No. 868,231. PATENTED OCT. 15, 1907.

L. H. THULLEN.

SIGNALING SYSTEM FOR ELECTRIC RAILWAYS.

APPLICATION FILED APR. 30, 1907.

2 SHEETS—SHEET 1.

Fig. 1

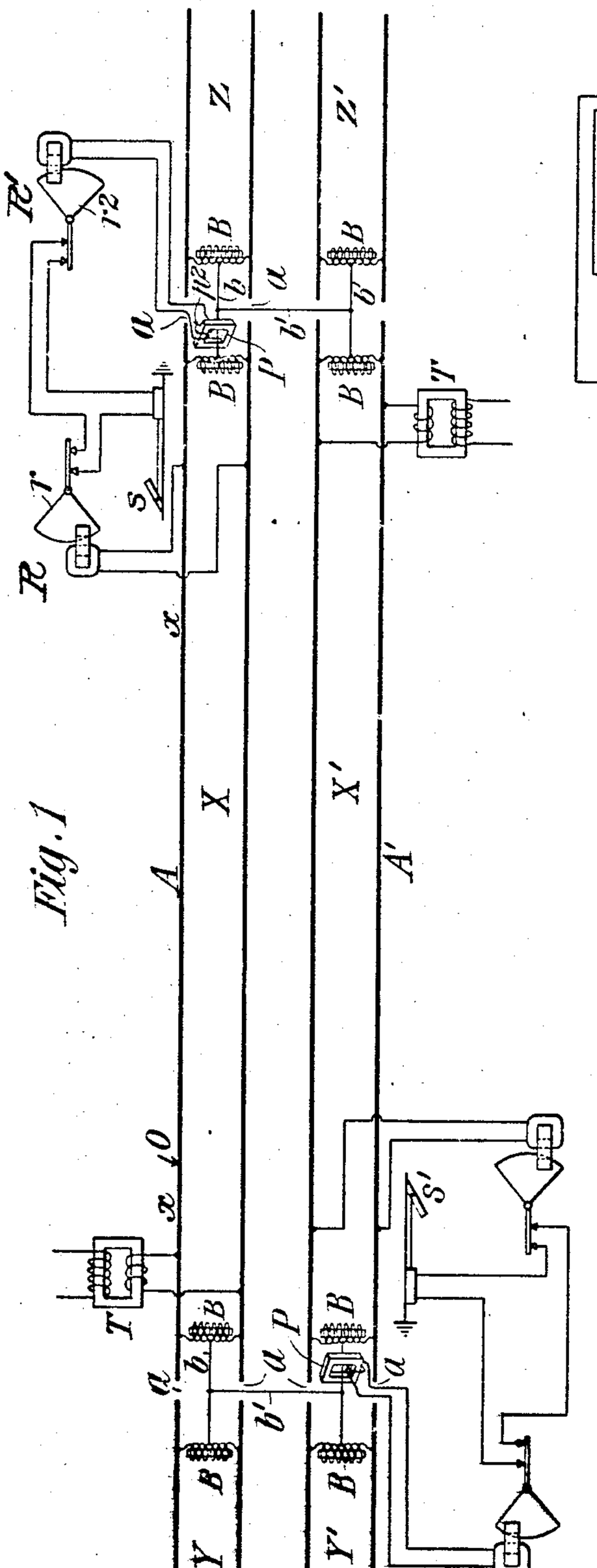

Fig. 2

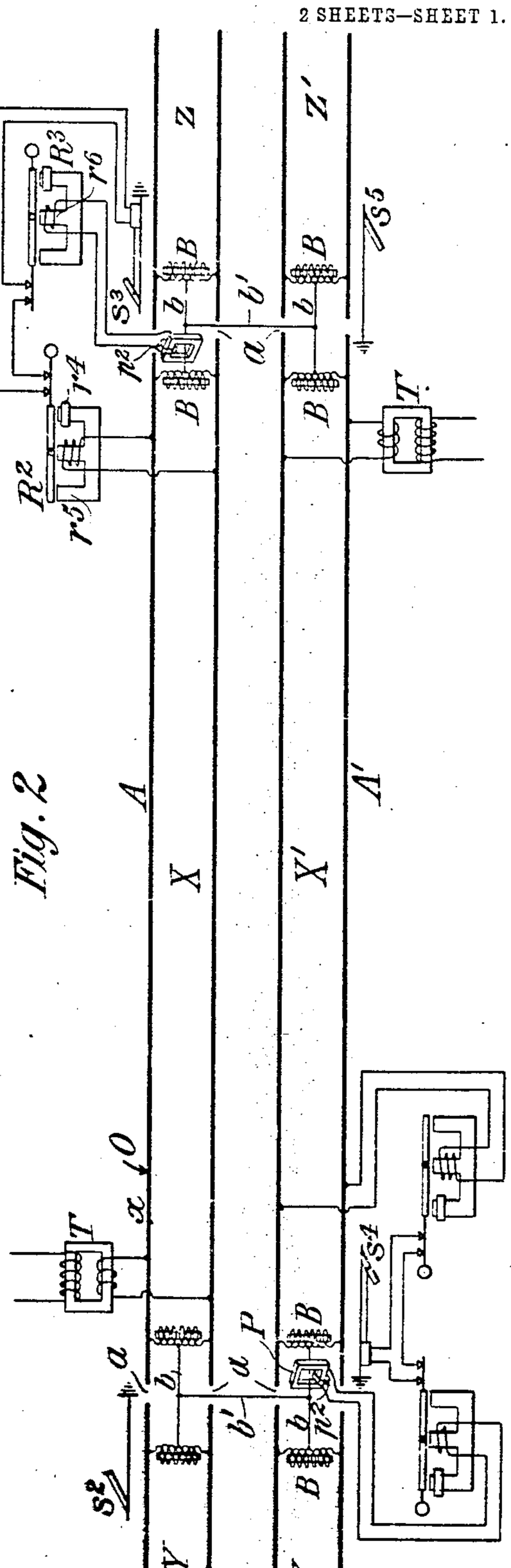

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Fig. 4

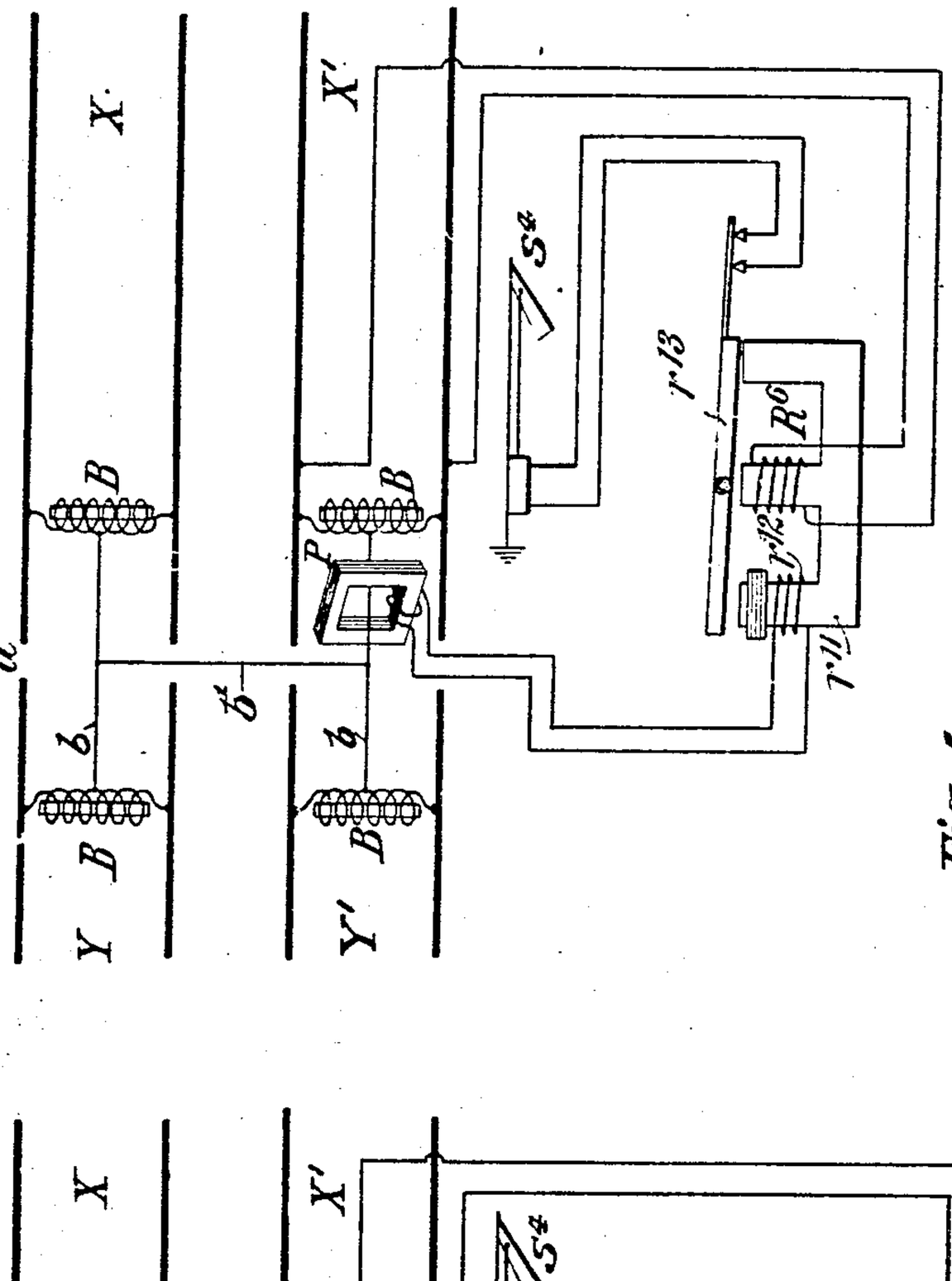


Fig. 5

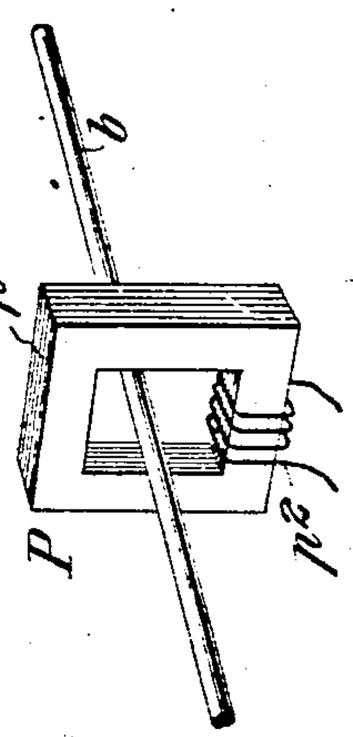
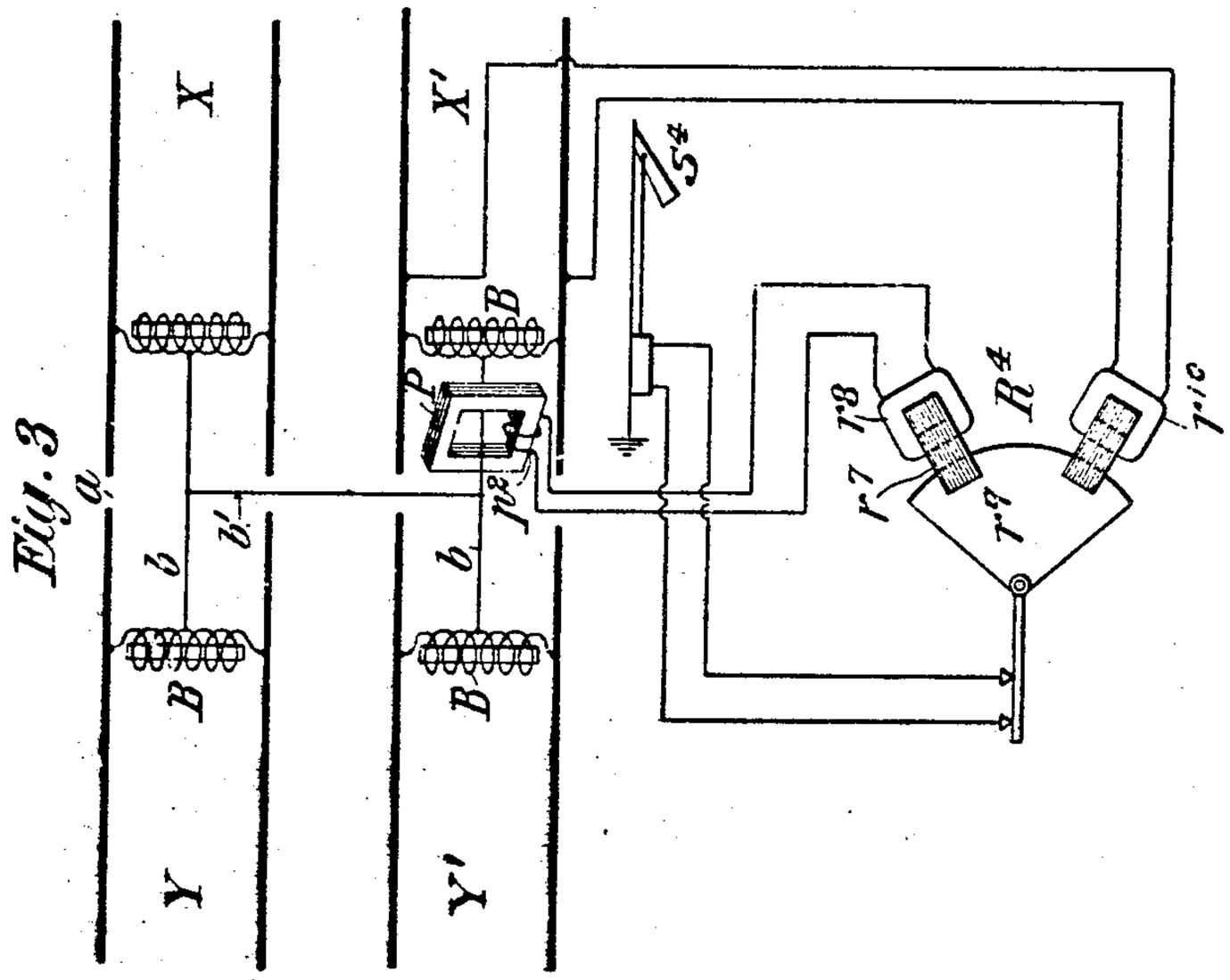


Fig. 3



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SIGNALING SYSTEM FOR ELECTRIC RAILWAYS

No. 868,231. Specification of Letters Patent. Patented Oct. 15, 1907.

Application filed April 30, 1907. Serial No. 371,161.

To all whom it may concern:

Be it known that I, LOUIS H. THULLEN, a citizen of the United States, residing at Edgewood Park, in the county of Allegheny and State of Pennsylvania, have invented certain new and useful Improvements in Signaling Systems for Electric Railways, of which the following is a specification.

My invention relates to signaling systems for electric railways and has for an object the prevention of an improper operation of a railway signal for one track by the signaling current from an adjacent track. I will describe a signaling system embodying my invention and then point out the novel features thereof in claims.

In the accompanying drawings, Figure 1 is a diagrammatical view of a portion of a double track railway, the rails of each track being divided by insulation to form block sections and all the track rails being included in the return circuit for the car propulsion current and having applied thereto a signaling system embodying my invention. Fig. 2 is a view similar to Fig. 1, but showing a modification of the signaling system due to its being applied to a railway wherein an alternating current is employed for car propulsion purposes. Figs. 3 and 4 are each detail diagrammatical views showing different forms of relays which may be used in the signaling system. Fig. 5 is a detail perspective view.

In Fig. 1 the signaling system is applied to an electric railway using a direct current for car propulsion purposes. In Fig. 2 the signaling system is applied to an electric railway using an alternating current for car propulsion purposes. I have not illustrated the direct or alternating car propulsion systems in these figures as such systems are well known and understood in the art. The relays diagrammatically illustrated in Figs. 3 and 4 are applicable more particularly in signaling systems applied to electric railways using alternating current for car propulsion purposes.

Similar letters of reference designate corresponding parts in all of the figures.

Referring to the drawings, A, A^1, designate portions of two parallel railway tracks of an electric railway, each of which is divided by insulated joints *a* to form block sections. As shown, both rails of each track are provided with insulated joints *a* to form block sections though, if desired, only one rail of each track may be so divided. Both arrangements are well known in the art. In Figs. 1 and 2, I have shown one block section X and portions of two others Y, Z, in one railway track, and one block section X^1 and portions of two others Y^1, Z^1, in the other railway track.

As the both rails of each railway track are included in the return path for the car propulsion current and are suitably connected, one pole of the generator for the car propulsion current, which as stated, may be either direct or alternating, provision is made for conducting the propulsion current around insulation points by means of reactance bonds. In the drawings I have diagrammatically illustrated what is known in the art as the "balanced type" of reactance bonds. B designates such bonds. These bonds, as is well known, comprise a core or windings, all the turns of which are in the same direction and in close inductive relation. Such a type of bond is set forth in U. S. Patent No. 838,916, granted to me on December 18, 1906. In this type of bond the propulsion current is made to flow through two equal parts of the winding or two windings of the same number of turns in reverse directions, so that the propulsion current produces no magnetizing effect on the core, thus leaving the bond free to act as impedances for the alternating signaling current of the track circuits. As shown, the windings of two adjacent bonds are connected by a conductor *b* or there may be a plurality of such conductors. Cross bonds b^1 are also provided between the two railway tracks wherever possible, and they are for the purpose of reducing the resistance in the return circuit for the car propulsion current. In the drawings I have shown the cross bonds b^1 as being connected with the conductors *b* of the two railway tracks.

The signaling system applied to the railway, comprises a railway signal or signals, for each block section, and a track circuit for each block section to control one operation of the railway signal or signals. S, S^1, S^2, S^3, etc., designate two railway signals which may be any of the well known types of automatic signals.

Each track circuit comprises a source of alternating current and a relay or relays. The source of alternating current for each track circuit is shown in the form of a transformer T, the secondary of which is connected with the track rails of its block section while the primary may be in multiple circuit with mains extending from a suitable generator. The signaling current is preferably of a high frequency (60 or more cycles). The signaling current of the signaling system is of a different frequency from the alternating propulsion current when the signaling system is applied to electric railways using alternating current for propulsion purposes.

Referring now to Fig. 1, each track circuit is provided with a relay R, but in addition to this relay R, a second relay R^1 is provided to control the railway signal. The relay R is connected with the track rails of its track circuit in the usual manner and when energized by the alternating signaling current of its track circuit its vane *r* is moved to close contacts in the signaling circuit. The relay R^1, however, is normally deenergized, and its vane r^2 is usually held by gravity or otherwise in such position to close its contacts in the signaling circuit. With no car or train in a block section the apparatus will be in the condition illustrated and the signal device *s* of the railway signal will be in its clear position of indication. Should a car or train enter a block section, the wheels and axles thereof

would short circuit the alternating signaling current from the relay R, which being deënergized, its vane would move to open the signaling circuit and thus permit the signal device of the railway signal S to move to indicate danger. When the car or train moves out of the block section the relay R is again energized to close the signal circuit. These operations are well understood in the art. It will be seen that the relay R^1 had no part in the operations just described. Its only purpose is to open the signaling current in which it is included, should for any cause alternating signaling current from an adjacent track circuit find a path through the cross bonds and conductors connecting the windings on adjacent reactance bonds to the track circuit of a relay R with which the relay R^1 is associated. With normal or the usual conditions existing under which the signaling system operates, the alternating signaling current for the several track circuits will be confined thereto and there is no tendency for it to flow in paths other than the track circuits. But suppose that a rail of one block section was broken, for example, at the point O in Figs. 1 and 2: Alternating signaling current from the transformer T of block section X would then flow along the rail x to the bond B at the left of the figures. Half the potential of the transformer would exist at the middle point of the winding of the bond, and alternating signaling current will flow through the adjacent cross bond b^1 to the rails of block section X^1, bond B at the right of block section X^1 adjacent cross bond b^1, bond B at the right of block section X and the track relay R, imposing on this relay an electro-motive force which may be sufficient to energize this relay should it have been short-circuited by a train in its block section, thus causing it to move its vane and close the signal circuit to have the railway signal clear with a train in the block section. To avoid this wrong clearing of the signal by this leakage current described, I have provided the relay R^1 and the transformer P, (shown in detail in Fig. 5). This transformer or inductive apparatus comprises a laminated iron core P^1, and a secondary winding P^2 which is in circuit with the relay R^1. The core P^1 is placed adjacent a conductor b as shown so that when the stray or leakage alternating current traverses the conductor b it will generate a current in the secondary winding P^2 which causes the relay R^1 to move its vane to open its signal circuit. Thus, should a track relay be improperly energized by alternating signaling current from an adjacent track circuit the apparatus (transformer P and relay R^1) acts to open or keep open the signal circuit The relays R, R^1, may be substantially of the form illustrated and described in U. S. Patent No. 823,086, issued June 12, 1906, to me.

Fig. 2 illustrates the same arrangement of circuits and apparatus, but a different type of relay R^2 for each track circuit and the same type of relay R^3 for opening the signal circuit should a foreign signaling current enter the track rails of the relay R^2 with which it is associated. This relay *per se* forms no part of my invention, but is merely shown as a preferable type of relay in an alternating signaling system for railways using an alternating current for car propulsion purposes and the track rails as part of the return path. The relay comprises a substantially W-shaped core and an energizing winding on its middle leg. On one of its outside legs a closed conductor r^4 is employed, which, when an alternating current of high frequency traverses the winding on the middle leg exerts a counter-magneto force, thereby making the other outside leg r^5 a stronger pole to attract the armature. The armature of the relay R^3 is balanced to close the signal circuit when no high frequency current is flowing in its energizing winding r^6. When the stray alternating signaling current traverses the winding on the middle leg, the armature of the relay R^3 is moved to open the signal circuit.

Fig. 3 illustrates a further modification, the modification residing principally in the form of relay R^4. The relay is substantially like that illustrated in the patent hereinbefore referred to except that an additional core r^7 and coil r^8 is employed, which coil is in circuit with the transformer P. The core r^7 and coil r^8 are so arranged that when energized by a stray alternating signaling current it will move the vane r^9 to open the signal circuit, or if the vane has moved to open the signal circuit it will act to hold the vane in that position as the same stray alternating signaling current will traverse both coils of the relay simultaneously. The coil r^{10} is in circuit with the track rails and this coil is used to move the vane r^9 to close the signal circuit when energized by current from the transformer T. The normal operation of the relay R^4 is the same as that described in connection with the relay R of Fig. 1. The form of invention illustrated in Fig. 3 is applicable more especially to electric railways employing direct current as a motive power for the motor cars.

Fig. 4 illustrates a still further modification, the modification residing principally in the form of relay R^6. The relay R^6 is substantially the same as that illustrated in Fig. 2. In Fig. 2 two relays (R^2, R^3) are used whereas in Fig. 4 only one relay is used. The operation of the relay R^6 under usual conditions is the same as that described in connection with the relay R^2 of Fig. 2: When a stray alternating signaling current flows over the conductor b and induces a current in the winding P^2 of the device P, it magnetizes the leg r^{11} of the relay by the winding r^{12} and causes the armature r^{13} to move to open the signal circuit.

Having thus described my invention, what I claim is:

1. The combination with two parallel tracks of an electric railway the rails of each trackway being divided to form block sections and are used to conduct car propulsion current to the generator thereof, of reactance bonds placed across the rails of each trackway, a conductor connecting adjacent bonds in the same trackway, cross bonds between such conductors, a block signaling system for each track way employing an alternating signaling current in the track circuits of the signaling system, means adjacent the said conductors in which a current is induced by a stray alternating signaling current flowing over such conductor, and means affected by said induced current for opening a signal circuit.

2. The combination with two parallel tracks of an electric railway the rails of each trackway being divided to form block sections and are used to conduct car propulsion current to the generator thereof, of reactance bonds placed across the rails of each trackway, a conductor connecting adjacent bonds in the same trackway, cross bonds between such conductors, a block signaling system for each track way employing an alternating signaling current in the track circuits of the signaling system, means adjacent the said conductors in which a current is induced by a stray alternating signaling current flowing over such conductor, and a relay affected by said induced current for opening a signal circuit.

3. The combination with two parallel tracks of an electric railway the rails of each trackway being divided to form block sections and are used to conduct car propulsion current to the generator thereof, of reactance bonds placed across the rails of each trackway, a conductor connecting adjacent bonds in the same trackway, cross bonds between such conductors, a block signaling system for each track way employing an alternating signaling current in the track circuits of the signaling system, transformer adjacent the said conductors in which a current is induced by a stray alternating signaling current flowing over such conductor, and a relay affected by said induced current for opening a signal circuit.

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

LOUIS H. THULLEN.

Witnesses:
ELMER R. COE,
DANIEL J. MCCARTHY.