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SYSTEM FOR COMMUNICATING WITH MOVING VEHICLES

Filed March 30, 1928

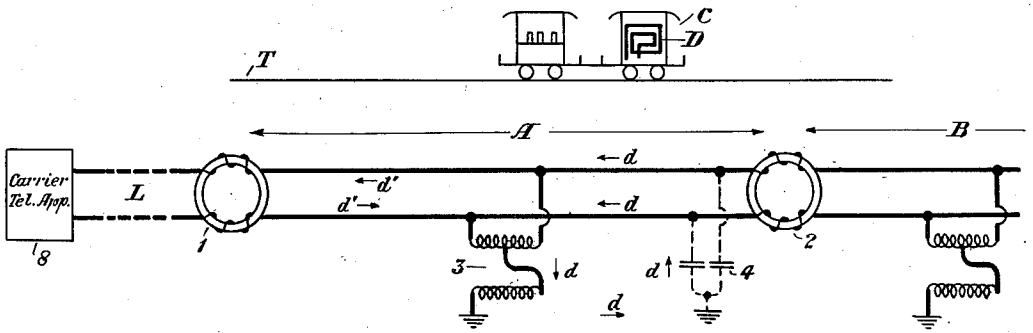


Fig. 1

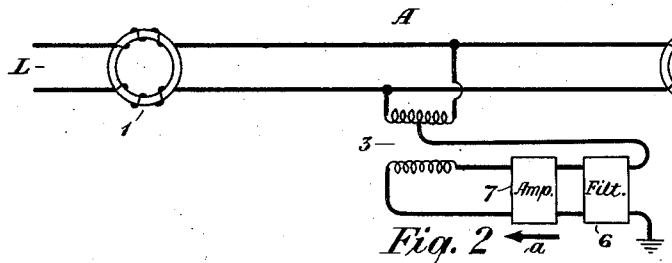


Fig. 2

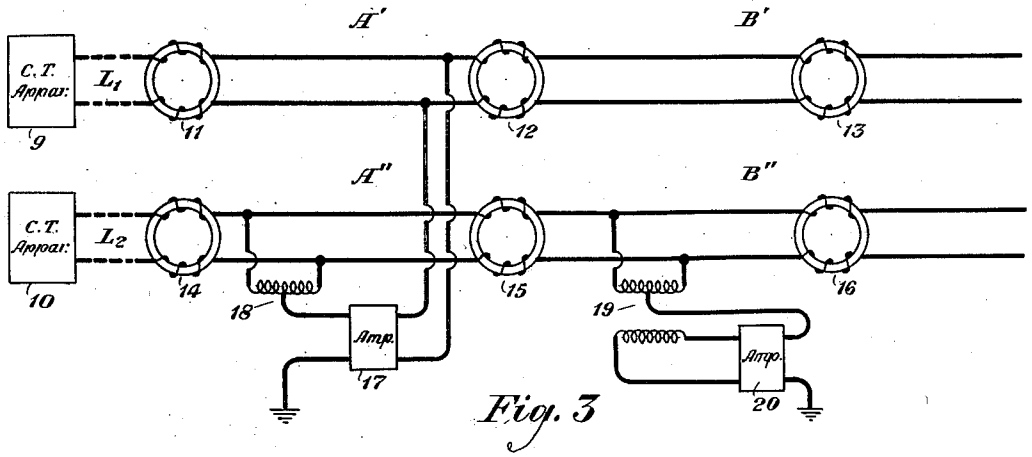


Fig. 3

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UNITED STATES PATENT OFFICE

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SYSTEM FOR COMMUNICATING WITH MOVING VEHICLES

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The invention relates to improved arrangements for establishing communication between a fixed transmission system and a moving vehicle, such as a railroad train.

In certain systems of the above type it has been proposed to transmit the signals along a line circuit paralleling the railroad track and to transfer the signaling energy across the gap between the fixed portion of the system, such as a transmission line, and the movable portion, such as the train, by induction. It has also been proposed to utilize relatively high frequency currents rather than ordinary voice currents, as it has been found that better coupling is obtained at the higher frequencies, and hence there can be secured a greater transfer of energy across the gap to and from the moving vehicle than in the case of relatively low frequency signaling currents.

The use of high frequency currents in systems of this type to overcome the "induction attenuation" across the gap between train and line presents certain problems in connection with the attenuation to be encountered on the line circuit, as in general high frequencies are subject to greater attenuation on the line than low frequencies. Also, the tranmission in the direction from the moving train to the fixed station presents a particularly serious problem because the transmitting level on the train must be sufficient to overcome the induction attenuation and provide on the wire circuit a level substantially above the level of the line noise. Accordingly, it is the primary object of arrangements of this invention to provide a fixed transmission system for use in communicating with a moving vehicle, which will permit high frequency currents to be utilized to reduce "induction attenuation" across the gap and in which the attenuation of such currents on the line will be materially reduced. Further objects and features of the invention will appear more fully from the detailed description thereof hereinafter given.

The invention may be more fully understood from the following description together with the accompanying drawing, in the Figures 1, 2 and 3 of which the invention is illustrated. In Fig. 1 is a circuit diagram embodying a preferred form of the invention. Fig. 2 shows a modification of a portion of the arrangements of Fig. 1. Fig. 3 is a modification of the system of Fig. 1. Similar reference characters have been utilized to denote like parts in all of the figures.

In the arrangements of Fig. 1 is shown a track T on which would be a moving vehicle, such as the car C. In the car C is shown a loop or antenna D to which would be connected high frequency carrier transmitting and receiving apparatus. In the vicinity of the track would be located a transmission line L. With one end of the line L would be associated high frequency carrier transmitting and receiving apparatus, such as 8. The longitudinal circuit of the transmission line would be divided into certain sections, such as A and B, by means of inductance coils, such as 1 and 2. Connected to each of these line sections would be a translating device, such as 3.

Considering the transmission from the train to the fixed station, the high frequency carrier currents in the loop D on the train would be transmitted across the gap from the train to the transmission line L by induction and would traverse the conductors of the line in parallel with ground return due to the capacity between the conductors and earth, as indicated by the condensers 4, shown in dotted lines. In other words, under such conditions the line circuit L would operate as a longitudinal circuit with ground return. It is pointed out that the attenuation between a longitudinal circuit of this type and earth is ordinarily high as compared to the attenuation between a pair of conductors forming

a metallic circuit, and a greater amount of line noise is generally found on the longitudinal circuit. Furthermore, the longer the longitudinal line circuit the greater would be such attenuation. Accordingly, the longitudinal line circuit is, in accordance with the arrangements of the invention, broken up into a number of sections by the induction coils, such as 1 and 2. The windings of these induction coils are arranged to be parallel aiding and hence produce a large flux in the core and a high impedance to the longitudinal currents. As the windings are series opposed the flux is negligible, and hence the impedance in a metallic circuit would be negligible. Bridged across each longitudinal section of the line would be a translating device 3 having two transformer windings, one connected to ground and to the mid-point of the other. The longitudinal currents induced in the section A of the line circuit by the currents in the loop D in the car might take the path shown by the arrows *d*. These currents, in passing through the lower winding of the transformer of device 3, would induce currents in the upper winding of the transformer, which currents would be applied to the sides of line circuit L in series or as if the line were now a metallic circuit. These currents are indicated by the arrows *d'*. These currents would readily be transmitted through the induction coils, such as 1 and 2, as the line would now be operating as a metallic circuit. Accordingly these currents would be transmitted metallically to the carrier apparatus 8 at the end of the circuit. As has been previously pointed out, the attenuation of the signal currents when transmitted over a metallic circuit is much smaller than when these currents are transmitted over a longitudinal circuit. Accordingly, the arrangements of the invention effect a large reduction in the attenuation of the currents in transmission over the fixed portion of the system and afford greatly improved transmission features. In transmitting from the fixed station to the train, the operations will, of course, be the reverse of those just described.

In the arrangements of Fig. 2 is shown a modification of the device 3 of Fig. 1 in that an amplifier 7 and wave filter 6 are provided so that the induced longitudinal signal currents may be amplified before being applied to the metallic circuit. It is pointed out that noise currents originating in various adjacent longitudinal sections of the line may all be applied by the translating devices, such as 3, into the same metallic circuit. However, by utilizing an amplifier 7 in connection with device 3, the voice or signal currents in a section, such as A, may be raised in level before encountering and mixing with noise currents originating in adjacent sections.

For transmission from the train to the line, the direction of transmission through the amplifier 7 is indicated by the arrow *a*. In transmitting from the line to the train, the direction of transmission through the amplifier would be reversed, and a different frequency band employed for the signals. The amplification of undesired frequencies may be prevented by the filter 6 placed ahead of the amplifier.

In Fig. 3 is shown an arrangement whereby the longitudinal currents in each section of the line may be applied to different metallic circuits. For example, the longitudinal currents originating in section B'' of line L_2 will be applied to a metallic circuit comprising the conductors of line L_2. However, the longitudinal currents originating in section A'' of line L_2 would be applied to a metallic circuit comprising the conductors of line L_1. Similarly, metallic currents transmitted over the line L_2 are applied to the longitudinal section B'' of line L_2, while metallic currents on the line L_1 are applied to the longitudinal section A'' of the line L_2. With such an arrangement the sectionalizing of the longitudinal circuit will present the advantage that the noise will be considerably less than if the line represented one continuous circuit with each section having led to it the noise from external sources picked up in all the other sections. Also such an arrangement makes it possible to communicate with different trains in different sections.

While the invention has been disclosed as embodied in certain specific arrangements which are deemed desirable, it is understood that it is capable of embodiment in other forms without departing from the spirit of the invention as defined by the appended claims.

What is claimed is:—

1. A system for communicating with moving vehicles comprising a transmission line inductively associated with a moving vehicle, means for sectionalizing said line with respect to currents applied thereto in a certain manner, said means comprising inductance coils having their windings parallel aiding and series opposed, and means in each of said line sections to apply said currents to said line in a different manner.

2. A system for communicating with moving vehicles comprising a transmission line inductively associated with a circuit in a moving vehicle, means for sectionalizing said line with respect to currents traversing said line in a certain manner, means for amplifying said currents, and means for applying said amplified currents to the line so that they will traverse the line in a different manner and will not be affected by the sectionalizing thereof.

3. A system for communicating with moving vehicles comprising a plurality of transmission lines inductively associated with a cir-

cuit in a moving vehicle, means for sectionalizing each of said lines with respect to currents traversing said lines in a certain manner, and means in a section of one of said lines for applying to another of said lines the currents thus traversing said line section so that they will traverse said other line in a different manner and not be affected by the sectionalizing thereof.

In testimony whereof, I have signed my name to this specification this 28th day of March, 1928.

HERMAN A. AFFEL.