June 14, 1927.

W. WHITNEY

1,632,051

TELEPHONE SYSTEM

Filed July 28, 1926

2 Sheets-Sheet 1

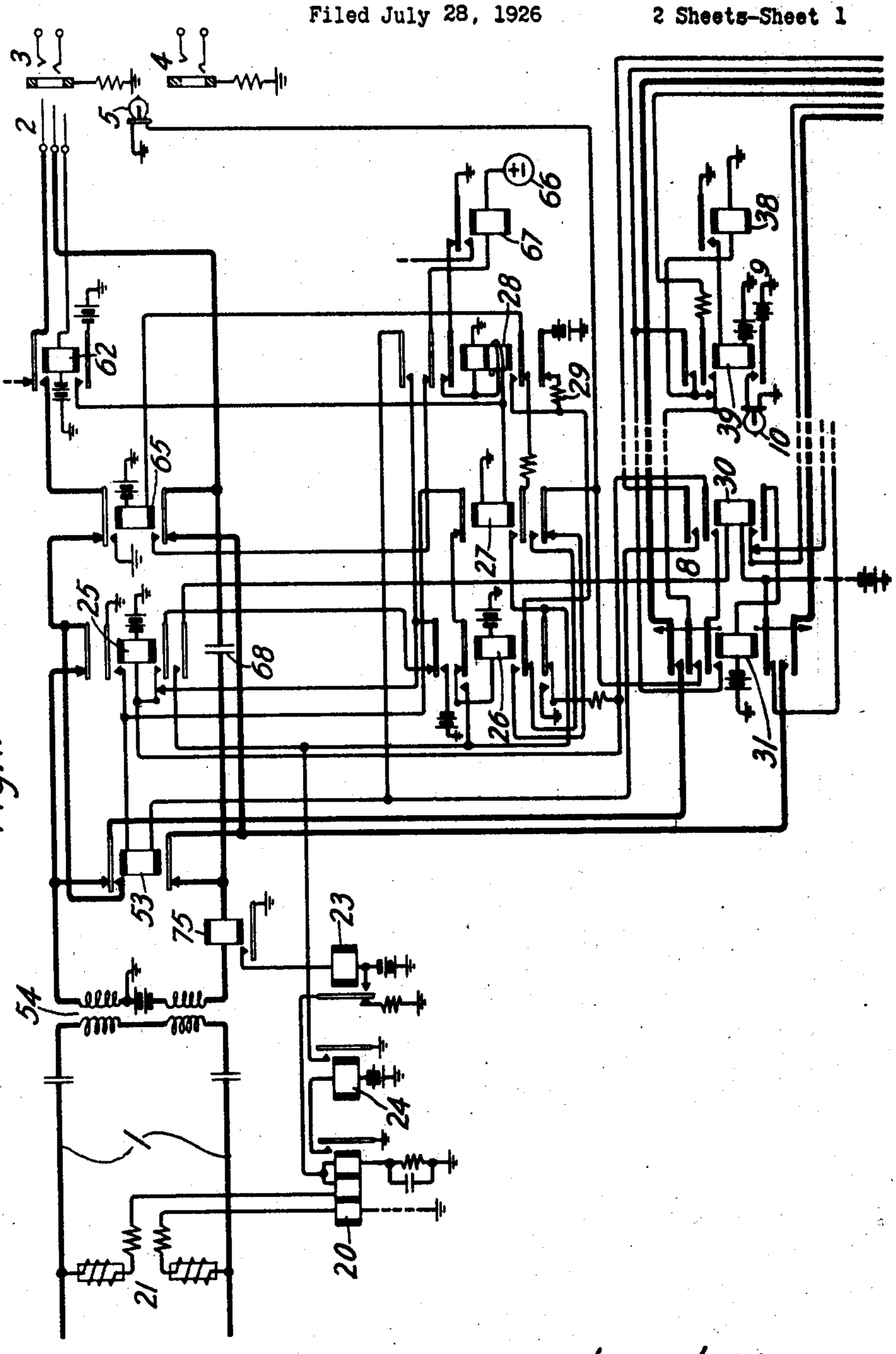

Fig. 1.

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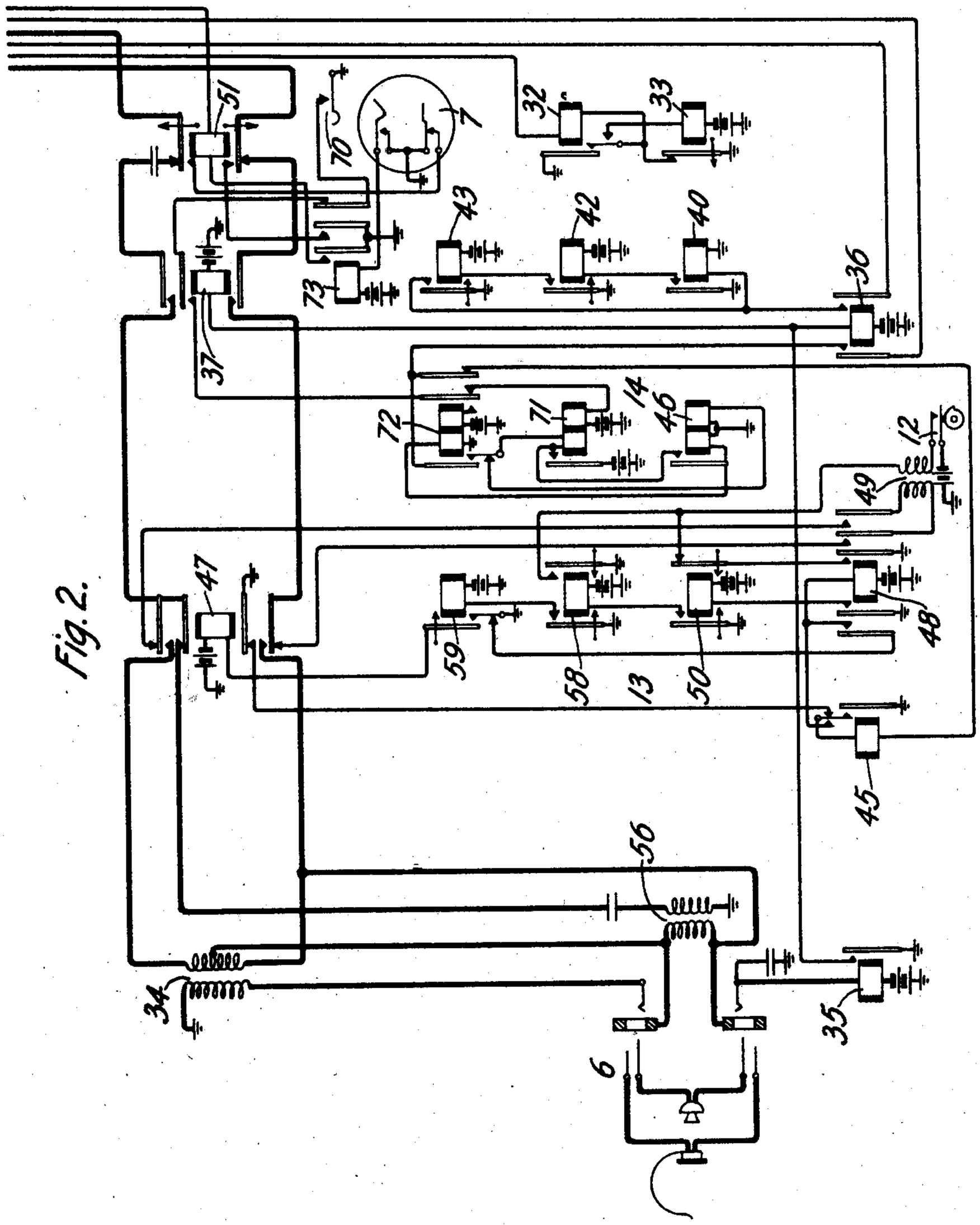

Fig. 2.

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Wiley Whitney.

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Patented June 14, 1927. 1,632,051

UNITED STATES PATENT OFFICE.

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TELEPHONE SYSTEM.

Application filed July 28, 1926. Serial No. 125,367.

This invention relates to telephone systems, and more particularly to improvements in the establishment and supervision of connections over straightforward trunks.

Heretofore in trunking systems of this type it has been customary to provide, at the incoming ends of the straightforward trunks, means for associating therewith a circuit, containing a dialing equipment and a "B" operator's telephone set, which is common to a plurality of such trunks. A sequence circuit is often interposed between the trunks and the common equipment for the connection of said equipment with the straightforward trunks in the order in which such trunks are taken for use. Trunks of this type may terminate in plugs at the incoming end and be equipped for extension to various kinds of wanted subscribers' lines. Connection may be extended either directly to a subscriber's line, or through intermediate interoffice trunks leading to operators' positions at a distant exchange or to automatic equipment of a distant exchange. From these operators' positions a wanted subscriber may be reached through a manually completed connection, or through automatic switches that may be operated by the actuation of the "B" operator's common dialing equipment to associate a straightforward trunk with the wanted subscriber's line.

According to the present invention there is provided an arrangement whereby the common equipment, including a dial and a "B" operator's telephone, is automatically associated with and prepared for use with a straightforward trunk when said trunk is seized at the originating end and whereby a signal consisting of a plurality of distinctive tone impulses is automatically produced and transmitted to the operator at the call originating end and to the "B" operator when the connection between the common equipment and the seized trunk is completed.

According to another aspect of the invention the usual ringing relay is employed for two different purposes, namely to connect ringing current to a line that has been connected with a straightforward trunk and to open the incoming end of the straightforward trunk in response to the abandonment of the call by the operator at the originating end thereof, or in response to the usual disconnection by this operator. This opening of the trunk conductors may be utilized to produce a disconnect signal at the distant end of the line or trunk connected to the straightforward trunk.

A further advantage resides in an arrangement for automatically disconnecting the common equipment from a straightforward trunk upon the abandonment of a connection involving said trunk.

Moreover there is provided means whereby the usual guard and disconnect lamp associated with a straightforward trunk is not locked in actuated condition when a trunk is seized but is free to release if the operator at the originating end abandons the call before the common equipment is connected to the trunk.

The invention has been illustrated in the accompanying drawings, in which Fig. 1 shows the incoming end of a straightforward trunk arranged in accordance with this invention. A portion of a sequence circuit is also shown in this figure whereby the common equipment may be connected in succession to seize trunks, while Fig. 2 shows this common equipment which includes, besides the operator's telephone set and dial, an arrangement for producing a plurality of tone impulses.

Referring now in general to the circuit arrangements shown, a straightforward trunk 1 incoming from a distant exchange terminates in a plug 2 whereby connections may be extended to various types of lines, for example, to jack 4 of a tandem trunk that may terminate at a distant exchange at an incoming operator's position or automatic equipment, or through a jack 3 directly to a wanted subscriber. This trunk 1 is provided with a guard and disconnect lamp 5 for the supervision of a call over this trunk and a sequence circuit through which the "B" operator's telephone set 6 and a dial 7 may be associated with the trunk. Of this circuit only a relay arrangement 8 individual to trunk 1 has been shown together with a relay arrangement 9 which is common to a plurality of trunks, it being understood that each trunk such as 1 of the same group is equipped with an individual relay arrangement such as 8. This last mentioned common equipment 9 includes a pilot lamp 10. The common equipment shown in Fig. 2 includes besides the B operator's set 6 and dial 7

a tone source 12 and a relay arrangement 13, whereby two impulses of tone may be produced for transmission to the call originating operator and to the telephone set 6, and also a relay arrangement 14 whereby the common equipment may be manually disconnected from the trunk 1. A relay arrangement for flashing the guard and disconnect lamp 5 shown in Fig. 2 will be hereinafter described.

To clearly bring forth the various features of this invention a description will now be made of a connection extending over trunk 1 to a manual subscriber and to an automatic subscriber and a description of the functions taking place when the operator at the originating exchange abandons a call over trunk 1. Assuming then that the operator at the originating exchange has seized trunk 1, in a manner well known in the art by establishing a battery connection for the conductors of trunk 1, relay 20 will operate over a circuit from the conductors, retardation coil 21, left winding of relay 20 to ground and middle winding of relay 20, armature and back contact of relay 23 to ground. The operation of relay 20 closes an obvious circuit for relay 24, which in operating closes a circuit for the operation of relay 25 as follows: Battery, winding of relay 25, lower outer armature and back contact of relay 26, armature and front contact of relay 24 to ground. Relay 25 in operating opens the tip conductor of trunk 1 at its upper outer armature and back contact and provides a circuit for the operation of relay 26 as follows: Battery, winding of relay 26, upper inner armature and back contact of relay 26, upper armature and back contact of relay 27, upper inner armature and front contact of relay 25 to ground. Relay 26 in operating closes a locking circuit for itself through its upper make-before-break contacts to ground at the armature and front contact of relay 24, and closes a circuit for the lighting of guard lamp 5 as follows: Battery, lower outer armature and back contact of relay 28, resistance 29, lower inner armature and front contact of relay 26, lower outer armature and back contact of relay 27, lamp 5 to ground. The lighting of lamp 5 indicates to the "B" operator that trunk 1 has been seized.

If the common equipment shown in Fig. 2 has not been seized by any other trunk at this time, battery will be supplied for the operation of relay 30 over the following circuit: Battery, winding of relay 30, outer lower armature and front contact of relay 25, armature and front contact of relay 24 to ground. The operation of relay 30 closes a circuit for the operation of relay 31 as follows: Battery, winding of relay 31, lower armature and front contact of relay 30 through lower make-before-break contacts of relays corresponding to relay 30 individual to other trunks through the winding of relay 32, armature and back contact of relay 33 to ground. This circuit also causes the operation of relay 32, which in operating closes an obvious circuit for relay 33 that removes the ground from the previously traced circuit and is locked with the relays 32 and 31 through the front contacts of relay 32 to ground. Relays 32 and 33 are provided to insure that the lowest numbered of the waiting trunks will be next connected to the common equipment when released from the last trunk in the group in a manner which will be set forth hereinafter. The operation of relay 31 associates the common tip and ring conductors from the operator's telephone set 6 with the tip and ring conductors of trunk 1 at its outer upper and lower armatures and front contacts.

It should be understood that the operator's telephone set 6 is connected through the plugs and jacks shown connected to the common talking circuit through the repeating coil 34 when the "B" operator is in attendance at this position. Relay 35 is, therefore, at such times operated by a circuit from battery, winding of relay 35 through the transmitter, the primary of the repeating coil 34 to ground. Relay 35 in operating causes the operation through obvious circuits of relays 36 and 37, so that a talking circuit from the operator's telephone set 6 is normally extended to the upper and outer lower armatures of relays, such as 31, except that this circuit is broken at the contacts of relay 47 until required as will be hereinafter described. The operation of relay 31 closes a circuit for relay 38 as follows: Battery, resistance 29, inner lower armature and front contact of relay 26, outer lower armature and back contact of relay 27, middle upper armature and front contact of relay 31, make-before-break contacts of relay 39, winding of relay 38 to ground. The operation of relay 38 closes an obvious circuit for the operation of relay 39, which in operating closes an obvious circuit for the lighting of pilot lamp 10 to indicate that a trunk is being connected to the common equipment. This relay in operating also transfers the control over the operation of relay 38 from the battery at relay 28 to battery through the winding of relay 25 through the inner upper armatures and front contacts of relays 31 and 30 and the outer upper armature and front contact of relay 39.

Another circuit closed by the operation of relay 39 is that for the operation of relay 40 which may be traced as follows: Battery, lower outer armature and back contact of relay 28, resistance 29, lower inner armature and front contact of relay 26, lower outer armature and back contact of relay 27, upper middle armature and front contact

of relay 31, upper inner armature and front contact of relay 39, right hand armature and front contact of relay 36, winding of relay 40 to ground. It should be noted that this relay 40 is in a connection to ground parallel to the connection to ground of lamp 5. When relay 40 attracts its armature an obvious circuit will be closed for the slow to operate relay 42, which in attracting its armature closes an obvious circuit for the operation of slow to operate relay 43. On the operation of this last mentioned relay a connection is closed to ground at its armature and front contact for the shunting of relay 40 and lamp 5. Relay 40 is released and lamp 5 is extinguished. On the release of relay 40 relays 42 and 43 are released in succession and on the release of relay 43 the short-circuit for relay 40 and lamp 5 is removed so relay 40 is reoperated and lamp 5 is again lighted. This cycle of operations of relays 40, 42 and 43 is continuous, so that lamp 5 alternately becomes lighted and extinguished to indicate to the "B" operator that the common equipment has been associated with the trunk 1.

It will be noted that on the operation of relay 31 a circuit is closed for the operation of relay 45 as follows: Battery, winding of relay 25, upper inner armatures and front contacts of relays 30 and 31, left hand armature and front contact of relay 36, outer right hand armature and back contact of relay 72, winding of relay 45, normal make-before-break contacts of this relay through the lower inner armature and back contact of relay 47 to ground. Relay 45 in operating provides a locking circuit for itself independent of the ground at the relay 47, through its armature and front contact to ground. This relay 45 in operating also closes an obvious circuit for the operation of relay 48. Relay 48 in operating provides a circuit from the tone device 12 to the tip and ring conductors of trunk 1, the primary of tone coil 49 of tone device 12 being connected to ground through the inner right hand armature and front contact of relay 48 and right hand armature and back contact of relay 50, while the secondary of the tone coil 49 is connected to the two outer right hand armatures and front contacts of relay 48, the upper and lower outer armatures and back contacts of relay 47, upper outer and lower armatures and front contacts of relay 37, upper outer and lower armatures and back contacts of relay 51, upper and lower outer armatures and front contacts of relay 31 through the upper and lower armatures and back contacts of relay 53 winding of relay 75 on the ring through the right hand windings of the repeating coil 54 to battery and ground. Relay 75 does not operate in this circuit due to the inclusion of a condenser at the back contact of the upper armature of relay 51. A connection is also established from the secondary of the coil 49 of the tone device to the upper armatures and back contacts of relay 47 to the primary winding of the repeating coil 56 associated with the receiver of the operator's telephone set 6, so that a tone will now be transmitted through the repeating coil 56 to the operator's telephone set 6 and through the repeating coil 54 to the operator at the distant end of the trunk 1. This tone will be interrupted on the operation of the slow to operate relay 50 for which a circuit is closed on the operation of relay 48. The operation of relay 50 opens the primary circuit for the tone device 12 and also closes an obvious circuit for the slow to operate relay 58 which again closes a circuit at its right hand armature and front contact to ground for the primary of the repeating coil 79 so that a tone is again transmitted to the operator at the distant end of trunk 1 and to the "B" operator's telephone set 6. The operation of relay 58 closes an obvious circuit for the slow to operate relay 59, which in operating closes an obvious circuit for the operation of relay 47. The operation of this relay opens the original energizing circuit for relay 45 at its inner lower armature and back contact and also opens the circuit from the secondary of the tone coil 49 to the tip and ring conductors leading to the trunk 1 and disconnects the repeating coil 56 so that the tone from the device 12 will cease to be transmitted to the two operators. These two impulses of tone indicate to the "B" operator and to the operator at the distant end of the trunk 1 that the "B" operator's telephone set 6 has been connected to the trunk 1. This takes place on the operation of relay 47 when the secondary of the transformer 34 is connected through the upper outer and the lower outer armatures and front contacts, through two of the contacts of relays 37, 51, 31 and 53 to trunk 1.

Conversation between the operator at the distant end and the "B" operator may now take place and when the "B" operator receives the number of the wanted subscriber's line she may initiate the desired connection by inserting plug 2 into jack 3 if a local subscriber is wanted. In this case a circuit is established through the sleeves of plug 2 and jack 3 for the operation of relay 62. The operation of relay 62 completes the tip conductor for trunk 1 to the terminals of plug 2 and jack 3 and closes the circuit for the operation of relay 27 as follows: Battery, lower armature and front contact of relay 62, winding of relay 27 to ground. The operation of relay 27 opens the original energizing circuit for relay 26 at its upper armature and back contact and at its lower outer armature and back contact opens the

circuit for lamp 5, which is now extinguished. This relay also closes a circuit for ringing relay 65 as follows: Battery, winding of relay 65, lower inner armature and back contact of relay 28, lower inner armature and front contact of relay 27, armature and front contact of relay 24 to ground.

The operation of relay 65 connects ringing current from source 66 through the ringing trip relay 67, upper middle armature and back contact of relay 28 through the lower armature and front contact of relay 65 to the ring conductor of trunk 1 and a ground through the upper armature and front contact of relay 65 to the tip conductor of trunk 1. This ringing current is transmitted to the subscriber connected to jack 3. It should be noted that ringing is also inductively transmitted through condenser 68 and repeating coil 54 to the outgoing end of trunk 1, so that the operator at this end will hear the ringing of the wanted subscriber.

When the wanted subscriber answers ringing trip relay 67 operates as is well known in the art and by removing the ground from the outer contact of its armature causes relay 28 to operate from the battery at the lower armature and front contact of relay 62. The operation of relay 28 causes the release of ringing relay 65 and also ringing trip relay 67 and ringing current is thereby removed from the trunk 1. The release of relay 65 establishes a connection for the tip and ring leads between the repeating coil 54 and the plug 2, so that relay 75 will now become operated through the subscriber's loop. This relay in operating closes an obvious circuit for the operation of relay 23 and this relay which by attracting its armature applies battery to the tip conductor of trunk 1 to cause a signal indication, as is well known in the art, to be made at the distant operator's position, indicating that the called subscriber has answered.

It should be noted, however, that before conversation between the subscriber at the distant end of trunk 1 and the wanted subscriber can take place the "B" operator's telephone set must be disconnected from the trunk. This is done by having the "B" operator actuate release key 70. The operation of key 70 closes a circuit for relay 71 as follows: Battery, right hand winding of relay 71, right hand armature and back contact of relay 72, upper inner armature and front contact of relay 37, outer left armature and back contact of relay 73 and key 70 to ground. The operation of relay 71 closes a circuit for the operation of relay 46 as follows: Battery, armature and front contact and left hand winding of relay 71, make-before-break contact of relay 72, right hand winding of relay 46 to ground. The operation of relay 46 closes a circuit from battery at the armature and front contact of relay 71 to the left hand armature and front contact of relay 46 through the left hand winding of this relay to ground, and also through the left hand winding of relay 72 to ground. Relay 72 operates and breaks the original energizing circuit for relay 46 which, however, is now held up from the battery on the armature and front contact of relay 71 through its own left hand armature and front contact. Relay 72 in operating however opens the energizing circuit for relay 71, but before this relay releases a connection from battery at the armature and front contact of this relay is connected through the left hand armature and front contact of relay 72 to the left hand armature of relay 36, the purpose of which will be explained later. Relay 72 in energizing closes a locking circuit for itself to battery through its right hand winding, inner right hand armature and front contact to the ground at key 70 and the release of relay 71 causes the release of relay 46. The operation of relay 72 also opens the circuit for relay 45, which in releasing causes the release of relay 48 and the release in succession of relays 50, 58, 59 and 47. The release of relay 47 opens the circuit from the operator's telephone set 6 to the tip and ring leads of trunk 1 and the temporary battery from the armature and front contact of relay 71 mentioned above causes the release of relays 25, 38 and 39 and extinguishes pilot lamp 10. Relay 25 now becomes locked in non-operated position due to the battery connected through its make-before-break contacts and upper outer armature and front contact of relay 26. The release of relay 25 causes the release of relay 30 in the sequence circuit and the release of this relay causes the release of relays 31, 32 and 33. Upon the release of relay 32 the ground connection provided by relays 32 and 33 is opened for an interval timed by the slow release of relay 33 so that if another relay such as 31 is in a condition to be energized its circuit will not be completed through the chain contacts of relays such as 30 until the disconnection of the operator's set 6 from the present trunk is completed. Upon the reapplication of this ground connection by the release of relay 33 the lowest numbered of the waiting trunks will be next connected to the counting equipment because the circuit of the relay 31 of the lowest numbered trunk will be completed and the circuit of other relays such as 31 will be opened by the energization of the relay corresponding to relay 30 of such lowest numbered waiting trunk. The release of relay 25 also causes the release of relay 53 if the plug 2 has been inserted in jack 3 before the operation of key 70 in which case this relay became operated on the operation of relay 28. The operation of relay 53 in this type of connec-

tion is believed of no importance. The connection from the operator at the distant end of trunk 1 to the wanted subscriber's line is now completed through contacts of the relays 53, 25, 65 and 62 so that conversation may now take place between these subscribers.

When conversation ceases and the wanted subscriber hangs up his receiver, relay 75 releases, causing the release of relay 23, which removes the battery from the tip conductor of trunk 1, causing a disconnect signal to be received at the distant operator's position. This operator thereupon removes the plug from the jack associated with the opposite end of trunk and thus causes the release of relays 20 and 24. The release of relay 24 causes the release of relay 26. This closes a circuit for the lighting of lamp 5 and operation of relay 65 as follows: Battery, winding of ringing relay 65, inner lower armature and front contact of relay 28, inner lower armature and back contact of relay 26, outer lower armature and front contact of relay 27, lamp 5 to ground. When the "B" operator finds lamp 5 lighted, she will remove the plug 2 from jack 3, causing the release of relays 62, 27, 28 and 65 and the circuits are now in normal condition. In this type of connection the operation of the ringing relay 65 at this time is of no importance.

If the operator at the distant end of trunk 1 should abandon the call by removing the plug of her cord from the jack of trunk 1 before the "B" operator had time to operate her release key 70, the "B" operator's telephone set 6 and dial 7 would be automatically disconnected from the trunk 1, that is, relays 20 and 24 will release and the release of relay 24 will cause the release of relay 26 and relays 30 and 31. The release of relay 26 causes the release of relay 25. If plug 2 is inserted in jack 3, relay 53 will also be released at this time and in that case the lamp 5 will light on the release of relay 26 so that the "B" operator will now remove plug 2 from jack 3. The release of relays 30 and 31 will naturally cause the release of relays 38 and 39, 32 and 33, and relays 45, 48, 50, 58, 59 and 47 so that the common equipment will be restored to normal condition and is now therefore available for use with other trunks.

If the wanted subscriber is one that can be reached only through an intermediate trunk such a trunk terminating, for example, in jack 4, such trunk may be selected by the usual call wire method and the connection established at the distant exchange through the usual manual cord circuit. If an automatic subscriber is desired, the connections will be established at the distant exchange to automatic switches so that the "B" operator may dial the desired subscriber's number. As the means of extending the connection to an automatic exchange subscriber forms no part of this invention, no showing has been made thereof, nor will any further descriptions be made in this respect, except to show how the "B" operator may dial such a subscriber. Under these circumstances, on insertion of plug 2 into jack 4, the operations will be identical to the operations described for the connection through jack 3, except that the ringing will be tripped immediately to cause the operation of relay 28. It will be noted that on the operation of relay 28 relay 53 operates from ground at the upper inner armature and front contact of relay 25 to the battery applied at the upper inner armature and front contact of relay 26. The operation of relay 53 connects the tip of plug 2 to the tip conductor of the common equipment through the upper outer armature of relay 31 independent of relay 25, so that the common equipment is now connected to plug 2. The "B" operator may now actuate her dial 7 and on the operation of the dial from normal a ground connection is made to the off-normal contacts of the dial for the operation of relay 73 over an obvious circuit and on the operation of relay 73 a circuit is closed for the operation of relay 51 as follows: Battery, upper outer armature and front contact of relay 26, upper outer armature and front contact of relay 28, upper outer armature and front contact of relay 30, winding of relay 51, right hand armature and front contact of relay 73 to ground. On the operation of relay 51 ground from the middle left hand armature and front contact of relay 73 is connected through the lower armature and front contact of relay 51 to the ring conductor of plug 2 through the trunk connected to jack 4, and a ground is also connected through the pulsing contacts of dial 7 and upper inner armature and front contact of relay 51 to the tip conductor of plug 2 and the tip conductor of the trunk connected to jack 4. This second mentioned connection to ground will be interrupted on the return of the dial to normal in accordance with the digit dialed, to cause the operation of the usual pulsing relays in the automatic switches at the distant end thereby manipulating the switches to select the wanted subscriber's number as is well known in the art. Relays 73 and 51 are released between the digits so that the "B" operator's telephone set 6 will be connected through the induction coil 34 and the talking conductors of the plug 2 to the distant switches. This is to enable the transmission of busy tone to the operator's telephone set 6 in case a busy condition is encountered. After dialing is completed, the "B" operator releases her dial and telephone set by the operation of key 70 in the manner here-

inbefore described and the subscribers may begin conversation. After the subscribers have finished their conversation the disconnection may take place in the same manner as when a manual subscriber is connected to jack 3.

As mentioned in connection with the description of the release of the trunk 1 when the operator at the distant end removes a plug from the jack of trunk 1, relay 65 operates at the same time as lamp 5 is lighted. In this case the splitting of the trunk at the armatures and back contacts of relay 65 may be utilized as a disconnect signal. Relay 65 may therefore serve two purposes, namely, to apply ringing current and to split the conductors of trunk 1 to produce a signal at the distant end of a connector trunk.

What is claimed is:

1. In a telephone system, a trunk, a signal associated with said trunk, an operator's telephone set and an impulse sender, means responsive to the seizure of said trunk for actuating said signal and for automatically associating said telephone set and sender with said trunk, and means effective incident to the association of said telephone set and sender with said trunk for actuating said signal in a different manner and for transmitting a signal comprising a plurality of impulses of tone current to said trunk and to said telephone set.

2. In a telephone system, a trunk, a line, a signal associated with said trunk, means for actuating said signal responsive to the seizure of said trunk at its outgoing end, means for interconnecting said trunk and line, means including a relay responsive to the interconnection of the trunk and line for disabling the signal and another relay under control of said first relay for opening the trunk conductors and applying ringing current to said line, means including another relay responsive to the tripping of the ringing for releasing said second mentioned relay, and means responsive to the release of the outgoing end of the trunk for reactuating said signal and for reactuating said second mentioned relay to reopen the trunk conductors.

3. In a telephone system, a trunk, a line, means for seizing said trunk, means for interconnecting said trunk and line, means including a relay operating in response to the interconnection of said trunk and line for opening the trunk conductors and applying ringing current to said line, means responsive to the seizing of said line for releasing said relay to discontinue the ringing and close the trunk conductors, and means responsive to the release of said trunk for reoperating said relay to open the trunk conductors without applying ringing current to the line.

4. In a telephone system, a trunk, an operator's telephone set and a dial, a signal associated with said trunk, means responsive to the seizure of said trunk for actuating said signal and for automatically associating said telephone set and dial with the trunk, means effective incident to the automatic association of the telephone set and dial with the trunk for actuating said signal in a different manner, and means for automatically releasing said telephone set and dial and disabling the signal responsive to the release of said trunk.

5. In a telephone system, a trunk, a line, an operator's telephone set and a dial, a signal, means responsive to the seizure of the trunk for actuating said signal and automatically associating the telephone set and dial with the trunk, means effective incident to the association of the telephone set and dial with the trunk for actuating said signal in a different manner and for applying a tone signal comprising a plurality of tone current impulses to the trunk and to the operator's telephone set, means for associating the trunk with the line, a source of ringing current, means effective incident to the association of said trunk and line for disabling said signal before applying ringing current to the line and to the trunk and for opening the trunk conductors, means effective incident to the seizure of the line at the free end thereof for removing the ringing current from the line and reconnecting the conductors of the trunk, and means responsive to the release of the trunk at the seized end for reoperating the signal, for automatically disconnecting the operator's telephone set and dial from the trunk and for reopening the trunk conductors.

In witness whereof, I hereunto subscribe my name this 23rd day of July, A. D. 1926.

WILEY WHITNEY.