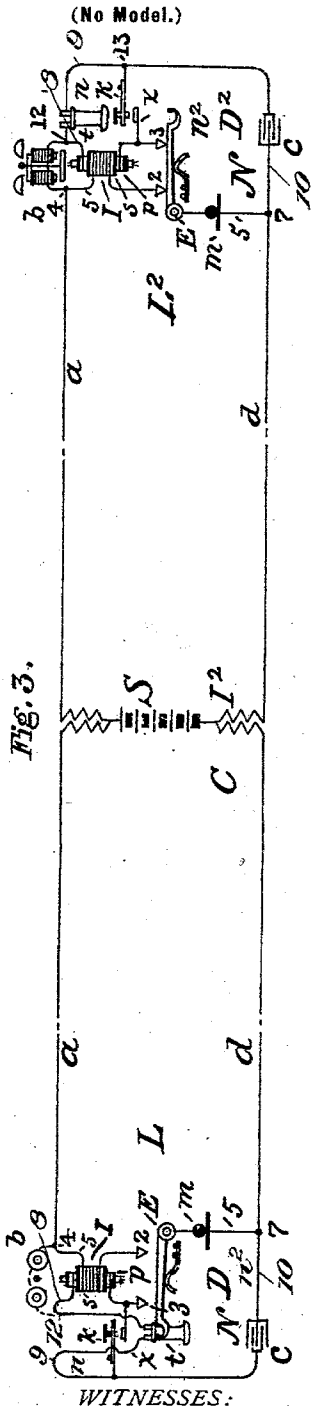


A. B. STETSON.
TELEPHONE TRANSMITTER CIRCUIT.

(Application filed June 8, 1902.)



Joseph A. Gately
James E. Lynch.

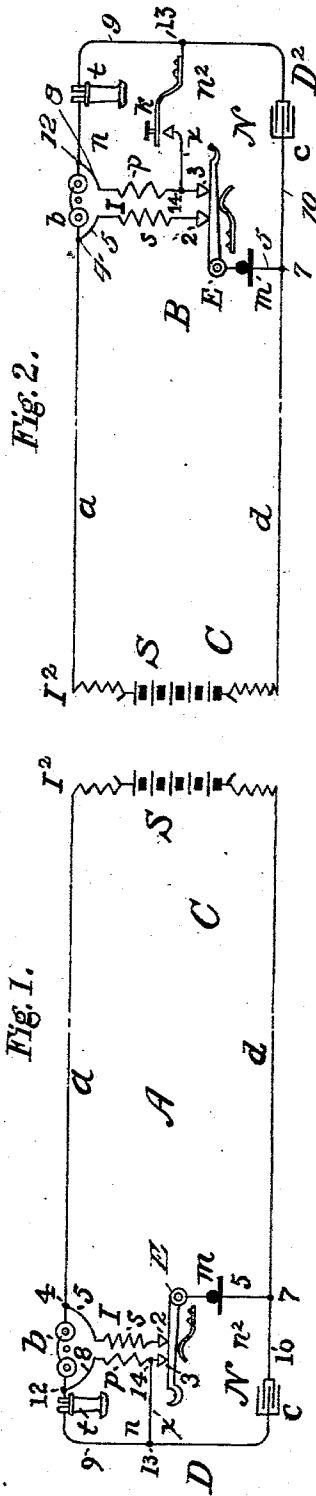


Fig. 2.

Fig. 1.

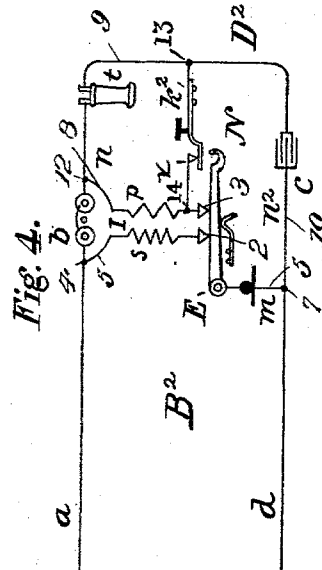


Fig. 4.

INVENTOR.

Almon B. Stetson

UNITED STATES PATENT OFFICE.

ALMON B. STETSON, OF MALDEN, MASSACHUSETTS, ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

TELEPHONE-TRANSMITTER CIRCUIT.

SPECIFICATION forming part of Letters Patent No. 716,779, dated December 23, 1902.

Application filed June 6, 1902. Serial No. 110,503. (No model.)

To all whom it may concern:

Be it known that I, ALMON B. STETSON, residing at Malden, in the county of Middlesex and State of Massachusetts, have invented certain Improvements in Telephone-Transmitter Circuits, of which the following is a specification.

This invention concerns variable-resistance telephone-transmitters and their operation, and more particularly relates to circuit arrangements for powerful instruments of this character by means of which the disturbing effects which tend to be exercised by them on the associated receiver or receivers at the same stations may be prevented, or in any event greatly ameliorated.

Sensitive and powerful transmitters not only reproduce the desired sounds or words in the receiver at the distant station, but also produce an echoing or resonant sound, colloquially termed the "side tone," in the associated receiver at the same or transmitting station. Moreover, in the operation of central-source telephone-exchanges involving toll or inter-urban lines it is often desirable in the interest of efficiency to supply the substation-transmitters with working current under higher voltage than has ordinarily been employed, and under such conditions the microphonic action is materially intensified, so that in addition to the side tone there is present an increased tendency to create and manifest in the home receiver buzzing and crackling noises and sounds, as well as to take up and reproduce all such sounds as are being produced in the immediate proximity of the instrument. The noise in the ear of the person using the telephone becomes under these circumstances so loud as to be both unpleasant and confusing and operates to disturb and disconcert the user, making it very difficult for him to follow the conversation or intelligently receive the message. To reduce such side tone and other disturbances to the lowest possible point and generally to prevent the disturbing effects attributable to undesigned or abnormal action of the transmitter from manifesting themselves in the associated or home receiver and to effect this without materially reducing the volume of transmission are the objects of this invention.

Attempts have heretofore been made to attain some of these objects by specially-designed induction-coils with associated balancing resistances, and such a system is disclosed in Letters Patent of the United States issued to Theodore Spencer, No. 501,472, and dated July 11, 1893; but such arrangements though measurably successful with transmitters of moderate power operating under the local battery conditions shown in said patent are not fully satisfactory under present conditions and apparently are not of a character capable of modification or improvement to meet immediately prospective conditions.

In the modern practice of a common and central battery-exchange the substation apparatus comprises the call-bell, the telephone-transmitter and its induction-coil, the telephone-receiver, the regular gravity-switch, and a condenser. When the said switch is in its normal position with the receiver on the hook, the circuit is through the call-bell and condenser, while when the receiver is taken up for use and the switch has moved to its second position the main circuit is conductively closed through one winding of the induction-coil and the transmitter and a local or transmitter circuit is arranged which contains serially the telephone-receiver, the condenser, the other winding of the induction-coil, and the transmitter. The last-named appliance is thus common to the main circuit and also the said local circuit. The source of transmitter-current is in the main circuit at the central station, and in the second position of the substation-switch develops a steady current which flows through the main line, the substation-transmitter, and the main-circuit winding of the induction-coil. Differences of potential between the two sides of the transmitter are determined by the resistance variations produced in the operation of said transmitter, and as a consequence waves or surges in the local circuit which circulating in the second winding of the induction-coil induce similar currents in the first winding thereof, and these flowing through the main circuit act upon the distant receiver and cause it to reproduce the sounds whereby the transmitter was originally actuated.

In the present invention the telephone substation apparatus has the local or transmitter circuit which is set off from or formed in part of the main-circuit conductors divided by a suitable conductive connection into two sub-

circuits, one containing the transmitter and the condenser and the other containing the receiver and the local-circuit winding of the induction-coil.

The invention further consists in combining the said improved organization with a key or circuit-changer placed in the circuit of the said cross-connection conductor and designed to establish and disestablish the same at will, thereby controlling the continuity thereof; also, in the substation apparatus of a central-source main telephone-circuit, a local transmitter system or circuit and instrument arrangement comprising the main circuit, the telephone-transmitter included therein, a shunt-circuit about said transmitter, the telephone-receiver and a condenser included therein, an induction-coil for the transmitter having one winding in said main circuit and the other in said shunt-circuit, and a conductive connection forming the said shunt-circuit into two subdivisions, one containing the transmitter and condenser and the other the receiver and the said second induction-coil winding; and it consists, further, in combining the substation apparatus thus constructed, arranged, and improved with a main telephone-circuit extending between the central and sub stations and a source of current in said main circuit and preferably located at said central station.

In the drawings which accompany and illustrate this specification, Figure 1 is a diagram showing the invention in its primary or simplest form and indicating a single substation-circuit arranged and connected as it would be for talking, but not connected with any other circuit. Fig. 2 is a diagram of a like organization, but with a circuit-controlling key provided for the conductive connection which divides the transmitter local circuit. Fig. 3 is a diagram of two such substation-circuits united at the central station for through communication between their respective substations, the present invention being contained in the apparatus at each substation; and Fig. 4 is a detail diagram indicating a slightly-modified arrangement of the circuit-controlling key at a substation.

Referring to the said drawings, A and B represent the single main substation-circuits of Figs. 1 and 2, respectively.

B² is the main circuit in Fig. 4, while L and L² represent the two substation-circuits united to form the compound talking-circuit of Fig. 3.

C represents the central station, D the substation of main circuits A and L, and D² the substation of main circuits B, B², and L².

At the central station C, S indicates the central and common source of current, and I² a repeating coil having its two windings con-

nected as usual with respect to the said source S, so that each winding is centrally divided and the said source connected in the middle or between the two halves of both.

At each substation there is an electromagnetic call-bell *b*, a telephone-switch E, a telephone-transmitter *m* and induction-coil I associated with said transmitter, a telephone-receiver *t*, and a condenser *c*.

When the station apparatus is out of use, the receiver *t* hangs on the hook of the switch E, as at station D of line L, and holds the same in its lower position out of contact with the switch-points 2 and 3. At such time the main circuit is conductively open at the substation, but the bell *b* is in the circuit (which is inductively closed by means of the condenser *c*) and is responsive to the usual alternating call-currents when transmitted from the central station. When, however, the receiver is taken from the switch-hook, the said switch moves to its other position and makes contact with the switch-points 2 and 3. The circuits for talking are thus established, and it will be sufficient to trace them in Fig. 1, since there is no difference, as far as they are concerned, between the several figures. Referring, therefore, to Fig. 1, the main circuit entering the substation D by conductor *a* diverges at the point 4 from the bell *b* and continues by branch 5, which contains in series the winding *s* of induction-coil I and the transmitter *m*, and leads through switch-point 2 and switch E to the other main conductor *d* at point 7, and thus back to the source of current S at the central station C, the other pole of said source being connected with main conductor *a*. The current from said source flows through the main circuit A (or B, L, or L², as the case may be) thus established. N in each case is a local or primary circuit set off from or formed in part of the main circuit. It contains the winding *p* of the induction-coil, the receiver *t*, and the condenser *c* and leads from switch-point 3 through the said winding *p*, conductor 8, said receiver, conductor 9, the condenser, and conductor 10 to point 7 on main-circuit conductor *d*, and thence again to switch-point 3 by way of conductor 5, the transmitter *m*, and the switch E. The said transmitter *m* and switch E are thus included in the main circuit A and also in the local circuit N. The operation of the transmitter in a manner well understood sets up surges or waves in the local circuit which constantly charge the condenser and are discharged therefrom and which by means of the induction-coil develop the required voice-currents in the main circuit. Under these conditions another way of viewing the local transmitter-circuit system is to regard the transmitter *m* as being in the main circuit alone and to consider that portion of the local circuit bounded by point 7 and switch-point 3 and including the coil-winding *p*, the receiver *t*, and the condenser *c* as being a shunt around or about

said transmitter. It will be observed that the bell b when the circuits are thus arranged for talking is joined up between points 4 and 12 of the main and local circuits, respectively, and is thus shunted out of the talking-circuit. This arrangement is, however, wholly incidental, without consequence, and a pure matter of convenience. If the said bell were entirely disconnected, as is indicated at station D of main circuit L, by placing its connection in dotted lines, the operation would remain precisely the same.

In all of the figures the connection-conductor or cross connection x is shown as being associated with the transmitter local circuit N. The said cross connection x is in Fig. 1 indicated as a continuous and an unchangeable conductor extending between points 13 and 14 of the local circuit and dividing the said local circuit into two subcircuits or subdivisions n^2 and n , one containing the transmitter m and condenser c and the other containing the induction-coil primary winding p and the receiver t . It has been found that this arrangement effects the required reduction of the sounds which disturb the ear and distract the attention of the person using the transmitter. This improved effect is due to the fact that a considerable portion of the alternating currents or surges caused by the microphonic action of the transmitter is shunted through the condenser and its sub-circuit n^2 as the path of lowest impedance, and being thus diverted no surplus of current passes through the receiver, as heretofore. Such reduction of disturbing effect renders receiving much easier and does not reduce the volume of the received talking-current. This particular arrangement does, however, tend to reduce the volume of transmission, albeit only to so small extent as may in local work and lines of no great length be disregarded; but for long-distance service, where the greatest possible volume of transmission is desirable, an additional device enabling the benefit of the arrangement to be obtained without any impairment of volume or power in transmission is provided. This, as shown in Figs. 2 and 3, is a key or circuit-changer k in the circuit of the cross-connection conductor x and arranged to control the continuity thereof. The key k in its normal or resting position, as shown in these figures, maintains the discontinuity of the said connection x or holds the circuit thereof open; but when the said key is depressed the continuity of the said cross connection is established. When the apparatus is being used in long-distance service, where extreme quietness is desirable in order that every word of the incoming message may be plainly heard and perfectly understood, the subscriber or customer will depress the key and close the cross connection x while listening and will open the same while talking by allowing the key to resume its normal position.

The modified arrangement of Fig. 4 differs

from that already described only in that the key k^2 is connected to maintain the circuit of the cross connection normally continuous or closed and is adapted to open the same when depressed. In this case the person operating the transmitter will depress the key when transmitting and will release it or permit it to remain undepressed while receiving.

Having thus described the invention, the several claims of the application are as follows:

1. In a main telephone-circuit substation apparatus, the combination with the transmitter; its induction-coil; the receiver; a condenser; and a local circuit formed in part of the main-circuit conductors and containing in series the said transmitter, receiver, condenser, and the primary winding of said induction-coil; of a connection-conductor dividing said local circuit into two subcircuits one containing the said transmitter and condenser, and the other the said receiver and induction-coil primary; substantially as described.

2. In a central-source telephone-exchange system, the combination of a main telephone-circuit extending between a central station and a substation; a source of current connected therein at said central station; and a local circuit associated with said main circuit at said substation containing in series the station transmitter and receiver the primary winding of the transmitter induction-coil and a condenser, the said local circuit being formed in part of the main conductors and receiving transmitter-current therefrom; with a circuit connection uniting two points of said local circuit, and constituting thereof two subdivisions or sections including respectively the said transmitter and condenser, and the said receiver and the primary winding of the induction-coil; substantially as set forth.

3. In the substation apparatus of a central-battery main telephone-circuit, a local transmitter-circuit system comprising a telephone-transmitter, and a winding of an induction-coil included in the said main circuit; a shunt-circuit around said transmitter, and a telephone-receiver, a condenser, and a second winding of said induction-coil, all included in said shunt-circuit; a cross connection between two points of said shunt-circuit dividing the same into two subdivisions one containing the transmitter and condenser, and the other the receiver and the said second induction-coil winding; substantially as described.

4. In the substation apparatus of a central-battery main telephone-circuit, a local transmitter-circuit system comprising a telephone-transmitter, and a winding of an induction-coil included in the said main circuit; a shunt-circuit around said transmitter, and a telephone-receiver, a condenser, and a second winding of said induction-coil, all included in said shunt-circuit; a cross connection be-

tween two points of said shunt-circuit dividing the same into two subdivisions one containing the transmitter and condenser, and the other the receiver and the said second induction-coil winding; and a continuity-controlling key or circuit-changer in said cross connection; substantially as described.

5. The combination of a telephone-line or main circuit extending between a central station and a substation; a source of transmitter-current in said main circuit; a local telephone-circuit at said substation formed of two parallel branches of said main circuit; a telephone apparatus at said substation comprising an induction-coil having its primary and secondary windings in the said local and main circuits respectively, and a transmitter, a receiver, and a condenser, all connected in

said local circuit in series with one another, and with said primary winding; a circuit connection adapted to form said local circuit into two subcircuits one containing the said transmitter and condenser, and the other the said receiver and primary winding; and a key or circuit-changer in said circuit connection controlling the continuity thereof; substantially as described.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 31st day of May, 1902.

ALMON B. STETSON.

Witnesses:

GEO. WILLIS PIERCE,
FRANK C. LOCKWOOD.