

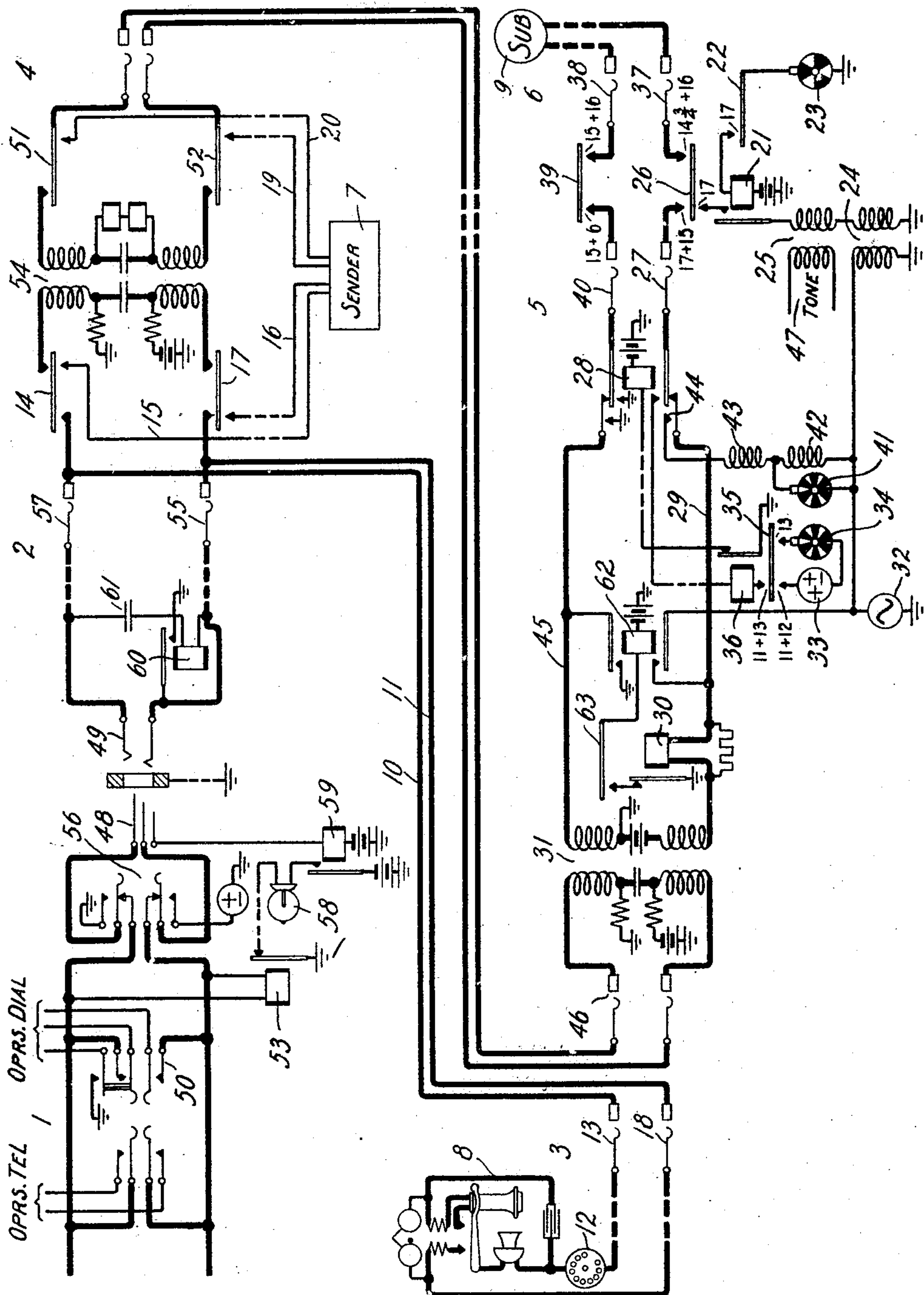
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TELEPHONE EXCHANGE SYSTEM

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TELEPHONE-EXCHANGE SYSTEM

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This invention relates to telephone systems and more particularly to improvements in telephone systems employing machine switching apparatus whereby supervisory signals may be transmitted to either a calling subscriber or a calling operator to apprise them of the progress of a connection.

In machine switching systems as now organized, toll calls are usually extended over special trunks extending from the toll switching operator's position to a "B" or cordless operator's position and thence over selector switches to subscribers' lines. Local calls are terminated over regular incoming and final selectors. In systems employing toll dialing the toll lines terminate at machine switching offices in special line switches which have access to special district selectors. The toll operator, to establish a toll connection, dials into the sender associated with the special district selector, and the connection is then extended over a toll switching train to the wanted line. Local calls are extended over a train of regular selectors.

It is thus apparent that two separate trains of selectors are employed in an office, one for terminating toll calls and the other for terminating local calls. One of the difficulties which has been encountered and which has necessitated the use of separate switch trains, has been the transmission of supervisory tones, such as busy and ringing tones, and supervisory signals, since tones and signals which are adequate for notifying a local calling subscriber of the progress of the call are not suitable for similarly notifying a toll operator and for giving the toll operator the necessary answering and disconnect signals. It is therefore the object of the present invention to improve the means for producing and transmitting supervisory signals and tones, and to associate such means with a selector switch train, whereby the same train of selector switches may be used for terminating either toll or local connections, thereby materially economizing in switching apparatus and utilizing the switching apparatus more economically.

More specifically the invention, one embodiment of which has been disclosed by way

of illustration in the drawing, provides means for associating a source of interrupted high frequency tone current which may, for example, be of 1000 cycles frequency interrupted at a rate of 20 cycles per second, with an incoming selector, for the purpose of transmitting to either a toll operator or to a local subscriber a suitable ringing tone when the calling subscriber is being rung, means for associating said source of tone with a final selector for the purpose of transmitting a suitable busy signal if the wanted line being tested is found to be busy, and for transmitting answering and disconnect signals to the toll operator on toll calls when the called subscriber responds or hangs up his receiver.

The drawing shows at the left thereof, a toll operator's cord circuit and a local subscriber's station both of which have access over line switches to a district selector shown in the upper right portion of the drawing, having associated therewith a suitable common sender, said selector having access to any subscriber's line in the exchange over the train of selector switches diagrammatically illustrated in the lower right portion of the drawing.

The toll operator's cord circuit 1 may be of well-known type. The line switches diagrammatically shown at 2 and 3, the district selector 4, office selector 46, incoming selector 5, final selector 6, and sender 7 may be of the type disclosed in the patent to F. A. Stearn, No. 1,505,171, granted August 19, 1924, the selectors 5 and 6 being modified, however, as to the tone and supervisory features thereof in accordance with the present invention. Although line switches have been illustrated at 2 and 3 it is, of course, obvious that line finders could be used with equal facility and also although the invention has been illustrated in connection with switching apparatus of the panel power driven type it could be practiced as well with other types of switching apparatus such as, for example, step-by-step switches. It is believed that the invention will be best understood from a detailed consideration thereof in connection with the attached drawing.

It will be first assumed that the calling sub-

scriber at substation 8 whose line terminates in the exchange in which the switching apparatus 2, 3, 4, 46, 5, 6 and 7 is located, desires to establish a connection with the line of the subscriber at substation 9. Upon the removal of the receiver from the switchhook at the substation 8, the line switch 3 functions in the well-known manner to hunt for and connect with an idle district selector. It will be assumed that the district selector 4 is idle and that the substation 8 becomes connected therewith over the line switch 3 and the trunk conductors 10 and 11. Upon the seizure of the district selector 4, an idle sender 7 becomes associated therewith in the well-known manner, and a dialing tone is transmitted to the calling subscriber. The calling subscriber thereupon manipulates the dial 12 to transmit dial impulses to the sender 7 in accordance with the directory number of the wanted line 9. These dial impulses are transmitted to the sender 7 over a circuit which may be traced in part from the substation dial 12 over the tip brush 13 and bank terminal of line switch 3, conductor 10, the lower contacts of sequence switch spring 14, conductor 15, to the sender 9, thence returning over conductor 16, the left contacts of sequence switch spring 17, conductor 11, the ring brush 18 and bank terminal of switch 3 to the substation dial.

Following the registration of the wanted line number upon the registers of the sender 7, the sender proceeds to control the setting of the selector switches 4, 46, 5 and 6 in the well-known manner over the fundamental circuit conductors 19 and 20 to extend the connection to the wanted line 9. When the final selector 6 has been set upon the terminals of the wanted line, the sender 7 is dismissed and the talking circuit is established over springs 14, 17, 51 and 52 at the district selector 4. A test is then made to determine if the line is busy. If the line is found to be busy the sequence switch (not shown) associated with the final selector is advanced to the busy signaling position 17, and an interrupted circuit is closed for the control relay 21, extending from battery through the winding of relay 21, sequence switch spring 22, to ground through the interrupter 23. Upon each energization of relay 21, a tone circuit is thereupon closed, extending from the secondary winding of tone coil 24, through the secondary winding of tone coil 25, the contact of relay 21, the left contacts of sequence switch spring 26, brush 27 and the bank terminal of selector 5, the lower back contact of relay 28, conductor 29, the winding of supervisory relay 30, the lower right winding of repeating coil 31 to battery. Superimposed on this tone current is the busy tone current of 60 impulses per minute from the source 47 through the primary of tone coil 25. Tone current is induced into

the circuit above traced from the source of high frequency current 32 which may, for example, have a frequency of 1000 cycles per second, interrupted at a rate of 20 cycles per second. The tone current in the secondary circuit above traced is induced in the circuit extending from the left-hand windings of repeating coil 31, back over the brushes of the office selector 46 and of the district selector 4, the upper contacts of sequence switch springs 51 and 52 through the right hand windings of repeating coil 54, and is again induced in the circuit extending through the left windings of repeating coil 54, back to the calling subscriber's line. Upon the receipt of the busy tone, the calling subscriber releases the connection in the usual manner.

If, however, the called line is not busy, the final selector sequence switch is arrested in the talking position 15 and the ringing of the called subscriber's bell is initiated at the incoming selector 5 by the energization of the relay 28, in the manner set forth in the patent to Stearn hereinbefore referred to. Ringing takes place with the sequence switch of the incoming selector first in position 11 and then in position 13. With relay 28 energized and the sequence switch in position 13, ringing current flows from the ringing current source 33, through the ringing interrupter 34, the lower right and upper contacts of sequence switch spring 35, winding of ringing trip relay 36, the lower front contact of relay 28, brush 27 and bank terminal of selector 5, the upper contacts of sequence switch spring 26, brush 37 and bank terminal of final selector 6, over the subscriber's line through the substation bell thereat, returning over brush 38 and bank terminal of selector 6, contacts of sequence switch spring 39, brush 40 and bank terminal of selector 5, to ground at the upper front contact of relay 28.

During the application of ringing current, a ringing tone is transmitted to the calling subscriber's line from the high frequency source 32 which is intermittently changed from high to low volume by the interrupter 41, which is upon the same shaft with the ringing interrupter 32. The interrupter 41 intermittently short circuits the resistance 42 in the ringing tone circuit, thereby changing the volume of the ringing tone. With the short circuit about resistance 42 open, a low volume tone current is transmitted from the source 32 through resistances 42 and 43, the contacts 44 of relay 28, the winding of relay 30, to ground through the lower right winding of repeating coil 31. This tone current is then transmitted to the calling line in the same manner above described in connection with the busy tone current.

When the called subscriber responds, relay 36 energizes over the ringing circuit and opens the circuit of relay 28 to disconnect the ringing source, and to connect the talk-

ing conductors 45 and 29 to the called line. A circuit is now closed for the supervisory relay 30 which may be traced from battery through the lower right winding of repeating coil 31, winding of relay 30, conductor 29, lower back contact of relay 28, brush 27 and bank terminal of selector 5, thence as traced to the called subscriber's station, returning over brush 40, the upper back contact of relay 28, conductor 45, to ground through the upper right winding of repeating coil 31. Relay 30, upon energization, performs the usual supervisory functions set forth in the patent to Stearn above referred to.

It will now be assumed that the toll operator, one of whose cord circuits is shown at 1, desires to complete a toll call to the subscriber's line 9. She will therefore insert the plug 48 of her cord 1 into the jack 49 of an idle trunk extending to the machine switching exchange in which the wanted line is located. Upon the insertion of the plug in the trunk jack, the line switch 2 operates in the well-known manner to extend the trunk to an idle district selector 4. As soon as the district selector and an idle sender 7 have been associated with the operator's cord circuit, she operates the dial key 50 to associate her dial (not shown) with the cord circuit, and proceeds to dial the wanted subscriber's line number. The connection then becomes extended in the manner previously described to the line of the wanted subscriber. When the connection is established to the terminals of the wanted line, the sender 7 is dismissed and the sequence switch springs 14, 17, 51 and 52 establish the talking circuit at the district selector. A circuit is then established for the cord supervisory relay 53, which may be traced from battery through the lower left winding of repeating coil 54, the upper contacts of sequence switch spring 17, brush 55 and bank terminal of line switch 2, the rings of jack 49 and plug 48, lower normal contacts of ringing key 56, winding of relay 53, upper normal contacts of key 56, tips of plug 48 and jack 49, brush 57 and bank terminal of switch 2, the lower left and upper right contacts of sequence switch spring 14, to ground through the upper left winding of repeating coil 54. Relay 53 energizes in this circuit and opens the circuit of lamp 58, which became closed at the contact of sleeve relay 59 when the plug 48 was inserted in jack 49. If it be assumed that the wanted line is busy, and that busy tone current from source 32 is induced back upon the established connection through the right windings of repeating coil 54, current is then induced through the winding of the alternating current relay 60, in a circuit extending from battery through the lower left winding of repeating coil 54, upper contacts of sequence switch spring 17, brush 55 and bank terminal of switch 2, winding of relay 60, condenser 61, brush 57 and bank terminal of switch 2,

lower left and upper right contacts of sequence switch spring 14, to ground through the upper left winding of repeating coil 54. Relay 60, which is tuned to respond to current from the high frequency source 32, thereupon intermittently responds under the influence of the busy back interrupter 23 at the final selector 6, and upon each energization closes a shunt about the supervisory relay 53 of the cord circuit, extending from ground through the contact of relay 60, rings of jack 49 and plug 48, thence as traced through the winding of relay 53 to ground at the upper left winding of repeating coil 54. Supervisory relay 53 thereby intermittently deenergizes, flashing the lamp 58 as a busy signal. Busy tone current from the tone source 47 will also be transmitted over the established connection to the calling subscriber's line.

Similarly if the wanted line is found to be idle, relay 60 is intermittently operated from the source 32 through the action of interrupter 41 at the incoming selector, to cause the lamp 58 to flash at a different rate, as a signal to the toll operator that the wanted subscriber is being rung. When the wanted subscriber responds, the ringing current source 33 becomes disconnected from the wanted line through the release of relay 28 as previously described, and the transmission of ringing tone current from source 32 ceases. The extinguishing of lamp 58 is a signal that the wanted subscriber has responded.

When the wanted subscriber hangs up at the termination of the conversation, relay 30 deenergizes and a circuit is established from ground at its back contact, over the contact of sequence switch cam 63, which becomes closed following the termination of ringing, to battery through the winding of relay 62. With relay 62 energized the source of tone current 32 is connected directly through the lower right winding of repeating coil 31, to battery and ground, and current is thereby steadily induced over the established connection through the winding of relay 60. Relay 60 now responds steadily to this induced current from the source 32, and in turn shunts down relay 53 to close the circuit of lamp 58. The toll operator noting the steady illumination of lamp 38 is apprised of the fact that the called subscriber has restored his receiver, and that she may then proceed to restore the connection.

While the source of high frequency current 32 has been described herein as of 1000 cycles frequency it is obvious that this source might be of any frequency within the voice range which could be readily transmitted over the talking path extending to the calling subscriber's line or to the toll operator's position. It is further apparent that this source of signaling current might be employed for the transmission of any other supervisory

tones that might be desirable for use in supervising telephone connections.

What is claimed is:

1. In a telephone exchange system, a calling line, an operator's position, a called line, a switching train available to either said calling line or to said operator's position for extending a connection to said called line, and means including a source of high frequency current for transmitting supervisory signals to said calling line or to said operator's position.

2. In a telephone exchange system, a calling line, an operator's position, a called line, a switching train available to either said calling line or to said operator's position for extending a connection to said called line, and means including a source of current within the voice frequency range for transmitting supervisory signals to said calling line or to said operator's position.

3. In a telephone exchange system, a calling line, a called line, selector switches for extending a connection from said calling line to said called line, and means including a source of current within the voice frequency range for transmitting supervisory tone signals to said calling line.

4. In a telephone exchange system, a calling line, a called line, selector switches for extending a connection from said calling line to said called line, means for applying ringing current to said called line, and means including a source of high frequency current for transmitting a supervisory tone to said calling line during the application of ringing current to said called line.

5. In a telephone exchange system, a calling line, a called line, selector switches for extending a connection from said calling line to said called line, means for applying ringing current to said called line, a source of high frequency current, and means for transmitting an intermittently varying supervisory tone current from said source to said calling line during the application of ringing current to said called line.

6. In a telephone exchange system, a calling line, a called line, selector switches for extending a connection from said calling line to said called line, means for applying ringing current to said called line, a source of high frequency current, and means including an interrupter and resistances for transmitting a supervisory tone of intermittently varying volume from said source to said calling line during the application of ringing current to said called line.

7. In a telephone exchange system, an operator's position, a called line, selector switches for extending a connection from said operator's position to said called line, a supervisory signal at said operator's position, a relay, means for applying ringing current to said called line, and means including a

source of high frequency current for operating said relay to control said signal during the application of ringing current to said called line.

8. In a telephone exchange system, an operator's position, a called line, selector switches for extending a connection from said operator's position to said called line, a supervisory lamp at said operator's position, a relay, means for applying ringing current to said called line, a source of high frequency current, and means including an interrupter for intermittently transmitting current from said source to said relay during the application of ringing current to said called line whereby said relay causes said lamp to flash.

9. In a telephone exchange system, an operator's position, a called line, selector switches for extending a connection from said operator's position to said called line, a supervisory lamp at said operator's position, a relay, means for testing the called line to determine if it is free or busy, a source of high frequency current, and means including an interrupter for intermittently transmitting current from said source to said relay for causing said lamp to flash if said called line when tested is found to be busy.

10. In a telephone exchange system, a calling line, an operator's position, a called line, a switching train available to either said calling line or to said operator's position for extending a connection to said called line, a responsive device on the calling line, a supervisory signal at said operator's position, a relay for controlling said signal, means for applying ringing current to said called line, a source of high frequency current, and means for applying current from said source to operate either said responsive device or said relay during the application of ringing current to said called line.

11. In a telephone exchange system, a calling line, an operator's position, a called line, a switching train available to either said calling line or to said operator's position for extending a connection to said called line, a responsive device on the calling line, a supervisory signal at said operator's position, a relay for controlling said signal, means for applying ringing current to said called line, a source of high frequency current, and means for applying current from said source to either produce a tone in said responsive device or to operate said relay during the application of ringing current to said called line.

12. In a telephone exchange system, a calling line, an operator's position, a called line, a switching train available to either said calling line or to said operator's position for extending a connection to said called line, a responsive device on the calling line, a supervisory signal at said operator's position, a relay for controlling said signal, means for testing said called line to determine if it is

free or busy, a source of high frequency current, and means for applying current from said source to operate either said responsive device or said relay if said called line when tested is found to be busy.

5 13. In a telephone exchange system, a calling line, an operator's position, a called line, a switching train available to either said calling line or to said operator's position for extending a connection to said called line, a
10 responsive device on the calling line, a supervisory signal at said operator's position, a relay for controlling said signal, means for testing said called line to determine if it is free or busy, a source of high frequency current, and means for applying current from
15 said source to either produce a tone in said responsive device or to operate said relay if said called line when tested is found to be busy.

20 In witness whereof, I hereunto subscribe my name this 29 day of June, A. D. 1927.

RAY S. WILBUR.

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