

H. S. OSBORNE.
SIGNALING CIRCUITS FOR ELECTRIC RAILWAYS.
APPLICATION FILED JAN. 10, 1916.

1,358,777.

Patented Nov. 16, 1920.

Fig. 1

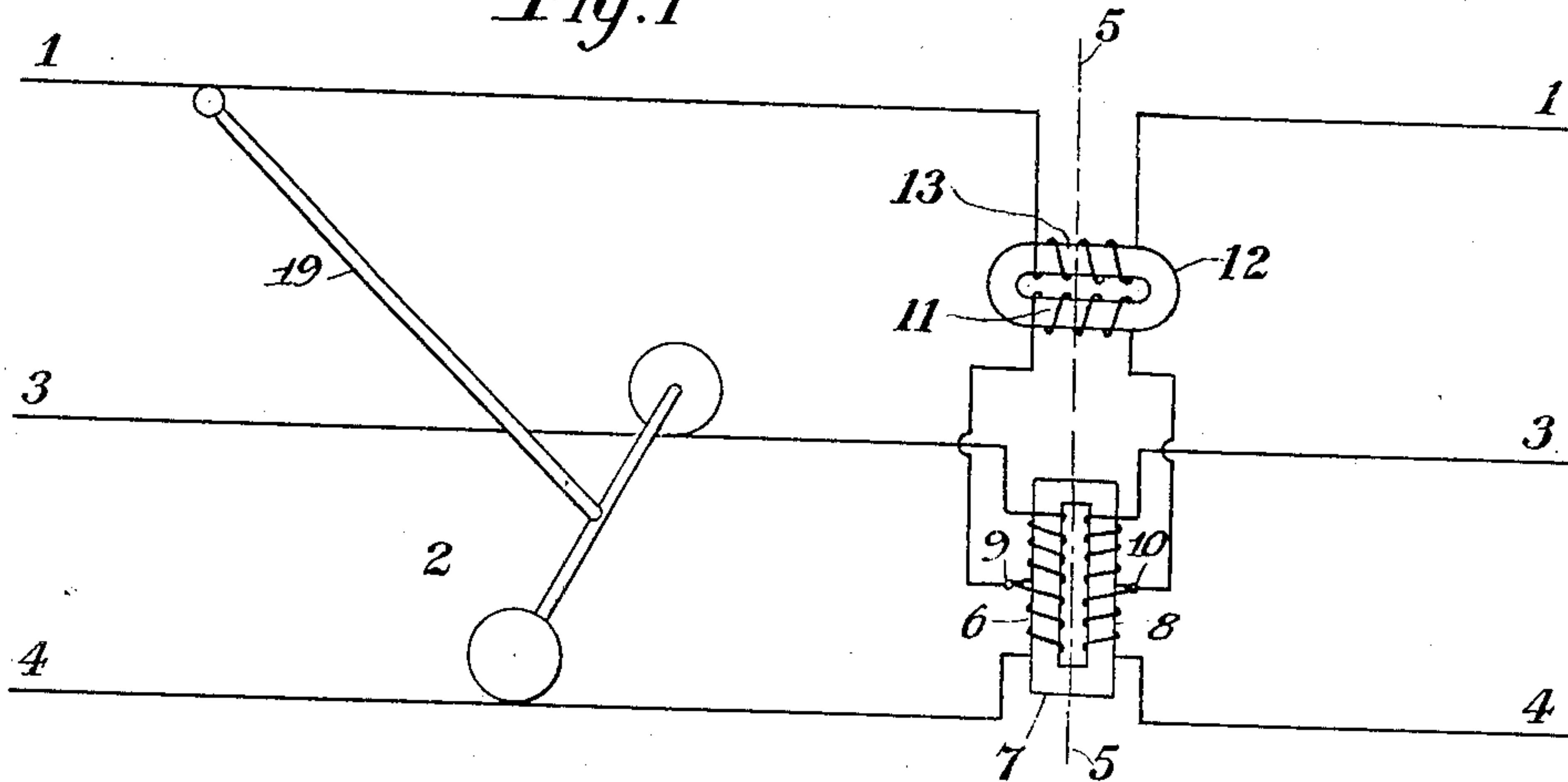
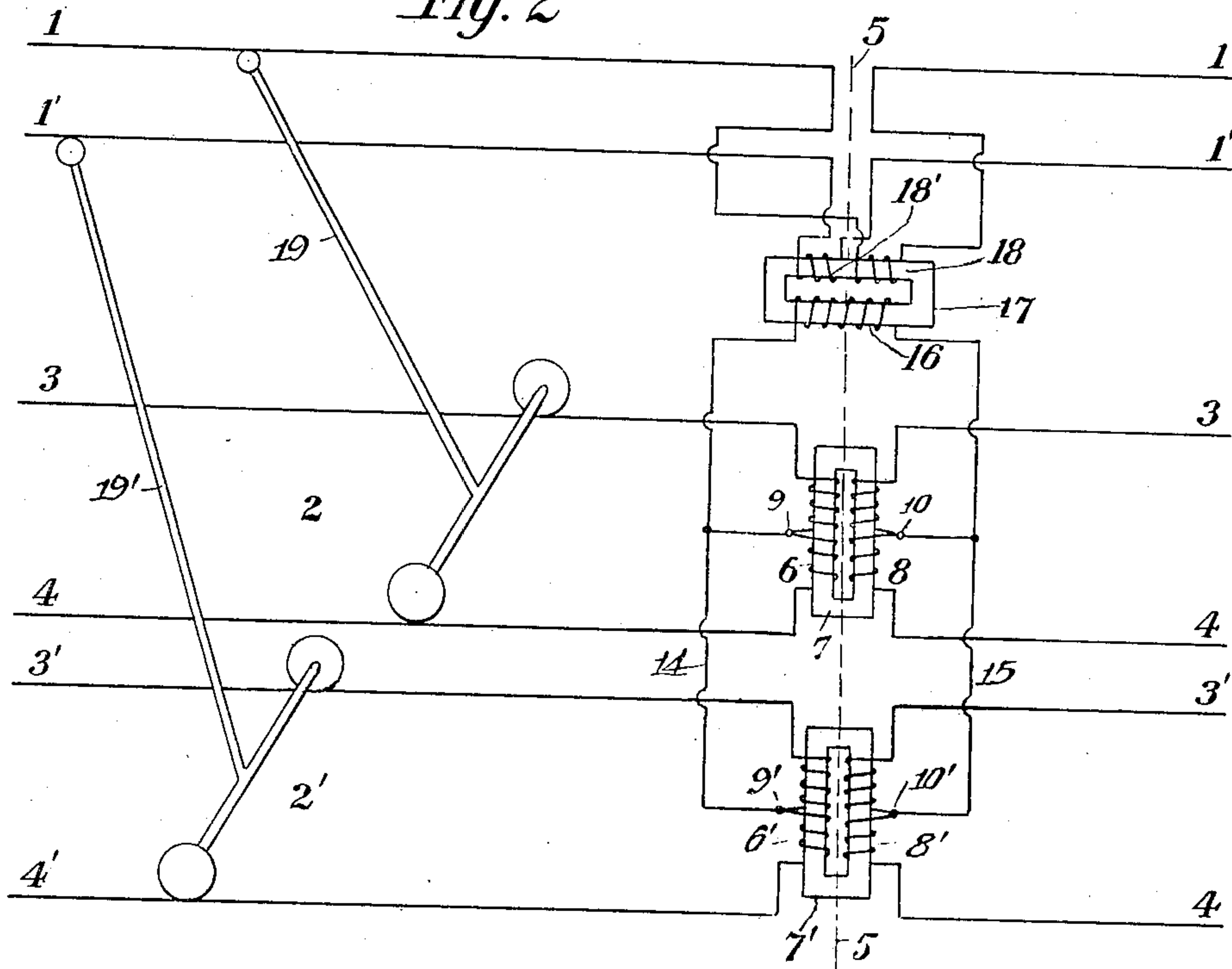


Fig. 2



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UNITED STATES PATENT OFFICE.

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SIGNALING-CIRCUITS FOR ELECTRIC RAILWAYS.

1,358,777.

Specification of Letters Patent.

Patented Nov. 16, 1920.

Application filed January 10, 1916. Serial No. 71,310.

To all whom it may concern:

Be it known that I, HAROLD S. OSBORNE, a citizen of the United States, residing at New York, in the county of New York and State of New York, have invented certain Improvements in Signaling-Circuits for Electric Railways, of which the following is a specification.

This invention relates to an electric railway system, and more particularly to an electric railway system which employs alternating current both for propulsion and for signaling and in which the rails of said railway system serve as conductors for both said propulsion and signaling currents. It is the object of this invention to provide means for the transmission of said signaling current independently of the circuit arrangements associated with said propulsion current.

In an electric railway system comprising a plurality of parallel tracks, each of which tracks has associated therewith a third conductor, such as a trolley or an insulated third rail, it is desirable that the three following conditions be satisfied; first, that the sum of the propulsion currents flowing in the plurality of third conductors shall be equal and opposite to the resultant current flowing in the rails of the plurality of parallel tracks, thereby preventing the flow of current in the ground with consequent differences of potential between different points in the ground and induction in neighboring circuits; secondly, that the return current flowing in the rails of two or more adjacent tracks shall be equally distributed among the rails of said tracks to the end that the impedance of the return conductors shall be low; thirdly, that the two parallel rails of any particular track shall serve as the circuit for the transmission of alternating signaling current for the operation of signals associated with said track. The first two of the above-mentioned requirements have been satisfied by arrangements known to the art, but their satisfaction renders it difficult to comply with the third named condition. This invention consists broadly in providing means for satisfying said third named condition and in particular to embody said means in an arrangement in which all the above-mentioned requirements are satisfied.

An arrangement known to the art, for confining the propulsion current to the rails and excluding it from the neighboring ground, may be briefly described as follows: At specified points along the line of the track insulating joints are inserted in the rails of said track, thereby breaking the electrical conductivity. At each side of said insulating joints the two rails are electrically connected, preferably by inductance coils. Between the mid-points of said coils is connected one winding of a series transformer, the other winding of which is connected in series with the third conductor, such as an overhead trolley. These two windings are so related to a common magnetic circuit that the resultant magnetic flux is substantially zero when equal and opposite currents flow in said windings.

The manner in which such an organization confines the propulsion current to the rails and excludes it from the neighboring ground is well known. The series transformer operates to oppose any inequality in value of the currents flowing in its two windings. With an efficient transformer the current flowing through one winding and thence through the rails in parallel is substantially equal and opposite to that flowing in the third conductor. By confining the current to the rails potential variations in the ground are greatly reduced as well as the electromagnetic field at distant points; consequently interference in telephone or telegraph circuits is largely reduced. In practice it is customary to introduce a plurality of said arrangements along the track, whereby the efficiency of operation is increased.

In electric railway systems it is customary and desirable to employ the rails as the circuit conductors for alternating signaling current. Said signaling current is superposed on the propulsion current flowing in said rails and is to be distinguished therefrom in that the signaling current flows in opposite directions in the two rails while the propulsion current flows in the same direction in said rails. It is evident that in a system such as that described above, the insulating joints constitute breaks in the circuit of said signaling current. If then, in such an organization, signaling current is transmitted along the rails, it is necessary

to terminate the signaling section at every point at which a series transformer is introduced in the propulsion current circuit.

The principles underlying this invention and the invention itself may best be understood by reference to the accompanying drawings in which like characters designate like parts. Figure 1 is a diagram of an organization combining an arrangement for confining the alternating propulsion current to the rails with the arrangement of this invention for the transmission of signaling current along the rails of the track; Fig. 2 is an arrangement combining the arrangements of Fig. 1 in an organization which also distributes equally the propulsion current between the rails of two parallel tracks.

Referring to Fig. 1, 1 is a third conductor, shown as an overhead trolley wire, associated with a track 2 consisting of two parallel metallic rails 3 and 4, and 19 represents an electric vehicle having its wheels in contact with said rails and a trolley extending to and in contact with said third conductor. At different points along the track, such as 5, 5, insulating joints are inserted in both rails, such joints being shown for convenience as actual breaks in the continuity of said rails. At one side of said insulating joints a winding 6 of a transformer 7 is connected between rails 3 and 4; similarly at the other side of said insulating joints, a second winding 8, preferably similar and equal to winding 6, is connected between said rails. The mid-points 9 and 10 of said windings are connected to the terminals of a winding 11 of a transformer 12. Another winding 13 of said transformer, preferably similar and equal to winding 11, is connected in series with conductor 1. Windings 11 and 13 have a common magnetic circuit and are so related thereto that if equal and opposite currents flow in said windings the resultant magnetic flux is substantially zero. In the arrangement shown in Fig. 1, the two metallic rails 3 and 4 serially constitute the circuit for the signaling current, and in parallel one side of the circuit for the propulsion current, the other side of said circuit being conductor 1.

It will be evident from the foregoing description that the organization shown in Fig. 1 effectively provides for the independent transmission of the signaling current across the insulating joints, said signaling current being inductively transmitted by transformer 7. Therefore, in so far as the signaling current is concerned, the organization of Fig. 1 is essentially equivalent to an ordinary electric railway system in which the insulating joints in the rails and the transformers 7 and 12 are omitted. Further, since the propulsion current enters the winding 6 and 8 at the end terminals and leaves at the mid-points, or vice versa, said wind-

ings offer substantially no impedance to said propulsion current.

Fig. 2 is a diagram embodying my invention in an electric railway system comprising two parallel tracks 2 and 2', each having an associated third conductor 1 and 1' respectively, and electric vehicles 19 and 19'. The same reference numerals with and without primes designate corresponding component parts, those without primes referring to component parts associated with track 2 and those with primes to component parts associated with track 2'. The mid-points 9 and 10 of windings 6 and 8 respectively of transformer 7 are connected to the corresponding mid-points 9' and 10' of windings 6' and 8' of transformer 7' by means of conductors 14 and 15. Between conductors 14 and 15 is connected winding 16 of a transformer 17 whose three windings 16, 18 and 18' are preferably similar and equal as regards number of turns. Said windings are so related to a common magnetic circuit that if the current flowing in winding 16 is equal and opposite to the sum of the currents flowing in windings 18 and 18' the resultant magnetic flux is substantially zero. The current flowing in winding 16 is the sum of the propulsion currents flowing in the rails of tracks 2 and 2' and therefore as heretofore explained, said transformer operates to maintain the track propulsion currents equal and opposite to the sum of the currents, flowing in conductors 1 and 1'. Further since winding 16 is symmetrically related to tracks 2 and 2', said propulsion current divides equally between said tracks, one-half flowing in rails 3 and 4 of track 2 and the other half flowing in the rails 3' and 4' of track 2'. The manner in which the signaling current flowing in the rails of tracks 2 and 2' is transmitted across the insulating joints by transformers 7 and 7' is the same as that explained in reference to the system shown in Fig. 1.

My invention is ultimately directed to providing means whereby telephonic and other signaling circuits are protected from interference and disturbances from alternating current railway systems. The immediate means for such protection consists, as stated, in the track transformers described above which confine the current to the rails. The inclusion of said track transformers necessitates other means in order that the rails may be employed as the circuit conductors for signaling current and my invention is directed to providing such second named means. It is thus directed broadly to providing freedom in telephonic or telegraphic circuits from induction or interference from electric railway systems.

I claim:

1. In an electrical transmission system for the simultaneous transmission of two sepa-

rate component alternating currents, the combination of three parallel conductors, two of which serially constitute the circuit of one of said component currents, and in parallel one side of the circuit of the other of said component currents; an insulating joint in each of said two conductors; a transformer having two windings, one of said windings being connected between said two conductors at one side of said insulating joints and the other of said windings being similarly connected between said two conductors at the other side of said insulating joints whereby said first named component current is transmitted inductively across said insulating joints, and a second transformer, one winding of which may be connected in series with the said third conductor and the other winding connected between the mid-points of the windings of said first-mentioned transformer, whereby the currents in said third conductor and said two conductors in parallel may be substantially equalized.

2. In an electric railway system employing alternating current for both propulsion and signaling, the combination of a track consisting of two conducting rails; a third conductor paralleling said track; an insulating joint in each of said two rails of said track; a transformer having two windings, one of said windings being connected between said rails on one side of said insulating joints and the other of said windings being connected between said rails at the other side of said insulating joints, whereby said signaling current may be inductively transmitted across said insulating joints; and a series transformer having two windings, one of said windings being connected in series with said third conductor and the other of said windings being connected between the mid-points of the windings of said first named transformer, whereby said propulsion current in returning to its source may be confined entirely to the rails associated with said third conductor.

3. In an electric railway system employing alternating current for both propulsion and signaling, the combination of a plurality of tracks, each of said tracks consisting of two conducting rails; a plurality of third conductors, paralleling said plurality of tracks; an insulating joint in each rail of said plurality of tracks; a plurality of transformers hav-

ing two windings, each of said plurality of transformers being associated with one of said plurality of tracks by having one of its windings connected between the rails of said track at one side of said insulating joints in said rails, and the other winding connected similarly at the other side of said insulating joints, whereby the signaling current associated with said track may be inductively transmitted across said insulating joints, and said plurality of transformers having the mid-points of corresponding windings connected in parallel; a plurality of series transformers having a plurality of windings, each one of said plurality of windings being connected in series with one of said plurality of third conductors, and an additional winding connected between the common mid-points of said plurality of first named transformers, whereby said propulsion current associated with said plurality of tracks in returning to its source may be confined entirely to said plurality of tracks.

4. In an electrical transmission system the combination of a plurality of groups of conductors, each group, comprising three parallel conductors, adapted for the simultaneous transmission of two separate component alternating currents, two of which conductors serially constitute the circuit of one of said component currents and in parallel one side of the circuit of the other of said component currents, insulating means inserted at corresponding points in each of said two conductors in each group, thereby rendering said conductors discontinuous, transforming means associated with said two conductors in each group, whereby the first of said component currents may be transmitted inductively across said point of discontinuity, and second transforming means associated with said third conductors and said two conductors in parallel in each group, whereby the sum of the currents in said third conductors and the sum of the currents in said two conductors in parallel may be substantially equalized.

In testimony whereof, I have signed my name to this specification in the presence of two subscribing witnesses, this sixth day of January, 1916.

HAROLD S. OSBORNE.

Witnesses:

JOHN R. CARSON,
FRED'K S. ROBINSON.