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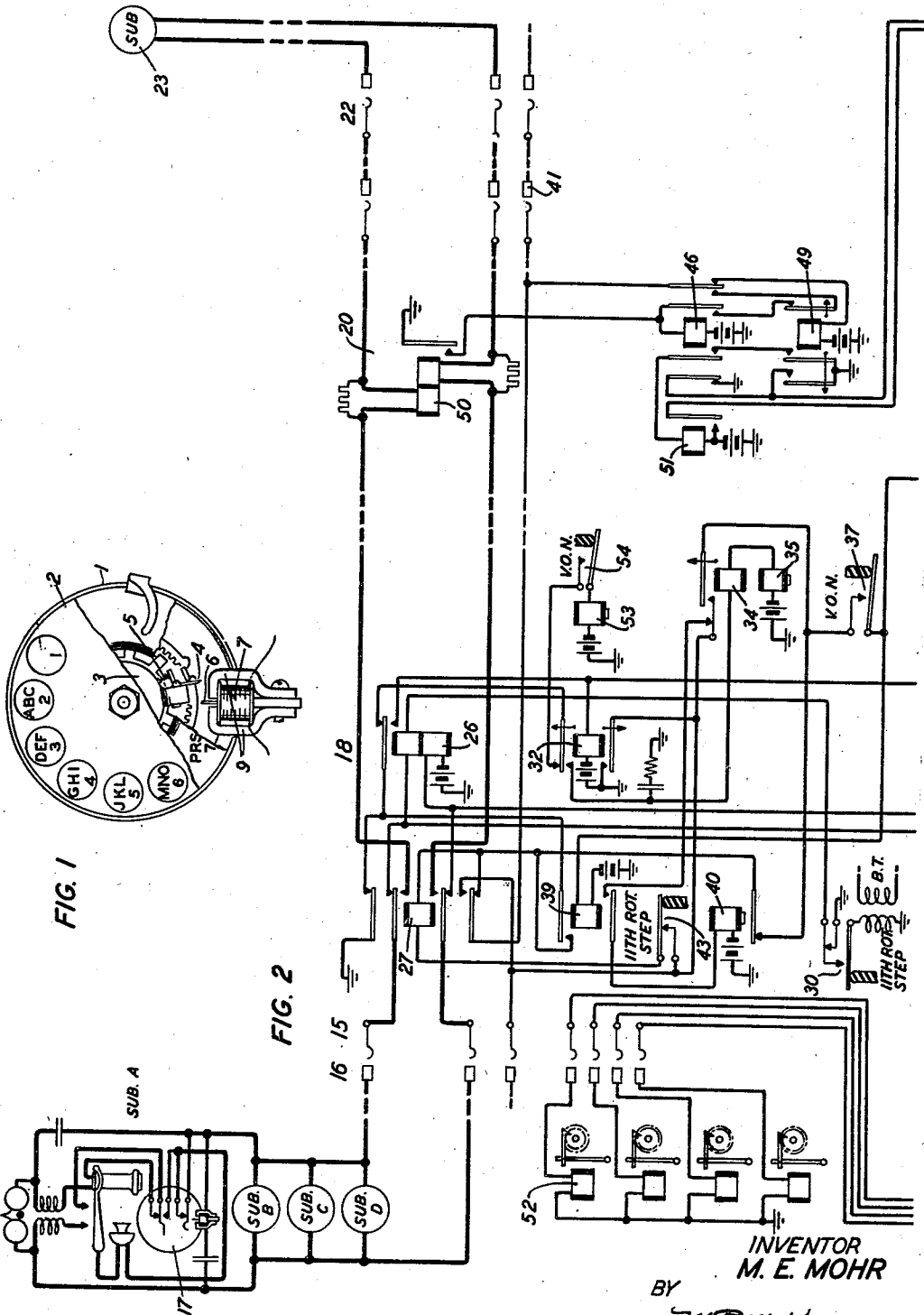
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2,283,610

TELEPHONE SYSTEM

Filed Feb. 2, 1940

2 Sheets-Sheet 1



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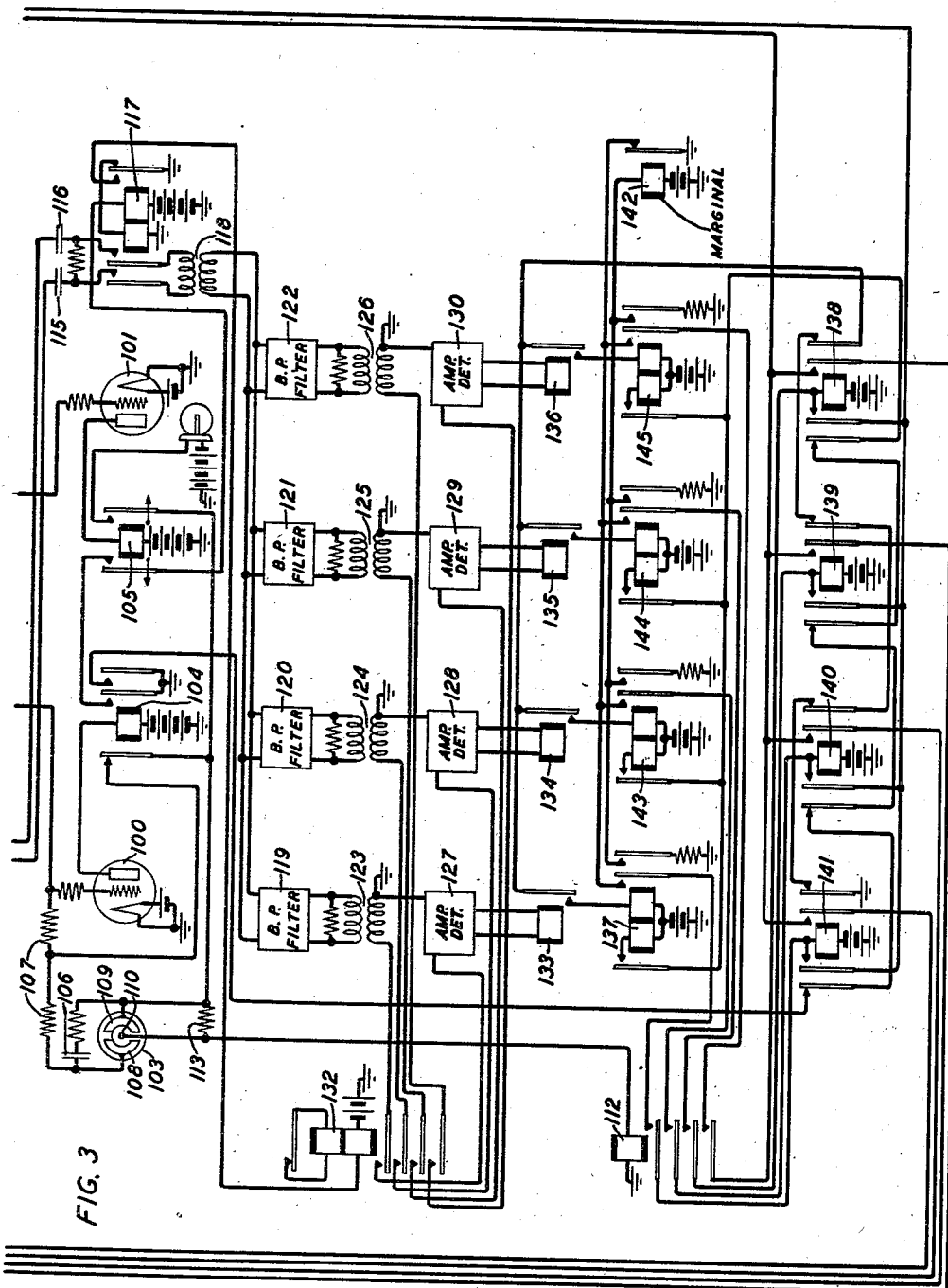
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TELEPHONE SYSTEM

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11 Claims. (Cl. 179—8.5)

This invention relates to telephone systems and particularly to improvements in systems for identifying subscribers on party lines.

An object is to increase the reliability and effectiveness of the identification tests used for determining the calling subscribers on party lines.

Heretofore various systems have been provided in which tests were performed by employing devices at the different party line stations for producing oscillations on the line, the frequency of which differs according to which station is calling. These oscillations become effective when a party is calling by the application of direct current or alternating current at the central office in various manners to identify the calling line. Some systems of this kind employ variously tuned reeds at the substation for producing the oscillations which may be detected at the central office for identification of a calling party. The reeds may be operated by the operation of a dial at the substation or by the operation of separate levers. The reeds may be arranged to interrupt the line or act in the magnetic field of a coil to produce the oscillations.

According to the present invention advantages are obtained over these prior arrangements by utilizing a party line identification system in which a vibratory reed of a different natural frequency is provided at each subscriber's station, with means for plucking the reed at the calling station when the dial returns to normal after having been operated to send the digit. The vibratory reed sets up in a coil electrical oscillations of a frequency corresponding to the natural frequency of the plucked reed.

It is a feature of the present invention to provide means at the central office comprising a selector and a register associated therewith which responds to such oscillations for identifying the calling station on a party line. The arrangement is such that this register is not actively connected to the line until after the selector has been operated by dial pulses, to prevent false oscillations, due to the dialing over the line, from being picked up by the register. Service meters may be provided in the line circuit to be controlled by the setting of the register to record calls from the various stations of the party line.

The invention has been illustrated in the accompanying drawings in which:

Fig. 1 shows a dial structure with a vibrating reed that may be actuated when the dial returns to normal. This reed is located in a coil to produce electrical oscillations in the line; and

Figs. 2 and 3 show a telephone system including

a selector and register circuit, embodying the applicant's invention.

Referring to the drawings, a party line has been shown with one subscriber's station circuit in detail, and a line finder connected thereto which has only been illustrated by means of the terminals for the party line and brushes for the line finder. A selector circuit has been shown for connecting the party line through the line finder to circuits beyond, which have been indicated merely in a diagrammatic form as leading to a called subscriber's line. A registering device connectable to the selector for identifying a calling line has been shown in detail in accordance with the applicant's invention.

Referring to Fig. 1, a dial 1 has been shown in which the usual finger-wheel 2 is attached to the hub 3. To this hub 3 is connected a trigger 4 operated upon by a spring 5 so that when the finger-wheel 2 is moved in the clockwise direction to send a digit, this trigger 4 will pass by a reed 6 without causing it to vibrate but on the return of the dial to normal, the trigger will pluck the reed and cause it to vibrate. The reed is mounted in a coil 7 which is provided with magnetic return pole-pieces 9 that may be connected in any suitable manner to the reed and to the side of the dial structure. This coil is connected across the line conductors as shown at the substation A in Fig. 2, so that the mechanical vibrations of the reed will, by acting in the electromagnetic field between the pole-pieces, set up in the coil electrical oscillations of a frequency corresponding to the natural frequency of the reed.

Referring now to the Figs. 2 and 3, the line finder will be operated to connect its brushes 15 to the terminals 16 of the calling line when any one of the parties on this line removes his receiver from the switchhook and any suitable line-finder circuit well known in the art may be used for this purpose. When this connection is established the calling party, for example, party A of the four parties A, B, C and D, will dial the first digit by operating the dial 17. This first series of impulses will operate the selector 18 to select as is usual in circuits of this kind a group of trunk circuits leading to second selectors and hunt to find an idle one of these selectors and the succeeding digits will operate the second selector and a connector such as 22 to establish a connection to a called subscriber's line 23 as is well known in the art.

A description will now be made of the effect of the first digit to establish a connection by the selector 18 to a second selector and to connect the

register shown in Fig. 3 to this selector 18 at the end of the digit to identify the calling party and record the call. When the connection is extended to the first selector 18 a circuit is completed for the operation of relay 26 from battery through the lower winding of this relay, contacts of relay 27 over the ring conductor, over the line finder through the calling subscriber's loop, back over the tip conductor, over the line finder, contacts of relay 27, upper winding of relay 26 to ground at the eleventh rotary step contacts 30 of the selector. Relay 26 closes a circuit for the operation of relay 32 from battery through the winding of this relay, contacts of relay 26 and 27 to ground. The register circuit shown in Fig. 3 is provided with vacuum tubes 100 and 101 and also a cold cathode tube 103, the purposes of which will become apparent hereinafter. The grid of tube 100 is normally negatively biased by being connected to battery through the winding of relay 32 so that the tube is normally not conductive, but it should be noted that on the operation of relay 26, a circuit is completed for this grid from ground through contacts of relays 27 and 26 causing current to flow through the winding of relay 32 and consequently this negative bias is reduced to zero making the tube conductive. This causes the operation of relay 104 from battery through the winding of this relay over the plate and filament circuit to ground. The operation of this relay 104 has no immediate effect on the circuit.

When relay 26 is released due to the opening of the circuit at the first impulse operation of the dial 17, the circuit for the grid of tube 100 to ground at contacts of relay 27 is opened and thus the tube 100 again becomes non-conductive, causing the release of relay 104. At the same time relay 34 and vertical magnet 35 become operated from battery through the windings of this magnet and relay in series through contacts of relays 32, 26 and 27 to ground. The operation of magnet 35 causes the brushes of selector 18 to take one step, thus closing the vertical off-normal contacts 37. These contacts now close a circuit for the operation of relay 39 from battery, winding of this relay, vertical off-normal contacts 37, contacts of relays 34 and 32 to ground. Relay 39 in operating provides a locking circuit for itself from battery, winding of this relay, off-normal contacts 37, contacts of the rotary magnet 40, contacts of relays 39 and 27 to ground. The grid of tube 101 is now connected to ground through the off-normal contacts 37 and contacts of relays 34 and 32 to ground or through contacts of the rotary magnet 40 and contacts of relays 39 and 27 to ground, thus removing the negative bias normally on this grid as applied through the winding of relay 39 from battery. Tube 101 now becomes conductive and closes a circuit for the operation of relay 105 from battery, winding of this relay over the plate, and filament circuit to ground. Relay 26 now operates at the end of the first impulse and releases and operates in response to the succeeding impulses of the first digit and alternately operates and releases the vertical magnet 35 to advance the brushes of the selector 18 to the desired group of second selectors. Relay 104 thus operates and releases for each impulse transmitted while relay 105 remains operated during the transmission of the impulse of the first digit as relay 34 is slow in releasing and remains operated during this transmission of the succeeding impulses and as long thereafter as relay 34 remains operated. In addition, relay 105 remains operated due to its slow-to-release char-

acteristics during the succeeding hunting operations even though relay 39 releases and operates alternately during these operations as herein-after described. When relay 26 operates after the last impulse is received, tube 100 becomes conductive and relay 104 now remains operated during the succeeding hunting operations of the selector and the vertical magnet 35 and relay 34 release. Relay 34 in releasing closes a circuit for the rotary magnet 40 from battery, winding of this magnet, contacts of relays 39, 34 and 32 to ground. The rotary magnet now operates and opens the locking circuit for the relay 39. Relay 39 therefore releases causing the release of the rotary magnet 40. The operation of rotary magnet 40 advances the brushes of the selector to the terminals of the first circuit to a second selector. If this selector is busy there will be a ground on the sleeve terminal 41 thereof so that when the rotary magnet 40 releases a circuit for relay 39 is again closed from battery through the winding of this relay, vertical off-normal contact 37, contacts of the rotary magnet 40, contacts of relay 27 to the sleeve brush of the first selector and the sleeve terminal 41 to ground. Relay 39 in operating closes the locking circuit through its upper armature and front contact and operates the rotary magnet 40 over the circuit before traced so that selector 18 will now take a second step. However, if the circuit leading to this second selector is idle, there will be no ground on the sleeve terminal 41 and consequently when the relay 39 releases on the operation of the rotary magnet 40, it will not be reoperated and thus prevents the selector from taking another step. It should be noted now that on the release of relay 39 relay 27 will operate over a circuit from battery through the winding of relay 39, vertical off-normal contacts 37, contacts of the rotary magnet 40, winding of relay 27, eleventh step rotary off-normal contact 43, contacts of relay 32 to ground. The electrical characteristics of relay 39 are such that this relay will not operate at this time. Relay 27 in operating opens the circuit for relay 26 which now releases, causing the release of relay 32. Relay 27 is maintained operated over the ground from the sleeve at the second selector, contacts of relay 27 through the eleventh rotary step contacts 43, winding of relay 27, contacts of rotary magnet 40, vertical off-normal contacts 37, winding of relay 39 to battery. This ground on the sleeve terminal 41 makes the seized second selector busy. On the operation of relay 27 the ground connection for the grid of tube 100 is removed and consequently tube 100 becomes non-conductive and relay 104 releases. By examining the circuits as described it will be noted therefore that while the tube 100 and relay 104 follow the pulsing, the tube 100 will remain conductive and relay 104 remains operated during the above-described hunting operation and released at the end of these operations, that is when relay 27 operates. The relay 105 which is slow in releasing will remain operated during the pulsing operations, as well as during the hunting operations, even though the tube 101 will alternately become conductive and non-conductive due to the opening of the pulsing circuit by the rotary magnet 40. The relay 105 will, of course, release on the final release of relay 39.

The registration for identifying the calling subscriber will take place immediately after dialing of the first digit ceases and the operations to this effect are as follows: When relays 104 and 105 are first operated a circuit is completed from battery

through contacts of relay 105 through the condenser 106, resistances 107 to ground through the contact of relays 26 and 27, thus causing the charging of the condenser 106. However, this condenser is slow in charging so that it will not be fully charged to break down the control gap between the electrodes 108 and 109 of the tube 103 before relay 104 releases due to the tube 100 becoming non-conductive as the ground is removed at contacts of relay 26. When relay 104 releases, the condenser 106 discharges through contacts of this relay. These operations take place repeatedly during the dialing of the digit. However, as soon as the dialing is completed as described, relay 104 remains operated for a longer period, permitting the condenser 106 to fully charge and ionize the control gap between the electrodes 108 and 109 of tube 103 and thus closes a circuit through the main gap for the main electrode 110 for the operation of relay 112 from battery, contacts of relays 105, electrodes 109 and 110, winding of relay 112 to ground. Resistance 113 is inserted from battery through the contacts of relay 105 of the circuit for relay 112 to partly energize this relay and secure a quick operation thereof when the tube 103 ionizes. Thus relay 112 will not be operated until the dialing has been completed.

The electrical oscillations received from the calling subscriber's station as produced by the vibration of the reed 6 in the coil 7 are now transmitted as soon as the dial returns to normal over the tip and ring conductors. These oscillations are, of course, different for each calling station as the reeds are differently tuned and are transmitted through the contacts of relay 27, condensers 115 and 116, contacts of relay 117, which was operated by an obvious circuit through contacts of relays 104 and 105, and repeated through the repeating coil 118 through the band-pass filters 119, 120, 121 or 122, and repeated through the step-up transformers 123, 124, 125 or 126 to the amplifier-detectors 127, 128, 129 or 130 over circuits closed by relay 132 which it will be noted is energized over an obvious circuit closed by relay 117. Depending, however, on the characteristics or frequency of the oscillations received one of these filter and amplifier-detector circuits will respond and cause the associated relays 133, 134, 135 or 136 to operate to start the identification of the calling party. If the first party A is the one calling, it may therefore be assumed that the amplifier-detector 127 will be operated to close a circuit for the operation of relay 133 at this time. Relay 133 now closes a circuit for an associated relay 137 from battery through the right-hand winding of this relay, contacts of relays 133, 138, 139, 140 and 141 to ground. Relay 137 in operating closes a locking circuit for itself from battery through its right-hand winding and left-hand armature and front contact, through contacts of the relays 138, 133, 140 and 141 to ground at contacts of relay 104. The operation of relay 137 now closes a circuit for the operation of the associated relay 141 from battery through the winding of this relay, contacts of relays 112, 137 to ground at relay 142 and relay 141 closes a locking circuit from battery through its winding and inner left-hand armature and front contact to ground at relay 46. When relay 141 operates, the locking circuit for relay 137 is opened and this relay 137 may now release as the relay 133 releases as soon as the oscillations from the calling subscriber ceases. The relays 104 and 105 are now not needed so

that they may release which, of course, takes place the moment relay 26 is released on the operation of relay 27 and tubes 100 and 101 become non-conductive. Similarly, tube 103 becomes non-conductive on the release of relay 104, and relays 112, 117 and 132 release. The operation of the relay 141 therefore disconnects or disables the register in regard to any effects thereon that may be caused from transients in the tip and ring conductor during the hunting operations as such transients, while they may possibly operate relays 133, 134, 135 or 136, relays 137, 143, 144 or 145 will not operate as their operating circuits are open at contacts of relay 141. If it should happen that any two of the relays 137, 143, 144 or 145 would operate during the identification period due to any transients that may occur, the relay 142 would operate over a circuit from battery, winding of relay 142, contacts of these relays through resistances to ground. This would prevent any of the relays 141, 140, 139 or 138 from operating. It should also be noted that during the pulsing period of the first digit, no registration can take place due to any transient that may be received during dialing. Should such false frequencies arrive, the detecting circuits may pick up the frequencies and cause the corresponding relays 137, 143, 144 or 145 to operate but as relay 112 is not operated at this time, no registration can take place.

The calling line is now connected through the selector 18 over contacts of relay 27 to the second selector and the succeeding series of digits may be dialed as is well known in the art to operate the second selector and a connector such as 22 to establish a connection to the called subscriber's line 23. It should be observed that when the ground was applied to the sleeve circuit for the second selector, relay 49 operated from battery, winding of this relay, contacts of relay 46 to ground. This relay closes a substitute ground for maintaining relay 141 operated. Now, therefore, when the called subscriber at 23 answers, a reversal of the current over the connection causes the relay 50 to operate. This in turn closes a circuit for relay 46 which in operating opens the ground connection through its contacts for relay 141, closes a circuit for the operation of relay 51 and opens the circuit for relay 49. Relay 49, however, is slow in releasing so that relay 51 will have time to close a connection from battery, contacts of this relay, contacts of relay 141 over a terminal of the line finder and the winding of the corresponding meter 52 to ground to cause this meter to operate and register the call before relay 49 releases to release relay 141. When relay 49 releases, the relays 141 and 51 release and relay 49 provides a locking circuit from battery, inner right-hand armature and front contact of this relay, right-hand armature and back contact of relay 49, outer right-hand armature and front contact of relay 46 to ground on the sleeve.

When the subscriber releases the connection by hanging up the receiver, the ground on the sleeve is removed and relay 27 releases. This in turn closes the circuit for the release magnet 53 from battery through the vertical off-normal contact 54, contacts of relays 32, 26 and 27 to ground. The release magnet returns the first selector 18 to normal and then releases due to the opening of the vertical off-normal contacts 54. Similarly, due to the removal of the ground from the sleeve connection, relay 46 releases and all the circuits are now restored to normal, the

second selector, connector 22 and the line finder being returned to normal in the usual manner.

Although the mechanism for identifying the calling party is shown herein as being connected directly to the link between the line finder and selector 20, it will be understood that this mechanism may be common to a plurality of these links and may be associated with a link when needed by the usual selecting switches or relays.

What is claimed is:

1. In a telephone system, a line having a plurality of subscribers' stations, a vibratory reed at each station having a different natural frequency, a dial at each station adapted to vibrate the associated reed after the dial has been operated to send a digit, means responsive to the vibrations of the reed for causing in the line oscillations of a frequency corresponding to the natural frequency of said vibrating reed, a station identifying register, means responsive to said oscillations for operating said register to identify the calling station, means for preventing said oscillation responsive means from operating to register false oscillations in said line caused by the digit transmission, and service meters controlled by said register.

2. In a telephone system, a line having a plurality of subscribers' stations, a vibratory reed at each station having a different natural frequency, a dial at each station adapted to vibrate the associated reed, means responsive to the vibrations of the reed for causing in the line oscillations of a frequency corresponding to the natural frequency of said vibrating reed, a station identifying register, means responsive to said oscillations for operating said register to identify the calling station, and means controlled by said dial pulses for preventing the operation of said register by any false oscillations that may occur on the line during the dialing period.

3. In a telephone system, a line having a plurality of subscribers' stations, a vibratory reed at each station having a different natural frequency, a dial at each station adapted to vibrate the associated reed after the dial has been operated to send a digit, means responsive to the vibrations of the reed for causing in the line oscillations of a frequency corresponding to the natural frequency of said vibrating reed, a station identifying register, means controlled during the dialing period for preventing transient oscillations from reaching the register and controlled after the dialing period for permitting the register to be operated by the oscillations caused by the vibration to identify calling stations, and service meters controlled by said register.

4. In a telephone system, a line having a plurality of subscribers' stations, a vibratory reed at each station having a different natural frequency, a dial at each station adapted to vibrate the associated reed, means responsive to the vibrations of the reed for causing in the line oscillations of a frequency corresponding to the natural frequency of said vibrating reed, a station identifying register, circuit means including two vacuum tubes operative in one manner during a dialing period for preventing transient oscillations from reaching the register and operative in another manner after the dialing period to permit the register to respond to the oscillations caused by the vibrating reed to identify the calling station, and service meters controlled by said register.

5. In a telephone system, a line having a plu-

5 rality of subscribers' stations, a vibratory reed at each station having a different natural frequency, a dial at each station adapted to vibrate the associated reed after the dial has been operated to set a digit, means responsive to the vibrations of the reed for causing in the line oscillations of a frequency corresponding to the natural frequency of said vibrating reed, a station identifying register responsive to said oscillations to identify calling lines, a normally open circuit for connecting said register to said line, means for closing said circuit after the dialing period to permit said oscillations to be transmitted to said registers to operate it to identify the calling line, and service meters controlled by said register.

6. In a telephone system, a line having a plurality of subscribers' stations, a vibratory reed at each station having a different natural frequency, a dial at each station adapted to vibrate the associated reed, means responsive to the vibrations of the reed for causing in the line oscillations of a frequency corresponding to the natural frequency of said vibrating reed, a selector circuit responsive to the dialing of a digit for establishing connections beyond, a station identifying register associated with said selector and responsive to said oscillations to identify calling lines, means controlled by said selector after a digit has been dialed for connecting the register to the line so that the register will respond to said oscillations to identify the calling line, and service meters controlled by said register.

7. In a telephone system, a line having a plurality of subscribers' stations, a vibratory reed at each station having a different natural frequency, a dial at each station adapted to vibrate the associated reed after the dial has been operated to send a digit, means responsive to the vibrations of the reed for causing in the line oscillations of a frequency corresponding to the natural frequency of said vibrating reed, a selector circuit responsive to the dialing of a digit for establishing connections beyond, a station identifying register associated with said selector and connectable to said line and responsive to said oscillations to identify a calling line, means operated during the dialing of a digit for preventing the connection of the register to the line and operative after the dialing period for connecting the register to the line so that it will respond to said oscillations to identify the calling line, and service meters controlled by said register.

8. In a telephone system, a central office, a plurality of lines some of which are party lines, a vibrating reed at each of the stations on a party line, a dial at each party line station, means controlled by the dial at any one of the stations of a party line for transmitting impulses over said line representing different digits and for starting the associated reed to vibrate at its natural frequency after the impulses have been transmitted, means responsive to the vibrations of any one of said reeds for causing in the associated line electrical oscillations of a frequency corresponding to the natural frequency of said vibrating reed, means at the central office responsive to said impulses for selecting a corresponding group of lines and for thereafter establishing a connection from the calling party line to an idle one of said selected group of lines, means for establishing a connection from said selected line to a called line, a station identifying register at said central office and means re-

sponsive to said oscillations for operating said register to identify a calling station, means for enabling said last-mentioned means when the group of lines has been selected, a service meter for each of the subscribers' stations of said party lines, and means responsive to the setting of said registers for operating the corresponding service meter when the connection has been established through to a called subscriber and the called subscriber has answered a call.

9. In a telephone system, a line having a plurality of subscribers' stations, a dial at each station for producing dial pulses, said dial having a coil connected to the line, a vibratory reed in said coil and means for plucking the reed operative in response to the movement of the dial on its return to normal after the dial impulses have been produced, said plucked reed serving to cause electrical oscillations corresponding to its natural frequency in said line, the natural frequency of the reed in each dial being different from that of any of the others, a station identifying register, means responsive to said oscillations for operating said register to identify the calling station, and means for preventing said oscillation responsive means from operating to register false oscillations in said line caused by the digit transmission.

10. In a telephone system, a line having a plurality of subscribers' stations, a dial at each station for producing impulses, said dial having a coil connected to the line, a vibratory reed in said coil and a lever mechanism associated with said dial for plucking said reed after impulses have been produced on the return movement of the dial to normal to cause in said line electrical oscillations corresponding to the natural frequency of the plucked reed, the natural fre-

quency of the reed in each dial being different from that of any of the others, a station identifying register, means responsive to said oscillations for operating said register to identify the calling station, and means for preventing said oscillation responsive means from operating to register false oscillations in said line caused by the digit transmission, and service meters controlled by said register.

11. In a telephone system, calling party lines, having a plurality of subscribers' stations, called lines, a dial at each party line station, switching means responsive to digits dialed at party line stations for connecting the associated party line to a called line, a vibrating reed at each party line station having a different natural frequency, means associated with each dial for vibrating the associated reed while dialing, means responsive to the vibration of a reed for causing on the associated party line, oscillations of a frequency corresponding to the natural frequency of said reed, a party line station identifying register associated with said switching means, means responsive to oscillations on a party line originating only from a vibrating reed for operating said register to identify the calling party line station and operative only after the dialing of a first digit is completed, service meters controlled by said register and means for operating a service meter in accordance with the setting of the record on said register, to meter the identified party line station operative when the dialing has been completed and the subscriber on the called line has answered the call and means operative when the called subscriber answers and after said service meter has operated for releasing the register and the operated meter.

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