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TESTING ARRANGEMENT FOR TRUNKS TO COMMUNITY DIAL OFFICES

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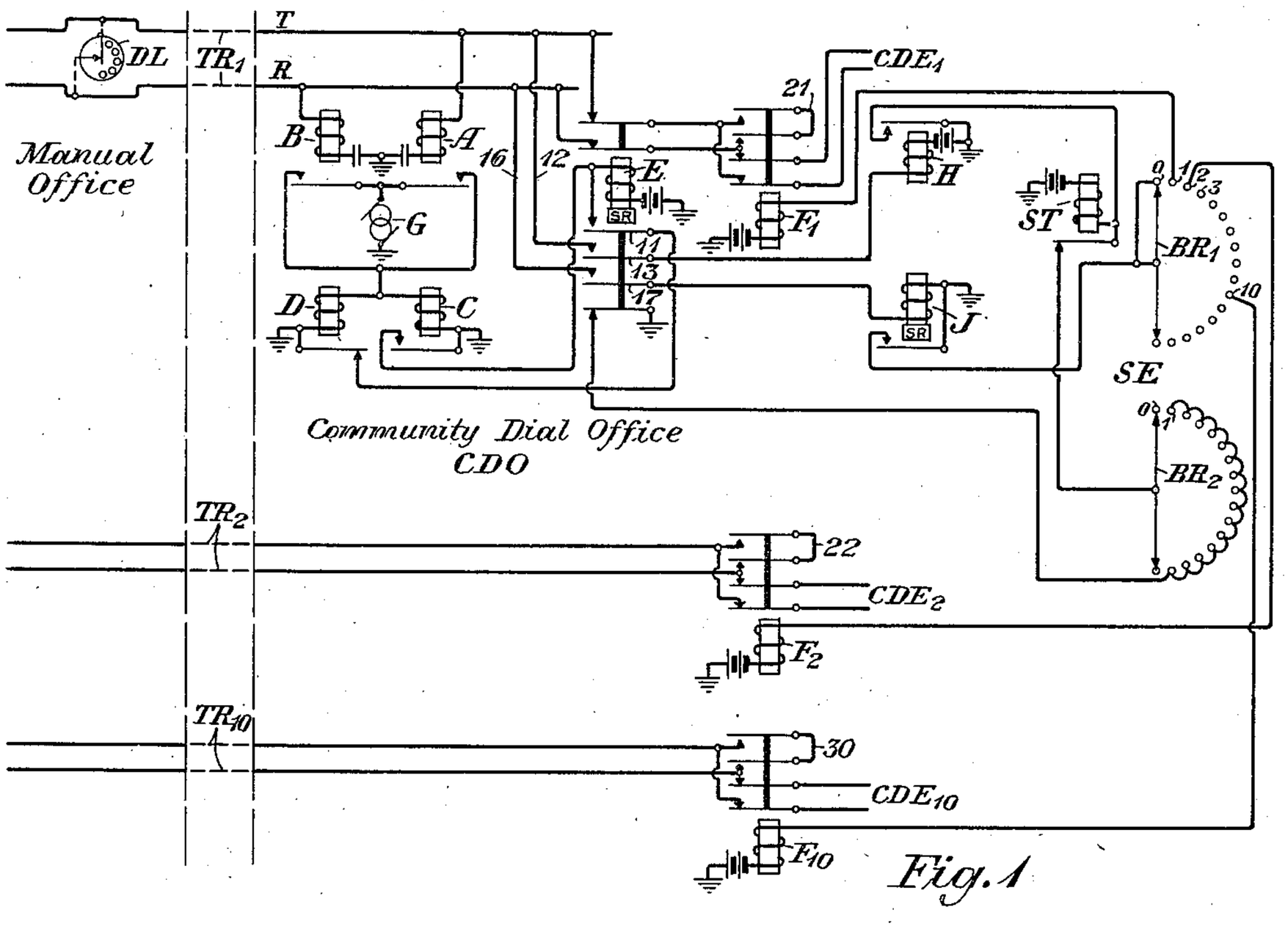


Fig. 1

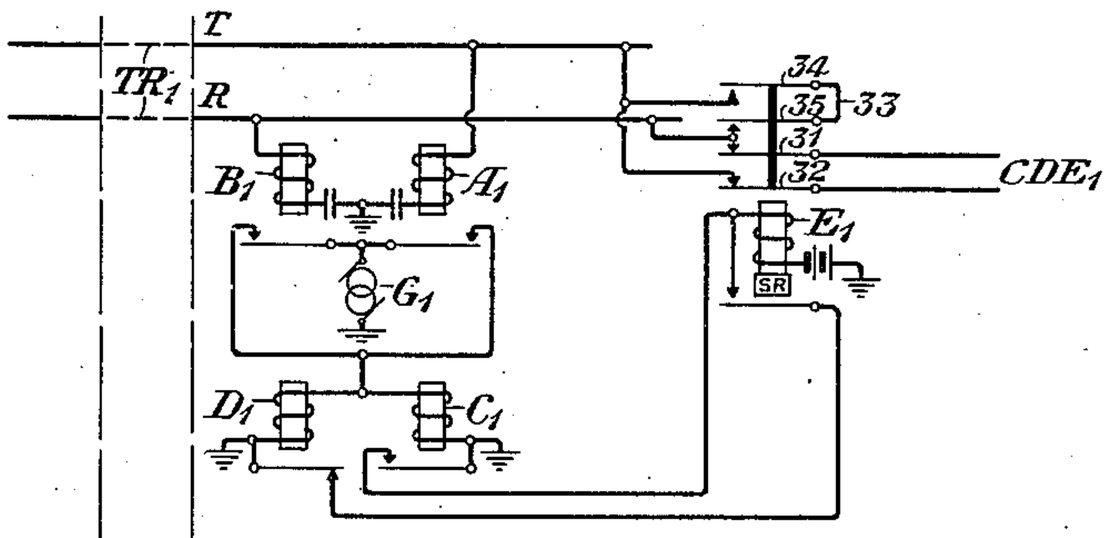
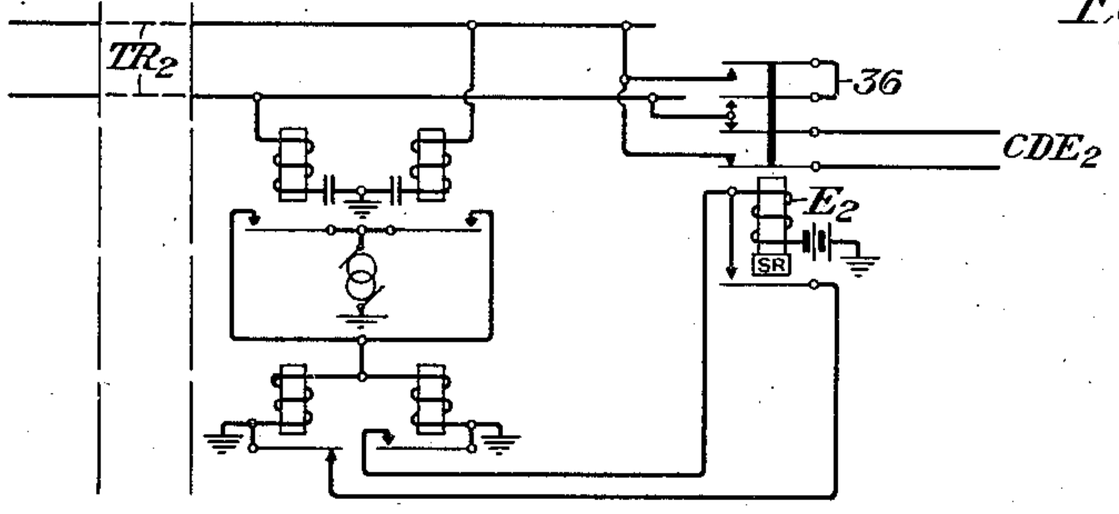


Fig. 2



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TESTING ARRANGEMENT FOR TRUNKS TO COMMUNITY DIAL OFFICES

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8 Claims. (Cl. 179—175.2)

This invention relates to testing systems suitable for testing telephone lines in machine switching offices and in telephone systems generally. More particularly, this invention relates to testing systems for testing the lines connected to small telephone offices generally known as community dial offices.

It sometimes happens that a community or hamlet too small to justify an ordinary manual exchange is located near a larger town or city provided with a regular telephone exchange or exchanges. Frequently in such cases the outlying hamlet or community is too far away from the city to justify direct connections from each subscriber to a central office in the city. Under such circumstances it is usually the practice to provide the outlying hamlet with telephone service by means of a so-called community dial office. This is a small office located in the local community and provided with relatively simple, automatic switching machinery by which the local subscribers may dial each other. A relatively few trunks extend between the community dial office and the exchange in the nearby city to take care of calls from the local community to the larger telephone area. An operator in the city may establish a direct connection over one of these trunks to any desired subscriber coming into the community dial office, and any local subscriber desiring a city connection can, by dialing, connect his line to one of the trunks leading to the city. These community dial offices are unattended, except at such times as maintenance and inspection employees make temporary visits thereto.

Where such a situation exists and troubles arise either in the trunks leading from the city to the community dial office or in the circuits connected to the community dial office, a somewhat elaborate procedure for clearing the troubles is involved. It is frequently found necessary to send a lineman from the testing office at the city exchange to the outlying community dial office to open and cross out the circuits in order to measure or locate line troubles which sometimes are only a short distance from the testing office. This results in excessive loss of time, and in addition, there is the expense of the unnecessary distance traveled.

In order to overcome this difficulty it is proposed to provide arrangements in the dial office whereby the tester at the city or manual office may remove the usual office trunk equipment from the trunk conductors at the community dial office and short-circuit or ground the trunk conductors so as to make measurements for faults. It is also proposed to add step-by-step equipment at the dial office to enable the tester to select any one of the trunks or lines connected to the dial office so that measurements may be made of any of the lines or circuits selected.

In providing the equipment at the dial office to carry out the tests above referred to, a relay is provided for controlling the connection or disconnection of the dial office equipment from the trunk extending between the dial office and the city or manual office. The arrangement of this invention is set up so that it is necessary to transmit alternating current for a predetermined interval of time (or longer) over the trunk to cause this relay to operate, and it is necessary subsequently to transmit the same current for a shorter interval of time to release the relay. This will be explained in more detail hereinafter.

This invention will be better understood from the more detailed description hereinafter following when read in connection with the accompanying drawing in which Figure 1 illustrates one embodiment of the invention in which is shown apparatus for receiving currents over one of the trunks to control the connection of equipment at the dial office with respect to any other trunk connected to the dial office, and Fig. 2 shows a somewhat different arrangement of the apparatus of this invention, the Fig. 2 arrangement involving control apparatus common to each trunk.

Referring to Fig. 1 of the drawing, a city or manual telephone office is shown connected to a community dial office CDO by a plurality of trunks, of which the three shown are designated TR_1, TR_2 and TR_{10}. The trunk TR_1 may be considered the main or control trunk for the purposes of this invention, while trunks TR_2 and TR_{10} are two of a number of additional trunks. The control apparatus at the office CDO may be actuated by sending a low frequency ringing current over the upper or tip conductor T of trunk TR_1, or by sending such a current over the lower or ring conductor R of the trunk TR_1. When such a current is sent from the manual office over the tip conductor T, relay A will be operated while, on the other hand, relay B will be operated when such current is sent from the manual office over the ring conductor R. Relays C and D are connected in parallel with each other and both of these relays are controlled by relays A and B. When either relay A or relay B operates, the generator G will be connected to the windings of relays C and D. Relay C is a slow-oper-

ating relay, and it will be operated only when the generator G is connected to its winding for a predetermined time interval such, for example, as six seconds. Hence relay C will be operated only when ringing current is applied to the tip or ring conductors T and R of trunk TR_1 for at least the predetermined time interval (of six seconds).

When relay C operates, it will cause the main or control relay E to be operated. Relay E—which is of the slow-release type—will then be locked in its operated position immediately after the ringing current has been removed from the tip and ring conductors T and R of trunk TR_1. The locking circuit for relay E includes battery, the winding of relay E, the lower inner make contact and armature **11** of relay E, the back contact and armature of relay D and ground. The operation of relay E will disconnect the trunk TR_1 from the community dial office trunk circuit and from equipment CDE_1 at the back contacts of the upper two armatures of relay E.

Three additional relays F_1, H and J and a selector SE are associated with the main or control trunk TR_1. Relay F_1 is controlled by the selector SE, as will be explained hereinafter. The conductors T and R of trunk TR_1 are connected to the windings of relays H and J, respectively, through the contacts of armatures **13** and **17** of relay E. Thus, the circuit from conductor T to the winding of relay H includes conductor **12**, armature **13** of relay E and its make contact, the winding of relay H, battery and ground. The circuit from conductor R to the winding of relay J includes conductor **16**, armature **17** of relay E and its make contact, the winding of relay J and ground.

Relays F_1, H, and J are normally released. But after relay E is operated and locked in its operated position by sending alternating or ringing current over either of the conductors T or R of trunk TR_1 for the necessary time interval, as already explained, relays H and J may be operated by the operator or testman at the manual office whenever desired. The latter relays may be so operated by the testman by connecting a dial set or holding bridge across trunk TR_1, a dial set DL being shown in dotted lines connected across trunk TR_1 for illustrative purposes. When the dial set is so connected, current will flow through the windings of relays H and J over a circuit which includes battery, the winding of relay H, armature **13** of relay E and its make contact, conductors **12** and T, the dial set DL, conductors R and **16**, armature **17** of relay E and its make contact, the winding of relay J and ground. The relays H and J are now ready to receive dial pulses from the dial set DL, although only relay H will follow the dial pulses, as will be explained hereinafter.

Upon the operation of relay E, relay H will follow the dial pulses transmitted from the dial set DL. If a number 2 is dialed by the dial set, relay H will release its armature and thereafter re-close its make contact twice in succession. If, instead, a number 5 is dialed, the armature of relay H will open and close its make contact five times. Although the winding of relay J is connected to the circuit of the winding of relay H, relay J will not follow the dial pulses because this relay is of the slow-release type. The stepping magnet ST of selector SE will, however, respond to each operation of relay H and hence follow the dial pulses. The circuit controlling the stepping magnet ST includes battery, the winding of magnet ST, the armature and make contact of relay H and ground. Although the stepping magnet ST is energized by the operation of relay H as soon as the dial set DL is connected to trunk TR_1, the brush arms BR_1 and BR_2 are not stepped in the clockwise direction until the stepping magnet ST is subsequently de-energized. The stepping magnet becomes de-energized only when relay H is released with each digit dialed.

Thus it is observed that the selector magnet ST will be operated any desired number of times under control of the manual office operator's dial set DL. When the magnet ST is operated twice, for example, brushes BR_1 and BR_2 will be stepped from their initial contacts **0** to their number **2** contacts. Relay F_2 will then be operated over a circuit which includes battery, the winding of relay F_2, contact **2** of the upper arc of selector SE and its brush BR_1, the armature and make contact of relay J and ground. A short circuit **22** will then be connected by the upper two armatures of relay F_2 and their make contacts, respectively, across the conductors of trunk TR_2. At the same time the community dial office equipment CDE_2 will be disconnected from trunk TR_2 at the contacts of the lower two armatures of relay F_2. The testman at the manual office may then test the trunk TR_2 in the usual way.

If a No. 10 were dialed instead of a No. 2, the stepping magnet ST would have been operated ten times and the brush arms BR_1 and BR_2 would have been stepped in a clockwise direction to their No. 10 contacts. In that case, relay F_{10} would have been operated (instead of relay F_2) and the circuit element **30** would have been bridged across trunk TR_{10} while the community office dial equipment CDE_{10} was disconnected from trunk TR_{10}. The testman could then test trunk TR_{10} in the usual way.

The arrangement so far described enables the testman at the manual office to selectively operate one of the relays F_2—F_{10} to test the particular trunk associated with that relay. The selection of one of the relays is accomplished by the step-by-step equipment SE controlled over the trunk TR_1. The step-by-step equipment is started into operation only if an alternating or ringing current is applied to one of the trunk conductors T or R for a predetermined time interval and, upon connection of the dial set DL to trunk TR_1, a group of dial pulses are then transmitted to the community dial office to operate the stepping equipment SE.

The removal of the dial set DL from trunk TR_1 will not disable the control equipment associated with trunk TR_1. This is because relay E is held locked in its operated position over the path provided by the back contact of relay D. However, the removal of the dial set DL will cause relays H and J to release.

In order to restore all of the equipment at the community dial office to its normal condition, the same alternating or ringing current previously referred to may be applied to either of the conductors T or R of trunk TR_1 for a brief interval. Then either relay A or relay B will be operated by this current, and generator G will then be connected to the windings of relays C and D. Relay C will remain unoperated because it requires current to traverse its winding for the much longer interval of, for example, six seconds, to cause its operation. But relay D will be operated to release relay E. As relay E becomes released, the stepping magnet ST will be energized over a circuit which includes battery, the winding of stepping magnet ST, the armature and back con-

tact of stepping magnet ST, brush BR_2 of selector SE and the conductor connected to its terminals, the lowermost armature of relay E and its back contact and ground. The energization of the stepping magnet ST will break its own circuit at the back contact of its armature and hence the armature will be released. This will again cause the stepping magnet ST to be energized and then again released, etc. The brush arms BR_1 and BR_2 will thus be rotated step-by-step in a clockwise direction until these brush arms reach their initial contacts No. 0.

Relay F_1 may be operated by dialing digit No. 1. This will cause element **21** to be bridged across trunk TR_1 and the office equipment CDE_1 will be simultaneously removed from trunk TR_1. If desired, equipment similar to that associated with trunk TR_1 may be associated with one of the other trunks such as trunk TR_{10} to bring about the operation of relay F_1. There will then be two control equipments at the community dial office, one for controlling the trunks TR_2 to TR_{10} for testing purposes and the other for controlling trunk TR_1 for the same purpose.

A Western Electric relay of the KS–7805 type has been found satisfactory for use as relay C. Any other time controlled relay may be substituted for this relay in practicing the invention.

Fig. 2 is a modification of Fig. 1. Here the operator at the manual office may disconnect the community dial office equipments from the various trunks by sending predetermined currents over the respective trunks. Suppose it is desired to remove the dial office circuit and equipment CDE_1 from trunk TR_1. The necessary alternating or ringing current will be transmitted either over conductor T or R to operate relays A_1 or B_1 as already explained. Relay C_1 will in turn be operated, causing relay E_1 to be operated and locked in its operated position through the back contact of relay D_1. The manner in which these relays are operated has already been described in connection with Fig. 1 and, therefore, need not be repeated.

As soon as relay E_1 is operated, its armatures **31** and **32** will disconnect the dial office line equipment generally designated CDE_1 from trunk TR_1 and at the same time connect a short circuit **33** to trunk TR_1 through the armatures **34** and **35** of relay E_1 and their make contacts. The trunk circuit TR_1 may then be tested. In a similar manner currents transmitted from the manual office over trunk TR_2 will cause dial circuit CDE_2 to be disconnected and short circuit **36** at the same time will be connected to trunk TR_2. All of the relays associated with either trunk will be released when the alternating or ringing current is transmitted over the trunk for the briefer predetermined time interval.

It has been pointed out in regard to both Figs. 1 and 2 that in response to certain predetermined currents, a short circuit may be bridged across a trunk for testing purposes. It will be understood that any other desired type of circuit, impedance or equipment may be bridged across the trunk for testing or other purposes within the scope of this invention.

While this invention has been shown and described in certain particular embodiments merely for the purpose of illustration, it will be understood that the general principles of this invention may be applied to other and widely varied organizations without departing from the spirit of the invention and the scope of the appended claims.

What is claimed is:

1. In a signaling system, the combination of a line, relay apparatus, pulse-responsive apparatus controlled by said relay apparatus, means responsive to alternating current transmitted over said line for a predetermined time interval to operate said relay apparatus and connect said pulse-responsive apparatus to said line, and means responsive to the same alternating current transmitted over said line for a different predetermined time interval to release said relay apparatus and disconnect said pulse-responsive apparatus from said line.

2. In a telephone system, the combination of a line, pulse-responsive apparatus, means responsive to alternating current transmitted over said line for longer than a predetermined time interval to connect said pulse-responsive apparatus to said line, and means responsive to the same alternating current transmitted over said line for less than a shorter predetermined time interval to disconnect said pulse-responsive apparatus from said line.

3. Testing apparatus comprising a line, pulse-responsive apparatus, means responsive to alternating current transmitted over said line for a predetermined time interval to connect said pulse-responsive apparatus to said line, a selector controlled by said pulse-responsive apparatus, means responsive to pulses transmitted over said line to operate said pulse-responsive apparatus in accordance with pulses transmitted over said line, whereby said selector will be operated a number of times corresponding to the number of pulses transmitted over said line.

4. In a telephone system, the combination of a plurality of trunks, a relay having its winding connected to a predetermined one of said trunks and responsive to alternating current transmitted over said trunk, pulse-responsive apparatus, means responsive to the operation of said relay for a predetermined time interval to connect said pulse-responsive apparatus to said predetermined trunk, a step-by-step selector controlled by said pulse-responsive apparatus, a plurality of circuits each associated with one of said trunks, and means controlled by said selector to connect any one of said circuits to the trunk with which it is associated.

5. In a telephone system, the combination of a plurality of trunks, a relay having its winding connected to a predetermined one of said trunks and responsive to alternating current transmitted over said trunk, pulse-responsive apparatus, means responsive to the operation of said relay for a predetermined time interval to connect said pulse-responsive apparatus to said predetermined trunk, a step-by-step selector controlled by said pulse-responsive apparatus, a plurality of circuits each associated with one of said trunks, means controlled by said selector to connect any one of said circuits to the trunk with which it is associated, and means responsive to the operation of said relay for a different predetermined time interval to disconnect said pulse-responsive apparatus from said predetermined trunk.

6. In a telephone system, the combination of a plurality of lines, one of which is the main line, a plurality of circuit elements each associated with one of said lines, a step-by-step selector, one step of which is associated with each line and its corresponding circuit element, means responsive to the operation of said selector to one of its steps to connect the associated circuit element to the corresponding line, means responsive to alternating current transmitted over the main line to

couple said selector to said main line, and means responsive to pulses of direct current transmitted over said main line to operate said selector to any desired step.

7. In a telephone system, the combination of a plurality of lines, one of which is a main line, all of said lines interconnecting two stations, a plurality of circuits, one of which is associated with each line, means including a selector for selecting one of said circuits and connecting it to its associated line, means responsive to alternating current transmitted over said main line to couple said selector to said main line, and means responsive to d. c. pulses transmitted over said main line to repeatedly operate said selector for selecting one of said circuits.

8. In a telephone system, the combination of a plurality of trunks interconnecting a manual office and an unattended dial office, means for short-circuiting any one of said trunks at the dial office so that each such trunk may be tested, said means including a selector, means responsive to alternating current transmitted from said manual office over a predetermined trunk for a predetermined period of time to couple said selector to said predetermined trunk, means responsive to d. c. pulses received over said predetremined trunk from the manual office to operate said selector, a plurality of short-circuiting elements each associated with one of said trunks, means controlled by said selector for bridging one of said short-circuiting elements across its associated trunk, and means responsive to said alternating current transmitted for a different period of time over said predetermined trunk from said manual office to uncouple said selector from said trunk and release said selector.

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