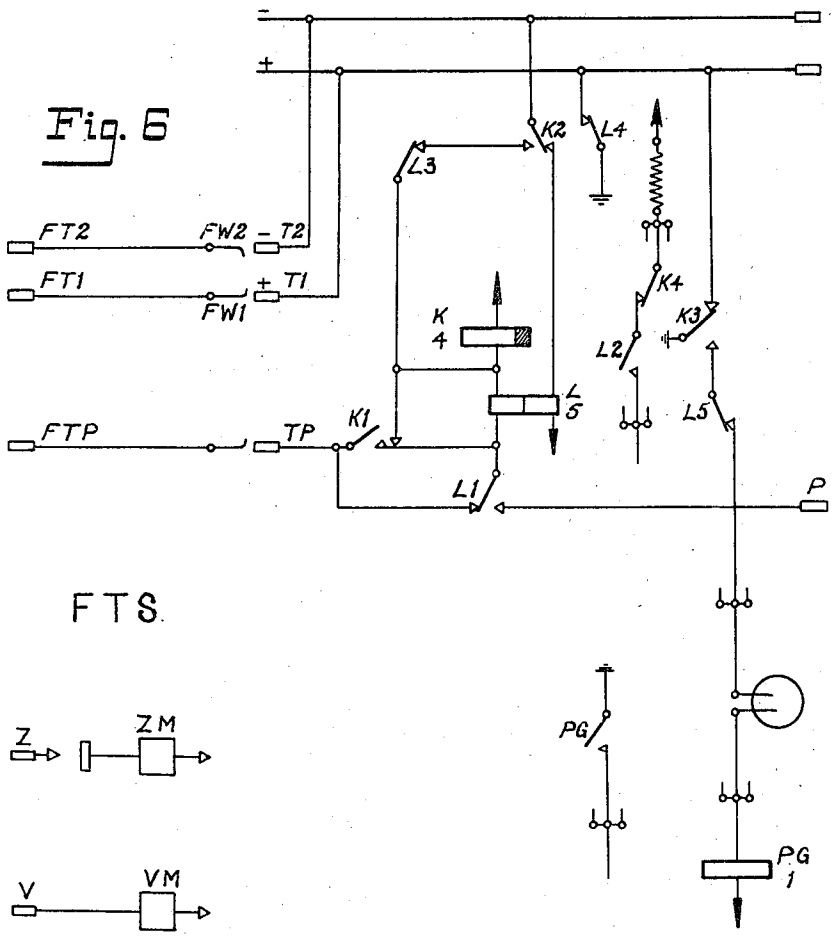
May 12, 1942. R. F. STEHLIK 2,282,900

TELEPHONE SYSTEM

Filed April 13, 1940 4 Sheets-Sheet 1

Fig. 1



INVENTOR
RUDOLPH FRANK STEHLIK

PER Chas. L. Candy
ATTORNEY

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Filed April 13, 1940 4 Sheets-Sheet 2

Fig. 2

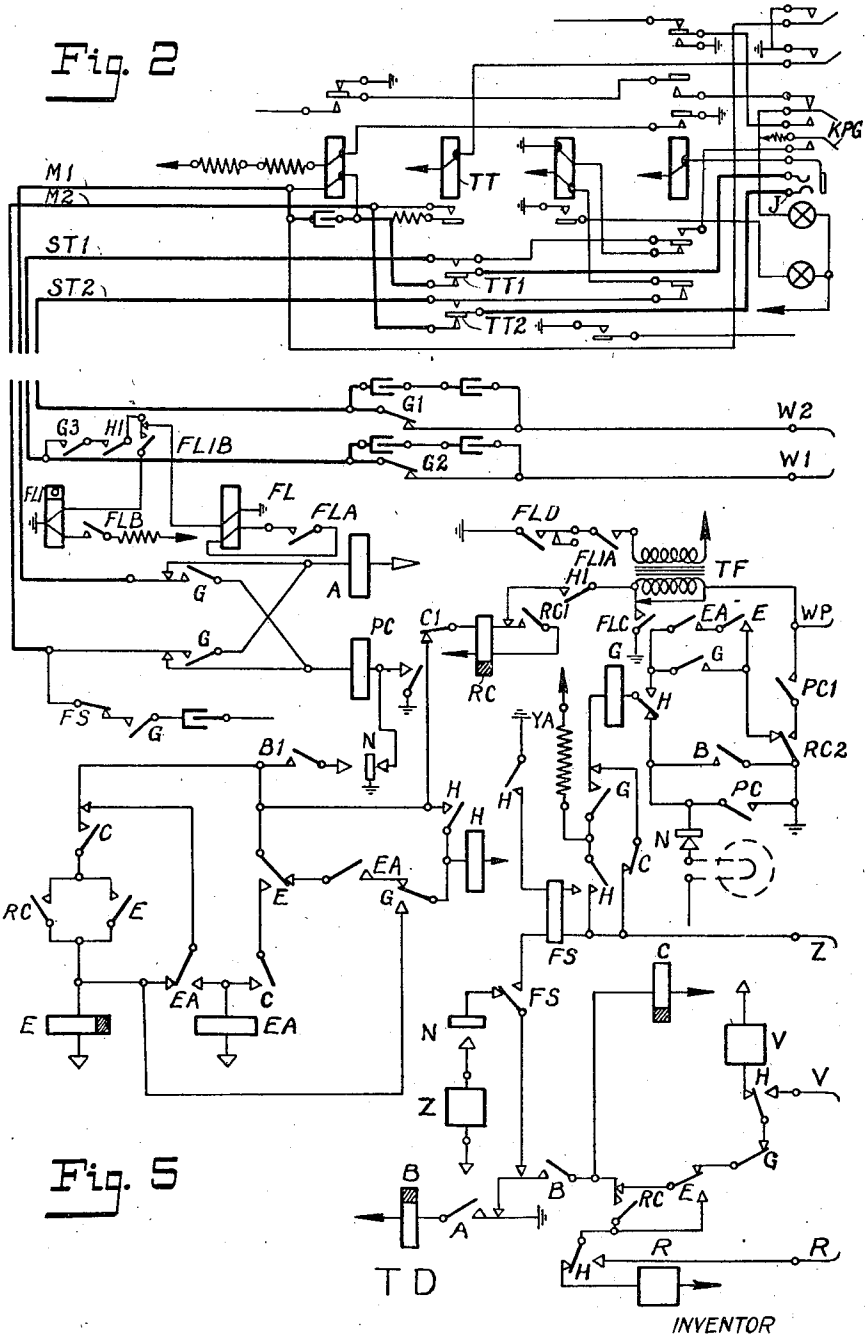

Fig. 5

INVENTOR
RUDOLPH FRANK STEHLIK

PER
ATTORNEY

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TELEPHONE SYSTEM

Filed April 13, 1940 4 Sheets-Sheet 3

Fig. 3

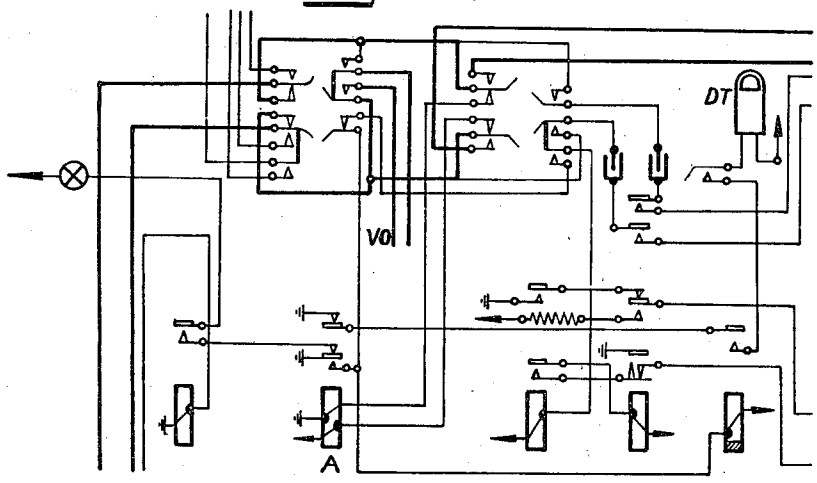
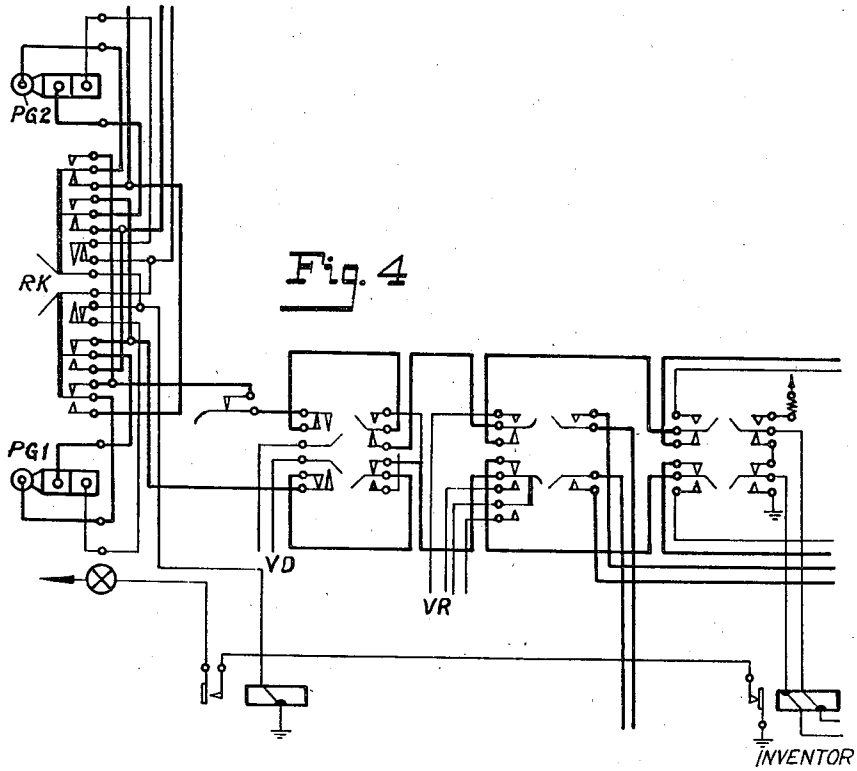


Fig. 4



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Filed April 13, 1940 4 Sheets-Sheet 4

Fig. 3A

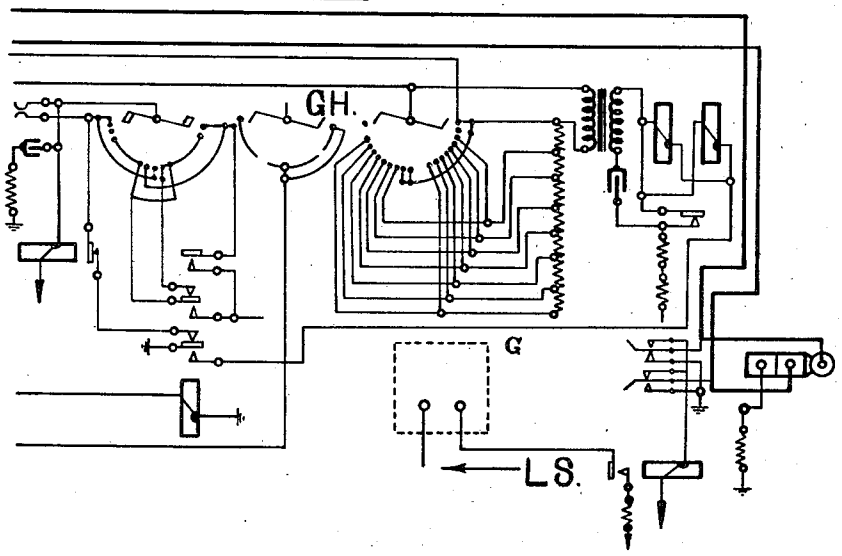
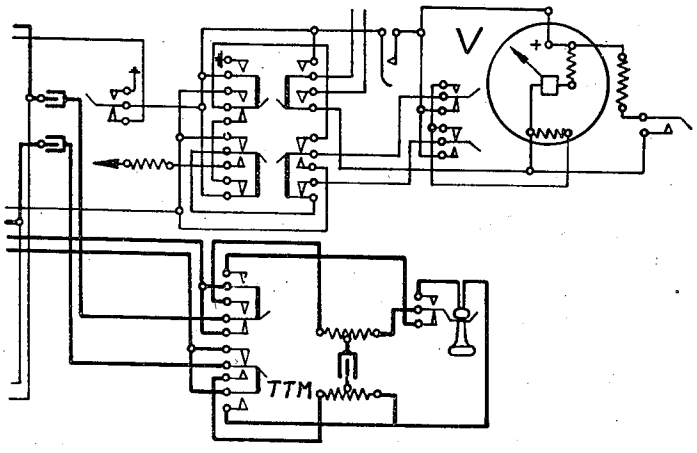


Fig. 4A



INVENTOR
RUDOLPH FRANK STEHLIK

PER Chas. Tu. Candy.
ATTORNEY

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2,282,900

UNITED STATES PATENT OFFICE

2,282,900

TELEPHONE SYSTEM

Rudolph Frank Stehlik, Antwerp, Belgium, assignor to Associated Telephone & Telegraph Company, Chicago, Ill., a corporation of Delaware

Application April 13, 1940, Serial No. 329,404
In Great Britain May 22, 1939

4 Claims. (Cl. 179—175.2)

The present invention concerns improvements in or relating to telephone systems and more particularly concerns improved arrangements for testing of subscribers' lines.

It is usual in certain telephone systems to provide means whereby a subscriber's line when permanently short-circuited is dissociated from the exchange apparatus until the short circuit has been removed so that on a subscriber removing his receiver after the removal of the short circuit the exchange apparatus will immediately operate to connect the subscriber's line with an idle outgoing junction line.

This lock-out arrangement puts the subscriber's line into an unsatisfactory condition for testing purposes and the object of the present invention is to provide means whereby all connections to the subscriber's line which is being tested may be removed while testing is taking place.

According to this invention in a telephone system in which means are provided for automatically cutting a calling line out of service in the event of a low resistance shunt persisting thereon, which means involves an electrical connection to such lines at the exchange whilst such conditions exist, manually controlled means are provided at a test distributor's position which cause a control to be exerted over the test switch when a line in such a condition is found to cause the said electrical connections to be removed and enable the calling line to be tested independently thereof.

In one arrangement a cut-off relay is alone operated over a line which has a low resistance shunt persistent thereon and the cut-off relay and the line relay are energised in series to establish a through connection for said line to common exchange apparatus which has been previously selected, and a further feature of the invention consists of providing means for applying a high potential to the line relay to cause it to energise when the cut-off relay is alone energised so as to establish a through connection independently of the selection of common exchange apparatus whereby the line may be tested independently of either the connection of the cut-off relay or other connections from common exchange apparatus.

The invention will be better understood by referring to the accompanying drawings which illustrate one arrangement for carrying the invention into effect.

Figure 1 illustrates a known line circuit of a subscriber.

Figure 2 illustrates a circuit at a test desk, modified for the purpose of the invention but otherwise known, over which appropriate tests are made in conjunction with known testing cord circuit or circuits illustrated in Figures 3, 3*a*, 4 and 4*a*.

Figure 5 illustrates a test distributor modified for the purpose of the invention but otherwise known, and

Figure 6 illustrates a known final test selector.

For the purpose of understanding the invention it is only necessary to refer to the line circuit in Figure 1 and to the means by which the line test circuit is controlled under what are known as "P. G. conditions." "P. G. conditions" can occur due either to an accidental short circuit on the line or due to a subscriber leaving his receiver off the hook for an undue length of time.

Considering first of all what happens when a subscriber lifts his receiver to initiate a call, it will be noted that a circuit is completed over the loop for the right-hand winding of relay L.

Relay L in operating an armature L1 prepares a circuit for relay K, at the same time as it controls at armature L2 a common starting circuit over armature K4 for an idle or preselected line finder. When the line finder finds the calling line a circuit is completed over the test conductor P for relay K over armature L1 and resting contacts of armature K1. Relay K operates and while it opens at armature K2 the circuit through the right-hand winding of relay L it opens at armature K1 a short circuit across the left-hand winding so that relays L and K are both operated in series and remain operated in series throughout the connection. If, however, the subscriber neglects to dial within a certain time earth is automatically removed from the private P at the first selector by known means, relay L being quick acting releases and relay K being slow to release remains operated until a locking circuit is completed for it over the subscriber's loop including armatures L3, L4 and K2. At the same time relay PG common to a number of lines operates over armatures K3 and L5 and an alarm is given.

The test circuits of Figure 3, and its continuation Figure 3*a*, Figure 4 and its continuation Figure 4*a* are known and it is only necessary for the purpose of describing the invention to refer to them in general terms. The circuit of Figure 3 is provided with keys for bringing into play as required, a graduated howler G. H., a loud speaker L. S. and a dial switch tester D. T. together with access over leads VO to an oper-

ator, while the circuit of Figure 4 is provided with keys for bringing into circuit a dial switch over leads VD for setting up connections to the different subscribers' lines to be tested, means for talking to a subscriber over leads VR, a voltmeter V, and transmission testing means TTM.

Assuming that the test operator wants to test a line in the condition described above, that is to say a line of which the relay K is alone energised over the subscriber's loop, then he inserts one of the plugs PG1 or PG2 into the jack J of the test distributor circuit Figure 2. The leads M1, M2, ST1, ST2 to the left of Figure 2 are connected to the correspondingly designated leads of the test distributor of Figure 5 and while the first pair of leads M1, M2 are utilised for setting up the connection the second pair ST1, ST2 are used for test purposes being freed from feeding bridges and the like.

The operation of the dial switch if the reversing key RK is suitably operated as well as the appropriate key to connect up the dial switch, will cause impulses to be transmitted over leads M1 and M2 to first cause the test distributor TD to set itself with its wipers upon contacts leading to the final test selector FTS of Figure 6. The wipers V, R and Z of test distributor TD come into direct connection with the vertical magnet VM, the rotary magnet RM and the release magnet ZM of the final test selector FTS which is thereby directly under the control of relays associated with the test distributor and for that reason is provided with no individual controlling relays. The final test selector is therefore set after the test distributor and a through connection now exists from the cord circuit of Figure 4 or Figure 3 if the reversing key RK is switched over via the springs of the jack J, armatures TT1 and TT2 of relay TT, leads ST1 and ST2 (Figures 2 and 5), armatures G1 and G2 of relay G, wipers W2, W1 of test distributor TD, leads FT2, FT1 of final test selector FTS, wipers FW2, FW1 to contacts T2, T1 of Figure 1 to the line which it is desired to test. If the line had not been in the condition described it would have been possible to proceed to test the line in the usual way but as it is the connection of the relay K across the line will militate against making a clear test. In these conditions relays G and H are operated in known manner. The operator presses the key KPG (Figure 2) which on operating completes a circuit over the positive lead ST1 to the relay FL via armatures G3, H1.

Relay FL on operating at armature FLA closes a circuit around its lower winding so as to render it slow to release, at armature FLB completes the circuit for slow relay FL1, and at armature FLC opens a short circuit across the secondary of the transformer TF in the test lead to wiper WP leading through the final test selector, Figure 6, to the private wire terminal TP of Figure 1, at the same time placing earth between the relay RC and the secondary winding referred to. Relay FL1 at armature FL1A in conjunction with relay FL completes a circuit for the primary winding of transformer TF, the effect of which in conjunction with armature FLD of relay FL is to send a monetary high voltage pulse over wiper WP through the left-hand winding of relay L until relay FL releases. Relay L in these conditions operates and in doing so opens the circuit of relay K across the loop at armatures L3 and L4. Relay K however remains operated as well as relay L via earth connected up at armature FLC by relay FL in the test distributor, Figure 5. In due course relay FL releases followed by relay FL1. When this happens a circuit is completed from earth, off normal springs N, armatures B1 and C1 of relays B and C respectively, upper winding of relay RC, resting contacts of armature RC1 of relay RC, armature H1 of relay H, resting contacts of armature FLC, wiper WP of final test distributor FTD, Figure 6, to incoming test terminal TP, Figure 1, armature K1 of relay K, left-hand winding of relay L, winding of relay K to battery. Relay RC operates in this circuit and establishes a locking circuit for itself over armature RC1 independently of the latter part of the circuit described. Relay RC at armature RC2 also opens the locking circuit of relay G and connects earth via armature PC1 of relay PC to the private wiper to maintain relays L and K operated in the line circuit (Figure 1). Relay G on releasing at armature G3 opens the connection of both relays FL and FL1 to the test leads so that now direct connections to the subscriber's line can be traced without any earth or battery connections thereto, thereby rendering it possible to test the subscriber's line. After the test is completed, the test distributor and test final selector are released and the removal of earth from the private conductor TP releases relay L so that relay K again becomes locked over the subscriber's line if the short circuit still persists.

I claim:

1. In a telephone system wherein means are provided for automatically cutting a telephone line out of service in case a low resistance shunt persists thereon and making certain electrical connections thereto, a test operator's position, test switches controlled from the position to seize such lines, means on said line controlled from said position over said switches for causing said electrical connections to be removed from a seized line, and means controlled from said position for testing said line independently of said connections while said shunt remains thereon.

2. A telephone system such as claimed in claim 1 wherein said last means consists of a relay associated with the line, and means controlled over the test switches for momentarily operating said relay, and means controlled by said relay for removing the said electrical connections and then disconnecting itself from the line.

3. In a telephone system, a line, a line and cut-off relay therefor, means for causing the operation of the cut-off relay only when a fault occurs on the line, test equipment for seizing said line while the cut-off relay is operated under such a condition, means controlled over the test equipment for energizing the line and cut-off relays in series to place the line in normal condition for test irrespective of the low resistance shunt existing thereon.

4. A telephone system such as claimed in claim 1 having means in the test position for causing a momentary connection of high potential to the seized line over the test switches, and said means on the line is responsive to such high potential to remove the electrical connections.

RUDOLPH FRANK STEHLIK.