

April 11, 1944.

G. E. ATKINS

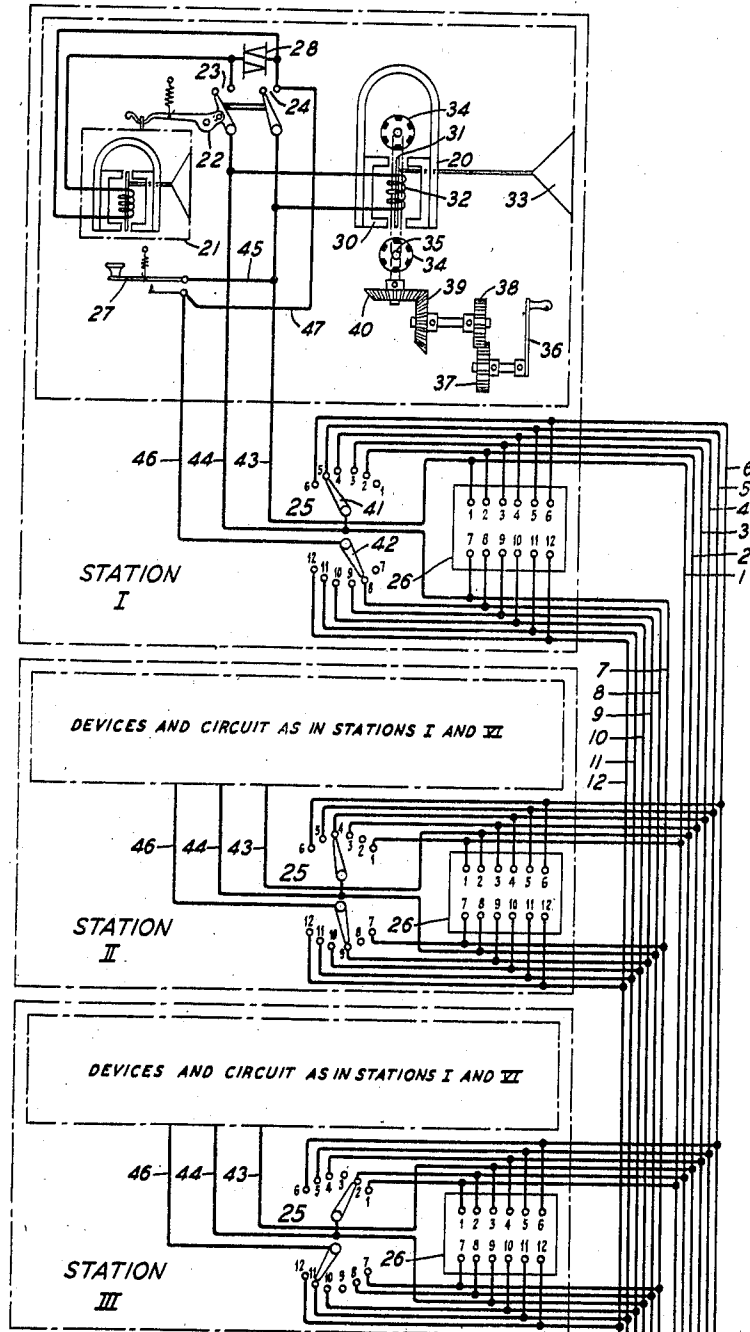
2,346,548

BATTERYLESS TELEPHONE SYSTEM

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2 Sheets-Sheet 1

FIG. 1



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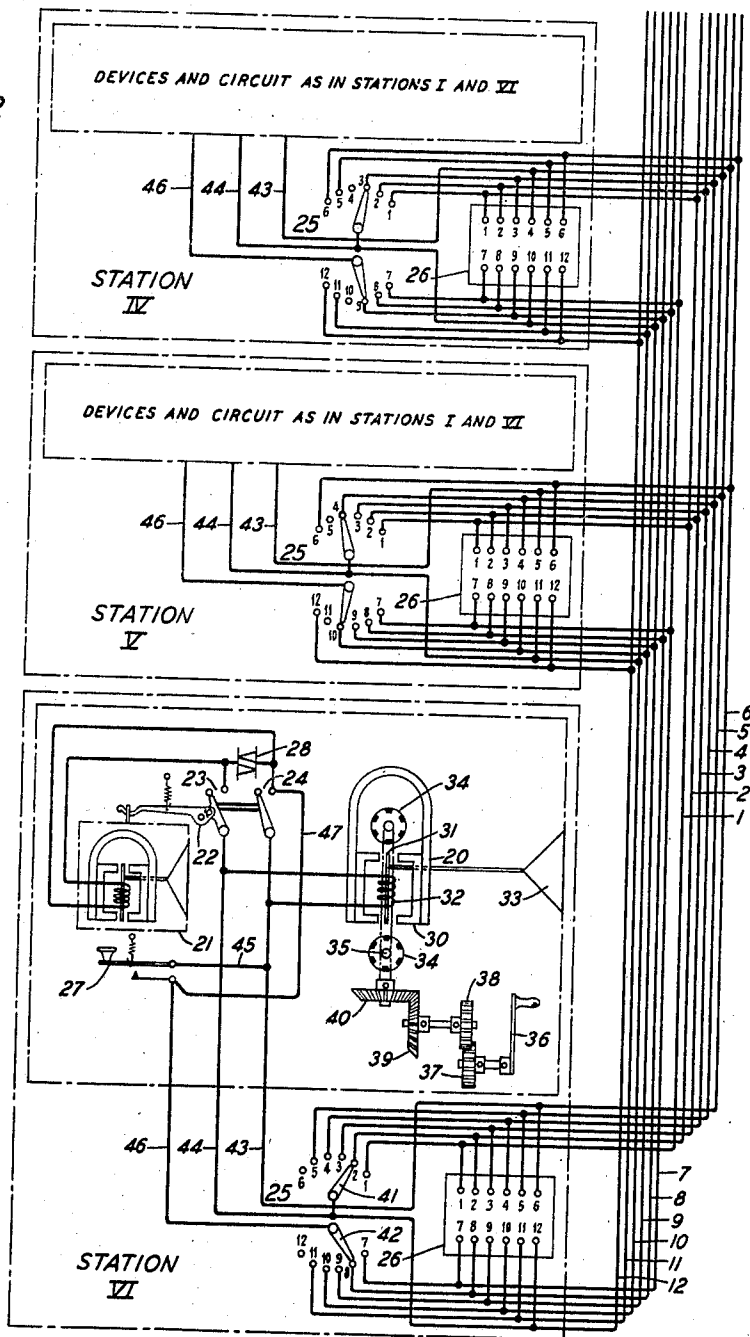
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2 Sheets-Sheet 2

FIG. 2



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BATTERYLESS TELEPHONE SYSTEM

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6 Claims. (Cl. 179—37)

This invention relates to batteryless telephone systems, that is, to intercommunicating systems which function without batteries or other similar sources of energy separate from the transmitting and receiving devices employed in such systems.

Batteryless telephone systems are known, as exemplified by my prior Patents 1,994,630 of March 19, 1935, and 2,144,867 of January 24, 1939. In systems of the type there disclosed, the basic structure of the receiver or the microphone may comprise a permanent magnet having opposed pole-pieces between which a vibratile armature is supported, the armature being mechanically coupled to a diaphragm and being encircled by a coil. Flow of alternating audio frequency current in the coil causes vibration of the armature and of the diaphragm to produce sound waves corresponding to the currents. Conversely, vibration of the diaphragm in response to sound waves causes vibration of the armature, variation in the reluctance of the magnetic path including the armature, and the inducing of currents in the coil surrounding the armature that correspond to the sound waves incident on the diaphragm.

In accordance with my Patent 1,994,630 and my Patent 2,166,155 of July 18, 1939, means may be associated with the above-described sound translating device whereby it may also function as a signal generator for signaling to another or similar device that might be connected to the same line at a distant point. This means may comprise rotatable magnetic members each having a slotted or undulatory periphery and adapted to be positioned in close proximity to the pole-pieces of the magnetic structure when signal generation is desired, but, if so desired, to be maintained removed from proximity to the pole-pieces when the device is to be used for speech purposes. The rotatable magnetic members may be supported on a shaft adapted to be rotated by a hand operated lever through a suitable gear train. Adjustment of the rotatable magnetic members to a position of proximity to the pole-pieces and operation of the lever, varies the reluctance of the magnetic path including the armature and induces in the armature-encircling coil an intense undulatory current which may be transmitted over a connecting line to a similar device. Received at the latter device, the signaling current flows through the armature-encircling coil thereat with consequent translation into an audible signal

through vibration of the armature and diaphragm of the signaled device. My Patent 2,144,867 illustrates how the combined speech and signaling device may be included in a multi-station batteryless telephone system arranged to have a common signaling currents channel and a separate, common speech currents channel with provision for protecting the users at the stations against acoustic shock that might occur through inadvertent or accidental operation of the signaling means at one station while the user at the other station has the device thereat held to his ear.

An object of this invention is to improve batteryless telephone systems of the general type described.

A feature comprises a batteryless telephone system in which a large number of stations may be included and in which speech current connections may be established at any one time between two or more pairs of stations.

A further feature of the invention comprises a batteryless telephone system involving more than three stations arranged for selective signaling and selective talking over a number of channels not in excess of the number of stations in the system.

Another feature of the invention comprises associating a non-linear resistance device with the speech and signaling circuit at each station to limit the current level effective in the speech currents device thereat while any two stations are in use.

A more complete understanding of the invention and the above features will be derived from the detailed description that follows read with reference to the appended drawings wherein Figs. 1 and 2 together illustrate a multi-station or multiparty batteryless telephone system embodying the invention.

The system of Figs. 1 and 2 involves six stations, I . . . VI. Each station embodies similar components, namely, a combined microphone and signaling device 20; a receiver 21 supported on a switchhook 22; contact pairs 23, 24 controlled by the position of the switchhook, open when the receiver is on its support and closed when removed from the switchhook; a station selector switch 25; a terminal strip or block 26; a normally open key 27; and a non-linear current-resistance characteristic device 28, for example, a pair of copper-copper oxide rectifier units connected in opposed multiple, connected

in shunt of the conductors adapted for coupling the receiver to the contact pairs 23, 24.

The combined microphone and signaling device 20 is shown schematically to simplify the drawings. It is to be understood that a complete disclosure and description of such device may be had by reference to my hereinbefore mentioned patents. As schematically illustrated at stations I and VI, the device 20 comprises a permanent magnet with pole-pieces 30, a vibratile armature 31, a coil 32 encircling the armature, a diaphragm 33 mechanically coupled to the armature, a pair of rotatable magnetic members 34 mounted on a shaft 35 which is actuated by a hand operated, rotatable lever 36 through a gear train comprising spur gears 37, 38 and beveled gears 39, 40. The receiver 21 is similar to the device 20 except that the signaling mechanism, that is, the rotatable magnetic members, shaft, gear train and lever, is omitted. To simplify the drawings, the detailed showing of the speech and signaling equipment, switchhook, key and non-linear resistance is omitted at stations II to V.

The station selector switch 25 comprises a pair of individually adjustable contact arms or contact wipers 41, 42 and two sets of six contacts, one set associated with each contact arm. The contacts of the selector switch are arranged and identified alike at each station. The stations are interconnected by the wires 1, 2 . . . 6 and 7, 8 . . . 12, multiplied to correspondingly numbered terminals on the terminal strips at each station. At each station, five pairs of these wires are also connected to correspondingly numbered contacts of the selector switch. Hence, the selector switch at each station has one pair of unused contacts; at station I these may be those numbered 1 and 7; at station II, 2 and 8; at station III, 3 and 9; at station IV, 4 and 10; at station V, 5 and 11; and, at station VI, 6 and 12. Instead of being connected to these unused selector switch contacts at the respective station, the correspondingly numbered station-interconnecting wires are terminated at the similarly identified terminals of the terminal strip. At each station, these latter terminals are connected over wires 43, 44 to the coil 32 of the device 20, wire 44 also connecting with contact arm 41, and wires 43, 44 also connecting with the movable contacts of contact pairs 23, 24. The contacts of key 27 are connected between wire 43 and the contact arm 42 of the selector switch by wires 45, 46, and the lower contact of the key is connected over wire 47 to the receiver side of contact pair 24.

The operation of the system illustrated in Figs. 1 and 2 and the functions of the various components thereof will be better understood from the following description of a call between two of the stations, for example, from station I to station VI. Since selector switch contacts 6, 12 at each station are assigned to station VI, the calling party at station I adjusts the contact arms 41, 42 to these contacts. Before operating his signaling equipment, the calling party will lift his receiver from its support and place it to his ear; doing so closes the contact pairs 23, 24 and connects the receiver to the selector switch contact arms over the wires 44, 46 and 47. If station VI is in use, the talking currents in the channel comprising wires 6, 12 will be reproduced in the receiver at station I. If, on the other hand, station VI or one of the other stations was at that moment signaling station I over the channel comprising wires 1, 7, the high intensity sig-

naling current would be incoming to station I and to the receiver 21 and the combined microphone and signaling device 20. Unless some safeguard were provided, the party at station I might experience definitely unpleasant or painful effects with the receiver at his ear. The device 23 has a decreasing resistance characteristic with increasing potential drop thereacross or current therethrough, and for incoming currents above a preassigned intensity level, that is, above the expected maximum communication or talking currents level, may be proportioned to assume a very low resistance thereby reducing the signaling current effective in the receiver to a non-annoying or non-harmful level. For the normal level of speech currents, the device 23 would be proportioned to present a very high resistance, whereby the attenuation of speech currents could be as small as possible.

If station VI is idle and station I is not being signaled, the calling party at the latter replaces his receiver and operates the signaling equipment, that is, by rotation of the lever 36 and rotation and adjustment of the members 34 in close proximity to the magnet pole-pieces, and simultaneously closing the key 27. The intense undulatory signal current generated in coil 32 is transmitted to station VI over a path that comprises coil 32, wire 45, key 27, wire 46, selector switch arm 42 and contact 12, wire 12 to station VI; wire 44, coil 32 and wire 43 at station VI back to station I over wire 6; switch arm 41 and contact 6, wire 44 to coil 32 at station I. The signaling current in device 20 at station VI is translated into an audible signal thereat. If at the moment that the calling party had started to signal, the called party had removed his receiver either in answer to an immediately previously received call signal, or preparatory to signaling to one of the stations of the system, the strong signaling current would also be effective in the receiver at station VI because of the closure of contact pairs 23, 24 thereat. The presence of the non-linear current-resistance device 23, however, protects the user at station VI against any detrimental effect. It will be noted that because of the positioning of the device 23 on the receiver side of the contact pairs 23, 24, that device does not normally interfere with or reduce the normal effect of the incoming signaling current.

Let it be assumed that station VI is in the circuit condition shown in the drawing at the moment the call signal from station I arrives. On cessation of the call signal, the called party responds by placing receiver 21 to his ear and by talking into his microphone. Upon ceasing to operate his signaling equipment at station I, the calling party will have placed his receiver to his ear and released the key 27. Although coil 32 is thus disconnected from a path through key 27 to the channel comprising wires 6, 12, it remains connected to that channel through contact pair 24, wire 47 and the lower contact of key 27. With this exception, the communication or speech currents generated at each of stations I and VI follow the same path as that traced for the signaling current. The speech currents are intended to be translated primarily by the receiver 21 held to one ear of the user, but, during listening, the party at each station may place his other ear adjacent the diaphragm 33 and, in effect, have a two-receiver set, since the

device 20 will also translate the speech currents incoming to the station.

In the course of the connection between the stations, either the called party or the calling party may accidentally or inadvertently operate his signaling equipment. Or, a party at one of the other stations, disregarding the busy condition of the stations in use may attempt to signal one of them, that is, station I over the channel comprising wires 1, 7, or station VI over wires 6, 12. Device 28, in such instances, effectively by-passes the signaling current that may be generated. At the conclusion of the conversation between the parties at stations I and VI, the connection is terminated by replacement of the receivers on their supports at the stations, whereby the station circuits are restored to their initial conditions.

It might be assumed that, if the selector switch at any of stations II . . . V had its contact arms in engagement with the contacts 6, 12 thereof, such station would be signaling simultaneously with station VI when the signaling equipment at station I was operated. The open key 27 in each of such stations II . . . V precludes this from occurring. Of course, if the receiver 21 at one of these latter-mentioned stations were off its support for some reason, an incoming signaling circuit to the coil 32 at the station would be completed through that station's wire 47 and contact pair 24. Because of the presence of variable resistance device 28, the call signal would be considerably below the normal loudness level, which fact could serve as a warning that the receiver was not on its support.

It will be apparent that the establishment of a speech currents connection between any one pair of stations in the hereinbefore described system does not render the system unavailable to the other stations for establishment of speech current circuits between pairs of the remaining stations. For example, during the described connection between stations I and VI, the party at station II might wish to call the party at any one of stations III, IV and V. If the party at station III is desired, the contact arms of the selector switch at station II are set to the contacts assigned to that station, namely, contacts 3, 9, key 27 of station II is depressed and the signaling equipment of device 20 operated. From the specific description with reference to stations I and VI, it will be evident that the signaling current generated at station II traverses the channel comprising wires 3, 9. It is to these wires that the wires 43, 44 at station III are permanently connected and the signaling current, therefore, is effective in the device 20 provided at station III to produce the audible call signal. When the latter station responds, a speech currents path is provided by the channel comprising wires 3, 9, the speech current path at station II being through the selector switch thereat and through wires 43, 44 at station III. Stations IV and V might be interconnected over either of the channels comprising wires 5, 11 or wires 4, 10, depending on which is the calling station. In the six-station system disclosed, therefore, three pairs of stations may be interconnected at any one time. The system is not limited to six stations, but may comprise a larger number by increasing the number of pairs of contacts on the selector switches at each station, and increasing by the same number the pairs of wires multiplied between the stations.

Although the invention has been disclosed with reference to a single illustrative embodiment, it is to be understood that it is not limited thereto, but is capable of other exemplifications without departing from the inventive concept.

What is claimed is:

1. In a telephone system of the batteryless type, a plurality of current transmission channels, a batteryless telephone station individual to each channel and permanently connected thereto, and means at each station for selectively signaling to and establishing a speech currents connection with another of said stations over the channel to which the latter station is permanently connected.

2. In a telephone system of the batteryless type, a plurality of batteryless telephone stations and a like number of current transmission channels multiplied to said stations with one station individual to and permanently connected to each channel; each of said stations comprising a station selector switch for connecting the respective station with all channels except that to which the respective station is permanently connected, a combined speech and signaling telephone, means for permanently connecting the telephone to the channel individual to the station, means for connecting said telephone through said selector switch to any one of the other channels during signaling out of the station to one of the other stations, and means for connecting said telephone over an alternative path through said selector switch after cessation of signaling to enable speech current transmission over the selected one of said channels.

3. In a telephone system of the batteryless type, a plurality of batteryless telephone stations and a like number of current transmission channels multiplied to said stations with each station individual to and permanently connected to a different channel; each of said stations comprising a station selector switch for selectively connecting the respective station with any one of the channels other than that to which the respective station is permanently connected, each station comprising a combined speech and signaling telephone including a coil, signaling means for generating signaling frequencies in the coil, means for generating speech frequencies in the coil, said coil being permanently connected across the channel individual to its station whereby any signaling current in the said channel has access to the coil, means for connecting the coil through its respective selector switch to any one of the other channels for and only during signaling out of the station to one of the other stations in the system, and means for reconnecting the coil over an alternative path through the selector switch to the channel of the selected station upon cessation of signaling out of the station, said last-mentioned means simultaneously connecting in parallel with the coil a device presenting a high resistance to speech currents and a relatively low resistance to signaling currents.

4. In a telephone system of the batteryless type, a plurality of batteryless telephone stations and a plurality of current transmission channels for interconnecting said stations, each channel providing a path for both signaling currents and speech currents in a call between a different pair of the stations; each station comprising a coil adapted to receive and transmit speech and signaling currents over any of said channels but

permanently connected to and individual to only one of said channels, signaling means for generating signaling currents in said coil, means for generating speech currents in said coil, and means connectible in parallel with said coil and independent of the signaling means to minimize the effect of inadvertent signaling on a channel in use between two stations.

5. In a telephone system of the batteryless type, a plurality of batteryless telephone stations and a plurality of current transmission channels for interconnecting said stations, each channel providing a path for both signaling currents and speech currents in a call between a different pair of the stations; each station comprising a combined speech and signaling telephone including a coil adapted to receive and transmit speech and signaling currents over any of said channels but permanently connected and individual to only one of said channels, a second telephone to be held to the ear of the party at the station during a call and including a coil, said second coil being connectible with said first coil to said one channel, signaling means for generating sig-

naling currents in said first coil, means for generating speech currents in said first coil, and means connectible with said second coil simultaneously to said one channel and independent of the signaling means at any of the stations, for substantially reducing the effect in the second telephone of the presence of signaling current in said one channel during the course of a call thereover.

10 6. In a telephone system of the batteryless type, a common speech and signaling currents channel, a coil adapted to receive and transmit speech and signaling currents over said channel, and means bridged across said channel during
15 transmission of speech currents over said channel, said means offering high resistance to speech current flow therethrough but relatively low resistance to signaling current flow therethrough, thereby minimizing the effect in the coil of signaling current flow in the channel during use
20 of the coil and channel for speech currents transmission.

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