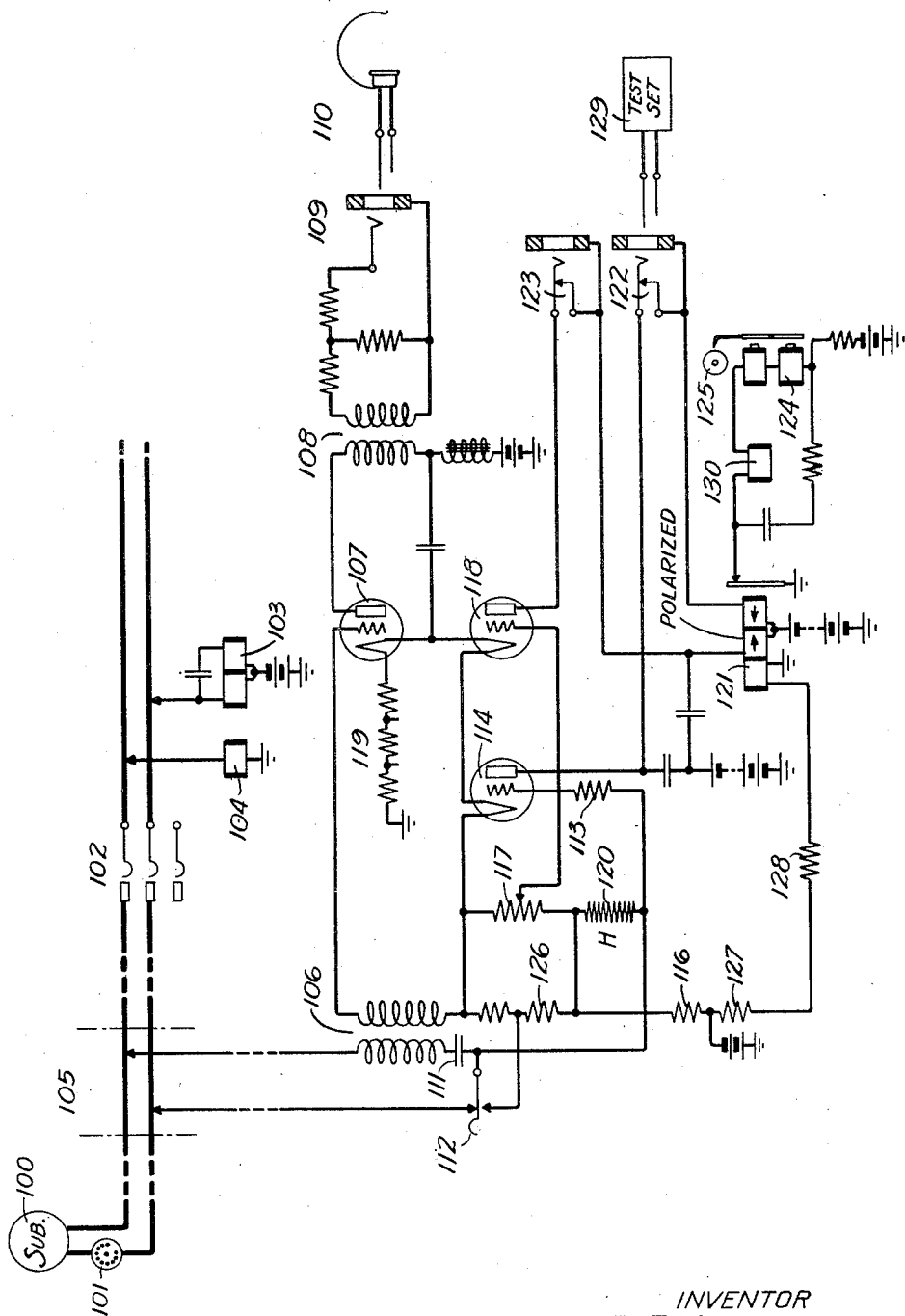


March 10, 1931.

R. F. MASSONNEAU
SERVICE OBSERVING SYSTEM

1,795,656

Filed Aug. 7, 1929



INVENTOR
R. F. MASSONNEAU
BY P. C. Smith

ATTORNEY

UNITED STATES PATENT OFFICE

ROBERT F. MASSONNEAU, OF SCARSDALE, NEW YORK, ASSIGNOR TO BELL TELEPHONE LABORATORIES, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK

SERVICE-OBSERVING SYSTEM

Application filed August 7, 1929. Serial No. 384,161.

This invention relates to telephone exchange systems, and more particularly to means for observing the operation of telephone equipment.

5 Broadly the object of the invention is to improve the recording of pulses in that the record is made a more accurate repetition of the pulses actually transmitted and that the chances for interference with the progress
10 of the pulsing is reduced.

One specific embodiment of the invention employs a pair of vacuum tubes, one of which operates in parallel with the pulsing relay of the central office circuit under observation
15 while the other tube serves to balance the steady plate current in the first tube. The plate circuits of these two tubes extend through the windings of a differential relay. The relay is normally not operated
20 since the steady plate current in the two windings balance but the relay is unbalanced and operates whenever the dial is operated to open the subscriber's dial circuit.

The invention will be more clearly understood from a consideration of the description given hereinafter in connection with the drawing which discloses in a schematic manner a subscriber's line and the pulsing relay of the sender, while the pulse recording
25 equipment is shown in a detailed manner.

In conducting observations on the service given subscribers by central office equipment, whether manual or automatic, a fundamental requirement is that the subscriber shall not
30 be annoyed because of poor transmission or wrong connections due to the current drain through the observing apparatus. It is, of course, obvious that the observing equipment must respond accurately and permit the observing operator to hear the response on the
35 called line since otherwise the observation would be useless. The present invention meets both of these requirements, as will be seen subsequently.

45 In the drawing the subscriber's line 100, together with the dial 101 by which open pulses for controlling the central office equipment are generated, is shown extended by line finder 102 to an outgoing trunk with
50 which is connected the pulsing relay 103 and

a balancing coil 104. While the drawing has been based on the panel type of equipment, in which the pulsing relay 103 will be located in a common register sender and connected with the subscriber's line through
55 some form of sender selector and the line finder 102, the observing circuits are equally useful in connection with any other form of dial switching telephone equipment. The dot and dash lines across the subscriber's
60 line indicate the distributing frame through which the line is connected to the switching apparatus and at which the observation circuit is connected with the line in any desirable manner. U. S. Patent 1,551,023 to J. W. Gooderham discloses a complete observing
65 arrangement in which the present pulse recording circuit might be employed and shows a suitable method of connecting the observing equipment with the line to be observed.

Transformer 106, the high impedance primary winding of which is connected in series with low capacity condenser 111 and the upper contact of key 112 across the subscriber's
70 line, is a talking transformer and supplies talking current to the grid circuit of vacuum tube 107 which amplifies the small currents allowed to pass by condenser 111 and transmits the amplified speech through transformer 108 to the operator's telephone 110
75 which is connected with the equipment through jack 109. While the various batteries, particularly that supplied to the filament circuits of the vacuum tubes are shown directly connected, it is obvious that a key
80 or a contact of jack 109 might be employed to supply battery only when the operator is ready to use the equipment.

The pulse recording equipment is not normally connected with the subscriber's line when it is idle but is connected with it automatically by equipment in the general observing system when the sender is connected with the line and the pulsing circuit established. Until this time, the vacuum tubes are held in a normally balanced condition. Full
85 battery potential is applied through resistances 116, 113 and 120 to the grid element of vacuum tube 114. Resistance 120 is of the order of two million ohms so that it does not
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affect the operation of the system. The filament circuit for tube 114 as well as tubes 118 and 107 may be traced from battery through resistance 116, resistance 117 through filaments of tubes 114, 118 and 107 in series through resistance 119 to ground. A circuit also exists from battery through resistances 127 and 128, left winding of relay 121 to ground. This winding serves to polarize the relay slightly and hold the armature against its back contact. Potential is applied to the grid of vacuum tube 118 through resistance 116 and a portion of resistance 117. The plate element of tube 114 is connected through the contact of jack 122 to the right winding of relay 121 and high potential battery, while the plate of tube 118 is connected through contacts of jack 123, middle winding of relay 121 to the same high potential battery. This battery may very well be the battery used for the collecting of coins in the central office. It is to be noted that this battery is positive battery as opposed to the negative battery used elsewhere. With the equipment in this condition the current in the middle and right windings of relay 121 just balance, and the circuit of pen register 124 is closed and the pen held in contact with the recording tape indicated by the roller 125. Relay 130 controls equipment (not shown) for stopping the tape after a predetermined interval.

When now the subscriber's line is extended to the sender and the observing equipment connected therewith, the current flowing over the subscriber's line reduces the potential on the ring conductor and this reduction of potential is transferred to the grid of tube 114. Increased current therefore flows in the plate circuit of that tube and in the right winding of relay 121. Relay 121 attracts its armature, permitting the pen register to release the pen and the tape to start moving. When the subscriber operates his dial, at each interruption of the current flow over the line the grid of tube 114 will receive the full potential of the central office battery and will momentarily release relay 121. When relay 121 releases the pen register operates to draw the pen against the tape and a dot and dash record is made on the roller 125 from which the operation of the dial may be observed. The operator may determine by listening whether the connection was established to the desired line and, if not, may from a comparison of the pulses as recorded with the line actually obtained determine wherein the difficulty lies.

It is apparent that since the vacuum tube 114 is an open circuit device and depends for its action merely upon the potential established at a particular point in the pulsing circuit, there is no current drain from the pulsing circuit aside from the small amount permitting the operator to hear and hence prac-

tically no interference due to the fact that the line is under observation. Likewise, due to the character of such a device, its response to the variations in potential due to dialing is extremely accurate. The device may also be operated to observe supervisory signals in manual systems, etc.

However, these variations might be completely offset by the natural variations in central office battery potential were it not for the use of tube 118. When the observing equipment is first made ready for use the two vacuum tubes are inserted in the circuit and key 112 operated to close its lower contact. In that case battery is connected through resistances 116 and 126, lower contact of key 112, resistance 113 to the grid of tube 114, this condition being comparable to the condition when the observing equipment is connected to a subscriber's line before dialing starts. The test set 129 is then inserted in the plate circuit of tube 114 by means of jack 122. This test set need be merely an ammeter of the proper range. The amount of current flowing in the plate circuit of tube 114 under these conditions is determined. The test set 129 is then inserted in the plate circuit of tube 118 by means of jack 123 and the movable contact on resistance 117 adjusted until the current flowing in this circuit is the same as that in the plate circuit of tube 114. After these adjustments have been made for a particular pair of tubes no further adjusting is necessary until one or the other of the tubes either becomes very old or actually burns out and is replaced by another.

It will be seen from a consideration of the foregoing that the present arrangement renders the observing equipment independent of fluctuations of the central office battery since the actual potentials connected to the grids of tubes 114 and 119 and supplied to the pulsing relay vary together and the operation of relay 121 depends upon the change in relative potentials and not upon the absolute potentials.

What is claimed is:

1. In a telephone system, a device for generating open pulses, and means for recording the pulses from said device comprising a pair of vacuum tubes, a plate circuit for each tube, and a differential relay having one winding in each of said plate circuits.

2. In a telephone system, a device for generating open pulses, and means for recording the pulses from said device comprising a pair of vacuum tubes, a plate circuit for each tube, a differential relay having one winding in each of said plate circuits, and a register responsive to said differential relay.

3. In a telephone system, a device for generating open pulses, and means to record the pulses from said device comprising a differential relay having a plurality of wind-

ings, means to establish balanced circuits through said windings when said pulsing device is inactive, and means responsive to the operation of said pulsing device to unbalance said circuits to operate said relay.

4. In a telephone system, a device for generating open pulses, and means to record the pulses from said device comprising a differential relay having a plurality of windings, a pair of vacuum tubes, means to establish balanced circuits through said vacuum tubes and said windings when said pulsing device is inactive, and means responsive to the operation of said pulsing device to unbalance said circuits to operate said relay.

5. In a telephone system, a pulsing device, and means for recording the pulses from said device comprising a differential relay having a plurality of windings, a vacuum tube having an input and an output circuit, said input circuit being associated with said pulsing device and said output circuit extending through one of the windings of said relay, a second vacuum tube having an input and an output circuit, the output circuit of said second tube extending through a second winding of said relay, and means to adjust the input circuit of said second tube to produce a balanced condition in said relay.

6. In a telephone system, a telephone line, a pulse generating device in said line, a pulsing relay operable over said line, and means for observing the operation of said pulse generating device comprising a vacuum tube connected in parallel with said pulsing relay, and a differential relay connected to the output element of said vacuum tube.

7. In a telephone system, a telephone line, a pulse generating device in said line, a pulsing relay operable over said line, and means for observing the operation of said pulse generating device comprising a vacuum tube connected in parallel with said pulsing relay, a second vacuum tube having a fixed potential connected to the input element of said tube, and a differential relay having its windings connected to the output elements of said tubes.

8. In a telephone system, a telephone line, a pulse generating device in said line, a pulsing relay operable over said line, and means for observing the operation of said pulse generating device comprising a vacuum tube connected in parallel with said pulsing relay, a second vacuum tube, a differential relay having its windings connected to the output elements of said tubes, and means for adjusting the potential applied to the input element of said second tube to produce a balanced condition in said relay.

9. In a telephone system, a telephone circuit, means to open said circuit to transmit signals over said circuit, and means to observe said signals comprising a vacuum tube connected to said circuit, a second vacuum

tube and a differential relay under the joint control of said tubes.

10. In a telephone system, a telephone circuit, a relay associated with said circuit, means to open and close said telephone circuit to control said relay, and means to observe said controlling means comprising a vacuum tube having its input element connected in parallel with said relay, a second vacuum tube having its input element connected with a fixed potential and a differential relay having its windings connected with the output elements of said tubes.

11. In a telephone system, a device for generating open pulses, and means for recording the pulses from said device comprising a pair of vacuum tubes, a plate circuit for each tube, a differential relay having one winding in each of said plate circuits, and means for associating only one of said vacuum tubes with said pulse generating device.

12. In a telephone system, a device for generating open pulses, and means to record the pulses from said device comprising a differential relay having a plurality of windings, means to establish balanced circuits through said windings when said pulsing device is inactive, means responsive to the operation of said pulsing device to unbalance said circuits to operate said relay, and means for associating only one of said vacuum tubes with said pulse generating device.

In witness whereof, I hereunto subscribe my name this 5th day of August, 1929.

ROBERT F. MASSONNEAU.