(No Model.)

W. W. DEAN.

TELEPHONE EXCHANGE SYSTEM.

No. 560,845. Patented May 26, 1896.

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UNITED STATES PATENT OFFICE.

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TELEPHONE-EXCHANGE SYSTEM.

SPECIFICATION forming part of Letters Patent No. 560,845, dated May 26, 1896.

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To all whom it may concern:

Be it known that I, WILLIAM W. DEAN, a citizen of the United States, residing at the city of St. Louis, in the State of Missouri, have invented a certain new and useful Improvement in Telephone-Exchange Systems, (Case No. 7,) of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawing, forming a part of this specification.

In telephone-exchange systems it has been found desirable to provide a battery at the central station adapted to supply current to all or a group of the telephone-lines. In such systems metallic circuits have been employed and apparatus has been provided whereby the individual telephone-lines may be utilized as conductors of battery-current from the centralized battery to the various transmitter-circuits of such lines when in active use for telephonic communication—that is to say, the battery-current passes over the two limbs of a telephone-line, the battery having a ground connection at the central office, and its circuit being completed by ground at the subscriber's station when the line is in service. In such systems of telephone-exchange one of the principal problems has been to close the battery-circuit over the two limbs of each of the telephone-lines, so that the battery may work efficiently to supply the volume of current desired to the transmitter-circuits without shunting the voice-currents, which are at the same time being impressed upon the metallic circuit of the telephone-lines joined together in metallic circuit.

My invention herein relates particularly to apparatus for effecting such efficient working of the telephone-lines in such systems, and is an improvement upon the telephone system illustrated, described, and claimed in Letters Patent No. 541,077, granted to me June 18, 1895.

The principal and most important features of novelty of my present invention consist, first, in the manner of winding the retardation-coils which are bridged across the telephone-lines at the subscribers' stations and across the strands of the cords or connecting-wires at the central office, and, second, in the manner of laying on the primary windings of the induction-coils, such windings of the retardation-coils and of the induction-coils being in parallel. By the use of my invention the very highest efficiency is obtained. The retardation-coils are of low ohmic resistance and high impedance. Each of the two windings may be of, say, about three thousand two hundred turns of No. 22 silk-covered copper wire. The number of turns and the size of the wire may be varied, however, within wide limits. The primary windings of the induction-coil—that is, the two strands which are laid on together—may be of, say, No. 26 silk-covered copper wire, and the secondary winding may be of, say, No. 28 silk-covered copper wire.

My invention will be more readily understood by reference to the accompanying diagrammatic illustration of the circuits and apparatus of two telephone-lines united in metallic circuit by means of central-office apparatus, the induction-coils and retardation-coils at the two stations and the retardation-coil bridged between the strands of the pair of cords at the central office being wound and connected with the other apparatus in accordance with my invention.

Referring to the drawing, the station A and station B are shown connected in metallic circuit for conversation through the central station C. At subscriber's station A the limbs a and a' of the telephone-line are shown permanently connected with different contacts or portions of the telephone-switch b. When the telephone is hung on the switch, the limb a is connected through the subscriber's bell c, which is of high resistance, to ground. When the telephone is removed, as shown, the limbs a a' are connected at d d', thus looping the telephone d^2 into circuit. The retardation-coil consists of a core of soft iron e, upon which are wound in parallel the two coils e' and e^2. One of these coils, e', is connected with the wire leading from contact d', while the other coil, e^2, is connected with the wire leading from the contact d, these coils being united at e^3 where connection is made with the coils which constitute the primary windings of the induction-coil. About the core f of the induction-coil are two windings f' and f^2. These primary coils are of the

same size and number of turns, the two primary windings being laid on together side by side, the wires f' and f^2 being united as shown at e^3 and also at f^3. The transmitter g, placed in one side of the transmitter-circuit, is balanced as to resistance by the coil g', placed in the opposite side of the said transmitter-circuit, this manner of placing the transmitter g and resistance g' being similar to that which is shown in my prior patent, No. 541,077. The coil g^2 simply indicates resistance, which may be adjusted as to amount according to the resistance of the telephone-line, so that only the desired quantity of current will flow over the transmitter-circuit from the battery at the central office C.

Referring to the apparatus at station B, it is similar to that shown at station A, the various corresponding parts being indicated by corresponding letters of reference.

At the central office at h I have indicated the position of an ordinary operator's telephone set adapted to be bridged across the cord-circuit. I have also indicated a power-generator h' of high electromotive force in connection with a key in one of the strands of the cords, by means of which current, directed over that limb which is closed through the high resistance, signal-bell c at the subscriber's station of the telephone-line may be rung. The plugs i i' are shown inserted, respectively, in the switches i^2 i^3 of the telephone-lines of stations A and B, the circuit of the lines being completed through the cord-strands i^4 i^5. The telephones d^2 d^2 of the different stations A and B are shown united in metallic circuit for conversation. Normally—that is, when the lines are not in use—the telephones are hung upon their hooks, respectively, and the plugs i i' being removed from the switches i^2 i^3 the springs of said switches will close upon the contacts i^6 i^7, and thus the centralized battery k will be connected to the two limbs of each of the metallic circuits of said stations A and B, the individual annunciators being included in the circuits thus formed—that is, individual annunciator k' is included in the branch leading from the battery k to contact i^6, and individual annunciator k^2 is included in the branch leading from said battery k to contact i^7.

Simply removing the telephone d^2 at one of the stations from the switch b causes the switch to close the limbs of the telephone-line to contacts d d', as shown, and thus the battery-current is sent through the individual annunciator of the line (as k' or k^2) to indicate the call to the operator. The answering-plug (as plug i) of the pair is then inserted in the switch of the calling subscriber's line, and the operator's telephone set (as h) being at once bridged into the circuit the operator is told what connection is wanted, and the operator inserts the calling-plug (as plug i') of the pair in the switch of the line of the subscriber called for and signals the called subscriber by means of the generator h'. The clearing-out annunciators k^3 k^4 are connected in the strand i^4 of the cords in a well-known way.

The centralized battery k is shown connected at l between the two coils l' and l^2 of the retardation-coil, which is connected between the strands i^4 i^5 of the cords. The current derived from the battery divides at l, one half passing over the winding l' to the strand i^4 and the other half passing over the winding l^2 to the strand i^5, as shown. Thus the ampere turns of the two coils of the retardation-coil will be the same, and the coils being parallel the currents in the two coils will flow in opposite direction. Therefore the soft-iron core of the retardation-coil will not become magnetic by reason of the battery-current passing over the coils. A retardation-coil offers the greatest impedance when neutral, and therefore, though the coils of the retardation-coil are made use of as conductors for the battery-current which supplies the transmitter-circuits, such currents do not polarize the core or create a magnetic field of force, but leave the retardation-coil as sensitive and as efficient to intercept or impede voice-currents as if there were no battery-current flowing over the coils of the said retardation-coil. The same may be said of the retardation-coils and their action at the subscribers' stations, and it is by the special winding which I have described that the increased strength of the transmission of telephonic current is obtained between the subscribers or between a subscriber and the central-office operator—that is to say, the retardation-coils furnish paths of comparatively low ohmic resistance for the battery-current and at the same time are left in that neutral magnetic condition which is best adapted to prevent telephonic or voice currents from being shifted across the metallic circuit.

Somewhat analogous results as to efficiency are obtained by disposing the primary winding of the induction-coil in two parallel coils wound on together, as already described.

The user speaking at the transmitter g, placed in the side f' of the transmitter-circuit, varies the resistance of that side. The current, it will be understood, in passing from the point e^3 to the point f^3 in parallel paths is divided between the side f' (indicated by a full black line) and the side f^2, (indicated by a light or open line.)

When the transmitter g is in condition of rest, its resistance is about equal to the resistance g', so that nearly equal amounts of current flow through each of the primary coils and in opposite directions, so that the core f of the induction-coil will be in a state of zero magnetization. It is thus evident that the induction-coil is in the most efficient condition for transforming the undulating currents caused by the variations of resistance of the transmitter g.

Increased resistance at transmitter g diminishes the current through side f' and increases

the current through side f^2. The current passing through the parallel coils f' and f^2 in opposite directions varies inversely, and thus the reciprocal undulations of the current act together to impress the desired high-tension currents upon the circuit including the secondary winding of the induction-coil.

I do not claim to be the first to provide two primary coils on an induction-coil used in connection with a transmitter-circuit; but the combination of such an induction-coil with a transmitter-circuit in a system employing a centralized battery or in which retardation-coils are required to prevent the voice-currents from being shunted from the telephone I consider broadly new.

It is evident that retardation-coils such as I have described herein may be applied and adapted to modified forms of circuits without departing from my invention.

Having thus described my invention, I claim as new and desire to secure by Letters Patent—

1. The combination with a transmitter-circuit, the two sides thereof including each a primary coil of an induction-coil, the two coils being connected upon the core of the induction-coil oppositely, of a telephone-circuit including the secondary coil of the induction-coil, a retardation-coil bridged across the two sides of the telephone-circuit and having the central portion of the coil thereof connected to the transmitter-circuit between the two primary coils, and a circuit containing a battery extending from the side of the transmitter-circuit, which is opposite the united ends of said primary coils, to the telephone-line, whereby the transmitter-circuit is supplied with current directed over the two sides or limbs of the telephone-circuit in parallel, while alternating or voice currents impressed upon the telephone-circuit are prevented from passing from one side of said telephone-circuit to the other side; substantially as and for the purpose specified.

2. The combination with a telephone-circuit, of a retardation-coil bridged across the sides thereof, the wire forming the bridge being disposed about the core thereof in two equal coils, laid on side by side, and united as at e^3, and a closed circuit containing a battery extending therefrom to the said telephone-circuit; whereby battery-current may be directed over the sides of the telephone-circuit in parallel, while telephonic currents impressed upon the telephone-line are prevented from passing over the bridge from one side of the telephone-circuit to the other; substantially as and for the purpose specified.

3. The combination with a telephone-line, of a telephone-switch having two contacts to which the different limbs of said telephone-line are respectively connected, a loop-circuit containing a telephone and the secondary of an induction-coil to which loop said switch-contacts are adapted to be closed, a retardation-coil bridged across said loop, having two uniform coils, one end of each of said coils being connected with the opposite sides of said loop and the other ends being united, the united ends being extended to form a transmitter-circuit and the primary of the induction-coil, said transmitter-circuit being provided with a ground connection; substantially as and for the purpose specified.

4. A loop-circuit containing a telephone and a telephone-switch for uniting said loop with a telephone-line permanently connected with the said switch, in combination with a retardation-coil bridged across said loop, the said retardation-coil having high impedance and comparatively low ohmic resistance, and consisting of a core of soft iron and two windings of insulated wire laid on together, one end of each of said windings being connected respectively with opposite sides of the loop, and the remaining ends of said windings being united, and a transmitter-circuit connected on one side with said united ends and on the other with a ground or other continuation of the circuit, the different sides of the transmitter-circuit, each including a uniform winding of the primary of the induction-coil, the windings of the different sides of the transmitter-circuit being in opposite directions and the said loop including the secondary winding of the induction-coil; substantially as and for the purpose specified.

5. The combination with a metallic circuit, having telephones connected in different portions thereof, of a retardation-coil bridged between the sides of said circuit between the telephones, said retardation-coil being provided with two uniform coils of wire, said coils surrounding the core of the induction-coil and being laid about the same, side by side, the inner ends of said coils being united, whereby an electrical connection is formed, through the medium of said coils, between the sides of the circuit, while the alternating or voice currents are prevented from being shunted across the said connection; substantially as and for the purpose specified.

In witness whereof I hereunto subscribe my name this 28th day of March, A. D. 1896.

WILLIAM W. DEAN.

Witnesses:
W. E. HARKNESS,
WM. J. WOELK.