K^1 to the line 50 and thence through caution signal magnet M^1 and lines 46 and 47 to line 1 and back to battery QB. When magnet M^1 is energized in the manner above described, it, in turn, causes the three-position signal T to come to the cautionary position and also energizes indicator magnet i^1. The circuit by which the signal T is set to the intermediate position is as follows: Battery Q^2, lines 48 and 55, lower contact of magnet M and lines 56 and 57, signal T, lines 47 and 50 contact of magnet M^1 and lines 58 and 54 back to battery Q^2. The circuit by which magnet i^1 is energized, when magnet M^1 is energized, is as follows: Battery Q^2, lines 48 and 55, lower contact of magnet M, line 56, contact W^1, lines 59 and 37, contacts 10 and 11, switch J^1 (the latter being to the right) line 5, including switch P^1, and winding of magnet i^1, circuit breaker H^1, line 4, line 1 to the junction with line 47; lines 47 and 50, contacts of armature M^1, line 58 back to battery Q^2. After signal T has thus been set in the permissive position the train moving from siding D^1 into the block deënergizes relay Z^3 and this restores the signal T to danger and also returns the indicator connected to armature of magnet i^1 to the normal position. After switch D^1 has been closed the signal circuits are then in the usual condition in which it is possible to admit a train by signal T or by signal SA into the block AB with a cautionary signal provided other conditions permit.

With the system disclosed it is possible to eliminate "Form 31" train orders and use "Form 19" train orders only when train orders are necessary. Moreover when the switches are all interlocked as they readily may be in my system and are placed under the control of the signal operators, no train orders are required.

While in accordance with the requirements of the statutes I have shown and described in detail the best forms of my invention now known to me, it will be understood by those skilled in the art that many changes may be made from the forms disclosed without departing from the spirit of the invention and that certain features of invention disclosed herein may be used in some cases without a corresponding use of other features of the system disclosed.

Having now described my invention, what I claim as new and desire to secure by Letters Patent is:

1. In a block signal system an electrically controlled manually operated signal and operating mechanism therefor including a slot circuit and means preventing the energization of said circuit except when a portion of the track at one side of the signal is free from trains and a portion of track at the other side of the signal is occupied by a train.

2. In an electrically controlled block signal system for single track railways, the combination of signals which may be cleared absolutely or permissively, located one at each end of a block, devices responsive to the presence and location of a train or trains in the block, means for clearing each of said signals, the clearing means for each signal being governed by said devices and including parts at the two ends of the block, which must be manually actuated for every clearance either absolute or permissive of the signal, and means actuated by the entrance of a train into the block at either end for returning the corresponding signal to danger.

3. A block signal system for single track railways comprising the combination of a circuit closing key, a magnet serving when energized to hold said key in the circuit closing position, a three-position switch, and an electrically controlled signal mechanism at each end of a block, circuit closing devices responsive to the presence of a train or trains in the block, and circuit connections whereby when both of said switches are set in predetermined positions and one only of said keys is moved into the circuit closing position and said block is free from trains, a circuit is established which energizes the magnet for holding said one key and permits the signal mechanism at the opposite end of the block to be operated.

4. A block signal system for single track railways, comprising in combination an electrically controlled signal mechanism including a slot circuit at each end of a block, and means responsive to the presence of a train on a track portion without said block, but adjacent one end thereof, for preventing the closure of the slot circuit of the signal mechanism at that block end, except when said track portion is occupied by a train.

5. A block signal system for single track railways, comprising in combination an electrically controlled signal mechanism including a slot circuit at each end of a block, means responsive to the presence of a train on a track portion without said block, but adjacent one end thereof, for preventing the clo-

sure of the slot circuit of the signal mechanism at that block end, except when said track portion is occupied by a train, and means for indicating at the adjacent block end the presence of a train on said track portion.

6. In a block signal system the combination at each end of a block of a manually operated circuit closing key, means tending to hold each key open, a magnet which after the key is closed holds the latter closed so long as the magnet is energized, and a manually operated slot controlled signal, means for establishing an electric current when one key is closed which energizes its holding magnet and controls the slot for the signal at the other end of the block, and means responsive to the entrance of a train in the block at said other end for interrupting said circuit.

7. A block signal system for single track railways comprising the combination at each end of a block of a normally open circuit closing key, a magnet serving when energized and after said key is closed to hold the latter closed, a three-position switch and an electrically controlled manually actuated signal, circuit closing devices responsive to the presence, location and direction of movement of a train in said block, and circuit connections so arranged that when the key at one end of the block is closed and the switches at the two block ends are set in predetermined positions, the signal at the other end of the block may be cleared absolutely or permissively depending on the condition of said devices.

8. A block signal system for single track railways, comprising the combination of a circuit closing key normally in the open circuit position, a magnet by which said key after being closed may be held closed, a three-position switch and an electrically controlled signal mechanism at each end of a block, circuit closing devices responsive to the presence, location and direction of movement of a train in said block, and circuit connections whereby when the circuit closing key at one end of said block is moved into the circuit closing position and the three-position switches at the two ends of the block are set in predetermined positions the magnet for maintaining the closure of the closed key is energized and the signal mechanism at the other end of the block from said closed key may be cleared absolutely accordingly when the block is free from trains or permissively when the portion of the block immediately adjacent said other block end is free from trains, and the trains in the block have entered at said other block end.

9. In a block signal system for single track railways the combination with the main track between the stations at the end of a block and a siding joining the main track adjacent one of said stations, of main signal mechanisms adapted to give clear and permissive indications located one at each station, and a signal mechanism for said siding also adapted to give clear and permissive indications, circuit closing devices responsive to the presence of a train or trains in different portions of the track and circuit connections controlled thereby and by the signal operators at the ends of the block, governing the signal indications of all of said signals and arranged to prevent more than one of said signals from being cleared at a time.

10. In a block signal system, a block signal instrument comprising a case having a pair of openings formed in one side in juxtaposition to each other, a two-position indicator back of each opening, an electro-magnetic device for each indicator arranged when energized to move the corresponding indicator from one position to the other and means for energizing one of said electro-magnetic devices when a permissive signal indication is to be had and the other of said electro-magnetic devices when a clear signal indication is proper.

11. In a block signal system, a block signal instrument comprising a case having a pair of openings formed in one side in juxtaposition to each other, a two-position indicator back of each opening, an electro-magnetic device for each indicator, arranged when energized to move the corresponding indicator from one of said positions to the other and means for energizing one of said electro-magnetic devices when a permissive signal indication may be had and the other of said electro-magnetic devices when a clear signal indication is proper, each of said indicators bearing two legends, one or the other of which is exposed through the corresponding casing opening accordingly as the indicator is in one or the other of its positions, and the legends on the two indicators exposed at one time being arranged to jointly indicate the condition of the block.

12. In a block signal system for single track railways, an interlocking relay including a pair of magnets for each block, means for deënergizing one of the magnets of said relay when the portion of a block adjacent one end is occupied by a train and for deënergizing the other magnet of the relay when a portion of the block adjacent the other end is occupied, a signal at each end of the block, means dependent upon the energization of both magnets of said relay for establishing absolute signal clearing circuits for said signals, and means dependent upon said relay for establishing a permissive signal clearing circuit when one or both magnets of said relay are deënergized for the signal at the end of the block corresponding to the one magnet of the relay, or the first magnet of the relay deënergized.

13. In a block signal system for single

track railways a siding joining the main track at a point within a block and adjacent one end thereof, a signal at said block end, a signal at the siding, means governed by the conditions existing in said block for establishing absolute and permissive signal clearing circuits for said signals, a slot circuit for the main signal, and a pair of magnets one energized when an absolute clearing circuit is established and the other when a permissive clearing circuit is established, contacts controlled by said magnets normally serving to permit said slot circuit to be energized when either of said magnets is energized, and contacts operated by the opening of said siding to the main track for causing the siding signal to be cleared absolutely or permissively when said signal clearing circuits are established, and for preventing the slot circuit for the main signal from being established.

14. In a block signal system for single track railways the combination with the main track between the stations at the ends of the block and a siding joining the main track between the stations, of devices responsive to the presence of a train or trains in the block, a signal at each block end, means operated jointly by the operators at the two stations and controlled by said devices by which each signal may be cleared absolutely or permissively under different conditions, and means automatically actuated by the opening of said switch for preventing either of said signals from being cleared while the switch is opened and for returning either of the signals to danger if the latter is cleared when the switch is opened.

15. In a block signal system for single track railways the combination of a manually controlled signal at each end of a block, an automatic signal between the ends of the block, devices responsive to the presence of a train or trains in the block, circuit connections, and operating means at the two ends of the block whereby the clearance of either signal either absolutely or permissively requires the coöperation of the operators at the two ends of the block and whereby said automatic signal indicates to a train moving from one end of the block to the other whether or not the portion of the track between said automatic signal and the far end of the block is occupied by a train or trains.

16. In a block signal system for single track railways, the combination with signals at the ends of a block, of means by which said signals may be cleared absolutely or permissively depending on the condition of the block between the signals, said means including an interlocking relay, comprising a pair of magnets energized when the block is free from trains, and one deënergized when one portion of the block, and the other deënergized when another portion of the block, is occupied by a train or trains, and armatures, one for each of said magnets, which interlock when both magnets are deënergized to prevent the armature of the magnet first deenergized from returning to its normal position until after the magnet last deënergized is again energized, and to prevent the armature of the magnet last deënergized from moving, when such magnet is deënergized, into the position in which it would move if the other magnet were energized at that time, and circuit controlling devices operated by the movements of said armatures.

GEORGE S. PFLASTERER.

Witnesses:
W. S. LYNCH,
H. W. FORMAN.