No. 787,393. PATENTED APR. 18, 1905.

F. P. J. PATENALL & G. H. DRYDEN.

SIGNAL SYSTEM AND APPARATUS THEREFOR.

APPLICATION FILED JAN. 23, 1905.

2 SHEETS—SHEET 1.

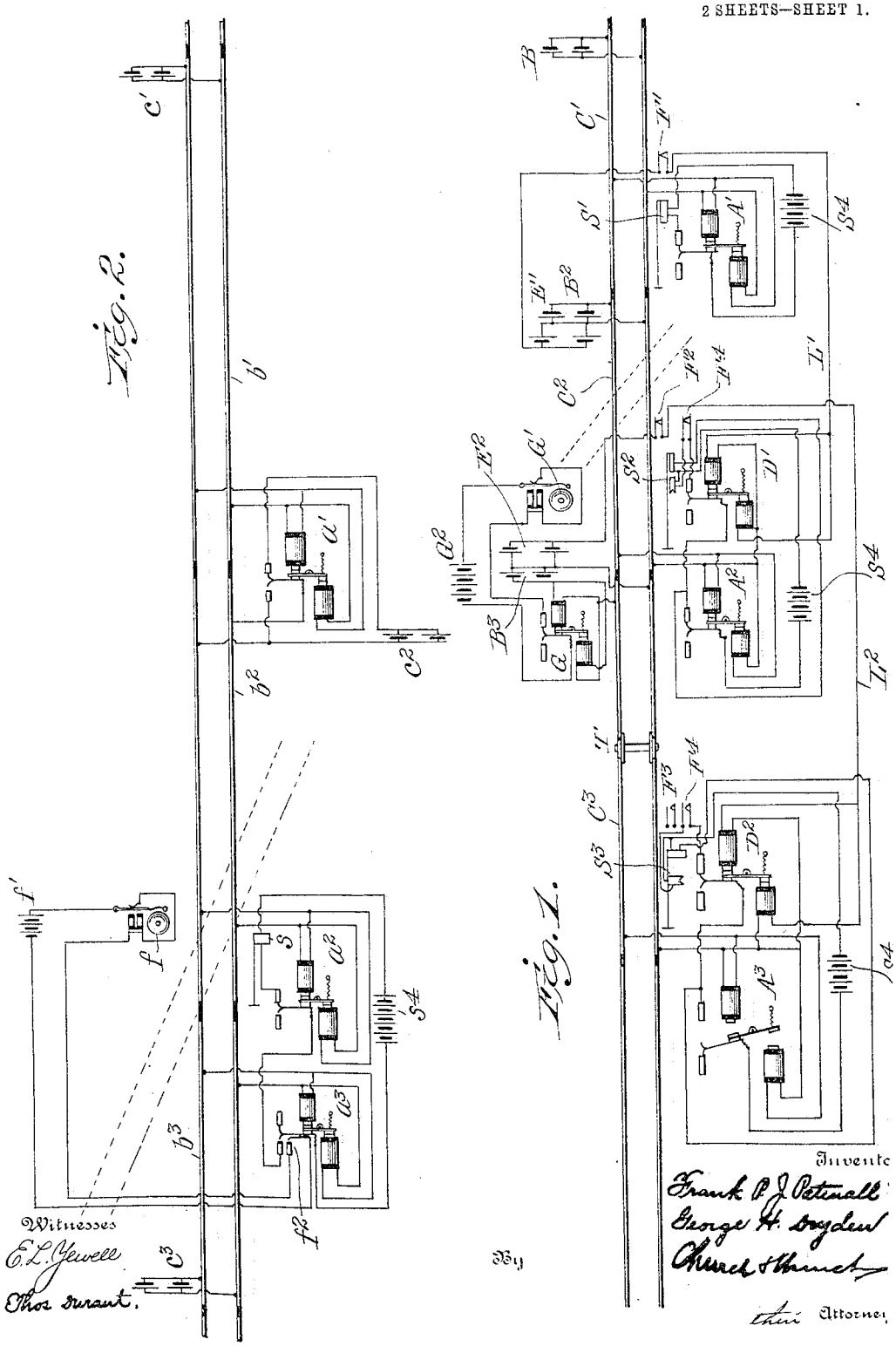


Fig. 2.

Fig. 1.

Witnesses
E. L. Yewell
Thos. Durant.

Inventor
Frank P. J. Patenall
George H. Dryden
By Church & Church
their Attorneys

No. 787,393. PATENTED APR. 18, 1905.

F. P. J. PATENALL & G. H. DRYDEN.

SIGNAL SYSTEM AND APPARATUS THEREFOR.

APPLICATION FILED JAN. 23, 1905.

2 SHEETS—SHEET 2.

Fig. 5.

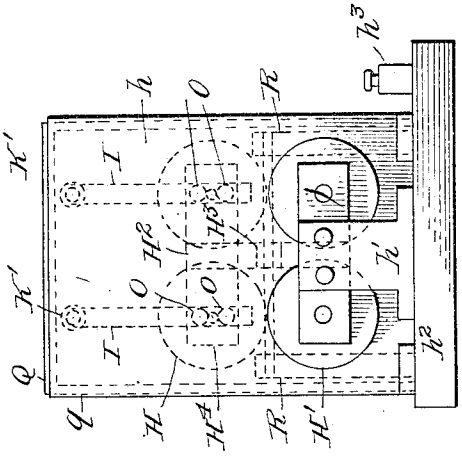


Fig. 3.

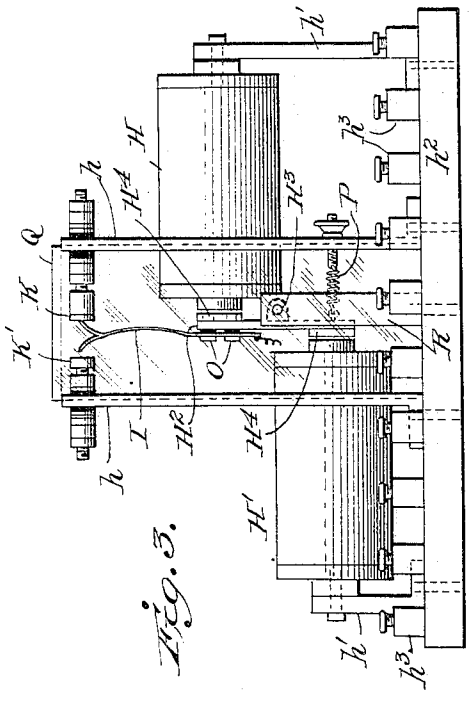
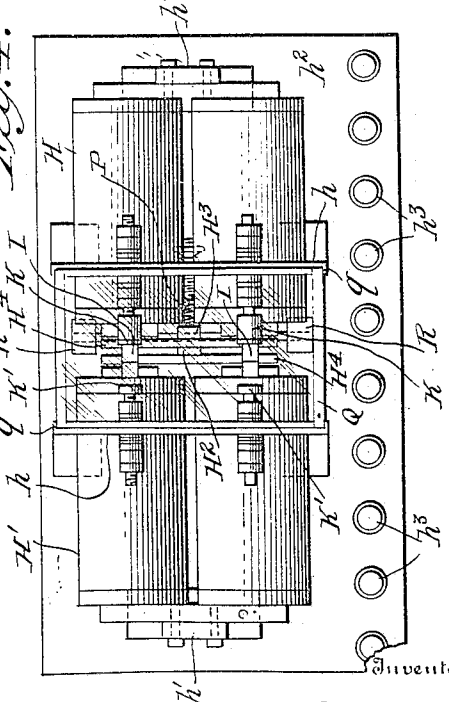


Fig. 4.



Witnesses

Edwin L. Yewell

Thomas Durant

Inventors:

Frank P. J. Patenall &

George H. Dryden

By Church & Church

their Attorneys

No. 787,393. Patented April 18, 1905.

UNITED STATES PATENT OFFICE.

FRANK P. J. PATENALL AND GEORGE H. DRYDEN, OF BALTIMORE, MARYLAND.

SIGNAL SYSTEM AND APPARATUS THEREFOR.

SPECIFICATION forming part of Letters Patent No. 787,393, dated April 18, 1905.

Application filed January 23, 1905. Serial No. 242,399.

To all whom it may concern:

Be it known that we, FRANK P. J. PATENALL and GEORGE H. DRYDEN, citizens of the United States, residing in the city of Baltimore, State of Maryland, have invented certain new and useful Improvements in Signal Systems and Apparatus Therefor; and we do hereby declare the following to be a full, clear, and exact description thereof, reference being had to the accompanying drawings, forming a part of this specification, and to the letters of reference marked thereon.

This invention relates, primarily, to an improved apparatus and system of signaling for railway-service, although features of the invention may be used in connection with any signaling system such as are ordinarily employed for transmission of intelligence from one point to another through the agency of an electric current.

The invention consists in certain novel appliances and arrangements of the circuits in connection therewith whereby the signals are rendered more pronounced and certain, even with the employment of relatively light battery-power, a further object of the invention being to provide an apparatus capable of use in connection with long track-sections wherein the rails are employed as conductors in the signal system.

Referring to the accompanying drawings, Figure 1 is a diagrammatic view of a signal system wherein the present invention is employed. Fig. 2 is a similar view showing certain features of the invention in a signal system such as has heretofore been suggested. Fig. 3 is a side elevation of one of the control-relays. Figs. 4 and 5 are a top plan and end elevation, respectively, of said control-relay.

As shown in Figs. 1 and 2 of the accompanying drawings, the invention is supposed to be applied in connection with a railway-track whereon trains are to be run in one direction—*i. e.*, from left to right—and consequently it is desirable to provide signals for indicating to the engineer of each succeeding train the position of a preceding train, at least to the extent of indicating whether a preceding train still occupies a section of the track in dangerous proximity to the engineer and the train he is running.

Referring particularly to Fig. 1, the track is divided into insulated block-sections in order that the track-rails may be utilized for the conductors in the signal system, and the sections shown are indicated, respectively, by the letters C', C^2, and C^3. At the beginning of each section there are semaphore-signals, (indicated at S', S^2, and S^3,) these signals being usually, as shown at S^2 and S^3, composed of two semaphore-arms, one, a "block" signal, to indicate "danger" or the presence of a train in the section ahead, and the other, a "distant" signal, to indicate "caution" to the engineer or that a train occupies a distant section—say the second block or section ahead. This arrangement is a common one, and it will be understood that in so far as the invention is concerned the signals themselves may be of the semaphore-arm variety, with two arms or a single arm adapted to be moved into three positions or a disk signal, all of which are well known and in themselves form no part of the present invention.

In convenient relation to the signals there are track-relays A' A^2 A^3, adapted to be operated through circuits part of which are formed by the track-rails of the sections C' C^2 C^3 from track-batteries B', B^2, and B^3, respectively—that is to say, said batteries are normally connected with the track-rails—and through said rails the circuit is completed to the relays to energize the relay-magnets, so as to attract their armatures at all times save when the track-sections are occupied by a train or from some other cause the batteries are short-circuited or the battery-power destroyed, at which times the armatures of the relays are released.

D' and D^2 are relays for the control of the distant or caution signals and are operated by batteries E' and E^2 through the circuit-controllers F' and F^2, operated by the block semaphore-arm of signals S' and S^2, the circuit connections from the circuit-controllers

extending through one of the track-rails and outside line-wires L′ L², as shown, and in accordance with the well-known practice controllers F′ and F² are open only when the semaphore-arms are in danger position, as shown, for instance, at F³ in connection with the semaphore S³. The circuit-controller F³, however, is shown without any circuit connections, inasmuch as it is to be located in a circuit forming part of the devices at the preceding block-station. (Not shown in the drawings.)

From the foregoing it will be seen that at each block-station there are provided two relays, one of which is controlled directly by the presence of a train in the block-section the track-rails of which form a part of the relay-circuit and the other of which relays is controlled by the position of the danger semaphore-signal at the next succeeding block-station. Both relays control the semaphore-signal arms—that is to say, they control the circuits which directly operate, or which in accordance with the well-known practice set an operating mechanism in motion, and the system shown in Fig. 1 is so arranged that whenever the circuit controlled by the relays is broken said semaphore-signals will move to the danger position. This arrangement is known as the "normal safety" system—that is to say, the normal position of the semaphore arms or signals is at "safety," which position, however, is maintained only when the proper circuits are energized, and any failure in any of the circuits will result in the semaphores moving to the danger position. The batteries for operating the semaphore-arms are shown at S⁴, and the circuits lead from one side of each of said batteries to the armature of its relay A′, A², or A³, and each of said circuits from its battery S⁴ can be completed only when the armature of the relay at that station is attracted by its magnet, the closing of the circuit at the relay A′, A², or A³, as the case may be, serving to establish directly the circuit controlling the block-signal semaphore; but the caution-signal semaphore is controlled through a branch circuit leading through the armature of relay D′ or D² and also preferably through a circuit-controller F⁴ and at each station, which is closed only when the block-signal is cleared or at "safety." The result of such an arrangement is that when the track-relay at the beginning of any section is released by short-circuiting its battery through the wheels and axles of a train in the section the battery S⁴, controlling the semaphore-arm, is thrown out of action by its circuit being broken at the relay A′, A², or A³, and both semaphore-arms move into danger position. When the track-relay A³, for instance, is again energized by the train moving out of the section, the "danger" semaphore-arms will move to safety position; but at such time the relay D², for instance, has been deënergized through the breaking of its circuit by the controller F² of the next succeeding station, and consequently the caution-signal remains set and the caution-signal can only move to "safety" after the block-signal of said next succeeding station has moved to "safety" and again established the circuit through the relay D² and its own block-signal has also moved to "safety" and closed the controller F⁴.

A train is supposed to occupy the section C³ of the track, said train being indicated at T, under which conditions the signals S′ and S² are in clear positions and all relays at these stations are closed. Signal S³ is shown in its danger position, because the section C³ of the track is occupied by a train, which train short-circuits track-battery B³, allowing the relay-armature A³ to fall, thereby opening the circuit governing both the block and caution signal mechanisms. It will be understood that when the train enters track-section C² the armature or relay A² will open, and when the rear of the train clears the section C³ the armature of relay A³ will close. When the armature of relay A² opens, the local battery S⁴, governing both the block and caution signal system S², is cut out at relay A², thus setting both signals to the danger position, and the upper blade or block-signal blade opens the circuit-controller F², cuts off the battery E² from the relay D², and consequently while the relay A³ is closed the upper blade only of signal S³ can be cleared, the lower blade being left raised to give a caution-indication until the rear of train has passed out of track-section C², at which time the upper blade of signal S² will assume the clear position, closing the circuit at F² to the relay D² and allowing the lower blade of signal S³ to assume its clear position.

In addition to operating track-signals the system shown in Fig. 1 is well adapted for controlling a crossing-signal. Thus G′ indicates a crossing-bell, and G a special relay wired in series with the track-battery B³, in practice this special relay being wound with a very low resistance—one-eighth ohm, for instance—so as to stand normally open or to stand normally open so long as the resistance of the relay A³ is in the circuit; but upon the establishment of a short circuit between the track-rails, as by the entrance of a train into the section C³, the entire strength of the battery B³ will be exerted in the relay and its armature will be attracted, and thus may be utilized to close a local circuit, including a battery G², together with the crossing-bell G′, before referred to. Obviously with this arrangement the crossing-bell will begin to ring as soon as the track-section C³ is occupied and will continue to ring until the short circuit in said section is broken.

In Fig. 2 of the accompanying drawings a somewhat different arrangement of the cir-

cuit connections is shown in order to illustrate features which could not be well illustrated in Fig. 1 without undue complication and also to illustrate a different method of connecting up instrumentalities embodying features of the present invention. In this figure three relays a' a^2 a^3 are employed, each adapted to be operated through its respective track-section b' b^2 b^3 by track-batteries c', c^2, and c^3. The relay a' is shown as a repeating instrument and is located at what is commonly known to those skilled in the art as a "cut-section," and it operates to control the track-battery c^2, as will be presently explained.

The semaphore s is directly controlled or operated by the battery s^4, and the circuit from the battery s^4 is completed to the semaphore through the armatures of both the relays a^2 and a^3 with suitable contacts so arranged that said circuit is only completed when the relay a^2 is energized and the relay a^3 not energized, or, in other words, the relay-armatures must be in relatively opposite positions in order to complete the semaphore-operating circuit, and as this semaphore operates on the "normal danger" principle it can only be cleared when the relay a^2 is energized and the relay a^3 not energized. The track-section b^3 is a preliminary or clearing section and is usually of only sufficient length to permit an engineer to stop or control his train while in sight of the semaphore. Thus a train entering the preliminary track-section b^3 short-circuits the battery c^3 through its wheels and axles, causing the armature of relay a^3 to open, thereby completing so far as this relay is concerned the circuit to the signal clutches or magnets, and if no train be in the section b^2 the semaphore will be cleared or moved to the safety position. As the train passes to the section b^2 the relay a^2 is opened, because of the short-circuiting of the battery c^2, and the semaphore s therefore returns to danger position, because of the breaking of its circuit controlled by the armature of relay a^2, and consequently regardless of the position of the armature of relay a^3 the signal cannot be cleared so long as the track-section b^2 is occupied. The conditions existing at this time will also be maintained until the train moves off of the section b' because of the action of the repeating-relay a'. This repeating-relay a' is adapted through its armature and suitable contacts with which it coöperates to establish the circuit from the battery c^2 to the track-section b^2 whenever the relay-magnets are energized and to break said circuit as well as short-circuit the tracks of the section b^2 whenever said magnets are deënergized, the result being that whenever a train is on the section b' and the magnets of relay a' are deënergized through the short-circuiting of the battery c' no battery can reach the track-section b^2 and in addition the rails of the track-section b^2 are short-circuited. Thus the relay a^2 is deënergized and the circuit from the battery s^4 for clearing the semaphore-signal is broken, and said signal cannot be cleared by the entry of a train into the clearing-section b^3 until after the preceding train has moved out of the section b'.

The clearing-section relay a^3 in addition to partially closing the semaphore-operating circuit may be utilized to close a local circuit for operating a crossing-signal. Thus the crossing-signal bell f includes in its circuit a battery f'' and contacts f^2, one of which is on the armature of the relay a^3 and the other is in position to coöperate therewith when the relay-magnets are deënergized, whereby the crossing-bell will be rung and will continue to ring so long as a train remains in the clearing-section b^3 and the magnets of relay a^3 are deënergized.

The relays referred to in the foregoing description are of a uniform type, and in order to make the system effective it is of prime importance not only that they should be certain in action, but that their action should be easily controlled by shunting or short circuiting their operating-batteries. This in connection with the fact that it is desirable to have them operate through relatively long and poorly-insulated circuits from a very weak battery makes it necessary that said relays should be extremely sensitive. The conditions under which the relays must operate makes it difficult to provide efficient instruments; but in the present invention the difficulties heretofore found to exist have been overcome, and in Figs. 3, 4, and 5 a relay is illustrated, which in practice and in systems such as heretofore described has answered all the demands. By referring to the last-mentioned figures of the drawings it will be seen that each relay embodies two sets of magnets H H', located on opposite sides of the plane of the armature-lever H^2 as well as on opposite sides of the pivot or axis H^3 of said lever, whereby said magnets will both operate on their armature H^4 to move the lever in one direction about its axis. The pivot or axis about which the armature-lever swings is located at one side of its center of gravity in order that it will normally tend to turn by gravity away from the magnets and will only be held against such tendency when the magnets are energized. In the preferred construction the magnets H are mounted upon and have their pole-pieces projecting through carrying-plates h, while the rear ends of the magnets are supported by posts h'. Said posts and plates are both mounted upon a base h^2, on which the binding-posts h^3 may be located for the several circuit connections to which the instrument is adapted.

The armature-lever H^2 supports any desired number of spring or elastic contact-carriers I, adapted to coöperate with contacts K K', preferably mounted upon and extending through

the upper portions of the plates *h*, but insulated therefrom. The contact-carriers I are also preferably insulated from the armature, for which purpose screw-threaded bone insulators O are employed, and each support I is adapted to have a circuit-wire connected therewith through any suitable or usual means, so that the circuit may be made or broken by the movement of the armature and contacts before referred to.

To make the pressure on the back contact more secure, a retractile spring P may be employed in addition to the force of gravity, such spring being preferably located between the lower portion of the armature and one of the plates *h*, the arrangement of the parts, however, being such that the armature, contacts, and adjustable portions of the device may all be inclosed by the plates *h* and a U-shaped casing Q, which is adapted to slide in grooves *q*, Figs. 4 and 5. This casing is preferably of transparent material, so as to permit of the inspection of the working parts without permitting access of dust-laden or damp air, which might affect the operation of the parts.

The contacts K K', it will be observed, may be adjusted toward and from each other and are preferably so arranged as to form the stops for arresting the movement of the armature in each direction. Thus the spring-support I will be held under slight tension when the armature is in either position, and its resiliency will aid very materially in inaugurating the movement of the armature in either direction.

The pivots on which the armature turns may be of the usual type illustrated in Figs. 4 and 5, and the posts R, on which the trunnion-screws are mounted, extend up from the base h^2 within the area inclosed by the casing, as will be readily understood.

In operation the coöperating pairs of magnets H and H' are preferably connected in the circuit in multiple with each other, as is shown uniformly in Figs. 1 and 2, inasmuch as with this arrangement it is found that each pair of magnets of the relay may be wound to a relatively high resistance twice that which would be practicable with an ordinary relay and that they will release upon the establishment of a short circuit with much greater facility and certainty than would otherwise be possible.

Obviously the relay is susceptible of use in any of the situations illustrated in Figs. 1 and 2, and, in fact, its use is not limited to the systems illustrated inasmuch as it may be incorporated in other systems for signal-work or for other purposes.

Having thus described our invention, what we claim as new, and desire to secure by Letters Patent, is—

1. In a signal system, the combination with a signal mechanism, and a relay embodying two magnets, and an armature-lever pivoted at a point intermediate its length and adapted to be swung in one direction by the attraction of both magnets, of a local signal-operating circuit controlled by the relay, a distant battery and a relay-operating circuit extending therefrom and including said magnets in multiple with each other said circuit being adapted to be short-circuited intermediate the battery and relay; substantially as described.

2. In a signal system, the combination with a signal mechanism and a relay embodying two oppositely-arranged magnets and an armature-lever pivoted at a point intermediate its length and between the magnets to be swung in one direction by both magnets, of a local signal-operating circuit controlled by the relay, a distant battery and a relay-operating circuit including the battery and said magnets, the latter being in multiple with each other; substantially as described.

3. In a signal system, the combination with a signal mechanism and a relay embodying two oppositely-arranged magnets located in different planes and an armature-lever pivoted at a point intermediate its length and between the magnets, of a local circuit controlled by the relay, a distant battery included in a closed circuit with the relay-magnets and means for short-circuiting the battery; substantially as described.

4. In a relay for signal-work, the combination with oppositely-arranged magnets located in different planes, of an armature-lever between the magnets carrying armatures for both magnets and pivoted at one side of its center of gravity and at a point intermediate its length and contacts controlled by said lever, whereby the lever will be moved in one direction by gravity and in the opposite direction by the simultaneous action of both magnets.

5. In a relay for signal-work, the combination with oppositely-arranged magnets located in different planes, of an armature-lever between the magnets and carrying armatures for both magnets, said lever being pivoted at one side of its center of gravity to normally tend to move away from the magnets under the influence of gravity and contacts controlled by the lever.

6. In a relay for signal-work, the combination with oppositely-arranged magnets located in different planes, of an armature-lever between the magnets and carrying armatures for both magnets, said lever being pivoted at one side of its center of gravity to normally tend to move away from the magnets under the influence of gravity, a spring-contact support mounted on the lever, a contact carried thereby and a fixed contact with which it engages, whereby the resiliency of the support will inaugurate the movement of the lever away from the magnets.

7. In a relay for signal-work, the combination with the oppositely-arranged relay-mag-

nets located in different planes, parallel supporting-plates on which said magnets are mounted and fixed contacts carried by but insulated from said plates, of an armature-lever carrying armatures for both magnets said armature-lever being pivotally mounted at a point intermediate its length and between the magnets, contacts carried by said armature-lever and coöperating with the before-mentioned fixed contacts and a casing bridging the space between the supporting-plates and inclosing the armature-lever and contacts; substantially as described.

8. In a relay for signal-work, the combination with the base, the magnets mounted on said base with their poles oppositely arranged and in different planes, of an armature-lever pivotally mounted between the magnets and at one side of its center of gravity whereby it normally tends to move away from the magnets, movable contacts carried by the armature-lever, fixed contacts carried by the base and a removable casing inclosing the lever, contacts and pole-pieces of the magnets; substantially as described.

9. In a signal system for railways, the combination with the track-rails constituting conductors in the signal-circuit and a battery connected with said track-rails, of a relay connected with said contact-rails at a point distant from the battery and embodying oppositely-located relay-magnets in multiple with each other and an armature pivoted intermediate said magnets in position to be attracted by both of said magnets when they are simultaneously energized, whereby a train occupying the track-rails between the battery and relay connections will short-circuit the battery and deënergize the relay-magnets.

10. In a signal system, the combination with a railway-track divided into blocks, signals located at the meeting-points of said blocks and embodying block and caution signal indicators and two relays with local circuits controlled one by each relay for operating the respective signals, of a signal-circuit including the track-rails and one of said relays, whereby the presence of the train in the block will cause said relay to operate to render the danger-signal effective and a second signal-circuit including the other relay and a controller operated by the danger-signal of a succeeding block-station and controlling the local circuit which renders the caution-signal effective whereby the caution-signal cannot be cleared until the danger-signal at the succeeding block-station is actuated.

11. In a railway-signal system divided into blocks, a block-station equipment comprising danger and caution signals, a local operating-circuit for said signals and in which the signals are included in separate branches, a relay controlling said local circuit and itself controlled by the presence of a train in the block and a second relay controlling the caution-signal branch of the local circuit and itself controlled from a succeeding block-station; substantially as described.

FRANK P. J. PATENALL.
GEORGE H. DRYDEN.

Witnesses:
ALFRED GAGNEUX,
T. M. ELPHINSTONE.