No. 618,328. Patented Jan. 24, 1899.

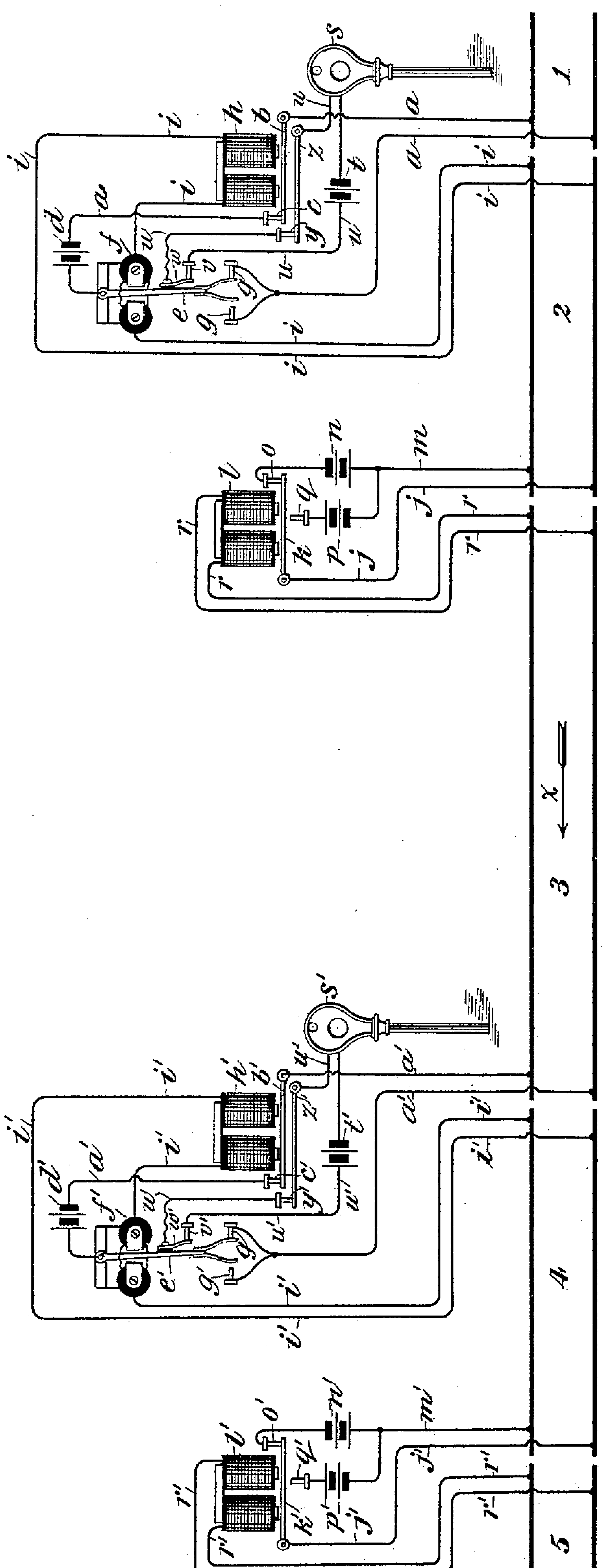
J. P. BUCHANAN.

ELECTRICAL SIGNAL SYSTEM.

(Application filed June 10, 1893.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1.



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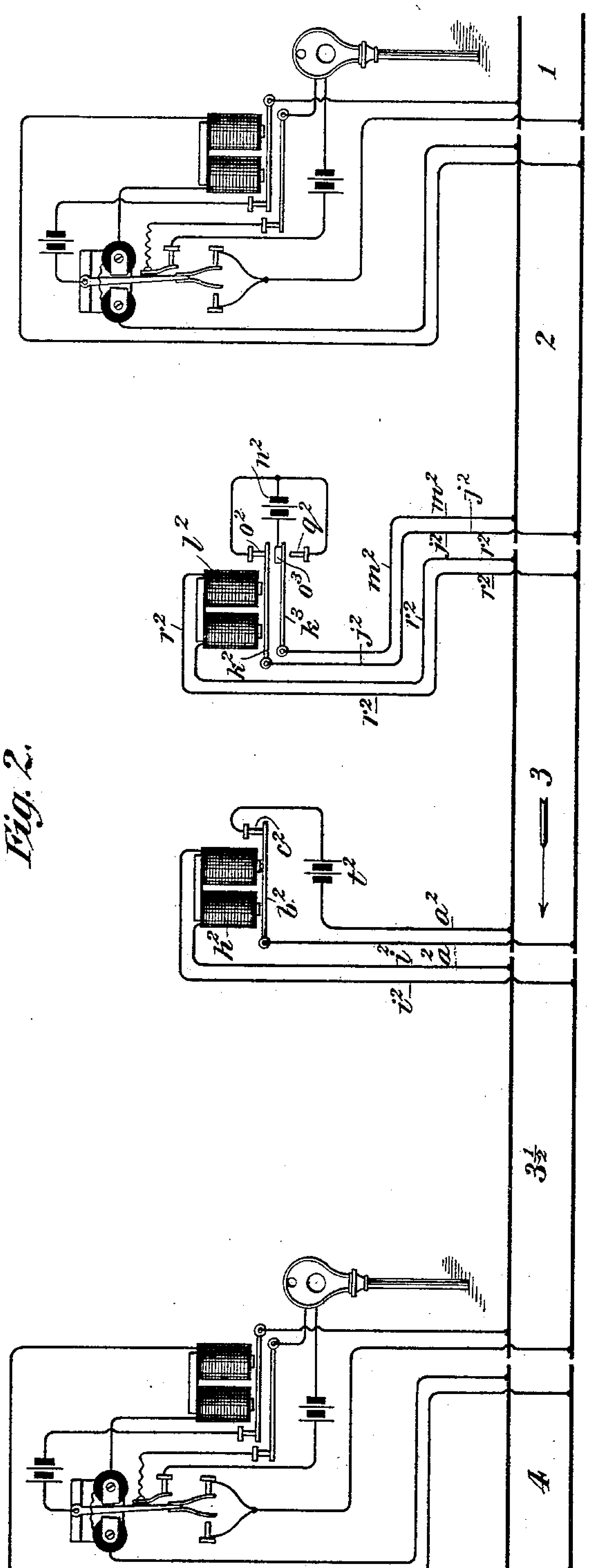

Fig. 2.

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ELECTRICAL SIGNAL SYSTEM.

SPECIFICATION forming part of Letters Patent No. 618,328, dated January 24, 1899.

Application filed June 10, 1893. Serial No. 477,186. (No model.)

To all whom it may concern:

Be it known that I, JOHN P. BUCHANAN, a citizen of the United States, residing at Boston, county of Suffolk, State of Massachusetts, have invented certain new and useful Improvements in Electrical Signaling Systems, of which the following is a specification, reference being had to the accompanying drawings, forming part hereof.

This invention relates to electrical signaling systems, and has for its object to improve and simplify the operation of such systems.

My complete invention consists of an electrical block-signaling system for railways and in its best form, as shown in the accompanying drawings, is embodied in a signaling system where no line-wires are employed, the rails of the tracks forming the conductors along the line. In my improved signaling system I utilize in a signaling-circuit a polarized electromagnet or electrical translating device which responds to reversals of current in combination with a current-reverser controlled by another signaling-circuit, whereby said other circuit reverses the first signaling-circuit, and thereby coöperates therewith in the control of a signal.

My invention also includes a plurality of series of signaling-circuits, each series containing two or more of said circuits, one circuit in each series containing a polarized translating device controlled by an adjacent signaling-circuit, whereby the action of one circuit or one signal is continued by the adjacent circuit, while on another signal it is reversed by said adjacent circuit.

In the accompanying drawings, Figure 1 shows, diagrammatically, my complete invention applied to a line of railway, one complete signaling-block and portions of the adjoining blocks being included therein. Fig. 2 is a similar view showing modifications.

In Fig. 1 the sections of rails of the several successive track or rail circuits which form the primary signaling-circuits of the system are numbered, respectively, 1, 2, 3, 4, and 5. Portions only of track-sections 1 and 5 are shown. Track-sections 2, 3, and 4 form one signaling-block, guarded by the signal *s*. Track-sections 4, 5, and 6 (not shown) form another signaling-block, guarded by the signal *s'*. Track-sections 1 and 2 belong to the block guarded by the signal next in the rear of the signal *s*.

The rails of section 1 are joined at their front ends by wires *a a*, including in their circuit the armature *b* and contact *c*, (of a circuit-controller controlled by the neutral or unpolarized electromagnet *h*,) the track-battery *d*, the armature *e*, (of the polarized electromagnet *f*,) and the double contacts *g g*. Similarly the rails of section 3 are joined at their front ends by wires *a' a'*, including in their circuit the armature *b'* and contact *c'*, (of neutral electromagnet *h'*,) the track-battery *d'*, the armature *e'*, (of polarized electromagnet *f'*,) and the double contacts *g' g'*.

The rails of section 2 are joined at their rear ends by the wires *i i*, including in their circuit the coils of polarized electromagnet *f* and the coils of neutral electromagnet *h*. Similarly the rails of section 4 are joined at their rear ends by the wires *i' i'*, including in their circuit the coils of polarized electromagnet *f'* and the coils of neutral electromagnet *h'*.

The rails of section 2 are joined at their front ends by the wire *j*, running from one rail to the armature *k*, (of the electromagnet *l*,) and by the divided wire *m*, running through the battery *n* to contact *o* and through the battery *p* to contact *q*. The contacts *o* and *q* are arranged on opposite sides of the armature *k*, so that in the normal position of said armature, with the electromagnet *l* energized and the armature held up, as shown, the contact *o* is closed and contact *q* is open, while in the opposite position of said armature, with the electromagnet deënergized and the armature dropped, the contact *o* is open and the contact *q* is closed. The batteries *p* and *n* are reversely placed, so that the cutting out of one and putting in of the other reverses the current flowing through the rails of track-section 2, wires *i i*, &c. It will thus be evident that the position of the armature *k* controls the direction of the current through the primary circuit of track-section 2; also, that a current will flow through said circuit in either position of said armature and that in either position of said armature the current flowing through the circuit will be in the reverse direction from that resulting from the other position of said armature. In track-section 4 there are corresponding wires j' and m', armature k', (of electromagnet l',) contacts o' and q', and batteries n' and p'.

The rails of section 3 are joined at their rear ends by wires r r, including in their circuit the coils of the electromagnet l, which magnet controls the armature k of the current-reverser of rail-circuit of section 2. Similarly the rails of section 5 are joined at their rear ends by wires r' r', including in their circuit the coils of the electromagnet l', which magnet controls armature k'.

It will of course be readily understood that the rear end of track-section 1 will correspond to the front ends of sections 3 and 5, and that the front end of section 5 will correspond to the front ends of sections 1 and 3, and that the system can be extended through any desired number of track-sections or of signaling-blocks.

The secondary signaling-circuit controlled by the primary signaling-circuit of section 2 is the circuit of the signal s. This secondary circuit receives its current from the battery t by wires u u, including in their circuit the contact v, the contact-spring w, (mounted on the armature e of the polarized electromagnet f,) the contact y, and the armature z, (controlled by the neutral electromagnet h,) and also some suitable and usual device for actuating directly or indirectly the signal s. Similarly the secondary signaling-circuit of the signal s' receives its current from the battery t' by wires u' u', including in their circuit the contact v', the contact-spring w', (mounted on the armature e' of the polarized electromagnet f',) the contact y', and the armature z', (controlled by the neutral electromagnet h',) and also the device for actuating the signal s'.

The operation of a moving train upon the several primary signaling-circuits when these circuits are rail-circuits, as shown, is the usual one of connecting the two rails by a conductor of low resistance and shunting the battery-current, and thus deënergizing the translating devices in said primary circuits. In the operation of the complete block system as embodied in the accompanying drawings the train moves in the direction of the arrow x. The various devices are shown in their normal positions, as they would be in the absence of trains.

First operation: When the train is upon track-section 2, the current is shunted from the wires i i and from the coils of polarized electromagnet f and neutral electromagnet h. The polarized electromagnet f loses its electromagnetism and is therefore controlled by its permanent magnetism. If this permanent magnetism is sufficiently strong to overcome the weight of the armature e, said armature will be retained in its normal position, as shown. If not, then the armature e will drop to vertical or middle position, opening the contact v of the circuit of signal s, and thus sending the signal s to "danger" and opening the contact g of the circuit of track-section 1, and thus continuing the signal at the rear of signal s at "danger." The operation of this single polarized electromagnet will thus alone effect the desired objects; but these objects are more certainly attained according to my entire invention by the coöperation of the neutral electromagnet h. It will be remembered that the presence of the train on the track-section 2 deënergized the neutral electromagnet h. This electromagnet, having no appreciable permanent magnetism, immediately drops its armatures z and b, and thereby breaks the circuit of signal s at y (sending s to "danger") and of the track-circuit of section 1 at c, (continuing the signal at the rear of signal s at "danger.") In this operation I may by proper adjustment of the weight of armature e in relation to the permanent magnetism of the magnet produce two breaks in each circuit, or altering this adjustment and permitting the armature e to be retained by the permanent magnetism produce one reliable break in each circuit.

Second operation: When the train is upon track-section 3, the current is shunted from the wires r r and electromagnet l. This deënergizes said electromagnet, so that it drops the armature k, thereby opening the contact o and closing the contact q, and thus cutting out the battery n from the track-circuit of section 2 and putting the reversed battery p into the said track-circuit of section 2, thereby reversing the direction of the current flowing through the said circuit of section 2. As soon as the last shunting device (usually the last wheels and axle) of the train has passed off from the rails of section 2 this reversed current is permitted to flow through the polarized electromagnet f and through the neutral electromagnet h. The effect of this reversed current upon the polarized electromagnet h is to throw its armature to extreme left-hand position, and this position will be assumed whether the armature e was previously in the middle position or in extreme right-hand position. In this extreme left-hand position the armature e holds the circuit of signal s open at the contact v, while it closes the circuit of track-section 1 at left-hand contact g. The effect of this reversed current upon the neutral electromagnet h is the same as was that of the normal current and causes it to hold up both of its armatures b and z. Thus the presence of the train upon track-section 3 causes a break at contact v in the circuit of signal s, thus holding that signal at "danger," while it closes all breaks in the circuit of track-section 1, thereby sending to "safety" the signal next at the rear of signal s.

Third operation: When the train is upon track-section 4, the current is shunted from the polarized electromagnet f' and from the neutral electromagnet h', thereby breaking the circuit of the signal s' at y' (and, if armature e' is heavy enough, also at v') and sending the signal s' to "danger," and thereby also breaking the circuit of track-section 3 at c', (and, if armature e' is heavy enough, also at g',) and thus continuing the deënergization of the electromagnet l and the consequent reversal of the current in the circuit of track-section 2 and maintaining the signal s at "danger." Thus while the train is upon section 4 both signals s and s' are at "danger," just as when the train was on track-section 2 both the signal s and the signal guarding the rear block were at "danger."

Fourth operation: When the train is upon the track-section 5, the current is shunted from the electromagnet l', so that its armature k' falls and reverses the current flowing through the circuit of track-section 4 in precisely the same way as the train on section 3 reversed the current in track-section 2. This breaks the circuit of signal s' at v', (continuing that signal s' at "danger,") while it closes all breaks in the circuit of track-section 3, thus energizing the electromagnet l and by lifting the armature of said electromagnet l restoring the circuit of track-section 2 to normal condition and the signal s to "safety."

From the above description the operation of the system through any desired number of signaling-blocks will be readily comprehended. It will be noted that the control over each signal is continued through a portion of the block guarded by the next signal, according to the usual overlapping principle. Track-section 4 is the overlap of the block 2 3 4, guarded by signal s, upon the block 4 5 6, (not shown,) guarded by signal s', and track-section 2 is the overlap upon the block 2 3 4, guarded by signal s of the block next in the rear.

It will be evident that the manner of controlling a circuit-controller device in one primary or track circuit by a translating device or electromagnet in the next succeeding primary or track circuit may include any desired number of primary or track circuits in a signaling-block. In the modification shown in Fig. 2 each section contains three primary or track circuits, the one complete section shown containing the three track-sections 2, 3, 3½, and 4, the section 3 containing a circuit-breaker b^2 c^2, connected thereto by the wires a^2 a^2, including battery t^2, and said circuit-breaker controlled by the electromagnet h^2, connected by wires i^2 i^2 to the rails of section 3½. It is also evident that the current-reverser may be combined with a single battery, so that its operation is to reverse the connection of said battery with the circuit. This modification is also shown in Fig. 2, wherein wires j^2 m^2 of track-section 2 are connected to separate armatures k^2 k^3, said armature k^2 being normally against the upper contact o^2, connected to one end of the battery n^2, and said armature k^3 being normally against the middle stop o^3, connected to the other end of said battery n^2. When the electromagnet l^2 is deënergized, armature k^2 falls against the middle contact o^3 and armature k^3 against the lower stop q^2, and thus the current flows in a reverse direction from the same battery through the wires j^2 m^2 and other parts of the circuit of track-section 2.

It is evident that any convenient source of electricity may be used in place of batteries and also that the power for operating the signals may be electric, pneumatic, hydraulic, mechanical, or any other convenient power.

Although I have shown and prefer to employ the primary or track circuits in the form of normally-closed rail-circuits—*i. e.*, circuits including the rails of the track—it is of course obvious that these circuits need not in all cases be of this especial type. Other forms of primary or track circuits could be used. Rail-circuits that are not normally closed or rail-circuits that are permanently open and closed by a passing train could be used. Also the track-circuits might be track-circuits that do not include the rails, such as track-circuits operated by track instruments, and these could be normally open or normally closed. Again, the signals could be arranged to stand normally at "danger," as well as normally at "safety," and instead of the circuit-controllers being in the form of make-and-break devices, as shown in the drawings, they could be shunt devices, as will be readily understood.

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

1. The combination of a track-circuit including a polarized translating device and a current-reverser, a signal operated or controlled by said polarized translating device, said current-reverser arranged to maintain in its circuit a continuous current of either polarity according to its position whereby the polarized device is enabled to maintain the signal at "safety" and also at "danger" for prolonged periods, according to the polarity of the current, means for controlling the current-reverser, and another circuit controlling another signal and operated by the circuit of the polarized device, substantially as set forth.

2. The combination of a plurality of series of track-circuits, each series comprising two or more circuits, one circuit of each series including a polarized translating device and a current-reverser, a signal for each series operated or controlled by the circuit of the polarized device, and each of the other track-circuits of a series including a circuit-controller controlled by an adjacent circuit, one of the said other circuits controlling the said current-reverser, said circuits arranged to be operated upon the passage of a train.

3. The combination of a rail-circuit including a polarized translating device, a neutral translating device and a current-reverser; a signal-circuit for operating or controlling a signal having circuit-controllers operated by said translating devices; and a rail-circuit

controlling the current-reverser, substantially as set forth.

4. The combination of a track-circuit including a polarized translating device, a neutral translating device and a current-reverser; a signal controlled by said circuit; means for operating the current-reverser; and another circuit controlling another signal and operated by the circuit including said translating devices, substantially as set forth.

5. The combination of a rail-circuit including a polarized translating device, a neutral translating device and a current-reverser; a signal-circuit for operating or controlling a signal having circuit-controllers operated by said translating devices; a rail-circuit controlling the current-reverser; and another circuit controlling another signal and operated by the circuit including said translating devices, substantially as set forth.

6. In a block-signaling system, the combination of two overlapping blocks, signals for the blocks, circuits for the advance block comprising a rail-circuit including polarized and neutral translating devices and a current-reverser, said rail-circuit controlling the signal of its block, and means for operating the current-reverser; with a circuit for the rear block controlling the signal therefor and controlled by a circuit of the advance block, substantially as set forth.

7. In a block-signaling system, the combination of a series of overlapping blocks, signals and signal-circuits for the blocks, circuits for each block comprising a rail-circuit including a polarized and a neutral translating device and a current-reverser, said polarized and neutral devices controlling the signal-circuit for their block, and a rail-circuit for operating the current-reverser; with a circuit for the block in the rear controlling the signal therefor and operated by the said neutral translating device, substantially as set forth.

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Witnesses:
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