H. E. SHREEVE.

TELEPHONE REPEATING SYSTEM.

APPLICATION FILED AUG. 21, 1908.

937,189. Patented Oct. 19, 1909.

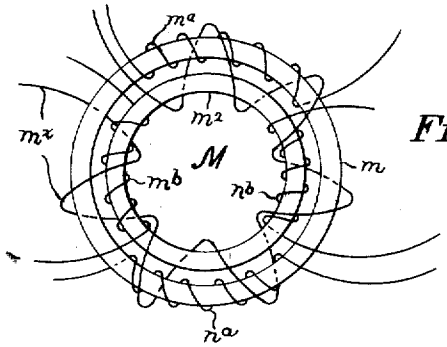


Fig. 3.

Fig. 2.

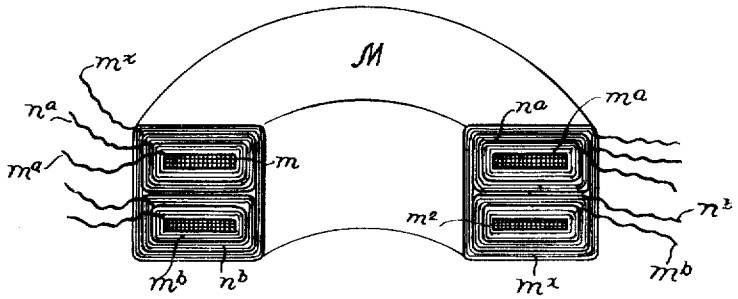
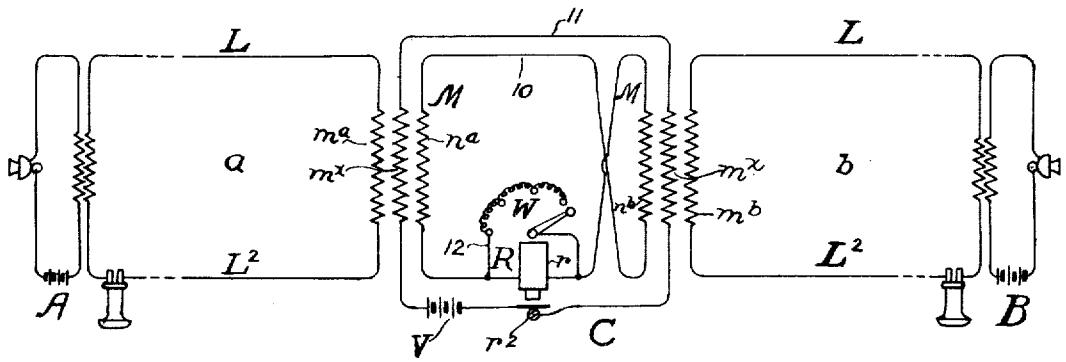


Fig. 1.



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TELEPHONE REPEATING SYSTEM.

937,189. Specification of Letters Patent. Patented Oct. 19, 1909.

Application filed August 21, 1908. Serial No. 449,693.

To all whom it may concern:

Be it known that I, HERBERT E. SHREEVE, residing at Wyoming, in the county of Essex and State of New Jersey, have invented certain Improvements in Telephone Repeating Systems, of which the following is a specification.

In the use of telephone repeating apparatus, it is found that under certain conditions it becomes difficult to prevent the serious impairment of transmission through reactive disturbances in the repeater, or differences in phase relation between the voice currents in the originating section of the line and in that to which the apparatus supplies reinforced energy. For example, a repeater circuit giving satisfactory reinforcement when used between sections of ordinary or unloaded lines, provided the transmitting equivalent or total attenuation of such sections does not fall below a certain minimum value, may result in negative amplification and a poor quality of transmission when applied to loaded lines presenting the same transmitting equivalent but being equipped with different types of loading coils. This, so far as I am at present able to determine, is caused largely by the failure of the renewed energy to agree in phase and thus at all times add to the original energy transmitted from section to section without the intervention of the repeater, this lack of accord probably resulting from differences in the inductance of the various kinds of loading coils.

With this in view, my present invention consists, more broadly, in means for confining to the transmitting section of the line all, or substantially all, of the current originated therein, and delivering to the second or receiving section only the augmented current produced in the repeater.

In the accompanying drawings illustrating the invention, and in which similar characters of reference designate like parts in the several views, Figure 1 is a diagrammatic representation of my improved repeater circuit; Fig. 2 is a sectional perspective of an induction coil employed therein; and Fig. 3 shows said coil diagrammatically.

Extending between stations A and B is a connecting circuit, which may comprise opposite metallic limbs L, L1, divided into sections *a* and *b* by a repeating circuit located at an intermediate station C. At this repeating station is a compound induction coil M, best illustrated in Figs. 2 and 3 of the drawings, where it is shown as consisting of two cores m, m^2, each of which is endless or closed upon itself, they being here represented as annular. These cores may be formed from coils of soft iron. They have each two windings m^a, n^a, m^b, n^b, respectively, one winding of each pair being superposed upon its associated winding, and all preferably completely encircling the cores, though shown in Fig. 3, to more clearly distinguish between them, as extending about only a portion of the circumference.

The cores with their individual windings are situated side by side in close proximity to one another and upon both is placed a common winding m^x. The windings m^a, m^b upon independent cores, are separately connected in series with the respective line sections *a*, *b* (see Fig. 1). The windings n^a, n^b are joined in series by a conductor 10 with the receiving element r of a repeating apparatus R, which may be of the character described in my Patent No. 791,655, dated June 6, 1905. The connection between the windings n^a, n^b appears in Fig. 1 as reversed, for a reason which will later be made clear. Included with the winding m^x in a conductor 11 is the transmitting element r^2 of the repeater R and some such source of electrical energy as the battery V. Though for convenience in making the diagram the winding m^x appears in Fig. 1 as in separated sections, it is to be understood that it is practically continuous, the conductor 11 merely furnishing the necessary taps for the transmitting element and battery.

There is shown associated with the receiving element a means for varying the current traversing its winding, this conveniently consisting of a shunt 12 including an adjustable resistance W.

In considering the operation of the system, assume voice currents to be originated in the line section *a* from the station A and therefore traversing the line winding m^a on the core m of induction coil M. Corresponding current is thereby induced in the associated receiver winding n^a and in the common transmitter winding m^x of the induction-coil. From the first named winding the current circulates through the conductor 10 and the coil of the receiving element, energizing said element, and through the

winding n^b of the core m^2. The current in the circuit 11 of the transmitting element induced in transmitter winding m^x is, of course, without effect upon said element as regards the operation of this system. Because of the reversal of the terminals of the winding n^b the current in the circuits 10 and 11 flow oppositely about the core m^2, and therefore by properly proportioning the windings and the resistances of said circuits the magnetization of this core may be substantially nullified. This being the case, and since with the ring cores there is practically no leakage through the adjacent core, no appreciable current is induced in the line winding m^b and therefore no appreciable direct transfer of originating energy either inductively or conductively from section *a* to section *b* of the line. The receiving element, however, operates the transmitting element in the manner usual in repeaters, and by the variations in the resistance of the circuit 11 causes the current from the battery V to induce by the action of the winding m^x of the core m^2 stronger current in the line winding m^b of its core. This fresh or relayed energy continues the transmission through the line section *b* to station B. The reinforcing current in the transmitter winding m^x will also act inductively upon the receiver winding n^b, but winding n^a is under its influence as well, and, on account of the reversed connection and the equality in ampere turns of the windings, these will balance and consequently will not react upon the receiving element, and the repeater will not "sing".

It will be seen that by my improved organization, the confining of the originating current to the first or transmitting section of the line precludes all possibility of its acting in opposition to the current in the second or receiving section, and even if the sections differ widely in length and electrical properties a lack of balance will affect neither the degree of amplification nor the quality of transmission. Furthermore, as the currents which oppose one another to prevent the reaction of the transmitter circuit upon the receiving element are local to the repeating circuit, they would be comparatively little disturbed by inequality between the line sections. It is also probable that the common winding of the induction coil exerts a more uniform action upon the other windings on separate cores than would a plurality of windings upon the same core.

It is not important that the common winding of the induction coil be that in circuit with the transmitting element; it might equally well be that of the receiving element, provided the connection of the windings joined to the transmitting element were reversed. What is really of consequence is that the line windings shall be without effect upon each other, while both are in operative inductive relation to a coil winding belonging to one of the two repeating elements and that windings included with the other repeating element shall be paired with the line windings and shall be connected to one another in opposition.

Though the present system gives a wide margin with regard to the balance of the line sections, there may be instances in which transmission would be unsatisfactory, if the repeater gave its maximum amplification. Such might be the case if one of the sections were comparatively long, while the impedance of the other approached zero. Here the reinforcing effect would be too great and the quality of the transmission poor. This may be easily remedied by decreasing the sensitiveness of the repeating apparatus by diverting more or less current from the receiving element by means of the shunt 12, with suitable variation of the resistance W. This shunt method of control is preferable to the insertion of resistance in series with the coil of the receiving element, because it has a less tendency to disturb the relation between the induction coil windings.

I claim:

1. A system for the renewal of telephone currents comprising line sections, a circuit associating the sections for transmission from one to the other, a repeating apparatus and an induction coil having windings included in said circuit, and means forming part of the induction coil for preventing the direct transmission of voice currents between the line sections.

2. A system for the renewal of telephone currents comprising line sections conductively discontinuous for telephone transmission, a repeating apparatus, and a coil in circuit with the repeating apparatus and serving to inductively associate the line sections therewith, said coil having means whereby incoming telephonic energy from a line section is confined to the repeating circuit.

3. The combination with a telephone line and an associated telephone repeater, of an induction coil provided with a plurality of cores and with line and repeater windings, one of said windings being common to a plurality of cores.

4. The combination with a telephone line and an associated telephone repeater, of an induction coil provided with a plurality of cores and with line and repeater windings, one of said windings being common to a plurality of the cores and other of the windings being upon independent cores and being connected in opposition.

5. The combination with a telephone line and an associated telephone repeater, of an induction coil provided with a plurality of endless cores and with line and repeater windings, one of said windings being common to a plurality of the cores.

6. The combination with telephone lines or line sections, of a repeating apparatus having receiving and transmitting elements, an induction coil provided with a plurality of cores and with windings included in each line section and being situated upon different cores, and separate windings in circuit with the receiving or transmitting elements, one of said windings being common to the cores.

7. The combination with two sections of telephone line and a telephone repeating apparatus comprising receiving and transmitting elements, of an induction coil having a winding in each line section and separate windings in the circuits of the receiving and transmitting elements respectively, these repeater windings of the coil being in inductive relation with both line windings, and those included with one of the repeating elements being connected in opposition.

8. A telephone system comprising two line sections, a repeating apparatus having receiving and transmitting elements, an induction coil provided with two cores, a winding included in each line section, said windings surrounding different cores, separate windings in circuit with the receiving and transmitting elements of the repeater, one of said elements being joined to a pair of windings each encircling a different core and with the connection between their terminals reversed, while the other repeater winding of the coil surrounds both cores.

In testimony whereof, I have signed my name to this specification in the presence of two subscribing witnesses, this eighteenth day of August 1908.

HERBERT E. SHREEVE.

Witnesses:
R. P. TRACY,
H. F. BRUSH.