No. 759,543. PATENTED MAY 10, 1904.

E. W. McGUIRE.

ELECTRIC RAILWAY SIGNAL.

APPLICATION FILED AUG. 15, 1902.

NO MODEL.

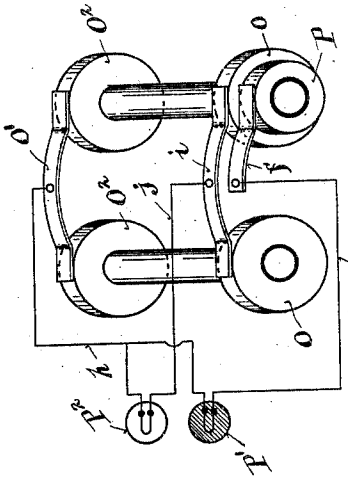

Fig. 3.

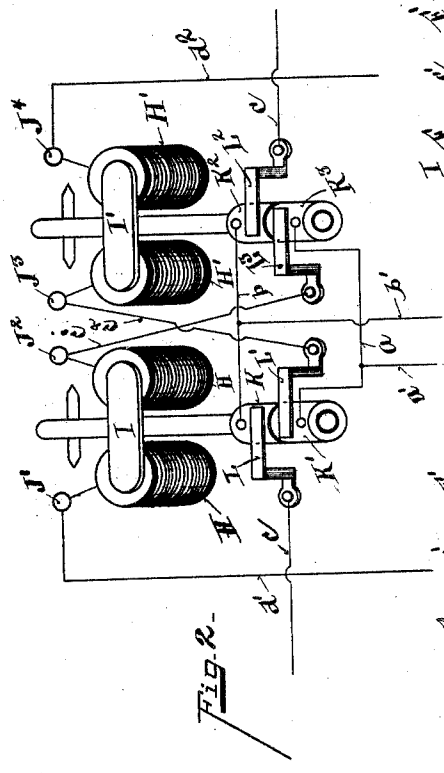

Fig. 2.

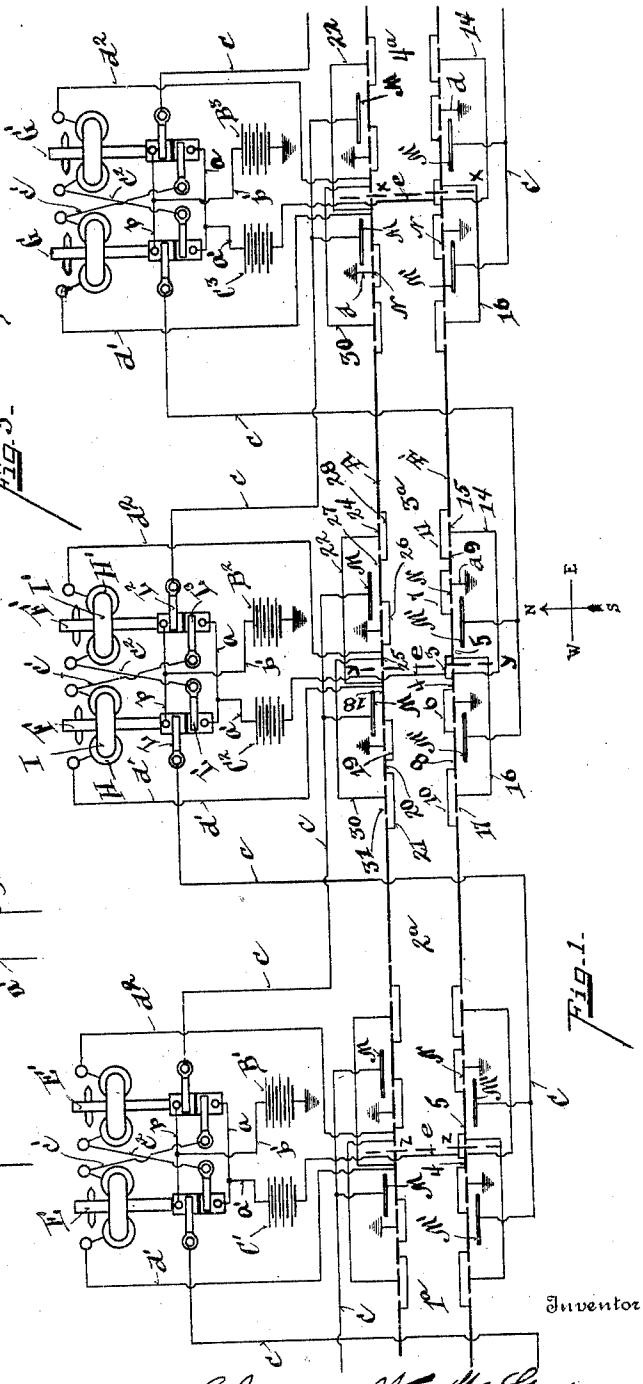

Fig. 1.

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UNITED STATES PATENT OFFICE.

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ELECTRIC RAILWAY-SIGNAL.

SPECIFICATION forming part of Letters Patent No. 759,543, dated May 10, 1904.

Application filed August 15, 1902. Serial No. 119,768. (No model.)

To all whom it may concern:

Be it known that I, ELWOOD W. McGUIRE, a citizen of the United States, residing at Richmond, in the county of Wayne and State of Indiana, have invented certain new and useful Improvements in Electric Railway-Signals, of which the following is a specification.

My invention relates to an electric block-signal system for railroads.

My invention contemplates the use of two independent electric block-circuits, one of which controls a safety-signal, the other a danger-signal. These circuits are derived from suitable power sources preferably distributed at appropriate intervals along the track, and the circuits are disposed in the rails and certain contact-rails parallel to the track. These circuits are respectively connected through the engine-wheels and transmitted to the engine-cab to actuate the respective signals.

Of course my organization and arrangement of the electric connections, terminals, &c., constitutes partial circuits in the absence of the locomotive. The safety-signal partial circuit is closed for each block when any locomotive is in that block; but the partial circuit for the danger-signal is only closed when locomotives are on the contact-rails of separate blocks, and when in this condition the safety-signal partial circuits are locked out of even partial circuit.

My disposition of the circuits and connections are such that under no normal conditions can both the safety and the danger signals be received at the same time. The operation of the safety-signal tells the engineer that the track is both clear and intact and the connections established.

The cessation of the safety-signal without the operation of the danger-signal tells the engineer that the track is injured or the electric signals broken or a train approaching from the rear, any of which conditions necessitates investigation.

The operation of the danger-signal is positive orders to stop.

The features of my invention are more fully set forth in the description of the accompanying drawings, forming a part of this specification, in which—

Figure 1 is a diagrammatic plan view of my electric block-signal system, illustrating three block-sections. Fig. 2 is an enlarged diagrammatic view of duplex switch-operating instrument with its circuit connections. Fig. 3 is a diagrammatic view of locomotive-truck with the circuit connections.

A A′ represent the tracks running, say, east and west and suitably blocked off into sections, 1^a representing the lap end of the west block, only partially shown, and 2^a, 3^a, and 4^a representing the successive blocks going east.

The dotted lines $x\,x$, $y\,y$, and $z\,z$ indicate the division between the blocks 4^a and 3^a, 3^a and 2^a, and between 2^a and 1^a, respectively.

Any source of electrical energy may be used, batteries being shown for convenience. A central power-station or separate relays may be employed, as desired.

B′, B^2, and B^3 represent the danger-signal batteries for blocks 2^a, 3^a, and 4^a, respectively.

C′, C^2, and C^3 represent the safety-signal batteries for said blocks 2^a, 3^a, and 4^a, respectively. Between each two blocks are the duplex switch-operating instruments E E′, F F′, and G G′, respectively, through each one of which connections are made and broken from both the safety and danger signal batteries—that is, each block has at each end an instrument connected with the instrument of its adjacent block. Thus block 1^a has at its eastern end instrument E connected to instrument E′ at the west end of block 2^a. Block 2^a has at its east end instrument F connected with the instrument F′ at the west end of block 3^a, and block 3^a has at its east end instrument G connected with instrument G′ at the west end of block 4^a, and so on over the route. This duplex switching instrument is shown in enlarged diagram, Fig. 2, in which H H′ represent pairs of magnet-coils, and I I′ the armature-levers, suitably pivoted at one end and held by suitable springs out of contact with the magnet-coils.

J′, J^2, J^3, and J^4 represent the four binding-posts of the magnet-coils. On the armature I are two metallic-contact electrode-col-

lars K K′, suitably insulated and making and breaking contact with the stationary electrodes L L′, respectively. The collar K′ and electrode L′ are for the safety-signal circuit. The duplex armature I′ has similar collars K^2 K^3 and similar electrodes L^2 and L^3, K^2 and L^2 being for the danger-signal circuit and K^3 and L^3 for the safety-signal circuit.

The collars K and K^2 for the danger-signal circuits are electrically connected by the wire *b*, which connects through wire *b′* with the danger-signal battery B^2. The collars K′ and K^3 are electrically connected by wire *a*, having connection through wire *a′* with the safety-signal battery C^2. The danger-signal electrodes L L^2, respectively, are electrically connected through wire *c* with the danger-signal rails M going east and M′ going west.

N represents the insulated grounded sections of the track-rails opposite the contact-rails M M′, and *d* represents the wires connected thereto and to the ground, constituting the return or ground circuit end of the danger-signal circuits.

The safety-signal electrodes of the instrument L′ L^3 are connected as follows: L′ to binding-post J^3 and L^3 to binding-post J^2 through the wires *c′* and c^2. The binding-posts J^2 and J^3 connect by wires with the magnetic coils and binding-posts J′ and J^4. *d′* d^2 represent the wires from the binding-posts J′ J^4 to the main-track rails of the adjacent blocks. Thus it is apparent that the danger-signal partial circuit goes from the battery through wires *b′ b*, collars K K^2, electrodes L L^2, wires *c* to the danger or contact rails M M′, through the car-wheels and signal device on the engine to the rail N, and thence to the ground through wire *d*.

The safety-signal partial circuit goes from the battery through wires *a′ a* to the collars K′ K^3, to the electrodes L′ L^3, through wires *c′* c^2 to the binding-posts J^2 J^3, through the magnetic coils, through binding-posts J′ J^4, through wires *d′* d^2 to the track-rails A, through the car-wheels on the locomotive to the safety-signal device, and thence through the opposing rail A′ and back to the battery through return-wires *e*.

The wheels on one side of the front locomotive are insulated from their axles. (See Fig. 3.) O represents these wheels. P represents a third wheel at one side designed to run upon the contact-rails M M′. *f* represents a brush engaging the third wheel P and connected by wire *g* to the red or danger-signal light P′ in the engine-cab, thence back through wire *h* to brush O′ and wheel O^2, and thence to the opposing track-rail. *i* represents the brush engaging the front truck-wheels connected by wire *j* with the green or safety-signal light P^2 in the engine-cab and thence returning through wire *h* to the opposing rail. The track being clear, say a train runs onto block 3^a from block 4^a going west—that is, the train is standing on rails immediately west of the division-line *x x* in the east end of block 3^a, at which the safety-signal circuit is instantly made through the locomotive-wheels and over the following course: from the rail A through the wire *d′* of the instrument G, through the coil of instrument G, through the wire *c′*, through the electrode L^3, wire *a*, branch wire *a′* to the safety-signal battery C^3, thence by wire *e* to the rail A′, and thence through the safety-signal circuits on the locomotive. As rail A is connected by branch wire through block 3^a, the west end of the block 3^a will also be energized as follows: starting with the short rail 25 through wire d^2, through instrument F′, through the wire c^2, electrode L′, armature switch-lever of instrument F, wires *a a′*, battery C^2, wire *e*, (at the west end of block 3^a,) and into the short rail 5, rail 5 being connected by branch wires with the rail A′ at the beginning of the east end of block 3^a. Thus it is apparent that when the train stands on block 3^a the instruments G and F′ at the east and west end, respectively, of block 3^a are energized. Therefore the instrument G′ at the west end of block 4^a and the instrument F at the east end of block 2^a are held with their armature-levers locked in position of contact, thus locking in the danger-signal circuits controlled through the armature-switches of the instruments F and G′. This operation breaks the contact of collar K^2 with electrodes L^2 and also the contact of collar K^3 with electrodes L^3, so breaking both the safety and the danger signal circuits in the instrument F′. The same operation is simultaneously effected in the instrument G. Now inasmuch as the circuits through the magnet-coils of instruments F and G′ can only be established by passing an electric current through the switches of their companion instruments F′ and G, respectively, it follows that when instruments F′ and G are energized by a train in block 3^a opening their armature switches the instruments F and G′ are locked in normal position with the danger-signal circuit closed as long as the train is in block 3^a. Note that the danger-signal contact-rails M at the east end of block 2^a and at the west end of block 3^a are wired together and controlled by the safety-signal switch of the instrument E′ at the west end of block 2^a and charged from the battery B′. In like manner the danger-signal rails M at the east end of block 3^a and at the west end of block 4^a are wired together and controlled by the danger-signal switch of the instrument F′ at the west end of block 3^a and charged by the battery B^2. The same system is illustrated on the south side of the track—that is, danger-signal contact-rails M′ at the west end of block 3^a and at the east end of block 2^a are wired together and controlled by the instrument G at the east end of block 3^a and charged from battery B^3. Likewise the danger contact-

rails M′ at the west end of block 2^a and at the east end of block 1^a are wired together and controlled by the instrument F at the east end of block 2^a, charged by the battery B^2. Therefore it follows that if the track be clear and a west-going train is passing on block 3^a—say as it passes on the danger-signal contact-rail M at the northwest side of block 3^a—it would receive the red signal through the instrument E′ at the west end of block 2^a were there not some connection in proximity to the rail M in the northwest end of block 3^a adapted to energize the instrument E′ as the train passes off of block 3^a onto block 2^a. It must be remembered that as long as a train is in block 3^a instruments F′ and G are energized, and that, therefore, the instrument F at the east end of block 2^a cannot be energized; but an insulated section of the track opposite the northwest contact-rail M of block 3^a is wired westward and included in the partial safety-signal-circuit control controlling the instrument E′, so as to energize that instrument while the train is still at the west end of block 3^a, and so shutting off the current from the danger-signal contact-rail M at the northwest end of block 3^a. The train enters block 3^a, the instruments F′ and G are magnetized, and the instruments F and G′ are locked in contact position with their controlling-coils deënergized, so that any train going east would receive the red signals when it passed onto the contact-rails M′ at the end of block 1^a and the beginning of block 2^a, said rails being charged from the battery B^2 of block 3^a through wire *e*, through electrode L of the instrument F, wires *b b′*, and battery B^2 of block 3^a, the return-circuit being through the opposite ground-rails N at the east and west ends of blocks 1^a and 2^a, respectively. Assuming a train still standing in block 3^a, as the instrument G′ is held in locked position of contact any west-going train would receive the danger-signal whenever it passed onto the contact-rails M, charged by battery B^3 of block 4^a, the connection of which is made through the instrument G′. Assuming that a train enters block 2^a from block 3^a—that is, the train passes west of the dotted line *y y*, forming the division between block 2^a and 3^a—the instruments F′ and G become demagnetized and the instruments E′ and F become magnetized, locking their companion instruments E and F′ in contact position, so that any train approaching in either direction would receive the danger-signal whenever its third wheel passed onto the contact-rails charged from battery B in block 2^a through the danger-signal switch of the instrument E or charged by battery B^2 of block 3^a through the danger-signal switch of the instrument F′. Thus a train passing along as it enters each new block magnetizes the instrument at the beginning and end of that block, so rendering it impossible for an engine on the adjacent blocks to receive the green signal and insuring that approaching trains will receive the danger-signal in passing onto the respective danger-signaling contact-rails, the circuits of which are controlled by the first-named train.

An east-going train at the end of block 1^a would send its danger-signal onto the contact-rails M at the end of block 2^a and beginning of block 3^a. The west-going train at the end of block 3^a would send its signal onto contact-rails M′ at the end of block 1^a and beginning of block 2^a, so that both trains would receive the danger-signal before either one of them passed onto block 2^a. If the trains are running in the same direction, the approaching train would receive the danger-signal and stop. For instance, assume that an east-going train passes onto block 3^a, it would hold the instrument F in locked position, and consequently the contact-rails M′ at the beginning of the block 2^a and at the end of block 1^a would be charged from battery B^2 in block 3^a, the connections being established through the locked instrument F. The second east-going train would receive the danger-signal at the end of block 1^a and the beginning of block 2^a.

In the preferred arrangement which I have shown for wiring the safety-circuit, *e* represents the wire connecting the battery C^2 with the south-track rail A′. 3 represents the wire branching from wire *e*, connecting with the block-rails 4 5. 4 5 are connected by the wires 6 and 7 with the rails 8 and 9 and rails 8 and 9 by wires 10 and 11 to the main rails A′ of the adjacent blocks 2^a and 3^a. Also on the south track A′, going east, the wire 14 connects rail 4 of block 2^a with the green rail 15 of block 3^a. Going west the wire 16 connects block-rail 5 of block 3^a with the green rail 17 of block 2^a On north track A, looking at Fig. 1, *d′* represents the wire connecting rail 18 of block 2^a with the magnet-coils of instrument F, the safety-signal circuit of which is formed through the contacting armature-electrodes of instrument F′. Rail 18 is connected by wire 19 with rail 20 and by wire 21 with the main-track rail A in block 2^a going west. Also the rail 18 of block 2^a is connected by wire 22 to green rail 24 of block 3^a going east.

d^2 represents the wire connecting the rail 25 of block 3^a with the magnet-coils of instrument F′, the circuit of which is formed through the contacting armature-electrode of the companion instrument F.

Going east from rail 25 wire 26 connects rail 25 with rail 27, thence by wire 28 with main rail A of block 3^a. Commencing again with rail 25, going west, 30 represents the wire connecting said rail 25 with the green rail 31 of block 2^a going west.

If block 1^a be clear and a west-going train is leaving block 3^a, in passing rails 24 and 15 the safety-signal would flash in the cab. The

connections would be as follows: on the north side of the track, rails 24, at the west end of block 3^a, by wire 22 to rail 18, at the east end of block 2^a by wire 19 and 21 and intermediate rail 20 to the main rail of block 2^a, then by branch wires to the short rail at the extreme west end of block 2^a, and thence by wire d^2 through the magnet-coil of instrument E′, through the safety-signal switch on the armature-lever of the instrument E to the battery, and thence back by similar connections through the main south-track rail of block 2^a to the insulated rail 15 at the southwest end of block 3^a. If a train be in block 1^a, of course the instrument E will be energized, opening its safety-signal switch and rendering it impossible for the west-going train in block 3^a to receive the safety-signal switch in passing over the rails 24 and 15. Thus the rails 24 and 15 of block 3^a are included in the partial safety-signal circuit of the main rails of the adjoining block 2^a. This including of the insulated rails 24 and 15 in the partial circuit of the track-rails of an adjoining block has the following three functions when a current is received through them: First, it tells a west-going train at the end of block 3^a that the instrument E′ is working; second, it tells also that the instrument E at the east end of block 1^a is in normal condition, and hence there is no train in block 1^a; third, the closing of the circuits through rails 24 and 15 by operating the instrument E′, if the track be clear, cuts out the current from the rail M at the northwest end of block 3^a in close proximity to the rails 24 and 15.

The same system of wiring is employed in the opposite direction at the east end of block 2^a. Rails 31 and 17 are insulated from block 2^a and included in the main-track partial circuit of block 3^a. Therefore as the west-going train enters block 2^a if it receives a safety-signal as it passes over insulated rails 31 and 17 it indicates that block 4^a is clear. This circuit would be established as follows: from rail 31 by wire 30, to rail 25 by wire 26, to rail 27 by wire 28, to main-track rail A of block 3^a, thence by branch wires and rails of block 3^a to wire d' through the coil of magnet G, through the safety-signal switch of the armature of instrument G′ to battery C^3, thence by wire e, thence by branch wire and coil connection to the south rail A′, thence by wire 11, rail 9, wire 7, rail 5, wire 16 to insulated rail 17 of block 2^a, thence through the locomotive connections to the insulated rail 31. Should a train be present in block 4^a, the instrument G′ would be magnetized, opening the safety-signal switch of instrument G, so that it would be impossible for the west-going train to close the circuit through rails 31 and 17. Hence the absence of the green signal on entering a block would indicate the presence of a train in the second adjoining block to the rear. Note that each block has two contact danger-signal rails on each side. As shown, the contact-rail at the west end of one block is wired to the contact-rail at the east end of the adjoining block and connected to the danger-signal switch of the instrument belonging to one of said blocks.

Without departing from this invention the contact-rails of a given block might be variously wired to the danger-signal switch of the instrument of any selected block. The principle being given, it is not essential whether the danger-signal contact-rail of a given block is controlled by the danger-signal switch of said given block, of an adjoining block, or of a second adjoining block in either direction. This is a matter of selection to be determined by the conditions.

It is to be understood that the grounded rails N are equivalent to a return-wire to the battery. It is evident that the energizing-circuit not only locks closed the switches of the adjoining blocks, but it continually indicates to the engineer in the cab the successive operation of the instruments in both directions of the track.

Of course instead of conducting the currents respectively through the safety-signal and danger-signal apparatus by conducting an electric impulse to said devices an agency is furnished in the cab which may be variously utilized in producing signaling effects.

The disposition of the contact-rails as to both the danger and safety signals may be variously arranged as to location, it being optional whether they are relatively reversed or otherwise modified as to position, provided they adhere to the principle of circuit-making herein described.

A great many modifications and other dispositions and arrangements of circuits and signals can be made without departing from the principles of this invention, and I do not wish to be limited to particular arrangements any further than is required by the specific reading of the claims.

It is obvious that the arrangements described as "a safety-signal and magnet operating circuit" may constitute an independent operative block-signal system, and the last four claims are directed to this feature of the invention.

Having described my invention, I claim—

1. In combination with an electric block-signal system for railways comprising a subdivision of rails into insulated blocks and a contact-rail for each block, a locomotive carrying insulated wheels, an insulated electrode for said contact-rail, a safety and a danger signal device, electric connections through said wheels and one of said signal devices, and independent electric connections through said electrode and the other of said signal devices.

2. An electrical signal system for railways comprising a subdivision of rails into insu-

lated blocks, a danger-signal contact-rail for each block, a magnet-coil and its armature switch-lever in each block, the rails of a given block, the magnet-coil of said given block and the armature switch-lever of the magnet-coil of an adjacent block being connected in partial circuit forming a magnet-operating circuit when closed, a source of electric supply therefor, the danger-signal contact-rail of said given block, an adjacent ground-rail, and the armature switch-lever of an adjoining block being connected in partial circuit forming a danger-signal circuit when closed, a source of electric supply therefor, and means on the locomotive for closing said partial circuits, substantially as described.

3. An electrical signal system for railways comprising a subdivision of rails into insulated blocks, a danger-signal contact-rail for each block, a magnet-coil and its armature-lever for each block, two independent stationary electrodes, two independent coacting electrodes therefor on said armature-lever, the rails of a given block, its magnet-coil and one of the coacting pairs of electrodes of an adjacent magnet-coil being connected in partial circuit, a source of electric supply therefor, the contact-rail of said given block, an adjacent ground-rail, and one of the coacting pairs of electrodes of the armature-lever of the magnet-coil of an adjoining block being connected in partial circuit, a source of electric supply therefor, and means on the locomotive for closing said partial circuits, substantially as described.

4. An electrical signal system for railways comprising a subdivision of rails into insulated blocks, a danger-signal contact-rail for each block, a magnet-coil and its armature switch-lever in each block, the rails of a given block, its magnet-coil, the armature switch-lever of the magnet-coil of an adjoining block being connected in partial circuit adapted to be closed by a train in said given block, a source of electrical supply therefor, a contact-rail for said block, an adjacent ground-rail, and the armature switch-lever of the magnet-coil of an adjacent block being connected in partial circuit, and means on the locomotive for closing said partial circuits whereby the presence of a train in a given block locks in the danger-signal partial circuit of an adjoining block, there being in proximity to said danger-signal contact-rail, rails included in the safety-signal partial circuit of said adjacent block, adapted to be closed while a train is passing over said danger-signal contact-rail of said given block, thereby energizing the instrument of said adjacent block, if the track be clear, and opening the danger-signal switch controlling the danger-signal contact-rail of said given block, while the locomotive is passing over said danger-signal contact-rail, substantially as described.

5. In an electrical signal system for railways comprising a subdivision of rails into insulated blocks, a danger-signal contact-rail for each block, a magnet-coil and its armature-lever for each block, each armature-lever having two independent electrodes, two coacting stationary electrodes therefor, the rails of a given block, the magnet-coil of said block, and one of the coacting pairs of electrodes of an adjoining block being connected in partial circuit, a source of electric supply therefor, the contact-rail of said given block, one of the pairs of coacting electrodes of an adjoining block being connected in partial circuit, and means on the locomotive for independently closing said circuits, substantially as described.

6. An electrical signal system for railways comprising a subdivision of rails into insulated blocks, each block having a magnet-coil, its armature switch-lever, two insulated electrodes on said lever, and two stationary coacting electrodes therefor, the magnet-coil of a given block being connected in partial circuit with one of the coacting pairs of electrodes of its next adjacent instrument, in the next block, and the rails of said given block, the contact-rail of said given block being connected in partial circuit with an adjoining ground-rail, and a coacting pair of electrodes of the magnet-coil of an adjoining block, means on the locomotive for independently closing said partial circuits and sources of electric supply for said two independent partial circuits, there being in proximity to said danger-signal contact-rail, rails included in the safety-signal partial circuit of said adjacent block, adapted to be closed while a train is passing over said danger-signal contact-rail of said given block, thereby energizing the instrument of said adjacent block, if the track be clear, and opening the danger-signal switch controlling the danger-signal contact-rail of said given block while the locomotive is passing over said danger-signal contact-rail, substantially as described.

7. An electrical block-signal system comprising a subdivision of the rails into insulated blocks, a contact danger-signal rail for each block, a magnet-coil and its armature-lever for each block, two independent electrodes on each lever, two stationary coacting electrodes therefor, the stationary electrodes being normally in contact with the armature-lever electrodes, and adapted to be broken when the magnet-coil is energized, the rails of a given block, the magnet-coil of said given block and one of a pair of coacting electrodes of an adjoining block being connected in partial circuit, the danger-signal contact-rail, an opposite ground-rail, and one of the coacting pairs of electrodes of an adjoining block being connected in a partial circuit, a source of electric supply for each of said partial circuits and means on the locomotive for independently closing said circuit, substantially as described.

8. An electric signal system for railways comprising a subdivision of rails into insulated blocks, a pair of instruments for each two adjoining blocks, each instrument comprising a magnet-coil and its armature-lever, each armature-lever having two independent electrodes, two stationary electrodes therefor, the magnet-coils of a given block being connected in partial circuit with the rails of said given block and with the coacting pairs of electrodes of the companion instruments of adjacent blocks at each end, the danger-signal of a given block having connection in partial circuit with a ground-rail, and one of the coacting pairs of electrodes of an adjoining block, a source of electric supply for each partial circuit and means on the locomotive for closing said partial circuits conducting them respectively to signaling devices, substantially as described.

9. An electrical block-signal system for railways comprising a subdivision of rails into insulated blocks, a contact danger-signal rail for each block, duplex instruments at the meeting ends of each two adjoining blocks, each comprising a magnet-coil, its armature-lever, a stationary electrode, a coacting movable electrode therefor on the armature-lever, forming a magnet-operating switch, a second independent set of electrodes on said armature-lever forming a danger-signal switch, each magnet-coil being connected to the magnet-operating switch of its companion magnet-coil, the rails of a given block, its magnet-coil, and the magnet-operating switch of the adjacent instrument being connected in partial circuit, a source of electric supply therefor, the danger-signal contact-rail, an opposite ground-rail, and the danger-signal switch of an adjoining block being connected in partial circuit, a source of electric supply and means on the locomotive for closing said circuits, whereby the presence of a locomotive in a given block energizes the magnet-coils at each end of said block, thereby breaking the connections through which circuits are established in the adjacent magnet-coil, and thus locking in position the danger-signal circuits in adjoining blocks, substantially as described.

10. An electrical signal system for railways comprising a subdivision of the rails into insulated blocks, a danger-signal contact-rail for each block, a pair of companion instruments at the meeting ends of each two blocks, each comprising a magnet-coil, its armature-lever, a magnet-operating and a danger-signal switch on each armature-lever, the magnet-coil of each instrument being connected with the safety-signal switch on the armature of its companion magnet-coil, a source of electric supply, the rails of a given block, its magnet-coil, the magnet-operating switch of the companion instrument and the source of electric supply being connected in partial circuit, the danger-signal contact-rail of a given block being connected with the danger-signal switch of the instrument of an adjoining block, a source of electric supply, and means on the engine for controlling said circuits, substantially as described.

11. An electrical signal system for railways comprising a subdivision of the rails into insulated blocks, a danger-signal contact-rail for each block, a pair of companion instruments at the meeting ends of each block, each comprising a magnet-coil, its armature-lever, a magnet-operating switch and a danger-signal switch on each lever, said switches being normally closed and broken by the energizing of the magnet-coils controlling the armature-levers on which they are mounted, the rails of a given block, its magnet-coil and the magnet-operating switch of the companion instrument being connected in partial circuit, a source of electric supply, the danger-signal contact-rail of a given block, and the danger-signal switch of the instrument of an adjoining block being connected in partial circuit, means for opening the danger-signal switch of the instrument of said adjoining block, while the train is passing over the danger-signal contact-rail of said given block, if the track be clear, a source of electric supply therefor, and means on the locomotive for closing said partial circuits, whereby the presence of a locomotive in a given block energizes the instruments at each end of said block, locking in position the danger-signal partial circuits of adjoining blocks, substantially as described.

12. In an electric block-signal system for railways, a subdivision of rails into insulated blocks, a pair of companion instruments between each two blocks, each instrument having a magnet-coil and armature, a magnet-operating switch and a danger-signal switch on each armature, the armature-switches being connected with the magnet-coils of the companion instrument, the rails of each block being connected with the magnet-coils at each end of said block, said rails forming through the magnet-operated switch a partial circuit adapted to be closed by a locomotive in a given block, whereby the magnet-coils of said given block at each end are energized, a danger-signal rail for each block connected to the danger-signal switch of adjoining blocks, and sources of electric supply for said two independent partial circuits, substantially as described.

13. An electric signal system for railways comprising a subdivision of the rails into insulated blocks, a contact-rail for each block, a pair of companion instruments between each two blocks, each instrument comprising a magnet-coil, an armature-lever, independent magnet-operating switch and danger-switch on each armature, the magnet-coils of a given block being connected in partial circuit with the rails of said given block, and the magnet-

operating switches of the next two adjacent blocks at each end, the contact-rail of said given block being connected in partial circuit with the danger-signal switch of an adjoining block, a source of electric supply for each two partial circuits, means on the locomotive for independently closing said partial circuits, a safety-signal on the locomotive, adapted to be actuated by the magnet-energizing-circuit current, when the selected adjacent block is clear, and a danger-signal on the locomotive adapted to be actuated by said danger-signal current, when there is a second train in said second adjacent block, substantially as described.

14. An electric block-signal system for railways comprising a subdivision of rails into insulated blocks, danger-signal contact-rails for each block, a duplex pair of instruments between each two adjoining blocks, each comprising a magnet-coil, its armature-lever, a danger-signal and a safety-signal switch on each armature, the rails of a given block being connected in partial circuit with the magnet-coils of said given block and with the safety-signal switches of the instruments of the next two adjacent blocks, there being in each block a pair of insulated safety-signal contact-rails included in the partial circuits of the main rails of oppositely-adjacent blocks, the danger-signal contact-rails of each block being connected in partial circuit with the danger-signal switches of selected blocks, a source of electric supply for both partial circuits, a safety and a danger signal on the locomotive, and connections thereon for independently closing said two partial circuits whereby they may independently energize their respective signal devices on the locomotive, substantially as described.

15. An electrical signal system for railways comprising a subdivision of rails into insulated blocks, a danger-signal contact-rail for each block, a magnet-coil and its armature-switch lever at the beginning and end of each block each armature-lever having two independent electrodes thereon, two stationary cooperating electrodes therefor, one of the said pair of electrodes being connected to the coil of the magnet of its adjoining block, substantially as described.

16. An electric signal system for railways comprising a subdivision of the rails into insulated blocks, a contact-rail for each side of each block, a pair of companion instruments between each two blocks, each instrument comprising a magnet-coil and armature-lever, independent magnet-operating switch and danger-signal switch on each armature, the magnet-coils of a given block being connected in partial circuit with the rails of said given block, and the magnet-operating switches of the next two adjacent blocks at each end, the contact-rails of said given block being connected in partial circuit with the danger-signal switches of selected blocks, a source of electric supply for said two partial circuits, a safety-signal and a danger-signal on the locomotive, connections on the locomotive for independently closing said two partial circuits and conducting them to their respective signals, substantially as described.

17. An electric signal for railways, comprising a subdivision of rails into blocks, for each block a magnet-coil and its armature-lever in each block, each lever having an independent safety and danger signal switch, said switches being normally closed and opened when their controlling magnet-coil is energized, the rails of a given block being in partial circuit with the magnet-coil of said given block, and the safety-signal switch of another block, the danger-signal contact-rail of a given block being in partial circuit with the danger-signal switch of a selected block, a locomotive having a signal and connection for independently closing said circuits, and electric supply for said circuits, substantially as described.

18. An electric block system for railways, comprising a subdivision of rails into blocks, a danger-signal contact-rail for each block, a magnet-coil and armature-lever in each block, each lever having an independent safety and danger signal switch, said switches being normally closed and opened when their controlling magnet-coil is energized, the rails of a given block being in partial circuit with the magnet-coil of said given block and the safety-signal switch of an adjacent block, the danger-signal contact-rail of said given block, being in partial circuit with the danger-signal switch of a second block, the said given block having in proximity to the danger-signal contact-rail, a pair of insulated rails included in the partial circuit of the main rails of the said adjacent block, the main rails of said given block including in their partial circuit a pair of insulated rails belonging to an adjacent block, a locomotive having signals and connections for independently closing said partial circuits, whereby a given block, if the track be clear, the safety-signal is received in the cab from the pair of insulated rails of said given block which are included in the partial circuit of the main rails of said adjacent block indicating that the instrument of said adjacent block is working, and electric supply for said circuits, substantially as described.

19. An electric block system for railways, comprising a subdivision of rails into insulated blocks, a magnet-coil, an armature-lever in each block, each lever having an independent safety and danger signal switch, the rails of a given block being in partial circuit with the magnet-coil of said given block, and the safety-signal switch of another block, each block having a danger-signal contact-rail connected in partial circuit with the danger-signal switch of said block, a locomotive having a signal thereon, and means for independently

closing said circuits and operating said signal, substantially as described.

20. An electric block-signal system for railways comprising a subdivision of rails into blocks, each block having a signal-rail, the signal-rail of a given block being included in the partial circuit of the main rails of an adjacent block, the main rails of said given block including in their partial circuit the signal-rail of an adjacent block, a source of electric supply for the main rails of each block, a locomotive equipped with a contact and circuit connections adapted to engage the signal-rail of a given block and close the circuit through the main rails in the said adjacent block, and a signal device on the locomotive adapted to be actuated by the electric impulse transmitted through said signal-rail, substantially as described.

21. An electric block-signal for railways comprising a subdivision of rails into blocks, each block having two signal-rails, one of said signal-rails of a given block, being included in the partial circuit of the main rails of an adjacent block in one direction, the other signal-rail of said given block being included in the partial circuit of the main rails of an adjacent block in the opposite direction, the main rails of said given block including in their partial circuit the signal-rails of the said two adjacent blocks, upon opposite sides of the given block, a source of electric supply for the main rails of each block, a locomotive equipped with a contact and circuit connections adapted to engage the signal contact-rails of each block, and with circuit connections adapted to close the circuit through the main rails of the adjacent block, and a signal device on the locomotive adapted to be actuated by the electric impulse transmitted through said contact-rails.

22. An electric block-signal system for railways comprising a subdivision of rails into blocks, each block having a pair of signal-rails, one of said rails of a given block being connected to one of the main rails of an adjacent block, the other signal-rail of a given block, being connected to the opposite rail of an adjacent block, the opposing rails of said given block being respectively connected to two signal-rails belonging to an adjacent block, the main rails of each block being in partial circuit with a source of electric supply, which open circuit is adapted to be closed by the wheels of the locomotive, a locomotive equipped with contacts adapted to engage the said signal-rails and circuit connections adapted to close the partial circuit of the adjacent block to which said signal-rails of a given block are connected, and a signal device on the locomotive adapted to be actuated by the electric impulse transmitted through said signal-rails.

23. An electric block-signal system for railways, comprising a subdivision of rails into blocks, each block having two pairs of signal-rails, one pair of said signal-rails of a given block, being connected respectively to the opposite main rails of an adjacent block upon one side of the given block, the other pair of rails being connected respectively to the opposing main rails of an adjacent block upon the other side of said given block, the main rails of said given block being connected respectively to one pair of signal-rails of an adjacent block on one side of the given block and also a pair of signal-rails of an adjacent block upon the other side of said given block, the main rails of each block being connected in partial circuit with a source of electric supply which open circuit is adapted to be closed by the wheels of the locomotive, a locomotive equipped with contacts adapted to be engaged with said signal-rails and with circuit connections adapted to close the partial circuit of the main rails of the adjacent block to which said signal-rails are connected, and a signal device on the locomotive adapted to be actuated by the electric impulse transmitted through the said signal-rails.

In testimony whereof I have hereunto set my hand.

ELWOOD W. McGUIRE.

Witnesses:
OLIVER B. KAISER,
C. M. THOMPSON.