June 1, 1943. A. HERCKMANS 2,320,726

TELEPHONE STATION EQUIPMENT

Filed Nov. 29, 1940 4 Sheets-Sheet 1

FIG. 1

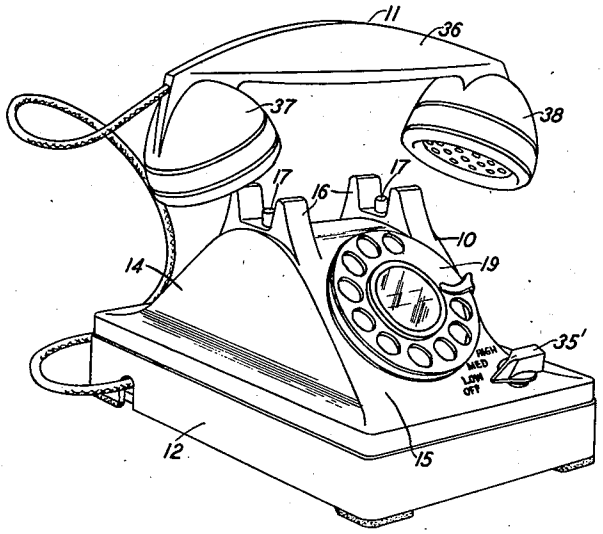

FIG. 3

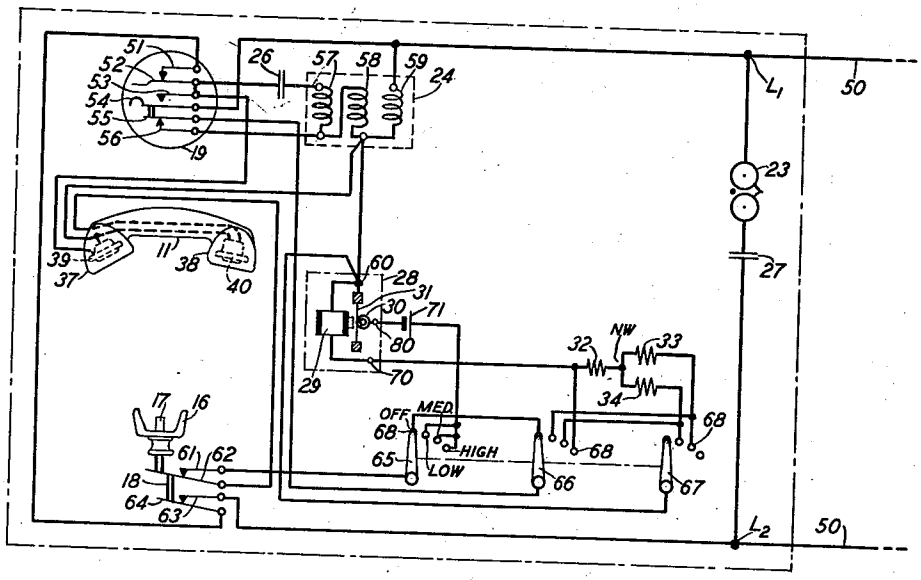

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FIG. 2

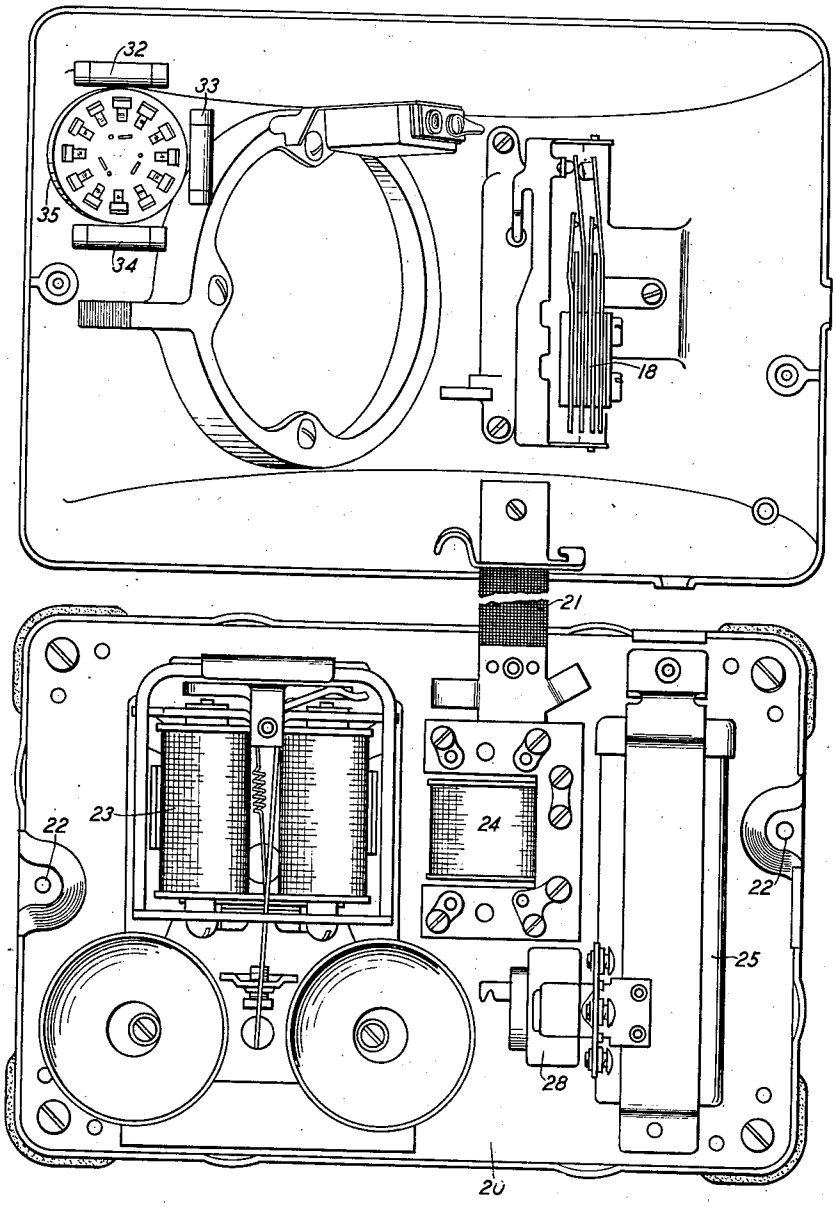

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FIG. 5A

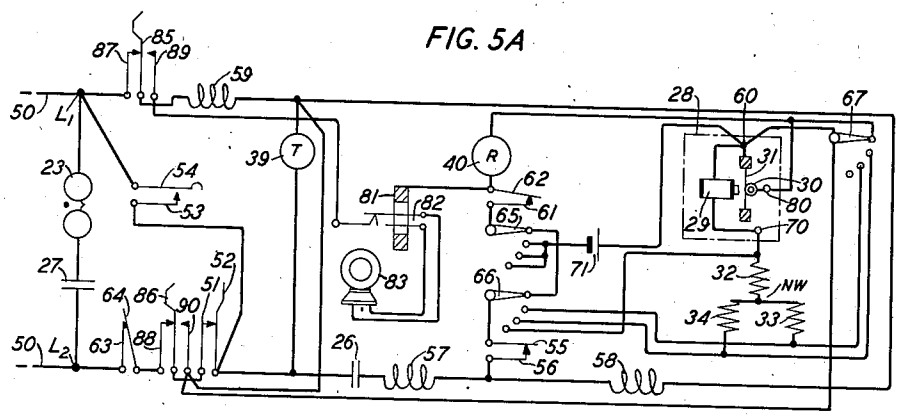


FIG. 3A

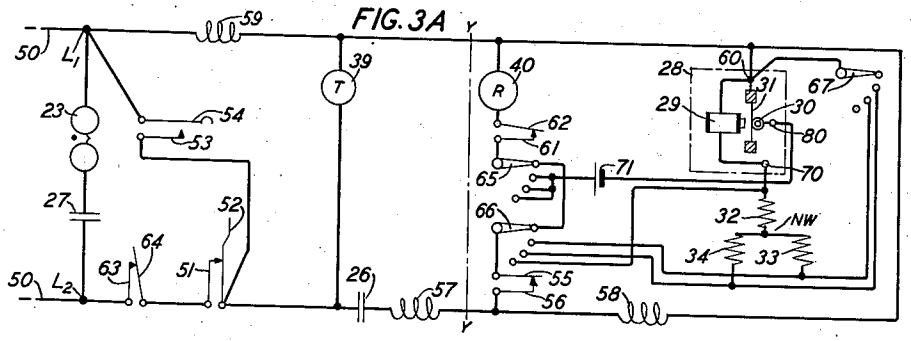


FIG. 3B

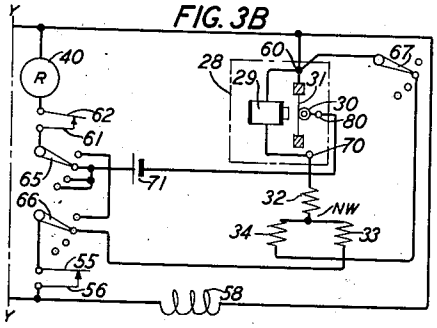


FIG. 3C

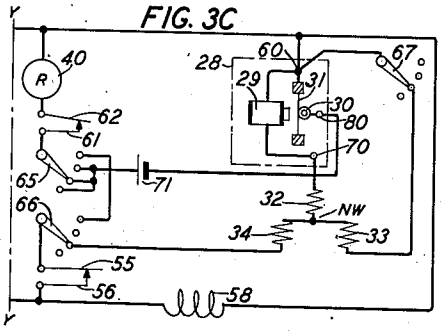
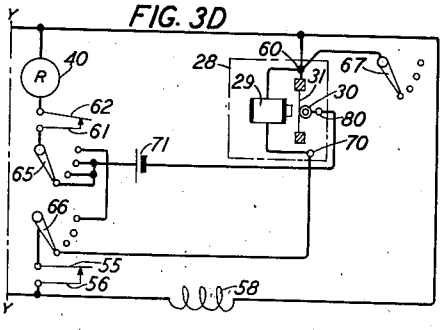


FIG. 3D



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TELEPHONE STATION EQUIPMENT

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FIG. 4

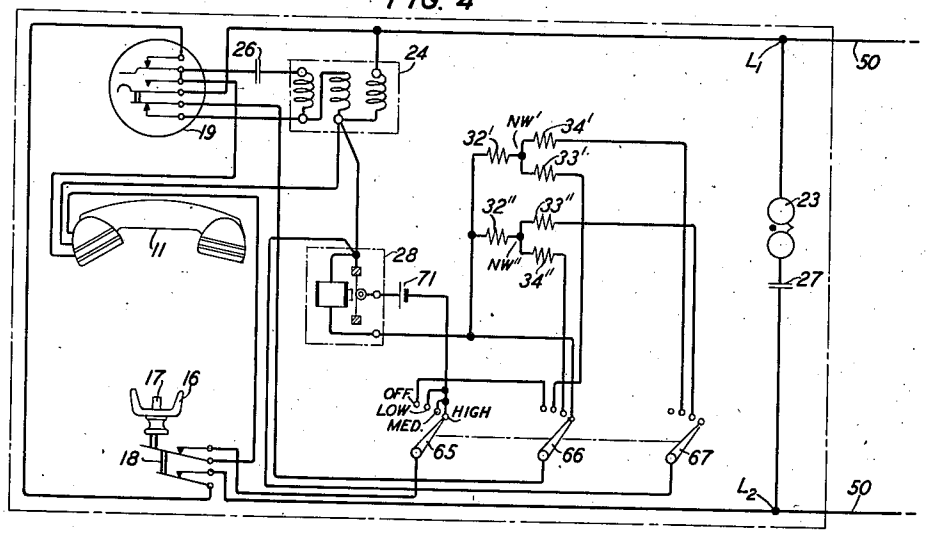
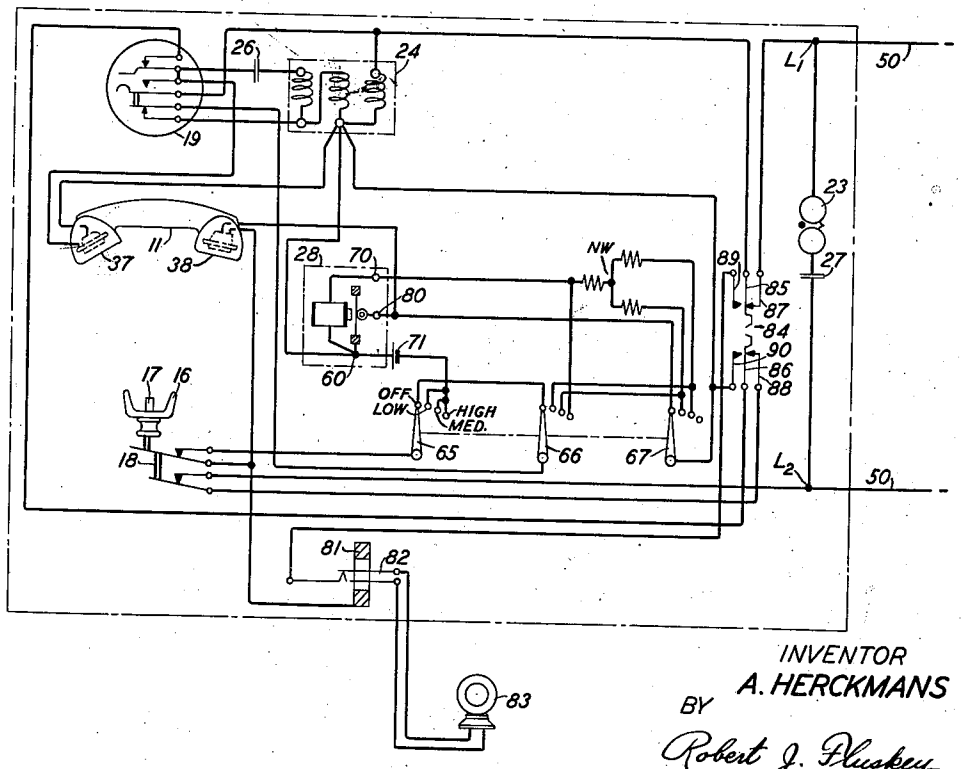


FIG. 5



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Patented June 1, 1943

2,320,726

UNITED STATES PATENT OFFICE

2,320,726

TELEPHONE STATION EQUIPMENT

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Application November 29, 1940, Serial No. 367,689

2 Claims. (Cl. 179—81)

This invention relates to telephone station equipment, and, more particularly, to substation or subscribers' sets and circuits.

An object of this invention is to enable a user of a telephone station or set to receive telephone signals or messages at the ordinary level for the telephone system, or, if he is hard of hearing, to amplify the telephone signals to preassigned extents before translation by the receiver or reproducing means at the station.

A further object of the invention is to enable a user of a telephone station or set to utilize it for telephone purposes and, also, to employ it, if desired, as a hearing aid or audiphone for direct conversation with persons in the vicinity of the station or set, or for listening to other than articular sounds occurring in the region of the station or set.

Still another object is to incorporate amplification means in existing telephone station equipment with minor, if any, changes therein.

In accordance with the invention, a subscriber's station or telephone set is arranged to include small, compact audio frequency amplification means, and means to vary or adjust the degree of amplification. In a preferred embodiment, the amplification means comprises an electromechanical amplifier comprising a telephone receiver element and a variable resistance microphone element having a common diaphragm element. The amplifier may be mounted on the base member or support for other components of the telephone set. The amplification level or gain-adjusting means may comprise a manually operable switch and a variable resistance means or network, adapted for adjustment to enable gain changes in desired or preassigned steps. The switch is preferably associated with the member providing a support for the receiver or the handset of the telephone station.

In accordance with the invention, also, the telephone station circuit includes means to enable it to be used for telephone purposes, with or without amplification for telephone signals received thereat, and also to be utilized as an amplifier or hearing aid with respect to conversation or other sounds occurring in the vicinity of the station or set. Such means may comprise a switching device that isolates all of the substation circuit, except the ringer circuit, from the telephone line, and associates an auxiliary microphone or transmitter with the receiver and amplifier circuit of the telephone station circuit.

A more complete understanding of this invention will be derived from the detailed description that follows, taken in conjunction with the appended drawings, wherein:

Fig. 1 shows, in perspective, a telephone station or set embodying the invention;

Fig. 2 is a view of the interior of the mounting of the set of Fig. 1;

Fig. 3 shows the circuit arrangement of the components of the set of Fig. 1;

Fig. 3A shows the same circuit as that of Fig. 3, but in a form that indicates more clearly the character of the receiving circuit;

Figs. 3B, 3C and 3D show that portion of the circuit of Fig. 3A to the right of the line Y—Y, and illustrate the effect on the receiver circuit of adjustment of the volume control switch to preassigned positions;

Fig. 4 shows a modification of the circuit of Fig. 3 in which a plurality of resistance networks is employed;

Fig. 5 shows another embodiment of the invention in which means are included to enable a telephone station or set to be used for telephonic purposes, with or without amplification for voice frequency currents thereat, and for amplification of sound waves generated or occurring in the vicinity of the station or set; and

Fig. 5A shows the circuit of Fig. 5 arranged to indicate more clearly the character of the receiver and amplifier circuit and the various switching means embodied in the circuit.

Figs. 1 and 2 show mechanical features of a telephone set embodying the invention. The telephone set comprises a hollow mounting or support 10 and a handset 11. The mounting comprises a base portion 12 and a pedestal portion having a pair of substantially parallel lateral surfaces 14 and a front upwardly and rearwardly inclined surface 15 terminating in a handset cradle portion defined by the spaced tines or projections 16. Plunger members 17, associated with a switching spring assembly 18 within the mounting, project into the cradle portion, and are adapted to be depressed by the handset when the latter rests within the cradle portion, and to cause the spring contacts of the spring assembly to open. Although the mounting is shown as including a calling dial 19 so that the set may be utilized in an automatic telephone system, the dial may be replaced by a suitable apparatus blank when a dial is not desired. The lower end of the mounting is closed by a metallic base plate 20, connected with the base portion by a flexible fabric hinge 21 and adapted to be fastened to the base portion by screws (not shown) projecting through apertures 22. The

base plate has secured to it, and provides a support for, a ringer 23; a three-winding induction coil 24; a container 25, for a condenser 26 (Fig. 3) included in an anti-side tone circuit for the set, and a condenser 27 (Fig. 3) to be connected in series with the ringer; and a mechanical amplifier 28. The mechanical amplifier comprises a combined receiver 29 and microphone 30 of small size having a common diaphragm 31, and is preferably of the type disclosed in A. F. Bennett-R. E. Polk-W. L. Tuffnell Patent No. 2,242,284, of May 20, 1941. Within the mounting, and fastened thereto under the cradle portion, is the switching spring assembly 18. Also mounted within the mounting are a multicontact switch 35 and a plurality of resistors 32, 33, 34 of preassigned resistance values. The switch is manually controlled from the outside of the mounting by means of a knob 35', and is arranged, in the particular instance, for adjustment to four positions "off" (OFF), "low" (LOW), "medium" (MED) and "high" (HIGH), which designations are preferably engraved on the surface 15 in line with the tapered portion of knob 35' for the respective adjustments of switch 35. The handset comprises a handle or common support 36 for a transmitter 39 enclosed in one enlarged end 37 of the handle, and preferably of the carbon granule type such as is disclosed in A. F. Bennett et al. Patent 2,042,822 of June 2, 1936, and for a telephone receiver 40 enclosed in the other enlarged end 38 of the handle, and preferably of the type disclosed in L. A. Morrison-E. E. Mott Patent No. 2,220,942 of Nov. 12, 1940.

A preferred circuit arrangement is shown in Fig. 3. The ringer 23 and condenser 27 are connected in series across the set's terminals L_1, L_2, to which the subscriber's line conductors 50 are adapted to be connected.

The dial 19 comprises the normally-closed or engaged impulse springs 51, 52, the normally open circuit-shunting springs 53, 54, and the normally-closed or engaged receiver springs 55, 56.

The induction coil 24 comprises the three windings 57, 58 and 59. The upper end of winding 57 is connected through condenser 26 to dial spring 52 and to one terminal of the transmitter 39. The lower end of the winding 57 is connected to the upper end of winding 58 and to dial spring 56. The lower end of winding 58 is connected to the lower end of winding 59, to the second terminal of the transmitter and to one terminal of the receiver 40, and to the common terminal 60 of the mechanical amplifier. The upper end of winding 59 is connected to line terminal L_1 and to dial spring 54.

The telephone set switching spring assembly 18 comprises the contact spring 61, 62, 63 and 64, springs 61 and 62 and springs 63 and 64 being shown in contact or engagement, the handset 11 being removed from the cradle of the mounting 10. Dial spring 51 and switching spring 64 are connected together, and switching spring 63 is connected to line terminal L_2. Switching spring 61 is connected to one blade or wiper 65 of the switch 35, and the switching spring 62 is connected to the second terminal of the receiver 40.

The switch 35 comprises a plurality of contact blades or wipers 65, 66, and 67 each associated with a group or a plurality (in the particular embodiment, four) of fixed contacts 68. Contact blade 66 is connected to the dial spring 55, and contact blade 67 is connected to the common terminal 60 of the mechanical amplifier 28.

The blades of switch 35 are arranged to move clockwise and counter-clockwise in an arc and simultaneously to engage similarly located contacts in each group, that is, when blade 65 engages the contact labeled "Off," blade 66 and blade 67 engage, as shown, the initial contact in their associated contact groups. As the knob 35' is turned clockwise, the blades are moved from their initial positions to simultaneously engage with the second, the third and the fourth contacts of each associated contact group for the "Low," "Med" and "High" positions of the switch. Preferably, when the switch 35 is adjusted to a new position, the contact blade or wiper engages with the adjacent contact in the arc before completely disengaging with the contact for the previous adjustment.

The resistors 32, 33, 34 are arranged in a T-network NW. The resistors have a common connection for one termination of each resistor; the other termination of resistor 32 is connected to the receiver winding terminal 70 of the mechanical amplifier, that of resistor 33 is connected to the LOW-contact of the contact group associated with blade 66 and to the MED-contact of the contact group associated with blade 67, and that of resistor 34 is connected to the LOW-contact of the contact group associated with blade 67 and to the MED-contact of the contact group associated with blade 66.

A source 71 of current, for example, a dry cell battery, is connected between the terminal 80 of the mechanical amplifier and all but the OFF-contact of the contact group associated with blade 65. Space within the mounting 10 may be provided for this battery, but, in actual practice, it may be more convenient to have the battery outside of the mounting and in some suitable receptacle near the telephone set with a two-conductor cord for connecting the battery and the set.

Fig. 3A shows the same components and circuit as Fig. 3, but in a form that indicates more clearly the character of the receiver and amplifier circuit. It is evident that, as to the circuit arrangement of transmitter, receiver, induction coil windings, dial springs, switching springs, ringer and ringer circuit condenser, the circuit of Fig. 3 is of the anti-side tone type disclosed in G. A. Campbell Patent 1,254,476 of January 22, 1918, and J. W. Gooderham Patent 1,901,958 of March 21, 1933. A circuit of such type is combined with the additional means shown to provide amplification in preassigned steps for voice currents incoming to the circuit overconductors 50, thereby permitting one who is hard of hearing to listen to the received voice frequency energy at a higher than normal transmission level.

In the "off"-position of the switch 35, the mechanical amplifier, network NW and battery 71 are not connected in circuit, and the user of the set hears the voice frequency energy reproduced by the receiver at the ordinary level for the circuit.

With the switch 35 adjusted to its "low"-position as shown by Fig. 3B, the receiver 40, the battery 71 and the microphone 30 of the mechanical amplifier are connected in series. At the same time, the winding of the receiver 29 of the mechanical amplifier resistor 32 and resistor 33 are connected in series between the junction point for the transmitter 39 and receiver 40 and the

junction point of windings 57, 58. Resistor 34 is connected in parallel with the series-connected resistor 32 and the winding of the receiver 29. The voice frequency currents incoming to the subscriber's set do not pass directly through the receiver 40; instead, they flow through the resistor 33 and the parallel paths provided by the resistor 34 and the series-connected winding of receiver 29 and resistor 32. The diaphragm 31 is vibrated in accordance with the voice frequency currents, the microphone 30 varies in resistance, and the direct current flowing in the receiver 40 is correspondingly varied. Because of the amplifying action of the microphone element, the current flow in the receiver 40 is at a preassigned higher level than if the amplifier were not present.

With the switch 35 adjusted to its "med"-position, the circuit arrangement of Fig. 3C obtains. This is the same as that of Fig. 3B except that resistors 33 and 34 are interchanged. With this volume switch adjustment, a still higher level of amplification in the receiver 40 is realized.

With the switch 35 adjusted to its "high"-position, no part of the network NW is effective to reduce the maximum amplification to be obtained with the mechanical amplifier. The effective circuit configuration is shown by Fig. 3D.

In a particular embodiment constructed in accordance with the invention, the resistors 32 and 33 were of equal resistances, and the resistor 34 was of substantially lower resistance. Specifically, resistors 32, 33 were each approximately of 80 ohms and resistor 34 was approximately of 32 ohms. It is apparent that with the arrangement described, two different T-network configurations are made available with the use of three resistors and switching means only. In the embodiment constructed, adjustment of the switch 35 from the "off" to the "low"-position resulted in a gain of 8 decibels in the receiver circuit; from its "low" to its "med"-position, in an additional gain of 8 decibels, or a total of 16 decibels; and from its "med" to its "high"-position, in still another gain of 8 decibels for a total gain of 24 decibels. With the receiver 40 held to the user's ear, gains of this order are obtainable without singing or howling, although the handset receiver and transmitter may be of very high efficiency, and despite the fact that the side tone in the receiver circuit is increased in substantially the same degree as the amplification in the voice frequency currents.

In a particular situation, it might be considered desirable to utilize two T-networks for volume control purposes instead of the single network NW of Fig. 3. Fig. 4, which is otherwise the same from a circuit standpoint as Fig. 3, shows such an arrangement. The T-network NW' and the T-network NW'' comprise resistors 32', 33', 34' and 32'', 33'', 34'', respectively, each of a resistance value corresponding to the resistors 32, 33, 34, respectively. When the switch 35 is adjusted to its "off"-position, neither network nor mechanical amplifier is connected in the receiving circuit. With switch 35 adjusted to its "low"-position, the series circuit for the receiver 40, battery 71 and microphone 30 is established and network NW' is connected in circuit to provide an effective configuration corresponding to that of Fig. 3B. With switch 35 adjusted to its "med"-position, the network NW' is removed from the circuit and network NW'' inserted to provide an effective configuration corresponding to that of Fig. 3C. For the "high"-position of switch 35, neither network NW' nor NW'' is included in circuit, the effective configuration corresponding to that of Fig. 3D.

Fig. 5 shows a circuit arrangement for a subscriber's set that enables the user to employ it for telephone purposes, and, also, to utilize it, when occasion warrants, to "pick up" and to amplify direct speech or other sounds in the vicinity of the set. The arrangement of Fig. 5, it will be observed, embodies many of the components and circuit connections that are to be found in the arrangement of Fig. 3, corresponding elements bearing like identifying characters. In addition, the circuit arrangement of Fig. 5 includes a jack 81 adapted to receive a plug 82 connected to an auxiliary transmitter or microphone 83, preferably of the granular carbon type, and a manually operable key or switch 84. The switch 84 comprises a pair of main springs 85, 86 adapted to be moved by a button, lever or other means (not shown), and additional pairs of springs 87, 89 and 88, 90 associated with springs 85 and 86, respectively, contact springs 87 and 88 normally being in engagement with the springs 85, 86, and springs 89, 90 normally being out of engagement with the springs 85, 86. So that the circuit of Fig. 5 may be compared readily with that of Fig. 3, the components and circuits of the former have been rearranged as shown in Fig. 5A.

As shown in Figs. 5 and 5A, the handset 11 has been removed from the mounting, the switching springs 61, 62 and 63, 64 of assembly 18 are closed, and the springs 87, 88 are in engagement with main springs 85, 86, respectively. If a call is being initiated, e. g., in an automatic system, operation of dial 19 causes dial impulse springs 51, 52 to make and break, during which springs 53, 54 are in engagement to short-circuit the set circuit and springs 55, 56 are out of engagement to open the receiver circuit, all in manner well known in the art. Instead of being connected to terminal L_1, spring 54 could be connected to the junction of the transmitter T and winding 59, whereby, during the dialing operation, winding 59 would remain in the line circuit. A transmitting circuit may be traced from line conductor 50, line terminal L_1, springs 87, 85, winding 59, transmitter 39, springs 52, 51, 86, 88, 63, 64, terminal L_2, to the other line conductor 50. Some of the voice currents generated in the transmitter flow through that part of the set circuit in shunt of the transmitter, but, as taught by Campbell, the balancing network or winding 58 is proportioned and the windings 57, 58 and 59 are poled so that a minimum of this local current flow is effective in the receiver. A receiving circuit may be traced from the junction of winding 59 and transmitter 39, transmitter 39, condenser 26, winding 57, springs 56, 55, switch blades 66, 65, springs 61, 62, receiver 40, switch blade 67, spring 90, and back to the junction of winding 59 and transmitter 39. The proportions and poling of the windings are such that, during receiving, a minimum of the telephone currents incoming to the set circuit is effective in the balancing network or winding 58. When it is desired to amplify the received telephone currents, the switch 35 is adjusted to its "low," "med" or "high"-position as with the circuit of Fig. 3, to associate the electromechanical amplifier 28, volume control network NW and battery 71 with the receiver 40, in the manner already described hereinabove.

When it is desired to use the telephone set as a hearing aid or deaf set separate from its use in a telephone system, the key 84 is adjusted to its

off-normal position, i. e., the contacts between springs **85**, **87** and **86**, **88** are disestablished, and springs **85** and **89**, and **86** and **90**, are brought into engagement. This disconnects the telephone set circuit from the line without affecting the ringing circuit; hence, the substation can be signaled for an incoming call. At the same time, the transmitter **39** is shunted by the connection between its junction with the winding **59**, and spring **90**. Adjustment of the switch **35** to its "low"-position provides the microphone with the following circuit: Sleeve of jack **81** to springs **62**, **61**, switch blade **65** to battery **71** to common terminal **60** of amplifier, to spring **90**, to winding **59**, to spring contacts **85**, **89**, to tip of jack **81**, through transmitter **83** and back to sleeve of jack **81**. The auxiliary transmitter is thus placed across the line terminals in series with the battery and takes the place of the telephone line. The handset transmitter is short-circuited which increases the receiving efficiency of the set. The receiver circuit including the amplifier and volume control remain the same as before. The sound waves impressed on the microphone **83** and translated into voice frequency currents will be amplified by the electromechanical amplifier **28**, and appear in the circuit of and be reproduced by receiver **40**. If a higher level of amplification is desired, the switch is adjusted to its "med" or "high"-positions, the effect of such adjustment being to alter the configuration of or to short-circuit the network NW, as in the case of the circuit of Fig. 3. When such amplification of direct conversation or other sound is no longer desired, the set is restored to its utility for telephone purposes by restoring the key **84** to its initial position.

Although the invention has been described with reference to specific embodiments, it will be understood that it is not limited thereto, those described being preferred embodiments, the scope of the invention being limited only by the prior art and the appended claims.

What is claimed is:

1. In combination, a hollow mounting including a telephone receiver support, said mounting having a base portion closed by a removable plate member, a telephone receiver to be held against a user's ear when in use but resting on said support when not in use, line terminals in said mounting for connection with a telephone line leading to an exchange, a receiving circuit connected to said line terminals and including said receiver, a plurality of contacts in said mounting to complete and to interrupt said receiving circuit, said contacts interrupting said circuit when the receiver is on its support and completing said circuit when the receiver is removed from its support, an amplifier in said mounting and supported on said plate member, means for connecting said amplifier in circuit with said receiver, for amplifying audio frequency currents incoming to the circuit through said line terminals and supplying said amplified currents to said receiver for translation into sound waves, and means including a multiposition contact device and a plurality of resistors supported in said mounting independently of said plate member but connected in circuit with said amplifier, to adjust the degree of such amplification.

2. The combination of the preceding claim in which the position of said multiposition contact device determines the arrangement of said resistors in the amplifier circuit, the contact device being adjustable from the exterior of said mounting.

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