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L. F. MOREHOUSE

MEANS FOR EQUALIZING TRANSMISSION OVER LINES OF DIFFERENT ELECTRICAL CHARACTERISTICS

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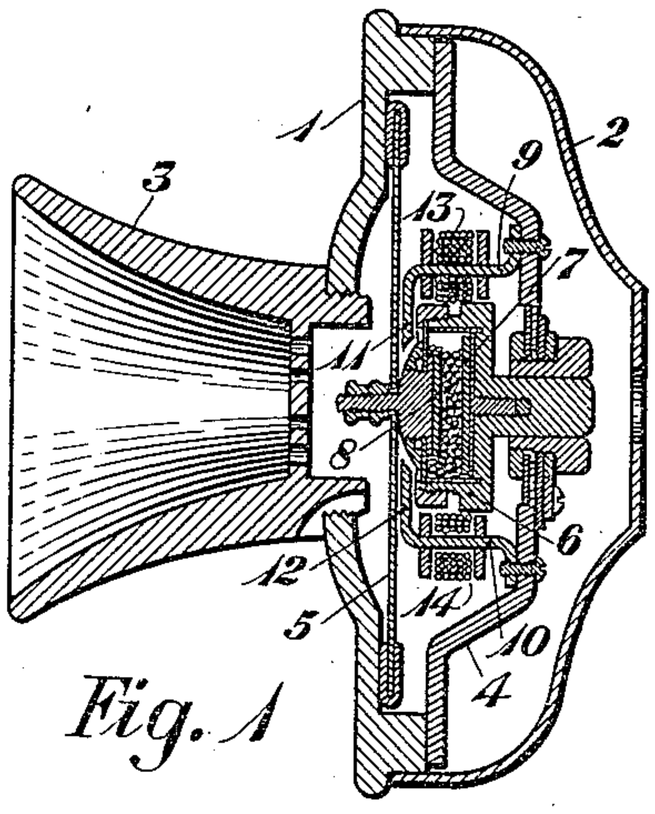


Fig. 1

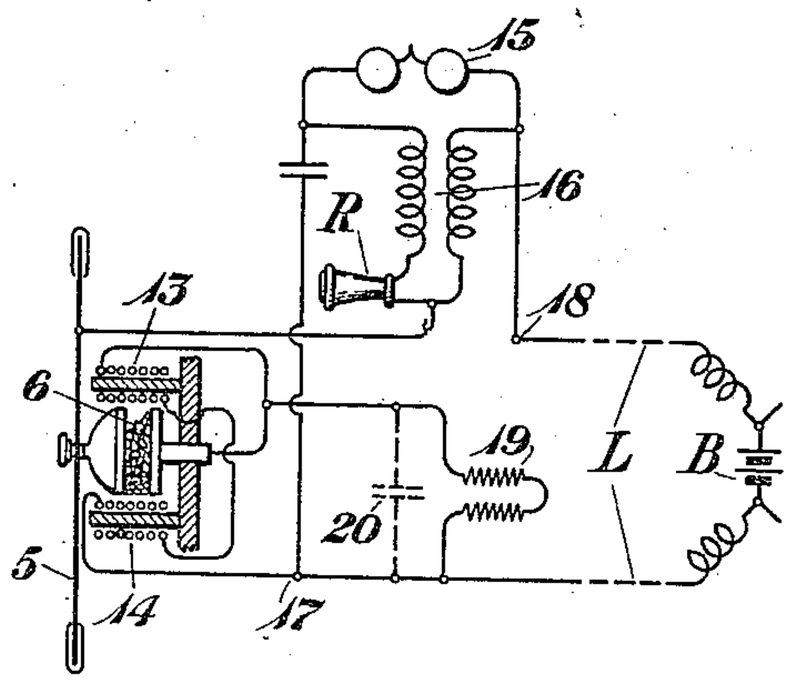


Fig. 2

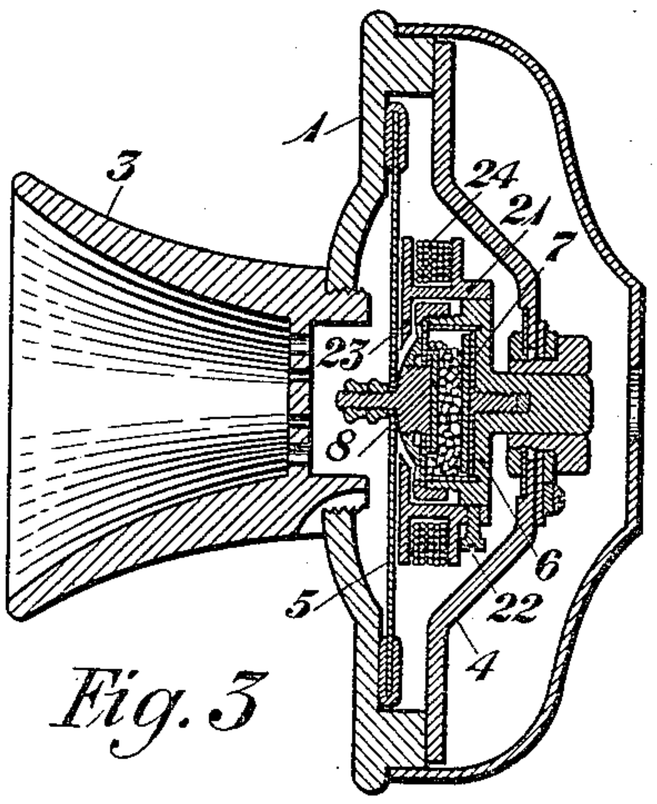


Fig. 3

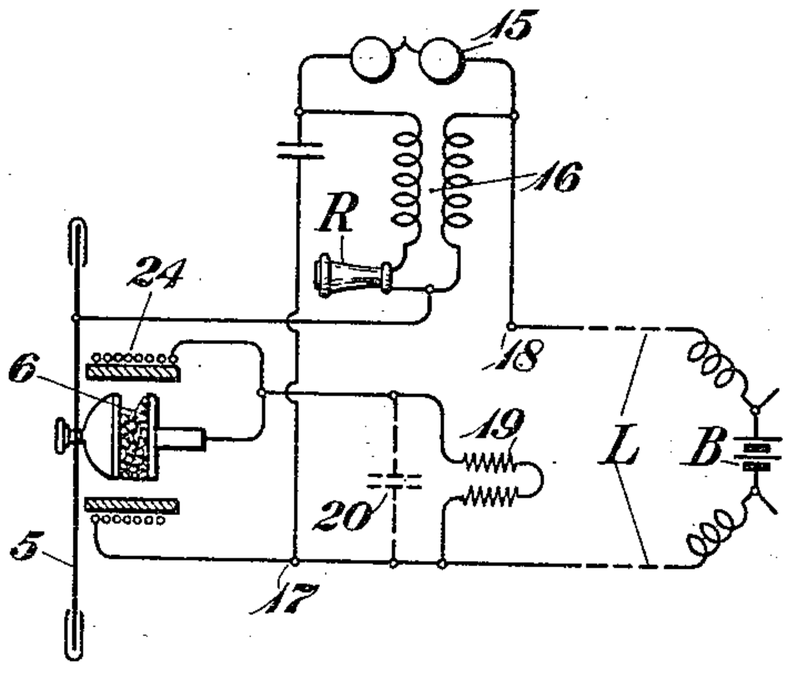


Fig. 4

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# UNITED STATES PATENT OFFICE.

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## MEANS FOR EQUALIZING TRANSMISSION OVER LINES OF DIFFERENT ELECTRICAL CHARACTERISTICS.

Application filed October 29, 1918. Serial No. 260,155.

*To all whom it may concern:*

Be it known that I, LYMAN F. MOREHOUSE, residing at Montclair, in the county of Essex and State of New Jersey, have invented certain Improvements in Means for Equalizing Transmission Over Lines of Different Electrical Characteristics, of which the following is a specification.

This invention relates to telephone systems and more particularly to the provision of means whereby the transmission over telephone lines of different electrical characteristics may be equalized or rendered more uniform.

Telephone lines have, in general, different electrical characteristics varying with the length of the lines. For any particular type of line construction which may be employed the resistance, capacity, inductance and leakage of the circuit increase with the length. These variations in the electrical characteristics of the different subscribers' lines in a telephone system introduce a number of variable effects in the telephone service rendered from different stations. For example, the different electrical characteristics result in different degrees of attenuation in the alternating telephone current passing over the subscribers' lines and thus give louder and more effective telephonic communication to subscribers connected by means of short lines than to subscribers connected by means of long lines. As a result, a subscriber having a long line, when connected with any other subscriber, does not receive as good telephone transmission as would a subscriber having a short line similarly connected. Furthermore, in the common battery systems now so generally employed in all but small communities, the resistance of the line causes a further effect on the transmission in that it reduces the amount of direct current which the transmitter receives from the central office battery and so renders it less efficient in the generation of the alternating telephone current.

In view of the conditions above referred to, it has not been heretofore possible to provide all subscribers with the same grade of transmission and it is one of the objects of this invention to provide means whereby this difficulty may be overcome, although other and further objects of the invention will appear from the description hereinafter given.

The objects of this invention may be secured by providing a telephone transmitter having an electromagnetic coil associated therewith and magnetically related to the diaphragm of the transmitter, said coil being so related to the transmission line that the current supplied to the granular carbon resistance button of the transmitter will energize said coil. By means of this arrangement damping of the diaphragm due to the action of the coil will increase with the increase in the current supplied over the line and by properly proportioning the coil and relating it to the diaphragm a practically uniform grade of transmission may be secured for loops of all reasonable lengths.

The invention may now be fully understood from the following description when read in connection with the accompanying drawing in which Figure 1 is a sectional view of a transmitter embodying the principles of the invention, Figure 2 is a circuit diagram of a transmission line provided with a transmitter of the type shown in Figure 1, Figure 3 is a sectional view of a modified form of transmitter and Figure 4 is a circuit diagram of a transmission line employing a transmitter of the type shown in Figure 3.

Referring to Figure 1, a telephone transmitter is shown comprising the usual front casing 1, back casing or shell 2, mouth piece 3, supporting bridge 4 and diaphragm 5. Suitably mounted upon the supporting bridge 4 is a granular carbon resistance button 6 of a well known type comprising a back electrode 7 and a front electrode 8 between which is placed a suitable amount of granulated carbon, said front electrode 8 being carried by and movable with the diaphragm 5. Also mounted upon the supporting bridge 4 is a two-pole electromagnetic structure comprising pole pieces 9 and 10 secured to the bridge by means of screws, said pole pieces having their ends bent at right angles as shown at 11 and 12 in order that the faces of the pole pieces may lie closely to the diaphragm 5 in the region of the resistance button 6. These pole pieces carry coils 13 and 14 through which the cur-

rent supply for the transmitter flows. The magnetic circuit is completed through the bridge 4.

The circuit connections of the transmitter of Figure 1 are shown in Figure 2 in which is shown a transmission line L provided with a source of supply current B at the central office and terminating at the subscriber's station in a substation arrangement comprising the usual receiver R, ringer 15 and induction coil 16. From one terminal 17 of the line L, a series connection extends through the windings 14 and 13 in series and thence through the granular carbon button 6 to the diaphragm. From the diaphragm a connection extends through one winding of the induction coil 16 to the terminal 18 of the line L. It will thus be seen that the current supply from source B flows over the line and through the coils 13 and 14 in series with the resistance button 6, so that the increased efficiency of the transmitter which would normally result from the large current supply on short lines will be overcome by the damping of the diaphragm due to the action of the coils 13 and 14. The damping is effected by eddy currents set up in the diaphragm due to its vibration in the magnetic field produced by the direct current through coils 13 and 14, and to the alternating flux set up by the coils as the result of changes in the transmitter resistance. The magnitude of the direct and alternating fluxes are proportional to the amount of current flowing through the coils and hence the damping will increase as the current increases with decreasing lengths of loop. In order to prevent transmission loss due to the impedance of the magnetic coils, they may be shunted by a non-inductive resistance 19 or a condenser 20, or both. By this arrangement also current variations produced by the resistance button 6 will pass through the shunt circuit, including the noninductive resistance 19, or condenser 20, without actuating the coils 13 and 14, so that singing will not result. A modified arrangement of the transmitter is illustrated in Figure 3, like parts being indicated by the same reference characters. This arrangement differs from that of Figure 1 in that a single pole magnetic structure surrounds the granular carbon resistance button 6. The pole piece 21 of this magnet is cylindrical in shape and is mounted on the body of the resistance button 6, being secured in place by means of a set screw 22. Adjacent the diaphragm 5 the pole piece 21 is provided with a right angular extension 23 lying parallel to the diaphragm in the vicinity of the mounting of the movable electrode 8. The cylindrical pole piece 21 is surrounded by a coil 24 which, as shown in the diagram of Figure 4, is connected in series with the resistance button 6, the circuit extending from the terminal 17 of the line L through the winding of coil 24, through the button 6, to the diaphragm 5. From the diaphragm the circuit continues through one winding of the induction coil 16 to terminal 18 of the line L. As in Figure 2 the coil 24 is shunted by a noninductive resistance 19, or a condenser 20, or both. The diaphragm 5 may be of either magnetic or nonmagnetic material and the action will be the same as that described in connection with Figures 1 and 2.

It will be seen that by means of the arrangements above described a simple yet efficient means has been provided whereby the telephonic transmission over lines of different character may be equalized and rendered more uniform so that subscribers having instruments on loops of different length will receive substantially the same transmission. It will also be obvious that the general principles herein disclosed may be embodied in many other organizations widely different from those illustrated without departing from the spirit of the invention as defined in the following claims.

What is claimed is:

1. In a signaling system, transmission lines of different electrical characteristics, telephone transmitters for each line, a common source of current supply for said transmitters, and means associated with said transmitters to automatically vary the efficiency thereof in accordance with the current supplied thereto.

2. In a signaling system, transmission lines of different electrical characteristics, telephone transmitters for each line, a common source of current supply for said transmitters, and means associated with said transmitters and operating automatically to cause transmitters receiving small current supply to generate relatively greater talking currents than transmitters receiving larger current supply.

3. In a signaling system, transmission lines of different electrical characteristics, telephone transmitters for each line, a common source of current supply for said transmitters, diaphragms for said transmitters, means for damping said diaphragms so that the damping thereof will automatically vary in accordance with the current supplied to said transmitters.

4. In a signaling system, transmission lines of different electrical characteristics, telephone transmitters for each line, a common source of current supply for said transmitters, diaphragms for said transmitters, means for damping said diaphragms so that the damping will automatically be adjusted to become greater for transmitters receiving larger current supply than for transmitters receiving small current supply.

5. In a signaling system, transmission lines of different electrical characteristics,

telephone transmitters for each line, a common source of current supply for said transmitters, diaphragms for said transmitters, electromagnetic means for damping each transmitter, said electromagnetic means being included in circuit with said source of current supply to automatically adjust the damping of each transmitter diaphragm in accordance with the current supplied to the transmitter.

6. In a signaling system, transmission lines of different electrical characteristics, telephone transmitters for each line, a common source of current supply for said transmitters, diaphragms for said transmitters, electromagnetic means for damping each transmitter, said electromagnetic means being included in circuit with said source of current supply in such manner that the diaphragms of transmitters receiving a large current supply will be automatically damped more than those of transmitters receiving a small current supply.

7. In a signaling system, transmission lines of different electrical characteristics, telephone transmitters for each line, a common source of curent supply for said transmitters, diaphragms for said transmitters, electromagnetic coils in magnetic relation to each of said diaphragms, said coils being in series with said transmitters so that the damping of each diaphragm will automatically vary with the current supplied to the transmitter.

8. In a signaling system, transmission lines of different electrical characteristics, telephone transmitters for each line, a common source of current supply for said transmitters, diaphragms for said transmitters, electromagnetic coils in magnetic relation to each of said diaphragms, said coils being in series with said transmitters so that the diaphragms of transmitters receiving a large current supply will be automatically damped more than those of transmitters receiving a small current supply.

9. In a signaling system, a transmission line, a telephone transmitter, a source of current supply for said transmitter, said transmitter comprising a resistance button and a diaphragm, an electromagnetic coil in magnetic relation with said diaphragm, said coil being in series circuit with said resistance button with respect to said source of current supply, and a by-pass circuit in shunt with said coil to prevent transmission losses due to the impedance of said coil at the frequencies of voice currents.

In testimony whereof, I have signed my name to this specification this twenty eighth day of October, 1918.

LYMAN F. MOREHOUSE.