PBX SYSTEMS
NO. 555 STATION LINE CIRCUITS
FOR JACK PER STATION 2 PARTY LINE
COMMERCIAL OFFICE SUBSCRIBER SETS
LONG STATION LINES, ORDER TURRET NO. 1 OR 4
BUSINESS OFFICE OR SPECIAL ORDER SERVICE
TRUNK CIRCUITS
FOR ORDER TURRETS NO. 2, 2A, OR 6A
AND KEY EQUIPMENT NO. 101A, 101B, OR 102A
CENTRAL OFFICE TRUNKS ARRANGED
FOR NIGHT JACK
MODIFICATION OF EXISTING CIRCUITS

Drawings for SD-66537-01 have been converted to 8-1/2 by 11 inch handbook size.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5336-LEVD-EVDL

PLEASE NOTE AND RETURN:
BURNS, J. G. 3
DIVINS, G. C.
JACKSON, G. C. 5
KLAISS, M. J.
PERRIN, A. B. 4

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CHANGES

D. DESCRIPTION OF CIRCUIT CHANGES

D.1 Figure 11 is rated (Mfr. Disc).

D.2 Figure 19 and 20 is added.

D.3 Circuit Note 102 and 104 was changed to reflect changes on Issue 9-D.

D.4 Circuit requirement table was change to add relay data per Figure 19.

D.5 Option "K" designated and rated Mfr. Disc. and "J" Option added.

D.6 Options "J" and "K" added to options used table.

D.7 The ground lead designated E was removed from Fig. 18.

D.8 Circuit Note 105 was added.

E. CHANGES IN TRANSMISSION TEST REQUIREMENTS

E.1 Transmission Req. for Fig. 19 are added.

All other headings under Changes, no change.

1. PURPOSE OF CIRCUIT

1.1 This circuit is used at a 555 PBX for terminating commercial office subscriber sets, lines and trunk circuits of order turrets No. 1, 2, 2A, 4 or 6A key equipment No. 101A, 101B or 102A, and two-party station lines which are on a jack per station basis, and central office trunks equipped with manual long line circuits for modification of existing circuits.

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2. WORKING LIMITS

	Station Signaling			Trunk Signaling	
	Figs. 1, 5 & 10	Fig. 7	Figs. 2&3	Fig. 4	Fig. 11
Max. Ext. Ckt. Loop	750ω	1200ω	200ω	200ω	2000ω**
Min. Insulation Resistance	20000ω	20000ω	*	*	**
Max. Conductor Resistance					
Fig. 5, 6, or 7 Lead B or C					200ω
Fig. 5, 6, or 7 Lead A					50ω

Trunk Circuit Fig. 19	Max. Conductor Loop Res. - Ohms		
	72V AC	80V AC	84V AC
Ring up range	1700Ω	2200Ω	2400Ω
Min. Insulation Res.	20,000Ω	20,000Ω	20,000Ω

*Combined insulation resistance of all station line circuits without line relays common to one buzzer circuit.

**Includes loop between Central Office and long line circuit and is limited by range of long line circuit.

3. FUNCTIONS

3.1 To provide for terminating two-party lines on a jack per station basis.

3.2 To provide for terminating commercial office subscriber sets and key control circuits.

3.3 To provide for terminating the No. 1 order turret lines with provision for busy test to indicate when the turret position is vacant.

3.4 To provide a multiple of the No. 2, 2A or 6A order turret trunk circuit.

3.5 To provide one-way, two-way and overflow line circuits to No. 4 order turret attendants with provision for indication of availability of the order turret.

3.6 To provide for terminating a manual central office line equipped with a manual long line circuit.

3.7 To provide for terminating stations lines beyond the range of the regular 555 PBX station line circuit.

3.8 To provide for use of KS-15668 rectifier with 555 PBX.

3.9 To provide a multiple for key equipment No. 101A, 101B or 102A trunk circuit.

4. CONNECTING CIRCUITS

When this circuit is listed on a keysheet, the connecting information thereon is to be followed.

4.01 Two-party Common Battery Subscribers Lines.

4.02 No. 1 Order Turret Line Circuit-SD-66389-01.

4.03 No. 2 or 2A Order Turret Incoming Trunk Circuit - SD-66322-01.

4.04 No. 4 Order Turret Line Circuit for Individual Attendant - SD-66510-01.

4.05 No. 4 Order Turret Line Circuit Common to 10 Order Turret Attendants - SD-66510-01.

4.06 Supervisor's Cabinet Associated with No. 4 Order Turret.

4.07 Commercial Office Subscriber Sets No. 523B, 523C, 623B or 623C - SD-69063-01.

4.08 Commercial Office Key Control Circuits - SD-69065-01.

4.09 Manual Long Line Circuits - SD-66021-01.

4.10 Long Station Lines.

4.11 Order Turret No. 6A Incoming Trunk Circuit - SD-65543-01.

4.12 Rectifier Per KS-15668.

4.13 1A Key Telephone System Business Office Station Circuit or Special Order Service Key Telephone Circuit - SD-69185-01.

4.14 No. 101A, 101B or 102A Key Equipment Trunk Circuit - SD-69076-01.

DESCRIPTION OF OPERATION

5. STATION LINE ARRANGED FOR PARTY LINE SERVICE ON JACK PER STATION BASIS - FIGS. 1 AND 2.

Fig. 1 differs from Fig. 2 only in that it is equipped with the line relay for use when the loop exceeds the capability of the line lamp or when leak conditions are encountered which may cause false operation of the buzzer relay. Incoming calls are received from the station in the usual manner in that when the receiver is removed from the switchhook, the line lamp lights and the call is answered by inserting the plug in the jack associated with the lighted line lamp.

5.1 Outgoing Calls

The attendant determines by the station line number which jack to use for making the outgoing call. With the plug inserted in the jack arranged for ringing on the tip, operation of the cord circuit ringing key connects ringing current to the tip side of the line to ring the bells which are connected to that side of the line. If the call is for a party connected to the ring side of the line, insertion of the plug in the ring on ring party jack will signal the party on the ring side of the line when the ringing key is operated.

Other functions of this circuit are similar to the regular station line circuit in the 555 PBX.

6. STATION LINE FOR USE WITH COMMERCIAL OFFICE STATIONS - FIGS. 1 AND 2

On a call originated in a commercial office station, relay (L), Fig. 1, operates lighting the line lamp or in the case of Fig. 2, the line lamp is lighted directly over the loop. The call is answered by the attendant inserting the plug in the jack associated with the lighted line lamp. The call is extended in the usual manner by the attendant.

6.1 Busy Test Provided from Commercial Office

When the Telephone Company employee at the commercial office station is not at this desk, a key is operated in the subset which places ground on the lead "B" thus causing both jacks of the associated Fig. 1 or 2 to test busy.

6.2 Outgoing Calls

Two jacks are provided, one for ringing on the ring side of the line and one for ringing on the tip side of the line. The PBX attendant is provided with instructions as to the class of the calls which shall be originated in each jack. The subset is arranged to provide separate and distinctive signaling according to which side of the line ringing current is applied. This arrangement is provided to inform the commercial office employee of the class of call before the conversation is started.

7. STATION LINE CIRCUIT FOR TERMINATING A NO. 1 ORDER TURRET LINE OR FOR USE WITH LINES TO COMMERCIAL OFFICE SUBSCRIBER SETS OR KEY EQUIPMENT - FIG. 3

7.1 Incoming Calls

When the attendant at the No. 1 order turret or the clerk at the commercial office subscriber set or key equipment operates the two-way trunk key, the line lamp lights at the PBX similar to an ordinary station call.

7.2 Answering Incoming Calls

The attendant at the PBX answers the call in the usual manner. Calls are completed to other stations or to the central office trunks in the usual manner.

7.3 Outgoing Calls

Calls from central office trunks or from other stations in the PBX are completed to the station line circuit in the same manner as to an ordinary station with the exception that a busy test is made on the sleeve of the jack to ascertain that an attendant is at the turret or subset to receive a call.

8. TRUNK CIRCUIT - FIG. 4 - MULTIPLE OF NO. 2 OR 2A ORDER RECEIVING TURRET TRUNK CIRCUIT

8.1 Incoming Calls

On an incoming call from the central office, the relay equipment in the turret operates and lights line lamps at the turret and at the PBX. If the attendant at the PBX knows that the turret is vacant, the call is answered by inserting a "trunk and station" cord in the jack. If the turret is known to be attended, no attention is given to the line signal at the PBX which is extinguished when the call is answered at the order turret.

8.2 Answering Incoming Calls

If the call is to be answered at the PBX, the insertion of the plug in the jack causes the contact under control of the tip spring to connect ground over the "S" lead to the relay equipment in the order turret which operates, disconnects the ringing relay from it across the line, extinguishes the line lamps at the order turret and at the PBX and connects battery over the "BS" lead to operate relay (B). Relay (B) in operating, connects battery through resistance lamp (A) to the sleeve of the jack and the cord to operate the cord sleeve relay and connects the ring conductor of the jack through to the tie trunk circuit to provide the talking circuit.

8.3 Outgoing Calls

Outgoing calls are completed by inserting the trunk end of a cord circuit in the jack, thus operating the relay on the "S" lead in the order turret. This in turn causes the circuit to operate relay (B) which cuts the ring conductor through to the jack. Relay (B) also connects battery through one-half of the resistance lamp (A) Fig. 9 to the sleeve of the jack to operate the cord sleeve relay. This sequence of operation is to prevent a false pulse being given to the central office by the tip of the plug touching the ring spring while the plug is being inserted in the jack.

9. LINE CIRCUIT FOR USE WITH NO. 4 ORDER TURRET - FIG. 5

9.1 Individual Two-Way Line to Order Turret Position - Fig. 5

An individual two-way line per order turret attendant is provided at the manual PBX. In addition to the usual line lamp, there is an availability lamp provided which indicates when the order turret is available to take incoming calls. In the case of "Y" wiring, two (A) lamps are provided which are under control of a key at a supervisory desk associated with the number order turret to indicate to the PBX attendant the class of calls which the order turret attendant is assigned to handle.

9.2 Outgoing Calls

When the PBX attendant inserts the plug of a cord in the jack associated with the lighted lamp, ground is connected to the winding of relay (CO) which operates and opens the circuit to relay (A). Relay (CO) also disconnects battery and ground

through relay (L) from the ring and tip of the line respectively. Relay (A) released, keeps lamp (A) extinguished and connects ground to the sleeve of the jack for the cord circuit supervision. The PBX attendant signals the order turret attendant by ringing on the line in the usual manner.

9.3 Incoming Call from the Order Turret

If the order turret attendant desires to make an outgoing call, the operation of the talking key at the order turret places a bridge across the line which operates relay (L) lighting lamp (L). Relay (L) operated also extinguishes the (A) lamp. The call is answered by the PBX attendant inserting a station plug in the jack associated with the lighted (L) lamp. Relay (CO) operates from the contact under control of the tip spring of the jack, disconnects relay (L) from the station line circuit, thus extinguishing the line lamp and opens the circuit to relay (A), which releases. This keeps lamp (A) from lighting when relay (L) releases.

10. INDIVIDUAL OUTGOING LINE CIRCUIT TO NO. 4 ORDER TURRET - FIG. 6

10.1 The operation of Fig. 6 is similar to Fig. 5, except that there is no incoming service from the No. 4 order turret. No line lamp is provided since there is no incoming service from the No. 4 order turret. However, there is an availability lamp provided which indicates when the order turret is available to take incoming calls. When "Y" option is provided, two (A) lamps are provided which are under control of a key at a supervisory desk associated with the No. 4 order turret to indicate to the PBX attendant the class of calls which the order turret attendant is assigned to handle.

10.2 Outgoing Call

When the attendant at the No. 4 order turret inserts the plug of the telephone set into the telephone jacks, a ground on the "A" lead operated relay (A) in Fig. 6 which lights either the first or second choice (A) lamp if "Y" option is used. The (A) lamp which lights is dependent upon the type of call handled by the order turret attendant. When "X" option is provided only one (A) lamp is provided. In either case, a lighted (A) lamp is an indication that the order turret position is ready to receive incoming calls. When the PBX attendant inserts the plug of a cord in the order turret jack, ground on the contact under control of the tip spring of the jack short circuits the winding of relay (A), causing it to release. Relay (A) released extinguishes the (A) lamp and connects ground to the sleeve of the jack to cause the proper operation of the cord circuit. The PBX attendant then signals the order turret attendant by ringing on the line in the usual manner. No provision is made for handling calls incoming from the No. 4 order turret.

11. OVERFLOW LINE CIRCUIT COMMON TO TEN ORDER TURRET POSITIONS - FIG. 7

Fig. 7 is used as an overflow line when all the station lines per Figs. 5 or 6 in a group are busy.

The (A) lamp is used in the same manner in the overflow line as in Fig. 5 or 6, except that it is under control of all the order turret cabinets which may be associated with this circuit. If all the turret positions are vacant, there will be no ground on lead "A" and the lamp is extinguished to indicate to the PBX attendant that this group/overflow line should not be used.

An outgoing call to the order turret on this overflow line is originated by the attendant inserting a plug in the jack and ringing in the usual manner. The circuit operation is similar to that of a regular trunk in the PBX in that ringing current causes the thermistor, on the side of the line on which ringing current is connected, to drop in resistance after an interval of approximately one-half second and allow enough current to flow through relay (R) to cause it to operate. Relay (R) operated locks up and connects battery to the "L" lead, lighting the line lamp at all positions associated with this particular circuit. When the order turret operator answers by operating the key to the talk position, a ground over the "C" lead operates the (C) relay, Fig. 7, which releases the (R) relay, thus retiring the line lamp at the order turret. Varistor (A) is connected in multiple with relay (R) to provide a low resistance path to insure enough current flowing through the thermistor (T) or (R) on ringing current because the impedance of relay (R) is so high that the thermistor would take too long to become low resistance. Varistor (A) is a half-way rectifier and permits one-half cycle to flow through it and the other half cycle is blocked. Sufficient current, however, flows under this condition to cause the thermistor to drop in resistance and the relay will then get enough current on the half cycle which is blocked by the varistor to operate.

Option "M" (Mfr. Disc.)

The (E) resistance limits the current through the (A) varistor when it is conducting, which lengthens the life of the (A) varistor. The (E) varistor permits a better current flow on the half-cycle which operates the (R) relay (i.e. better than through the (E) resistance). The combination of the (E) resistance and the (E) varistor limits

the over-all current flow which in turn reduces the heating of the thermistors, thereby increasing thermistor life and affording less chance of a line unbalance, or interference from induced voltages from excess and uneven thermistor heating.

Option "M"

The option "M" functions as a voltage limiting device which protects the thermistors and varistor by shunting any high voltage surges.

This combination of thermistors, condensers, varistor and relay is provided for two purposes. One is to provide a ringing bridge across the circuit which will not give a false lamp when the line is used for an outgoing call. The second is to provide such a high impedance during the dialing period so as not to interfere with the dial pulses. Resistance (A) is connected in the locking circuit for relay (R) to prevent too much current flowing through varistor (A) while relay (R) is locked up.

12. STATION LINE CIRCUIT WITH LINE RELAY - Fig. 10

This circuit is a modification of a regular PBX station line circuit in which relay (L) is added in order to obtain a longer loop than could be obtained with lighting the line lamp directly over the station loop. Relay (L) operates when the handset is removed from the mounting and lights the line lamp, operates the buzzer if the buzzer key is operated. The call is answered in the usual manner and outgoing calls are made in the usual manner as with the regular line circuit.

13. TRUNK CIRCUIT FOR USE WITH MANUAL LONG LINE CIRCUIT - FIG. 11 (M.F. DISC)

This is a modification of the regular central office trunk circuit and provides a bridged ringing scheme instead of the double thermistor to ground ringing circuit normally provided in the trunk. The regular trunk circuit will not operate with the manual long line circuit because the ringing voltage transmitted through the repeating coil in the long line circuit is too low to operate the thermistor on one side of the line to ground. By using a bridged ringing arrangement full ringing voltage from the long line circuit is provided to operate the ring-up relay. The traffic of this trunk circuit is similar to that of the regular 555 PBX trunk circuit.

Option "N" (Mfr. Disc.)

The (E) resistance limits the current through the (A) varistor when it is conducting which lengthens the life of the (A) varistor. The (E) varistor permits better current flow on the half cycle which operates the (R) relay. The combination of the (E) resistance and (E) varistor limits the over-all current flow which in turn reduces the heating of the thermistor, thereby increasing thermistor life.

Option "M" (Mfr. Disc.)

The option "M" functions as a voltage limiting device which protects the thermistors and varistor by shunting any high voltage surges.

14. GROUND AUXILIARY SIGNAL CIRCUIT - FIG. 8

In order to prevent interference with the auxiliary signal circuit in the order turrets, it is necessary as shown in Note 102 to provide one Fig. 8 per group of trunks common to one order turret auxiliary signal circuit. If only one Fig. 8 were provided with two groups of trunks, the auxiliary signal associated with one group of trunks would operate falsely when a lamp is lighted in the other group of trunks.

15. TRUNK CIRCUIT MULTIPLE OF NO. 6A ORDER TRUNK CIRCUIT - FIG. 13

15.1 Incoming Calls

On an incoming call from the central office, the relay equipment in the order turret operates and lights the line lamp at the order turret. If the turret attendant decides that the call should be handled at the 555 switchboard, a transfer key is operated which gives a line signal at the PBX.

15.2 Answering Incoming Calls

When the line lamp lights at the PBX, the insertion of the cord plug in the jack causes the contact under the control of the tip spring to connect ground over the "SL" lead to the relay equipment in the order turret which operates. The operation of the order turret relay equipment disconnects the ringing relay from across the line, extinguishes the line lamp at the PBX, transfers the tip and ring of the central office trunk to the PBX, and connects battery over the "SL" lead to operate relay (B), Fig. 13. The (B) relay in operating closes battery through resistance lamp (A) to the sleeve of the jack and cord to operate the cord sleeve relay, and connects the ring conductor through to the jack to provide the talking circuit.

15.3 Outgoing Calls

Outgoing calls are completed by inserting the trunk end of a cord circuit in the jack, thus operating the relay on the "SL" lead in the order turret circuit. This in turn causes the circuit to operate the

(B) relay which cuts the ring conductor through to the jack. Relay (B) also connects resistance battery through resistance lamp (A) to the sleeve of the jack to operate the cord sleeve relay. The sequence of operation is to prevent a false pulse being given to the central office by the tip of the plug, touching the ring spring while the plug is being inserted in the jack.

16. USE OF 555 PBX WITH KS-15668 RECTIFIER-FIGS. 14, 15, 16 17

These figures provide for connection to a KS-15668 rectifier, and provide for protection of the NL relays, since the rectifier has 2 amp fuses. Figs. 16 and 17 insure that the S, S1 or S2 fuses will blow instead of the rectifier fuses when the rectifier is inaccessible.

17. TRUNK CIRCUIT - FIG. 18 MULTIPLE OF NO. 101A, 101B OR 102A KEY EQUIPMENT

17.1 Incoming Calls

On an incoming call from the central office, a relay in the key equipment operates and lights the line lamps at both the key box and the PBX.

17.2 If the attendant at the key equipment answers or holds on the call, the key equipment functions as described in the circuit description for that system and the line lamps at the PBX will be extinguished. In eigher case, battery will be connected to either the "L" or "H" lead which will operate relay (B). Relay (B) operated connects battery to the sleeve of the PBX jack for a busy indication.

17.3 If the call is answered by the PBX the insertion of a trunk and station plug into the trunk jack causes the contact under control of the tip spring to connect ground over the "A" lead to operate relay (A) in the key equipment. Relay (A) operated, (1) Connects battery to lead "L" to light the busy lamp at the key box, (2) Connect battery to lead "L" to operate relay (B) in the trunk circuit, (3) Extinguishes both of the line lamps. Relay (B) operated (1) Connects the ring lead through to the jack, (2) Connects battery to the sleeve of the jack for the proper operation of the cord circuit.

17.4 Outgoing Calls

Outgoing Calls from the PBX operate as described in paragraph 17.3. Resistance A is provided in series with the A lead to permit satisfactory operation of certain types of key equipment installations when a PBX cord is connected to the T jack at the same time that a pickup key of the key equipment is operated. This resistance A performs a useful function only where the key equipment is equipped with a relay having its winding in series with its A lead.

18. CENTRAL OFFICE TRUNK CIRCUIT ARRANGED FOR NIGHT JACK - FIG. 19

This circuit is equipped with a thermistor - Varistor combination in the ring up circuit which prevents false line signals from operating the trunk relay (K).

The 8A thermistor normally has a high resistance (over 50,000 ohms) but when ringing current is applied for approximately half a second or longer the resistance is reduced giving an operating path for relay (T).

Varistor (B) is provided for two purposes, (1) to provide a low resistance operating path for the thermistor, (2) to shunt relay (R) on one-half of the ringing current cycle so that relay (R) will operate steadily during the other one-half cycle.

Varistor (A) is provided for two purposes, (1) the shunt reduces the effective (heating) current through the thermistor due to dialing transients to such an extent that false relay operation is eliminated. (2) Protects Varistor (B) and thermistor (T) by offering a very high resistance on normal ringing and dialing voltages, but on very high transients and surges it's resistance becomes low so as to shunt the high voltage around the varistor and thermistor.

18.1 Incoming Call (No Night Connections)

When ringing current is applied at the central office to the trunk, one half cycle will flow thru condenser T, thermistor T, Varistor B and by-pass relay R, but the other half cycle will be blocked by varistor B causing the flow thru the secondary winding of relay R, thermistor T, condenser T to operate relay R. Relay R operated (1) locks operated thru the primary winding, (2) lights the trunk lamp and (3) operates the auxiliary signal circuit.

18.2 Answering

The call is answered by inserting the left plug of a cord circuit (trunk) in the jack associated with the lighted lamp. Relay (R) releases extinguishing the lamp as the locking circuit is opened by the operation of an auxiliary contact on the jack. The auxiliary contact on the tip spring connects the ring side of the line through to the ring spring. The second auxiliary

ring contact connects battery through the (B) resistance lamp to the sleeve of the jack to cause the operation of the cord circuit relay.

18.3 Outgoing Calls (No Night Connections)

Outgoing calls require that when the trunk plug is inserted into the jack A, the ring spring shall be open until the tip spring starts to move to avoid possible short-circuiting of the tip and ring springs while the plug is entering the jack. This prevents a false pulse to the central office equipment. When the plug is fully seated in the jack the tip and ring conductor are extended to the cord circuit in the usual manner. Battery through resistance lamp (B) is connected to the sleeve of the jack to cause the operation of the cord relay. Condenser (T) in series with varistor (A) is bridged across the trunk in parallel with thermistor (T) in series with the secondary winding of relay (T). Varistor (B) and thermistor (T) because of their high resistance offer no interference to dialing. Condenser (T) prevents any D-C from affecting the resistance of either varistor (A) or thermistor (T).

18.4 Night Connections

When a night connection is made, one plug of a patching cord is inserted into Jack B. The operation of the tip and ring spring opens the circuit to the trunk relay equipment. The other end of the patching cord is inserted into the station line jack which connects the station directly to the central office.

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