No. 787,029. PATENTED APR. 11, 1905.

H. GERSTMANN.

APPARATUS FOR PREVENTING COLLISIONS ON RAILWAYS.

APPLICATION FILED JULY 21, 1902.

2 SHEETS—SHEET 1.

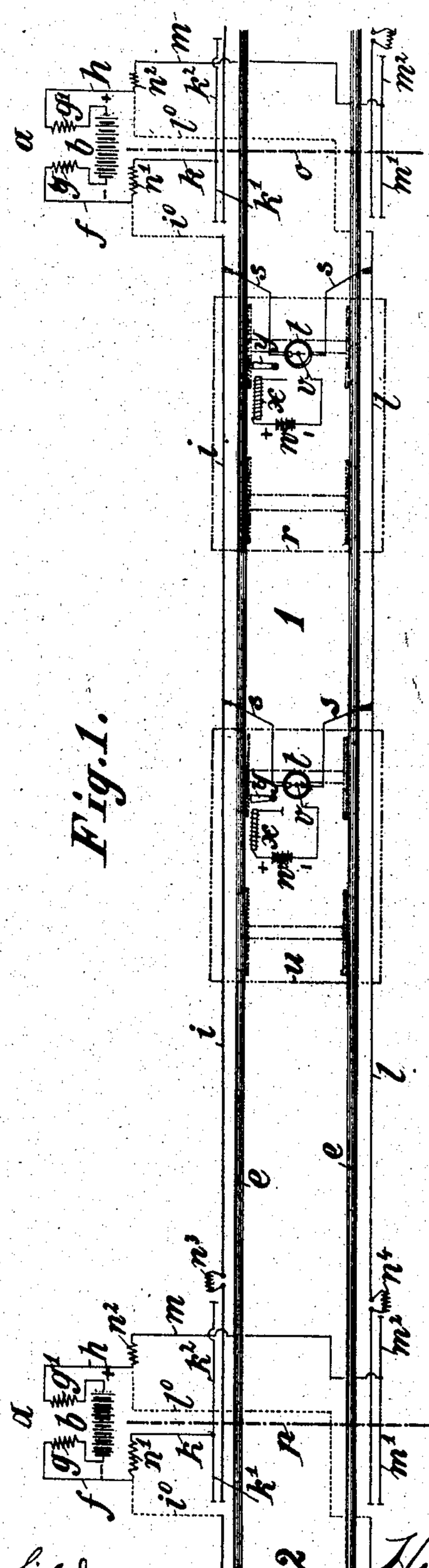

Fig. 1.

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2 SHEETS—SHEET 2.

Fig. 2.

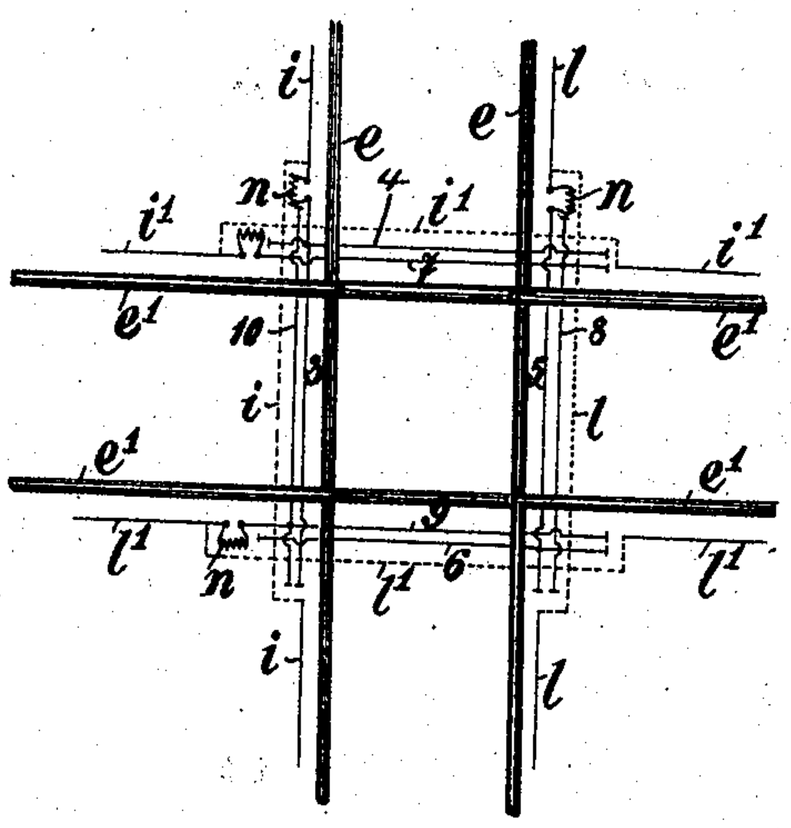
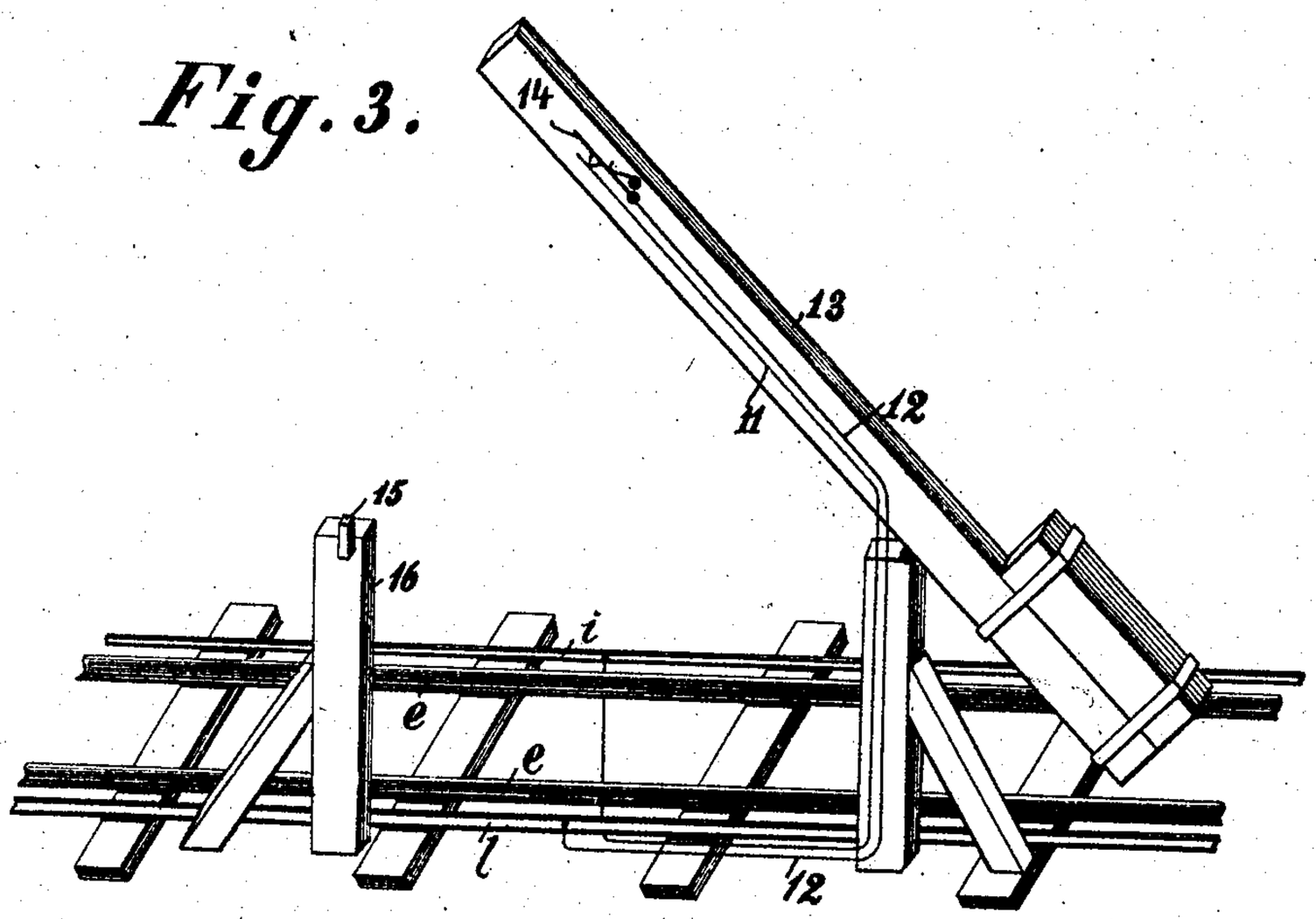


Fig. 3.



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UNITED STATES PATENT OFFICE.

HEINRICH GERSTMANN, OF CHARLOTTENBURG, NEAR BERLIN, GERMANY.

APPARATUS FOR PREVENTING COLLISIONS ON RAILWAYS.

SPECIFICATION forming part of Letters Patent No. 787,029, dated April 11, 1905.

Application filed July 21, 1902. Serial No. 116,448.

To all whom it may concern:

Be it known that I, HEINRICH GERSTMANN, a subject of the German Emperor, residing at Charlottenburg, near Berlin, in the German Empire, have invented certain new and useful Improvements in Apparatus for Preventing Collisions on Railways, of which the following is a specification.

This invention is an improved railway-car-brake-controlling apparatus; and its object is to prevent collisions. If, for example, one train is running or stopped upon a section of the line and another train approaches within braking distance of the first on the same line, then both trains shall be halted or the train in motion shall be halted, or if two trains on intersecting lines approach the crossing together within braking distance then both trains shall be halted, or if a grade-crossing gate is left open while a train is approaching such train shall be halted.

The accompanying drawings illustrate diagrammatically the apparatus for carrying out these several objects, electricity being used as the controlling agent.

Figure 1 is a plan view of a section of a railway, showing apparatus for stopping trains approaching dangerously near upon the same track. Fig. 2 is a view illustrating the apparatus for stopping trains approaching dangerously near at a crossing. Fig. 3 is a detail view illustrating part of the apparatus for stopping a train approaching an open grade crossing.

In Fig. 1, *a* represents the section signal-boxes, containing a source of electrical current *b*, to whose electrodes wires *f* and *h* are fixed. Resistance-coils *g* and *g'* of such dimensions are intercalated therein that the resistance of the length of the wires or contact-rails *i* and *l* extending along the track may (in comparison therewith) be practically disregarded. Beyond the resistances *g* and *g'* the wires *f* and *h* divide into two branches. The one branch of wire *f* (the wire i^0) leads to the track-rail *e*, along which it continues as a conductor or contact-rail *i* to the point n^3 a braking distance from the next block-station *p*, where a resistance-coil n^3 is intercalated therein, and it then passes on to and beyond the block-station or boundary *p* of the block-section 1 and terminates at a point at braking distance beyond such station. A resistance-coil n' is intercalated in the other branch, *k*, of wire *f*, which on reaching the track-rail *e* divides again into two branches k' and k^2, extending on opposite sides of boundary *o* and ending at braking distances therefrom. The branches *k* and k' are insulated in a convenient way from the conductor-rail *i*, but practically a continuation thereof for engagement of the trolley of a locomotive. The wire *h* is divided into two branches l^0 and *m*. The branch l^0 crosses the track and extends as a conductor or contact rail *l* parallel with the other track-rail, *e*, in the same manner as the conductor *i*, to and beyond the station *p*, a resistance n^4 being intercalated in conductor *l* at a braking distance from station *p*. The branch *m*, intercalated by resistance-coil n^2, crosses the track also and runs beside track-rail *e*, extending on opposite sides of boundary *o*, as indicated at m' m^2. The wires i^0 and l^0 are insulated, and so are the conductors *i* and k', *l* and m'. The conductors i l k' k^2 m' m^2 are also all electrically insulated from the track-rail *e* in any convenient manner known. The wire *k* may connect with conductors k' k^2 and wire *m* with conductors m' m^2 at any convenient point—for instance, in the middle or at one end—as k' k^2, on the one hand, and m' m^2, on the other, are in reality one conductor whose branches are at such distances from the boundaries *o* and *p* that trains are stopped even under the most unfavorable circumstances. The resistances n' n^2 n^3 n^4 are such as to reduce the strength of the current in the conductors k' k^2 m' m^2 and in the ends of the conductors *i* and *l* beyond the resistances to such proportions that the current in k' k^2 m' m^2 and the current in the ends of conductors i l are together equal in strength to the normal current. For instance, if the resistance n^3 reduces the current in the end of conductor *i* to one-half then the resistance n' must reduce the current in k k' k^2 also to one-half, both together being equal to the normal strength of current.

Should the resistance n^3 reduce the strength of current in conductor *i* to one-third, the

coil n' must reduce the current in $k\,k'\,k^2$ to two-thirds of its normal strength.

Instead of employing resistances the current in the conductors may be reduced by diminishing their cross-section or by forming them of several wires, only part of which continue beyond the point where the resistances would have been placed.

It will be noticed by reference to Fig. 1 that the circuit of the electric current is broken, no connection existing between the conductors i and l, or between conductors i and k, or between conductors l and m'.

In Fig. 1, r and u represent locomotives or other vehicles of a train provided with means to close the circuit and to work a signaling device or an automatic brake or the like. I do not, however, confine myself to the particular form of signaling or braking device shown in Fig. 1.

Instead of a galvanometer a solenoid or any other suitable device may be employed for braking or signaling.

In the example shown in Fig. 1 the locomotive takes off the current from the conductors i and l by trolleys s, thus closing the circuit of the source b at this point. In this circuit there is arranged upon the locomotive a galvanometer t, the magnet of which is formed by a pair of astatic needles, which are therefore independent of the direction of the current and of the earth's magnetism. To the galvanometer-magnet t is connected a metal contact-piece v, arranged to turn simultaneously with the needle and closing a second circuit supplied by a battery w upon the locomotive when the current from the source b, passing through the galvanometer t, is reduced in strength—for instance, to one-half—or when this current is altogether interrupted. In the second circuit is intercalated the coil of an electromagnet x, which can attract an armature y, to which the brake-lever may be suitably connected.

My improved apparatus acts as follows: The moment a locomotive r or a train enters a section of the track—for instance, section 1 (shown in Fig. 1)—the right-hand source a is circuited, as the corresponding sources of other sections were circuited before. The astatic needles of the electromagnet t therefore do not alter their position, and the train can proceed on its way. If, however, another locomotive or train u having a similar current connecting apparatus enters section 1 or is standing thereon the current must pass through both locomotives, each galvanometer t receiving only half the current. The galvanometer-magnets therefore move through an angle from their position of rest, and with them the contact-piece v, circuiting battery w, in consequence of which the electromagnet x is actuated and attracts the armature y, acting on the brake, and thus stopping the trains. The same braking action would occur if three or more trains were on the section if the circuit were broken by some accident or if the barriers of level crossings remained open, as will be explained later on. By the resistances g and g', intercalated in the wires f and h, the strength of the current in the contact-rails i and l and its action upon the galvanometer t on the locomotive are independent of the position of the locomotive within the section—that is to say, the action is practically the same at the beginning, middle, or end of the section.

As mentioned in the introduction, the main object of my invention is to avoid the risk of two trains colliding at the boundary between two neighboring sections of the line, which is prevented by the overlapping of the contact-wires at the blocks. If an engine or train enters the part of the line near the block-station where the conductors i and l overlap $k'\,k^2$—viz., at braking distance from the boundary o—the astatic needle of the galvanometer t does not alter its position, as the trolleys of the locomotives receive on both sides of the boundary the currents from the overlapping contact-rails, which are both together equal to the full strength of current. For instance, the electromagnet t of a train running from section 1 to section 2 would receive after passing the resistances $n^3\,n^4$ of the left-hand block of Fig. 1 a part of the current, usually one half, from the source of current b of the right-hand block-station a by conductors $i\,l$ and the rest of the full current—for instance, the other half—from the source of current b at the left-hand block-station a by the conductors $k'\,k^2\,m'\,m^2$. If, however, there are two trains on the part of the line where the conductors overlap—viz., on both sides of block a for braking distance—then each train only receives a part—for instance, one-half—of the full strength of current, the astatic needle of the galvanometers t on the locomotives move, the contact-pieces v circuit the electromagnets x, and both trains are braked. Collisions at level crossings of two or more lines are prevented by the same means. Thus a train passing the crossing of Fig. 2 will receive the full current.

Fig. 2 shows the application of my invention to protect an intersecting crossing of two single railway-lines. At a braking distance from the crossing conductors $i\,l\,i'\,l'$ are led under ground or in any other suitable manner completely isolated until they reach a braking distance beyond the crossing, where they again reappear beside the track-rails. Branch conductors 3 5 7 9 are arranged beside the track-rails e and extend for braking distances beyond the crossing. At the places where the conductors 3, 5, 7, and 9, respectively, branch off from conductors i, l, l', and i' resistances n are intercalated in such a manner that the strength of the current passing through these resistances is reduced in the

same way as described above for a block-station. At the crossing-point the conductors *i l i″ l′* each sends out two branches to the right and left along the track-rails of the other line, which branches extend a braking distance from the crsssing, but overlap the conductors of the other line, from which they are insulated, while forming a practically continuous contact-rail for the trolleys of the locomotive. Thus contact-rail 3 sends out two branches 4 along 7, contact-rail 5 two branches 6 along 9, contact-rail 7 two branches 8 along 5, and contact-rail 9 two branches 10 along 3.

Where there are several tracks, the strength of the current may be reduced by resistance *n*, intercalated there in such a manner that the sum of all the parts of strength of the currents is equal to the strength of the current in the contact-rails *i* and *l*. A train running, for instance, on the track *e′ e′* and approaching from the right of Fig. 2 to braking distance will receive partial or half currents from the conductors belonging to both lines on running over the crossing, as the trolleys of the engine will circuit the conductors *i* and *l* by their branches 3 4 and 5 6 and the conductors *i′* and *l′* by their branches 9 and 7, the right-hand trolley contacting with rail 4 7 and the other with 6 9. The full current therefore passes to the galvanometer *t*, as it consists of two partial currents from the track-sections crossing each other. If a second train enters the braking distance on the other track, *e e*, then both sets of conductors are circuited a second time—contact-rails *i″ l″* by 7 8 9 10 and rails *i l* by 3 5. Therefore each train receives only a part—for instance, one-half—of the full current, this causing the galvanometer-needle upon the locomotive to turn so far that the brake-lever is automatically actuated by the electromagnet *x*. In the same manner trains will be stopped if two, three, or more lines cross one, two, or more railway-tracks. The branches of the contact-rails are led to the crossing-lines and receive a part of the full current. Two or more trains approaching to braking distance are therefore stopped by reduction of the working current.

Where there are points in the railroad, the wires are carried alongside of the points by means of jointed connections and lie at the points in such a manner that also these sections of the line are protected.

If roads cross the track in the same level, they may be closed by the barriers shown in Fig. 3. Such barrier circuiting the contact-rails *i* and *l* acts, therefore, exactly in the same way as of a second train were within the section. The current passes only with part or half the strength through the galvanometer *t*, disposed upon the locomotive, whereby the locomotive is automatically braked.

In Fig. 3 a level crossing is provided with a barrier 13, along which the wires 11 and 12 are led from the contact-rails *i* and *l* to a metal contact-piece 14. On the post 16 of the gate there is a projection 15, by which when the beam 13 falls upon its post 16 the metal piece 14 is lifted, so that the wires which are led to the gate are disconnected and the circuit coming from the source of electricity *b* at the signal-box *a* is broken. If, however, the gate is not down, the circuit between these two wires *i* and *l* will be closed by means of the metal piece 14.

If any damage is done to the apparatus, the current along the track is not in action and the train is halted, which makes the system preferable to the arrangements hitherto in use, which the trains are liable to collide if the signal apparatus is damaged.

What I claim, and desire to secure by Letters Patent of the United States, is—

1. In combination with a railway-section, electrical conductors extending along the sides thereof of opposite polarity; circuit-closers on the trains; electrical signaling or braking apparatus on the train, electrical controlling devices for said apparatus on the trains, said controlling apparatus being inoperative when the full strength of the current passes through the circuit-closers, but operating when the said current is weakened or broken, substantially as described.

2. The combination of conductors extending along the track of each block-section of a railway-line, of a source of electricity and of two conductors, containing resistances of suitable dimensions between the source of electricity and the conductors, said conductors being circuited by devices on the locomotive or train, said devices being connected electrically to a galvanometer, with an astatic needle, a contact-piece closing a local circuit from a battery on the locomotive or train, and an electromagnet in the local circuit adapted to automatically operate braking or signaling devices the moment a second train enters the same block, substantially as described.

3. The combination, with suitably-insulated conductors extending along a railway-line, divided into block-sections, of a source of electricity, and of two conductors with resistances, said conductors dividing into two branches beyond said resistance; the one branch of each conductor leading to the contact-rails that run along the track-rails to braking distance from the next block, where a resistance is intercalated and then continuing to a braking distance beyond the next block, while the second branch of each conductor is intercalated by a resistance and then extended to a braking distance on both sides of the block and overlapping the conductor in the preceding block, said conductors being circuited by a locomotive or train provided with trolleys, a galvanometer, an astatic needle, a contact-piece, circuiting the current from a battery on the locomotive or train, and an electro-

magnet actuating automatically the brake or signal the moment a second train enters the same section, substantially as described.

4. In combination, contact rails or wires running along the track-rails of a railway-line, each contact rail or wire dividing at a braking distance before a level track-crossing into two branches, the first of which is led insulated in a suitable manner round the crossing, on the other side of which it continues from the braking distance along the track, while the second branch is intercalated at braking distance with a resistance and then on reaching the track-rails of the crossed line divides into two further branches running along the track-rails of the cross-line, to braking distance on each side of the crossing overlapping the corresponding branches of the cross-line, said contact-rails and the contact rails or wires formed by the overlapping parts which are insulated from each other being circuited by a locomotive or train provided with trolleys connected electrically to a galvanometer with an astatic needle, a contact-piece, circuiting the current from a battery on the locomotive or train, and an electromagnet actuating automatically the brake or signal the moment a second train enters the same section, substantially as described.

5. The combination, with contact rails or wires running along the track-rails of a railway-line of two insulated conductors leading to the movable beam of a barrier of a level road-crossing, and of a contact-piece adapted to be opened by hitting against a suitable projection, said contact rails or wires being circuited by a train or locomotive provided with trolleys and a suitable automatic braking or signal apparatus, substantially as described.

6. The combination of conductors extending along a railway block-section, and of opposite polarity; a suitable electric-current supply to each conductor; devices on each train for closing the circuits through said conductors, said controlling devices being inoperative when the full strength of the current passes therethrough but operating when a current is weakened or broken, and one electrical signaling or braking apparatus on each train controlled by the said devices, substantially as described.

7. The combination of conductors extending along the track of each block-section of a railway-line, a source of electricity, resistances interposed between the source of electricity and the conductors; devices on the locomotives or trains for circuiting said conductors, a local source of electrical energy on each locomotive or train, means controlled by said devices for closing the local circuits, and signaling or braking apparatus operated by the local circuits, substantially as and for the purpose set forth.

8. In combination, line conductors of opposite polarity extending along the track of a railway block-section, an electrical-current supply to each conductor, devices on the locomotives or trains for closing the circuits through said conductors, and for controlling a local circuit on each train, an electric signaling or braking apparatus on each train or locomotive, and an electric-current supply on each train or locomotive in electrical circuit with such braking or signaling apparatus, such signaling or braking apparatus being operated when its local circuit is closed by said controlling devices, and said controlling devices operating when the currents in the line conductors are cut down, substantially as and for the purpose set forth.

In testimony whereof I have hereunto set my hand in the presence of two witnesses.

HEINRICH GERSTMANN.

Witnesses:

MAX FÖRSTER,

FRANZ TAUSCH.