INCOMING TRUNKS

ARRANGED FOR

STRAIGHTFORWARD OPERATION

GENERAL INSTALLATION ENGINEER

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PREFACE

This pamphlet is issued for the benefit of the Western Electric installer and describes in a general way the operation of incoming trunks arranged for straightforward operation. No attempt is made to describe all the miscellaneous features of the various circuits, but sufficient information is given so that a general understanding of the circuit operation may be obtained.

It is thought that this information will assist in the training of personnel for the straightforward trunking installation program as an understanding of the operation of the circuits as a whole will facilitate the analyzation of the individual circuit drawings during installation and test.

The contents of this pamphlet are taken from a bulletin issued by the Plant Department of the New York Telephone Company. The information given herein is of a purely descriptive nature and is not designed to prescribe methods or instructions for the installation or maintenance of the equipment described. This maintenance and installation information should be obtained from the job drawings and specifications supplemented by handbooks and other information issued specifically for this purpose.

While particular types of equipment are discussed, this publication will not be reissued in the event of a change in this equipment. If a change is of sufficient importance or general interest to warrant it, a new pamphlet will be written.

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INCOMING TRUNKS ARRANGED FOR STRAIGHTFORWARD OPERATION

GENERAL DESCRIPTION

The term "straightforward" is applied to a type of trunk which has been developed to improve the method of handling calls over central office trunks. The use of straightforward trunks results in greater efficiency in trunking calls between "A" and "B" boards than can be obtained by the use of the present call circuit trunks.

The fundamental difference between a call circuit trunk and a straightforward trunk is as follows:

Call Circuit Trunk: When a call circuit trunk is used, the number called is passed by the "A" operator to the "B" operator over a separate circuit, known as a call circuit. The trunk to be used for the connection is then assigned by the "B" operator.

Straightforward Trunk: When a straightforward trunk is used, the number called is passed by the "A" operator to the "B" operator over the trunk to be used for the connection. In this case the trunk used is selected by the "A" operator. The call circuit is, therefore, not required.

It will be noted from the above comparison that the straightforward method entirely eliminates the call circuit. This has several advantages, among which are: elimination of interference between "A" operators, who use the same call circuit (each call circuit is multipled to a large number of "A" positions); the clearing of the keyshelf of the large number of call circuit buttons (in large central office districts the number of buttons required is above one hundred); the service rendered to subscribers is somewhat improved.

Straightforward trunks are divided into three classes, known as:

1. Key Listening.
2. Automatic Listening.
3. Jack Listening.

KEY LISTENING STRAIGHTFORWARD TRUNKS

General Operation

This class of straightforward trunks is so called because each trunk has a key associated with it at the "B" board which must be operated before the "B" operator can be connected to it to receive the number of the line being called.

Of the several types of key listening straightforward trunks, which differ mainly in the operation of their lamp signals, the CITS (Call Indicator Temporarily Straightforward) trunks only will be considered herein.

The key listening straightforward operation of a CITS position, is as follows:

"A" Board

A call is answered in the usual way by an "A" operator plugging an answering cord into the calling subscriber's answering jack. After the "A" operator has received the subscriber's order, she leaves the listening key operated and, using the associated calling cord, tests in the usual way for an idle outgoing trunk, to the office in which the called subscriber is located, by touching the tip of the cord to the sleeves of the outgoing trunk multiple jacks. Having selected an idle trunk and plugged the calling cord into it, the "A" operator waits on the connection for momentary tone signals signifying that the "B" operator's telephone set has been connected to the trunk. The "A" operator then tells the "B" operator the number called. The calling party, waiting for the connection, can hear the number passed and can correct it if necessary. The "A" operator restores the listening key and then handles the call in the same manner as for call circuit trunks. When the called subscriber answers, the supervisory lamp of the cord connected to the trunk is extinguished.

"B" Board

A key listening straightforward trunk terminates at the "B" board in a cord and plug associated with which are an assignment lamp, a disconnect lamp and a key, all located in the keyshelf at the "B" board. The relays associated with the trunk are located on the relay rack in the terminal room.

When a cord is plugged into a trunk at the "A" board, the assignment lamp of this trunk is lighted at the "B" board, thus indicating to the "B" operator that a call is waiting on that trunk.

The "B" operator operates a key associated with the lighted assignment lamp. This—

1. Connects her telephone set to the trunk.

2. Sends momentary tone signals over the trunk to the "A" board so that the "A" operator will know that the "B" operator is ready to receive the order.

3. Changes the steady assignment lamp to a flashing signal to show the "B" operator which trunk she is connected to in case she should forget which key she had depressed.

After the operator learns the number wanted, she tests the called line in the usual way by touching the tip of the plug to the sleeve of the called line multiple jack. If the line is idle, she inserts the plug in the multiple jack and the ringing starts automatically. If the line is busy, she inserts the plug in the busy back jack which returns a busy tone to the calling subscriber and flashes the supervisory lamp at the "A" board.

Insertion of the plug into any working jack extinguishes the flashing assignment lamp and disconnects the "B" operator from the trunk. The operator is now ready to take up a call on another trunk.

Although both subscribers control supervisory signals at the "A" board, neither subscriber has any control over the disconnect signal associated with the trunk at the "B" board. This signal is entirely controlled by the "A" operator.

The "A" operator disconnects from the trunk by removing the calling cord from the trunk jack. This causes the disconnect lamp to light. The "B" operator removes the trunk cord, extinguishing the disconnect lamp. Should the "B" operator fail to remove the cord before the trunk is selected for another call, the assignment lamp will relight together with the disconnect lamp, but ringing current will not be placed on the trunk. In such a case the operator must remove the cord, extinguishing the disconnect lamp, otherwise her telephone set will not be connected to the trunk when the key is depressed.

Several assignment lamps may be lighted simultaneously, each indicating a call waiting on the associated trunk but only one trunk can be connected to the operator's set at a time. In order to facilitate handling calls when traffic is heavy, the equipment may be arranged to permit the operator to overlap her calls, that is, operate a second key to disconnect her set from a trunk to which she is connected and cause her set to be connected to the second while she is completing the connection for the first trunk. It is necessary for the operator to remember the number wanted on the first trunk until she completes that connection.

Detailed Circuit Operation

The detailed circuit operation of a call indicator trunk temporarily arranged for straightforward operation is given below. The operation of other types of key listening incoming trunks differs somewhat in detail, but this description will serve as an example.

Assignment

When an operator plugs a cord into a trunk at the "A" board, the ground on the tip of the cord is connected to the tip side of the trunk. This causes the RS relay in the trunk (see Drawing A) to operate over the following circuit: battery through winding of the RS relay, normal contacts of the S-1 relay, 1-2 winding of the repeating coil, normal contacts of the I relay, tip trunk conductor to ground through the tip of the "A" board cord circuit.

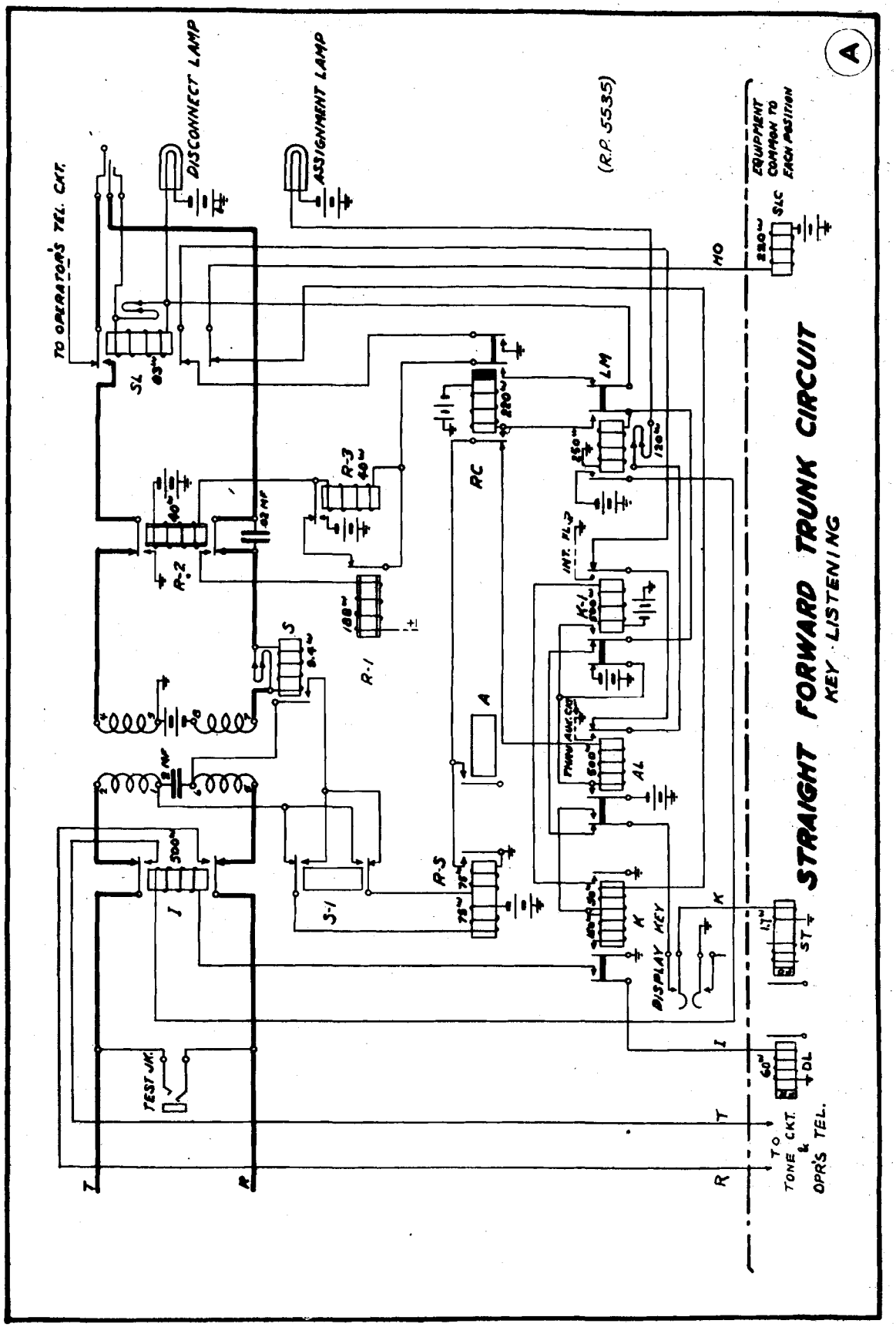
The operation of the RS relay causes the AL relay to operate as follows: ground, operated contacts of the RS relay, normal contacts of the RC relay, winding of the AL relay, normal contacts of the K-1 relay to battery. When the AL relay operates it locks up from battery through its own contacts to ground at RS relay. The AL operated, lights the assignment lamp steadily: battery through the assignment lamp, through the 120 ohm non-inductive winding of the LM relay, through the operated contacts of the AL relay, through the night alarm circuit to ground. The night alarm circuit is provided with a pilot lamp which is also lighted whenever any assignment lamp is lighted on the position.

The lighting of the assignment lamp indicates to the operator that a call is waiting on that particular trunk.

Taking Up Trunk

When the operator depresses the display key, a circuit is closed as follows: battery through the winding of the SLC relay, over the HO lead (which is common to all trunks on the position), normal contact of the SL relay, 50 ohm winding of the K relay, operated contacts of the AL relay, operated contacts of the key, over the common K lead, winding of the ST relay to ground. This operates the SLC, K and ST relays in series. The K relay locks up from ground over its own contact and through both windings in series with the winding of the SLC relay to battery.

The SLC relay, when operated, closes a circuit from ground to an interrupter used to flash the assignment lamp.



When the K relay operates, it closes a circuit from ground, through the winding of the K-1 to battery, operating the K-1. The K-1 in operating, opens a circuit from battery at its normal contact, thus opening the operating but not the locking circuit of the AL relay and closes a circuit to operate the LM relay from battery on the operated contact of the AL, through the operated contacts of the K-1, winding of the LM to ground. The LM in operating, places the RC relay in series with the 250 ohm winding of the LM (battery through the winding of the RC, operated contact and winding of the LM to ground). The RC will not operate, however, as it is shunted out by the battery through the operated contact of the AL relay, through the operated contacts of the K-1, through the operated contacts of the LM, to the winding of the RC relay. The LM operated, closes a circuit from battery through the operated contacts of the LM relay, winding of the I relay, through the operated contacts of the K relay, over the I lead to ground through the winding of the DL relay. This circuit operates the I and DL relays in series.

The operation of the I relay transfers the trunk conductors from the trunk circuit proper to the T and R leads of the position circuit.

The operation of the DL relay, in conjunction with the operation of the ST relay (operated in series with the SLC and K relays when the key was depressed) arranges the position circuit so that the T and R leads are momentarily connected to a tone circuit and then to the operator's telephone set.

When the I relay operated and transferred the trunk conductors from the trunk proper to the T and R leads, the circuit of the RS relay was opened and the RS relay released. The release of the RS opens the circuit to, and releases, the AL relay. The release of the AL changes the circuit of the assignment lamp from a steady ground through the night alarm circuit to an interrupted ground through the normal contacts of the AL, operated contacts of the K-1, thus causing the assignment lamp to flash.

The release of the AL also allows the RC to operate in series with the LM by opening the circuit, described above, that is shunting the RC relay.

The "B" operator is now connected to the trunk and the relays in the trunk circuit that are now operated are the K, K-1, SLC, LM, RC and I.

Completing Connection

After the "B" operator has received the order from the "A" operator over the trunk, she picks up the cord and tests the multiple jack of the line called in the usual way. When the cord is plugged into the jack, the SL relay operates (battery through the disconnect lamp, windings of the SL relay to ground on the sleeve of the jack).

The SL relay has a non-inductive winding connected in parallel with the inductive winding. This non-inductive winding provides a means by which the energy of the surge or "kick" of the inductive winding is dissipated so that it cannot be felt at the exposed sleeve of the cord when the plug is removed from the jack.

The operation of the SL relay opens the circuit of the HO lead, thereby releasing the K relay. The release of the K causes the release of the I relay, which transfers the trunk conductors from the operator's telephone set back to the trunk circuit proper, reoperating the RS relay. The release of the K relay releases the K-1, which opens the circuit of the assignment lamp. The RS relay when operated, closes a circuit from ground to hold the RC operated. This ground also shunts out and releases the LM relay.

Ringing

With the RC relay operated and the LM relay released, a circuit to operate the R-2 relay is closed as follows: , battery through the winding of the R-2 relay, normal contacts of the R-3 and R-1 relays, operated contacts of the RC, normal contacts of the LM, through the windings of the SL relay to ground on the sleeve of the jack. The normal contacts of the R-1 relay shunt out the winding of the R-3. The 40 ohm winding of the R-2 relay shunts out the disconnect lamp.

When the R-2 relay operated, it connected the ringing leads to the ring and tip of the cord. A circuit is now closed from the ringing lead, through the winding of the R-1 relay, through the operated contacts of the R-2 relay, ring of the cord to the ring side of line, through the subscriber's bell, tip side of line, tip of cord, operated contacts of the SL and R-2 relays to ground. This rings the subscriber's bell, but not enough current flows to operate the R-1 relay. The low capacity condenser wired across the contacts of the R-2 relay gives an audible ringing signal to the calling subscriber.

When the subscriber answers, the removal of the receiver from the switch hook increases the current flow, thereby operating the R-1 relay. The operation of the R-1 removes the shunt from around the winding of the R-3, which operates and locks up to battery on its contact. This battery on the contact shunts out the R-2, which releases.

The disconnect lamp is now shunted out by the 40 ohm winding of the R-3 relay.

Talking

The release of the R-2 relay opens the circuit of the ringing leads and connects battery and ground through the repeating coil to the ring and tip of the cord. The removal of the receiver from the hook at the called station causes the S relay to operate. The operation of the S relay closes a circuit from ground through the winding of the RS relay, normal contacts of the S-1, operated contacts of the S relay, through 6-5 winding of the repeating coil, normal contacts of the I relay, ring conductor of trunk, through the supervisory relay in the "A" board cord to battery. This circuit extinguishes the supervisory signal of the cord connected to the trunk at the "A" board.

The following relays are now operated and remain operated during conversation:

SL, RS, RC, R-3 and S.

The called party has no control over the disconnect signal. When the receiver is replaced on the switch hook at the called station, the S relay is released. This opens the circuit from ground to the ring conductor of the trunk, causing the supervisory signal of the "A" board cord to light.

Disconnection

When the "A" operator removes the cord from the trunk jack, the RS relay releases and in so doing, releases the RC. The RC relay opens the circuit of the R-3, causing it to release. This removes the shunt from the disconnect lamp, causing the lamp to light.

The "B" operator removes the trunk cord from the jack, opening the sleeve circuit of the cord. This extinguishes the disconnect lamp and releases the SL relay. The release of the S relay may be caused by the removal of the plug or by the called station replacing the receiver on the switch hook. With the removal of the plug, all apparatus is normal.

Double Lamp Signal

When the "A" operator disconnects from the trunk, the disconnect lamp will be lighted at the "B" board. The disconnect lamp once lighted, will remain lighted until the cord is removed from the jack. Should the trunk be again plugged into for a new call before the "B" operator removes the cord from the jack, the assignment lamp will be relighted, but the ringing will not be placed on the trunk. In order that the "B" operator may connect her telephone set to the trunk for the new call, she must remove the cord from the jack before depressing the key for the new call. The removal of the cord extinguishes the disconnect lamp.

The circuit operation is as follows:

When the plug is removed at the "A" board, the RS relay is released. The RS relay releases the RC. The RC released, opens the circuit of the R-3 relay which formed a shunt circuit around the disconnect lamp as explained previously. The disconnect lamp, therefore, is lighted by battery through the lamp, through the windings of the SL relay, over the sleeve of the cord and the sleeve circuit of the called subscriber's line to ground.

When the trunk is again selected, the RS relay is reoperated. The ground on the armature of the RS relay, normal contact of the RC relay, winding of the AL, normal contacts of the K-1 relay to battery, operates the AL relay. The operation of the AL relay relights the assignment lamp.

When the operator removes the cord from the jack, the sleeve circuit of the cord is opened, extinguishing the disconnect lamp and releasing the SL relay. When the SL relay is normal, it closes the circuit of the common HO lead so that when the key is depressed for the new call the operator's set will be connected to the trunk as described previously.

Overlap

It is not necessary for the "B" operator to wait until a call is completed, *i. e.*, for the cord of the trunk to be inserted in a jack, before depressing the key of another trunk. As soon as the operator has learned the number wanted on a trunk, she may depress the key of another trunk on which a call is waiting. This will disconnect the operator from the first trunk and connect her to the second. (It is necessary for the operator to remember the number wanted on the first trunk.) The operator completes that call while she is waiting for the call on the second trunk. This speeds up the handling of calls and is known as "overlapping."

The circuit operation under the above conditions is as follows:

While the operator is connected to the first trunk, the circuit is, of course, the same as described previously for regular operation, *i. e.*, battery from the HO lead, through both windings of the K relay to ground, locking up the K relay, which in turn holds the I relay operated. This connects the operator to the trunk.

When the second key is depressed a circuit is closed from the HO lead, through the normal contact of the SL relay in the second trunk, 50 ohm winding of the second K relay, operated contacts of the key, common K lead to ground through the winding of the ST relay.

As the HO lead is common, the 50 ohm winding of the second K relay is placed in multiple with the first K relay. This is shown schematically in Figure 1.

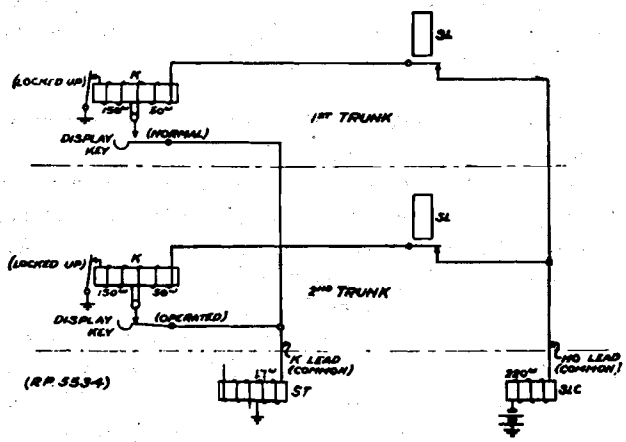


Fig. 1

Under this condition the ST relay and the second K relay will operate and the first K relay will release as it does not receive sufficient current to hold it operated when shunted by the 50 ohm winding of the second K relay in series with the winding of the ST relay.

The release of the K relay of the first trunk releases the I relay which disconnects the operator's telephone set from that trunk. The release of the K relay also releases the K-1. When the K-1 releases it closes a circuit from battery, through the assignment lamp, through the 120 ohm non-inductive resistance of the LM relay, normal contacts of the AL, K-1 and SL relays to ground on the operated contacts of the RC relay. This causes the assignment lamp to change from a flashing signal to a steady light.

The K relay of the second trunk operates and locks up to ground through both windings in series with the SLC relay. The K relay operates the I relay which connects the operator to the second trunk. From this point until the completion of the call, the circuit operation is the same as previously described.

Cut-Off

Should the "B" operator remove the cord from the jack while the trunk is being held by the "A" operator, the RS and RC relays in the trunk will remain operated, but the SL relay will be released. A circuit is then closed from battery, through the assignment lamp, through the 120 ohm non-inductive resistance on the LM relay, normal contacts of the AL, K-1 and SL relays to ground through the operated contacts of the RC relay. This causes the assignment lamp to be lighted steadily.

Should the operator fail to recognize this signal as a cut-off and depress the key as for a new call, the operator will not be connected to the trunk and the assignment lamp will not flash as the circuit of the 50 ohm winding of the K relay, to battery on the HO lead, is open at the AL relay when the AL is normal.

Trunks with steady assignment lights such as mentioned above are connected to the Supervisor's line. The supervisor goes in on the trunk and inquires of the calling subscriber the number called and then completes the connection according to traffic instructions.

AUTOMATIC LISTENING STRAIGHTFORWARD TRUNKS

General Operation

This class of straightforward trunk is so called because the "B" operator is automatically connected to a trunk on which a call is waiting.

"A" Board

The operation at the "A" board is the same as described under Key Listening operation.

"B" Board

An automatic listening straightforward trunk terminates at the "B" board in a cord and plug, associated with which is a trunk lamp which acts as both a guard and a disconnect signal.

When a cord is plugged into a trunk at the "A" board, the trunk lamp at the "B" board lights steadily as a guard signal, indicating a call waiting on the trunk. The circuits are so arranged that the operator's set is automatically connected to the trunk.

This—

1. Sends momentary tone signals over the trunk to the "A" board so that the "A" operator will know that the "B" operator is ready to receive the order.

2. Changes the steady guard lamp to a flashing signal to indicate to the "B" operator the trunk to which she is connected.

After the operator learns the number wanted, she tests the called line in the usual way by touching the tip of the plug to the sleeve of the called line multiple jack. If the line is idle, she inserts the plug in the multiple jack and the ringing starts automatically. If the line is busy, she inserts the plug in the busy back jack, which returns a busy tone to the calling subscriber and flashes the supervisory lamp at the "A" board.

Insertion of the plug into any working jack extinguishes the flashing lamp and disconnects the "B" operator from the trunk. The "B" operator will then be connected to another trunk if any call is waiting.

Several guard lamps may be lighted at the same time, each indicating a call waiting on the associated trunk, but only one trunk can be connected to the operator's set at a time. Each trunk on which a call is waiting will be connected in rotation, the lowest numbered cord first, then the next higher, etc.

In order to facilitate handling calls, each position is provided with a button, called "master release key," mounted on the keyshelf. The operation of the release key permits the operator to overlap her calls, that is, release her telephone set from a trunk to which it is connected and connect it to the next trunk on which a call is waiting while she is completing the connection on the first trunk. If an "A" operator plugs into a trunk but disconnects before the "B" operator is connected to the trunk, the guard signal will remain lighted and the "B" operator will be connected to the trunk in regular sequence as for a call. The "B" operator in such a case may release her set from the trunk by operating the release key.

Although both subscribers control supervisory signals at the "A" board, neither subscriber has any control over the disconnect signal associated with the trunk at the "B" board. This signal is entirely controlled by the "A" operator. When the "A" operator disconnects from the trunk by removing the calling cord from the trunk jack, it causes the lamp associated with the trunk to light as a disconnect signal. The "B" operator removes the cord, extinguishing the disconnect lamp.

Should the operator fail to emove the cord before the trunk is selected for another call, the trunk will be connected to the "B" operator's set in regular sequence and the lamp will flash as soon as the trunk is so connected, regardless of whether or not the trunk is still up in a multiple jack. Under this condition, however, the subscriber will not be re-rung.

Grouping of Trunks

The trunks on each position are arranged in groups of ten which normally are connected together to a "B" operator. Splitting keys (one for each group) are located above the subscribers' multiple at each position and when operated will separate or "split" the automatic listening circuit between the adjacent ten-trunk groups.

All trunks between two splitting keys which have been operated, will be grouped together. By operating splitting keys at different points on the board, it is possible to have operating positions of any number of ten trunk groups. If all splitting keys are normal, all automatic listening trunks will be connected to one "B" operator.

The circuits are so arranged that every ten-trunk group is always connected to some position, *i. e.*, even if the splitting keys are improperly operated, each ten-trunk group will still remain connected to some position circuit.

The operator's telephone set may be plugged into any telephone set jack located between two points where the groups are split. If more than one operator attempts to plug in on the telephone set jacks, however, only the operator plugging in at the left-hand position will be connected.

Emergency Equipment

To take care of the traffic if the automatic listening equipment fails, two emergency circuits consisting of two listening jacks and an emergency key are provided at each position. The emergency key, mounted

above the subscribers' multiple, is a two-way key, which, when operated in either direction, will suspend automatic listening on the position.

When the key is operated in one direction it will connect one of the emergency circuits to the operator's telephone set and when operated in the other direction, it will connect the other emergency circuit to the operator's telephone set.

The two emergency circuits are each multipled to eight positions but two positions should not be connected to one emergency circuit at the same time, *i. e.*, if it is necessary to operate two positions within the section (eight positions) on an emergency basis, one of these positions should be connected to one emergency circuit and the other position to the other emergency circuit.

In the event of failure of the automatic listening circuit of a position to operate properly, the emergency key may be operated. When a guard lamp is lighted, indicating a call waiting, the "B" operator plugs the trunk into the listening jack. This sends momentary tones over the trunk to the "A" operator, as in the case of automatic listening and will connect the trunk to the "B" operator's telephone set. After the "B" operator has received the order from the "A" operator, she removes the trunk from the listening jack and disposes of the call in the usual manner.

Detailed Circuit Operation

For convenience in studying the automatic listening operation, the circuits may be divided into the following groups:

Trunk Circuit.
Sequence Circuit.
Position Circuit.
Splitting Circuit.

Trunk Circuit

Lighting Guard Lamp

When the "A" operator plugs a cord into a trunk at the "A" board, the ground on the tip of the cord is connected to the tip side of the trunk. This causes the BB relay (see Drawing B) to operate over the following circuit: battery through the winding of the BB relay, 1-2 winding of the repeating coil, tip conductor of the trunk to ground through the tip of the "A" board cord circuit.

The operation of the BB relay causes the WO relay to operate (ground through the operated contacts of the BB, through the normal contacts of the DS relay, through the 250 ohm winding of the WO to battery).

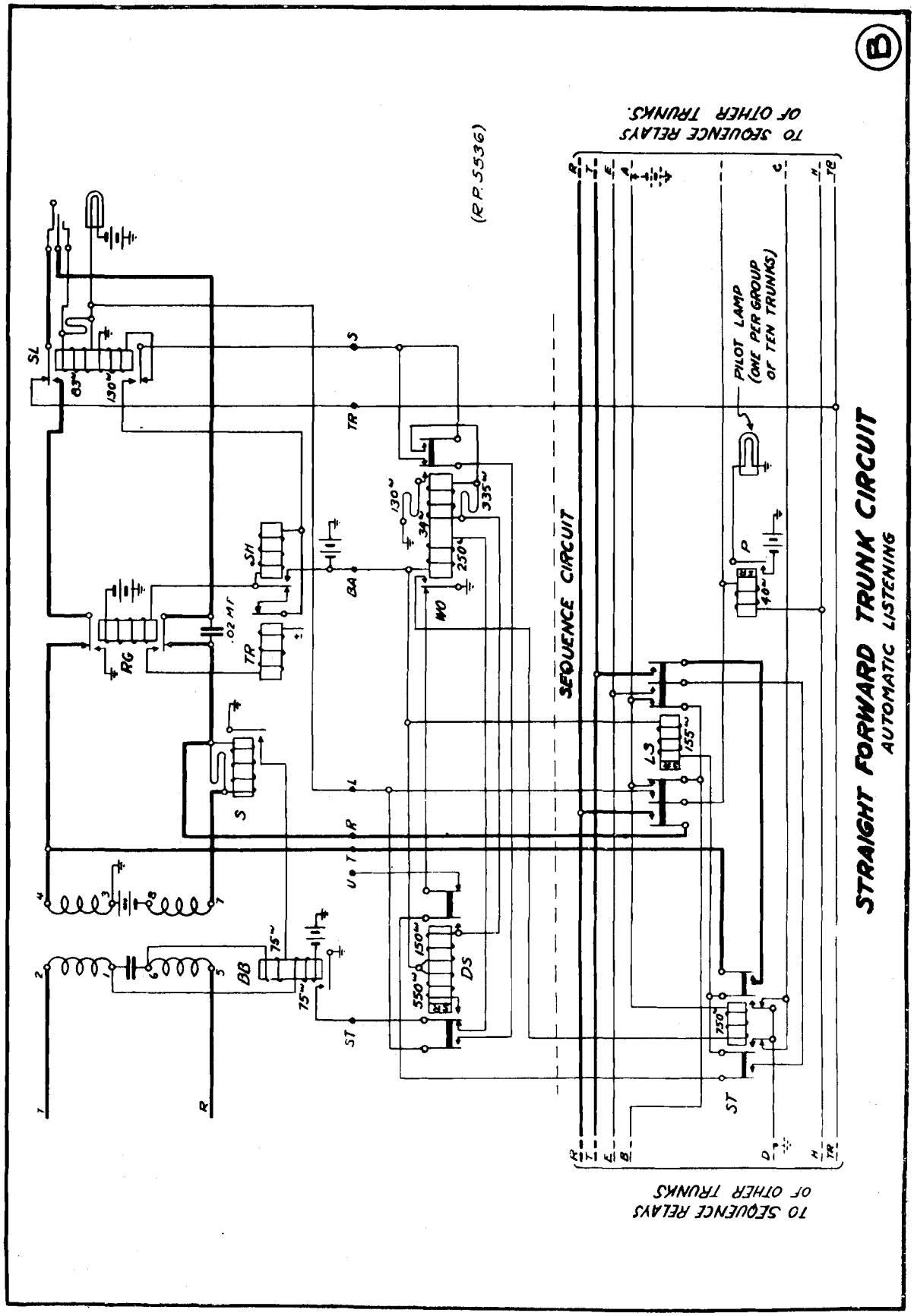
The WO relay operates the DS relay over the following circuit: battery through the 150 ohm winding of the DS relay, through the 34 ohm inductive winding in multiple with the 335 ohm non-inductive winding of the WO relay, through the operated contacts of the WO, through the normal contacts of the SL relay, through a resistance to ground. (In some cases this resistance consists of an extra winding placed for convenience on the SL relay; in other cases the resistance is mounted at a convenient point near the SL relay.) The operation of the DS relay opens the operating circuit of the WO relay, which, however, does not release as it is held operated over the circuit just traced. The DS relay remains locked up under the control of the BB relay (ground through the operated contacts of the BB relay, through the operated contacts of the DS relay, through the 550 ohm winding of the DS relay to battery).

With the DS and WO relays operated, a circuit is closed to light the guard lamp as follows: battery through the guard lamp, through the operated contacts of the DS relay, through the operated contacts of the WO relay, through the 130 ohm non-inductive winding of the WO relay to ground.

Operator Connected to Trunk

Assume that the operator is idle and that there are no other calls on the position.

When the WO relay operates, it closes a circuit which operates the ST relay as follows: ground through the operated contacts of the WO relay, through the winding of the ST relay, to battery on the "A" lead (through the normal contacts of the LS relays of other trunks). The ST relay operates the LS over a circuit which is closed from battery through the winding of the LS, through the operated contacts of the ST, to ground on the "D" lead (through the normal contacts of the ST relays of other trunks).



With the ST and LS relays operated, the T and R leads of the trunk are connected to the T and R leads of the Sequence Circuit, thence through the Splitting Circuit to the operator's telephone circuit; the T lead is connected through the operated contacts of the ST and LS relays and the R lead is connected through the operated contacts of the LS relay. When the R lead is closed through, a circuit from battery, through the winding of the repeating coil and S relay of the trunk to the R lead, is completed. This operates relays in the position circuit which place a momentary tone on the T and R leads. (The S relay in the trunk circuit does not operate due to a high resistance, through which the circuit of the R lead passes in the position circuit.) This tone can be heard at the "A" board end of the trunk, over the tip and ring conductors, through the trunk repeating coil. After the momentary tone signals have passed, the operator's telephone set is connected to the T and R leads which were previously connected to the trunk by the operation of the ST and LS relays.

Flashing Guard Lamp

While the operator is connected to the trunk (LS relay operated), the guard lamp is caused to flash as follows: a circuit is closed from the guard lamp, L lead, through the operated contacts of the LS relay, through the winding of the P relay, over the H lead, through the splitting circuit to battery in the position circuit. This causes a flashing circuit (described later under Position Circuit) to periodically introduce a resistance of 1050 ohms in series with the H lead and battery. When the 1050 ohms is not in the circuit, the battery over the H lead (and through the winding of the P relay) through the operated contacts of the LS relay to the L lead, shunts and extinguishes the guard lamp. Under this condition sufficient current flows through the winding of the P relay, through the operated contacts of the LS and DS relays, through the operated contacts and the 130 ohm non-inductive winding of the WO relay to ground, to operate the P relay and light the pilot lamp. When the 1050 ohm resistance is in the circuit of the H lead, there is not sufficient current in the shunt circuit to shunt out the guard lamp.

Note: The P relay, being slow in releasing, does not release between flashes of the guard lamp, therefore, the pilot lamp remains steadily lighted during the time the operator is connected to a trunk.

Completing Connection

After the "B" operator has received the order from the "A" operator over the trunk, she picks up the cord and tests the multiple jack of the line called in the usual way. When the cord is plugged into the jack, the SL relay operates (battery through the guard lamp, through windings of the SL relay, sleeve of cord, sleeve of jack to ground).

The SL relay has a non-inductive winding connected in parallel with the inductive winding. This non-inductive winding provides a means by which the energy of the surge or "kick" of the inductive winding of the relay is dissipated so that it cannot be felt at the exposed sleeve of the cord when the plug is removed from the jack.

The operation of the SL relay closes the tip of the cord through to the repeating coil and opens the holding circuit of, and releases, the WO relay. The release of the WO releases the ST relay which in turn releases the LS relay. The release of the LS relay disconnects the position circuit from the trunk and opens the flashing circuit between the P relay and the L lead of the trunk, releasing the P relay, thus extinguishing the pilot lamp.

Ringing

With the SL relay operated and the WO relay released, a circuit is closed to operate the RG (ringing) relay as follows: battery through the winding to the RG relay, through the normal contacts of the TR (tripping) relay, through the operated contacts of the SL relay, normal contacts of the WO relay, operated contacts of the DS relay, through the windings of the SL relay, sleeve of cord, sleeve of jack to ground. This circuit also shunts out the guard lamp. When the RG relay operates, it connects ringing current to the ring of the cord. A circuit is now closed from the ringing lead, through the winding of the TR relay, through the operated contacts of the RG relay, ring of the cord to line; through the subscriber's bell, tip side of line, tip of cord, operated contacts of the SL relay, operated contacts of the RG relay to ground. This rings the subscriber's bell, but not enough current flows to operate the TR relay. The condenser which is connected across the contacts of the RG relay allows sufficient ringing current to pass through

the S relay, through the 7-8 windings of the repeating coil, through battery to ground, to give an audible ringing signal to the calling subscriber.

When the subscriber answers, the removal of the receiver from the switchhook causes the TR relay to operate. The operation of the TR relay removes the shunt from around the winding of the SH (shunt) relay, which operates and locks up to battery on its contacts. This battery on the contact shunts out the RG which releases.

The guard lamp is now shunted out by the 40 ohm winding of the SH relay.

Talking

The release of the RG relay opens the circuit of the ringing current and closes through the subscriber's line to the repeating coil. The removal of the receiver from the switchhook at the called station also causes the S relay to operate. The operation of the S relay closes a circuit from ground, through a winding of the BB relay, through 6-5 winding of the repeating coil to the ring conductor of the trunk. This ground causes the supervisory lamp at the "A" board to be extinguished.

Disconnection

When the receiver is replaced on the switchhook at the called station, the S relay is released. This opens the circuit from ground through one winding of the BB relay, through 6-5 winding of the repeating coil, ring conductor of the trunk to the calling cord at the "A" board. This causes the supervisory lamp at the "A" board to light.

When the "A" operator disconnects, the circuit from battery through one winding of the BB relay, through 1-2 winding of the repeating coil, over the tip conductor of the trunk to ground on the tip of the "A" board cord, is opened when the "A" operator removes the plug from the trunk jack. This causes the BB relay to release, which in turn releases the DS.

The release of the DS relay opens the circuit of the SH relay. This releases the SH relay and removes the shunt around the lamp causing the lamp to light as a disconnect signal.

The "B" operator removes the cord from the jack, opening the sleeve circuit of the cord. This extinguishes the disconnect lamp and releases the SL relay. All apparatus associated with the trunk is now normal.

Should the trunk be again plugged into at the "A" board for a new call before the "B" operator removes the cord from the multiple jack, the BB relay will reoperate and cause the WO relay to operate as described under "Lighting Guard Lamp." The WO relay will not operate the DS relay, however, as the circuit to operate the DS relay (battery, through the 150 ohm winding of the DS, through the 34 ohm and 335 ohm windings of the WO relay, through the operated contacts of the WO, to ground through the winding of the SL relay) is open at the contacts of the SL relay, while the SL relay is operated (cord in jack). The trunk lamp is lighted as the shunt circuit around the lamp is open at the DS relay while the DS is normal.

With the WO relay operated, the ST and LS relays will be operated in proper sequence (as explained under Sequence Circuit) and will connect the operator to the trunk regardless of whether or not the cord is up in the multiple jack. When the operator is connected to the trunk, momentary tones will be applied to the trunk and the guard lamp will flash as previously explained. Ringing current will not be applied to the subscriber's line as the circuit to operate the RG relay is open at the contacts of the DS relay.

Cut-Off

Should the "B" operator remove the cord from a jack while the trunk is being held by the "A" operator, the BB and DS relays will remain operated, but the SL relay will be released. A circuit is closed from battery, through the lamp, L lead, operated contacts of the DS relay, normal contacts of the WO relay, S lead, normal contacts and 130 ohm winding of the SL relay to ground. This causes the lamp to be lighted steadily as a guard signal, but the operator will not be connected to the trunk (as the WO relay is normal).

Trunks with steady guards such as mentioned above, are connected to the Supervisor's line.

Overlap

It is not necessary for the "B" operator to wait until a call is completed, *i. e.*, for the cord of the trunk to be inserted in a jack, before she can be connected

to another trunk. As soon as she has learned the number wanted on a trunk, the operator may depress the release key (shown on Position Circuit). This will cause her to be disconnected from the trunk and to be connected to the next higher numbered cord on which a call is waiting (it is necessary for the operator to remember the number wanted on the first trunk). The operator completes the call on the first trunk while connected to the second trunk. This speeds up the handling of calls and is known as "overlapping."

The circuit operation of the trunk is as follows:

While the operator is connected to the first trunk, the BB, DS, WO, ST and LS relays are operated as explained for regular operation of the trunk.

When the operator depresses the release key to overlap, a low resistance ground is placed on the E lead (as will be explained under Position Circuit). This ground shunts out and releases the WO relay as follows: Ground on the E lead, through the operated contacts of the LS relay, through the operated contacts of the ST relay, through the operated contacts of the DS to the holding (34 ohm) winding of the WO relay. The WO will not reoperate when the shunt circuit is opened, since the original operating circuit of the WO relay is open while the DS relay is operated. (The DS relay is held operated by the BB relay, through the 550 ohm winding of the DS.)

The release of the WO relay releases the ST relay, which in turn releases the LS, opening the T and R leads. This disconnects the operator from the trunk and allows the sequence circuit to connect her to another trunk on which a call is waiting. The release of the LS relay also opens the flashing circuit between the P relay and the L lead, so that the trunk lamp is lighted steadily over a circuit from battery through the lamp, through the operated contacts of the DS relay, through the normal contacts of the WO relay, S lead through the normal contacts and the 130 ohm winding of the SL relay to ground. (The SL relay does not operate through its 130 ohm winding.)

When an "A" operator plugs into a trunk but disconnects before the "B" operator is connected to the trunk, the guard signal will remain lighted and the "B" operator will be connected in regular sequence. When the trunk is plugged into at the "A" board, the BB relay will operate but will release when the plug is removed. When the BB relay operated, it operated the WO, which in turn operated the DS as explained under "Lighting Guard Lamp." The WO and DS relays lock up and connect the operator to the trunk and the guard lamp flashes as previously explained.

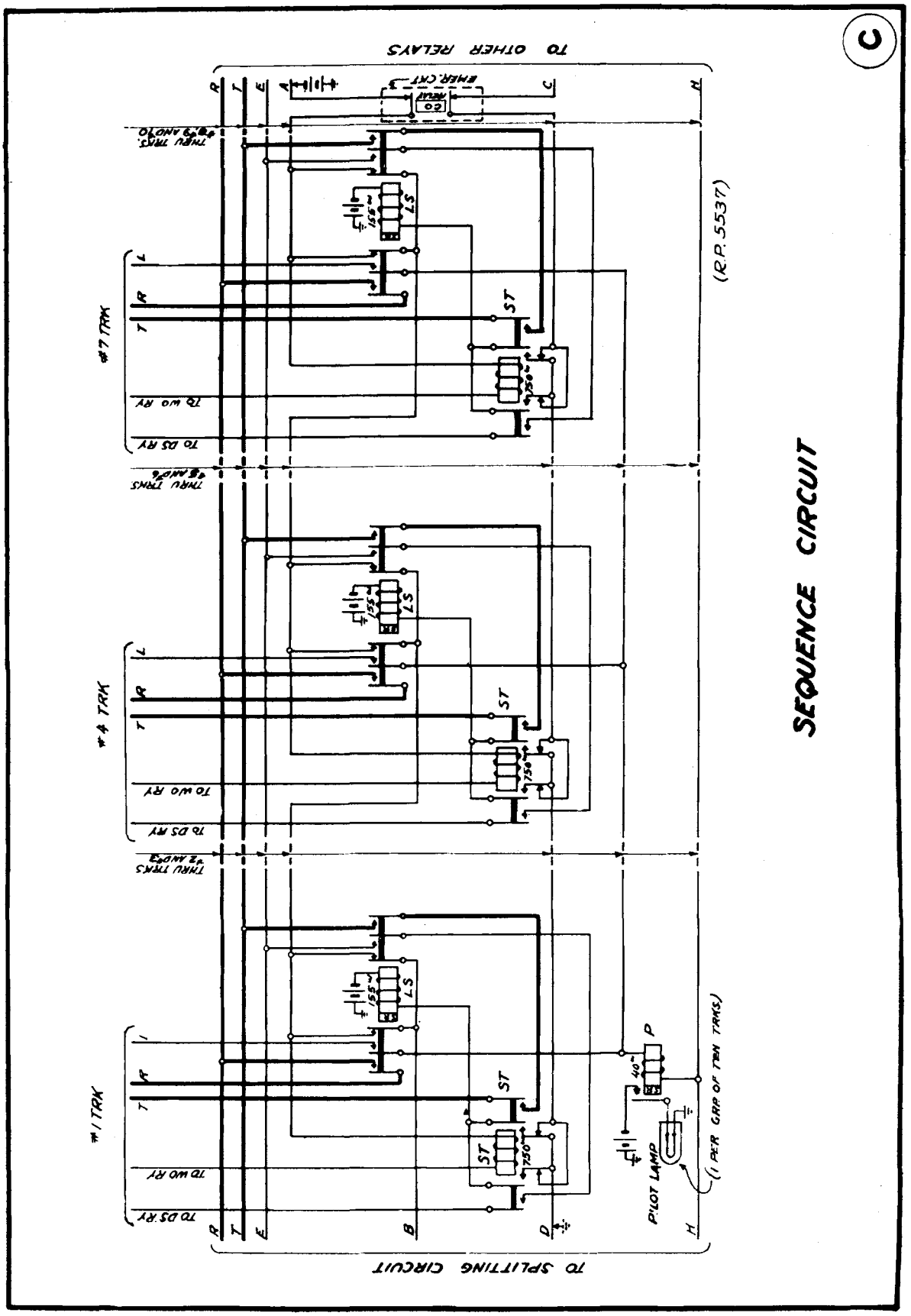
The "B" operator, not receiving an order over the trunk, depresses the release key. This disconnects her from the trunk, as described for overlap operation. The release of the BB relay (when the "A" operator removed the plug) opens the holding circuit through the 550 ohm winding of the DS relay so that when the ground is removed from the E lead, the DS relay will release. The guard lamp is extinguished as its circuit is open at the normal contacts of the DS relay.

Sequence Circuit

As the operator's telephone set can be associated with any trunk, it is evident that the circuits must be arranged so that the operator can be connected to only one trunk at a time. This is accomplished by the Sequence Circuit, so called, because it connects the operator, in sequence, to trunks on which calls are waiting, according to the numerical order in which they are located on the "B" position, regardless of the order in which they are selected by "A" operators. For example, assume that while the operator is connected to No. 4 trunk, a guard signal appears on No. 1 trunk, followed by a guard signal on No. 7 trunk. After the operator is disconnected from No. 4 trunk she will be connected to No. 7. When disconnected from No. 7 she will be connected to No. 1.

The operation of the Sequence Circuit (Drawing C) is as follows:

When trunk No. 4 is selected, the operator is connected to the trunk as follows: The WO relay is operated as explained under "Lighting Guard Lamp" in the trunk circuit description. The WO relay operates the ST over the following circuit: ground through the operated contacts of the WO relay, through the winding of the ST, through the normal contacts of the LS relays of trunks No. 5, No. 6, No. 7, No. 8, No. 9 and No. 10 (which at this time are idle), to the A lead, through the splitting circuit to battery. The ST relay operates and closes a circuit which operates the LS relay as follows: ground through the splitting circuit to the D lead, through the normal contacts of the ST relays of idle trunks No. 1,



No. 2 and No. 3, through the operated contacts of the ST relay of No. 4 trunk, through the winding of the LS relay to battery. The T and R leads of No. 4 trunk are closed through the operated contacts of the ST and LS relays to the position circuit; and the circuit to flash the trunk lamp is closed through from the winding of the P relay to the L lead of the trunk by the operated contacts of the LS relay.

If trunk No. 1 is now selected, the WO relay of the trunk will operate and light the associated guard lamp as described under "Trunk Circuit". However, the WO relay will not operate the ST, as the circuit from ground, through the operated contacts of the WO relay, through the winding of the ST relay, through the normal contacts of the LS relays of No. 2 and No. 3 trunks to battery on the A lead, is open at the operated contacts of the LS relay of No. 4 trunk. When the ST relay is normal, the circuit to operate the LS is open. The T and R leads to the position circuit and the circuit to flash the guard lamp are open at the normal contacts of the LS relay. The operator, therefore, is not connected to No. 1 trunk although a call is waiting on that trunk.

If No. 7 trunk is now selected, the WO relay of this trunk will operate and light the associated guard lamp. The WO relay will also operate the ST (ground through the operated contacts of the WO relay, through the winding of the ST to battery on the A lead). However, the ST relay will not operate the LS relay as the circuit from ground over the D lead to the contacts of the ST relay is open at the operated contacts of the ST relay of No. 4 trunk. The T and R leads to the position and the circuit to flash the guard lamp are open at the normal contacts of the LS relay. The operator, therefore, is not connected to No. 7 trunk, although a call is waiting on that trunk.

When the call on No. 4 trunk is disposed of, the ST and LS relays release as described under "Trunk Circuit". This disconnects the operator from this trunk.

Due to its make-before-break spring combination, the ST relay, when releasing, closes through the D lead before opening the circuit to release the associated LS relay. (The LS relay also has a slow releasing characteristic.) Therefore, as the ST relay of No. 7 trunk is in the operated position, the LS relay of No. 7 trunk will operate and break the continuity of the A lead at its contacts before the LS relay of No. 4 trunk releases and closes the A lead through its normal contacts. This holds open the circuit of the ST relay of No. 1 trunk so that the operator is not connected to No. 1 trunk but is connected to No. 7 trunk by the operation of the LS relay of No. 7 trunk.

It should be noted from the above circuit explanation, that, due to the make-before-break spring combination of the ST relays, the continuity of the D lead remains unbroken while the sequence is progressing (calls waiting on higher-numbered cords).

After the operator is disconnected from No. 7 trunk by the release of the ST and LS relays, the circuit operation of No. 1 trunk is as described under "Trunk Circuit".

Assume another case of the operator being connected to No. 7 trunk while calls are waiting on No. 1 and No. 4 trunks.

From the operation of the sequence circuit just explained, it will be seen that the ST relays of No. 1 and No. 4 trunks will not be operated under this condition. (The operating circuit for the ST relays is open at the operated contacts of the LS relay of No. 7 trunk.) When the operator is disconnected from No. 7 trunk, the continuity of the A lead is broken until the slow releasing LS relay of the trunk has closed through its normal contacts. This delays the operation of the ST relays of No. 1 and No. 4 trunks, resulting in a momentary break in the continuity of the D lead. When the LS relay of No. 7 trunk closes through its normal contacts the continuity of the A lead is completed. This closes the circuit of the ST relays simultaneously and both ST relays will operate.

After disconnection from the highest numbered cord on which a call has been received, the ground on the D lead is removed for a short time by a circuit in the Position Circuit as will be described later. Therefore, after the operator is disconnected from No. 7 trunk, the circuit of the D lead is momentarily opened so that the operation of the ST relays of No. 1 and No. 4 trunks does not operate the associated LS relays. By the time the ground is replaced on the D lead, the ST relay of No. 1 trunk is fully operated and has broken the continuity of the D lead to the ST relay of No. 4 trunk so that the LS relay of this latter trunk will not operate.

This circuit arrangement insures that the operator is connected to trunks on which calls are waiting in the numerical order of the cords beginning with the lowest-numbered cord and proceeding to the highest-numbered, thence dropping back to the lowest-numbered and continuing in this manner as long as calls are waiting.

Position Circuit

During the time the operator's telephone set is plugged into the position, the T relay (shown on Drawing E) and the CA and CB relays (shown on Drawing D) are in the operated position. The circuit to operate these relays may be traced as follows:

The T relay is operated by a circuit which is closed from battery, through the winding of the T relay, through the operator's transmitter, through the primary windings of the induction coil to ground.

The CA and CB relays are connected in multiple and are operated by a circuit which is closed from battery through their respective windings, TC lead, through the operated contacts of the T relay, TP lead, P lead to ground in the splitting circuit.

Connection to Trunk

When the trunk is connected to the position circuit (by the operation of the ST and LS relays of the trunk), a circuit is closed from battery on the BA lead (trunk circuit), through the 150 ohm winding and operated contacts of the DS relay, through the operated contacts of the ST and LS relays, E lead, through the splitting circuit, to the AE lead of the position circuit, through the operated contacts of the CB relay, normal contacts of the KC relay, through the winding of the SR relay, normal contacts of the TF relay to ground. This circuit operates the SR relay, which, when operated, locks up to ground through its own contacts and also prepares a circuit to operate the TF relay after the TE relay has operated, as will be explained later.

When the R lead of the trunk is closed through by the operation of the LS relay in the trunk, the AL relay in the position circuit is operated over the following circuit: battery through the winding of the repeating coil of the trunk, through the windings of the S relay to the R lead of the trunk, through the operated contacts of the LS relay, R lead of the sequence circuit, through the splitting circuit to the AR lead of the position circuit, through the operated contacts of the CA relay, through the winding of the AL relay to ground.

Note: The S relay in the trunk is not operated by this circuit due to the high resistance of the winding of the AL relay.

The AL relay closes a circuit from battery through the winding of the TA relay, through the normal contacts of the TF, through the normal contacts of the PC relay to ground. This operates the TA relay.

Flashing Guard Lamp

When the TA relay operates, it also closes the circuit from the flashing relays FA, FB and FC to the AH lead through the splitting circuit to the H lead of the trunk. When this circuit is closed the FA relay is operated (battery through the winding of the FA, through the normal contacts of the KB, operated contacts of the TA relay, AH lead, through the splitting circuit and over the H lead to ground in the trunk circuit). As the winding of the FA relay has a resistance of 1050 ohms, sufficient current will not flow over the H lead of the trunk to shunt out the guard lamp.

The operation of the FA relay completes a circuit from ground through its operated contacts, through the winding of the FB to battery. This circuit operates the FB after a delay (due to the slow operating characteristics of the relay). The FB closes a circuit from ground through its operated contacts, through the winding of the FC to battery. This circuit operates the FC, which is also slow operating.

While the FC is operated it places a shunt around the winding of the FA. This allows sufficient current to flow over the H lead to shunt out the guard lamp and also causes the FA relay to release. The release of the FA releases the FB which in turn releases the FC. The release of the FC removes the shunt from around the FA and again places the 1050 ohm winding of the FA in the circuit, causing the FA to reoperate.

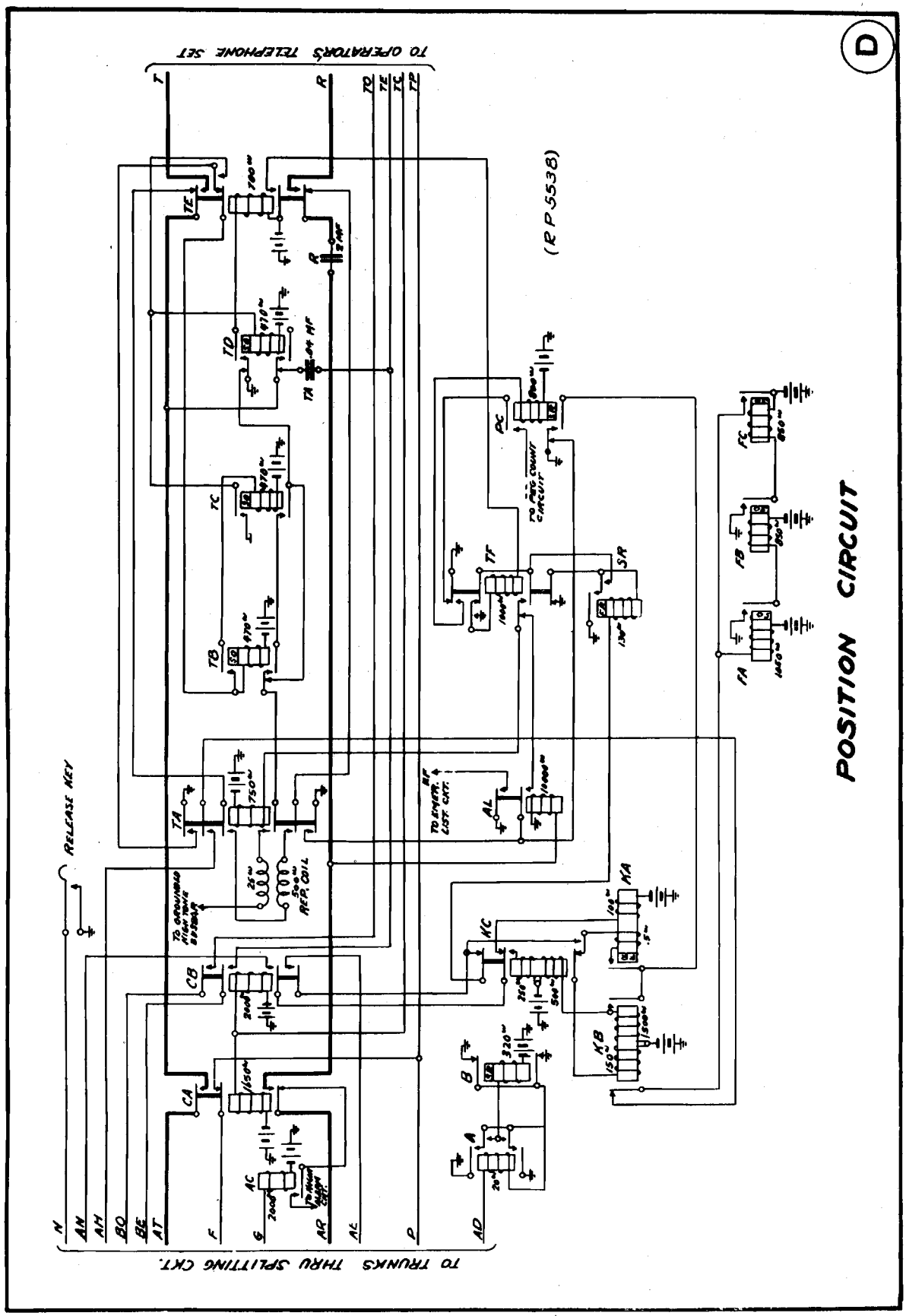
In this manner, battery through the 40 ohm winding of the P relay is periodically introduced in the H lead of the trunk to flash the guard lamp as explained in the trunk circuit description under "Flashing Guard Lamp".

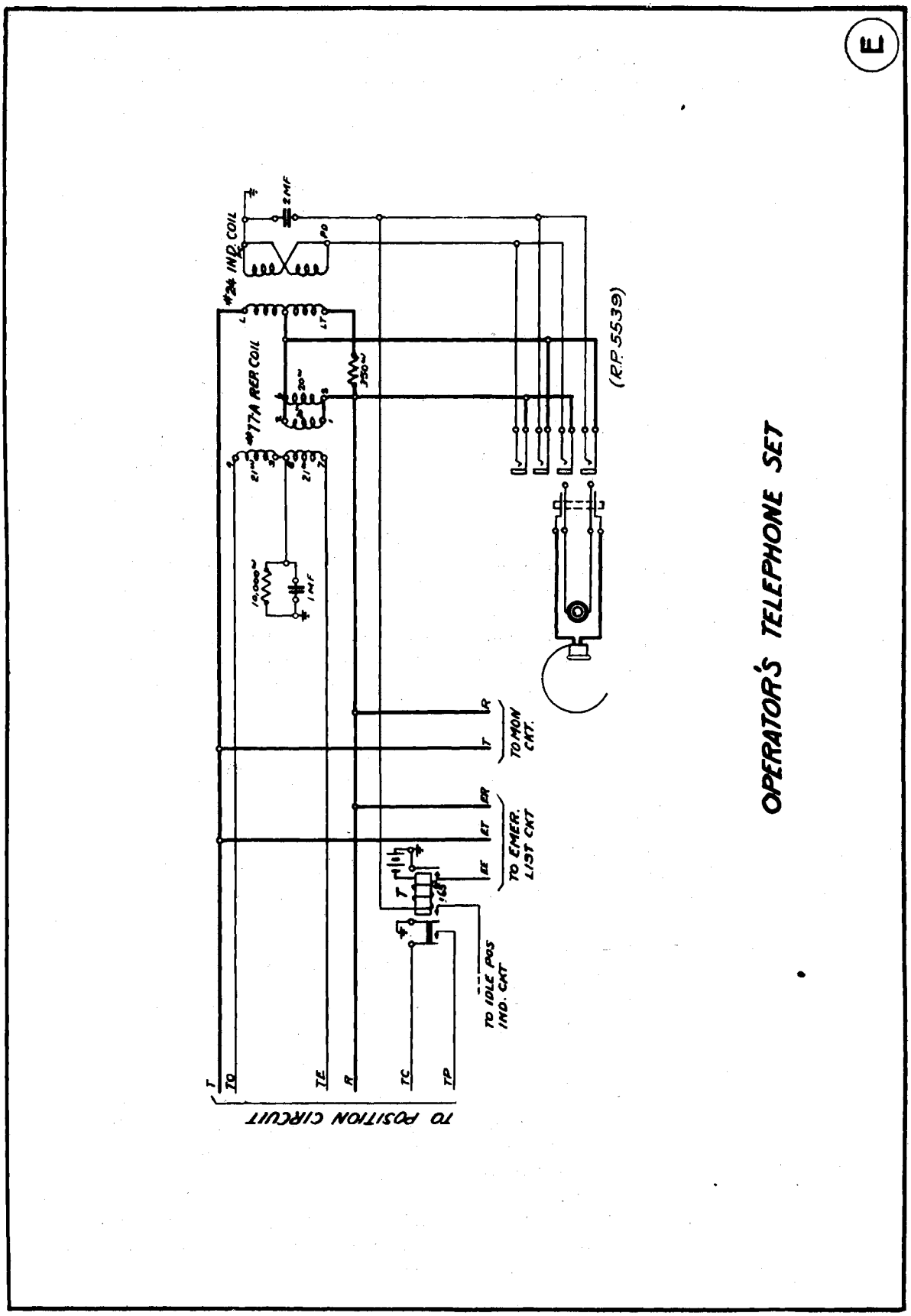
Tone Circuit

When the TA relay operates, it closes a circuit which causes two impulses of tone to be momentarily placed on the trunk as follows:

The secondary (500 ohm) winding of the tone repeating coil is closed through to the AT and AR leads by the operation of the TA relay. (One end of the winding of the repeating coil is connected to the AT lead, through the operated contacts of the TA, normal contacts of the TE and operated contacts of the CA, while the other end of the winding is connected to the AR lead in a similar manner.)

The primary circuit of the repeating coil is also closed through from tone bus bar, through the primary (25 ohm) winding of the repeating coil, operated contacts of the TA relay, normal contacts of the TB, normal contacts of the TD to ground.





The TB relay is operated after a slight delay (due to the slow operating characteristic of the relay) by the following circuit: battery through the winding of the TB, normal contacts of the TE relay, operated contacts of the TA to ground.

The operation of the TB relay opens the primary circuit of the repeating coil (the circuit from the primary of the coil, through the operated contacts of the TA and TB relays, through the normal contacts of the TD relay, is open from ground at the normal contacts of the TC relay).

The TB relay, however, closes a circuit which energizes the slow operating TC relay (battery through the winding of the TC, operated contacts of the TB, normal contacts of the TE to ground through the operated contacts of the TA relay). The TC again closes the primary circuit of the tone repeating coil and closes a circuit which energizes the slow operating TD relay. The operation of the TD relay opens the primary circuit of the repeating coil.

While the primary circuit of the tone repeating coil is closed, a tone is induced in the secondary winding. It will thus be seen that the successive operation of the TA, TB, TC and TD relays places two impulses of tone on the AT and AR leads. The tone is transmitted over the trunk to the "A" board and notifies the "A" operator that the "B" operator is connected to the trunk.

The busy circuit of the operator's telephone set is connected (via the TE lead, through the TA condenser and normal contacts of the TD relay) to the AT lead so that the "B" operator also receives the tone, but with less volume. After the tone impulses have been given, the operation of the TD relay disconnects the busy test circuit from the AT lead.

Connection of Operator's Telephone Set

When the TD relay operates, it closes a circuit to operate the TE relay (ground through the operated contacts of the TD, through the winding of the TE to battery). The operation of the TE relay connects the AT and AR leads respectively to the T and R leads of the operator's telephone set circuit; opens the circuit of, and releases, the TB and TC relays, closes a circuit to hold the TD relay operated under the control of the TA relay (battery through the winding of the TD, through the operated contacts of the TE relay to ground, through the operated contacts of the TA relay); closes the circuit previously mentioned to operate the TF relay (battery through operated contacts of the TE, through the winding of the TF, through the normal contacts of the TF relay to ground, through the operated contacts of the SR relay).

Note: After the TF relay operates, it locks up through its own contacts to ground.

The operation of the TF relay closes a circuit from ground through its operated contacts, through the winding of the PC relay to ground, operating the PC relay and causing the TA relay to be held operated under the control of the SR relay (the circuit of the TA relay now being completed from the relay, through the operated contacts of the TF, through the operated contacts of the SR to ground).

Disconnection from Trunk

If the operator places the trunk, to which she is connected, into a working jack, the ST and LS relays are released as explained under "Completing Connection" in the trunk circuit description. The release of these relays opens the circuit of the E lead (in the trunk circuit; AE lead in the position circuit), causing the SR relay in the position circuit to release. The release of the SR relay opens the circuit of, and releases, the TA. The release of the TA opens the circuit to the flashing relays FA, FB and FC; opens the primary and secondary circuits of the tone repeating coil and opens the holding circuit of the TD relay which in turn releases the TE. The TE releases the TF which opens the circuit of the PC relay. The PC relay, being slow releasing, does not release immediately and during the interval between the release of the TF and the PC relays, a circuit is closed which operates a peg count register.

If the operator releases her set from a trunk by depressing the release key, as in the case of "overlapping," the KA relay is operated over a circuit which is closed from battery through the 100 ohm winding of the KA relay, through the normal contacts of the KC, through the operated contacts of the CB relay to the AN lead, through the splitting circuit to the N lead, to ground through the operated contacts of the release key.

The KA relay operates the KB by closing a circuit from battery through the 150 ohm winding of the KB, through the normal contacts of the KC, through the 0.5 ohm winding of the KA, through the operated contacts of the PC relay to ground. The KB relay locks up through its 1500 ohm winding and operated contacts to ground through the PC relay contacts.

The KB relay, when operated, opens the circuit of the flashing relays FA, FB and FC and causes the KC relay to operate (battery through the 500 ohm winding of the KC, through the operated contacts of the KB to ground through the PC relay contacts).

The operation of the KC relay disconnects the SR relay from the AE lead and substitutes the 0.5 ohm winding of the KA relay. This circuit may be traced from the AE lead, through the operated contacts of the CB relay, operated contacts of the KC relay, through the 0.5 ohm winding of the KA, through the operated contacts of the PC to ground. (The KA relay is held operated by this circuit after the operating circuit through the 100 ohm winding is opened by the operation of the KC relay.) This reduction in resistance of the AE lead (E lead in the trunk circuit) to ground, shunts out and releases the WO relay of the trunk, as explained under "Overlap" in the description of the trunk operation, and disconnects the trunk from the position circuit.

When the SR relay was disconnected from the AE lead, it released and restored the relays in the position circuit to normal as previously explained. When the PC relay releases, it opens the circuit of, and releases, the KB and KC relays.

In order to insure that the operator is connected in proper numerical order to trunks on which calls are waiting, it is necessary to momentarily open the circuit of the D lead (sequence circuit) after the highest numbered cord on which a call has been received is disconnected from the position, as explained in the description of the Sequence Circuit. This is accomplished by the A and B relays in the Position Circuit as follows:

While a trunk is connected to the Position Circuit, the LS relay of the trunk is operated by a circuit which is completed over the D lead, through the Splitting Circuit, AD lead in the position circuit, through the winding of the A relay, through the normal contacts of the B relay to ground. This circuit operates the A relay, which locks up to ground through its own contacts. These contacts also close a circuit which operates the B relay. In this way a circuit from ground to the AD lead is closed through the operated contacts and winding of the A relay which remains locked up as long as the continuity of the AD lead is not broken.

After the highest numbered cord on which a guard signal has been received is disconnected from the position circuit, the continuity of the D lead is interrupted as previously explained in the operation of the Sequence Circuit. This interruption allows the A relay to release. This opens the circuit from the AD lead to ground and also opens the circuit of the B relay, which, however, does not immediately restore to normal due to its slow releasing characteristic. There is no ground on the AD lead, therefore, during the interval between the release of the A relay and the closing of the normal contacts of the B relay. This opening of the AD lead insures that the trunk sequence will always drop back to the lowest numbered cord after all calls on higher numbered cords have been disposed of, as explained in the sequence circuit operation.

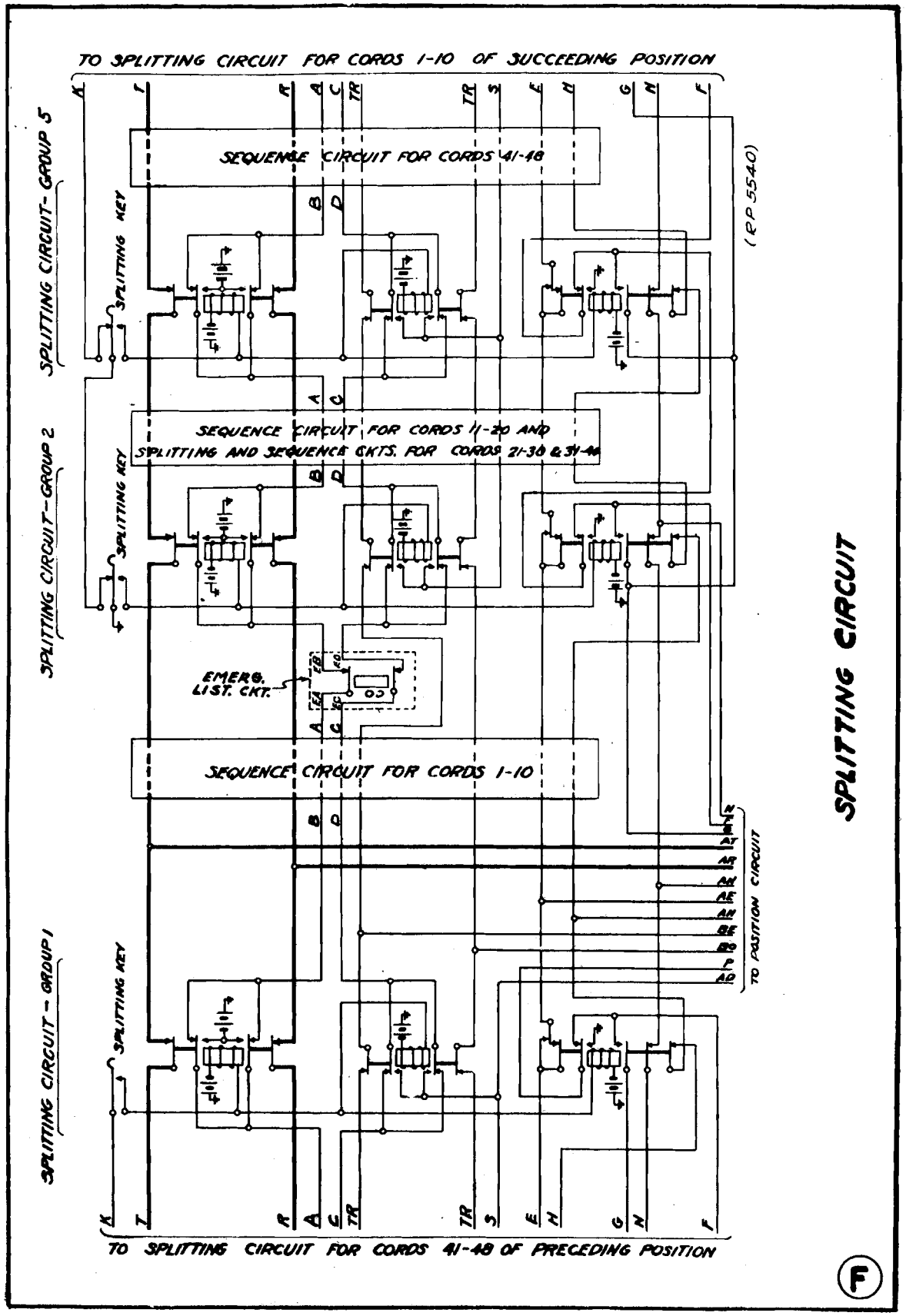
Splitting Circuit

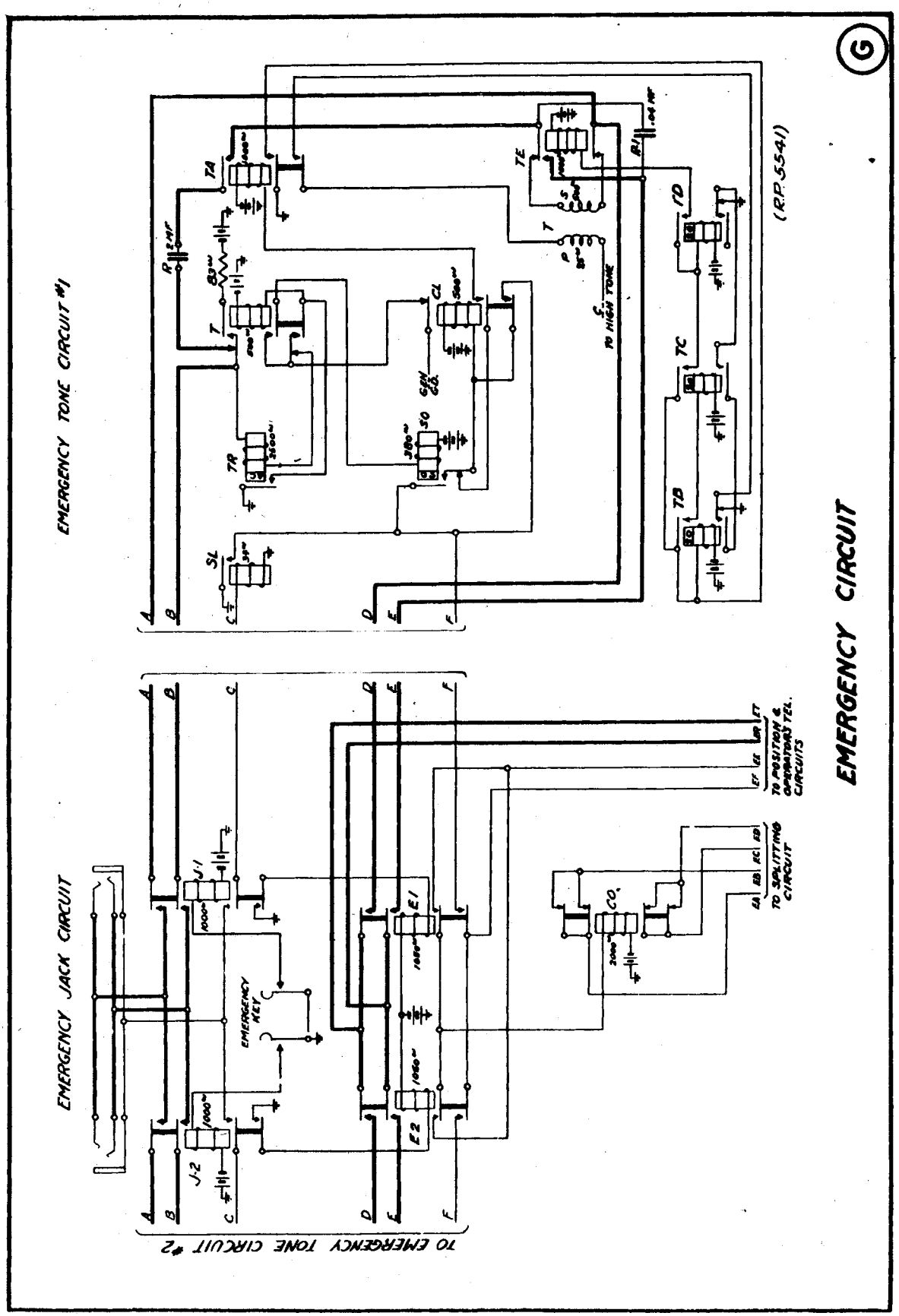
The sequence circuits of each ten-trunk group on a position are normally connected together and the last group of one position is connected to the first group of the succeeding position, so that when no splitting keys are operated, one operator will be connected in sequence to any trunk on any position on which a call is waiting. The sequence in this case being from the lowest-numbered cord on the first position to the highest-numbered cord on that position, then to the lowest-numbered cord on the next position to the highest-numbered cord and so on to the highest-numbered cord on the last position, then dropping back to the lowest-numbered cord on the first position. The operator in this case may be plugged in on any position.

The description of the Sequence Circuit (Drawing C) explained the operation for only three trunks in a ten-trunk group. However, the operation would be the same for any number of ten-trunk groups as long as the continuity of the various leads shown on Drawing C remains unbroken.

This single sequence, combining all trunks into one group and connecting the trunks to only one operator, may be split up into smaller trunk groups, each having its own sequence and operator. This is accomplished by opening the continuity of the various leads between different trunk groups. All trunks between two open points are grouped together.

Drawing F shows how the various leads are opened by means of splitting keys. There is one splitting key for each ten-trunk group, so that the trunks may be separated between any ten-trunk group.





Emergency Circuit

In the event of failure of the automatic listening circuit of any position to function properly, the emergency listening circuit may be used by operating the emergency key. This suspends the automatic listening feature of the position. The "B" operator connects her telephone set to a trunk on which a call is waiting by plugging the trunk into an emergency jack.

When the Emergency key is operated, either the J-1 or J-2 relay (Drawing G) is operated, depending upon the direction in which the key is turned. Assume the key to be turned in the direction to operate the J-1 relay. The operation of the J-1 relay closes through the tip and ring circuits from the springs of the emergency jacks to the emergency tone circuit. The operation of the J-1 relay also closes a circuit which operates the E-1 relay.

The operation of the E-1 relay closes a circuit which operates the CO relay as follows: ground through the operated contacts of the T relay in the Operator's Telephone Set Circuit (Drawing E), over the EE lead, through the operated contacts of the E-1 relay, winding of the CO relay to battery.

The operation of the CO relay opens the A and D leads of the sequence circuit, as shown on Drawing C, thus suspending automatic listening on the position.

When a guard lamp lights on a trunk, the operator inserts the cord in either of the two emergency jacks. The sleeve circuit of the emergency jacks is completed through the operated contacts of the J-1 relay, C lead, through the winding of the SL relay in the tone circuit to ground, so that when the trunk is plugged into the emergency jack, the SL relay in the trunk and the SL relay in the emergency tone circuit both operate.

The operation of the SL relay in the trunk causes the guard lamp to be extinguished and applies ringing current to the tip and ring of the cord. A circuit is closed from the ring of the cord, ring spring of the emergency jack, operated contacts of the J-1 relay, B lead to the emergency tone circuit, through the winding of the TR relay, normal contacts of the T relay, normal contacts of the CL relay to ground. This circuit operates the TR relay which operates the T relay (ground through the operated contacts of the TR, winding of the T relay to battery). The T relay locks up from battery through its winding and operated contacts, through the normal contacts of the CL relay to ground.

The operation of the T relay opens the circuit of, and releases, the TR relay and closes a circuit from the "B" lead, through the operated contacts of the T relay, through the 83 ohm resistance to battery. This circuit trips the ringing of the trunk and puts the trunk circuit in talking condition.

Note: Since the 83 ohm resistance is connected to battery, its circuit does not provide a path for operating the S (supervisory) relay of the trunk circuit.

The operation of the T relay also closes a circuit to operate the SO relay, as follows: ground through the normal contacts of the CL relay, operated contacts of the T relay, winding of the SO to battery. The SO operates the CL (battery through the winding of the CL, operated contacts of the SO, operated contacts of the SL to ground). The CL relay locks up from battery through its winding and operated contacts, to ground through the operated contacts of the SL relay.

The operation of the CL relay opens the locking circuit of, and releases, the T which in turn releases the SO.

With the CL operated and the SO released, the following circuit is closed, operating the TA relay: battery through the winding of the TA relay, operated contacts of the CL relay, normal contacts of the SO, through another pair of operated contacts of the CL relay, through the operated contacts of the SL to ground.

The operation of the TA relay closes a circuit which causes the successive operation of the TB, TC and TD relays, thus applying two impulses of tone to the A and B leads (and thence over the trunk to the "A" operator) in a manner similar to that explained under Tone Circuit in the description of the Position Circuit Operation. (The tone is heard through the R-1 condenser by the "B" operator.)

When the TD relay operates, it closes a circuit to operate the TE relay (ground through the operated contacts of TA, through the operated contacts of the TC and TD relays, through the winding of the TE to battery).

When the TE relay is operated, the tip and ring of the trunk cord are connected to the operator's set; the circuit of the ring side of the trunk may be traced from the ring spring of the emergency jack, through the operated contacts of the J-1 relay,

B lead, through the normal contacts of the T relay, through the R condenser, operated contacts of the TA and TE relays, E lead, operated contacts of the E-1 relay, ER lead to the operator's telephone set; the circuit of the tip may be similarly traced over the A, D and ET leads.

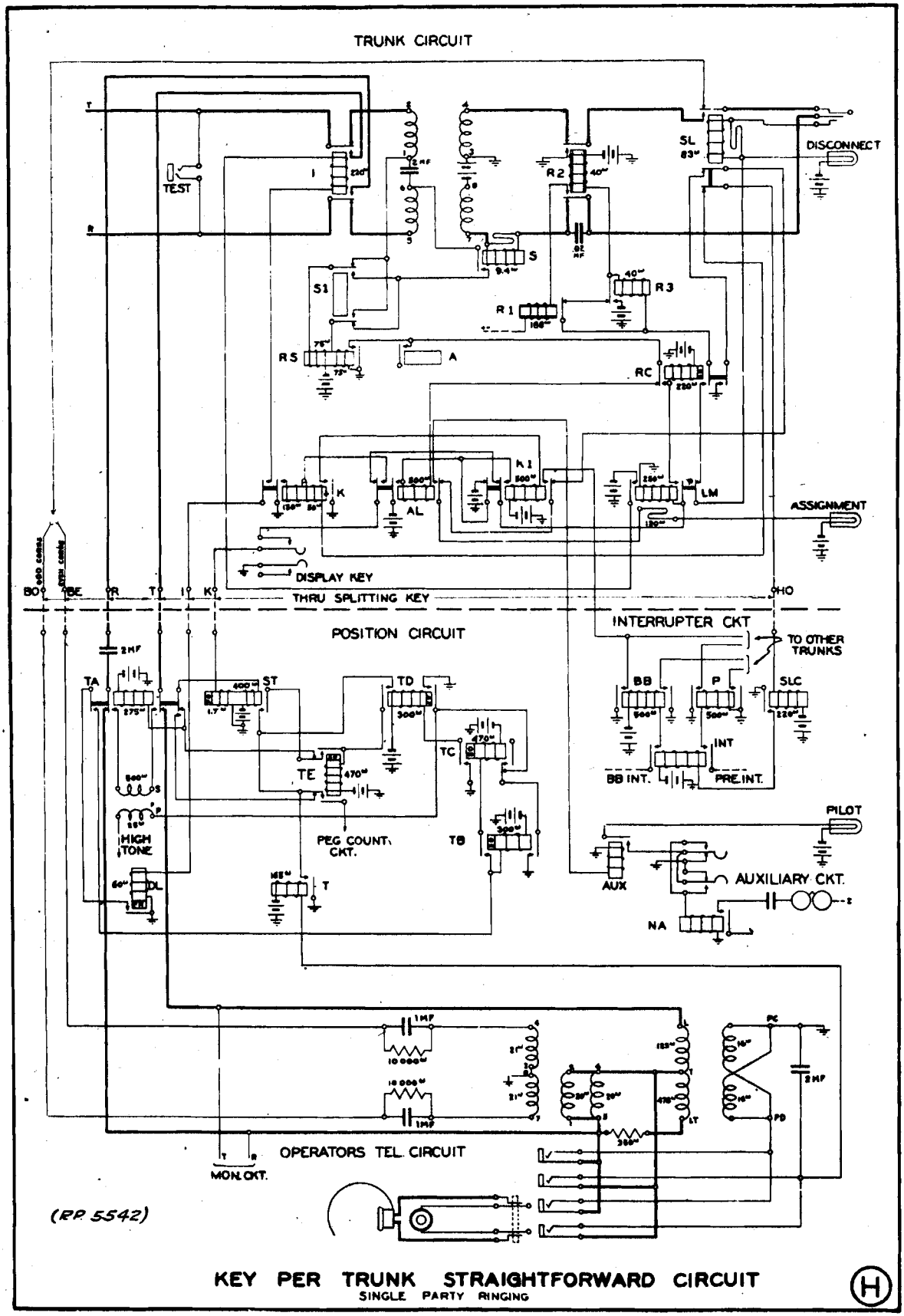
After the operator has learned the number wanted, she removes the cord from the emergency jack. This releases the SL relay in the emergency tone circuit. The release of the SL releases the CL and TA relays. The TA releases the TB, TC, TD and TE relays, restoring the emergency tone circuit to normal.

The removal of the trunk from the emergency jack causes the guard lamp to relight steadily. From this point, the operator handles the call as in regular straightforward operation.

JACK LISTENING STRAIGHTFORWARD TRUNKS

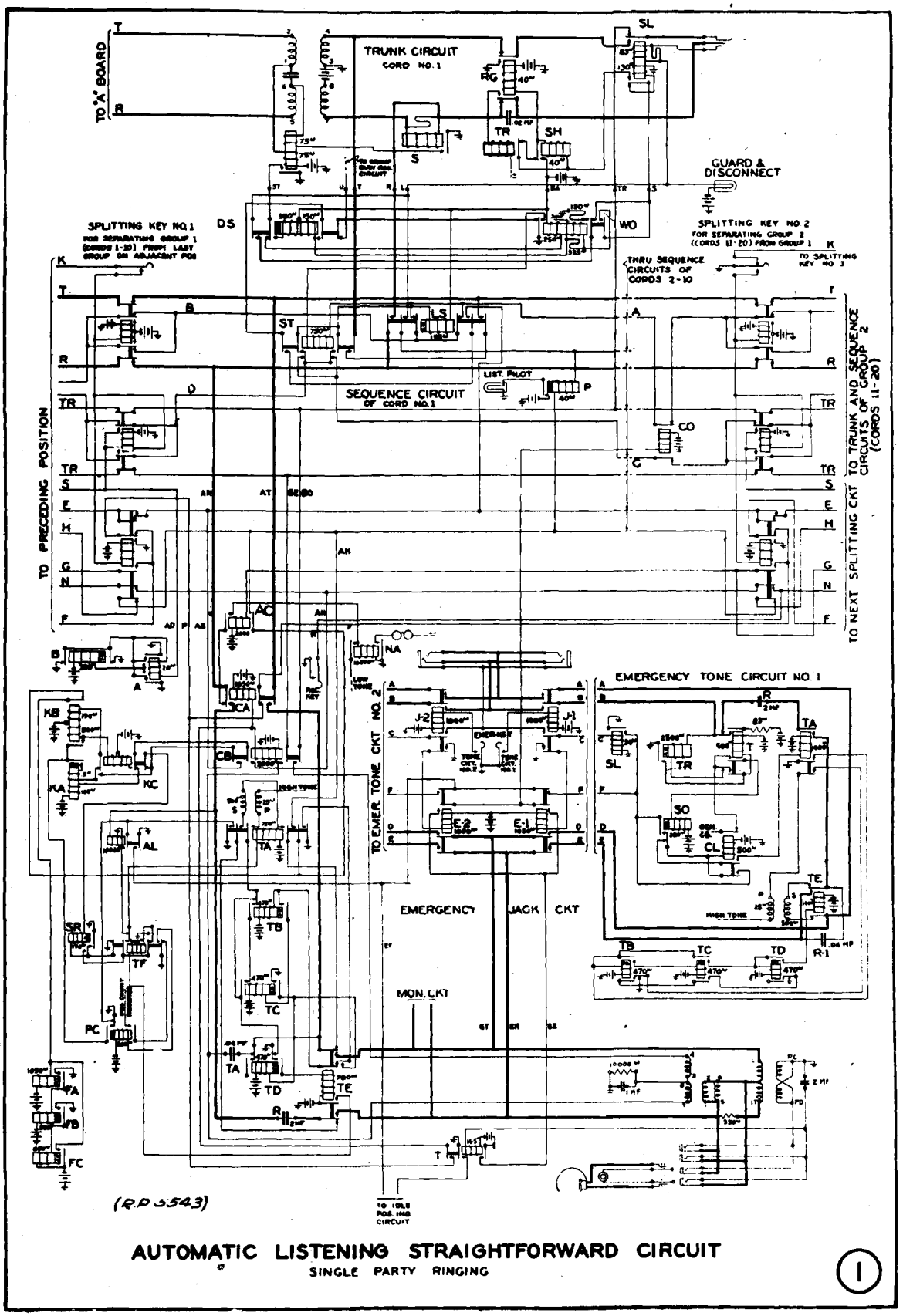
This class of straightforward trunk is so called because the "B" operator connects her set to any trunk on which a call is waiting by plugging the trunk into a listening jack. After learning the number wanted, the "B" operator removes the cord from the listening jack and disposes of the call in the usual way.

The efficiency of Jack Listening Straightforward Trunks over Call Circuit Trunks does not warrant the extensive use of the jack listening method. Therefore, the circuit operation of the Jack Listening Straightforward Trunk is not described at this time.



KEY PER TRUNK STRAIGHTFORWARD CIRCUIT
SINGLE PARTY RINGING

(H)



AUTOMATIC LISTENING STRAIGHTFORWARD CIRCUIT

SINGLE PARTY RINGING

(1)

QUESTIONS

The following list of questions is supplied to the reader as a guide to what may be considered the important points in the description of this equipment. The answers to some will be found stated in a single sentence or paragraph, while others will require a digest of several paragraphs. It is suggested that the reader test the completeness of the information gained from reading this pamphlet by answering each question and then referring to the text to see that the answers are correct.

Answers to these questions should not be sent in unless specifically requested.

1. What is the fundamental difference between a Call-Circuit trunk and a Straightforward trunk?

2. What are some of the advantages of the Straightforward method of trunking as compared with the Call-Circuit method?

3. Into what three classes are Straightforward trunks divided?

4. What is the meaning of CITS?

5. How does an "A" operator locate an idle Straightforward trunk outgoing to a "B" operator?

6. What signals are received by an "A" operator soon after she inserts the plug of a calling cord into the OGT jack of an idle Straightforward trunk?

7. When does an "A" operator pass the called subscriber's number to a "B" operator?

8. Is it possible for a calling subscriber to hear an "A" operator passing the called number over a Straightforward trunk to a "B" operator?

9. During what period of the completion of a call is it necessary for an "A" operator to have a Listening key operated?

10. How does an "A" operator know whether or not the called subscriber has answered?

11. What signals are received by the "A" operator if the called subscriber's line has been found busy by the "B" operator?

12. How does a "B" operator know that one of her Incoming Straightforward trunks has been selected by an "A" operator?

13. What does a flashing Guard light indicate to the "B" operator?

14. What operation is necessary to establish a talking connection,over a Straightforward trunk, between an "A" and a "B" operator, for order passing?

15. What operation, or operations, will cause a "B" operator's telephone set to be disconnected from a Straightforward trunk?

16. How can a "B" operator "overlap" her calls?

17. Is it necessary for a "B" operator to complete calls over Automatic-Listening Straightforward trunks in a definite sequence?

18. How does a "B" operator determine whether or not a called suboriber's line is idle?

19. When is a called subscriber's bell rung?

20. Can a "B" operator tell when either the calling or the called subscriber answers or disconnects?

21. How does a "B" operator know when to disconnect a Straightforward trunk from a called subscriber's line?

22. What happens when an "A" operator reselects a Straightforward trunk before the plug of that trunk has been disconnected from the called subscriber's line by the "B" operator? Will the called subscriber's bell be re-rung?

23. When would the Emergency Listening circuit of an Automatic-Listening position be used?

24. How is an Emergency Listening circuit cut into service?

25. What functions of an Automatic-Listening Control circuit are simulated by an Emergency Listening circuit?

26. Will the Guard lamp of an Automatic-Listening Straightforward trunk flash when that trunk is plugged into a Listening jack of an Emergency Listening circuit?

27. What is the purpose of a Trunk Splitting circuit?

28. How is a Trunk Splitting circuit controlled?

29. An Automatic-Listening Straightforward trunk position will have its Incoming trunks divided into groups of how many trunks each for splitting purposes?

30. Is it possible to isolate any group of trunks of an ALSF trunk position from an Operator's Control or Position circuit by improperly operating a Splitting key?

31. If two ALSF trunk positions are grouped together and a telephone set is connected to the Telephone circuit of each of these positions, which of the two Telephone circuits will be ineffective?