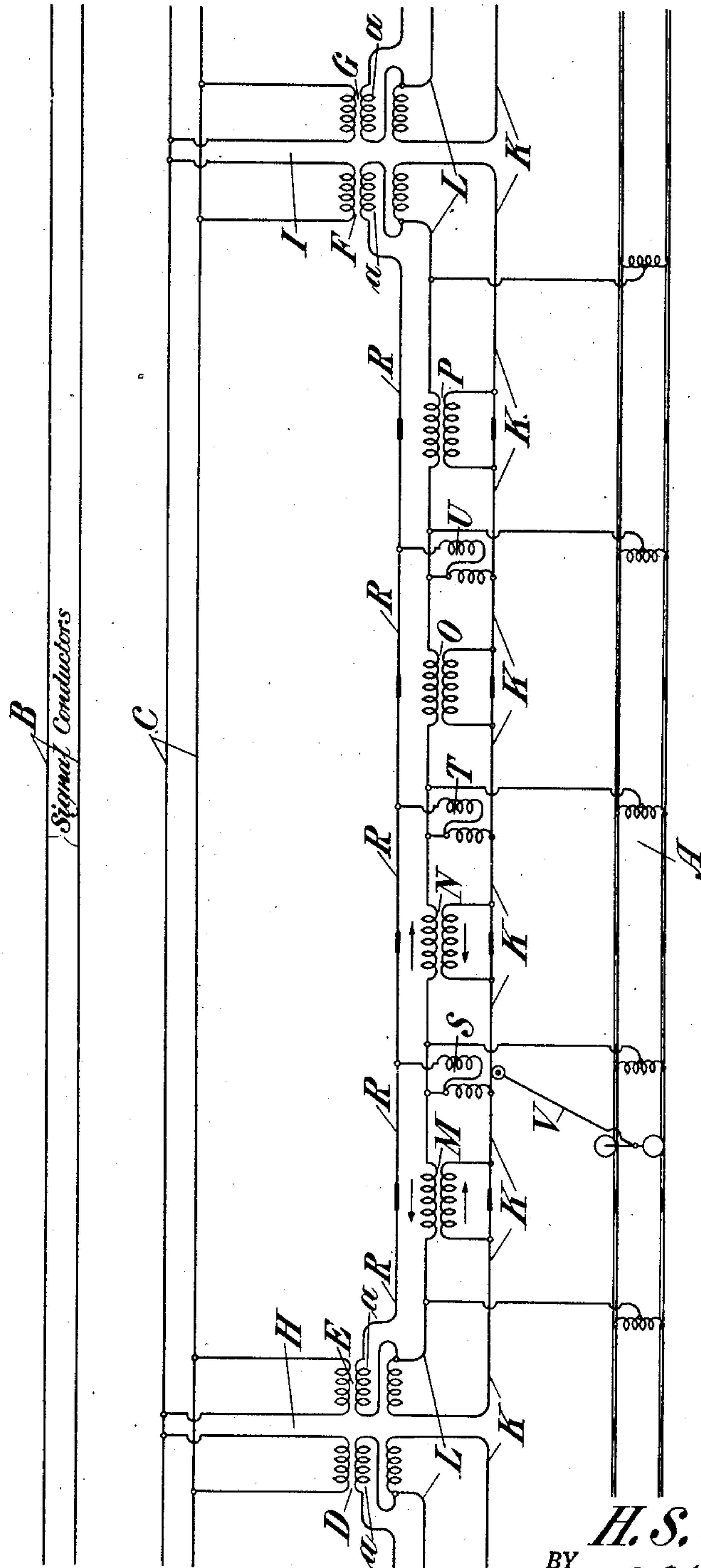


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H. S. OSBORNE
ANTIINDUCTIVE SYSTEM

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ANTI-INDUCTIVE SYSTEM.

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To all whom it may concern:

Be it known that I, HAROLD S. OSBORNE, residing at New York, in the county of New York and State of New York, have invented certain Improvements in Anti-Inductive Systems, of which the following is a specification.

This invention relates to anti-inductive systems, particularly to methods of and means for reducing the interference from alternating current railways in telephone, telegraph or other signal conductors paralleling the right of way.

The present invention proposes to neutralize the electromagnetic field of a trolley, or other current supply conductor, of a railway system by causing the return flow of the operating current through a feeder placed closely adjacent to the trolley conductor, and it proposes to neutralize the electrostatic field due to the voltage of the trolley conductor by impressing a substantially equal and opposite potential on a voltage balancing wire placed closely adjacent to the said trolley conductor.

It proposes, furthermore, to diminish the effect of any unbalance between the electromagnetic fields of the trolley and return feeder conductors by causing the operating current to flow from opposite directions to the railway vehicle so that the unbalance due to the current from one direction is substantially neutralized by the unbalance due to the current from the opposite direction. The invention proposes also to sectionalize the voltage balancing wire and to maintain each section at a potential corresponding to the potential of the adjacent portion of the trolley conductor, so that, as the voltage of the trolley wire varies from portion to portion during the travel of a railway vehicle therethrough, approximate balance for each portion is obtained by the various sections of the voltage balancing wire. It is proposed, furthermore, to sectionalize the track rails at comparatively frequent intervals in order to limit the maximum distance through which the operating current may flow through the track rails and the ground.

A good understanding of the invention may now be had from the following description thereof having reference to the accompanying drawing, showing in dia-

grammatic view one form and arrangement of apparatus embodying the invention.

In this drawing reference character A designates the tracks of a railway and B, the conductors of a telephone, telegraph or similar signaling system paralleling the right of way. Propulsion current is furnished by a high tension transmission line C through transformers D, E, F and G located at substations, of which two, designated H and I, are indicated on the drawing. The trolley conductor K and the return feeder L, placed closely adjacent, are connected to these transformers and sectionalized at the substations, so that a vehicle is limited for its supply of operating current to the adjacent substations. Feeder booster transformers M, N, O and P are provided at intervals between substations, the primary windings of these transformers being connected in series with the trolley conductor K and the secondary windings thereof in series with the return feeder L, these transformers having such numbers of turns in the two windings that, ideally at least, a flow of current through the primary windings will cause an equal flow of current in the secondary windings. The booster transformers are designed so as not to saturate under heavy loads or even short circuits, in order that the currents in the trolley and feeder are always substantially equal. The return feeder is connected to the tracks at points midway between booster transformers, these connections serving to conduct the operating current from the track rails to the return feeder. The tracks are sectionalized, for reasons explained hereinafter, by insulated joints placed in the track rails at points adjacent substations and feeder booster transformer locations. A voltage balancing wire R is placed closely adjacent the trolley wire K, this wire being sectionalized at the substations and feeder booster transformers, the sections of the wire being supplied with potential by transformers S, T and U, the primaries of which are bridged across the corresponding sections of the trolley conductor K and the return feeder L, and the secondaries of which are connected between the said feeder L and the corresponding sections of the wire R. Those sections of the wire which are adjacent to the substations

H and I are supplied with potential by extra windings α on the transformers D, E, F and G. The object of the wire R is to neutralize the electrostatic effect of wire K on the signal conductors, as explained below.

When a railway vehicle V is between substations H and I, it is supplied with operating current from transformers E and F, the current from transformer E flowing through trolley conductor K and booster transformer M to the vehicle V, and the current from transformer F flowing through trolley conductor K and booster transformers P, O and N in series to the vehicle. The current from substation H returns to transformer E by flowing through the rails of the sections of track, through which the vehicle V is passing, into the feeder conductor L and the booster transformer M to the transformer E at the substation H; and the current from the substation I returns through the track rails, return feeder L and transformers N, O and P into transformer F. The current flow in the feeder wire is substantially equal and opposite to that in the trolley wire, so that the inductive effect on the signaling conductors B due to the flow of current in the one is substantially equal and opposite to that due to the flow of current in the other, provided the feeder and trolley wires are sufficiently close to each other and substantially equal distances from the signaling conductors. Any difference in the inductive effects of the two wires is minimized by reason of the fact that the operating current is supplied from two substations and traverses both the trolley and feeder wires in opposite directions.

The inductive effect due to a current in the supply or return conductors will be proportional to the current times the distance which it parallels the signal circuit. If the current flowing to a given car from the two end sources were the same there would in general be an unbalance since the current from the one end would flow parallel to the signal circuit for a longer distance than the current from the other end. However, with the arrangement shown the currents flowing from the two sources through the respective supply branches will be to each other inversely as the distance of the car from the two sources because of the relative impedances of the branches containing conductors and boosters. In the case shown the current from the source E will be substantially three times that flowing from source F and the residual effects therefore neutralize each other the more completely.

It will have been noted that part of the current path described above consists of the track rails between the wheels of the vehicle and the adjacent connection of the return feeder to the rails. The current in this part of the path is not as well balanced by the

return feeder current flow as the part of the path which consists of the trolley conductor. This is all the more true because of the earth connection of the rails, by reason of which, part of the current flows through the ground instead of the rails proper. In the present invention the inductive interference of this current is minimized by the sectionalization of the track rails at comparatively frequent intervals, so that the distance through which the current flows in the track rails is small and the leakage surface between rails and ground is confined to that in only one of the sections of the track, whereby the amount of ground current is reduced to a minimum.

There remains to be explained the manner in which the present invention overcomes the electrostatic interference due to the voltage of the current in the trolley wire K, which voltage is not balanced by that of the current in the feeder wire L for the reason that the return feeder is at substantially earth or zero potential because of its connections to the track rails. The voltage balancing wire R, mentioned hereinbefore, is for this purpose maintained at a potential substantially equal and opposite to that of the trolley wire by means of the transformers S, T, V and the windings α on the transformers E and F. It will be observed that this wire is on open circuit and does not draw any power from the line; and is sectionalized, so that each section may correspond in potential to that of the adjacent portion of the trolley wire. The transformers S, T and V are preferably located adjacent the middle of their sections, so that the potential of each section of the wire is close to the average potential of the corresponding trolley section, which, of course, varies as the railway vehicle passes there-through. The wire R should be close to the trolley conductor K, so that its electrostatic effect on conductor B is substantially equal in magnitude to that of wire K.

Although I have hereby shown and described only one form and arrangement of circuits embodying the invention and described only one manner of practicing the same, it is readily understood that various changes and modifications may be made therein within the scope of the following claims without departing from the spirit and scope of the invention.

What is claimed is:

1. In combination, a signal circuit, a sectionalized supply conductor adjacent thereto for carrying current whose inductive effect on said signaling circuit is to be neutralized, a correspondingly sectionalized return feeder conductor, a third conductor of length corresponding to the supply conductor section adjacent thereto and itself further sectionalized, and means associated with

said conductors to impress a potential on each section of the third conductor substantially equal and opposite to that on the corresponding portion of the supply conductor section.

2. In combination, a signal circuit, a sectionalized supply conductor adjacent thereto for carrying current whose inductive effect on said signaling circuit is to be neutralized, a correspondingly sectionalized return feeder conductor, a third conductor of length corresponding to the supply conductor section adjacent thereto and itself further sectionalized, booster transformers in series in each section of said first two conductors for equalizing the currents flowing in them, and a transformer associated with the supply conductor between the booster transformers to impress a potential on each section of said third conductor substantially equal and opposite to that in the corresponding portion of the supply conductor section.

3. In combination, a railway track, a trolley and a feeder conductor closely adjacent to each other, booster transformers having one of their windings in series with one of said conductors and another winding in series with the other of said conductors, connections between the track rails and said feeder conductor substantially midway between said booster transformers, means adjacent said booster transformers for dividing said rails into sections, a voltage neutralizing conductor placed close to said trolley conductor, and means for impressing on said neutralizing conductor a voltage equal and opposite to said trolley conductor.

4. In a system for minimizing the interference effect due to the propulsion currents of an electric railway in a signal conductor parallel to the right of way, a current supply conductor, a return feeder conductor

placed closely adjacent thereto, means for dividing said conductors into sections insulated from each other, a current supply source for said conductors adjacent the end of each section, booster transformers located at intervals in each section of said conductors for rendering the flow of current in one substantially equal and opposite to that in the other, means for insulating the track rails at the ends of each section of the said conductors and at booster transformer locations, means for connecting the return feeder conductor to the track rails adjacent the midpoints of the track sections, a voltage balancing wire closely adjacent to said current supply conductor, said wire being divided into a plurality of sections for each section of the supply conductor, and means for maintaining each section of said wire at a potential substantially equal and opposite to that of the adjacent portion of the supply conductor.

5. In combination, a railway track, a trolley and feeder conductor closely adjacent to each other, booster transformers having one of their windings in series with one of said conductors and another winding in series with another of said conductors, connections between the track rails and said feeder conductor substantially midway between said booster transformers, means adjacent said booster transformers for dividing said rails into sections, a voltage neutralizing conductor placed close to said trolley conductor, and a transformer associated with said conductor for impressing on said neutralizing conductor a voltage equal and opposite to said trolley conductor.

In testimony whereof, I have signed my name to this specification this 2nd day of March, 1920.

HAROLD S. OSBORNE.