

Oct. 30, 1928.

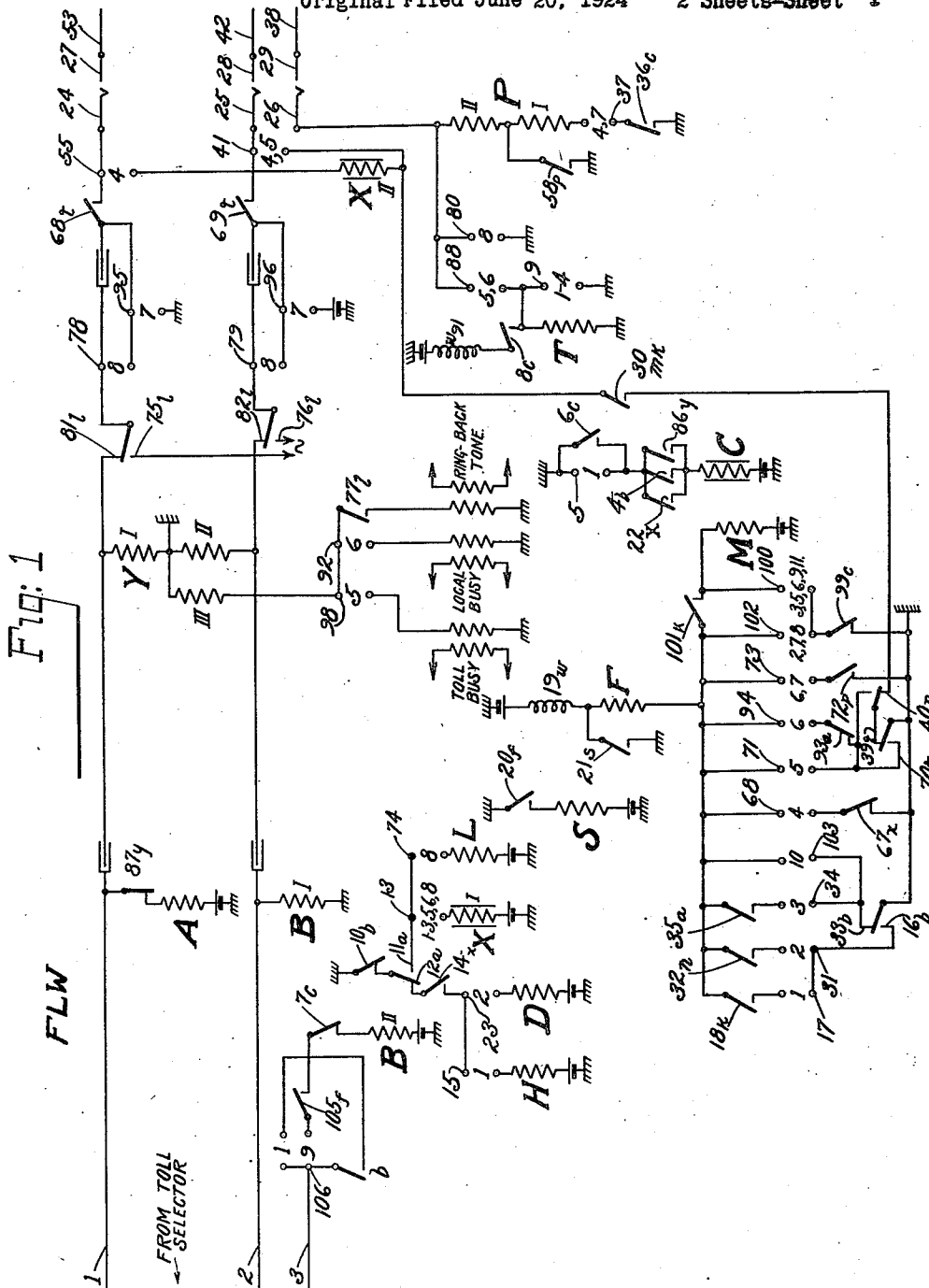
1,689,213.

A. SCHEUNERT

TELEPHONE SYSTEM

Original Filed June 20, 1924

2 Sheets-Sheet 1



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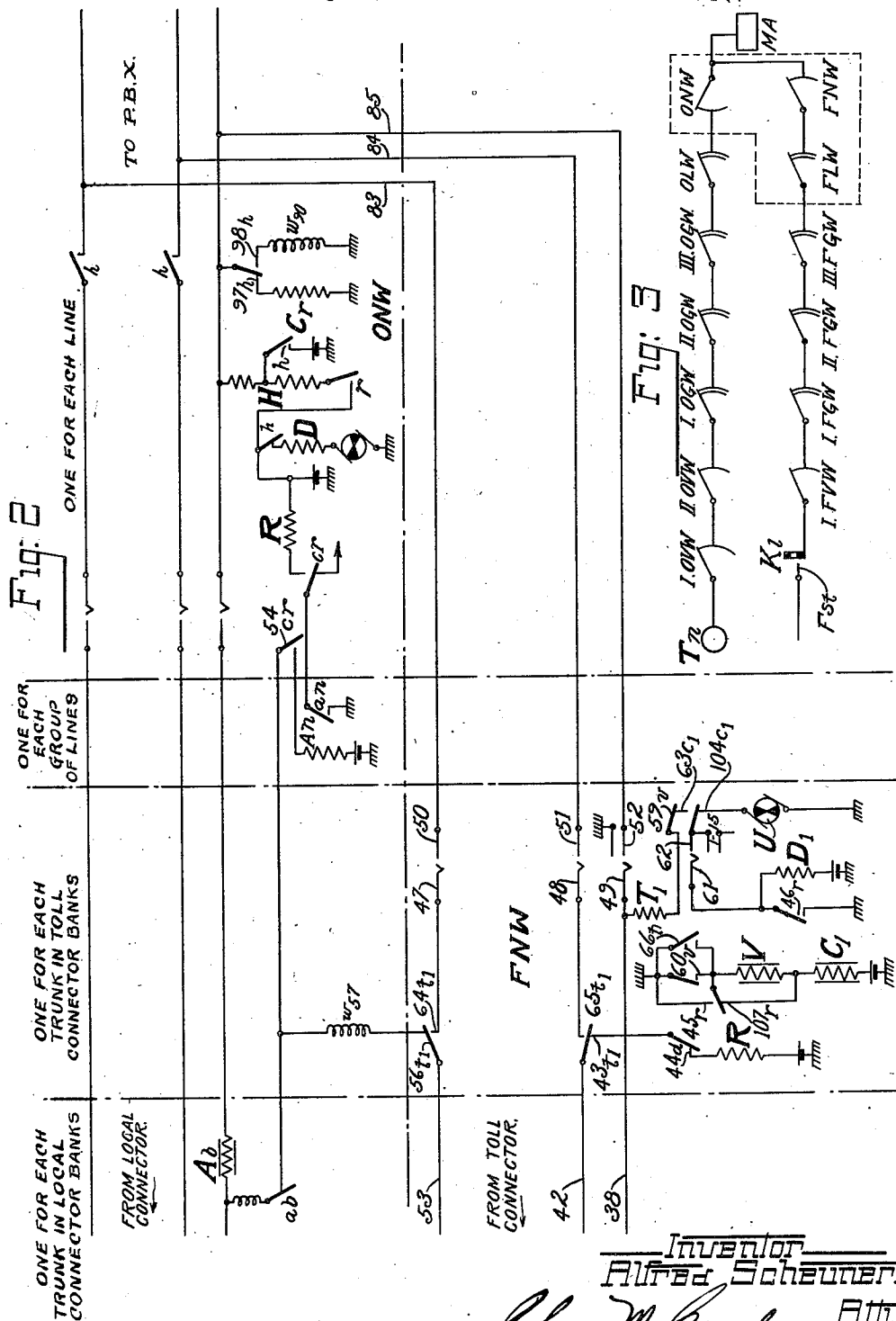
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UNITED STATES PATENT OFFICE.

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TELEPHONE SYSTEM.

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The invention relates to a circuit arrangement for setting up connections to private branch exchange subscribers in which a final selector arranged for such traffic is operated and is enabled to select a free outgoing line by means of switching devices which are adapted to be placed under the control of switching devices belonging to a preceding switching stage.

The invention more particularly concerns a development of this idea and enables the method of operating final selectors modified for P. B. X. working to be considerably simplified, especially in telephone systems having the local traffic separated from the toll traffic in that a testing device is provided which is common to the switches of two consecutive connecting stages. Preferably this common testing device is associated with the switch belonging to the first of these two stages.

In the example shown in the drawings, comprising Figs. 1-3, inclusive, the invention is applied to a system, in which the local traffic and the toll traffic are dealt with over separate connecting routes.

Such a system is shown diagrammatically in Fig. 3 from which it can be seen that a call originated by a subscriber T_n is connected through, in known manner, over first and second local preselectors and over the group selectors of the different connecting stages (I to III OGW), to a local final selector OLV. The local final selector OLV is set on the contact of the private branch exchange MA and then starts up a group of backwardly hunting switches ONW, each of which is associated with an exchange line of the private branch exchange MA, these switches then hunting for the final selector OLV that has been operated.

A toll call incoming to a toll exchange, is switched through to the automatic exchange by the toll operator by means of the toll connecting plug Fst and the jack KZ ; and as can be seen, the connection is further set up over a first toll preselector FVW and over the succeeding group selectors of the different connecting stages (I to III FGW) and over the toll final selector FLW to the number of

the wanted P. B. X. subscriber MA. All the toll final selectors FLW are provided with a hunting switch FNW for each P. B. X. which switch is started up by the toll final selector and selects a line that happens to be free or only rendered busy by a local call. The toll final selector FLW makes the test to ascertain whether the P. B. X. lines are free or rendered busy by a local call and also controls the hunting movement of the succeeding toll switches FNW.

Fig. 1 shows the toll final selector FLW in detail while Fig. 2 shows the toll switch FNW located beyond the toll final selector and shows the corresponding switch ONW located in the local route.

The circuits are based on the known earth impulse system.

It will be assumed that an incoming toll call received by way of the toll exchange FA and to be made to the P. B. X. subscriber MA connected to the lines shown in Fig. 2 has been set up as far as the taking into use of the toll final selector FLW (Fig. 1).

The relays A and B are operated over the leads 1, 2 and 3 when the toll final selector FLW is taken into use by a preceding third group selector. At the contact $4b$ the slow acting relay C is connected up in a circuit extending from earth over the side switch contact 5 in position 1, contact $4b$ and the winding of the slow acting relay C to battery. At contact $6c$ the relay C connects itself to a holding circuit not dependent on the side switch contact 5 and at its contact $7c$ it opens the test lead 3 coming from the third group selector. At the contact $8c$ the relay C prepares a circuit for the test relay T, which at first remains short circuited by earth at the side switch contact 9 in the positions 1-4.

When a train of impulses is now transmitted from the toll exchange for setting the toll final selector FLW the leads 1 and 2 are earthed in known manner when the finger dial is rotated forwards. Hence the relay B releases and at its contact $10b$ connects up the winding I of the relay X over the contact $11a$ of the energized relay A and over the side switch contact 13 in position 1. At its contact $14x$ the relay X prepares a circuit

for the vertical magnet H. During the return motion of the number dial the relay A releases a number of times corresponding to the number of impulses sent, so that the vertical magnet is operated over the circuit: earth, contacts 10*b*, 12*a*, 14*x* and side switch contact 15 in position 1, and raises the switch to the desired level. At the end of the train of impulses the relay B is again operated over the lead 2 and its winding I, and at its contact 10*b* disconnects the relay X and at its contact 16*b* closes a circuit for the relay F of the side switch extending from earth over the contacts 16*b*, 17 of the side switch in position 1, the closed off normal contact 18*k*, the winding of the relay F and the resistance 19*w* to battery. The side switch relay F operates and at its contact 20*f* it connects up the side switch magnet S. The side switch magnet S brings the side switch into position 2 and at its contact 21*s* short circuits the relay F, thereby causing it to release. The slow acting relay C holds itself over the contact 22*x* when the relay B is released. The next train of impulses causes the rotary magnet to operate in the circuit: earth, contacts 10*b*, 12*a*, 14*x* and the side switch contact 23 in position 2, hence the wipers 24, 25 and 26 of the toll final selector FLW are rotated into engagement with the contacts 27, 28 and 29 belonging to the calling number of the P. B. X. subscriber MA, whereupon the switch shaft closes the contact 30*m**k*. At the end of the train of impulses, the relay B is again energized over its winding I; at the contact 10*b* it disconnects the relay X and at the contact 16*b* it connects up the side switch relay F in a circuit which now extends from earth over contact 16*b*, the side switch contact 31 in position 2 and the closed shaft contact 32*n*. The side switch arms are thus moved into position 3 by the side switch magnet S in the manner already described.

The toll operator at the toll exchange FA has now transmitted all the trains of impulses for positioning the switches and for initiating the testing operation she presses a test key, provided in known manner, whereby earth is applied to the lead 2. Hence the relay B at the toll final selector FLW is de-energized and causes the slow acting relay X to operate over earth, the contacts 10*b*, 11*a* the side switch contact 13 in position 3 and the winding I of the relay X. The relay F of the side switch is now energized over earth, contact 33*b*, side switch contact 34 in position 3 and contact 35*a*, and the side switch moves into position 4. In this position the test relay P is connected over contact 36*c*, the side switch contact 37 in position 4 and the test wiper 26 and contact 29 to the test lead 38 leading to the succeeding toll switch FNW (Fig. 2). The relay R operates in a circuit extending from earth over the con-

tacts 39*t*, 40*p*, 30*m**k*, the side switch contact 41 in position 4, wiper 25, contact 28, the lead 42, the contacts 43*t**l* and 44*d* and the winding of the relay R of the toll switch FNW (Fig. 2) to battery. The switch FNW is thereby started up. The slow acting relays V and C1 are connected up from earth over contact 45*r*, winding of the relays V and C1, battery. The rotary magnet D1 is connected up at the contact 46*r*, and at contact 44*d* it opens the energizing circuit of the relay R, which therefore by opening its contact 46*r* again disconnects the rotary magnet D1. The wipers 47, 48 and 49 of the toll switch FNW have now taken one step and have reached for instance the contacts 50, 51 and 52. The testing that now takes place determines whether the switch FNW comes to rest or is moved on step by step in the manner above described.

A preliminary testing takes place over the speaking lead 53 at the same time as the switch FNW is started up; this test ascertains whether one or more exchange lines leading to the P. B. X. subscriber are free or whether all the lines happen to be engaged (locally or toll engaged). A contact 54*c**r* of a relay Cr is closed at the auxiliary local switch ONW so long as a line is free. The relay X at the toll final selector is locked by its winding II in the circuit used for this preliminary test: earth, contacts 39*t*, 40*p*, 30*m**k*, winding II of the relay X, side switch contact 55 in position 4, wiper 24, contact 27, lead 53, contact 56*t**l*, resistance 57*w*, contact 54*c**r*, starting relay An of the local auxiliary group of switches ONW and battery. Thus by the opening of contact 67*x* the side switch is prevented from leaving the position 4.

It will first be assumed that an exchange line is free and that therefore a contact 54*c**r* is closed. When the wipers 47, 48 and 49 of the toll switch FNW reach the contacts 50, 51 and 52 of this line, the relay P of the toll final selector operates in parallel with the high resistance winding of the relay Cr, (which is normally energized when the subscriber's line 83, 84, 85 is free) the relay P being energized in the following circuit: earth, contact 36*c*, side switch contact 37 in position 4, windings I and II of the relay P, wiper 26, contact 29, test lead 38, wiper 49 of the toll switch FNW (Fig. 2), contact 52, lead 85, and thence in known manner to battery at the preselector belonging to the subscriber's line. The relay P at its contact 58*p* short circuits its high resistance winding I, and at contact 40*p* it disconnects earth from the driving circuit for the toll switch FNW, so that the switch is stopped. The relay V at the toll switch FNW (Fig. 2) releases slowly, because it now remains short circuited at the contact 107*r*, and closes its contact 59*v* before opening the holding circuit at the contact 60*v*.

The relay T1 of the toll switch FNW is now energized in the following circuit: earth, battery, rotary magnet D1, wiper 61, contact 62, contacts 63c1 and 59v, winding of relay T1, lead 38, contact 29 and wiper 26 (Fig. 1), winding II of the relay P, contact 58p, earth. Relay T1 (Fig. 2) switches through the speaking leads at the contacts 64t1 and 65t1, and at the contact 66t1 closes a holding circuit for the relay C1. At the contact 56t1 moreover the holding circuit of the relay X is opened which circuit extends over winding II as above described. The relay X at the toll final selector FLW (Fig. 1) releases and closes its contact 67x, so that the side switch is caused to move on into position 5 over contact 68 in position 4. The side switch being in position 5, the relay T. (Fig. 1) operates, because its winding has a lower resistance than the holding winding II of the relay P; and at its contacts 68t and 69t switches through the speaking leads and closes its contact 70t. Hence the relay F of the side switch receives current from earth over contact 70t, and the side switch contact 71 position 5, so that the side switch arms move into position 6. The relay F again receives current over earth, contact 72p, and side switch contact 73 in position 6 and by means of the magnet S moves the side switch into position 7 and over the same contacts further into position 8.

At the toll exchange the toll operator now presses her testing key in order to call the selected P. B. X. subscriber MA, and thereby again applies earth to the speaking lead 2. Hence the relay B releases, and closes its contact 10b, thereby energizing the ringing relay L over contact 11a and side switch contact 74 in position 8. At its contacts 75l and 76l the relay L applies ringing current to the wanted subscriber's line and closes its contact 77l, hence the operator at the toll exchange receives a ring back tone over the windings of the relay Y. In position 8 of the side switch the speaking leads are switched through at the contacts 78 and 79 of the side switch, while the toll engaged potential, namely earth, is applied at the side switch contact 80 to the test lead of the subscriber's line taken into use. Owing to this direct connection to earth, the relay P can no longer hold up and therefore releases.

When the P. B. X. subscriber MA answers the call by taking down his receiver, he closes his line loop and the feeding relay Y is energized over both its windings, the contacts 81l and 82l, the side switch contacts 78 and 79 in position 8, the contacts 68t and 69t, the wipers 24 and 25, the contacts 27 and 28, the leads 53 and 42, the contacts 64t1 and 65t1, the wipers 47 and 48, the contacts 50 and 51 and the leads 83 and 84. The relay Y at its contact 86y closes a further holding circuit for the relay C and at its contact 87y it opens the circuit of the relay A. This therefore

opens the circuit to the toll exchange so that the operator is in known manner notified that the wanted subscriber has answered.

It will now be assumed that no P. B. X. line is free when the toll final selector FLW is set by the last train of impulses, but that they are all either locally or toll engaged. Hence the toll final selector must test for a locally engaged line with the assistance of the auxiliary toll switch FNW, in order to render this line free for the high value call (toll call). As already described the toll switch FNW was started up and a preliminary test was performed over the lead 53 when the side switch was in position 4. In the present case, since no contact 54cr (Fig. 2) is now closed, a holding circuit cannot be established over the winding II of the relay X. Hence over the contact 67x and the side switch contact 68 in position 4, the side switch is at once moved on into the position 5. In this position the test relay P is disconnected from the test lead 38, but the test relay T is connected to the test lead over the side switch contact 88 in the position 5. This relay can only operate when the toll switch FNW reaches a contact connected to earth over a contact 98h and a resistance w90, which has a higher resistance than the relay T, that is to say when the toll switch FNW finds a locally engaged line. If the leads 83, 84 and 85 shown in Fig. 2 form this locally engaged line, the relay T is energized over the contact 8c and over the resistance w91 and at contact 39t it opens the driving circuit of the toll switch FNW and at the contacts 68t and 69t it switches through the speaking leads. Over contact 70t and the side switch contact 71 in position 5, the side switch reaches position 6, in which the toll operator receives a locally engaged signal over the side switch contact 92. The toll operator then notifies the P. B. X. subscriber MA engaged in a local call that there is a toll call for him and that she must therefore release his connection. She then presses the release key located at the toll exchange, thereby interrupting the lead 1. Hence the relay A at the toll final selector FLW releases and, over earth, contacts 70t, 93a, and side switch contact 94 in position 6, causes the side switch to move on into position 7. In position 7 the test relay P is connected to the test lead 38 over earth, contact 36t, and the side switch contact 37 in position 7 in place of the relay T, which locks itself in the before mentioned circuit. Furthermore over the side switch contacts 95 and 96 in position 7 an opposing potential is applied to the line loop of the subscriber MA engaged in the local call, hence his feeding relay (not shown) at the local final selector OLW is de-energized and the release of the local connection is brought about. Hence the contact 98h (Fig. 2) is opened and the contact 97h is closed. The test relay P at the toll final selector (Fig. 1) now operates in

parallel with the high resistance winding of the relay CR and short circuits its high resistance winding at the contact 58p. It also closes its contact 72p, thus enabling the side switch to move into position 8. The other circuit changes are the same as before described.

If all the exchange lines of the subscriber MA are toll engaged, neither of the test relays P and T can operate and the side switch remains in the position 5, in which the toll operator receives a toll engaged signal over the side switch contact 98 and is thereby warned to release the connection. In response to the operator's releasing the connection, the relays A and B release thus causing the relay C to be de-energized and at its contact 99c to close a circuit for the release magnet M; this circuit extends from earth over contact 99c, side switch contact 100 in position 5 and the winding of the release magnet M to battery. Upon returning to normal the switch shaft closes the contact 101k, hence the relay F receives current over earth, contact 99c, side switch contact 100 in position 5, and off normal contact 101k, and the side switch arms are moved into position 6. Over the same circuit the side switch is moved into position 7, and thence over contact 99c and the side switch contact 102 into positions 8 and 9. The side switch is moved from position 9 into position 10 over contact 99c, the side switch contact 100 and off normal contact 101k; the relay F now again receives current over earth, contact 33b, and side switch contact 103; hence the side switch moves into position 11. From position 11 the side switch is returned to position 1 over contact 99c, side switch contact 100 and off normal contact 101k. When the side switch leaves position 5 the driving circuit for the toll switch FNW (Fig. 2) is opened at the side switch contact 41; hence the slow acting relays V and C1 release. The rotary magnet D1 now receives impulses from earth, over the interrupter U, the contacts 104c1, 62, etc., and the wiper 61, until the toll switch FNW reaches its normal position. It remains to be mentioned that in the side switch position 9, a releasing impulse is sent back from battery over the winding II of relay B, the contact 7c, the contact 105f, and the contact 106 of the side switch; this impulse in known manner effects the release of the preceding switches.

After the connection has been established and the conversation has been completed, the release of the connection is brought about by hanging up the receiver. When the subscriber MA hangs up his receiver, the relay Y releases and at contact 86y it opens the circuit of the relay C. The remainder of the releasing operation takes place in the manner just above described.

What I claim is:

1. In a telephone system, means including

a numerical switch and a non-numerical switch in serial relation for extending connections to idle lines in a group, said lines terminating in the bank of said non-numerical switch, and means in said numerical switch for testing said lines.

2. In a telephone system, means including a numerical switch and a non-numerical switch in serial relation for extending connections to idle lines in a group, said lines terminating in the bank of said non-numerical switch, and means in said numerical switch for controlling the operation of said non-numerical switch to cause the latter to advance and stop in engagement with an idle line.

3. In a telephone system, means including a numerical switch and a non-numerical switch in serial relation for extending connections to idle lines in a group, said lines terminating in the bank of said non-numerical switch, a trunk connecting said switches, means in said numerical switch for operating the non-numerical switch over one conductor of said trunk line to cause the latter to hunt for an idle line, and means in said numerical switch controlled over another conductor of said trunk line for rendering the said first means inoperative when an idle line is found.

4. In a telephone system, a group of lines any of which may be idle, engaged in a toll connection, or engaged in a local connection, a non-numerical switch having access to said lines, a numerical switch having access to said non-numerical switch, means for operating said numerical switch to connect with said non-numerical switch, and means in said numerical switch for testing said lines to determine whether said lines are idle, locally engaged, or toll engaged.

5. In a telephone system, a group of lines any of which may be idle, engaged in a toll connection, or engaged in a local connection, a non-numerical switch having access to said lines, a numerical switch having access to said non-numerical switch, means for operating said numerical switch to connect with said non-numerical switch, and means in said numerical switch for controlling the operation of said non-numerical switch to cause the latter to advance and stop in engagement with an idle line, providing at least one of said lines is idle, or to advance and stop in engagement with a locally engaged line if all said lines are engaged, providing at least one of said lines is locally engaged.

6. In a telephone system, a toll connector, a line switch accessible to said toll connector, a group of lines accessible to said line switch, a finder switch individual to each of said lines, local connectors, and trunk lines connecting the banks of said finders with the banks of said local connectors.

7. In a telephone system, a group of lines, an automatic switch having wipers, means

for moving said wipers into selective relation with said lines successively, a first test relay responsive when controlled over one of said wipers when an idle line is reached for stopping the movement of said wipers, a second test relay responsive when controlled over one of said wipers when a locally engaged line is reached for stopping the movement of said wipers, and means controlled independent of any wipers of said switch for determining which of said relays is to be controlled over one of said wipers. 10

In testimony whereof I affix my signature.

ALFRED SCHEUNERT.