

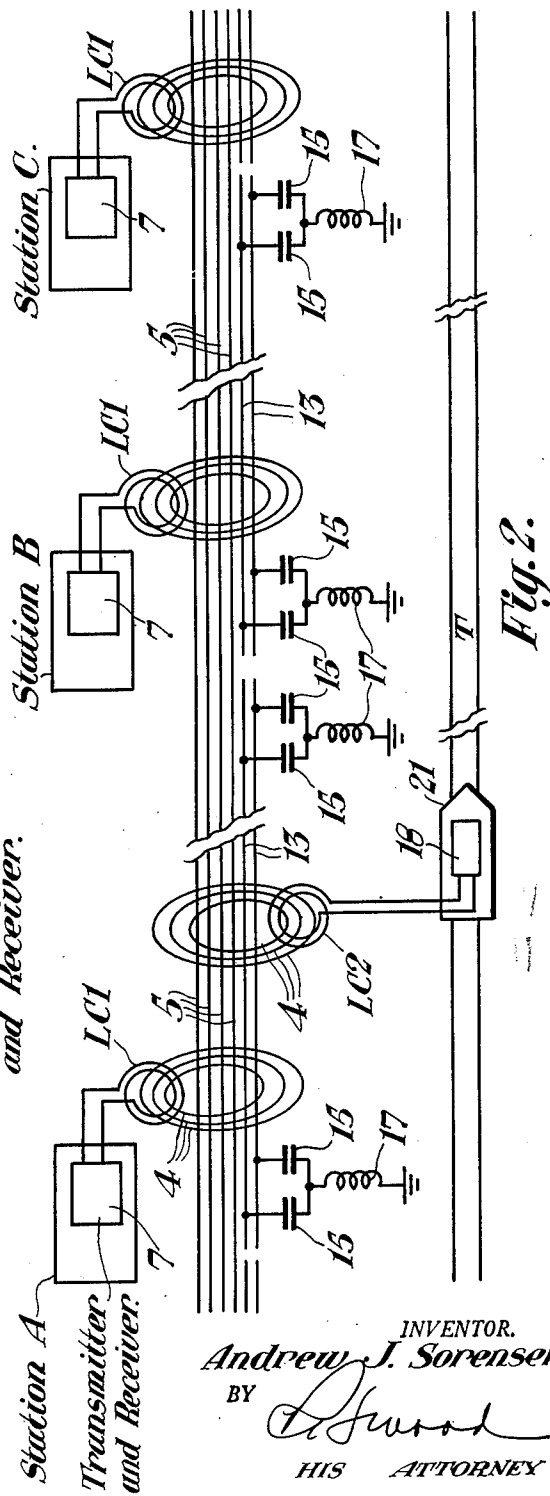
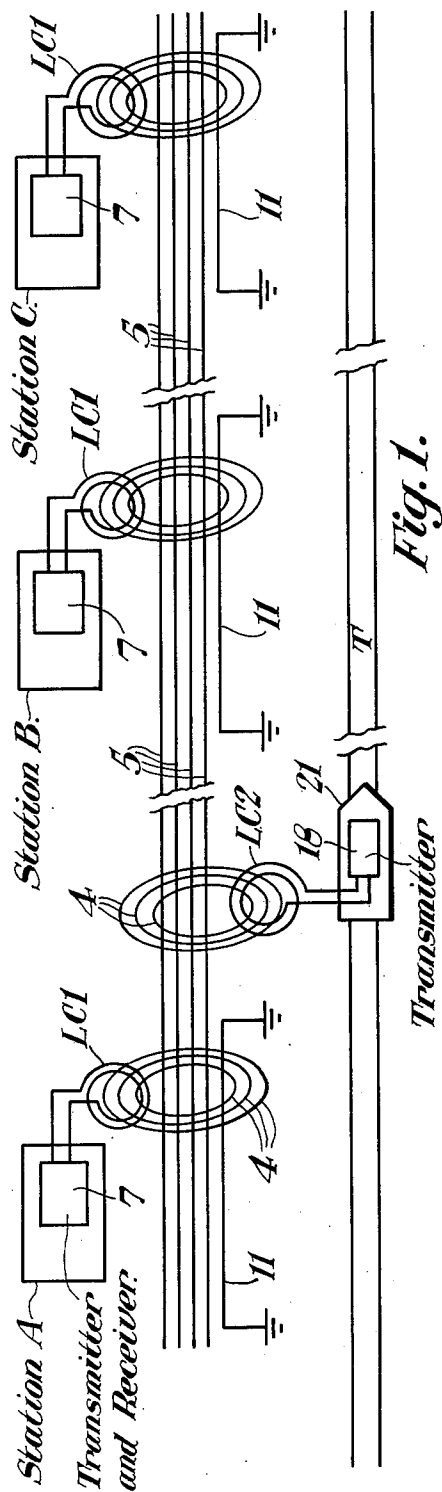
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INDUCTIVE TRAIN COMMUNICATION SYSTEM

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INDUCTIVE TRAIN COMMUNICATION
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1

My invention relates to inductive train communication systems and particularly to a method of and means for suppressing interference between stations in such systems.

Inductive railway train communication systems are well-known in the art, and the usual practice in such systems includes the use of line wires extending along the railway as a communication channel in the manner of the well-known longitudinal circuit. As the energy induced in a wayside line wire is also induced in adjoining line wires, it is difficult to isolate or sectionalize portions of the communication channel of an inductive train communication system. As a result, the communications between a train and an adjoining wayside station may be received by other wayside stations and trains which are a considerable distance from the train and wayside station in question.

Accordingly, it is an object of my invention to provide a method of and means for limiting the effective range of inductive communication systems to reduce the interference between stations.

Another object of my invention is to provide means for progressively attenuating the communication energy so that the value of energy received at a distant station is considerably reduced.

Another object of my invention is to provide an improved inductive train communication system.

Other objects of my invention and features of novelty will be apparent from the following description taken in connection with the accompanying drawings.

In practicing my invention, I provide artificial attenuating means comprising loops which are disposed in inductive relationship to the wires comprising the wayside longitudinal circuit. Such loops are disposed along the stretch of railway at spaced intervals to provide progressive attenuation of communication energy from the longitudinal circuit.

I shall describe two forms of inductive train communication systems embodying my invention and shall then point out the novel features thereof in claims.

In the drawings,

Fig. 1 is a diagrammatic view showing an inductive train communication system embodying my invention, and

Fig. 2 is a diagrammatic view showing a modification which I may employ.

Similar reference characters refer to similar parts in each of the two views.

2

Referring to Fig. 1, there is shown a stretch of railway track T having line wires 5 adjacent the track and extending along this stretch. Three wayside stations are shown, and designated as stations A, B and C. At each of the wayside stations there is provided an inductive transmitter and receiver designated by the reference character 7, which has associated therewith an induction coil LC1 and which induction coil LC1 is arranged to be in inductive relationship with the line wires 5 at the station. This induction is visualized by loops 4 linking the coil LC1 and the line wires 5. The details of the transmitter and receiver 7 are not shown, since the actual construction of the transmitter and receiver 7 forms no part of my invention and it is deemed sufficient to explain that during transmission communication energy in the longitudinal circuit supplied to the induction coil LC1 and induces energy in the longitudinal circuit including the line wires 5, and conversely during reception, communication energy in the longitudinal circuit induces energy in the induction coil LC1 which energy is supplied to the receiver portion of the unit 7. Although an induction coil is shown as the medium whereby the transmitter and receiver unit 7 is coupled to the longitudinal circuit, it is to be understood that other coupling arrangements well-known in the inductive communication art may be employed, for example, capacity coupling.

Each of the trains operated over the stretch of track T may be equipped with inductive train communication equipment and one such train is shown and designated by the reference character 21. The train carried inductive communication equipment is represented by the rectangle designated by the reference character 18 and has associated therewith an induction coil LC2 which is mounted on the train so that it is in inductive relationship to the wayside longitudinal circuit comprising the line wires 5. This induction is also visualized by loops 4 which link the coil LC2 with the line wires 5. As previously explained in connection with the inductive train communication equipment located at the wayside station, the actual construction of the train carried equipment 18 forms no part of my invention and may be arranged in any of the well-known forms. It is deemed sufficient to point out, that during transmission, energy is supplied by unit 18 to the induction coil LC2 and thereby induces energy in the wayside longitudinal circuit, while during reception, energy in the wayside longitudinal circuit induces energy in the induction coil LC2,

3

to thereby actuate the receiver of the unit. One such system arranged in this manner is shown and described in an application for Letters Patent of the United States Serial No. 575,311, filed on January 30, 1945, by Paul N. Bossart, for Railway Train Communication Systems, now Patent No. 2,484,680, granted October 11, 1949.

From the foregoing, it will be seen that the communication between the train and the wayside station utilizes a longitudinal circuit including the wayside line wires as a communication channel. The energy induced in these wires will accordingly travel in each direction from the point of induction, and with relatively little attenuation. Although each wire, taken by itself, may only extend for a few miles, the energy in one wire induces energy in the paralleling wires, and due to the usual overlapping of the line wires a substantially continuous channel is established for the communication energy along the entire length of the stretch.

As a result, the energy induced in the longitudinal circuit, for example, by train 21 between station A and station B and which is communicating with station A, will travel along the longitudinal circuit and may be picked up by stations B and C as well as by station A. This is undesirable, since in regions of heavy traffic density, communications from trains which are a considerable distance away from a particular station may interfere with communications from trains nearby the station. Additionally, since it is necessary for the operators in the wayside stations to hear the messages above the ambient noise, the volume gain controls on the equipment are usually adjusted for high volume and as a result, the operator will hear messages intended for other stations at his station.

My invention proposes the elimination of such interference by artificially progressively attenuating the energy in the wayside longitudinal circuit in such a manner that the stations which are relatively distant will receive only a small amount of the energy.

As shown in Fig. 1, an attenuating loop 11 is provided at each station, by extending in either direction from the station for a distance, say, of one mile, a line wire having its extreme ends grounded, so that the loop 11 comprises the line wire and the earth and is in inductive relationship to the line wires 5. It will be apparent that the energy flowing in the longitudinal circuit including the line wires 5 induces energy in the loop 11. Since resistance of the loop is relatively small, substantially large values of current will circulate in the loop circuit. The loop 11 taken in connection with the line wires 5 may be considered as a transformer having a short circuited secondary. Accordingly, at station B, the energy in the line wires 5 due to train 21 will be attenuated due to the power dissipated by the loop 11 at that location. The reduced value of communication energy may then travel along the line wires 5 to station C, where the loop 11 located thereat will further attenuate the signal.

From the foregoing, it will be seen that in an inductive train communication system embodying my invention, as shown in Fig. 1, the energy supplied to the communication channel is progressively attenuated so that the range of the communication is limited to the area desired. It will be seen however, that communication between a train and the adjacent wayside stations is not greatly affected, since only a small portion of the energy is attenuated by the line wires 5

4

and the attenuating loop 11 attenuates the energy which travels beyond the stations without seriously attenuating the energy at the station.

Conversely, the communication between the nearest wayside station and a train is not seriously affected, since only a small portion of the energy is attenuated by the loop located at the wayside station which is transmitting.

Referring to Fig. 2, there is shown a modification of the arrangement shown in Fig. 1, which utilizes existing line wires in the formation of the attenuating loops. Such existing wires may comprise any type of transverse circuit extending between two adjacent stations, such as, for example, a bridge telephone line, which comprises a pair of line wires extending between two adjacent stations, and having telephones connected across the line at each of the two stations as well as at intermediate points between the stations. Such a bridge telephone circuit is generally provided by railways to enable wayside maintenance crews and the crews of trains to communicate with the operators at the nearest wayside stations. As shown, a pair of line wires 13 extends between each of the adjacent stations and comprises a transverse circuit which may be employed in connection with telephone, telegraph, and other apparatus. At various points along the local transverse circuit, tuned circuits are provided which are connected between the two line wires and the ground. These tuned circuits comprise two condensers 15 having one terminal connected to one of the wires 13, and having their other terminals connected together and to ground through an inductance 17, and the parts are selected and arranged so that a series resonant circuit is formed having a resonant frequency equal to the frequency of the communication energy. The frequencies usually employed in such systems range from 50 to 250 kc., so that, although the reactance of the condensers 15 is comparatively low at these frequencies, the reactance to the low frequency telephone energy, for example, is relatively high, so that the condensers 15 represent a high impedance to the energy flowing in the transverse circuit, and a low impedance to the high frequency energy flowing in the longitudinal circuit. It will be apparent therefore, that the line wires 13 are selectively and effectively grounded for the high frequency communication energy without interfering with the operation of the transverse telephone line. In a manner similar to that previously explained in connection with Fig. 1, the relatively high frequency communication energy flowing in the line wires 5 induces energy in the loop comprising the line wires 13, the resonant circuit including the condensers 15 and the inductance 17, and the earth. This loop, acting in a manner similar to a short-circuited secondary winding of a transformer, artificially attenuates the communication energy flowing in the wayside longitudinal circuit comprising the line wires 5.

Accordingly, as the energy travels further along the stretch, it is progressively attenuated by the attenuating loops so that the energy received at distant stations is considerably reduced.

Further grounding of the line wires 13 with respect to the communication energy may be accomplished by connecting additional resonant filters between the line wires 13 and the earth at various locations along the line.

In some types of inductive train communication systems, two different frequencies are employed, say, for example, 80 kc., and 144 kc. To

provide attenuating loops for such a system, the line wires 13 in alternate stretches between stations are grounded by filters resonant at one of the two frequencies, while the line wires 13 of the other stretches between stations are grounded by filters resonant at the other of the two frequencies. For example, in the stretch between stations A and B in Fig. 2, the resonant filters may be tuned for the 80 kc. frequency, while at the stretch between stations B and C, the line wires 13 are grounded by resonant filters which may be tuned for the 144 kc. frequency.

Accordingly, energy of each of the two frequencies is artificially attenuated in alternate sections with similar results to those described above.

Although I have herein shown and described only two forms of railway train communication systems embodying my invention, it is to be understood that various changes and modifications may be made therein within the scope of the appended claims without departing from the spirit and scope of my invention.

Having thus described my invention, what I claim is:

1. In an inductive train communication system, in combination, a communication channel comprising a wayside longitudinal circuit, a plurality of wayside stations disposed along said longitudinal circuit, each of said wayside stations being equipped with inductive transmitting and receiving apparatus coupled with said longitudinal circuit, and artificial attenuating means for reducing the interference between such stations comprising loops located at spaced intervals along said longitudinal circuit and inductively coupled thereto to thereby progressively attenuate the energy flowing in said longitudinal circuit.

2. In an inductive train communication system, in combination, a communication channel comprising a wayside longitudinal circuit, a plurality of wayside stations disposed along said longitudinal circuit, each of said wayside stations being equipped with inductive transmitting and receiving apparatus coupled to said longitudinal circuit, and means for reducing the interference between said stations comprising artificial attenuating means located at spaced intervals along said longitudinal circuit and inductively coupled thereto to thereby progressively attenuate energy flowing in said longitudinal circuit, said artificial attenuating means comprising a length of line wire grounded at each end and disposed in inductive relationship to said longitudinal circuit.

3. In an inductive train communication system, in combination, a communication channel comprising a wayside longitudinal circuit, a plurality of wayside stations disposed along said longitudinal circuit, each of said wayside stations

being equipped with inductive transmitting and receiving apparatus coupled with said longitudinal circuit, and means for reducing the interference between said stations comprising artificial attenuating means located at spaced intervals along said longitudinal circuit and inductively coupled thereto to thereby progressively attenuate the energy flowing in said longitudinal circuit, said artificial attenuating means comprising a pair of wires extending between each two adjacent wayside stations, said pair of wires being grounded at least at said wayside stations by a combination of inductance and capacitance tuned to the frequency employed in the inductive train communication system.

4. In an inductive communication system utilizing at least two carrier frequencies, in combination, a communication channel for said frequencies comprising a wayside longitudinal circuit, a plurality of wayside stations disposed along said longitudinal circuit, each of said wayside stations being equipped with inductive transmitting and receiving apparatus for each of said frequencies and coupled to said longitudinal circuit, and means for reducing the interference between said stations comprising artificial attenuating means located at spaced intervals along said longitudinal circuit and inductively coupled thereto to thereby progressively attenuate energy flowing in said longitudinal circuit, said artificial attenuating means comprising a pair of wires extending between each two adjacent wayside stations and terminating at said wayside stations, the pairs of wires in the stretches between said wayside stations being alternately grounded for each of said frequencies by a combination of inductance and capacitance tuned to said frequencies.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,312,068	Werner	Aug. 5, 1919
1,368,530	Woodbridge	Feb. 15, 1921
1,803,454	Affel	May 5, 1931
1,815,976	Green	July 28, 1931
2,001,847	Lockrow	May 21, 1935
2,086,603	Cash	July 13, 1937
2,298,468	Curtis	Oct. 13, 1942
2,393,291	Clark	Jan. 22, 1946

FOREIGN PATENTS

Number	Country	Date
142,968	Australia	Oct. 10, 1935
685,701	France	Apr. 1, 1930