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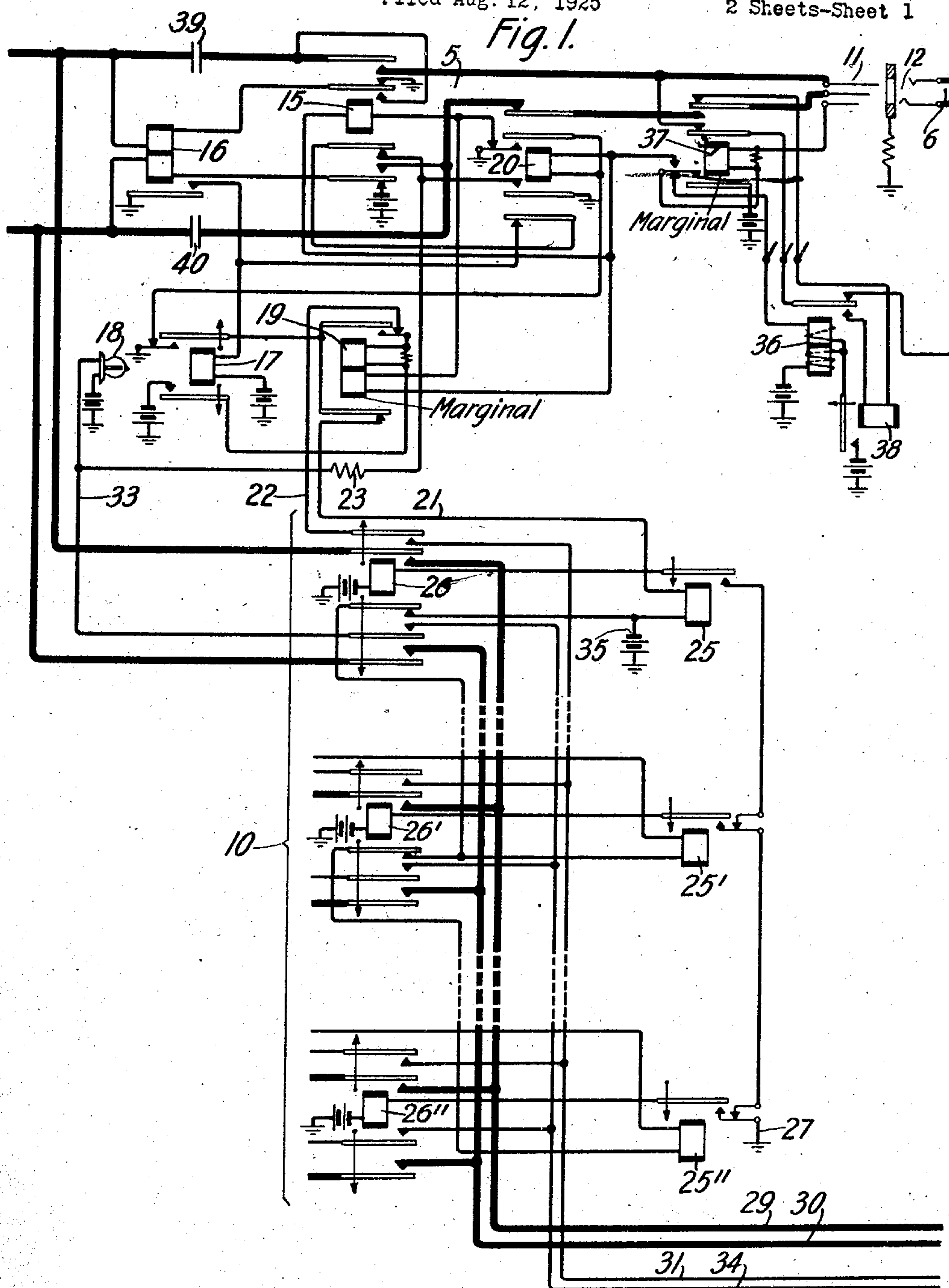
W. C. KIESEL ET AL

1,642,500

TELEPHONE SYSTEM

Filed Aug. 12, 1925

2 Sheets-Sheet 1



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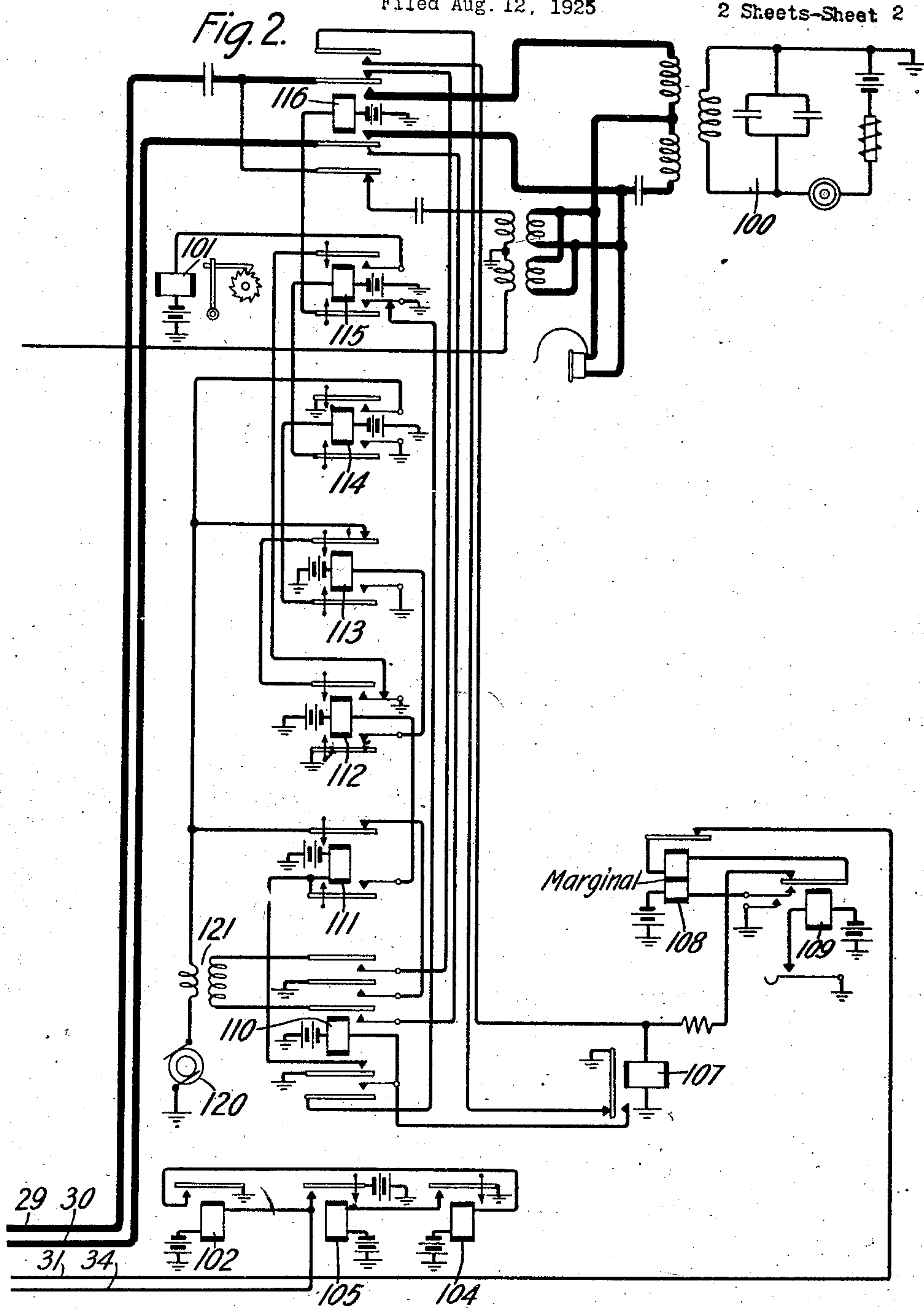
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UNITED STATES PATENT OFFICE.

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TELEPHONE SYSTEM.

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This invention relates to telephone systems and more particularly to improvements in service measuring arrangements as applied to the use of connecting circuits in trunking systems.

In telephone systems including trunk lines or cord circuits for the completion of connections, a trunk line, for example, outgoing from an "A" operator's position may be selected by an "A" operator for the extending of connections to a "B" operator's position at a distant point. On the engagement of such a trunk the "B" operator's telephone set is automatically or manually connected to the incoming end thereof and the connection of the telephone set to engaged trunks is often done in an order depending on a numerical sequence rather than in the order in which the trunks become engaged.

An object of this invention is to provide improved means applicable to systems of the above and similar types for counting the number of times the lines incoming to an operator's position are engaged.

To attain this and other objects of the invention as will hereinafter appear; one feature of the invention resides in the provision of means whereby a service meter or so-called peg-counting meter operates to register but once for each time a trunk is engaged and whereby the registration takes place on the release of the operator's telephone set from a trunk employed in a connection. That is, the meter after having once operated to register the engagement of a trunk is entirely removed from control of said trunk until this trunk is again engaged in another connection.

This invention has been illustrated in connection with a trunking system of the above type in which a sequence circuit is employed for the automatic connection of the "B" operator's telephone set to engage trunks in a numerical sequence. The arrangement is such that the peg-count meter is actuated each time the "B" operator's telephone set is disassociated from a trunk. This disengagement of the operator's telephone set takes place when the plug in which the trunk terminates at the incoming end is inserted in the jack of a line outgoing from the "B" operator's position.

In the accompanying drawings, Fig. 1 shows the incoming end of a trunk circuit

terminating at a "B" operator's position, a portion of the sequence circuit whereby the "B" operator's telephone set may be connected to engage trunks in succession and the outgoing end of a trunk or subscriber's line whereby a call incoming over the trunk may be extended beyond, while Fig. 2 shows a "B" operator's telephone set and a circuit arrangement for associating it with the sequence circuit.

To make clear the functions of the invention as applied to a trunking arrangement of this type, a detailed description will be made of a connection established over the trunk to subscriber's line from a distant office (not shown) at which the outgoing end of the trunk terminates and where the connection is completed in the usual manner from the calling subscriber's line. In this description it will be pointed out how the "B" operator's telephone set is automatically connected to engage trunks in the order in which they are numbered or arranged in the sequence circuit and particularly the connection of the telephone set to trunk 5. It will also be pointed out how the peg-count meter 101 is operated to register the engagement of trunk 5 at the time the operator's telephone set is released from said engaged trunk, this release taking place when plug 11 of trunk 5 is inserted in jack 12 of the subscriber's line 6. It should be understood that this invention is not limited in its application to this particular type of system but may equally well be applied to other systems such as plug-ending cord circuits with which an operator's telephone set may be automatically or manually associated.

Assuming then that a connection is desired over trunk 5 and that an "A" operator at the distant end of this trunk has caused the tip and ring conductor thereof to be connected together in the usual manner to signal the "B" operator that a connection is desired, the following circuit is completed: Battery, lower outer armature and back contact of relay 15, lower winding of relay 16, ring conductor of trunk 5 over the loop at an "A" operator's position to the tip conductor of trunk 5 through the upper winding of relay 16 and upper inner armature and back contact of relay 15 to ground. This causes the operation of relay 16 which

in operating closes an obvious circuit for relay 17 and also closes a circuit for the lighting of the guard lamp 18 as follows: Battery, lamp 18, resistance 23, lower inner armature and back contact of relay 15, lower outer armature and back contact of relay 20, armature and front contact of relay 16 to ground. The lighting of lamp 18 indicates to the "B" operator, at which position trunk 5 terminates, that a connection is desired over this trunk. The operation of relay 17 completes connections to the sequence circuit 10 such as a connection from ground at its upper armature and front contact to lead 21 and a connection from battery at its lower armature and back contact to lead 22.

A description of this sequence circuit 10 will now be made. In case the operator's telephone set 100 is not connected at the time to any other engaged trunk it will be immediately connected to trunk 5. The first operation towards accomplishing this will be the operation of relay 25 over a circuit as follows, assuming that trunk 5 is number one of the trunks that may be connected to the operator's telephone set: Battery 35, winding of relay 25, conductor 21, lower armature and back contact of relay 19, upper armature and front contact of relay 17 to ground. The operation of relay 25 closes an energizing circuit for relay 26 as follows: Battery, winding of relay 26, armature and front contact of relay 25, make-before-break contacts of relays 25' and 25'' to ground at 27. The operation of relay 26 extends through the operation of its armatures, the tip and ring leads of trunk 5 to the common leads 29 and 30, respectively. It also connects lead 22 to a common lead 31, lead 33, from lamp 18, to a common lead 34 and opens a connection from battery 35, through its lower inner armature and back contact to corresponding contacts of relay 26' and other intermediate relays (not shown) for other trunks for purposes as will hereinafter be described.

The connection of lead 33 to lead 34 completes a circuit for relay 102 as follows: Battery, winding of relay 102, lead 34, lead 33, resistance 23, lower inner armature and back contact of relay 15, lower inner armature and back contact of relay 20, armature and front contact of relay 16 to ground. This circuit causes the operation of relay 102 which in turn closes an obvious energizing circuit from relay 104 and relay 104 in energizing closes an obvious energizing circuit for relay 105. It should be noted that relays 104 and 105 are slow to operate so that an appreciable time interval will elapse before relay 105 is operated after the operation of relay 102. When relay 105 finally operates, a connection is made at its armature and front contact directly to battery from lead 34. This connection shunts the connection

from ground at relay 16 to the battery through lamp 18 and relay 102, so that lamp 18 will now become extinguished and relay 102 released. On the release of relay 102, relays 104 and 105 are in turn released. On the release of relay 105 the shunt to battery for lead 34 is removed and lamp 18 is again lighted, and relay 102 is again operated. The reoperation of relay 102 causes the repetition of the above cycle of operations and release of relays 104, 105, 102 and extinguishing of lamp 18, and consequently the closing of a connection between lead 33 and lead 34 will effect continued flashing operations of lamp 18. This lighting and extinguishing of lamp 18 at intervals indicates to the "B" operator that the telephone set 100 is connected to trunk 5, for it will be noted in the following description that simultaneously with the operations just described for the flashing of relay 18 the connection of the set 100 has actually taken place.

On the connection of lead 22 to lead 31, a circuit was completed for relay 107 as follows: Battery, lower armature and front contact of relay 17, upper winding of relay 19, make-before-break contacts of relay 19, leads 22 and 31, armature and back contact of relay 108, upper winding of relay 108, armature and back contact of relay 109, winding of relay 107 to ground. This causes the operation of relay 107 which in turn closes an obvious energizing circuit for relay 110. Relay 110 in operating completes a locking circuit for itself through its lower outer armature and front contact to the make-before-break contacts of relay 115 and also completes a connection from a tone source 120 through the primary winding of repeating coil 121, upper armature and back contact of relay 111, upper middle armature and front contact of relay 110 to ground. Relay 110 also connects the secondary of the repeating coil 121 to the tip and ring conductors of trunk 5 over a circuit as follows: Tip conductor of trunk 5, upper inner armature and front contact of relay 26, conductor 29, upper inner armature and back contact of relay 116, upper outer armature and front contact of relay 110, secondary winding of repeating coil 121, upper inner armature and front contact of relay 110, lower inner armature and back contact of relay 116, conductor 30, lower outer armature and front contact of relay 26 and ring conductor of trunk 5. The operation of relay 110 therefore through its connections for the tone source 120 to the tip and ring conductors of trunk 5 causes a tone to be transmitted over the trunk to the outgoing end at the "A" operator's position and as is well-known in the art this tone is heard by the "A" operator through her telephone set.

The following operations of relays 111, 112, 130

113, 114, 115 and 116 will cause the alternate removal and application of the tone to the "A" operator's position, these signals serving as an indication to the "A" operator that the "B" operator's telephone set 100 is connected to a trunk 5. The operation of these relays to accomplish this purpose will now be described. It will be noted that on the operation of relay 110, an obvious circuit is completed for the operation of relay 111. The operation of relay 111 opens the circuit through the primary winding of repeating coil 121 from the tone source 120 so that when this relay operates, the tone is removed from the tip and ring conductors of trunk 5. Relay 111 is however slow to operate so that the tone applied by the operation of relay 110 will be of a sufficient duration to be heard by the "A" operator. On the operation of relay 111 an obvious circuit is closed for the slow to operate relay 112. The operation of relay 112 again closes a circuit through the primary winding of repeating coil 121 from ground at its upper armature and front contact through the upper armature and back contact of relay 113 so that when relay 112 operates after a certain period a tone will be again applied to the tip and ring conductors of trunk 5. The operation of relay 112 closes an obvious energizing circuit for the slow to operate relay 113 so that before relay 113 operates the tone will have been transmitted to the "A" operator for a period of time approximately of the same length as the period of the first application of tone to the "A" operator. The operation of relay 113 closes an obvious energizing circuit for the slow to operate relay 114 which now closes a circuit through the primary winding of repeating coil 121 so that a third application of tone is made through the tip and ring conductors of trunk 5 and heard by the "A" operator. On the operation of relay 114 an obvious energizing circuit is closed for the slow to operate relay 115. The operation of relay 115 opens the locking circuit for relay 110 previously traced but as relay 107 is still operated, relay 110 will not release at this time. The operation of relay 115 also closes an obvious energizing circuit for relay 116 which in operating opens the connections from the secondary winding of repeating coil 121 to conductors 29 and 30 and trunk 5 and consequently upon the operation of this relay, the third and last application of tone to the "A" operator is removed. The operation of relay 116 now connects at its inner upper and lower armatures and front contacts the tip and ring conductors of the operator's telephone set to the conductors 29 and 30, so that the connection from this operator's telephone set is now completed to the tip and ring conductors of trunk 5.

When the "A" operator receives the above

mentioned signals, she will understand thereby that the "B" operator's telephone set is connected to trunk 5 and she will then transmit the number of the wanted subscriber to which the "B" operator is to complete a connection. As the above operations, that is, the connection of the "B" operator's telephone set to the trunk 5, the signaling of the "A" operator and the flashing of lamp 18 take place practically simultaneously the "B" operator will be prepared for the reception of the number of the wanted subscriber as soon as the "A" operator is ready to give it.

Before proceeding with the description relating to the completion of the connection, a description of the functions of the sequence circuit 10 will now be made. In a case where the operator's telephone set 100 is connected to any engaged trunk other than trunk 5 at the time trunk 5 becomes engaged and it is assumed that the trunk associated with relays 25' and 26' is the one with which the operator's telephone set 100 is engaged the circuits will function as follows: On the engagement of trunk 5, relay 25 will operate directly from battery 35 but relay 26 will not become energized as the circuit for this relay to ground at 27 is broken at the make-before-break contacts of relay 25' so that a connection of the operator's telephone set 100 to trunk 5 cannot take place until it has been disengaged from the trunk associated with relays 25' and 26' and not until the release of relay 25'. On the other hand if, for example, the trunk associated with the relays 25'' and 26'' is the one with which the operator's telephone set 100 is engaged at the time the trunk associated with relays 25' and 26' becomes engaged, this latter trunk cannot be associated with the operator's telephone set until relays 26'' and 25'' are released, as relay 26' will be prevented from operating due to the fact that the circuit for this relay will be broken at the make-and-break contact of relay 25''. Another example might be mentioned: in case the operator's telephone set is engaged with trunk 5 and the trunk associated with relays 26' and 25' becomes engaged, the operator's telephone set cannot be connected with this trunk as the circuit for relay 25' will be opened at the inner lower armature and back contact of relay 26 so that relay 25' cannot operate and close the circuit for relay 26'. Also after the operator's telephone set is connected to trunk 5 and the trunks associated with relays 26' and 25' and 26'' and 25'' becomes engaged while the operator's set is still connected to trunk 5, the trunk associated with relays 26'' and 25'' will be connected to the operator's telephone set first. On the operation of relay 25'' the circuit for relay 26' from ground at 27 will be opened. Returning now to completion of the con-

nection to the wanted subscriber's line the "B" operator having received the desired number from the "A" operator inserts plug 11 in jack 12 of the wanted subscriber's line 5 6. If plug 11 is inserted in jack 12 slowly so that the connection through the sleeve terminals is completed prior to the completion of a connection through the tip and ring terminals a circuit will be completed as follows: Battery, windings of relay 36 in series, make-before-break contact of marginal relay 37, winding of relay 37, sleeve terminals of plug 11 and jack 12 to ground. The electrical characteristics of relay 37 are such 15 that it will not operate in this circuit, this is with the high and low resistance windings of relay 36 in series in the circuit. Relay 36, however, will operate and a circuit will be closed for relay 38 as soon as the tip and ring terminals of plug 8 have made contact with the corresponding terminals of jack 12. This circuit may be traced as follows: From one side of battery, supplied at the line 6 which may be a subscriber's line or a trunk such as 25 trunk 5 or any other well-known type of line having a battery connected to the tip and ring conductor over the ring conductor of line 6, ring terminals of jack 12 and plug 11, upper armature and back contact of relay 37, winding of relay 38, armature and back contact of relay 36, upper inner armature and back contact of relay 37, tip terminals of plug 11 and jack 12, over the tip conductor of line 6 to the opposite side of 35 the battery on line 6. This circuit causes the operation of relay 38 which now closes a short circuit to battery for the lower high resistance winding of relay 36. The change in the electrical character of the circuit through relay 37 will now be such that this relay will operate. The operation of relay 37 opens the circuit for relay 38 from the tip and ring conductors of line 6, causing relay 38 to release and also opens the sleeve circuit 40 to relay 36 and closes this circuit through the lower armature and front contact of relay 37 to battery so as to maintain relay 37 energized. Relay 37 also completes the ring conductor from the ring terminal of plug 11 45 to trunk 5. Another circuit is closed through the operation of the lower armature of relay 37 for the operation of relays 15 and 19 as follows: Battery, lower armature and upper front contact of relay 37, lower winding of relay 19 to ground at the make-before-break contacts of relay 20 and a parallel branch from the battery at relay 37, winding of relay 15 to ground at relay 20. The operation of relay 15 now completes a circuit 50 from the tip conductor of the trunk 5 through the upper winding of relay 16, upper inner armature and front contact of relay 15, upper outer armature and front contact of relay 15, tip terminal of plug 11 thus 60 completing the tip conductor for the trunk

around the condenser 39. A similar connection is completed around condenser 40 from the ring conductor of trunk 5 through the lower winding of relay 16, lower outer armature and front contact of relay 15 to the ring terminal of plug 11. It will be noted 70 that only on the completion of the connection between the tip and ring terminals of plug 11 and corresponding terminals of jack 12 will relay 37 operate so as not to cause relay 15 to operate until the battery on line 6 has actually been connected to the tip and ring conductors of trunk 5. The battery connection for the incoming end of trunk 5 will now therefore not be disturbed or broken 75 by the operation of relay 15 but will be immediately extended to the battery on line 6. The provision of relays 36 and 38 and the marginal operating characteristics of relay 37 therefore prevent any false operation 80 at the outgoing end of trunk 5 should the plug 11 not complete the connection between the tip and ring terminals to the battery on the line 6 simultaneously with the closing of the sleeve circuit on the insertion of the plug 85 11 into jack 12. In ordinary circuits heretofore, if the tip and ring connection is not extended simultaneously with the sleeve connection, the ordinary relay corresponding to relay 37 might operate and cause the relay 90 corresponding to relay 15 to operate before the connection to battery on a line such as 6 is completed and thus cause an interruption in the battery supplied to the outgoing end of trunk 5. This provision is of particular 95 importance in branch connections where the battery supplied to the outgoing end of the branch line performs some important function at this end such as the holding of certain relays operated for the prevention of premature release of the connection. 100 105

The operation of relay 19 mentioned above causes the operator's telephone set 100 to be disconnected from trunk 5 by opening the connection to battery for lead 22 at the make-before-break contacts of relay 19 and by opening the connection to ground for lead 21 at the lower armature and back contact of relay 19. The removal of the ground from lead 21 causes relays 25 and 26 to be returned 110 to normal and the release of relay 26 opens the connection from the common leads 29 and 30 to the trunk 5. The opening of the connection between lead 22 and lead 31 opens the circuit for relay 107 which now releases. 115 On the release of this relay the circuit for relay 110 is opened and this relay is in turn released. The release of relay 110 causes in turn the release of relays 111, 112, 113, 114, 115 and 116 and when relay 116 releases the common conductors 29 and 30 are disconnected from the operator's telephone set 100. 120 125

It will be noted that on the release of relay 112, a circuit is completed for the peg count meter 101 as follows: Battery, winding 130

of peg count meter 101, upper armature and front contact of relay 115, make-before-break contacts of relay 112 to ground. As stated, the release of relay 112 causes in succession the release of relays 113, 114, 115 and 116 so that when relays 113, 114 and 115 have released, the circuit for the meter is opened. This circuit cannot again be closed until the operator's telephone set 100 is connected with another trunk circuit, that is, until a cycle of operation such as just described for the relays 110 to 115 is again caused to take place due to the operation of relay 107. It will be noted that on the release of relay 107 a short-circuit to ground is closed for leads 31 through the upper outer armature and front contacts of relay 116 to ground at the armature and back contact of relay 107 so that relay 107 cannot again operate until relay 116 has released. This arrangement insures the completion of one cycle of operation of these relays to remove the operator's telephone set 100 from the common leads 29 and 30 before battery on lead 31 that may again be connected thereto in case another trunk has in the meantime begun the operations for the association of the operator's telephone set 100 with that trunk will have any effect on the relays mentioned. In accordance with this arrangement, therefore, the operation of the peg-count meter 101 will not take place until the operator's telephone set has been automatically disconnected from the trunk 5 due to the insertion of the plug 11 into jack 12. The meter 101 cannot therefore be again operated due to any accidental operations that may take place in a trunk connection such as, for example, if the plug 11 is temporarily removed from jack 12. In accordance with this invention, therefore, the peg-count meter 101 will register only once for each connection established by a trunk in the

group having access to the operator's telephone set 100. 45

Relays 108 and 109 are provided in conjunction with a key shown below relay 109 to release the operator's set 100 from a trunk if for any reason the operator cannot complete a connection and the apparatus for automatically performing this function is not brought into play or if it fails to function. On depression of the release key relay 109 is operated and the connection between lead 31 and relay 107 is broken, thus releasing relay 107 with the result described. 50
Ground is then connected to both windings of relay 108 but as long as a battery connection is maintained over lead 31 relay 108 does not operate since one winding opposes the other. As soon as the battery connection to lead 31 is broken, relay 108 operates through its lower winding and this connection will be maintained as long as the release key is depressed, thus preventing the operation of the release key from being effective on more than one trunk for a single depression of the key. When the key is released, relays 108 and 109 release. 55

What is claimed is: 70

In a telephone system, link circuits, an operator's telephone set, means for connecting said set to one of said link circuits comprising a train of relays sequentially operated for connecting said set to said one of said link circuits, said train of relays controlling means to transmit signaling current over said link circuit, means to disconnect said set from said link circuit and release said train of relays sequentially, a meter, and means controlled by said relays in releasing for operating said meter. 75

In witness whereof, we hereunto subscribe our names this 23 day of July A. D., 1925.

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