

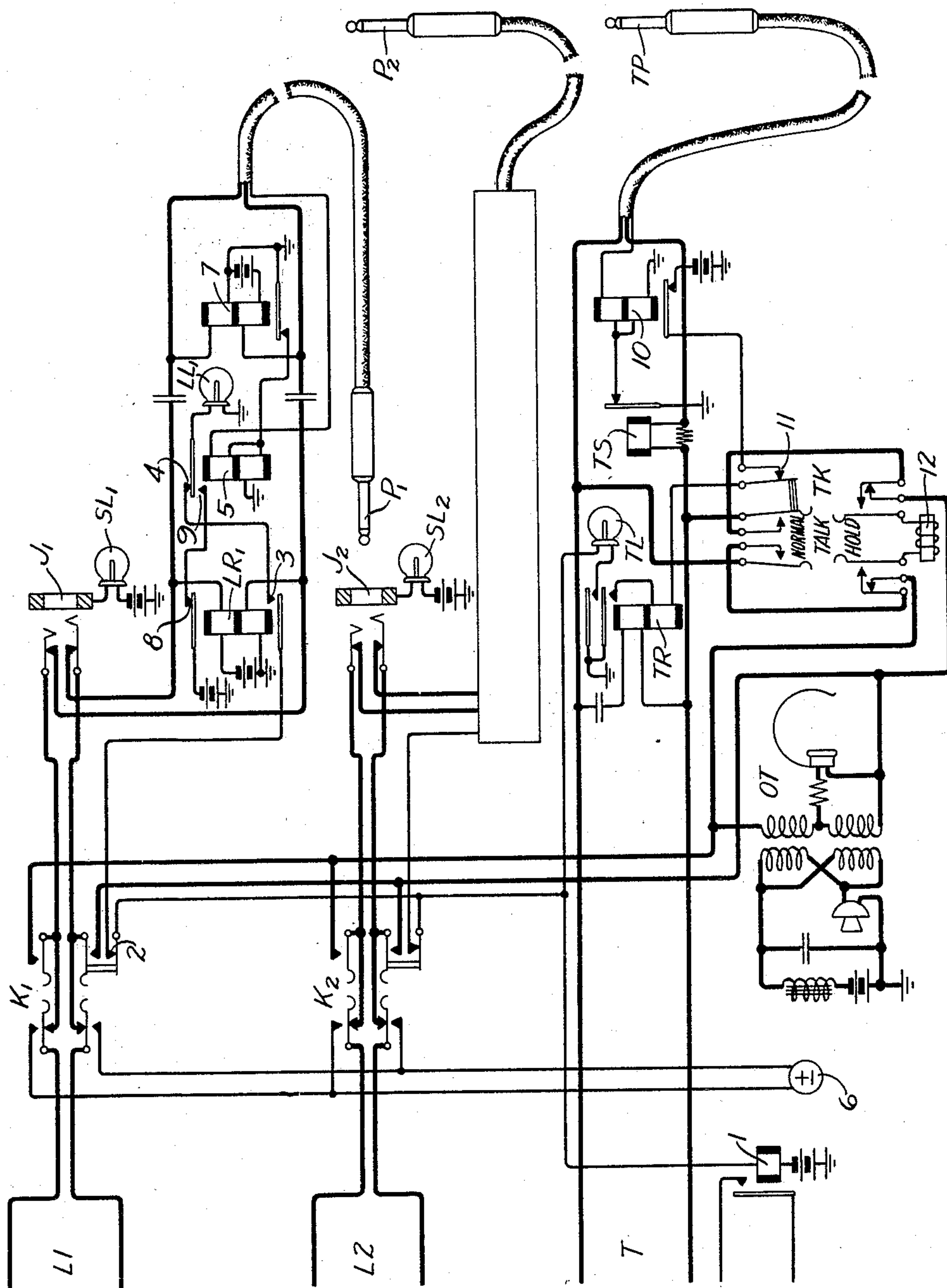
Feb. 18, 1930.

G. V. KING

1,747,833

TELEPHONE SWITCHBOARD SYSTEM

Filed March 20, 1929



INVENTOR
G. V. KING

BY *John Attall*
ATTORNEY

UNITED STATES PATENT OFFICE

GERALD V. KING, OF ST. ALBANS, NEW YORK, ASSIGNOR TO BELL TELEPHONE LABORATORIES, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK

TELEPHONE-SWITCHBOARD SYSTEM

Application filed March 20, 1929. Serial No. 348,391.

This invention relates to telephone systems and more particularly to telephone switchboards of the type sometimes called single cord boards in which each line terminates in a single cord and plug for outgoing service and is also equipped with a jack for incoming service.

An object of the invention is to give the switchboard attendant suitable calling signals and after a connection is established between two lines to give adequate and selective supervisory signals for both the calling and called lines.

A feature of the invention, whereby the above object is attained, resides in a line circuit arrangement, particularly adapted for use in small private branch exchange switchboards, in which a first and a second signal device are associated with each line, the first signal device functioning as a line signal when its associated line is a calling line and as a calling supervisory signal after the calling line is connected to a called line and said second device functioning as a called supervisory signal when its associated line is a called line.

Other features will appear from the following description when read in connection with the accompanying drawing which shows, in a conventional manner, circuits of a PBX telephone switchboard embodying the invention.

It is believed the invention will be best understood from a description of the operation of a switchboard constructed in accordance therewith which is shown as having two local subscribers' lines L_1 and L_2 and a trunk line T which extends to a distant central office.

Local connection

It will be first assumed that a subscriber (not shown) connected to line L_1 calls, by lifting his receiver from the hook in the usual manner, whereupon the line relay LR_1 operates in an obvious circuit including the subscriber's telephone set. This causes the line lamp LL_1 to become lighted in a circuit which may be traced from battery, winding of the auxiliary signal relay 1, contacts 2 of key K_1 ,

contact 3 of relay LR_1 , contact 4 of the sleeve relay 5 and lamp LL_1 to ground.

The switchboard attendant upon noting the lighted lamp answers by operating the key K_1 to the right or talking position, thereby extinguishing lamp LL_1 by opening, at contacts 2, its previously traced energizing circuit. The operator's set OT is also bridged across the line.

If it is assumed that the calling subscriber desires connection with another local subscriber reached over line L_2 , the attendant inserts plug P_1 of the cord associated with the calling line in the jack J_2 associated with the line L_2 and operates the key K_2 of the called line to the left or ringing position, whereupon ringing current from the source 6 is connected to the line L_2 to actuate the bell at the called subscriber's station.

When plug P_1 was inserted in jack J_2 a circuit including supervisory lamp SL_2 of line L_2 was closed, which circuit can be traced from battery, lamp SL_2 , sleeve contacts of the jack and plug, upper and lower resistance winding of relay 5 and the lower normal contacts of supervisory relay 7 to ground. Relay 5 operates in this circuit and, at contacts 4, opens at a second point the previously traced circuit for lamp LL_1 and prepares at contacts 9 an auxiliary path for lighting lamp LL_1 when the line relay LR_1 releases.

It will be noted that until the called subscriber answers the lower winding of relay 5, which is of a relatively high resistance, is short-circuited by the ground on the armature of relay 7 and consequently lamp SL_2 lights in the previously traced circuit for the reason that the upper winding of relay 5 is of relatively low resistance, thereby permitting sufficient current to flow to effect proper brilliancy.

Lamp SL_2 continues to burn until the called subscriber answers by lifting his receiver from the hook, whereupon the supervisory relay 7 operates in an obvious circuit, thereby removing the short circuit from the high resistance winding of relay 5. This causes a considerable increase in the resistance of the circuit of lamp SL_2 and reduces the current flow to such a point that the lamp

is substantially extinguished, that is, the filament is not heated sufficiently to cause it to glow. Relay 5, however, remains operated by the current flowing through its two windings in series.

When lamp SL_2 ceases to glow it signals the attendant that the called subscriber has answered.

When the calling subscriber hangs up, before the plug is removed from the jack, line relay LR_1 releases, thereby closing the circuit, for again lighting lamp LL_1 , which was prepared when relay 5 operated. It will thus be noted that the lamp LL_1 which first served as a line signal, later serves as a supervisory signal.

When the called subscriber hangs up, supervisory relay 7 releases again, short-circuiting the high resistance winding of relay 5, thereby causing an increase in the sleeve circuit current which causes the lamp SL_2 to light once more, this time as a signal that the called subscriber has hung up.

If, however, the calling or called subscribers desire to attract the attention of the switchboard attendant, it is only necessary to move their switchhook down and up a few times in the usual manner, thereby alternately releasing and operating either relay LR_1 or 7 as the case may be, which will cause the associated lamp LL_1 or SL_2 to flash.

Upon noting that both lamps LL_1 and SL_2 are lighted, the attendant removes plug P_1 from the jack, whereupon the circuit restores to normal.

Trunk connection

It will now be assumed that the local subscriber on line L_1 wishes to be connected with a distant central office subscriber, reached over the trunk line T. In this case instead of establishing the connection by means of the calling line plug P_1 , the attendant reverses the process and inserts the trunk plug TP in jack J_1 of the calling line, thereby extending the calling subscriber's line through to the central office over trunk T which causes the line signal thereat to be displayed in the usual manner and at the same time energizes the trunk supervisory relay TS, which removes the normal short-circuit around the lower and high resistance winding of the sleeve relay 10, thereby increasing the resistance of the sleeve circuit including the lamp SL_1 of the calling line to such a value that the lamp will not receive sufficient current to light.

When the trunk plug was inserted in the jack J_1 the spring contacts of the jack were opened, thereby cutting off the terminal apparatus of the line and preventing interference with the connection if the plug P_1 should be accidentally plugged into another line.

When the conversation is completed and the calling subscriber hangs up, the trunk supervisory relay TS releases, thereby re-

storing the short-circuit around the high resistance winding of relay 10, thus decreasing the resistance of the sleeve circuit and lighting supervisory lamp SL_1 of the calling line. The calling subscriber can attract the attendant's attention in the usual manner by flashing the switchhook, which will alternately release and operate relay TS, which results in flashing lamp SL_1 .

If it be assumed that a call arrives over the trunk line T for a local subscriber of line L_1 , the operation will be as follows. When the central office operator connects with the trunk and rings in the usual manner, the ring-up or line relay TR operates, thereby completing an obvious circuit for the line lamp TL to battery through the auxiliary signal relay 1. When relay TR operates, it locks up at its inner contacts to ground at contacts of relay 10, thereby maintaining the line signal or lamp TL lighted after the ringing impulse has ceased.

The switch board attendant noting the line signal answers by releasing the trunk key TK to the middle or trunk talking position, thereby bridging her telephone set OT across the trunk in an obvious circuit. Release of TK opens, at contacts 11, the previously traced locking circuit for relay TR which deenergizes and extinguishes the trunk lamp TL.

The attendant then converses with the calling operator or exchange subscriber and upon learning that a station on local line L_1 is desired, plugs the trunk plug TP into the jack J_1 , as in the previous case, restores the trunk key from the "talk" to the upper or normal position and rings the desired subscriber by operating the key K_1 to the left or ringing position. When the plug is inserted in the jack, supervisory lamp SL_1 of the line is lighted in the low resistance sleeve circuit which includes the upper winding of relay 10 only, the lower and high resistance winding being short-circuited by the back contact of trunk supervisory relay TS which is not yet operated due to the fact that the called subscriber has not answered.

When the called subscriber answers, supervisory relay TS of the trunk operates, thereby removing the short-circuit from the lower winding of relay 10 which increases the sleeve circuit resistance sufficiently to extinguish the lamp SL_1 , which indicates to the attendant that the calling and called stations are in communication.

Should the line wanted be busy, the attendant may disconnect her telephone set from the trunk for the purpose of listening in on the established connection, or, under certain conditions, break in and notify the wanted subscriber that a trunk call is waiting. In this case the trunk call is held by connecting an impedance bridge across the trunk, when the attendant's telephone is disconnected,

which prevents giving the central office operator a disconnect signal at this time. This is accomplished by operating the trunk key TK downward to the "hold" position, thereby bridging the impedance coil 12 across the calling trunk.

As soon as the called line becomes idle, the attendant may plug the trunk into the jack and ring in the usual manner. In practice, the holding bridge will not be removed until the attendant reconnects her telephone with the trunk by operating TK to the middle or trunk talking position, or until the called subscriber answers, at which time the key TK may be restored to the upper or normal position.

The sequence of operation from this point on is the same as previously described for the case in which the station on line L_1 was calling.

From the foregoing it will be noted that each local line has two lamp signals, one associated with the jack sleeve and indicated as SL_2 , for example, which serves only as a supervisory signal for its associated line L_2 when this line is the called line, but which performs no function if its associated line is the calling line. The other lamp signal, associated with the cord and line circuit apparatus and indicated, for example, as LL_1 in association with line L_1 , serves two functions, one as a line signal when its associated line initiates a call and later as a supervisory signal therefor when the calling line is connected to the called line.

What is claimed is:

1. In a telephone system, a line, means for extending said line into connection with other lines, means for extending other lines into connection with said line, a signal device individual to said line responsive to the initiation of a call thereover, means responsive to said first means for disabling said signal device as a calling signal and rendering said signal device responsive to supervisory signals from said line, a second signal device individual to said line, and means responsive to said second means for rendering said second signal device responsive to supervisory signals from said line.

2. In a telephone system, a switchboard, a calling and a called line terminating thereat, means for interconnecting said lines for conversation, first and second signal devices associated with each of said lines, means associated with said calling line to cause display of its first signal device in response to the call, other means for retiring said signal when the calling line is connected to the called line and for conditioning it to function as a calling supervisory signal thereafter, and a third means, associated with the calling line, for controlling the second signal associated with the called line, as a called

supervisory signal, when said lines are interconnected.

3. In a telephone system, a plurality of lines each terminating in both a calling and a called terminal and so arranged that a called terminal of one line may be engaged by a calling terminal of another line for establishing conversational connection between said lines, a signal device individual to each of said lines responsive to initiation of calls thereover, means responsive to connection of a calling line to another line for disabling said device as a calling signal and for conditioning it to thereafter respond to supervisory signals from said calling line and a second signal device individual to each line responsive to supervisory signals from their associated lines when the called terminals of said lines are engaged by calling terminals.

4. In a telephone system, a switchboard, a calling and a called line terminating thereat in both a plug and a jack, means comprising the plug of the calling line and the jack of the called line for connecting said lines for conversation, a signal device associated with the calling line responsive to a call incoming thereover, relay means in the calling line for retiring said line signal in response to association of said calling line plug with the called line jack and for conditioning it to respond thereafter to supervisory signal impulses incoming over said calling line, a signal device associated with the called line and second relay means in said calling line responsive to supervisory impulses from the called line for controlling said called line signal device.

5. In a telephone system, a first line, a second line, means for extending said first line into connection with the second line, a relay and a signal device controlled thereby individual to said first line and responsive to the initiation of a call thereover, means responsive to said first means for disabling said device as a calling signal and for conditioning it to function thereafter as a supervisory signal for said first line, a signal device individual to said second line and a second relay individual to said first line responsive to supervisory signal impulses from said second line for controlling the device of said second line.

6. In a telephone system, a line, means for extending said line into connection with other lines, means for extending other lines into connection with said line, a signal device individual to said line responsive to the initiation of a call thereover, means responsive to said first means for disabling said signaling device as a calling signal and rendering said signal device responsive to supervisory signal impulses from said line, a second signal device individual to said line, means responsive to said second means for rendering said second signal device responsive to supervisory signals from said line, and

other means responsive to said second means for rendering said first mentioned device unresponsive to signals from said line.

5 7. In a telephone system, a switchboard, a plurality of lines terminating thereat, means for interconnecting said lines for conversation, first and second signal devices associated with each of said lines, said first signal devices functioning as line signals when their
10 associated lines are calling lines and as calling supervisory signals after the calling lines are connected to called lines and said second signal devices functioning as called supervisory signals when their associated lines
15 are called lines.

In witness whereof, I hereunto subscribe my name this 19th day of March, 1929.

GERALD V. KING.

20

25

30

35

40

45

50

55

60

65