H. M. COULTER.

BLOCK SIGNALING SYSTEM.

APPLICATION FILED AUG. 2, 1907.

914,386.

Patented Mar. 9, 1909.

2 SHEETS—SHEET 1.

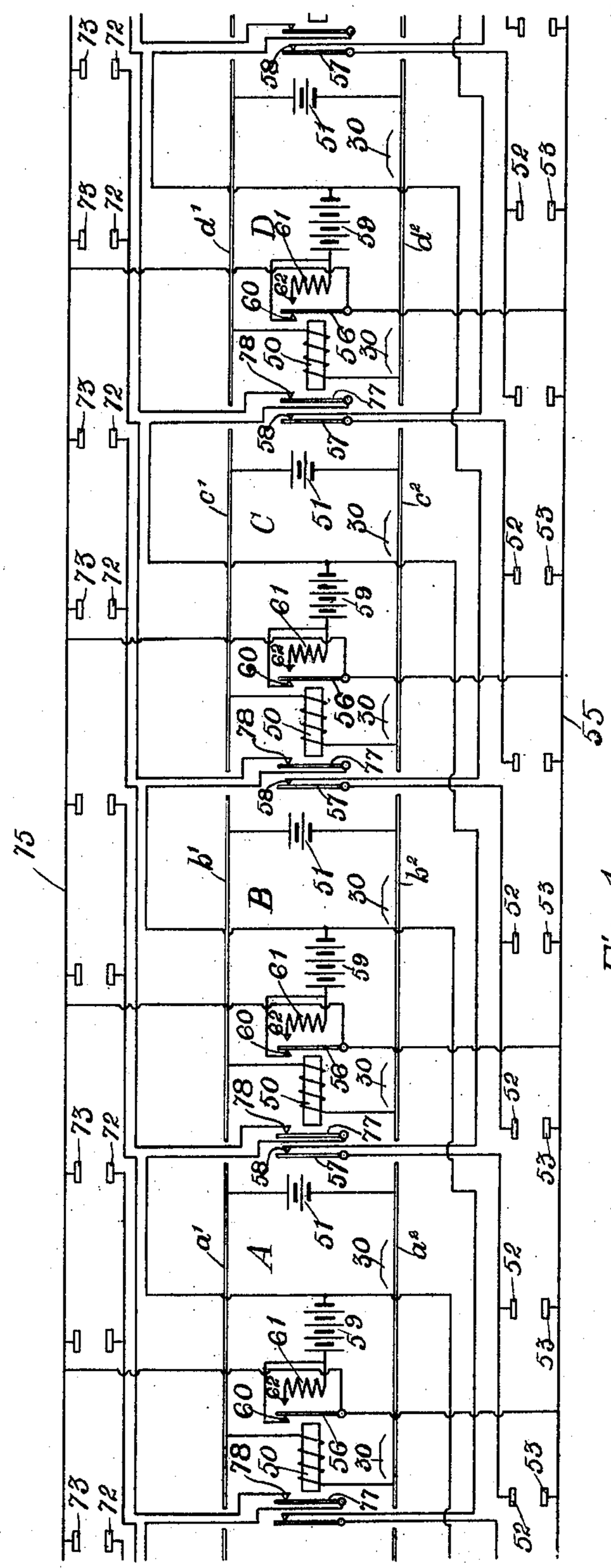

Fig. 1.

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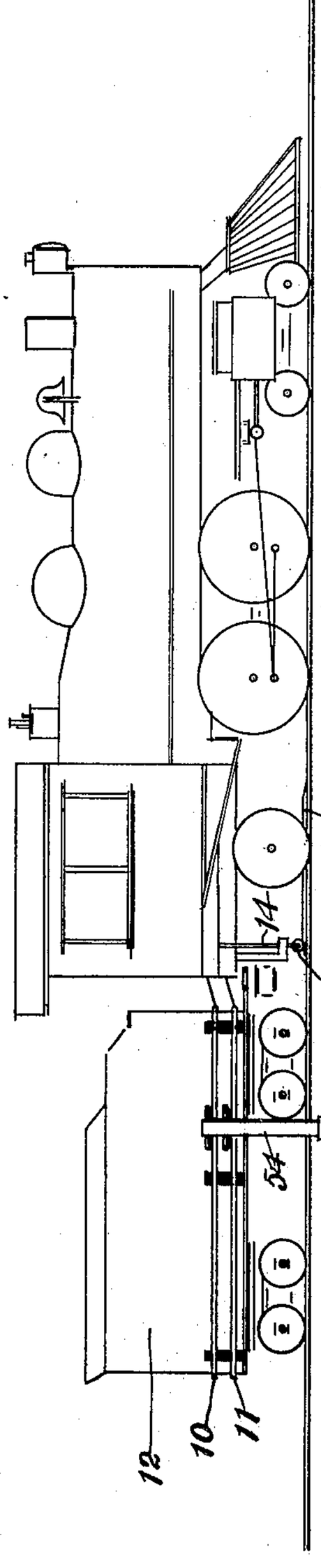

Fig. 2.

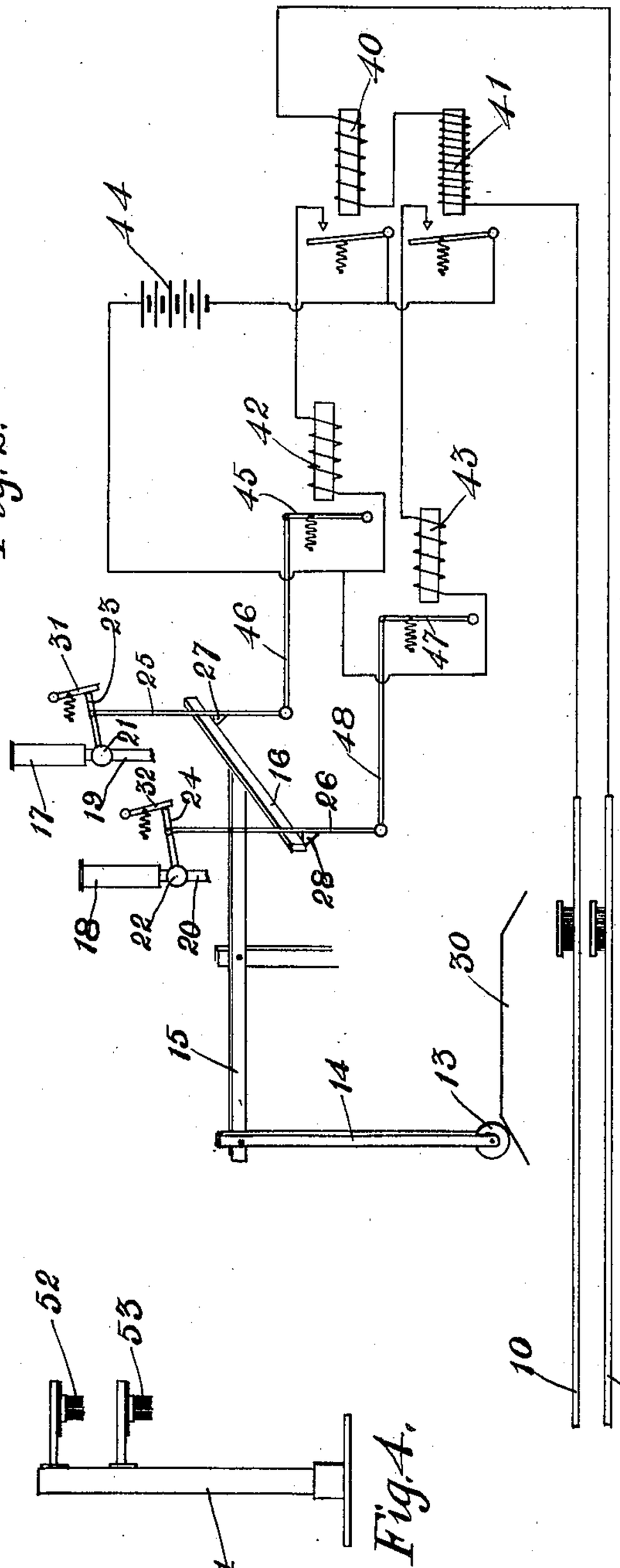

Fig. 3.

Fig. 4.

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UNITED STATES PATENT OFFICE.

HARRY M. COULTER, OF CHICAGO, ILLINOIS, ASSIGNOR OF ONE-HALF TO ALFRED STROMBERG, OF CHICAGO, ILLINOIS.

BLOCK-SIGNALING SYSTEM.

No. 914,386. Specification of Letters Patent. Patented March 9, 1909.

Application filed August 2, 1907. Serial No. 386,702.

To all whom it may concern:

Be it known that I, HARRY M. COULTER, citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Block Signaling Systems, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

My invention relates to railway block signaling systems and is more particularly intended for adaptation to cab signaling systems of the general type disclosed in Letters Patent No. 794,784, granted to me on July 18, 1905.

My present invention constitutes certain improvements upon the system therein shown and claimed, and upon the system described and claimed in my co-pending application, Serial No. 366,924, filed April 8, 1907.

In general the improvements which constitute my present invention are directed toward the increased efficiency and simplicity of the systems above mentioned. In both of these older systems the actuation of the caution and stop signals was made dependent upon the proper operation of electrical apparatus and circuits. If, therefore, the electrical apparatus failed to operate, the engineer might in some instances fail to receive the caution or stop signal when such signal should be given. These former systems provided a test circuit and signal for the purpose of warning the engineer of any accident to the electrical signaling apparatus.

My present invention is intended to overcome any accidents or mistakes which might arise if the testing circuit and apparatus of the former systems should indicate that the caution and stop signal circuits were in proper condition, when, as a matter of fact, they were liable to give false signals.

In accordance with my present invention I provide for the actuation of the cab signals by means of purely mechanical contrivances. Thus, for example, I provide at proper intervals along a railway track a series of mechanical actuating devices. These devices are arranged to coöperate with mechanism carried upon a locomotive, and the actuation of whistles or other signals is effected whenever the mechanism carried by the locomotive comes into contact with an actuating device which is located upon the track. Thus, the caution or stop signal, or both, will be actuated whenever such mechanical contact is made. The electrical circuits and apparatus are so arranged, however, that if the track is clear electromagnetic apparatus, preferably located in the locomotive cab, will be actuated to prevent the actuation of the signals when mechanical contact is made as above described. When the blocks in advance of a moving train are not clear the electrical apparatus is correspondingly operated, thus permitting the mechanical appliances to actuate the caution or stop signals, as may be required. If, therefore, the electrical apparatus or circuits become deranged in any part and therefore fail properly to operate, the signals will be actuated, thus notifying the engineer to bring his train under control or to a full stop. The comparative certainty with which the mechanical appliances can be operated serves to prevent accidents due to any failure of the electrical equipment.

The advantages of the combinations herein described and claimed will be more apparent to those skilled in the art after following the more detailed description.

In reading this detailed description reference may be had to the accompanying drawings, in all of which the same characters of reference apply to corresponding parts, and in which—

Figure 1 illustrates a railroad track divided into suitable blocks and provided with signaling circuits of my invention; Fig. 2 illustrates a locomotive equipped with the signaling appliances; Fig. 3 is a diagrammatic view of the mechanical and electrical equipment of the locomotive, and Fig. 4 illustrates the manner in which the contacts are mounted at the track side.

Preliminary to describing the preferred embodiment of the locomotive equipment, it should be understood that the railroad track is divided into a series of blocks and that each block is provided with one or more sets of contacts adapted to make electrical connection with the contact rails 10 and 11 which are carried at the side of the engine tender 12. Under normal conditions when the track is clear in advance of a moving

train, these contacts are connected through a circuit of low resistance with a battery. The track equipment is such that when there is a train in the second block in advance of a moving train, a resistance will be introduced into the circuit leading to the contacts at the track side. When a moving train moves into a block adjacent to that in which there is standing or moving another train, the circuit leading to the track contacts in question will be entirely opened. The conditions are, then, such that when the contacts in a given block are subject to the full voltage of the battery by way of a low resistance circuit, the track is entirely clear. When these contacts are subject to the voltage of this battery by way of a path containing some considerable resistance, the second block in advance is in some manner obstructed. When the contacts become disconnected from the battery, so that no difference of potential exists between them, there is some obstruction in the next succeeding block. The engine equipment is adapted to take advantage of these differing conditions in providing the proper signals for the guidance of the engineer.

The engine, as best indicated in Fig. 2, is equipped with a tripping device in the form of a small roller 13 carried at the lower end of a plunger 14. This plunger is pivoted to a rocking lever 15, the lever having at its opposite end a cross-piece 16. The caution whistle 17 and the stop whistle 18 are controlled by means of this plunger and lever mechanism. The whistles are connected with a suitable source of pressure supply, as, for example, the compressed air tank or the steam boiler, by means of the pipes 19 and 20. The valves 21 and 22 are controlled by the levers 23 and 24. To these levers are respectively connected the actuating rods 25 and 26. These rods are provided, respectively, with the catches 27 and 28, so that under normal conditions the upward movement of the plunger 14, causing in turn the depression of the crossbar 16, will engage the catches 27 and 28, thereby opening the whistle valves and causing each whistle to produce a blast. This actuation of the plunger and lever mechanism is periodically effected by means of properly placed mechanical track contacts 30. When the roller at the lower end of the plunger 14 strikes one of the mechanical contacts, the plunger is raised and the crossbar 16 is depressed, as previously described, and thus the whistles are periodically actuated one or more times in each block, as may be desired. When one of the valve levers is depressed to actuate the whistle, a mechanical detent 31 or 32, as the case may be, is drawn into a position such that the whistle valve will be maintained in an open condition until the engineer positively recognizes the signal by withdrawing the detent and thus permitting the whistle valve to return to its normal condition. Both of these whistles would therefore be actuated each time that the locomotive passed one of the mechanical track contacts if it were not for the operation of the electrical part of the equipment. It will be noted that the contact rails 10 and 11 are connected by a suitable electrical circuit with the relay magnets 40 and 41, the magnet 40 being of comparatively low resistance, while the magnet 41 is preferably of higher resistance.

The relay 40 controls the local circuit of an electromagnet 42, while the relay 41 controls the local circuit of the magnet 43, all of these relays and magnets and also the local battery 44 being carried upon the engine cab. When the relay 40 is actuated the circuit of the electromagnet 42 is closed, thus causing the attraction of the armature 45. This armature is connected by a link 46 with the actuating rod 25, so that the energization of the magnet 42 causes the catch 27 to be withdrawn from underneath the crossbar 16. When, therefore, the relay 42 is energized, the depression of the crossbar 16 will not cause the actuation of the caution whistle 17. In like manner the actuation of the relay 41 closes the circuit of the electromagnet 43, whereupon its armature 47 is attracted. This movement of the armature 47, acting through the link 48, withdraws the catch 28 from beneath the crossbar 16, thus preventing the actuation of the whistle 18 when the plunger 14 is tripped by one of the mechanical track contacts. Thus, it will be apparent to one skilled in the art that the adjustment of the relays 40 and 41 may be made such that when the tender contacts 10 and 11 make connection with the electrical track contacts the condition of these electrical track contacts will control the operation of the signal whistles. The relative disposition of the electrical track contacts and the mechanical track contact is such that the electrical connections with the tender contacts will be established slightly before the mechanical contacts are made. The electrical connections should preferably be continued until after the mechanical contact is broken. When, therefore, the tender contacts make electrical connection with a pair of electrical track contacts which are subject to the full voltage of the main battery through the normal low resistance circuit, both of the relays 40 and 41 will be actuated, thus causing in turn both of the catches 27 and 28 to be withdrawn from beneath the crossbar 16 before the roller 13 strikes the mechanical contact 30, and the actuation of the plunger and lever mechanism by means of the track contact 30 will not cause the actuation of either of the signal whistles. When, however, the electrical

track contacts are connected with the main battery only through a high resistance in the circuit, there will not be sufficient current to actuate both of the cab relays 40 and 41. The adjustments are so made that the high resistance relay 41 will alone be actuated when the connections are established through the high resistance track circuit. The actuation of this relay will, as before, prevent the mechanical apparatus from actuating the stop whistle 18, but the failure of the relay 40 to be actuated over this circuit will permit the plunger and lever mechanism to pull down the actuating rod 25, thereby causing a blast of the caution signal. The operation of the caution signal whistle will continue, as previously described, until the engineer positively takes account of this signal and removes the detent 31 to permit the whistle valve to return to its normal closed condition. When the tender contacts make connection with a pair of track contacts whose connection with the main battery has been entirely opened, neither of the cab relays 40 nor 41 will be energized. The catches of the actuating rods 25 and 26 will therefore be left in their normal position beneath the crossbar 16, so that when the plunger roller strikes the mechanical trip the lever 15 will be operated to open both of the whistle valves, thus causing a blast from the full stop whistle, as well as from the caution whistle, both of these blasts continuing as before until they are stopped by a positive act on the part of the engineer. The whistles are, of course, differently tuned, or otherwise made distinguishable to the engineer. It is, of course, possible to depend upon the differentiation of the means for restoring the whistles to their normal condition in order that the engineer shall distinguish the caution from the stop signal. I prefer, however, to use whistles of different tones so that the stop signal will be appreciated immediately upon the initiation of its operation.

Having, therefore, described the engine equipment and the conditions of the track equipment upon which the operation of the cab signals depends, I shall now describe the track circuits and equipment in detail. This is best shown in Fig. 1, in which the blocks A, B, C and D are indicated by insulated sections of railroad track, comprising in each instance the rails a^1, a^2, b^1, b^2, etc. These blocks of track are, of course, continued indefinitely for any required distance. The two rails of each block are connected at or near one end through the electromagnet winding of a track relay 50. At the other end the rails are connected through a track battery 51. Thus, under normal conditions current flows from the battery, through the electromagnet of the relay 50 to maintain its energization. The track shown in this figure is equipped with circuits for blocking trains running in both directions. I shall first describe the circuits which serve to block trains running from left to right. The track contacts 52 and 53 are preferably in the form of metal brushes, as indicated in Fig. 4, suitably mounted upon a supporting post 54 at the side of the track, as indicated in Fig. 2. These metal brushes are placed at such a height as to make electrical connection with the tender contacts 10 and 11 as the locomotive passes. It will be seen from Fig. 1 that I preferably place a pair of the track contacts at or near the beginning of each block and another pair of contacts at or near the middle of each block. The duplication of these track contacts in each block is simply to cause the repetition of the signals as each set of contacts is passed by a moving locomotive. One of each pair of track contacts is connected with a common return wire 55. The common return wire is connected as shown with the armature 56 of each of the track relays 50. The other track contacts of the pair, namely, the contacts 52 located in block A, are connected as shown with the armature 57 of the track relay 50 located in the next block to the right, namely, block B. On account of the normal energization of this relay the armature 57 makes electrical connection with the front contact 58, and this contact is connected in turn, as shown, with the negative pole of the main battery 59 located in block C. When, therefore, the armature 56 of the track relay in block C is in its normal attracted position in connection with the front contact 60, the positive pole of the main battery 59 is connected directly and without the intervention of special resistance in a circuit leading to the contacts 53 located in block A. This normal, full voltage circuit may be traced from the contacts 52 of block A, through the armature 57 and the front contact 58 of the track relay of block B, and thence to the negative pole of the main battery 59 of block C; the connection of the track contacts 53 may be traced through the common wire 55 to the tie wire which leads to the armature 56 of the track relay of block C, and thence through the front contact 60 to the positive pole of the same main battery 59. When, therefore, the tender contacts 10 and 11 establish connections with these track contacts in block A the cab relays 40 and 41 will be subjected to the full voltage of the main battery 59, which is located in the second block in advance of the moving train, namely, the main battery in block C. As previously described, this voltage without the intervention of special resistance, is sufficient to cause a flow of current which will actuate both of the relays 40 and 41, thus preventing the actuation of the signal whistles when the plunger roller strikes the

mechanical trip 30 which is associated with either pair of electrical track contacts. A similar circuit may be traced from the electrical track contacts of block B, through the armature 57 and the contact 58 of the track relay of block C, thence through the main battery located in block D and the front contact 60 and armature 56 by way of the common return wire 55 to the supplementary track contacts 53 which are located in block B. Similar circuits may be traced from the contacts of any of the blocks.

If, now, for example, there be a train or other obstruction upon the track which constitutes block B, the associated track relay 50 will become deënergized. This deënergization will occur if the tracks or rails are broken by opening the circuit of the relay 50. The deënergization of this relay will be caused also by the presence of a car truck connecting together the rails d^1 and d^2 of the block D, because such a truck would short-circuit the winding of the relay 50. The deënergization of this relay will permit all of the armatures to fall back into their unattracted position. This retraction of the armatures of the track relay in block D will cause the introduction of a resistance into the circuit of the track contacts of block B. This circuit may be traced from the contacts 52 of block B, through the armature 57 and the front contact 58 of the track relay of block C, thence to the negative pole of the main battery 59 which is located in block D; from the positive pole of this battery the circuit continues by way of the special resistance 61, the back contact 62, the armature 56, and thence through the common wire 55 to the track contacts 53 located in block B. The extra resistance 61 is of such magnitude that when it is thus included in the circuit leading from the track contacts of block B, the cab relay 40 will not be sufficiently energized to cause the attraction of its armature when the tender contacts 10 and 11 make connection with the track contacts 52 and 53. In this event a locomotive moving from left to right and reaching the block B will have its signaling mechanism actuated to give the caution signal but not the full stop signal. This will be readily apparent when it is considered that the roller 13 in striking the mechanical trip 30 will cause the actuation of the lever mechanism to open the valves of both whistles. The caution whistle 17 will be actuated because the current flowing through the cab relay circuit is not of sufficient strength to actuate the relay 40. As previously stated, the actuation of this relay is required in order to disconnect the whistle valve from the mechanical lever mechanism which is operated by the mechanical trip. The cab relay 41 will be sufficiently energized even over the high resistance circuit to cause the attraction of its armature, which, as previously described, disconnects the valve of the stop whistle 18 from the plunger and lever mechanism. The full stop whistle will not, therefore, be actuated under the conditions described. The engineer in apprehending the caution signal will be made aware of the fact that in the second block in advance of his train there is another train, or that there is some derangement of the track which requires that he bring his train fully under control.

Assuming that the obstruction in block D continues and that the engineer of the moving train advances into block C, he will receive upon entering his block a full stop signal. The actuation of the stop signaling mechanism is accomplished by virtue of the fact that the circuit leading from contacts 52 and 53 of block C is open between the armature 57 and the front contact 58 of the track relay in block D, this relay being deenergized on account of the obstruction in block D, as previously described. There being no complete circuit between the contacts 52 and 53, there will be no current to cause the energization of the cab relays 40 or 41. Neither of these relays will be actuated, therefore, to cause the disconnection of the whistle valves from the plunger and lever mechanism. When, therefore, the plunger wheel strikes the mechanical trip 30 of block C, the crossbar 16 of the lever mechanism will be depressed and will carry with it both of the actuating rods 25 and 26. Both of the whistle valves will thus be opened and maintained in their open position by means of the detents 31 and 32. The engineer will thus be notified by the blasts of both the caution and the full stop whistles that there is an obstruction in the next succeeding block, whereupon he will bring his train to a full stop. As previously stated, the whistle valves are returned to their normal condition by the engineer, who removes the detents 31 and 32 when he has apprehended the signals given.

It will be unnecessary to describe in detail the circuits for block signaling trains moving from right to left in the drawing of Fig. 1, these circuits being duplicates of those described for the protection of trains passing from left to right. It will be seen that the circuit of the track contacts 72 and 73 may be traced by way of the contact 78 and the armature 77 of relay 50 in block C to the negative pole of the main battery 59 which is located in block B. The circuit continues under normal conditions from the positive pole of the battery 59, through the front contact 60 and the armature 56 of the track relay 50 of block B, and thence by way of the common return wire 75 to the contacts 73 located in block D. When there is an ob-

struction in block B, the armature 56 of the track relay in that block will fall back, thus completing the circuit of the track contacts of block D through the special resistance 61 located in block B. When there is an obstruction in block C, which is next adjacent to block D, the armatures of the track relay in block C will fall back into their abnormal positions, in which case the circuit of the track contacts of block D will be opened between the contact 78 and the armature 77. These different conditions of the circuit connected with track contacts at the farther side of the track will serve to control in the manner already described the cab signals of locomotives moving from right to left.

My invention thus provides a simple and efficient means for controlling the operation of cab signals on moving trains and provides for the complete safe conduct of such trains, primarily because the full stop signals will be actuated if any part of the apparatus is out of order or fails in any way to operate as intended.

If assurance is required as to the proper operation of the plunger and lever mechanism, an additional test signal may be permanently connected with the lever so that this signal will be sounded whenever a mechanical trip contact is passed. In this event the failure to receive the periodical announcements of the test signal will indicate to the engineer that there is some derangement of the plunger and lever mechanism and he may govern himself accordingly.

It will be apparent to those skilled in the art that many modifications of the apparatus herein described may be made without departing from the spirit of my invention. I do not wish, therefore, to be limited to the precise construction and method of operation herein shown, but, on the contrary, I consider my invention to be as broad as the terms of the accompanying claims.

I claim as my invention:

1. In a railway block signaling system, the combination of a track divided into a series of blocks, electrical track contacts located in each block, signaling circuits each extending from the track contacts in one block to the next succeeding block, means in each block for controlling the signaling circuit terminating in the track contacts in the next block, a signal carried upon a moving train, a device located in each block for mechanically actuating the signaling apparatus upon the moving train, electrical contacts carried upon the moving train and adapted to make connection with the track contacts, and electrical apparatus on the moving train, said apparatus being connected with the moving contacts of the train and adapted to be actuated when the connected signaling circuit is in one condition to prevent the operation of the signal and to be actuated when the connected signaling circuit is in another condition to permit the operation of the associated signal.

2. In a railway block signaling system, the combination with a series of blocks, of two signal-controlling devices, each in a separate block, two signal-conveying paths, each path being connected with track contacts located in a different block, the actuation of the first signal-controlling device serving to establish one condition in the first of said paths and another condition in the second of said paths, and the actuation of the second signal-controlling device serving to establish the second condition in the first of said paths, two signals carried on a moving train, a device located in each block and adapted normally to mechanically cause the actuation of both of said signals upon the passage of a moving train, electromagnetic mechanism carried on said train and included in a circuit terminating in contacts adapted to make connection with said track contacts during the passage of said train, said electromagnetic mechanism being adapted for actuation of one character upon making connection with a path in one of said conditions to prevent the operation of one of said signals, and adapted for actuation of another character upon making connection with a path in another condition to prevent the operation of the other signal.

3. In a railway block signaling system, the combination with a series of blocks, of a signal-controlling device in each block, signal-conveying paths each adapted to convey signals from one block to the next succeeding block, each of said paths terminating in track contacts, the actuation of each signal-controlling device serving to change the electrical condition of the signal-conveying path controlled thereby, a signal carried upon a moving train, mechanical appliances adapted to actuate the signal during the passage of the train through each block, and electromagnetic apparatus carried on the moving train and included in a circuit adapted to make electrical connection with said track contacts, said electromagnetic apparatus being actuated whenever connection is made with a path having one of the two alternative conditions therein to prevent the actuation of said signal.

4. In a railway block signaling system, the combination of a series of blocks, two signal-controlling devices each in a separate block, two signal-conveying paths, each path being adapted to convey signals to a different block, the actuation of the first signal-controlling device serving to establish one condition in the first of said paths and another condition in the second of said paths, and the actuation of the second signal-controlling device serving to establish the second condition in the first of said paths, track contacts located in each block and

forming the terminals of said paths, differentially adjusted electromagnetic mechanism carried on a moving train and included in a circuit adapted to make electrical connection with the track contacts forming the terminals of said paths during the passage of the train, a caution signal and a full stop signal, a device adapted normally to mechanically cause the operation of both of said signals, and means controlled by said differentially adjusted electromagnetic mechanism for releasing the full stop signal from the control of the mechanical trip when the circuit of the electromagnetic mechanism is closed through a path in which the first of said conditions has been established and for permitting the control of said signal by said mechanical trip when connection is established with a path in which the second condition has been established.

5. In a railway block signaling system, the combination with a series of blocks each comprising a pair of rails insulated from the rails of the next succeeding block, a track circuit including a controlling relay associated with each block, track contacts located in each block, a signaling circuit extending from each controlling relay to the track contacts of the second block in each direction, switching mechanism actuated by the associated controlling relay during the presence of an obstruction in the associated block to increase the resistance of the signaling circuits terminating in the track contacts of the second block in each direction and serving to open the signaling circuits terminating in the next adjacent block in each direction, and electrically controlled signaling mechanism adapted for connection with the track contacts.

6. In a railway block signaling system, the combination with a series of blocks each comprising a pair of rails insulated from the rails of the next succeeding block, a track circuit including a controlling relay associated with each block, track contacts located in each block, a signaling circuit extending from each controlling relay to the track contacts of the second block in each direction, switching mechanism actuated by the associated controlling relay during the presence of an obstruction in the associated block to increase the resistance of the signaling circuits terminating in the track contacts of the second block in each direction and serving to open the signaling circuits terminating in the next adjacent block in each direction, a caution signal and a full stop signal carried on a moving train, a device located in each block and adapted normally to mechanically actuate both of said signals upon the passage of a train, tender contacts carried upon the moving train and adapted to make connection with the track contacts, an electric cab circuit terminating in the tender contacts, differentially adjusted cab relays included in said cab circuit, both of said relays being actuated to prevent the operation of the signals by the device when circuit through said relays is closed through a signaling circuit in which the normal condition exists, and one only of said cab relays being actuated to prevent the operation of the full stop signal by said device when connection is established with a circuit in which the resistance has been increased but which is not open circuited, neither of said cab relays being actuated when connection is established with an open signaling circuit, whereupon the full stop signal will be actuated by said device.

7. In a cab signaling system, the combination with differential signals located in the engine cab, mechanical contrivances serving normally to actuate said signals, and an electrical track circuit for preventing the actuation of said signals by said mechanical means when the track is in an unobstructed condition.

In witness whereof, I hereunto subscribe my name this 31st day of July A. D., 1907.

HARRY M. COULTER.

Witnesses:
HARVEY L. HANSON,
JOHN F. STAHR.