Jan. 5, 1937.

W. WHITNEY

2,066,502

TELEPHONE SYSTEM

Filed Oct. 2, 1935

FIG. 1

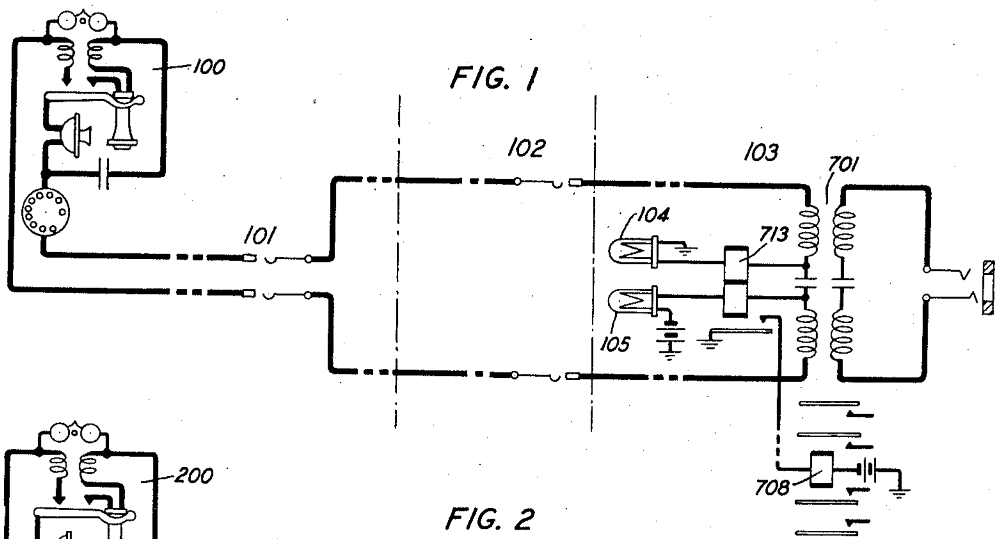


FIG. 2

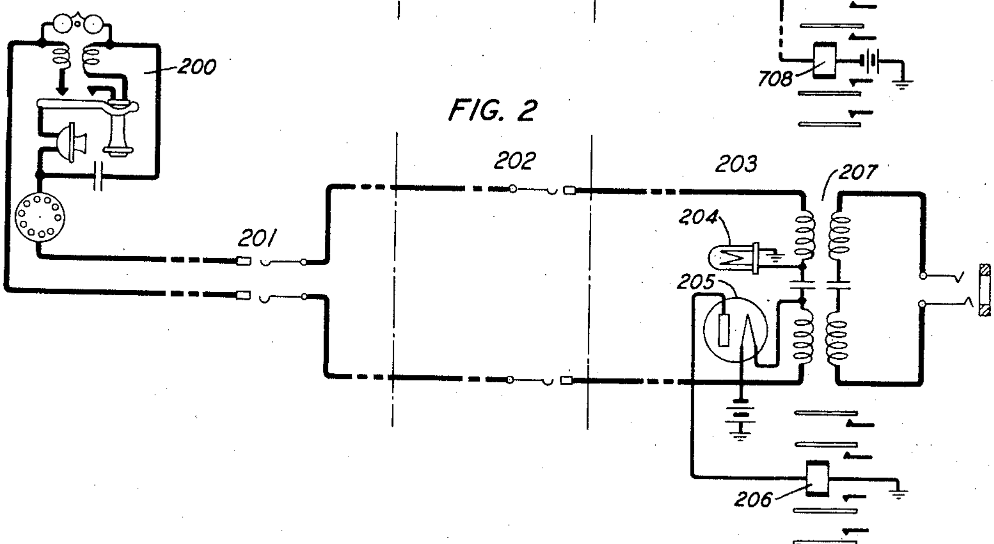
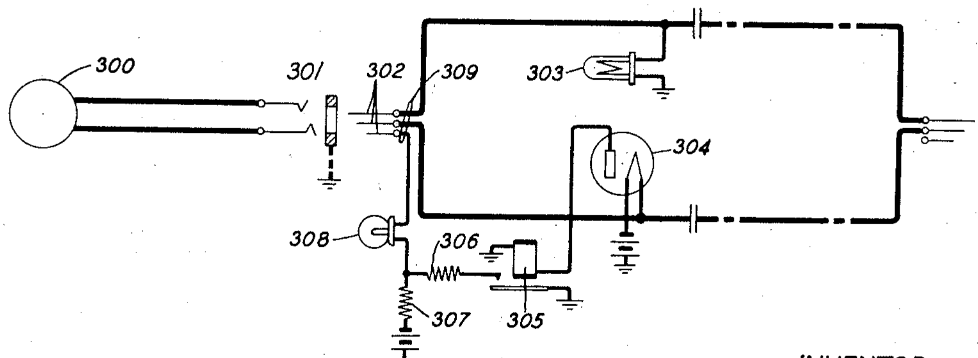


FIG. 3



INVENTOR
W. WHITNEY
BY
ATTORNEY

Patented Jan. 5, 1937

2,066,502

UNITED STATES PATENT OFFICE

2,066,502

TELEPHONE SYSTEM

Wiley Whitney, Bloomfield, N. J., assignor to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York

Application October 2, 1935, Serial No. 43,129

4 Claims. (Cl. 179—51)

This invention relates to common battery telephone systems and more particularly to a method of supplying central office battery current to a trunk or cord circuit and thence to a subscriber's line.

One commonly used method of supplying central office battery to a subscriber's line consists in connecting the battery and ground supplied to a trunk through tungsten filament ballast lamps, i. e., resistance lamps having a positive temperature-resistance characteristic which increases in resistance as the current therethrough increases. One of the purposes of these lamps is to protect subscriber stations transmitters on low resistance short lines or loops, it being understood that subscribers' lines or loops vary widely in length and resistance, all the way from substantially zero to a maximum of 750 ohms.

The present method of providing a supervision on such circuits is to insert a sensitive double-wound relay in series with the resistance lamps, one winding in series with each lamp. These relay windings obviously introduce a fixed resistance in the battery supply circuit which reduces, to some extent, the effectiveness of the control exercised by the ballast resistances.

In Patent 1,979,020, issued October 30, 1934 to the present applicant, Fig. 7 shows the toll board end of a trunk circuit arranged to supply central office battery to a subscribers' station **200**, Fig. 1, through a double-wound supervisory relay **713**. Although ballast lamps, as above referred to, were omitted from the patent drawing, lamps of this character are connected, in practice, between the battery and ground and the two windings of the supervisory relay **713**.

Relay **713** is a sensitive low resistance relay as before mentioned and controls at its single contact an auxiliary local circuit relay **708** which is arranged to close four different circuits.

An object of the present invention is to eliminate the fixed resistance heretofore introduced by the supervisory relay in the battery supply of such systems.

Another object is to reduce the number of relays required in such a system.

A feature of the invention whereby the foregoing objects are attained resides in eliminating the sensitive double-wound relay heretofore connected in series with the battery supply and in substituting for one of the ballast lamps the filament of a two-element thermionic tube, which filament has an equivalent temperature-resistance characteristic to the ballast lamp which it replaces. With this arrangement, a single local circuit relay equipped with sufficient contact springs to effect all the desired functions, such as the relay **708** of the Patent 1,979,020, can be connected to the plate circuit of the vacuum tube. With such an arrangement, no fixed resistance is included in the battery supply and a single multicontact supervisory relay can be operated directly from the plate circuit of the tube.

The invention will be understood from the following description and accompanying drawing:

Fig. 1 of the drawing is a schematic of the drawing of Patent 1,979,020 hereinbefore referred to which shows the present method of supplying battery current to a subscriber's station over a trunk circuit;

Fig. 2 is a schematic of a similar trunk circuit arranged in accordance with the present invention; and

Fig. 3 is a schematic of a manual subscriber's cord circuit also arranged in accordance with the present invention.

Fig. 1 shows a dial subscriber's station **100** connected over the brushes and bank terminals of line finder **101** and selector **102** to trunk circuit **103** which employs a well-known battery supply arrangement. Lamps **104** and **105** are ballast or resistance lamps and the battery and ground for the subscriber's station is supplied through these lamps, through the two windings of the sensitive relay **713**, and through the left windings of repeating coil **701** to the trunk conductors and thence to the subscriber's station. Relay **713** operates when the subscriber's station loop is closed by the removal of the receiver from the switch-hook at station **100** and releases when the receiver is replaced or when the switch-hook is depressed. The auxiliary local circuit relay **708** operates directly under control of relay **713** and, over its front contacts, closes the various circuits (not shown) required for the proper functioning of the trunk circuit.

Referring now to Fig. 2, there is shown therein a connection similar to that shown in Fig. 1 except that in this instance the battery for the subscriber's station is supplied from the trunk circuit by an arrangement in accordance with the present invention. The dial subscriber's station **200** is shown connected to the trunk circuit **203** over the brushes and bank terminals of line finder **201** and selector **202**. The upper or tip conductor of the trunk, incoming from the station line, extends through the left upper winding of repeating coil **207** and through the filament of ballast lamp **204** to ground. Lamp **204** is a tungsten filament ballast or resistance lamp of the same type as lamps 104 and 105 of Fig. 1.

The lower ring conductor of the trunk extends through the left lower winding of repeating coil 207 and through the filament of a two-element thermionic tube 205 to battery. The filament of tube 205 has a temperature-resistance characteristic equivalent to that of the filament of ballast lamp 204 and, together with the filament of lamp 204, provides for the regulation of the current flow over the subscriber's station loop in the same manner as is accomplished by the use of ballast lamps 104 and 105 of Fig. 1. The anode or plate of tube 205 extends to ground in a circuit through the winding of multicontact relay 206 which corresponds to the auxiliary local circuit relay 708 of Fig. 1.

Closure of the line loop of station 200 due to the removal of the receiver from the switch-hook at that station causes current to flow through the filaments of ballast lamp 204 and thermionic tube 205. Upon the energizing of the filament or cathode of tube 205, relay 206 operates due to the flow of current over the anode-cathode circuit of the tube. The operation of relay 206 closes the various circuits (not shown) over its front contacts which provide for the proper functioning of the trunk circuit. When the line loop of station 200 is opened, due to the receiver being replaced on the switch-hook or the switch-hook depressed, the filament or cathode of tube 205 is deenergized and relay 206 thereupon releases. The use of thermionic tube 205 in place of a ballast lamp therefore eliminates the necessity of using a double-wound sensitive supervisory relay, such as relay 713 of Fig. 1, since the valve action of tube 205 performs the same function as that performed by relay 713 in Fig. 1, i. e., operating the work relay 206 which corresponds to relay 708 of Fig. 1.

Fig. 3 illustrates schematically a manual subscriber operator's cord circuit in which the battery supply is also connected in accordance with the present invention. Ground is supplied to the tip conductor of cord 309 through the filament of ballast lamp 303. Battery is supplied to the ring conductor of cord 309 through the filament of the two-element thermionic tube 304, this filament having the same temperature-resistance characteristics as the filament of ballast lamp 303. The anode or plate of tube 304 connects to ground in a circuit through the winding of relay 305.

Assuming that the subscriber at station 300 initiates a call, the closure of the line loop due to the removal of the receiver from the switch-hook causes a signal (not shown) to be brought in adjacent to the location of the answering jack 301. When the subscriber's operator answers the call by inserting plug 302 of cord 309 into jack 301, current flows through the filaments of lamp 303 and tube 304. Relay 305 thereupon operates over the anode-cathode circuit of tube 304 since the cathode or filament of the tube is energized. The operation of relay 305 closes a circuit from ground over its front contact and through resistance 306 to the conductor extending between resistance 307 and supervisory lamp 308. With plug 302 inserted into jack 301, a circuit is completed from ground over the sleeve of jack 301, sleeve conductor of the cord, lamp 308, to battery through resistance 307. Supervisory lamp 308 does not light, however, since it is shunted out by the ground through resistance 306. When the subscriber's line loop is opened by the replacing of the receiver or the depression of the switch-hook, the filaments of lamp 303 and tube 304 are deenergized and relay 305 thereupon releases. The release of relay 305 opens the shunt around supervisory lamp 308 thereby allowing that lamp to light as a supervisory signal.

Assuming that cord 309 is used in making an outgoing call to station 300, lamp 308 lights immediately upon the insertion of plug 302 into jack 301. When the subscriber at station 300 answers the call, the closure of the line loop energizes the cathode of tube 304. Relay 305 thereupon operates and shunts out the supervisory lamp 308 as previously set forth.

What is claimed is:

1. In a telephone system, a trunk line, a supervisory relay, a central office battery connected across said line, a ballast resistance having a positive temperature-resistance characteristic connected in series between one pole of said battery and one side of the line, a thermionic tube comprising an anode and a filament, said filament having a positive temperature-resistance characteristic equivalent to the characteristic of said ballast resistance, and connected in series between the other pole of said battery and the line, and a plate circuit for said tube including said anode and supervisory relay.

2. In a telephone system, a trunk line, a supervisory relay, a central office battery connected to said line, a pair of ballast resistances having a positive temperature-resistance characteristic connected between said battery and line, one of said resistances also having the characteristic of emitting electrons when heated, an evacuated vessel containing a plate element enclosing said electron emitting resistance, and a circuit including said supervisory relay and said plate element.

3. In a telephone supervisory system, a trunk line, a central office battery connected to said line, a ballast resistance having a positive temperature-resistance characteristic in series between one side of the line and said battery, a thermionic tube having a filament of the same equivalent positive temperature-resistance characteristic as said ballast resistance, said filament being connected in series between the other side of said line and the battery, a plate circuit for said tube including said filament and battery, and a supervisory relay included in the plate circuit.

4. In a telephone system, a trunk line, a supervisory relay, a central office battery connected across said line, a ballast resistance having a positive temperature-resistance characteristic connected in series between one side of said battery and one side of the line, a thermionic tube comprising an anode and a thoriated tungsten filament, said filament being so constructed as to have a characteristic equivalent to said ballast resistance and connected in series between the other pole of said battery and the line and a plate circuit for said tube including said anode and supervisory relay.

WILEY WHITNEY.