(No Model.)

C. M. HAYNES.

LONG DISTANCE ELECTRIC TELEPHONY.

No. 492,467. Patented Feb. 28, 1893.

Fig 1

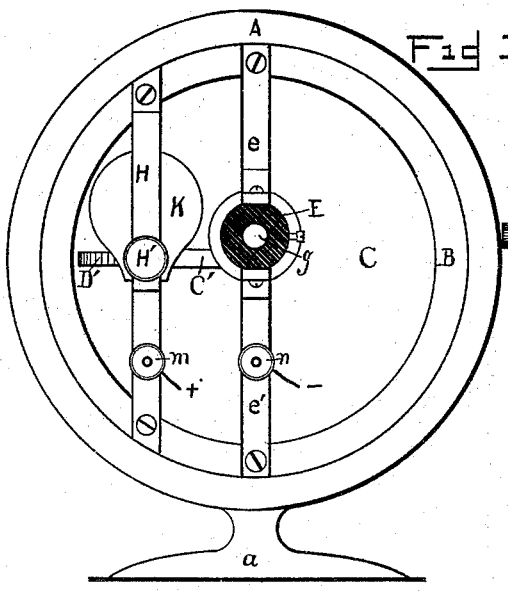


Fig 2

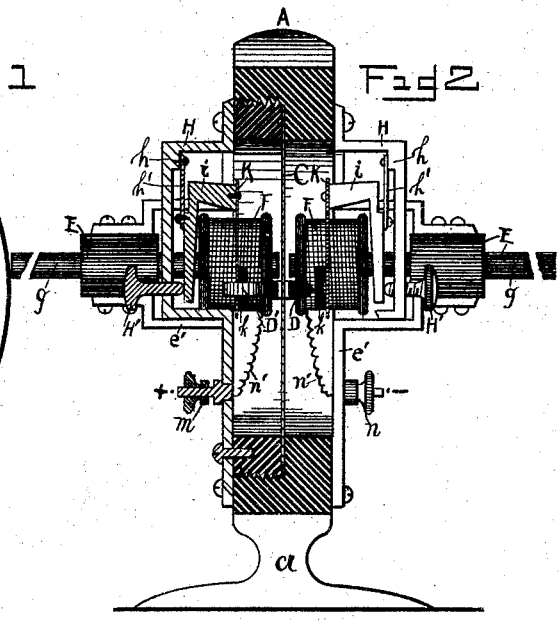


Fig 3

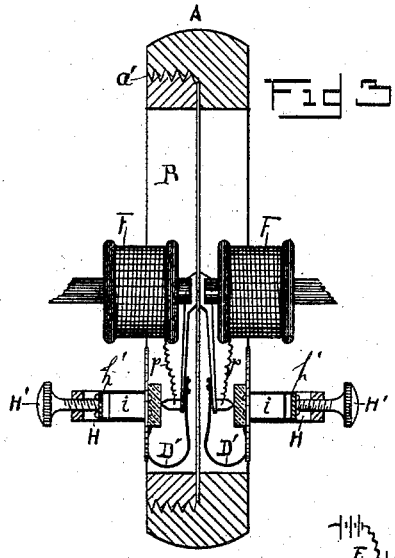


Fig 4

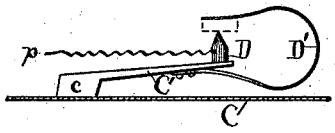


Fig 5

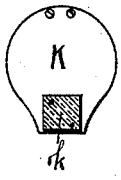
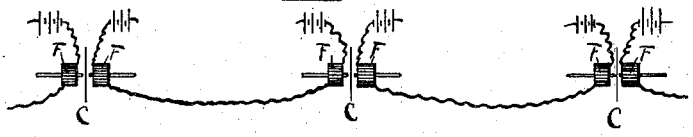


Fig 6



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LONG-DISTANCE ELECTRIC TELEPHONY.

SPECIFICATION forming part of Letters Patent No. 492,467, dated February 28, 1893.

Application filed January 12, 1892. Serial No. 417,845. (No model.)

To all whom it may concern:

Be it known that I, CHARLES MARSHALL HAYNES, of Omaha, in the county of Douglas and State of Nebraska, have invented certain useful Improvements in Duplex Telephone-Repeaters; and I do hereby declare that the following is a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, which form a part of this specification.

This invention has relation to a new and novel duplex telephone repeater.

The object of this invention is to provide a simple telephone repeater, that shall make long distance telephoning a possibility; and in furtherance of this object the invention consists in the construction, combination, and arrangement of parts as hereinafter more fully described and fully pointed out in the claims.

In the accompanying drawings, Figure 1 shows a front view of my repeater, Fig. 2 a side elevation with parts cut away to clearly show the arrangement of the several operative elements. Fig. 3 is a central transverse sectional view, with parts broken away. Fig. 4 is a detail top view of the diaphragm arm, Fig. 5, a rear view of one of the diaphragm springs, while Fig. 6, shows the arrangement of the repeaters, within a circuit.

Similar letters of reference refer to corresponding parts.

As is well known, in the telephone lines as usually equipped, a transmitting and a receiving instrument are placed at each end of a single circuit, through which the electrical undulations are transmitted uninterrupted, from one instrument to the other. Within certain distances the electric pulsations are transmitted unimpaired. But there is however a number of disturbing elements which interfere with the transmission of the electric pulsations, and finally limit the use of the telephone to within certain distances.

To provide a means of overcoming the obstructions incident to long distance telephoning and to increase the sphere of usefulness of the telephone, is the aim of this invention.

A represents the circular frame of my duplex repeater, of hard rubber, or any other suitable non-conducting material provided with the standard *a*. Upon one side, is the interiorly threaded rabbet *a'*, extending approximately half way into the frame, and within which the, preferably rubber ring B is held.

Fixed between the frame A and ring B, is an ordinary iron disk C forming the diaphragm of the repeater as shown.

Within the center of the plate C are secured the two similar rigid arms C', C', both extending slightly outward, horizontally and in the same direction. These arms are of non-conducting material, and are secured by means of their shanks *c*, which are fixed centrally within the disk C. They are preferably secured by means of two small sunken screws, not shown in the drawings, which pass through one shank, then the diaphragm and finally threaded into the shank of the arms opposite.

Secured to the free end of each arm, is the conically pointed metallic electrode D, extending outward from the diaphragm. Each arm is further provided, preferably upon the under side, with the recurved metallic tension spring D', which extends beyond the arm, the recurved portion however passing in front of and beyond the electrode D, as will be fully understood in referring to Fig. 4.

Vertically and centrally secured to the frame A, are the four angular supporting bars *e*, *e*, and *e'*, *e'*, shown in Figs. 1 and 2, giving support to the non-conducting hollow cylindrical holders E, E. Adjustably held within these cylindrical holders E, E, are the two similar electro magnets F, F, the cores *g*, *g*, of which extend a suitable distance beyond the holders as shown.

Mounted adjoining the supporting bars *e*, *e*, are the rectangular metallic brackets H, H, one of which is shown in section, in Fig. 2. These brackets are positioned immediately in front of and pass over the metallic electrodes D, D. At the upper under side, each bracket is provided with a shoulder *h*, giving support to an ordinary flat steel stub spring *h'*. To the lower ends of these depending stub-springs, are secured the inverted L shaped tension levers *i*, *i*, the depending stems of which are forced by the stub springs *h'* against the projecting ends of the adjusting screws H', H', as illustrated in Fig. 2.

To the upper inwardly extending arms *i*, *i*, are next secured the oval shaped diaphragm springs K, K, shown in Fig. 5, preferably secured at two points at their upper edges to the arms *i*, as shown. These springs are suspended between the tension arms *i* and the diaphragm, the lower edges being provided upon the side facing the diaphragm C and immediately in front of the metallic electrode D, with the rectangular carbon electrode *k*. These electrodes *k*, *k*, are secured by any suitable means to the diaphragm springs K, K, and are provided upon the rear and immediately in front of the electrode D, with a square recess, adapted to hold the recurved end, of the spring D′, as will be understood by referring to Fig. 2, where the electrodes *k* and D are shown in black. The tendency of the spring D′ is to press against the diaphragm spring K, and separate the electrodes D and *k*.

The brackets H, H, are provided with the binding posts *m*, *m*, while the arms *e′*, *e′*, are provided with the posts *n*, *n*, adapted to receive the connections from the batteries and line wires.

The electric connection of my duplex repeater is as follows: The current enters the instrument at the post *n*, which by means of the wire *n′* is in electrical connection with the induction coil F, as shown in Fig. 1. From this coil, the current is next led into the metallic electrode D, by means of the wire *p*, as shown in Fig. 3, and from there escaping through the carbon electrode *k*, passing through the diaphragm spring K, the lever *i*, stub spring *h′*, and leaving at the post *m* as shown in Fig. 1.

In arranging my duplex repeaters, I place one of more of the instruments within operative distance within the circuit and between the telephone transmitter and receiver, so as to break the circuit into a number of smaller independent circuits. The receiver and its several parts having been properly adjusted and placed within a telephone circuit, the operation of my device would be briefly as follows. As the transmitter diaphragm was made to vibrate in the transmission of a message, the undulations incident to the vibration of said diaphragm, would be carried along the electric circuit, until it encountered one side of my repeater, where it would end, the change in intensity however being recorded by the vibration of the diaphragm C. This vibration would be instantly recorded and taken up by the magnet and the delicately adjusted electrodes of the opposite side, and transmitted within a new electric circuit undiminished, to the receiver. It is of course understood, that any suitable number of these repeaters could be within one circuit, and so transfer and repeat the message from station to station. If desired the diaphragm C could be made of sheet rubber, and provided with two metal plates, upon which the magnets would exert their influence. In the adjustment of the instrumentalities the strength of the tension springs D must not be greater in force than the vibrations of the diaphragm C, and slightly less in strength than the diaphragm spring K, which spring is held in perfect vibratory sympathy in its relation to the said diaphragm C. In their operation, the arms C′, in connection with the tension springs D′ operate in strict mechanical uniformity to cause the pressure between the electrodes D and *k* at their point of contact to be controlled precisely by the vibrations of the diaphragm C. The movement of the electrodes D and *k* in operating is laterally and in a horizontal plane, the recurved free end of the tension spring D′ passing and re-passing the metallic electrode D, so as to bring the two electrodes into juxtaposition, with a rubbing or grinding movement. The pressure attending this grinding contact always being dictated or governed by only the exact vibrations of the diaphragm C, the strain being borne and the profusion of vibrations curtailed by the tension spring D′. And to adjust the lower end of the tension levers *i*, also causes a greater or less degree of pressure at the point of contact between the said electrodes; a regulation and a relief of strain also being granted to such pressure by the tension spring D′. The electrodes D and *k* are kept in constant contact, creating only such electrical undulations within said electric current as are incident to the vibrations of the diaphragm C, and so also in securing the recurved tension spring D′ it is essential that it form no mode of electrical connection between said electrodes, and it must also be insulated from the diaphragm C, and all else touching said diaphragm. The spring D′ is intended to be used in connection with any diaphragm. Being adjustably secured to the diaphragm, its tendency is to counterbalance the attraction of the field magnets, so as to prevent the diaphragm clinging to the magnets and thus becoming inoperative. As the strength of the magnet is increased or diminished, the spring is correspondingly adjusted, so as to hold the diaphragm in vibratory sympathy. That the distance between each repeater may be lengthened each electro magnet F is re-inforced by an auxiliary induction coil F′, of suitable capacity which is placed within the circuit. It is necessary too, that this auxiliary induction coil be placed between the electro magnet F together with the operative parts of the repeaters and the battery, thus causing the repeater to remain within the line circuit and forming part of it as shown in Fig. 3. This auxiliary induction coil in no way functions the diaphragm (its duty being limited to the act of attracting or inducing the electro current over a long distance), thus leaving the diaphragm free to the influence of the electro magnet F.

In my description I have confined myself to the duplex repeater, as shown, and while I prefer using this device, it could also be

used as a single telephone repeater: First: By eliminating the bracket H, the spring *h'*, lever *i*, diaphragm spring K, the carbon electrode *k*, and the arm C' and the connected electrode D and spring D'. With the proper line and battery connections, the diaphragm C in combination with the two electro magnets F, F, would form an operative single telephone repeater. Secondly: If we retain the elements just eliminated, in their proper positions and eliminate instead, the two electro magnets F, F, we would also have an operative instrument, the line wires in this instance being led to the electrode D. It would however be necessary in this instance, to use the auxiliary induction coil F', as shown in Fig. 3, so as to bring about the proper induction of current. If desired all the working effects could be positioned upon one side of the diaphragm alone, but the best results are obtained in positioning the elements as shown and described.

Having thus described my said invention, what I claim as new, and desire to secure by United States Letters Patent, is—

1. In a telephone repeater, the combination with a suitable standard, of a diaphragm held within said standard, electro magnets adjustably secured to said standard and upon opposite sides of said diaphragm, and two insulated tension springs, secured upon opposite sides to said diaphragm, and having their free ends working against suitable set screws, all substantially as and for the purpose set forth.

2. In a telephone repeater, the combination with a supporting standard, of a diaphragm secured within said standard and provided upon each side with an insulated arm secured at one point to said diaphragm, said arms being provided with a metallic electrode upon the free end, a recurved tension spring secured to each of said arms, and provided with an electrode in combination with said metallic electrode, and means for regulating the tension of said recurved springs, all substantially as and for the purpose set forth.

3. In a telephone repeater, the combination with a supporting standard of a diaphragm secured within said standard and provided centrally and upon each side with an insulated arm secured at one point to said diaphragm, said arms extending in like direction and provided with a metallic electrode upon the free end, a recurved adjustable tension spring secured to each of said arms, a supporting bracket secured to said frame, one upon each side, and positioned in front of said metallic electrode and provided with a set screw, a stub spring secured to each of said brackets upon the rear, and provided with an L shaped tension lever, one stem of said lever working against said set screws, a diaphragm spring secured to the free end of each of said levers, and provided with a recessed carbon electrode adapted to hold the free recurved end of said bow spring, so as to bring said carbon and metallic electrodes into juxtaposition, each set of electrodes being within a separate electric circuit, and an induction coil, within each of said circuits, all arranged to operate substantially as and for the purpose set forth.

4. In a duplex telephone repeater, the combination of a supporting standard, a diaphragm secured within said standard provided upon each side with an arm of non-conducting material, said arms extending slightly outward and secured at one end centrally within said diaphragm, said arms extending in like direction, and provided with a metallic electrode upon the free end, a recurved bow spring secured to each of said non-conducting arms, a supporting bracket secured to said frame one upon each side and positioned in front of said metallic electrodes and provided with a set screw, a stub spring secured to each of said brackets upon the rear, and provided with an L shaped tension lever, one stem of said lever working against said set screws, a diaphragm spring secured to the free end of each of said levers, and provided with a recessed carbon electrode adapted to hold the free recurved end of said bow spring, so as to bring said carbon and metallic electrodes into juxtaposition, each set of electrodes being within a separate electric circuit, and two adjustable and insulated electromagnets one within each of said circuits and positioned centrally within the field of said diaphragm, one upon each side, and secured by means of suitable brackets, all arranged to operate substantially as and for the purpose set forth.

5. In a duplex telephone repeater, the combination of a supporting standard, a diaphragm secured within said standard provided upon each side with an arm of non-conducting material, said arms extending slightly outward and secured at one end centrally within said diaphragm, said arms extending in like direction and provided with a metallic electrode upon the free end, a recurved bow spring secured to each of said non-conducting arms, a supporting bracket secured to said frame one upon each side, and positioned in front of said metallic electrodes and provided with a set screw, a stub spring secured to each of said brackets upon the rear, and provided with an L shaped tension lever, one stem of said lever working against said set screws, a diaphragm spring secured to the free end of each of said levers, and provided with a recessed carbon electrode adapted to hold the free recurved end of said bow spring, so as to bring said carbon and metallic electrodes into juxtaposition, each set of electrodes being within a separate electric circuit, two adjustable and insulated electro magnets one within each of said circuits and positioned centrally within the field of said diaphragm, one upon each side, and an auxiliary induction coil within each of said circuits all arranged to operate substantially as and for the purpose set forth.

6. In a telephone repeater, the combination of the following instrumentalities, to wit: the standard A, diaphragm C, the brackets *e*, *e*, *e'*, *e'*, supporting the cylindrical holders E, E, and the electro magnets F, F, adjustably held within the holder E, each magnet being within a separate circuit, all substantially as and for the purpose set forth.

7. In a telephone repeater, the combination of the following instrumentalities, to wit: the standard A, provided centrally with the diaphragm C, the non-conducting arms C', C', secured to said diaphragm and provided with the outwardly extending electrode D, and the recurved metallic tension spring D', the brackets H, H, provided in the rear with the shoulder *h*, giving support to the stub spring *h'*, the levers *i* secured to the springs *h'*, the lower end working against the set screw H', the diaphragm springs K secured to said levers, and provided with the carbon electrodes *k* adapted to hold the free end of the spring D' and work against said electrode D, each set of electrodes being within a separate electric circuit, all substantially as and for the purpose set forth.

8. In a duplex telephone repeater, the combination of the following instrumentalities, to wit: the standard A, diaphragm C, the arms C', C', secured to said diaphragm and provided with the metallic electrodes D, D, and the recurved tension springs D', D', the bars *e*, *e*, *e'*, *e'* supporting the cylindrical holders E, E, said holders adjustably securing the electro magnets F, F, the brackets H, H, provided with the shoulders *h*, *h*, supporting the stub springs *h'*, *h'*, to which are secured the L shaped levers *i*, *i*, working at their lower ends against the set screws H', H', the diaphragm springs K, K, provided with the carbon electrodes *k*, *k*, securing the free end of the tension springs D', D', and working upon the electrodes D, D, and the auxiliary induction coils F', F', each set of electrodes being within a separate electric circuit, to transmit and repeat the electric undulations, substantially as and for the purpose set forth.

9. In a telephone repeater, the combination with a supporting standard, of a diaphragm within the field of two or more electro magnets within separate circuits, an insulated arm secured at one point to said diaphragm and an adjustable tension spring secured to said arms, to counterbalance the attraction of said electro magnets, all substantially as and for the purpose set forth.

This 2nd day of January, A. D. 1892, in testimony I hereunto sign my name.

CHARLES MARSHALL HAYNES.

Witnesses:

HARRY CLARKE BRODRICK,

TILLY ORSON PUTNAM.