

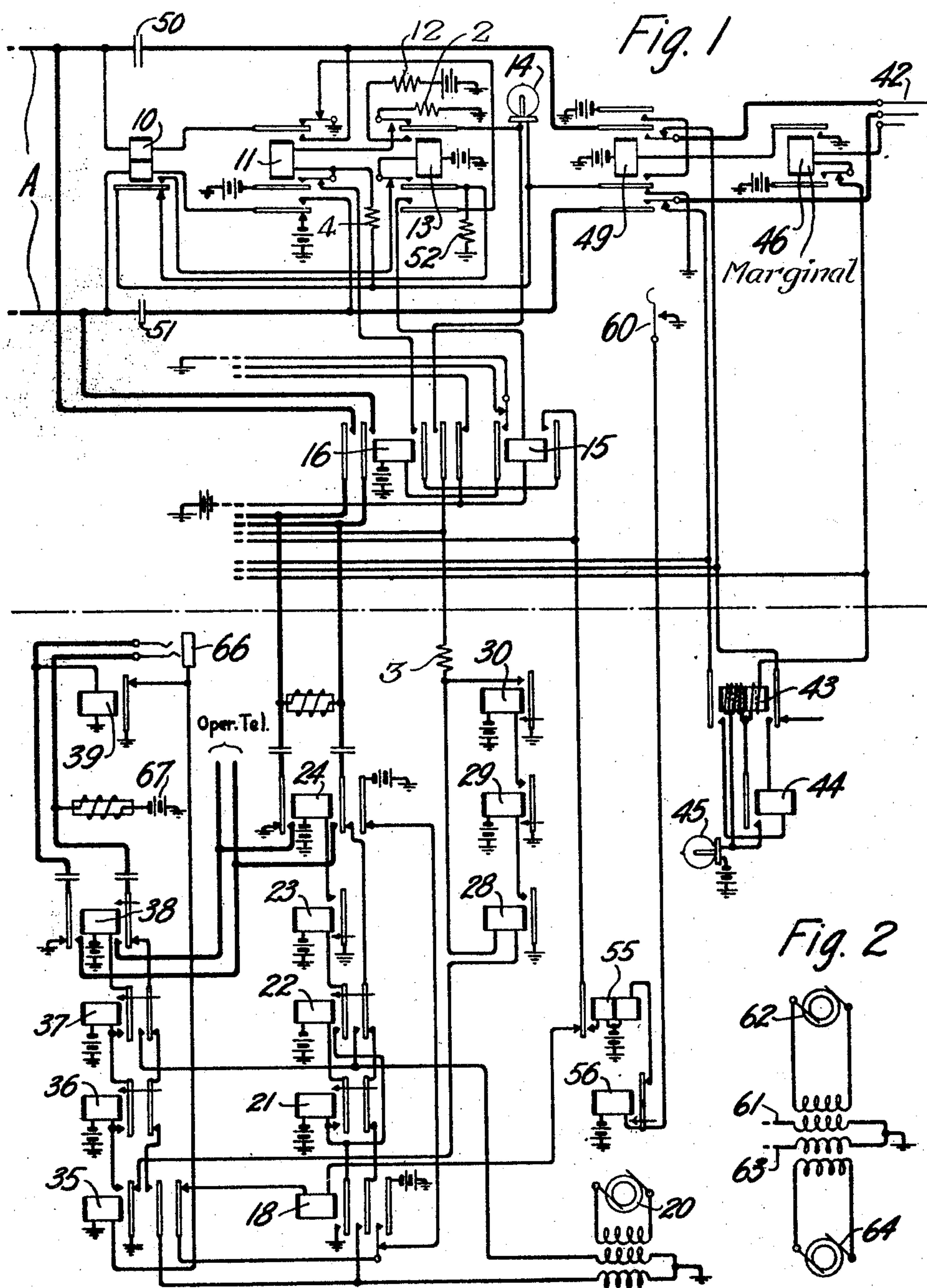
March 15, 1927.

S. F. NELSON

1,620,733

TELEPHONE SYSTEM

Filed April 3, 1926



Inventor:
Stanley F. Nelson
by *gator* Att'y.

UNITED STATES PATENT OFFICE.

STANLEY F. NELSON, OF BROOKLYN, NEW YORK, ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

TELEPHONE SYSTEM.

Application filed April 3, 1926. Serial No. 99,644.

This invention relates to telephone systems and more particularly to improvements in the supervisory arrangements for straightforward trunking systems.

5 Heretofore in straightforward trunking systems it has been the practice to transmit a single signal in the nature of a single impulse of tone current back to the call originating or "A" operator over a trunk selected
10 by her to notify her that the telephone set of the "B" operator at the distant end is in process of being connected to this trunk. When tandem connections are desired over a series of straightforward trunks a signal is
15 transmitted back to the "A" operator each time a "B" operator's telephone set is connected to the successively engaged trunks. While this arrangement is satisfactory, the
20 "A" operator may not always pay strict attention to the successive signals to follow the progress of the extension of the connection over one trunk after another.

It is therefore, an object of this invention to improve the supervision during the extension of these and other similar types of
25 connections by providing a distinctive signal for the A operator each time a trunk is engaged to enable this operator to follow with absolute certainty the progress of the connection.
30

To attain this and other objects of the invention as will hereinafter appear, there is provided in accordance with one feature thereof means whereby, on the seizure of
35 a trunk during the extension of a connection, two or more impulses of tone current are automatically transmitted back to the A operator's telephone, and whereby after these signals have been transmitted the B
40 operator's telephone set at the position indicated by the character of the tone signal is automatically associated with said trunk.

Another feature resides in the provision of a duplicate equipment, for transmitting
45 distinctive signals followed by the connection of the B operator's telephone set, that may be manually connected to a seized trunk and caused to function automatically in the same manner when so connected.

50 Referring to the drawings the invention has been illustrated in Figure 1 in connection with the straightforward trunk circuit of a common type. The portion of this figure above the dash dotted line shows the

incoming end of a straightforward trunk 55 circuit while the portion below this line shows a circuit arrangement in accordance with this invention for producing and transmitting over trunk circuits a distinctive signal which in this case, consists of two im-
60 pulses of tone current of the same character. Fig. 2 shows tone sources whereby the successive signals may be of different character. It should be understood that this in-
65 vention is not confined to the specific circuit arrangement shown in these drawings but may be applied to any other similar trunk circuit arrangements and arranged to produce more than two impulses of tone
70 current of different characteristics.

To clearly set forth the functioning of the invention in this circuit arrangement, a description will be made of the reception of a call over this trunk, and the resulting
75 automatic production and transmission of a distinctive signal consisting of two impulses of tone current, followed by a description of the functions of the duplicate equipment when used, and also a general description of
80 the application of this invention to tandem connections involving a plurality of straightforward trunks.

Assuming then that a call is incoming over the straightforward trunk A, this call may originate as is well known in the art by the
85 looping of the tip and ring conductors of the trunk at the call originating exchange. This will result in the operation of relay 10 at the incoming end over a circuit from battery, lower, outer armature and back contact
90 of relay 11, lower winding of relay 10, over the ring conductor of trunk A, through the above mentioned loop, back over the tip conductor of the trunk, through the upper
95 winding of relay 10, upper armature and back contact of relay 11 to ground. The operation of relay 10, causes the operation of relay 13 over a circuit as follows: battery, winding of relay 13, make before break
100 contacts of this relay, armature and front contact of relay 10, lower inner armature and back contact of relay 49 to ground. Relay 13 in operating closes a locking circuit for itself through its lower inner arma-
105 ture and front contact, through a resistance to ground, and also causes the lighting of lamp 14 over a circuit as follows: battery, resistance 12, upper armature and front con-

tact of relay 13, lamp 14, lower inner armature and back contact of relay 49 to ground. Another circuit closed by relay 13 is the circuit for the operation of relay 15. Relay 15 is part of a sequence circuit common to a plurality of trunks, which as is well known in the art may be provided for the connecting of a B operator's telephone set to trunks in succession. If the operator is idle at the time relay 13 operates, a circuit will therefore be completed for the relay 15 as follows: from battery, through this well known sequence circuit, winding of relay 15, lower outer armature and front contact of relay 13 to ground at the upper back contacts of relay 11. The operation of relay 15 closes a circuit for relay 16, which also forms part of this well known sequence circuit, as follows: battery and winding of relay 16, left hand armature and front contact of relay 15, through a ground supplied through the sequence circuit.

The operation of these relays, 15 and 16, completes various connections for the initiation of operations that will cause the distinctive signals above mentioned to be transmitted back over the trunk A to the call originating exchange and, after these signals have been sent, to connect the B operator's telephone set to the trunk A and cause the lamp 14 to be alternately extinguished and lighted to indicate to the B operator that a call is waiting on trunk A. Beginning with the operation of relay 16, this relay connects the tip and ring conductors on trunk A through its left hand armatures and front contacts to armatures of relay 24. The closing of the middle right hand armature of relay 16 to its associated contact closes a circuit as follows: battery, resistance 12, upper armature and front contact of relay 13, middle right hand armature and front contact of relay 16, resistance 3, winding of relay 28 to ground at the inner right hand armature and back contact of relay 35. This causes the operation of relay 28 and as is obvious the operation of the slow-to-operate relays 29 and 30 in succession. The operation of relay 30 short-circuits the connection to ground through the winding of relay 28 so that relay 28 will release and in turn cause the release of relays 29 and 30 in succession. Thus these relays will operate and release in succession and thereby cause the alternate decrease and increase in resistance in the original energizing circuit. On each operation of relay 30 the closing of the circuit from the battery at the upper armature and front contact of relay 13 to ground through the armature and front contact of relay 30 shunts lamp 14, and on each release of relay 30 the circuit will be completed through relay 28 and thus again cause lamp 14 to be relighted. Consequently the operation and release of re-

lays 28, 29 and 30 causes the alternate extinguishing and lighting of lamp 14 for purposes hereinafter described.

Turning now to the results obtained by the combined operation of relays 15 and 16, a circuit is first completed for the operation of relay 18 as follows: from battery, through outer right hand armature and back contact of relay 24, make before break contacts of relay 18, outer right hand armature and back contact of relay 35, winding of relay 18, armature and back contact of relay 55, right hand armature and front contact of relay 15, inner right hand armature and front contact of relay 16, make before break contacts of relay 11, resistance 4, inner lower armature and back contact of relay 49 to ground. Relay 18 in operating provides a locking circuit for itself from battery, outer right hand armature and front contact of this relay, outer right hand armature and back contact of relay 35, winding of relay 18 to ground at relay 49 independent of the battery supplied through the outer right hand armature and back contact of relay 24. The operation of relay 18 closes an obvious energizing circuit for a slow-to-operate relay 21 and also completes a connection from the tone source 20 to the trunk A over a circuit as follows: from the tone source 20, middle right hand armature and front contact of relay 18, outer right hand armature and back contact of relay 21, outer right hand armature and back contact of relay 22, inner right hand armature and back contact of relay 24, inner left hand armature and front contact of relay 16 to the ring conductor of trunk A through the operator's telephone set at the call originating end back over the tip conductor of trunk A, outer left hand armature and front contact of relay 16, left hand armature and back contact of relay 24 to ground. On the operation of relay 21, this circuit for the tone from source 20 is opened at the outer right hand armature and back contact of relay 21 so that the transmission of tone to the A operator ceases. The operation of relay 21 closes an obvious circuit for the operation of slow-to-operate relay 22 from the ground at relay 18. When relay 22 operates, another circuit is closed from the tone source 20 to the trunk A as follows: from the tone source 20, outer right hand armature and front contact of relay 22, and out over the trunk as hereinbefore traced. It will be noted that on the operation of relay 22 a circuit is closed for the operation of the slow-to-operate relay 23 from ground at the inner right hand armature and front contact of relay 18. On the operation of relay 23 an obvious circuit is completed for the operation of relay 24 so that when this latter relay operates the second application of tone current from the source 20 will be discontinued on the break-

ing of the tone circuit at the inner right hand armature and back contact of relay 24. The operation of relay 24 now connects the tip and ring conductors of trunk A through the inner right hand and the left hand armatures and front contacts of relay 24 to conductors extending to the operator's telephone set (not shown). Thus it will be seen that on the seizure of trunk A in accordance with this arrangement two successive impulses of tone current from the source 20 will be transmitted back over trunk A to the call originating or A operator and after this has been done, the B operator's telephone set is connected to the trunk.

The B operator now being connected with the A operator receives the number of the wanted subscriber's line, and the flashing of lamp 14 in the manner hereinbefore described, indicates to the B operator the trunk over which the call is incoming. The B operator will now insert her plug 42 into the jack of the wanted subscriber's line or into the jack of a trunk leading to another operator's position in the same exchange that may complete the call as into the jack of a trunk leading to another exchange as is well known in the art. The insertion of plug 42 into any one of these jacks closes a circuit for the operation of relay 43 from battery through the lamp 45, both windings of relay 43 in series, make before break contacts and winding of relay 46, sleeve terminals of the plug 42 and the jack to which the connection has been made to a ground connected to the sleeve as is well known in the art. The characteristics of relay 43 are such as not to cause the operation of relay 46 in this circuit at this time. However, when the tip and ring terminals of plug 42 have been actually connected to battery and ground through the tip and ring terminals of the jack to which the connection is extended a circuit is completed from plug 42 through the make before break contacts of relay 49, armatures and front contacts of relay 43 through the winding of relay 44 causing the operation of this latter relay. Relay 44 in operating short-circuits the left hand high resistance winding of relay 43 and this causes the operation of relay 46. Relay 46 in operating closes a locking circuit for itself from battery through its lower armature and front contact, and its winding to the ground on the sleeve terminal of plug 42. It will be noted that relay 46 in operating opens the connection from the sleeve terminal of relay 42 through the right hand winding of relay 43 and lamp 45 to battery, so that relay 43 will release. However, before this takes place the operation of relay 46 has caused the operation of relay 49 over an obvious circuit so that the battery and ground connected to the plug 42 have been extended through the upper

inner and lower outer armatures and front contacts of relay 49, to the front contacts associated with the upper and lower outer armatures and front contacts of relay 11. The purpose of relays 44 and 43 is to make sure that a connection is actually completed to battery and ground at plug 42 before the battery and ground supplied to trunk A at the upper and lower outer connections and back contacts of relay 11 are disconnected, so that there will be no interruption of the battery connection for the trunk A when relay 11 subsequently operates. It will be noted that the operation of relay 11 will take place on the operation of relay 49 over a circuit as follows: battery, upper outer armature and front contact and inner lower armature and front contact of relay 49, resistance 4, winding of relay 11, upper make-before-break contacts of relay 13, resistance 2 to ground. Relay 11 provides a locking circuit for itself from battery at lower inner armature and front contact, and also opens the tip and ring conductors of trunk A from the battery and ground connection of the armatures of this relay and connects these conductors through to the tip and ring terminals of plug 42 and the battery and ground connected thereto. This connection is made past the condensers 50 and 51. A connection from the call originating operator may now be completed to the wanted subscriber, this subscriber rung and a conversation carried on in the usual manner.

Upon the operation of relay 11 the circuit for relay 18 is opened and this relay thereupon releases. The release of relay 18 in turn causes the release of relays 21, 22, 23 and 24 in succession so that upon the operation of relay 11 the operator's set is automatically disconnected from the trunk.

When the connection is to be taken down, the call originating operator may open the loop circuit through the tip and ring conductors of the trunk A and thus cause the release of relay 10. The release of relay 10 closes a circuit for the release of relay 13 as the battery at the winding of relay 13 will be short-circuited through the battery supplied at the upper outer armature and front contact of relay 49. The circuit for this battery may be traced as follows: battery, upper armature and front contact of relay 49, inner lower armature and front contact of relay 49, armature and back contact of relay 10 to ground through the resistance 52 at the inner lower armature of relay 13. The release of relay 13 causes the release of relay 11 by the opening of the upper make-before-break contacts of relay 13 and the release of this relay 13 also causes the lighting of lamp 14 over a circuit as follows: battery, upper outer armature and front contact of relay 49, inner lower arma-

ture of relay 49 through lamp 14, upper armature and front contact of relay 13 to ground. The B operator noticing the steady lighting of lamp 14 takes this indication as a signal that the connection is to be taken down and consequently removes plug 42 from the jack in which it was inserted. The removal of this plug causes the release of relay 46 and the subsequent release of relay 49 and the extinguishing of lamp 14.

If the B operator decides to disconnect her telephone set from the trunk A prior to the automatic disconnection thereof by the operation of relay 11 as hereinbefore described, she may operate key 60. The operation of this key closes an obvious circuit for relays 55 and 56. Relay 55 in operating, opens the circuit for relay 18 which in releasing with relays 21, 22, 23 and 24 in succession causes the disconnection of the operator's telephone set from the trunk A and also provides a circuit for the operation of relay 11. This circuit may be closed as follows: battery, left hand winding of relay 55, armature and front contact thereof, right hand armature and front contact of relay 15, inner right hand armature and front contact of relay 16, lower make-before-break contacts of relay 11, winding of relay 11, upper lower make-before-break contact of relay 13 to ground. This circuit causes the operation of relay 11 and connection from the trunk A to the plug 42 will therefore be completed as hereinbefore described.

In case it is desirable to use tone of different characteristics for two successive impulses of tone hereinbefore mentioned, an arrangement such as shown in Fig. 2 may be employed. That is, lead 61 may be connected to the middle left hand front contact of relay 18 so that the tone from source 62 will be transmitted as a first impulse, while the lead 63 may be connected to the front contact and the outer right hand armature of relay 22 so that tone from source 64, which may be of a different character from that produced by source 62 may be transmitted as a second impulse. It is obvious that these tone sources, 20, 62 and 64 may be of any well known type and they are therefore merely illustrated in a diagrammatic form.

Referring now to the duplicate equipment for producing tones to be transmitted to the trunk and the connection of the B operator's telephone set, it is conceivable that the original circuit arrangement shown and described above may fail or be temporarily removed from service. If this is the case the B operator will, on noting the steady lighting of lamps such as 14, and when this lighting of the lamp is not followed by a flashing operation of this lamp, know that the sequence circuit is not functioning. In this case she will insert plug 42 in jack 66. Circuits will then be completed as before to

cause the functioning of the relay 43 and lamp 45. Upon the insertion of the plug completely into jack relay 44 will operate from battery at 67 and ground at relay 39. Consequently relay 43 will release and lamp 45 will be extinguished. While relays 46 and 49 will operate followed by the release of relay 44, relay 11 will then operate to extend the connection through to the call originating operator and relay 39 will operate through a circuit from battery at 67, ring terminals of jack 66 and plug 42 over the trunk through the loop of the call originating operator's position, back through ring terminals of plug 42 and jack 66, through the winding of relay 39 to ground.

Relay 39 in operating removes direct ground from the sleeve terminal of jack 66 so that relay 35 will now operate. The operation of relay 35 causes tone to be transmitted from source 20 over the trunk A in the same manner as tone was transmitted to the trunk on the operation of relay 18, on the obvious operation of relay 36 this tone will be removed while on the subsequent operation of relay 37, tone will again be applied to the trunk A from source 20 at the right hand armature of relay 37. On the subsequent operation of relay 38, the second application of tone from source 20 would be cut off and the operator's telephone set connected to the trunk.

The B operator may now communicate with the A operator at the call originating exchange and inquire as to the desired connection. When this information has been secured, the plug 42 will be removed from jack 66 and inserted in the jack of the line desired. On the removal of plug 42 from jack 66 relays 35, 36, 37, 38 and 39 will return to normal and relays 46, 49 and 11 will release and again operate on the insertion of plug 42 into the jack of the wanted line to complete the connection from the call originating operator.

If the connection desired by the call originating operator is a tandem connection, that is, one that includes several trunk circuits, such as A, as succeeding links, the common equipments for giving distinctive tones to the call originating operator would be differently arranged. In other words, each time an additional trunk circuit is included in the connection the distinctive tone for each additional trunk circuit will be of a different character. For example, in a tandem connection involving two trunks, the first trunk may be provided with a common equipment that would produce three successive impulses of tone current, while the second trunk may be provided with a common equipment that would produce two successive impulses of tone current. In this manner the call originating operator will, by merely listening to the different successive

tones, know when the corresponding operators are brought into the connection and thus be able to pass on to the operators in rapid succession the desired number.

5 What is claimed is:

1. In a telephone system, trunks, an operator's telephone set, means responsive to the seizure of a trunk for automatically associating the operator's telephone set with
10 said seized trunk, and means effective incident to the connection of the operator's telephone set with the seized trunk for automatically transmitting a signal over said trunk, said signal consisting of a plurality
15 of impulses of tone current.

2. In a telephone system, a plurality of trunks, an operator's telephone set, a signal associated with each of said trunks, means responsive to the seizure of a trunk for actuating the corresponding signal and for associating the operator's telephone set with
20 said trunk, and means effective incident to the association of the operator's telephone set with said trunk for actuating the corresponding signal in a different manner and for transmitting a tone signal over said trunk, said tone signal consisting of a plurality of impulses of alternating current.

3. In a telephone system, a plurality of
30 trunks, an operator's telephone set for each trunk, means for connecting said trunks in tandem, means responsive to the seizure of the first trunk for automatically associating the corresponding operator's telephone set therewith, means effective incident to the association of this operator's telephone set with said first trunk for transmitting a signal thereover to the point at which it was seized, means responsive to the seizure of
40 each of the succeeding trunks by a preceding trunk for associating the corresponding operator's telephone set therewith, and means effective incident to the association of each operator's set with its corresponding
45 trunk for transmitting a signal back over the preceding trunks to the point at which

the first trunk was seized, each of said succeeding signals consisting of a plurality of impulses of tone current, each signal being different in character from the others. 50

4. In a telephone system, a plurality of trunks, an operator's telephone set for each trunk, means for connecting said trunks in tandem, means responsive to the seizure of the first trunk for automatically associating
55 the corresponding operator's telephone set therewith, means effective incident to the association of this operator's telephone set with said first trunk for transmitting a signal thereover to the point at which it was seized, means responsive to the seizure of each of the succeeding trunks by a preceding trunk for associating the corresponding operator's telephone set therewith, and means effective incident to the association
65 of each operator's set with its corresponding trunk for transmitting a signal back over the preceding trunks to the point at which the first trunk was seized, each of said succeeding signals consisting of a plurality of impulses of tone current, the currents for said impulses being of different frequencies and each signal is of a different character from the other. 70

5. In a telephone system, a plurality of
75 trunks adapted for connection in tandem, an operator's position at the incoming end of each trunk, a telephone set for each operator, means for associating said telephone sets with their corresponding trunks, and means
80 at each operator's position effective incident to the association of the corresponding telephone set with the corresponding trunk for transmitting a signal back over the preceding trunk or trunks, the signal produced at each position being different in character from all the others. 85

In testimony whereof, I have signed my name to this specification this 2nd day of April, 1926.

STANLEY F. NELSON.