F. E. SMITH.

SIGNALING SYSTEM.

APPLICATION FILED JULY 24, 1908.

942,676. **Patented Dec. 7, 1909.**

3 SHEETS—SHEET 1.

Fig. 1.

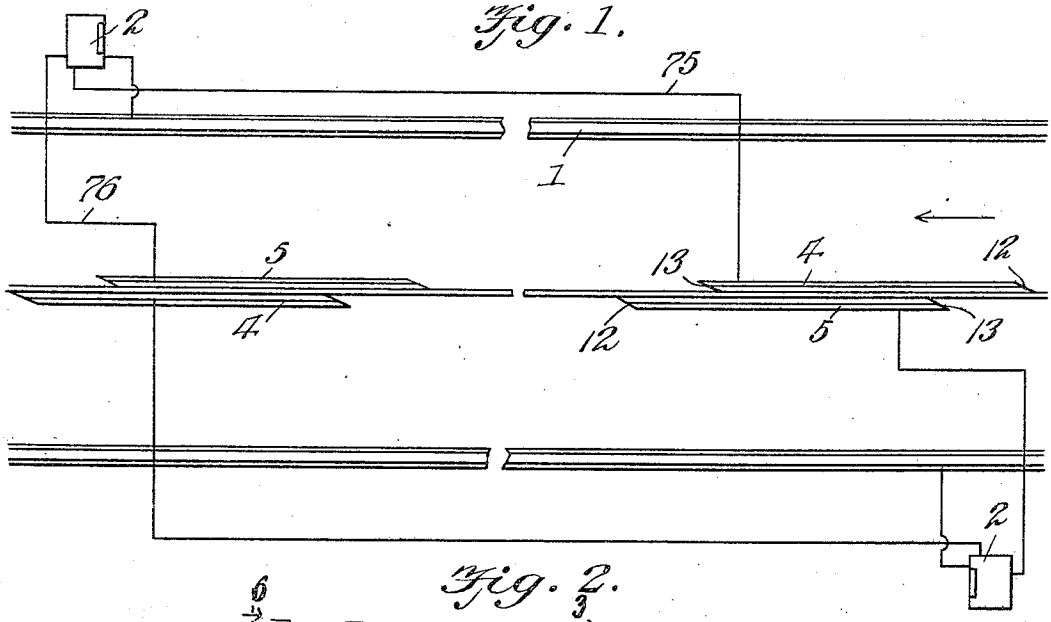
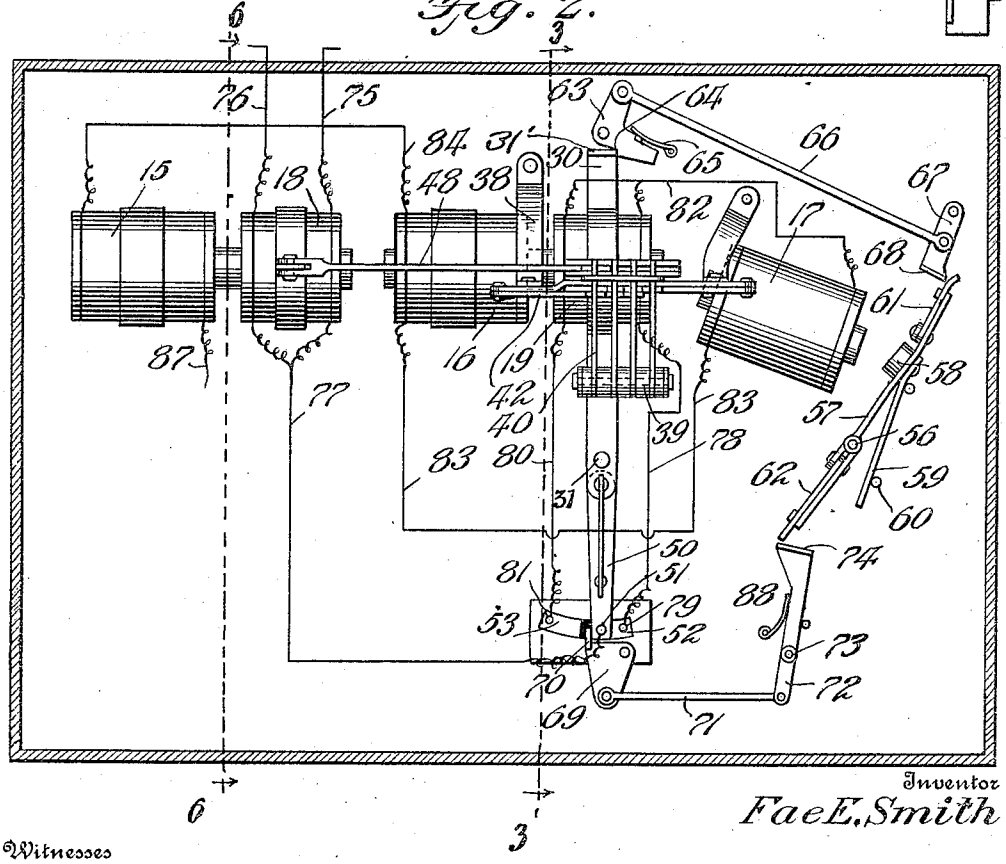


Fig. 2.



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3 SHEETS—SHEET 2.

Fig. 3.

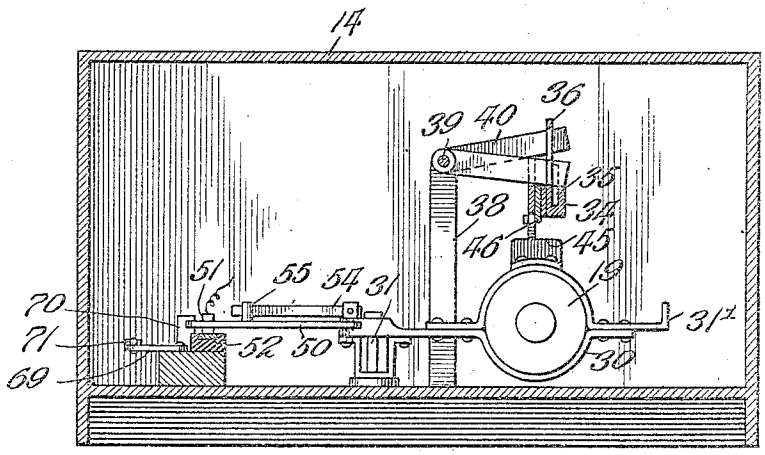
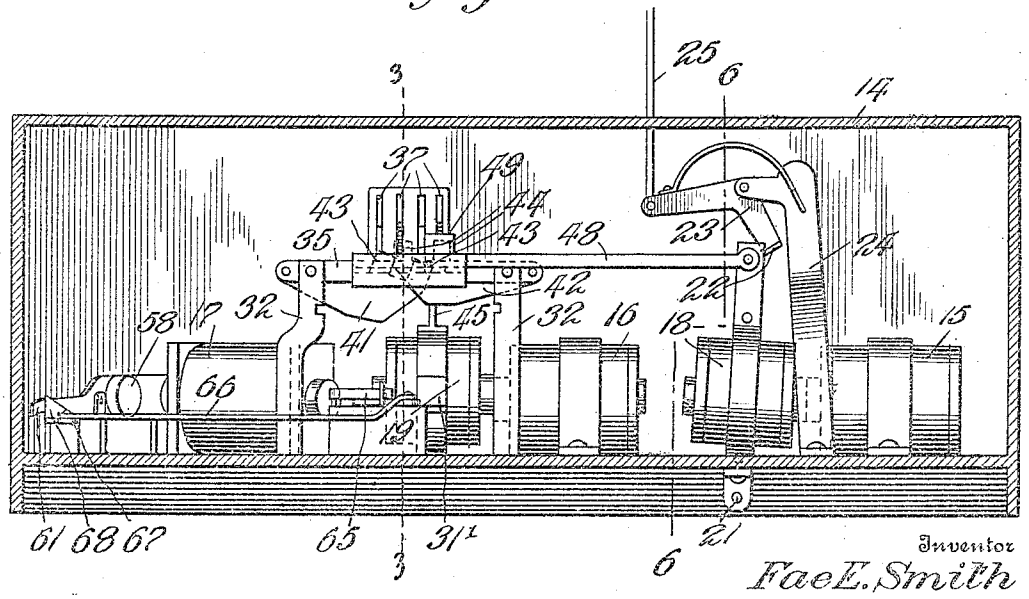


Fig. 4.



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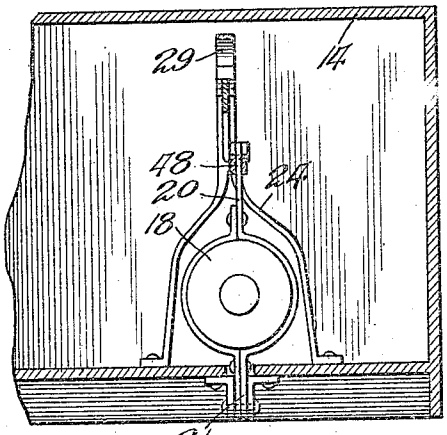
3 SHEETS—SHEET 3.

Fig. 6.



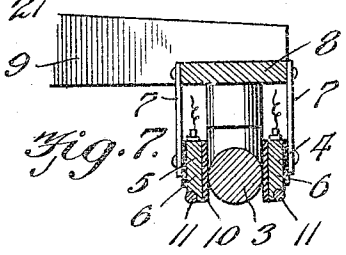


Fig. 7.

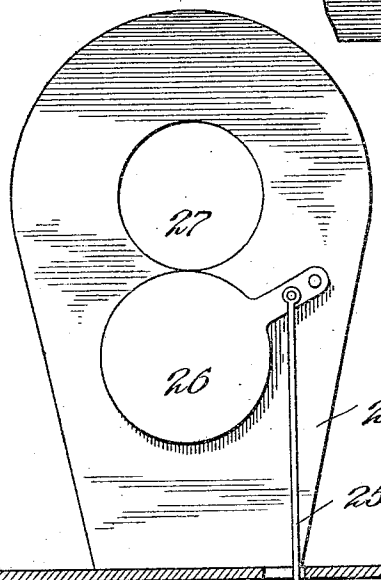
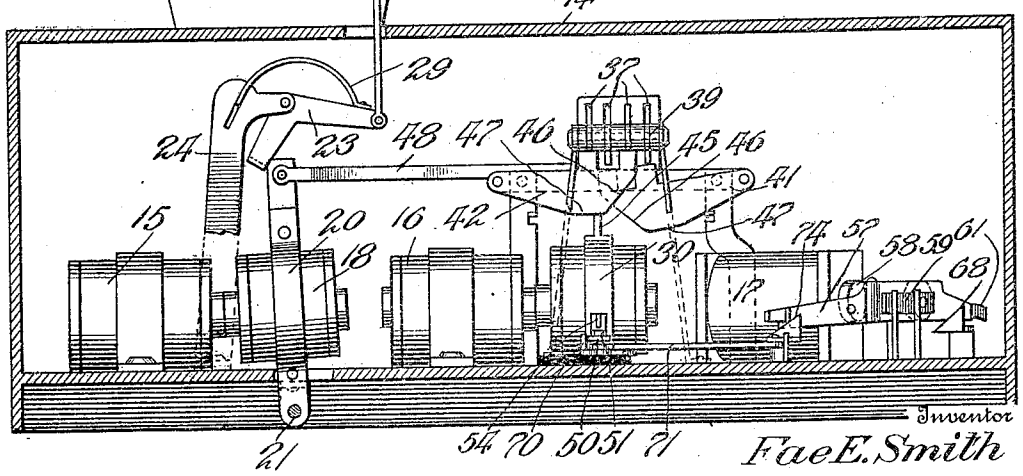


Fig. 5.



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UNITED STATES PATENT OFFICE.

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SIGNALING SYSTEM.

942,676. Specification of Letters Patent. Patented Dec. 7, 1909.

Application filed July 24, 1908. Serial No. 445,227.

To all whom it may concern:

Be it known that I, FAE E. SMITH, a citizen of the United States, residing at Ames, in the county of Story and State of Iowa, have invented new and useful Improvements in Signaling Systems, of which the following is a specification.

The invention relates to an improvement in signaling systems primarily adapted for electric roads, and is particularly directed to a signal apparatus and controlling circuits therefor in the use of which a train will operate or set a distant signal on entering a block and reverse or clear that signal on leaving a block.

The main object of the present invention is the production of a signaling apparatus arranged at the exit end of each block, a series of controlling circuits being provided by which a train entering the block will energize the distant apparatus to set the signal at danger and on leaving the block will again energize the apparatus to set the signal at clear, whereby an advancing train will automatically set a danger signal a block in advance and maintain said signal set during the travel of a train throughout the length of a block.

Another object of the invention is the production of means whereby the signal apparatus is adapted for operation by a plurality of trains successively engaging the entrance switch 4 before the first of said trains has engaged the exit switch 5, said means being arranged so that each successive train engaging the entrance switch will operate the apparatus a step beyond that induced by the passage of the immediately preceding train, so that it will require the coöperation of all of the successive trains with the exit switch 5 before the apparatus will be returned to full normal position and the signal set at clear. By this means the signal apparatus will automatically take care of a number of trains traveling within the block and will not set a clear signal for the block until each and all of said trains has passed beyond the exit switch.

Another object of the invention is the provision of controlling switches at the respective ends of the block by which the trolley wheel of a particular train may be utilized to energize the controlling circuit directly from the service wire.

The invention will be described in the following specification, reference being had particularly to the accompanying drawings, in which:—

Figure 1 is a diagrammatic view illustrating the circuits and signals for the single block. Fig. 2 is an enlarged plan of the signal apparatus, the casing therefor being shown in section. Fig. 3 is a section on line 3—3 of Fig. 2. Fig. 4 is a side elevation of the apparatus, the casing being shown in section. Fig. 5 is a similar view taken from the opposite side, the signal being shown in clear position. Fig. 6 is a section on line 6—6 of Fig. 2. Fig. 7 is a broken sectional view illustrating the mounting of the switches adjacent the trolley wire.

The present invention is designed particularly for use on that class of electric suburban and interurban railroads employing a single track for the main length of trackway and having determinate points at which sidings are provided to permit trains traveling in opposite directions to pass. While designed particularly for this purpose it will be obvious that it is equally serviceable for the protection of the full length of the trackway and may be used under any and all conditions in which it is designed to protect trains against rear-end and head-on collision.

In applying the system to a single trolley track, as 1, the signal apparatus 2 is arranged on opposite sides of the track and at opposing ends of a block, it being understood that the apparatus to the right of any one train is the apparatus controlled by that train, so that for a single trackway there will be a signal apparatus at each end of the block, one controlled by the train traveling in one direction and the other by the train traveling in the opposite direction, each apparatus being located at the remote end of the particular block with relation to the controlling train.

At each end of the block the service or trolley wire 3 is provided with opposing switches 4 and 5, the former constituting the initial or entrance switch for the train just entering the block, while the latter constitutes the resetting or exit switch for the train leaving the block. These switches are so arranged that a particular train will cooperate with the entrance switch 4 on entering the block and with the exit switch 5 on leaving the block, while at the same time displacing the adjacent switches.

The respective switches 4 and 5, arranged adjacent each other on opposite sides of the trolley wire, each include a strip 6 supported by one or more spring arms 7 from a cross strip 8 depending from or secured to the hanger arm of the trolley wire. The strips 6 are provided on their relatively inner surfaces with insulated sections 10, and said insulated sections are maintained normally in contact with the trolley wire of the spring arms 7. Secured lengthwise each strip 6, at the outer lower corner thereof, is a conductor 11, these conductors being on a plane with the trolley wire and normally spaced therefrom by the insulating strips 10 and the intervening portion of the strip 6. The respective end edges of the switches 4 and 5 are inclined to provide engaging portions 12 and 13, the former, which constitutes that portion of the switch first engaged by the trolley wheel of the advancing train is so inclined as to cause the flange of the trolley wheel to ride up the incline and press the switch into more or less close contact with the trolley wire, while the incline 13, which is the end at which the trolley wheel leaves the particular switch, is so formed that in the travel of the trolley wheel toward that end the flange will enter between the trolley wire and switch and force the latter from contact with the trolley wire.

The switches 4 and 5 are not disposed directly opposite each other, the end of the operative switch projecting toward the advancing train beyond the adjacent end of the opposing switch. The respective ends 12 and 13 are also reversed in the particular pairs of switches, so that a train advancing in the direction of the arrow in Fig. 1 will engage the incline 12 of the switch 4 and force said switch into more or less close contact with the trolley wire, and will immediately thereafter engage the incline 13 of the switch 5 and force said switch from contact with the trolley wire. As the trolley wheel travels lengthwise the particular switch, as 4, at the entrance end of the block the flange of the wheel will engage the outer surface of the switch and thereby electrically connect the conductor 11 of the switch 4 with the trolley wire 3 energizing said conductor for purposes which will presently appear. The displacement of the adjacent switch 5 of the flange of the trolley wheel will, of course, force the conductor 11 of said switch 5 from any possibility of contact with the trolley wheel and thereby prevent the energization of that conductor. In the particular entrance described the continued travel of the train lengthwise the block will engage the switch 5, and energize the conductor thereof, displacing the switch 4, as will be fully apparent from Fig. 1.

The signal apparatus is in duplicate throughout the length of the system so that a detailed description of one will suffice for all. Said signal apparatus comprises a casing 14 of substantial material and in sufficient size to inclose and protect the apparatus. Secured upon the base of the casing at appropriately spaced intervals are three electro-magnets 15, 16, and 17, the first of which constitutes a resetting magnet, the second of which constitutes a combined setting and resetting magnet, and the third a setting magnet. Arranged between the electro-magnets 15 and 16 is a signal controlling magnet 18, while arranged between the magnets 16 and 17 is a lock controlling magnet 19. The magnets 18 and 19 are arranged for movement between the respective magnets noted, their armatures being so disposed as to successively retract and repel under the influence of the currents, as will presently appear. The signal controlling magnet 18 is secured within an encircling strap 20, the ends of which are extended beneath the bottom of the casing 14 through an opening therein and mounted on a pivot 21, as clearly shown in Fig. 6. The terminals of the strap project above the magnet and are arranged to engage a laterally extending lip 22 formed at the lower end of an angle lever 23. The lever 23 is pivotally mounted on a standard 24 rising from the base, the forward end of one arm of the lever being connected by a rod 25 with a semaphore 26. In this instance the semaphore is shown as a pivot disk, preferably of red color, which, when in operative position, closes an opening 27 formed in a semaphore plate 28, the signal indicating clear when the opening 27, preferably carrying a white signal, is exposed. The parts are so arranged that when the arm carrying end of the lever 23 is depressed the signal 26 is in clear position, and when said arm is elevated the signal is in danger position. A spring 29 is connected to the rod carrying arm of the lever and to the standard 24, said spring being tensioned to normally force the lever to set the signal in danger position. The lock controlling magnet 19 is also supported in an encircling strap 30, one end of which projects beyond the magnet and is mounted upon a pivot pin 31 arranged in advance of the magnet, the opposing end of the strap projecting in rear of the magnet and terminating in an upwardly extending lip 31′. The signal controlling magnet is thus mounted for swinging in a vertical plane between the magnets 15 and 16, while the lock controlling magnet 19 is arranged for swinging in a horizontal plane between the magnets 16 and 17.

Supported on standards 32 rising from the base of the casing in rear of the lock controlling magnet is a cross bar 33 on the forward face and centrally of which is se-

cured a plate 34 bent into U-form at its lower end to provide a slideway 35, the forward wall of the plate being extended above the cross bar, as at 36, and formed with a series of vertically arranged parallel slots 37, forming a grating. Mounted in advance of the lock controlling lever are standards 38, the upper ends of which support a horizontally arranged pivot rod 39 on which are secured a series of arms or keys 40. The rear or free terminals of the keys are adapted to be projected through the slots 37 in the plate 36, as clearly shown in Fig. 3. Pivotally supported on the respective ends of the cross bar 33 are lifting plates 41 and 42, the former of which is provided on its upper edge with spaced lugs 43 designed to underlie, for example the first and third of the keys, while the latter lifting plate is formed with similar lugs 44 designed to underlie the second and fourth of the lifting keys. The relatively upper portion of the strap 30 of the lock controlling the magnet is provided with an upawrdly projecting finger 45 arranged for coöperation with the lower edges of the lifting plates. The adjacent ends of the lifting plates are formed at their lower edges with inclined portions 46, which incline from said lower edges outwardly toward the upper edge, and beyond the inclined portions said lower edges are projected for a portion of their lengths in lines parallel to the longitudinal line of the lifting plates, as at 47, the arrangement providing for the successive elevation of the lifting plates by the lip 45 as the magnet 19 moves back and forth, said lip for the purpose successively coöperating with the inclined edges 46 of the lifting dogs to gradually lower or elevate said dogs and with the plane edge 47 to maintain the dogs in elevated position during a portion of the movement of the magnet.

The upper end of the carrying strap 20 for the signal controlling magnet is provided with a locking bar 48, the relatively outer or free end of which is formed with an enlarged head 49 and is adapted to slide in the guideway 35 of the plate 34. The respective keys 40 are of such height that when fully elevated under the influence of the particular lifting plate the head 49 of the locking lever 48 will freely slide lengthwise the guideway 35, while with the keys in lowered position by the lowering of the particular lifting plate the particular key will bridge the guideway and engage the head 49 to limit further movement of the locking lever.

Pivotally mounted on the forward end of the strap 30 in advance of the pivot 31 is a switch plate 50, the forward end of which carries a contact 51 adapted to ride upon a contact plate mounted in an insulated block supported on the casing base, said contact plate being divided by an insulated section to form individual contact sections 52 and 53. Carried by the adjacent end of the strap 30 is one terminal of a leaf spring 54, the opposing terminal of which is secured in a post 55 carried by the switch plate near the free end of the latter. It will thus be obvious that in the movement of the magnet 19 by a swinging of the strap 30 on the pivot 31, the spring 54 will operate to cause a corresponding movement of the switch plate, it being understood that one of the contact plates as 52 is designed to receive the contact 51 of the switch plate when the electro-magnet 19 is in one position, while the contact section 53 is designed to receive the contact 51 when the electro-magnet is in the opposing position.

For the purposes which will presently appear means must be provided for locking the electro-magnet 19 and also the switch plate in determinate position pending certain conditions, and to provide for such operation I mount on a pivot 56, arranged adjacent the magnet 17, a trip lever 57, which, beyond the pivot, carries an armature 58 designed to be attracted by the core of the magnet 17. A spring 59 is arranged to maintain the trip lever normally retracted, being terminally secured to the lever and engaging a fixed post 60 projecting from the base. At one end the trip lever carries a gravity operated finger 61, and a similar finger 62 is secured at the opposite end of the trip lever, both of these fingers being mounted for relatively vertical movement. Mounted adjacent the lip 31′ of the strap 30 for the electro-magnet 19 is an angle lever 63, one arm of which is formed with a notch or shoulder 64 designed to engage the lip and hold the electro-magnet 19 in contact with the electro-magnet 16, a spring 65 being arranged to normally maintain the lever in position to engage the lip, the opposing arm of the lever being connected by a rod 66 which projects toward the trip lever and is connected to a pivot plate 67, the edge of which, adjacent the trip lever, is formed with an upwardly extending lip 68 which inclines upwardly and outwardly toward the trip lever when the parts are in normal position. The lip 68 is immediately adjacent the latch 61 of the trip lever, so that in the movement of said trip lever toward the electro-magnet 17 in the energization of said magnet the latch will engage the lip with the effect to move the plate 67 and through the rod 66 swing the angle lever 63 to release the magnet carrying the strap 30, the inclination of the lip 68 permitting the return of the trip lever under the influence of the spring 59 without affecting the rod 66, the gravital movement of the latch 61 providing for the free elevation of said latch in the return of the trip lever.

Immediately adjacent the contact sections 52 and 53 is arranged a trip plate 69, approximately of triangular form pivotally mounted at one corner of the base and carrying at the opposing corner an upwardly extending lip 70 designed to rest against one side edge of the switch plate 50 and prevent movement of said plate into electrical contact with the section 53. The forward edge or apex of the trip plate is connected to one end of an operating rod 71, the opposite end of which is connected to a lever 72 pivotally supported on the base of the casing at 73 and formed at the terminal beyond said pivot with an upwardly extending lip 74 arranged to coöperate with the gravity latch 62 of the trip lever, said lip inclining upwardly and outwardly in a direction away from the trip plate 69, so that in the movement of the trip lever in the energization of the electro-magnet 17 the latch 62 will ride freely up and over the lip 64 dropping in rear of the same when the trip lever is fully attracted, the opposing movement of said lever, under the influence of the spring 59, causing the latch 62 to engage the lip 74 and move the lever 72 on its pivot, thereby withdrawing the lip 70 from engagement with the switch plate 50, and permitting automatic movement of said switch plate to engage the contact section 53, as will presently appear.

From the above described construction it will be obvious that in the movement of the trip lever 57 by energization of the electro-magnet 17 the strap 30 carrying the electro-magnet 19 is released, while in the opposing movement of said trip lever under the influence of the spring 59 and after deënergization of the electro-magnet 18 the switch plate 50 is released for movement.

As previously stated the switch 4, at the entrance end of the block, and the switch 5, at the exit end thereof, are controlling switches for the signal apparatus located adjacent the exit end of the block. For the purpose of the controlling of the apparatus the conductor 11 of the entrance switch 4 is connected by a conductor 75 with the apparatus at the exit end of the block, the conductor 11 of the exit switch 5 being connected by a conductor 76 with the same apparatus. Within the apparatus the conductor 75 leads to one winding of the signal controlling electro-magnet 18, the conductor 76 leading to the opposing winding, it being understood that the electro-magnet 18 is of double winding so that the respective poles may be reversed by directing the current to said electro-magnet through one or the other of the conductors 75 or 76. Beyond the electro-magnet 18 the conductors from the respective windings join in a conductor 77, which leads directly to the contact 51 of the switch plate 50, as clearly shown in Fig. 2. The electro-magnet 19 is also a double winding magnet, the terminal of one winding forming a conductor 78 which leads to a contact 79 on one of the contact sections, as 52, of the contact plate, the terminal of the other winding forming a conductor 80, which leads to a contact 81 of the remaining contact section 53 of the contact plate. Beyond the electro-magnet 19 the terminals of the winding join to provide a conductor 82, which leads to and forms the winding of the magnet 17, from said magnet the current is carried by a conductor 83 to and about the electro-magnet 16, and from said electro-magnet the current is led by a conductor 84 to and about the electro-magnet 15, the conductor from said electro-magnet, as 85, being mounted or connected to a return, as one of the rails of the track. From the description of the circuits described it is to be understood that the electro-magnets 15, 16, and 17 are of constant and uniform polarity, while the electro-magnets 18 and 19 are of double and reversible polarity in accordance with the particular conductor over which the current is directed.

Assuming the parts in the position indicated in Figs. 2 and 5, which is the normal condition of the apparatus, I will describe the operation of the apparatus in the event that a single train travels throughout the length of the block or protective zone and engages the exit switch, it being noted that the electro-magnet 18 is in contact with the electro-magnet 15 and the electro-magnet 19 is in contact with the electro-magnet 16. In this position of the parts the strap 30 of the electro-magnet 19 is locked in position by the angle lever 63, the switch plate 50 is locked in contact with the sections 52 of the contact plate, and the trip lever is in inoperative position. As the electro-magnet 19 is at its limit of movement toward the electro-magnet 16 the lifting plate nearest said electro-magnet is elevated, while the lifting plate remote from the electro-magnet 16 is in lowered position. The first and third keys 40 are, therefore, elevated while the second and fourth keys are lowered. As the second key is lowered the head 49 of the locking lever 48 is in contact with said lowered key, thereby maintaining the upper end of the strap 20 of the electro-magnet 18 at its limit of movement toward the electro-magnet 15. In this position the upper end of the strap 20 engages the lip 22 of the signal controlling angle lever 23, maintaining the rod carrying end of said angle lever depressed against the tension of the spring 29 and holding the danger signal 26 clear or in set position. Assuming a train traveling in the direction of the arrow indicated in Fig. 1, the switch 4 is engaged and the conductor 11 thereof energized from the trolley wire 3.

The current is then directed through the conductor 75 to and about the electro-magnet 18, through the conductor 77 to the contact section 52, through the conductor 78, through and about the electro-magnet 19, through the conductor 82 to and about the electro-magnet 17, through the conductor 83 to and about the electro-magnet 16, through the conductor 84 to and about the electro-magnet 15 and to the return through the conductor 87. This energization causes the formation of poles in the cores of the respective magnets as follows: The end of the core of the magnet 15 adjacent the magnet 18 becomes for example a south pole, the contacting end of the core of the magnet 18 a south pole, while the opposing end of the core will, of course, become a north pole. The end of the core of the electro-magnet 16 adjacent the electro-magnet 18 becomes a south pole, the opposing end of this core a north pole. The core of the electro-magnet 19 adjacent the electro-magnet 16 becomes a north pole, while the opposing end of said core becomes a south pole. That end of the core of the electro-magnet 17 next the electro-magnet 19 becomes a north pole while its opposing end becomes a south pole. This energization causes a repellent action between the electro-magnets 15 and 18 and between the electro-magnets 16 and 19, and an attraction between the electro-magnets 16 and 18 and between the electro-magnets 17 and 19. The energization of the electro-magnet 17 also attracts the trip lever.

The initial movement of the trip lever moves the angle lever 63 to release the strap of the electro-magnet 19, the opposing end of the trip lever causing the latch 62 to override the lip 74 and rest in rear of the same. The magnet 19 will then move to and in contact with the electro-magnet 17, the movement of this lever releasing for gravital movement the lifting plate 42 and elevating the lifting plate 41. The dropping of the lifting plate 42 will free the first and third keys 40 while the elevating movement of the plate 41 will lift the second and fourth keys. As the second key has been holding the locking lever from movement, the lifting of this key will free said lever, permitting the attraction between the electro-magnets 16 and 18 to cause the magnet 18 to move toward but not in contact with the magnet 16. This movement of the electro-magnet 18 frees the signal controlling lever 23 and permits the spring 29 to force the signal 26 to danger position. As the head 49 of the locking lever 48 rides longitudinally of the guideway 34, after the lifting of the second key, it will engage the third key which has been lowered by release of the lifting plate 42. In this position of the head 49 the first key 40 will ride in rear of said head, preventing a return movement of the head, and thereby preventing the return of the electro-magnet 18 to normal position upon the deënergization of the apparatus.

In the movement of the strap 30 of the electro-magnet 19 the spring 54 of the switch plate is put under tension to move the switch plate in accordance with the movement of the strap, but such movement of the switch plate is prevented as the lip 70 of the locking plate 69 is still in engagement with the forward end of the switch plate. As the train rides off the switch 4 the various electro-magnets are deënergized, but the only operation occurring is the movement of the trip lever 57 under the influence of its spring 59. In the return of the trip lever to normal position, the latch 61 rides freely up the inclined lip 68, while the latch 72 engages the lip 74 and operates the lever 72. This movement of the lever frees the switch plate and permits the spring 54 to throw the switch plate into contact with the section 53, thereby establishing electrical communication between the conductors 77 and 80. The signal is now set at danger and remains so set during the travel of the train throughout the length of the block, or until the train engages the exit switch 5. On engaging this switch the current from the trolley wire is sent through the conductor 76, through the electro-magnet 18, conductor 77, conductor 80, through the electro-magnet 19, conductor 82, and through the path previously described. As the conductors 76 and 80 induce in the respective magnets 18 and 19 a polarity opposing that induced by the conductors 75 and 78, it will be obvious that the respective electro-magnets 18 and 19 are now attracted by the electro-magnets 15 and 16 respectively and repelled by the electro-magnets 16 and 17 respectively. This movement tends to restore the parts to normal position, swinging the electro-magnet 18 into contact with the electro-magnet 15 and operating the signal controlling lever to move the signal to clear position, the movement of the electro-magnet 19 again locking the parts and elevating the first and third key and dropping the second and fourth key. The trip lever in returning to normal position after the deënergization of the parts again releasing the switch plate 50 to permit the same to contact with the section 52 of the contact plate, it being understood that the contact plate is maintained in normal locking position by a spring, as 88.

In traveling along electric roads, particularly suburban and interurban roads, it frequently happens that trains will follow each other so closely that ordinarily the first train engaging the entrance switch 4 will not have passed the exit switch 5 before the second and probably other following trains have engaged said switch 4. Under

these conditions it is essential that means be provided for protecting the trains following the first train, or in other words that the apparatus be so arranged that with two or more trains passing the entrance switch 4 before the first train engages the exit switch 5, the parts of the apparatus must be so arranged that engagement of the first train with the exit switch 5 will not set the signal at clear. This provision is made in the keys 40, it being understood that there may be as many of these keys as may be desired. Assuming now that there are three trains following each other immediately within a distance less than the distance between the switches 4 and 5, so that all of said trains will successively engage the switch 4 before the first of said trains has engaged the switch 5. The first train, as previously described, will move the electro-magnet 19 in contact with the electro-magnet 17 and will move the electro-magnet 18 toward but not in contact with the electro-magnet 16. As the first train leaves the switch 4 and deënergizes the electro-magnet 17 the trip lever returns to normal position and thereby directs the current from the conductor 77 through the conductor 80 instead of through the conductor 78. As the second train engages the switch 4 the current flowing through the conductor 75 will maintain the polarity of the electro-magnet 18 as in the operation of the first train, but will reverse the polarity of the electro-magnet 19, as the release of the trip lever has shifted the switch 50 to the conductor 80. Therefore, the second train reverses the polarity of the magnet 19 and causes the same to be attracted by and moved toward the electro-magnet 16. This movement of the electro-magnet 19 will elevate the first and third key and release the second and fourth key. As the electro-magnet 18 is still attracted by the electro-magnet 16 the elevation of the third key in the movement of the electro-magnet 19 just described will permit the locking lever 48 to move beneath the third key into contact with the fourth key, the second key dropping in rear of the head 49 and locking the lever 48 in the new position.

Upon the deënergization of the circuits by the travel of the train beyond the switch 4, the trip lever, which, of course, has been actuated in the energization of the circuit by the second train, again returns to normal position shifting the switch 50 so that in the next energization of the circuit the current will be directed through the electro-magnet 19 over the conductor 78. As the second train leaves the switch 4 the head 49 of the locking lever 48 rests against the fourth key 40, and the parts are so proportioned that the electro-magnet 18 is not yet in contact with the electro-magnet 16. As the third train engages the switch 4 the current is sent through the conductor 75 to the electro-magnet 18, maintaining the original polarity of said electro-magnet, before said current reaches the electro-magnet 19 through the conductor 78. The polarity of the electro-magnet 19 is again reversed over the polarity induced by the energization of a circuit under the influence of a second train so that said electro-magnet moves toward and into contact with the electro-magnet 17. This movement raises the second and fourth key 40, and permits the electro-magnet 18 to move into contact with the electro-magnet 16, the head 48 traveling beneath the fourth raised key and being locked in position by the third key which gravitates in rear of the head. The locking lever 48 has thus been moved to its limit of movement by the successive operation of the three trains, the first of which, of course, set the signal at danger. It is now apparent that as the first train engages the exit switch 5, the current will travel over the conductor 76 and reverse the polarity of the magnet 18, thereby causing said magnet to be attracted toward the electro-magnet 19. This operation, however, moves the electro-magnet 19 so as to drop the second and fourth keys but elevate the first and third. The electro-magnet 18, therefore, under the pull of the electro-magnet 15 and the repel of the electro-magnet 16 will move toward the electro-magnet 15 until the head 49 of the lever 48 engages the third key, beyond which it cannot move as said latter key is in lowered position. The second train engaging the switch 5 reverses the polarity of the magnet 19 and causes it to move to elevate the first and third keys and drop the second and fourth. Therefore, the electro-magnet 18 can move one step farther toward the electro-magnet 15. The third train again reverses the polarity of the electro-magnet 19 causing it to elevate the second and fourth keys and drop the first and third. The head 49 of the locking lever 48 may then move into contact with the first key in which position the electro-magnet 18 is in contact with the electro-magnet 15 and the signal controlling lever 23 has been operated to move the signal clear to position. It is, therefore, apparent that the keys 40 are so successively actuated by a series of following trains as to impart a step-by-step advance movement to the apparatus which then requires the same step-by-step reverse movement before the signal is affected. In other words the first of a series of trains will set the signal at danger, the following trains not affecting the signal but affecting the apparatus, so that it requires all of the trains which affect the apparatus by entering the block to reversely affect it by leaving the block before the signal is returned to clear position. Therefore, no matter how

many trains may be within the block at one time, the signal at the exit of said block will not be set at clear until all of the trains have energized the apparatus at the exit end of the block.

Having thus described the invention what is claimed as new, is:—

1. A signaling system for electrically operated railroads including a trolley conductor, a signal, a plurality of switches supported adjacent the conductor and in electrical connection with the signal, and a conductor carried by each switch and spaced from the trolley conductor, the initially engaged end of the switch being formed to guide the trolley wheel to electrically connect the trolley conductor and switch conductor.

2. A signaling system for electric railroads including a trolley conductor, a signal, a movable electro-magnet arranged to directly affect the signal, and fixed electro-magnets coöperating with the movable electro-magnet to reciprocate the latter in the travel of the vehicle throughout a prescribed length of trolley conductor.

3. A signaling system for electric railroads including a trolley conductor, said system comprising a signal, a movable electro-magnet arranged to directly affect the signal, fixed electro-magnets between which the movable magnet is arranged for reciprocation, and spaced independently energized means for inducing a flow of current in the movable electro-magnet and in the fixed electro-magnet, said means being arranged to respectively induce a reversed polarity in the movable electro-magnet, whereby in the energization of the electro-magnet under one of said means said electro-magnet is moved in one direction and in its energization under the other of said means it is moved in the opposite direction.

4. An electrically operated signaling system including a signal, a signal controlling electro-magnet, fixed electro-magnets between which the signal controlling magnet is adapted for movement, and means for successively energizing all of said magnets during the travel of the vehicle, said successive energization reversing the polarity of the controlling magnet without affecting the polarity of the fixed magnet.

5. An electrically operated signaling system including a signal, a signal controlling electro-magnet, fixed electro-magnets between which the signal controlling magnet is adapted for movement, means for successively energizing and reversing the polarity of the controlling magnet, means for locking the controlling magnet in either position, and a movable electro-magnet adapted to control the locking means.

6. An electrically operated signaling system including a signal, a signal controlling electro-magnet, fixed electro-magnets between which the signal controlling magnet is adapted for movement, means for successively energizing and reversing the polarity of the controlling magnet, means for locking the controlling magnet in either position, and a movable electro-magnet adapted to control the locking means, and a fixed magnet coöperating with one of the first mentioned fixed magnets for inducing movement of the lock controlling electro-magnet.

7. A signaling system for electric railroads including a signal, a signal controlling magnet, two fixed magnets between which the controlling magnet is adapted for movement, means for locking the controlling magnet in a position engaging either fixed magnet, a movable lock controlling magnet, a fixed magnet coöperating with one of the first mentioned fixed magnets for inducing movement of the lock controlling magnet, and means for successively energizing all of said magnets, each energization reversing the polarity of the signal controlling and lock controlling magnets.

8. A signaling system for electric railroads including a signal, a signal controlling magnet, two fixed magnets between which the controlling magnet is adapted for movement, an arm carried by the signal controlling magnet, a series of dogs adapted to engage said arm to hold the signal controlling magnet in juxtaposition to either fixed magnet, a lock controlling magnet for operating the dogs, and means for energizing said magnets.

9. A signaling system for electric railroads including a signal, a signal controlling magnet, two fixed magnets between which the controlling magnet is adapted for movement, an arm carried by the signal controlling magnet, a series of dogs adapted to engage said arm to hold the signal controlling magnet in juxtaposition to either fixed magnet, a lock controlling magnet for operating the dogs, a fixed magnet coöperating with one of the first mentioned fixed magnets for limiting movement of the lock controlling magnet, and locking means for the lock controlling magnet arranged to be operated on the energization of the last mentioned fixed magnet.

10. A signaling system for electric railroads including a signal, a signal controlling magnet, two fixed magnets between which the controlling magnet is adapted for movement, an arm carried by the signal controlling magnet, a series of dogs adapted to engage said arm to hold the signal controlling magnet in juxtaposition to either fixed magnet, a lock controlling magnet for operating the dogs, a lock for the lock controlling magnet, means for successively energizing all of said magnets, and means controlled by the lock for successively directing

the energizing means to reverse the polarity of the lock controlling magnet.

11. A signal system for electrically operated roads including a signal, an entrance switch therefor, an exit switch therefor, and an apparatus in electrical connection with said entrance and exit switches, said apparatus including a movable signal affecting electro-magnet, a lock controlling electro-magnet, and connections between said electro-magnets and the switches, each successive actuation of either switch reversing the polarity of the lock controlling magnet.

12. A signal system for electrically operated roads including a signal, an entrance switch therefor, an exit switch therefor, an apparatus in electrical connection with said entrance and exit switches, said apparatus including a movable signal affecting electro-magnet, a lock controlling electro-magnet, connections between said electro-magnets and the switches, each successive actuation of either switch reversing the polarity of the lock controlling magnet, and means actuated by the lock controlling magnet to secure the signal controlling magnet in adjusted position, each reversal of polarity of the lock controlling magnet by energization of either one of the switches operating said locking means to permit an active movement of the signal controlling magnet in one direction.

In testimony whereof I affix my signature in presence of two witnesses.

FAE E. SMITH.

Witnesses:
W. M. GURLEY,
C. SWEILY.