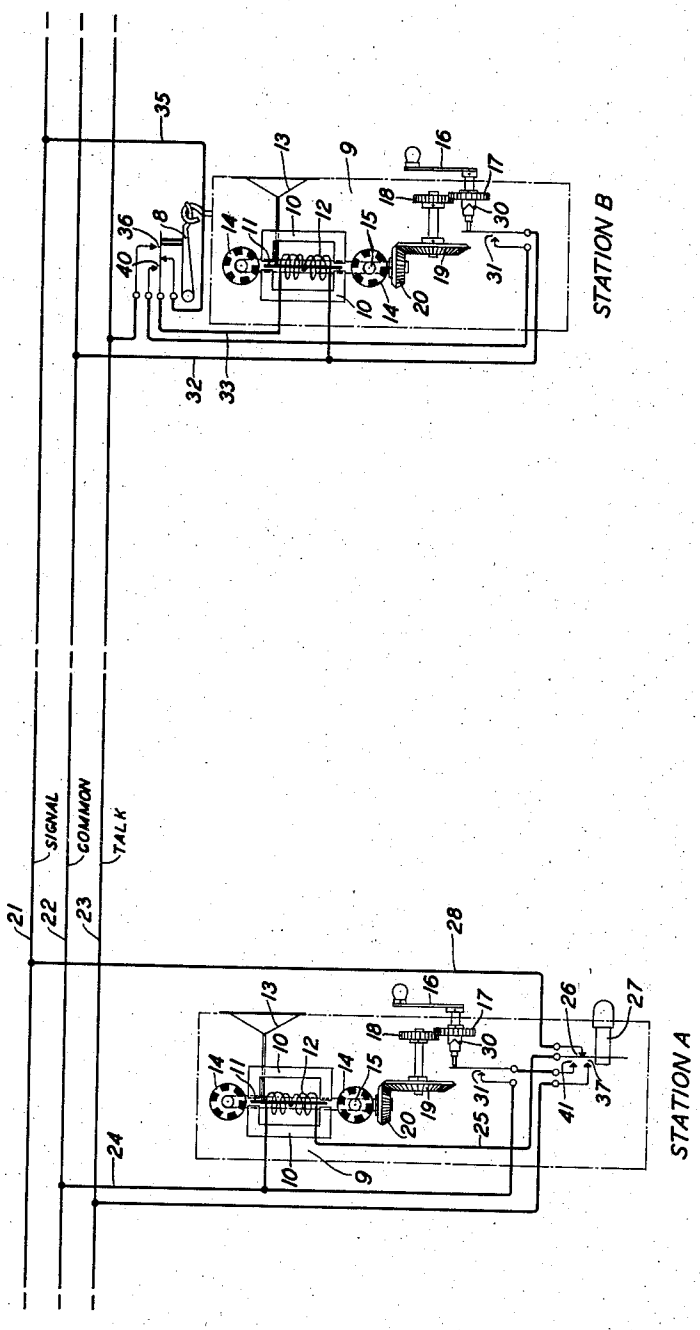
Jan. 24, 1939. G. E. ATKINS 2,144,867

TELEPHONE SYSTEM

Filed Feb. 6, 1937 3 Sheets-Sheet 1

FIG. 1



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TELEPHONE SYSTEM

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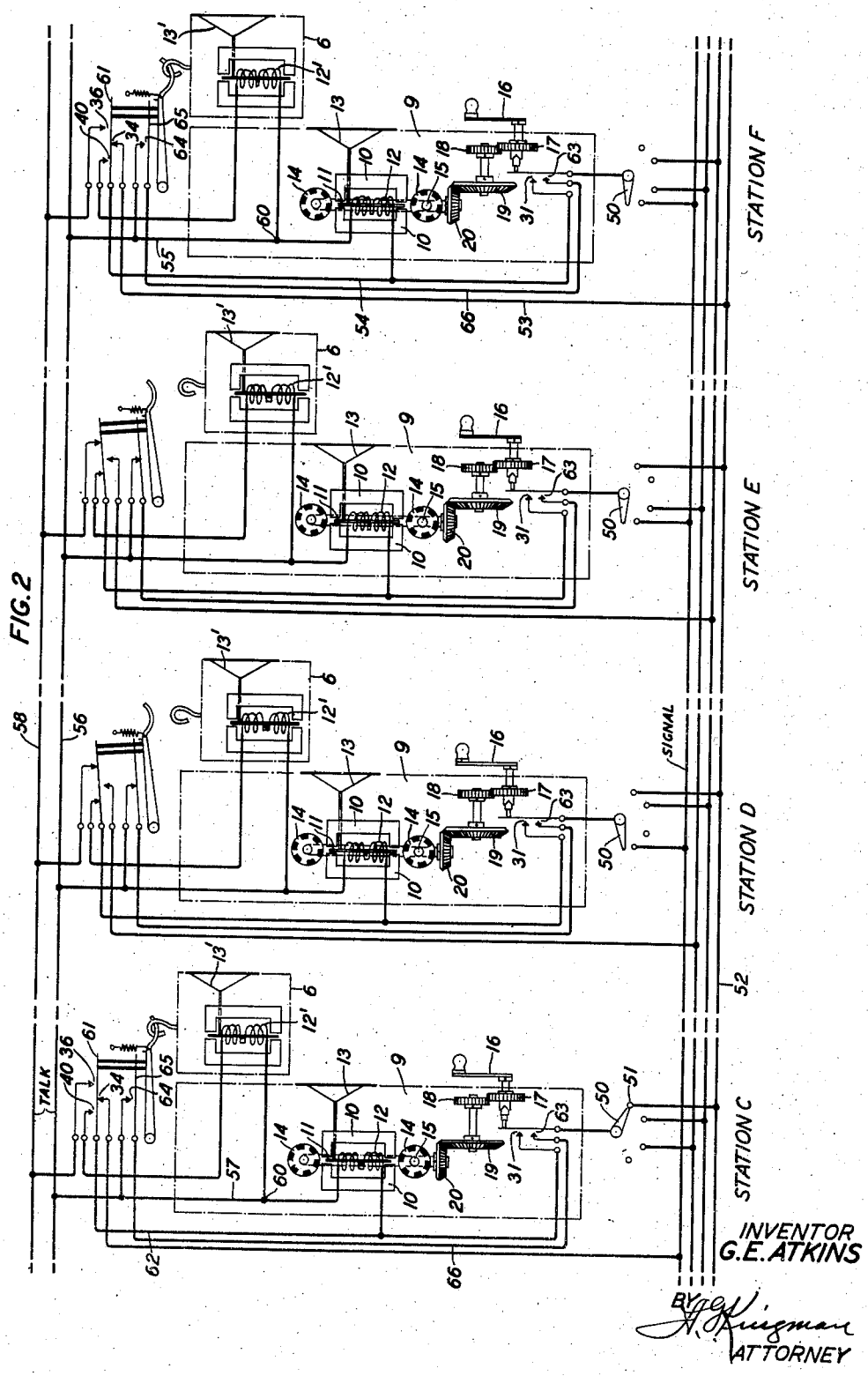

FIG. 2

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TELEPHONE SYSTEM

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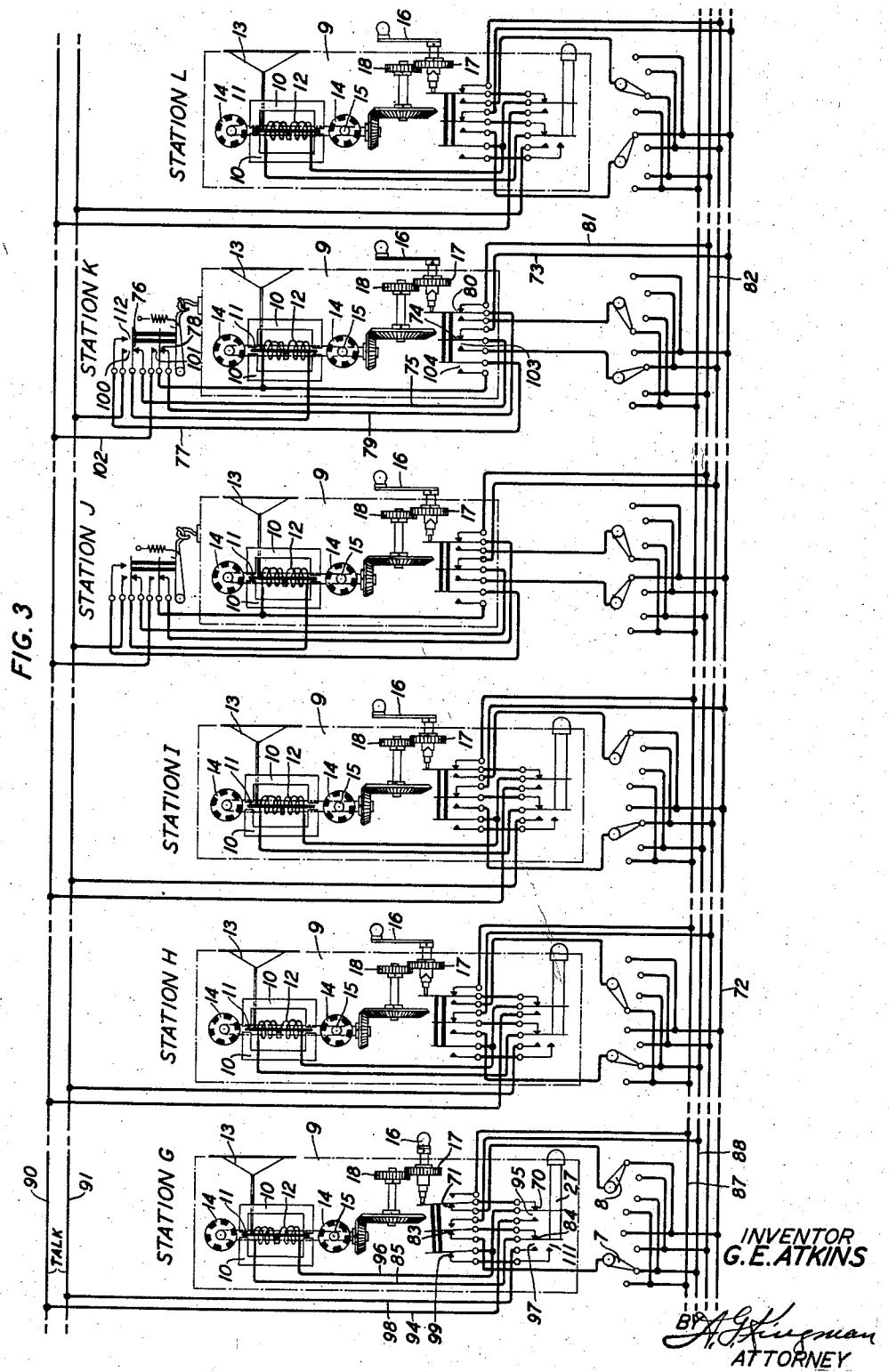

FIG. 3

Patented Jan. 24, 1939 2,144,867

UNITED STATES PATENT OFFICE

2,144,867

TELEPHONE SYSTEM

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Application February 6, 1937, Serial No. 124,414

14 Claims. (Cl. 179—37)

This invention relates to telephone systems and more particularly to intercommunicating systems which function without batteries or other similar sources of energy separate from the transmitting and receiving equipment employed in such systems.

In batteryless systems of telephone communication of the type disclosed in United States Patent 1,994,630 issued March 19, 1935, to G. E. Atkins, it is the practice to utilize a combined speech and signaling telephone device comprising, basically, a pair of armature type magnetic sound translating devices interconnected by line wires. Each sound translating device is operable both as a receiver and as a transmitter and comprises a permanent magnet having juxtaposed pole-pieces, a vibratile armature having a portion disposed between the armature pole-pieces and a coil encircling the armature and connected or adapted to be connected across the line. A diaphragm is mechanically coupled to the armature and is adapted to vibrate the armature in accordance with speech waves to induce an audible frequency current in the coil. Conversely, the diaphragm is vibratable by the armature in accordance with currents sent through the coil to reproduce speech and other audible signals.

As fully disclosed and described in the above-identified patent, means are provided for periodically varying the reluctance of the magnetic circuit including the armature whereby a signaling current of relatively strong intensity is induced in the coil to effect a call signal. In one form, a rotatable member of magnetic material having a slotted undulatory periphery is disposed so that as the magnetic member rotates on a shaft, it passes in immediate proximity to the pole-pieces.

The rotatable magnetic member is mounted so that it is moved from proximity to the pole-pieces of the magnet when it is desired to transmit or receive speech signals. To this end, the member is mounted on a slidable shaft engaged at one end by a spring which normally holds the shaft in such position that the member is removed from proximity to the pole-pieces of the magnet. The shaft may be rotated by a gear train including a pair of spiral gears one of which is mounted upon the shaft. The spiral gears are disposed so that the thrust thereof acts against a spring to move the shaft along its axis. The movement of the shaft resulting from this thrust is limited by a stop so that the magnetic member is brought into position in proximity to the pole-pieces of the magnet.

In a two-party telephone system of this nature, as disclosed in the Atkins patent, the armature encircling coil is permanently bridged across the line wires so as to be in constant readiness for the transmission or reception of speech or other audible signals.

It is the object of this invention to provide an improved batteryless telephone system of intercommunication utilizing a combined speech and signaling device of the type described generally above.

This object is attained in accordance with a feature of the invention by the provision of separate signaling and talking channels between stations and of means for switching the coil of the combined speech and signaling device from one to the other of said channels depending upon whether speech or call signals are to be transmitted.

Another feature of the invention resides in the provision of means for effectively short-circuiting the transmitter coil should an attempt be made by a subscriber to initiate a call signal when the transmitter coil is bridged across the talking channel thereby precluding the possibility of acoustic shock under such conditions.

A further feature of the invention provides for the selective signaling of stations on a multi-party line with a minimum of line wires interconnecting the stations.

These and other features of the invention will be readily understood from the following detailed description made with reference to the accompanying drawings, in which:

Fig. 1 illustrates a two-party system of telephone intercommunication embodying the features of this invention;

Fig. 2 illustrates a four-party line circuit, each station of which is provided with a dial type selector by virtue of which the other stations of the system may be selectively signaled; and

Fig. 3 shows a six-party line system which, by virtue of the provision of two dial-type selectors at each station, requires no more signaling channels between stations than does the four-party line arrangement shown in Fig. 2.

The combined speech and signaling telephone device located at each of the stations illustrated in the drawings is shown schematically in order to simplify the disclosure. It is to be understood that a complete disclosure and description of such a device may be had by reference to the Atkins' patent hereinbefore mentioned. As schematically represented in the drawings, each device consists of a permanent magnet 10,

a vibratile armature 11, a coil 12 encircling the armature, a diaphragm 13 mechanically coupled to the armature, a pair of rotatable magnetic members 14 mounted on a shaft 15 which is actuated by a rotatable lever 16 through the medium of a gear train comprising gears 17 and 18 and beveled gears 19 and 20.

With particular reference to Fig. 1, the stations A and B are shown interconnected by three wires 21, 22 and 23, the wires 21 and 22 combining to form a signaling channel and the wires 22 and 23 constituting a speech channel. At station A the transmitter coil 12 is normally bridged across the signaling channel by way of the conductors 24 and 25, normally closed contact 26 of a "push to converse" switch 27 and conductor 28. In this manner, the actuation of a signaling lever or crank 16 at another station, such as station B, would cause the coil 12 to be energized and the armature 11 and diaphragm 13 to be vibrated accordingly to produce a call signal at the station A. The transmitter coil 12 at station B is similarly bridged across the line wires 21 and 22 so that each station is normally conditioned for the reception of a call signal from the other station.

Assuming that the subscriber at station B desires to signal the subscriber at station A, the lever 16 at station B is actuated. Due to the V-slot construction illustrated at 30, the rotation of lever 16 causes the inner end of the lever shaft to experience an axial thrust which results in the closure of contacts 31, which, with the device 9 located on its switchhook 8, performs no useful function. The lever 16 is rotated to cause the rotation of the discs 14 and 15 in the proximity of the pole-pieces of the permanent magnet 10 to periodically vary the reluctance of the magnetic path including the armature 11, as fully described in the hereinbefore mentioned Atkins patent. A signaling current of relatively strong intensity is, accordingly, induced in the coil 12 which is bridged across the conductors 21 and 22 by way of conductors 32, 33, normally closed switchhook contacts 34 and conductor 35. This current traverses the conductors 21 and 22 and thence through the coil 12 at station A, which coil, as hereinbefore stated, is normally bridged across the signaling channel. The armature 12 and its associated diaphragm 13 at station A are accordingly vibrated, causing the latter to emit an audible signal.

After transmitting the call signal the subscriber at station B lifts the combined signaling and telephone device 9 from its switchhook, whereupon the coil 12 at station B is transferred from the signaling channel to the talking channel by virtue of the opening of switchhook contacts 34 and the closure of switchhook contacts 36.

Upon receipt of the call signal at station A, the subscriber thereat actuates the "push to converse" switch 27, thereby opening contacts 26 to remove the coil 12 from the signaling channel and closing contacts 37 to connect the coil to the talking channel. The subscriber's equipment at each station is now in condition for the transmission and reception of speech signals. When talking, the subscriber speaks into a mouth-piece (not shown) to actuate the diaphragm 13 in a well-known manner and when listening, the ear may be placed in close proximity to the mouth-piece, though the speech signals will be clearly audible to the subscriber when at a distance from the telephone.

It is to be understood that the device at station B may be equipped with a "push to converse" switch similar to that shown at station A in place of the receiver switchhook. In like manner, the switch 27 at station A may be replaced by a receiver switchhook arrangement, it being obvious that both types of switches perform the same functions. The arrangement at station A may be desirable where it is not convenient to hang the telephone on a switchhook.

At the termination of conversation, the party at station A releases the switch 27 and the party at station B replaces the device 9 on its switchhook and the circuit connections are restored to normal condition.

It will be noted that during the period of conversation or when the switch 27 at station A is actuated to the talking position and the device 9 at station B is removed from its switchhook, the coils 12 at the stations A and B are bridged across the talking channel made up of conductors 22 and 23. Under these conditions and unless provision is made to avoid it, the actuation of a signaling lever 16 at either station would result in the transmission of a call signal and should one of the subscribers, at that time, have the telephone device close to the ear, he would be subjected to an acoustic shock. In the present system, such an occurrence is avoided by the interconnection of switchhook contacts 40 at station B (or the corresponding contacts 41 at station A) and the signal switch contacts 31 at station B (or the corresponding contacts 37 at station A), the latter contacts in each case being actuated when the lever 16 is actuated to transmit a call signal. It will be noted that under this condition the coil 12 at the station at which the call signal is initiated is short-circuited so that no signal will be transmitted.

In the four-party selective system illustrated in Fig. 2, each station is provided with a selector switch 50 which is employed to selectively establish a signaling path to any of the other stations on the line. At each station there is provided a combined signaling and telephone device 9 similar to those illustrated in Fig. 1 and an additional telephone instrument 6 which is similar to the devices 9 except that the signaling equipment has been omitted. It is to be understood that the devices 6 are not essential to the proper functioning of the system disclosed but may be furnished as a separate receiver merely as a matter of convenience.

In order to provide a complete understanding of the system disclosed in Fig. 2, the following description is directed to the establishment of a connection between stations C and F with the party at station C calling the party at station F.

The selector switch 50 at each station will be provided with proper designations to enable the parties to select the correct terminal for the party with whom it is desired to converse. In the case to be described, the party at station C turns the selector dial to the terminal corresponding to the station to be called. The dial will then occupy the position shown in the drawings and the party at station C will actuate the lever 16 to generate a call signal in the coil 12 which is transmitted to station F over a circuit extending from the lower terminal of coil 12, contact 31 of the signaling equipment at station C, selector switch arm 50 and contact 51, conductor 52, conductor 53, normal switchhook contacts 34, conductor 54, coil 12, conductor 55, common conductor 56, conductor 57, to the upper terminal of coil 12. The coil 12 at the called station F is energized accordingly to

actuate the diaphragm 13 and cause it to produce a call signal.

After the actuation of the signaling mechanism at station C the receiver 6 is removed from its switchhook and upon receipt of the signal at station F the receiver 6 thereat is removed from its switchhook, whereupon coils 12 and 12' at each station are connected in parallel across the speech channel comprising conductors 56 and 58. The parallel circuit established by the removal of the receiver 6 from their respective switchhooks extends from conductor 56 to the point 60 and thence, in one path, through coil 12', switchhook contacts 40 and 36 and their associated spring 61 to the conductor 58 and, in a second path, through coil 12, conductor 62, switchhook spring 61 and switchhook contacts 36 to conductor 58. The switchhook contacts are shown in their actuated positions at stations D and E in order to illustrate the circuits just traced.

The equipment at stations C and F is now in condition for speech transmission and reception, the diaphragms 13 being used for transmitting and the diaphragms 13' for receiving. It is to be understood that the diaphragms 13 and 13' may be used either to transmit or receive speech signals at the convenience of the party using the equipment.

As in the case of the two-party system disclosed in Fig. 1, it is impossible for either party to transmit a call signal when the device 6 is removed from its switchhook at either station. The actuation of the signaling lever 16 causes the closure of contacts 31 and 63 so that, with the device 6 removed from its switchhook, the coils 12 are short-circuited, the short extending from conductor 56, switchhook contact 64 and associated spring 65, conductor 66, contacts 63 and 31, conductor 62, switchhook spring 61 and contact 36 to the conductor 58. The coils 12 thus being short-circuited do not function as a signal transmitting medium should the signaling equipment be actuated when the device 6 is removed from its switchhook.

It is unnecessary to describe how the party at station C may communicate with stations D and E or how any station in the system may signal any other station since the procedure is identical with that already set forth in the description of the connection between stations C and F. It is only necessary that the selector 50 at the calling station be set on the terminal corresponding to the called station and the signaling lever 16 be actuated in the manner already described.

The arrangement disclosed in Fig. 3 illustrates the manner in which the capacity of a system of intercommunication such as is shown in Fig. 2 may be enlarged without increasing the number of signaling conductors between stations. As in the four-party system hereinbefore described, but four signaling conductors are employed in the six-party system shown in Fig. 3. This is made possible by the use of a double selector switch at each station on the line, the movable switch elements of which may be set in various combinations to select any of five other stations. It will be understood also that the addition of a fifth signal conductor and corresponding selector switch contacts would increase the capacity of the system by four stations; a sixth conductor and corresponding selector switch contacts would increase the capacity by five more stations, etc., as will be more fully explained later.

Each station of this type system, which may be conveniently termed the "double dial" type, would be furnished with the necessary instruction card bearing the dial settings to be employed in signaling the various stations on the line.

In describing the operation of this system, it will be assumed that the party at station G desires to communicate with the party at station K. In accordance with instructions, the party at station G will set dial switch 7 on the second contact and dial switch 8 on the fourth contact and actuate lever 16, which is shown in the drawings in its actuated condition. A circuit will thereupon be established extending from the lower terminal of coil 12, conductor 96, normal contact 70 of "push to converse" switch 27, alternate contact 71 of the signaling switch dial switch 8 and its associated contact, signal conductor 72, conductor 73, normal contact 74 of the signal switch at station K, conductor 75, normal switchhook contact 76, conductor 77, coil 12 at station K, normal switchhook contact 78, conductor 79, normal signal switch contact 80, conductor 81, signal conductor 82, second selector contact and dial switch 7 at station G, alternate contact 83 of the signal switch at station G, normal contact 84 of "push to converse" switch 27, conductor 85 and through coil 12 back to its lower terminal. The signaling current generated in coil 12 at station G accordingly traverses the path just traced to energize the coil 12 at station K, which in turn causes the diaphragm 13 thereat to vibrate and emit a call signal.

The party at station G, after the actuation of the signal transmitter, operates the "push to converse" switch 27, thereby transferring the coil 12 from its normal association with signaling conductors 87 and 88 (the signal switch being now in its normal position) to the talking conductors 90 and 91. In like manner, the removal of the device 9 at station K from its switchhook in response to the call signal transfers the coil 12 thereat from the signal conductors 72 and 82 to the talking conductors 90 and 91. The parties at stations G and K may now converse, using their respective telephone diaphragms 13 for this purpose.

As in the other cases hereinbefore described, it is impossible for a call signal to be transmitted over the talking conductors when the coils 12 at interconnected stations are bridged across the speech channel for talking purposes. In order to more clearly describe how this feature is attained in the present case, the circuit established when the "push to converse" switch is actuated will be traced as follows: from line conductor 91, conductor 98, contact 97 and associated spring of "push to converse" switch 27, conductor 85, coil 12, conductor 96, spring and contact 95 of "push to converse" switch 27, conductor 94 to the other line conductor 90. When the signal lever 16 is actuated while switch 27 is in its operated position, coil 12 is effectively short-circuited by the switch contacts 99 and 111. The circuit just traced, instead of including the coil 12, passes through the closed contacts 97, 84, 99 and 95 and thence back to line conductor 90 by way of conductor 94. The signal switch therefore acts to short-circuit the coil 12 when the latter is connected across the speech channel by the actuation of "push to converse" switch 27, thereby preventing acoustic shock to any other party whose receiving device, or coil 12, is connected across the line when a calling party either inadvertently or otherwise actuates the signal-

ing mechanism when the telephone device is conditioned for the transmission of speech.

At stations, such as stations J and K, at which a receiver switchhook replaces the "push to converse" switch 27 at other stations a similar provision is made. When the device 9 at such stations is removed from its switchhook, the coil 12 is bridged across the line in a circuit extending from line conductor 91, alternate switchhook contact 100, conductor 77, coil 12, alternate switchhook contact 101, conductor 102 to the other line conductor 90. When the signal switch is actuated under this condition, contacts 104 and 112 are closed to effectively short-circuit the coil 12. The circuit just traced, instead of including the coil 12, passes through the closed contacts 112, 104 and 101 and thence back to line conductor 90 by way of conductor 102.

It is to be understood that the "push to converse" switches and receiver switchhook arrangements are interchangeable and applicant has illustrated certain stations equipped with one or the other merely as a matter of convenience.

In the foregoing description, it was shown that in order to signal station K, it is necessary that the selector switches at the calling stations be set on contacts 2 and 4. The selector switch settings for the other stations on the line are as follows:

Station	No. 1 switch setting	No. 2 switch setting
G	Contact 1	Contact 2
H	Contact 1	Contact 3
I	Contact 1	Contact 4
J	Contact 2	Contact 3
L	Contact 3	Contact 4

The selector switches at the various stations shown in Fig. 3 are illustrated as set to all the possible signaling positions and as positioned, station G would signal station K as already mentioned, station H would signal station G, station I would signal station L, station J would signal station H and station K would signal station J.

It will also be observed that by increasing the capacity of the selector switches and correspondingly increasing the number of signal conductors, such as 72, 82, 87 and 88, the capacity of the system may be greatly enlarged. For example, the addition of a fifth switch contact and a fifth signal conductor would permit the addition of four more stations or would increase the line capacity to ten stations; the addition of a sixth switch contact and a sixth signal conductor would further increase the line capacity by five stations, or to fifteen stations, etc. It is evident, therefore, that the capacity of such a system may be greatly extended with a minimum of additional equipment.

What is claimed is:

1. In a telephone system of the batteryless type, a speech channel, a signaling channel, a coil adapted to receive and transmit both speech and signaling currents, said coil being normally bridged across said signaling channel, and switching means for transferring said coil from said signaling channel to said speech channel.

2. In a telephone system of the batteryless type, a station, a speech channel, a signaling channel, a combined speech and signaling telephone at said station having a coil adapted to receive and transmit both speech and signaling currents, said coil being normally bridged across said signaling channel for the reception of incoming signals other than speech signals and a switch associated with said telephone for transferring said coil from said signaling channel to said speech channel for the reception and transmission of speech signals.

3. In a telephone system, a signaling channel, a speech channel, a coil normally bridged across said signaling channel, signaling means for generating a signal frequency in said coil, switching means for transferring said coil from said signal channel to said speech channel and switching means controlled by said signaling means and effective after the operation of said first switching means for short-circuiting said coil.

4. In a telephone system of the batteryless type, a station, a speech channel, a signaling channel, a combined speech and signaling telephone at said station having a coil adapted to receive and transmit both speech and signaling currents, said coil being normally bridged across said signaling channel for the reception of signals other than speech signals, signaling means operable to generate in said coil a signaling current, a switch associated with said telephone for transferring said coil from said signaling channel to said speech channel, and means effective upon the conjoint operation of said signaling means and said switch for short-circuiting said coil.

5. In a telephone system of the batteryless type, a speech channel, a combined speech and signaling telephone including a coil, signaling means for generating signaling frequencies in said coil, means for generating speech frequencies in said coil, switching means for connecting said coil to said speech channel for the transmission of the speech frequencies generated therein, and means effective upon the conjoint operation of said signaling frequency generating means and said switching means for rendering the operation of said signaling frequency generating means ineffective in generating signaling frequencies in said coil.

6. In a telephone system of the batteryless type, a speech channel, a combined speech and signaling telephone including a coil, signaling means for generating signaling frequencies in said coil, means for generating speech frequencies in said coil, switching means for connecting said coil to said speech channel for the transmission of the speech frequencies generated therein, and means effective upon the conjoint operation of said signaling frequency generating means and said switching means for rendering the operation of said signaling frequency generating means ineffective in generating signaling frequencies in said coil, said means comprising interconnected contacts associated with said signaling frequency generating means and said switching means which cooperate to effectively short-circuit said coil.

7. In a telephone system of the batteryless type, a line circuit having a plurality of stations associated therewith, a combined speech and signaling telephone located at each of said stations and each having a coil, a plurality of signaling channels interconnecting said stations, signaling means at each of said stations adapted to generate in the coil thereat a signaling frequency, means at each of said stations for selectively connecting the signaling means thereat with any of said plurality of signaling channels, and means controlled by said signaling means at each station for connecting the coil thereat to the selected signaling channel whereupon the signaling frequency generated in said coil is transmitted over the selected signaling channel.

8. In a telephone system of the batteryless type,

a multi-station line circuit, a signaling channel, a combined speech and signaling telephone at each of the stations on the line circuit including a coil adapted to receive and transmit speech and signaling frequencies and normally connected to said signaling channel, a receiver including a coil normally on open circuit with respect to said line circuit and said signaling channel, and means responsive to the removal of said receiver from its switchhook for disconnecting the coil of said combined speech and signaling telephone from said signaling channel and connecting it in parallel with the coil of said receiver across said line circuit.

9. In a telephone system of the batteryless type, a multi-station line circuit, a signaling channel, a combined speech and signaling telephone at each of the stations on the line circuit including a coil adapted to receive and transmit speech and signaling frequencies, and normally connected to said signaling channel, signaling means for generating signaling frequencies in said coil, a receiver including a coil normally on open circuit with respect to said line circuit and said signaling channel, means responsive to the removal of said receiver from its switchhook for disconnecting the coil of said combined speech and signaling telephone from said signaling channel and connecting it in parallel with the coil of said receiver across said line circuit, and means controlled jointly by the receiver switchhook and said signaling means for effectively short-circuiting the coils of both said combined speech and signaling telephone and said receiver.

10. In a telephone system of the batteryless type, a speech channel, a signaling channel, a combined speech and signaling telephone including a coil adapted to receive and transmit speech and signaling frequencies, means for generating speech frequencies in said coil, means for generating signaling frequencies in said coil, switching means for connecting said coil to said signaling channel for the transmission of signaling frequencies thereover, and switching means for connecting said coil to said speech channel for the transmission of speech frequencies thereover, both said switching means cooperating when operated jointly to short-circuit said coil.

11. In a telephone system of the batteryless type, a multi-station line circuit, a combined speech and signaling telephone at each station including a coil, signaling means at each station for generating in the coil thereat a signaling frequency, signal conductors of lesser number than the number of stations on said line circuit interconnecting said stations, means at each of said stations for selectively seizing said signal conductors in various combinations of two conductors to establish signaling channels and means for connecting said coil to the selected combination of signal conductors.

12. In a telephone system of the batteryless type, a multi-station line circuit, a combined speech signaling telephone at each station including a coil, switching means at each station for connecting said coil to the line circuit, signaling means at each station for generating in the coil thereat a signaling frequency, signal conductors of lesser number than the number of stations on said line circuit interconnecting said stations, means at each of said stations for selectively seizing said conductors in various combinations of two conductors to establish signaling channels, means for connecting said coil to the selected signaling channel, and means controlled by the conjoint operation of said switching means and said last-mentioned connecting means for short-circuiting said coil.

13. In a telephone system of the batteryless type, a multi-station line circuit constituting a common speech channel for the stations thereon, signal conductors interconnecting said stations and fewer in number than the number of stations, means at the stations for selectively seizing said signal conductors in various combinations of pairs, signaling means at each station, and means controlled by said signaling means and effective upon the operation thereof to connect said signaling means to the selected pair of signal conductors.

14. In a telephone system, a multi-station line circuit, a signaling coil at each station on the line circuit, signaling means at each station for generating in the coil thereat a signaling frequency, signal conductors of lesser number than the number of stations on the line circuit interconnecting the stations, means at each of the stations for selectively seizing said signal conductors in various combinations of two conductors to establish signaling channels and means for connecting said coil to the selected combination of signal conductors.

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