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SELECTIVE SIGNALING SYSTEM

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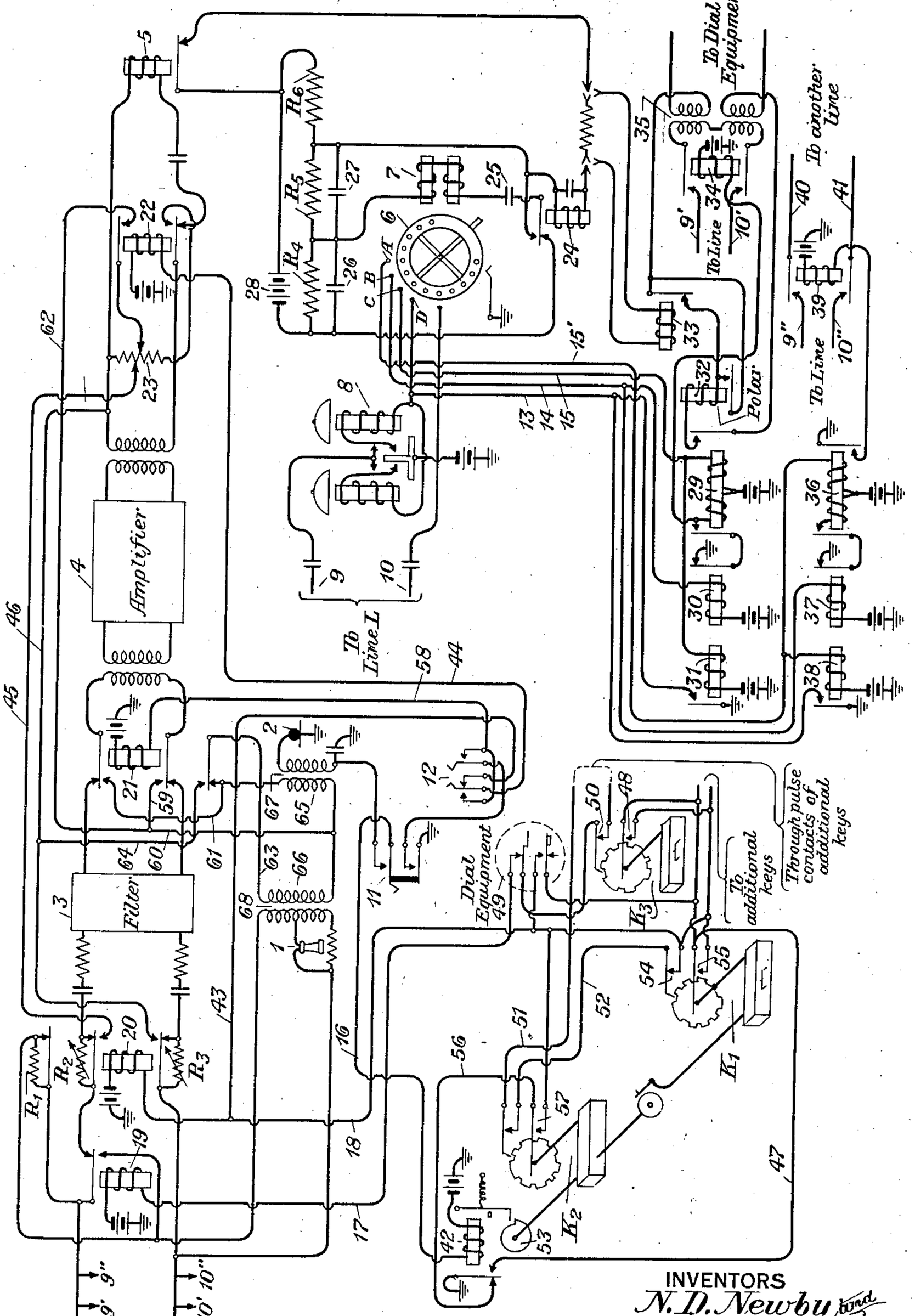

INVENTORS
N. D. Newby
D. L. Moody
BY
ATTORNEY

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SELECTIVE SIGNALING SYSTEM

Neal Dow Newby, Leonia, N. J., and Dwight Lyman Moody, Hempstead, N. Y., assignors to American Telephone and Telegraph Company, a corporation of New York

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This invention relates to telephone systems having lines of the multi-party type and, more particularly, to improved arrangements for selectively signaling over such lines.

The arrangements of the invention provide for full selective signaling on multi-station telephone lines. One of the features of the invention comprises improved means for utilizing voice frequency currents for signaling purposes. A further feature of the invention consists in the provision at each station of amplifier apparatus and circuits therefor, whereby the amplifier may be utilized for a variety of purposes. For example, under certain conditions it may be operated as an oscillator to generate the voice frequency currents used for signaling. Under other conditions it can be used to amplify incoming signaling currents or outgoing voice currents. Other features of the invention comprise arrangements for automatic switching to other similarly equipped lines as well as to or through a regular dial office or P. B. X. Further objects and features of the invention will appear more fully from the detailed description thereof hereinafter given.

The invention may be more fully understood from the following description, together with the accompanying drawing in the figure of which the invention is illustrated.

In the drawing are shown the arrangements of the invention which are provided at each of the stations connected to the multi-party line. A connection is made with the multi-party line over the line L. Connected to the line L is the subscriber's set comprising the receiver **1**, the transmitter **2** and the switchhook contacts **11**. The line L is extended through filter apparatus **3** to amplifier apparatus **4**. The amplifier apparatus has been shown schematically, but it is understood that it may be of any well known type, for example, the vacuum tube type of amplifier. The output of the amplifier is connected to an alternating current relay **5** which may be mechanically tuned. Incoming signaling currents which are of the voice frequency or carrier type, will actuate the alternating current relay **5**. The operation of this relay will control selective signaling receiving apparatus which comprises railway train dispatching selector apparatus of a well known type in the art. This would comprise code wheel mechanism **6** and electromagnetic apparatus **7** for stepping the code wheel ahead in response to the incoming coded signals. The code wheel apparatus **6** might actuate different types of apparatus. In response to a certain code it might actuate the ringer apparatus **8** shown in the form of a bell. The operation of this bell in addition to producing an audible signal at the station might, in accordance with this invention, be utilized to transmit a ringing tone over conductors **9** and **10** to the line L which would be audible to the distant sending station. Connected to the code wheel apparatus **6** are shown the conductors **13**, **14**, **15** and **15'**. These conductors would be connected to signal receiving apparatus and in response to other code signals might be used to establish a connection either to dialing equipment or to another line, as will be pointed out in detail hereinafter. For the transmission of signals from the station shown, to other stations on the line or to other lines, a plurality of selector keys and associated apparatus are shown connected with the conductors **16**, **17** and **18**. As will be pointed out in more detail hereinafter, these selector keys and their associated mechanism, in co-operation with the switchhook contacts **11** and the key **12**, can cause the amplifier apparatus to be used for several different purposes. For example, in transmitting code signals a portion of the output energy of the amplifier may be fed back to the input thereof to cause it to generate oscillations in the voice frequency or carrier range suitable for transmitting signals to a distant station. Under other conditions the amplifier apparatus may be utilized to amplify outgoing speech currents or to amplify incoming signaling currents. The details of operation of these and other features of the invention, will be more fully described hereinafter.

The operation of the arrangements in response to incoming signals will now be described. The coded signals coming in over line L will be transmitted through the filter **3** and the amplifier **4**, and will cause the tuned alternating current relay **5** to operate in accordance with the coded impulse. This will cause relay **24** to follow the coded impulses as hereinafter explained. Normally, current from battery **28** flows through resistances R_4, R_5 and R_6. The voltage drop across R_4 and R_5 serves to charge condensers **26** and **27**. The voltage drop across R_6 supplies energy to operate relay **24** over the contact of relay **5**. When relay **5** operates it will open this circuit for relay **24** and allow it to release. The back contact of relay **24** discharges condenser **27** through condenser **25** and the magnets **7** of the selector in series. Meanwhile condenser **26** is charged. At the end of the first signaling pulse the relay **5** returns to normal and relay **24** is operated again. The make contact of relay **24** causes condenser **26**

to be discharged through the magnets 7 of the selector and condenser 25 in series. This current is in the reverse direction to that which first operated the selector. One pulse and the break has advanced the selector one step. The remainder of the coded impulses cause the selector to function in the manner described above.

As pointed out heretofore, the selector mechanism is of the railway train dispatching type and is well known in the art. For example, such a selector is shown in United States Patent 1,343,256, issued June 15, 1920. The selector is a step-by-step selector operated by definite code of impulses. In general, each code consists of the same total number of steps, normally 17. The codes are developed by dividing these into three groups which allows a total of 78 codes. The signaling pulses cause the code wheel 6 to be advanced. This code wheel is arranged with a hole for each step and the selector is set for a particular code by inserting three code pins in the proper holes. Assume that a particular selector as, for example, the one shown, had been adjusted to operate on a code of 962. The first group of nine pulses advances all selectors along the line to the ninth step, but only those selectors having code pins on this step are held operated during the pause between the first and second group of pulses. The next group of six pulses advances to step fifteen all selectors which are held by their code pins on step fifteen because it will be the only one having the code pin on this step. All the selectors which were released on the previous group of pulses will be advanced to step six. However, only those having code pins on step six will be held. The next group of two pulses advances this particular selector to the ringing position. All other selectors will be advanced two steps whether from the zero setting or from positions equipped with code pins. The selector remains on the seventeenth step, or the ringing position, for about two seconds at which time a single pulse is sent over the line which releases not only this selector but all others which are being held on steps other than the zero step.

With the above general description of the operation of the selectors in mind, it will be seen that if the signal code is one for which the selector illustrated has been set, the selector will be advanced to the ringing position shown as D and battery will be connected to the bell mechanism 8. This will operate the bell mechanism to produce an audible signal. It will be noted that the bell mechanism 8 is connected by the conductors 9 and 10 to the line L. This is so that during the ringing interval the ringing tone may be put on the line. This is obtained by connecting one of the solenoids of the bell to the line simultaneously with the breaking of the direct current through the solenoid, and an inductive surge is thereby placed on the line at each vibration of the bell. The application of ringing tone to the line may, if desired, be made through a directional selection circuit in order to minimize its effect upon the relay 5 which should remain unoperated during the ringing interval. This application of ringing tone to the line is one of the desirable features of this invention in that it allows the calling station to determine if the bell at the called station is operated.

In order to guard against false operation of the selector by speech currents the codes utilized in the operation of the arrangements of the invention may be so chosen that no first group is less than, say, eight pulses. No code pins would, therefore, be used on steps below these on the selector and the selector may be stepped ahead by voice currents to step 7 without causing false operation. During any slight pause or break in the speech current within the signaling band, all selectors which have been stepped ahead are released.

If it is desired to ring more than one bell at a station or to operate a bell and other apparatus at a station, the selector may be so arranged as to allow selective operation of a number of devices at the station. Such a selector may be utilized in the arrangements of this invention to provide for signals involving a dial station or another line as will appear hereinafter.

If, for example, the coded signal sent over the line was for the purpose of establishing a connection with dialing equipment at the called station, the code wheel 6 of the selector would be advanced to a dial position, shown in the drawing as C. This would cause the operation of a relay chain comprising relays 29, 30, 31, 32, 33 and 34 to establish a connection between the local line and dial equipment in the following manner. When the code wheel 6 is advanced by the code signal for a dial connection to position C the relay 29 will be operated and will lock up over its left hand contact and the contact of relay 30. Relay 31 will also be operated and will apply ground over its armature and contact to the ringer apparatus 8, causing it to operate and give an audible signal and to put ringing tone on the line for the benefit of the calling party in a manner heretofore explained. The operation of relay 29 will connect ground over its left hand contact through the winding of relay 34 to battery and ground and cause relay 34 to operate. This will connect conductors 9' and 10', which are connected to line L, to the primary winding of transformer 35. The secondary winding of transformer 35 is connected to dialing equipment at the station. Thus in response to a certain code signal the line may be connected to dial equipment. The circuit of the secondary winding of transformer 35 is completed over the contact of the pulsing relay 33, winding of relay 32, right hand contact and armature of relay 29. When the coded signal calling for a connection to dial equipment is sent over the line it is followed by a pulse of signaling current which returns the code wheel 6 of the selector to normal. This pulse may operate the pulsing relay 33 and send a pulse into the dial equipment. However, the dial equipment is constructed to absorb this first pulse and it will have no effect thereon. The calling party will now transmit dialing signals over the line. These signals will operate relay 5 which in turn operates the pulsing relay 33, thus causing the dialing impulses to be relayed to the dialing equipment. When in response to the dialing the called subscriber answers the relay 32 will operate. This can be effected by making relay 32 a polar relay and causing the polarity of the battery applied to the winding thereof from the called line to be reversed when the called subscriber removes the receiver from the switchhook. The operation of relay 32 short circuits the contacts of the pulsing relay 33 so that future pulsing or operation of relay 33 by voice currents will not disturb or release the dial connection. When the calling subscriber restores his receiver to the switchhook a release or clearing signal is sent over the

line in a manner to be described hereinafter. This will cause the code wheel 6 to be advanced to position B and will cause the operation of relay 30. This will open the locking circuit of relay 29 and will cause it to release and will allow relays 34 and 32 to be released. At the end of the release or clearing signal a pulse is sent over the line restoring the code wheel to its normal setting, thus releasing relay 30.

If the coded signal sent over the line was for the purpose of establishing a connection with another line, the code wheel 6 would be advanced to position A. This would cause the operation of relays 36 and 38. Relay 38 would operate the ringer apparatus 8 and put ringing tone on the line. Relay 36 would lock up over its left hand contact and the contact of relay 37. The operation of relay 36 would close a circuit over its right hand contact for relay 39 and cause its operation. The operation of relay 39 would connect line L over conductors 9'' and 10'' to conductors 40 and 41 leading to the other line. Subsequently the release or clearing signal would advance the code wheel 6 to its position B and cause relay 37 to operate and restore the relay chain to normal.

Thus it will be seen that in response to different coded signals sent over the line the receiving equipment may selectively cause the operation of audible signaling means at the called station, or may establish a connection with dial equipment thereat, or may establish a connection with another line.

The operation of the arrangements when transmitting coded signals is as follows:

To merely call another station on the same line similar to the station shown one of the selector keys, such as key K_3, would be operated. The operaton of the key K_3 will close the off-normal contact 48. Additional keys similar to K_3 would be provided for calling other stations but have not been illustrated. The receiver 1 would also be removed from the switchhook contacts 11. The closing of the switchhook contacts 11 would complete the following circuit; from ground, transmitter 2, upper contact of switchhook 11, conductor 16, winding of relay 42, to battery and ground. This operates relay 42 which applies ground over its left hand armature and contact to conductor 47, off-normal contact 48 of selector key K_3, to conductor 18, winding of relay 20, to battery and ground. This operates relay 20. The heretofore mentioned ground applied to conductor 18 is also applied to the following circuit; from conductor 18, conductor 43, contacts of key 12, conductor 44, winding of relay 22, to battery and ground. This operates relay 22. The operation of relay 22 disconnects relay 5 from the output of the amplifier 4 and connects the output of the amplifier 4 through potentiometer 23 to the conductors 45 and 46. Conductors 45 and 46 are by the operation of relay 20 connected to the line L and also are connected through resistances R_2 and R_3 and filter 3 to the input of the amplifier. With this arrangement a portion of the energy from the output of the amplifier is fed back to the input and the amplifier is caused to oscillate and act as a generator of currents of a frequency suitable for signaling. This frequency can be determined by the type of filter used. The desired amount of this locally generated signaling current is applied to the line from conductors 45 and 46 over the contacts and armatures of relay 20. The aforementioned operation of relay 42 also completes the following circuit; from ground and battery, winding of relay 19, conductor 17, contact of dialing equipment 49, pulsing contact 50 of key K_3, through pulsing contacts of other similar keys (not shown), conductor 51, pulsing contact of key K_2, conductor 52, pulsing contact of key K_1, off-normal contact 48 of key K_3, conductor 47, contact and armature of relay 42 to ground. This will operate relay 19. It will be noted that this circuit is completed over the pulsing contact 50 of key K_3, as well as over the pulsing contacts of the other keys K_1 and K_2 and of the dial equipment 49. Accordingly relay 19 follows in its operation the code sent out by the pulsing contact 50 of key K_3. As relay 19 opens and closes the line L the signaling current generated from the oscillator will be applied to the line L in accordance with the code of key K_3. Relay 19 also connects receiver 1 across the line L through resistance R_1 during the interval when signaling current is applied thereto to facilitate and allow monitoring on the circuit at such time. After the relay 19 releases the short circuit around resistance R_1 is restored so that receiver 1 will be connected directly across the line.

To call dial equipment at another station the mechanically coupled keys K_1 and K_2 would be used. Key K_2 operates with key K_1 but it is locked in an operated position by the cam mechanism 53 and the operation of relay 42. When key K_1 returns to normal the pulsing contacts 54 open and close the circuit of relay 19 in accordance with the code for a connection to dialing equipment at the called station. As relays 20 and 22 will have been operated over the off-normal contacts 55 of key K_1 the code signals for such a desired connection will be sent out over the line and will operate a relay chain thereat similar to the chain comprising relays 29, 30, 31, 32, 33 and 34 as heretofore described. The calling party will then operate the dial equipment 49 to dial the equipment at the called station. The rate of pulsing of the dial equipment 49 will usually be of a substantially different rate from keys K_1, K_2 and K_3 so that the windings 7 of the selector and condensers 25, 26 and 27 may be proportioned so that the selector will not respond to pulses from dial 49. When this is not true the codes for the selectors may be chosen so that no pins will be required in code wheel 6 below the eleventh hole so that the selector may not be advanced to a code pin by a dial pulsing a maximum of ten pulses. When the calling party hangs up, the switchhook contacts 11 will open the circuit for relay 42 and allow it to release. This will unlock selector key K_2 and allow it to return to normal. While it is being returned to normal ground will be applied from the armature and left hand break contact of relay 42, over conductor 56, off-normal contacts 57 of key K_2, to conductors 18 and 43. This will cause relays 20 and 22 to remain operated while the selector key K_2 is returning to normal and as relay 19 has been released this will cause the application of signaling current to the line to give the release or clearing signal heretofore referred to for releasing the relay chain at the called station.

To establish a connection with another line a key (not shown) similar to key K_1 would be used to send out a code suitable to operate a relay chain at the called station similar to the heretofore described chain comprising relays 36, 37, 38 and 39. This key would have to be mechanically coupled also to key K_2 or a similar key so that

the release or clearing signal could be sent out when the call was completed. As the details of operation would be substantially similar to those already described, no further description thereof will be given.

If it is desired to use the amplifier 4 for the purpose of amplifying outgoing speech currents the key K_{12} will be operated. It is desirable to amplify outgoing speech currents on noisy lines rather than the incoming speech currents because the apparent noise level is thereby reduced. As the switchhook contacts 11 are already closed the operation of K_{12} will close the following circuit; from ground, lower make contact of switchhook 11, right hand make contact of switch 12, conductor 58, winding of relay 21, to battery and ground. This will operate relay 21. In addition to this ground will be applied from the lower make contact of switchhook 11, right hand and left hand make contacts of switch 12 to conductor 44, and, thence, through the winding of relay 22 to battery and ground. This will operate relay 22. The operation of relays 21 and 22 will connect the secondary winding 65 of transformer 67 to the input of the amplifier 4 and will connect the primary winding 66 of the transformer 68 across the output of the amplifier 4 in the following manner: Winding 65 will be connected across the input of the amplifier 4 in the following manner; upper armature and make contact of relay 21, conductor 61, winding 65, conductor 60, conductor 59, lower make contact and armature of relay 21. Winding 66 will be connected across the output of the amplifier 4 in the following manner; from the right hand contact of potentiometer 23, upper armature and contact of relay 22, conductor 62, conductor 60, winding 66, conductor 63, lower armature and make contact of relay 21, conductor 64, conductor 46 to the tip conductor in the output of the amplifier 4. Accordingly, by operating the switch 12 the amplifier may be used to amplify outgoing speech currents.

While the invention has been disclosed as embodied in certain specific forms which are deemed desirable, it is understood that it is capable of embodiment in many other widely varied forms without departing from the spirit of the invention as defined by the appended claims.

What is claimed is:

1. In a telephone system, a line having a plurality of stations connected thereto, each of said stations comprising a local line, an amplifier in said local line, a receiving relay normally connected to the output of said amplifier and adapted to respond to voice frequency coded signals coming in over said line, signal receiving apparatus controlled selectively by the operation of said receiving relay in response to said coded signals, selector switching mechanism adapted to control the application of coded signals to said local line, means responsive to the operation of said selector switching mechanism for causing said amplifier to oscillate and generate signaling currents of a desired frequency, and means for applying said locally generated signaling currents to said local line under the control of said selector switching mechanism.

2. In a telephone system, a line having a plurality of stations connected thereto, each of said stations comprising a local line, an amplifier in said local line, a receiving relay normally connected to the output of said amplifier and adapted to respond to voice frequency coded signals coming in over said line, signal receiving apparatus controlled selectively by the operation of said receiving relay in response to said coded signals, selector switching mechanism adapted to control the application of coded signals to said local line, means responsive to the operation of said selector switching mechanism for causing said amplifier to oscillate and generate signaling currents of a desired frequency, means for applying said locally generated signaling currents to said local line under the control of said selector switching mechanism, and means controlled by the operation of said selector switching mechanism for disconnecting said receiving relay from said amplifier during the application of said locally generated signaling currents to said local line.

3. In a telephone system, a line having a plurality of stations connected thereto, each of said stations including an amplifier, means for utilizing said amplifier for the amplification of incoming signaling currents, switching means whereby said amplifier may be used exclusively as a generator of outgoing signaling currents, and switching means whereby said amplifier may be used exclusively for the amplification of outgoing message currents.

4. In a telephone system, a line having a plurality of stations connected thereto, each of said stations comprising a local line, an amplifier in said local line, a receiving relay normally connected to the output of said amplifier and adapted to respond to voice frequency coded signals coming in over said line, signal receiving apparatus controlled selectively by the operation of said receiving relay in response to said coded signals, said signal receiving apparatus being of the railway train dispatching selector type and including a code wheel adapted to be advanced to different settings in response to different types of said incoming coded signals, and means responsive to the advancement of said code wheel to a certain setting for producing an audible signal and for applying a signaling current back over said line to a distant calling station during the audible signal interval.

5. In a telephone system, a line having a plurality of stations connected thereto, each of said stations comprising a local line, an amplifier in said local line, a receiving relay normally connected to the output of said amplifier and adapted to respond to voice frequency coded signals coming in over said line, signal receiving apparatus controlled selectively by the operation of said receiving relay in response to said coded signals, said signal receiving apparatus being of the railway train dispatching selector type and including a code wheel adapted to be advanced to different settings in response to different types of said incoming coded signals, and means responsive to the advancement of said code wheel to each of said different settings for operating different signaling arrangements at said station, each of the code wheels in each of the signal receiving apparatus at each of the stations being so adjusted that to advance any code wheel to a desired setting the initial number of impulses in any incoming coded signal must be greater than an arbitrarily chosen number whereby operation of the signal receiving apparatus by voice currents on the line may be avoided.

6. In a telephone system, a line having a plurality of stations connected thereto, each of said stations comprising a local line, an amplifier in said local line, a receiving relay normally connected to the output of said amplifier and adapted

to respond to voice frequency coded signals coming in over said line, signal receiving apparatus controlled selectively by the operation of said receiving relay in response to said coded signals, selector switching mechanism adapted to control the application of coded signals to said local line, means responsive to the operation of said selector switching mechanism for causing said amplifier to oscillate and generate signaling currents of a desired frequency, means for applying said locally generated signaling currents to said local line under the control of said selector switching mechanism, a subscriber's set associated with said local line, said subscriber's set comprising a receiver and a transmitter and switchhook contacts, and circuit arrangements controlled by the operation of said selector switching mechanism for connecting said receiver to said local line for monitoring purposes during the application thereto of said locally generated signaling current.

7. In a telephone system, a line having a plurality of stations connected thereto, each of said stations comprising a local line, an amplifier in said local line, a receiving relay normally connected to the output of said amplifier and adapted to respond to voice frequency coded signals coming in over said line, signal receiving apparatus controlled selectively by the operation of said receiving relay in response to said coded signals, selector switching mechanism adapted to control the application of coded signals to said local line, means responsive to the operation of said selector switching mechanism for causing said amplifier to oscillate and generate signaling currents of a desired frequency, means for applying said locally generated signaling currents to said local line under the control of said selector switching mechanism, a subscriber's set associated with said local line, said subscriber's set comprising a receiver and a transmitter and switchhook contacts, and means controlled by the removal of said receiver from said switchhook contacts for conditioning said selector switching mechanism for operation.

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