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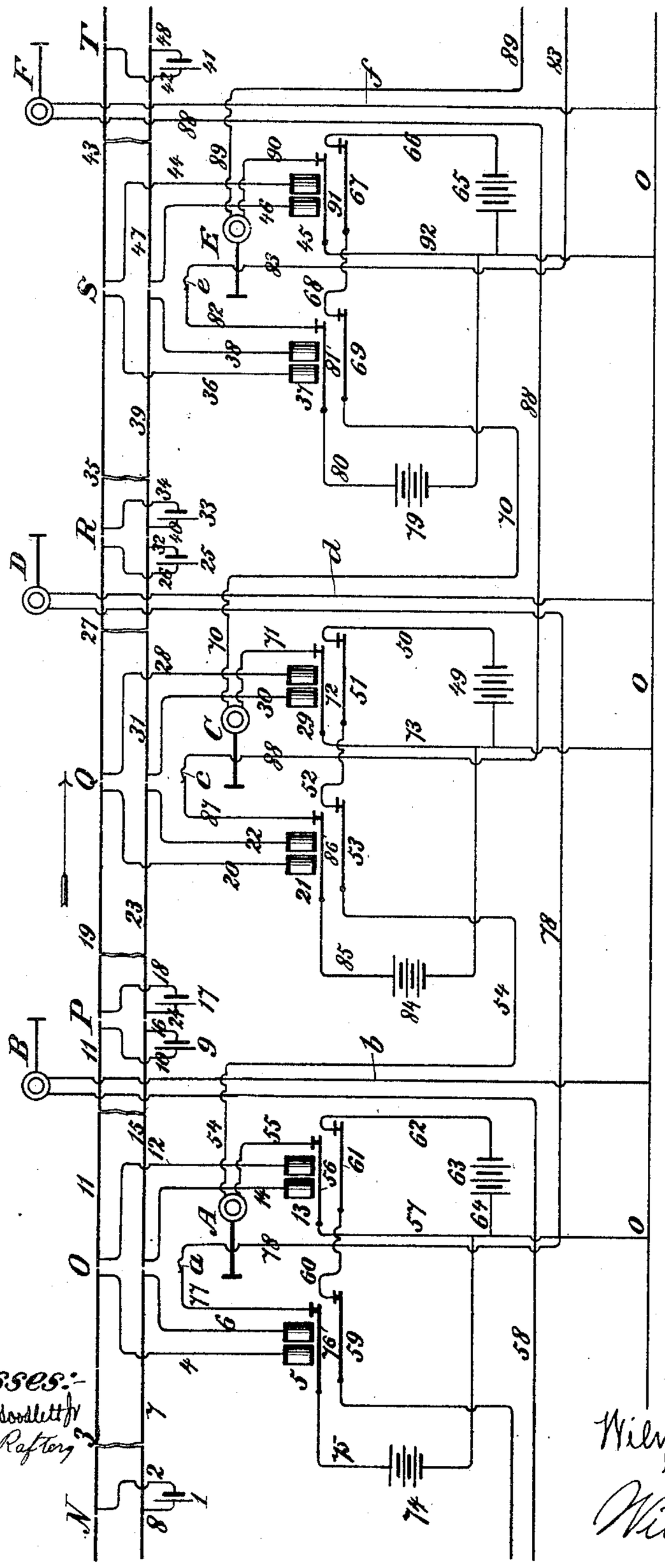
W. W. SALMON.

SIGNALING SYSTEM FOR SINGLE TRACK RAILWAYS.

(Application filed July 21, 1894.)

(No Model.)



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SIGNALING SYSTEM FOR SINGLE-TRACK RAILWAYS.

SPECIFICATION forming part of Letters Patent No. 697,277, dated April 8, 1902.

Application filed July 21, 1894. Serial No. 518,217. (No model.)

To all whom it may concern:

Be it known that I, WILMER W. SALMON, a citizen of the United States, residing at Chicago, in the county of Cook, State of Illinois, have invented certain new and useful Improvements in Signaling Systems for Single-Track Railways, of which the following is a specification.

My invention relates to electric block-signaling systems for single-track roads; and it has for its object to provide a more reliable system of this nature than has been heretofore known.

It consists of the various features hereinafter pointed out.

The system herein described is a modification of an electric signaling system described in an application filed simultaneously herewith, the principal difference being that in the present system the signal operating or controlling circuits stand normally closed with the signals at "safety," while in the other system the signal-circuits are normally open and the signals at "danger," which necessitates a material difference in the arrangement of the circuits and also a difference in the circuit-controlling means to produce a complete protective system for outgoing and incoming trains. To further distinguish the cases, I arbitrarily designate this case "Case 5" and the other case "Case 6."

The accompanying drawing represents diagrammatically the preferred embodiment of my present invention. In this diagram the track is provided with a series of signals A C E, &c., to signal trains running in the direction of the arrow or outrunning trains and a series of signals F D B, &c., to signal the trains running in the opposite direction or inrunning trains. The signals A C E, &c., may be therefore termed "outrunning signals" and the blocks which they guard "outrunning blocks," the signals F D B, &c., being termed "inrunning signals" and their blocks "inrunning blocks." Of course the terms "inrunning" and "outrunning" could be applied to either series of signals, and the terms are chosen and applied merely for the purposes of description. The signals are provided each with a signal-circuit for operating or controlling the signal, and these signal-circuits are controlled by the passage of a train by means of track-circuits. There are various types of track-circuits which might be employed in carrying out the broad spirit of my invention—for example, track-circuits permanently unbroken, normally closed or normally broken, track-circuits operated by track instruments, or track-circuits including the rails of the track. The track-circuits shown in the drawing include the rails of the track and are permanently unbroken, their magnets being shunted by the train. The track is divided into subsections, each including a magnet and battery. These subsections are lettered NO OP PQ QR RS ST, the batteries for their track-circuits are numbered 1, 9, 17, 25, 33, and 41, and their magnets are numbered 5, 13, 21, 29, 37, and 45, respectively. The signals are preferably arranged on opposite sides of the track, as shown.

The signals on one side of the track act as danger-signals to trains advancing in one direction and as opposing signals to trains advancing in the other. Thus signals A, C, and E act as danger-signals to trains proceeding in the direction of the arrow and are opposing signals to trains proceeding in the other direction, while signals B, D, and F act as danger-signals to trains proceeding in the reverse direction to that of the arrow and opposing signals to trains traveling in the direction of the arrow. For the sake of conciseness the terms "danger-signal" and "opposing signal" will be used in this specification with the meaning above given.

My preferred arrangement of devices will be best explained by describing in order, in connection with the drawing, the successive operations of a train upon those devices in passing over the sections of track represented. It will be understood that in the form of my devices shown in the drawing the various signals there shown are normally at "safety" and are held at "safety" by normally closed signaling-circuits.

First operation, on train entering track-section NO at N in the direction of the arrow: As soon as the wheels strike the rails of the section NO the relay 5 in the circuit, wire 2, rail 3, wire 4, relay 5, wire 6, rail 7, wire 8 of the battery is in the ordinary way demagnet-

ized, and the circuit-breakers 76 and 59 drop. The fall of the circuit-breaker 76 breaks the circuit of the battery 74 through the signal D, and accordingly puts that signal at "danger." This circuit is as follows: battery 74, wire 75, circuit-breaker 76, wire 77, circuit-breaker *a*, wire 78, signal D, wire *d*, common battery-wire *o*, back to battery 74. The effect, therefore, of the entrance of a train upon the section NO is, through the breaking of the circuit at 76, to put the signal D at "danger" and of course to continue it at "danger" as long as any part of the train is on the section NO. The signal B had previously, while the train was on a section of the road preceding NO, been put at "danger," as will appear hereinafter, and the effect of the train entering or remaining upon section NO is also to continue signal B at "danger," as will be hereinafter explained. Through the circuit-breaker 59, which also drops when the relay 5 is demagnetized, the train while on the section NO also continues at "danger" the signal which precedes A on the same side of the track as A, as will be hereinafter explained. The effect accordingly of the train entering upon or remaining upon section NO is to put D to "danger," continue B at "danger," and continue at "danger" the signal which precedes A on the same side of the track. The opposing signal D, which will act as a danger-signal to any train approaching in the direction opposite to that of the arrow, will prevent such train from approaching nearer than R, and the signal which precedes A on the same side of the track will prevent a rear collision with the train on the section NO. As soon as the train has entirely passed off from NO circuit-breakers 76 and 59 immediately close. This would immediately have the effect, first, of closing the circuit through signal D and putting it at "safety" were it not for the opening, in a manner presently to be described, of another circuit-breaker *a* in that circuit, and, secondly, of closing the circuit through the signal preceding A on the same side of the track and putting it at "safety" were it not for the opening, in a manner presently to be described, of another circuit-breaker 61 also in the same circuit.

Second operation, on said train entering section OP: As soon as the train enters this section it demagnetizes relay 13, the circuit through which is 14 15 16, battery 9 10 11 12, back to relay 13. Circuit-breakers 56 and 61 at once drop. The effect of the opening of 56 is to open the circuit through signal A. This circuit is as follows: signal A, wire 54, circuit-breaker 53, wire 52, circuit-breaker 51, wire 50, battery 49, common battery-wire *o*, wire 57, circuit-breaker 56, wire 55, back to signal A. Signal A accordingly goes to "danger" and stays there as long as the train remains on OP. This signal operates to protect the train on OP from rear-end collisions. In my preferred form of devices the circuit-breaker *a* in the circuit of the signal D is so connected to the mechanism of the signal A that when the latter goes to "danger" the circuit-breaker *a* is thereby mechanically opened. Such a mechanical arrangement is well known in the art and need not be here described. The opening of this circuit-breaker *a* continues the signal D at "danger," and it so remains as long as the train is on section OP. The dropping of the circuit-breaker 61 continues at "danger" the signal which precedes A on the same side of the track in the same manner as the dropping of circuit-breaker 51 by the entrance of the train upon section QR continues signal A at "danger," as will be presently described. The continuance at "danger" of the said signal preceding A on the same side of the track through a circuit-breaker in the circuit of the signal B, corresponding to circuit-breaker *a* in the circuit of signal D, continues B at "danger," just as the going to and continuance at "danger" of signal A through circuit-breaker *a* puts and continues signal D at "danger." The entrance of the train upon section OP accordingly puts signal A at "danger" and continues at "danger" signals D B and the one preceding A on the same side of the track. No train approaching in the opposite direction can come nearer than signal D, and no train following can approach nearer than the signal preceding A on the same side of the track. The entire removal of the train from section OP will close 56 and 61. The closing of 56 would close the circuit through signal A were it not for the opening of the circuit-breaker 53 in the same circuit in the manner presently to be described. The closing of 61 closes the last break in the circuit of the signal preceding A on the same side of the track, and that signal goes to "safety," with the effect of immediately closing the circuit through the signal B, which at once goes to "safety."

Third operation, on train entering section PQ: This will at once demagnetize relay 21, the circuit of which is as follows: 21 20 19 18, battery 17 24 23 22, back to relay 21. Thereupon circuit-breakers 86 and 53 will drop. Circuit-breaker 86 is in the circuit of the signal F, which circuit is as follows: battery 84 85 86 87, circuit-breaker *c* 88, signal F, wire *f*, common battery-wire *o*, back to battery 84. The dropping of circuit-breaker 86 accordingly sends signal F to "danger." The dropping of circuit-breaker 53, which is in the circuit of the signal A, continues that signal at "danger." As long as signal A remains at "danger" circuit-breaker *a* in circuit of signal D also remains open, and accordingly signal D is also continued at "danger" by the dropping of circuit-breaker 53. The effect accordingly of the entrance of the train upon section PQ is to send signal F to "danger" and to continue signals D and A at "danger." The train is thus effectually protected while on this section both in front and rear. As soon as the train has entirely passed off from

section PQ circuit-breakers 86 and 53 are at once closed. 86 in closing would close the circuit through signal F and send it to "safety" were it not for the circuit-breaker *c*, which is dropped in the manner about to be described, thus continuing F at "danger." 53 in closing would close the circuit through signal A were it not for circuit-breaker 51, which is opened in the manner about to be described, thus continuing A still further at "danger."

Fourth operation, on train entering section QR: This demagnetizes relay 29, the circuit of which is relay 29 30 31 32, battery 25 26 27 28, back to relay 29. Circuit-breakers 72 and 51 at once drop. In dropping 72 opens the circuit through signal C and sends it to "danger." This circuit is signal C 70, circuit-breaker 69 68, circuit-breaker 67 66, battery 65, common battery-wire *o* 73, circuit-breaker 72 71, back to signal C. As signal C goes to "danger" it mechanically opens circuit-breaker *c* in the circuit of signal F in the same manner as signal A when it went to "danger" opened circuit-breaker *a*. Signal F is accordingly continued at "danger" by the dropping of circuit-breaker 72. In dropping circuit-breaker 51 continues signal A at "danger." This accordingly continues signal D at "danger." The effect therefore of the entrance of the train upon section QR is to put C at "danger" and to continue A, D, and F at "danger." When the train quits section QR, circuit-breakers 72 and 51 are closed. 72 in closing would close the circuit through signal C and put it at "safety" were it not for another break made in this circuit at 69 in the manner about to be described. 51 in closing closes the last break in the circuit through the signal A and sends it to "safety." In returning to "safety" signal A closes the circuit-breaker *a*, and thus sends signal D also to "safety."

Fifth operation, on entering section RS: Relay 37 is at once demagnetized. Its circuit is as follows: Relay 37 36 35 34, battery 33 40 39 38, back to relay 37. Circuit-breakers 81 and 69 at once drop. 81 is in the circuit of the next signal beyond F on that side of the track. This signal is not shown, but if shown would be lettered H. This signal therefore goes to "danger." 69 in dropping makes another break in the circuit through the signal C, and accordingly continues that signal at "danger." This, through circuit-breaker *c*, also continues signal F at "danger." The train on entering section RS accordingly puts signal H at "danger" and continues signals C and F at "danger." As the train leaves section RS 81 and 69 close; but the circuits through signal H and signal C are not closed, because of new breaks made at *e* and 67, respectively, on the train entering section ST.

Sixth operation, on entering section ST: In the manner above described the train demagnetizes relay 45 and opens the circuit-breakers 91 and 67. 91 in dropping opens the circuit through signal E, and the latter in going to "danger" opens circuit-breaker *e* in circuit of signal H, continuing the latter at "danger." 67 in dropping continues signal C at "danger," which latter, also through circuit-breaker *c*, continues signal F at danger. On the train quitting section ST the last break 67 in the circuit through signal C is closed and that signal goes to "safety," thus allowing F also to go to "safety." Signal E is continued at "danger" by the train entering the next section just as signal A is continued at "danger" on the train entering section PQ. The effect of the passage of a train proceeding over the various track-sections in the direction the reverse to that indicated by the arrow would be the same upon the various circuits and signals as that previously described, except that it will be in the reverse order. Such a train entering upon section TS at T would send signal C to "danger," and thereby also signal F, and continue signal E, and thereby signal H, at "danger." On entering section SR it would continue signals C, F, and H at "danger." On entering section RQ it would send A and D to "danger" and continue C and F at "danger," and so on, through the remaining sections. The number of track-sections and of signals and circuits can of course be increased indefinitely, the arrangement of the same being mere duplications of the devices herein shown and described. In place of the circuit-breaker *a* in the circuit of the signal D, which is opened mechanically by the signal A as it goes to "danger" and is held in that position as long as signal A is at "danger," separate circuit-breakers could in the well-known manner be introduced into the circuit of signal D, controlled by the relays 13, 21, and 29, so that the presence of the train on any one of the sections OP, PQ, and QR would continue signal D at "danger." I prefer, however, the arrangement shown in the drawings as being of a simpler construction.

It will be noted from the above description that for an inrunning train the signal F guards its rear from the point T to the point P, that the signal D guards its rear from the point R to the point N, and that the signal B guards its rear from the point P to a point beyond the point N. These inrunning blocks therefore overlap each other. In the same way it will be observed that the outrunning blocks overlap each other. It will be noted, moreover, that when an outrunning train reaches the point O in advance of the outrunning signal A it puts it to "danger" behind the train and also puts the inrunning signal D ahead of the train to or holds it at "danger." The signals A and D may be termed "corresponding" signals, likewise the signals C and F. The signals A, C, and E face the outrunning trains or opposite the direction of the arrow, and the signals B, D, and F face the other direction. Any point away from a signal in the direction which it faces may be said to be in advance of or to precede the sig-

nal. Points on the other side of the signal would then be said to be in the rear of or to succeed the signal. For example, the point Q with respect to the signals A, C, and E is in the rear of or succeeds the signal A, but is in advance of or precedes the signal E. With respect to the signals B, D, and F the point Q precedes or is in advance of the signal B, but is in the rear of or succeeds the signal D.

In the systems heretofore known or used in single-track block-signaling a train proceeding in the direction of the arrow would send opposing signal D to "danger" when it reached point O and a train approaching in the opposite direction would send opposing signal A to "danger" when it arrived at point R. The following danger is inherent in such systems, to wit: Should two trains approaching each other pass the points O and R at the same moment, a collision would probably occur somewhere between signals B and C, for the engineer on the train at O seeing signal A go to "danger" as he passed would naturally think that it was his train that sent it to "danger," and so would proceed, and the engineer on the other train would likewise draw the same inference as to signal D. Signals B and C, it is true, are both at "danger;" but B is not a danger-signal for the train proceeding in the direction of the arrow, and C is not a danger-signal for the other train. Both trains would accordingly pass these signals and would meet at some intermediate point between. This danger is entirely removed by my improved device, as signal D is set at "danger" by the train when it reaches N a sufficient distance in advance of both signals A and B. If both trains pass points N and R at the same moment, signal A is at once set at "danger," and as signal B is also at "danger," having been previously so set by the train before it reaches point N, one train cannot pass signal A and the other cannot pass signal B, and a collision is impossible.

While I prefer to arrange the two sets of signals alternately, as shown in the drawings, my improved device can still be operatively used, as will on inspection be apparent to any one skilled in this art, even if the corresponding signals of the two series be set opposite or alongside of each other.

My preferred form shows the rail-circuits as normally closed. These circuits could, if desired and without departing from my invention, be made normally open, to be closed by the train in the well-known manner, such other modifications in the system as would be made necessary thereby being evident to any one skilled in the art.

What I claim as new, and desire to secure by Letters Patent, is—

1. In an electric signaling system for single-track roads, the combination of a series of outrunning blocks and a series of overlapping inrunning blocks, signals for the blocks, signal-operating devices connecting the inrunning signals together and the outrunning signals together and interconnecting the inrunning and outrunning signals, an electromagnetic double switch controlling the outrunning signals of its section, a second electromagnetic double switch controlling with the first of said switches the corresponding signal and the outrunning of the preceding blocks, and the inrunning signal of the section at which the second-named magnet is located, said inrunning signal being located in the rear of its corresponding outrunning signal not less than the distance between the said inrunning signal and the next inrunning signal toward the said outrunning signal, substantially as set forth.

2. In an electric block-signaling system the combination of a series of inrunning blocks, and a series of outrunning blocks, signals for the blocks and signal operating or controlling circuits for signals connecting the inrunning signals together and the outrunning signals together and interconnecting the inrunning and outrunning signals, an electromagnetic double switch controlling the outrunning signals of its section, a second electromagnetic double switch controlling with the first of the said switches the corresponding signal and the outrunning signal of the preceding block, and the inrunning signal of the section at which the second-named magnet is located, substantially as set forth.

3. In an electric signaling system for single-track roads, the combination of a series of outrunning blocks and a series of overlapping inrunning blocks, signals for the blocks and operating or controlling circuits for the signals connecting the inrunning signals together and the outrunning signals together and interconnecting the inrunning and outrunning signals, each outrunning signal guarding a portion of the track which is also guarded by a corresponding inrunning signal, said inrunning signal being located in the rear of its corresponding outrunning signal not less than the distance between the said inrunning signal and the next inrunning signal toward the said outrunning signal, a pair of double electromagnetic switches located at the outrunning signal, one of said switches controlling the outrunning signals of a block, the other of said switches controlling the corresponding signal, substantially as set forth.

4. In an electric signaling system for single-track roads, the combination of a series of outrunning blocks and a series of overlapping inrunning blocks, signals for the blocks connecting the inrunning signals together and the outrunning signals together and interconnecting the inrunning and outrunning signals, and operating or controlling circuits for the signals, each outrunning signal guarding a portion of the track which is also guarded by a corresponding inrunning signal, said inrunning signal being located in the rear of its corresponding outrunning signal not less than the distance between the said inrun-

ning signal and the next inrunning signal toward the said outrunning signal, a magnetic double switch controlling the outrunning signal of its section, a second magnetic double switch controlling with the first of the said switches the corresponding signal and the outrunning signal of the preceding block, and its corresponding signal, substantially as set forth.

5. In a single-track block-signaling system, two series of signals, each series adapted to act as danger signals for trains moving in one direction and as opposing signals for trains moving in the other direction, said signals being arranged alternately along the track, first a signal from one series, then a signal from the other and so on, insulated sections of track for the signals, a track-circuit for each of said sections of track adapted to be operated by the train while on said section, a double switch-relay in each of said circuits, secondary signaling circuits adapted to operate the signals, circuit-breakers in each of said signaling-circuits adapted in the signal-circuits of one series of said signals to be operated by the relays in three of said track-circuits and in the signaling-circuits of the other series to be operated by the relays in four of said track-circuits, substantially as set forth.

6. In a single-track block-signaling system, two series of signals, each series adapted to act as danger-signals for trains moving in one direction and as opposing signals for trains moving in the other direction, said signals being arranged alternately along the track, first a signal from one series, then a signal from the other and so on, insulated sections of track for the signals, a normally closed track-circuit for each of said sections of track adapted to be operated by the train while on said section, a double switch-relay in each of said circuits, secondary signaling-circuits, normally closed, adapted to operate the signals, circuit-breakers in each of said signaling-circuits, adapted in the signaling-circuits of one series of said signals to be operated by the relays in three of said track-circuits and in the signaling-circuits of the other series to be operated by the relays in four of said track-circuits, substantially as set forth.

7. In a single-track block-signaling system, two series of signals, each series adapted to act as danger-signals for trains moving in one direction and as opposing signals for trains moving in the other direction, insulated sections of track, track-circuits including said insulated sections adapted to be operated by the train, double switch-relays in said circuits, secondary signaling-circuits adapted to operate the signals, circuit-breakers in each of said signaling-circuits adapted in the signaling-circuits located at the danger-signals of one series of said signals to be operated by the relays of the track-circuits covering the portions of track between a signal of said first series and the opposing signal of the other series which is the second one of said series beyond a preliminary track-section which lies immediately in advance of the said signal of the first series, and adapted in the signaling-circuits of the other series of said signals to be operated by the relays of the track-circuits covering the said preliminary track-sections and the track-sections between it and the second signal of the said other series beyond said preliminary track-section, substantially as set forth.

8. The signal system comprising series of signals, each series constructed to operate as header-signals when a train is moving in one direction, and as rear signals when the train is moving in the opposite direction, and double switch-relays connecting the individual members of the series and interconnecting the members of the different series, and under the control of a moving train to set successively and maintain a plurality of signals of one series in advance of the train as header-signals and a signal of another series set to the rear of the train as rear signals, substantially as set forth.

9. The signal system, comprising series of signals arranged in sets, the individual members of a set being electrically interconnected, the one member of a set serving to control the setting of the signal of its companion to danger as a header-signal when the train is running in one direction, and a double switch-relay and electric circuits under the control of the train to simultaneously operate adjacent sets of signals to set two of the signals of one series in advance of the train as header-signals and to set two of the signals of another series to the rear of the train as rear signals, substantially as set forth.

10. The signal system, comprising series of signals arranged in sets, the individual members of a set being electrically interconnected, the one member of a set serving to control the setting of the signal of its companion to danger as a header-signal when the train is running in one direction, circuits for the signal and rail-circuits, double switch-relays in said rail-circuits operating or controlling the signal-circuits, said circuits being organized and arranged to protect the train in front and rear by at least three signals maintained at danger whereby when two signals of one series are held at danger as header-signals at least one signal of the other series must be held at danger as a rear signal and when two signals of one series are held at danger as rear signals at least one signal of the other series must be held at danger as a header-signal, substantially as set forth.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

WILMER W. SALMON.

Witnesses:
L. THOMAS,
JOS. F. KURCHER.