1 GENERAL

1.1 Scope

The circuit described here is for essentially the entirety of a 555 PBX.

1.2 The 555 PBX

The 555 PBX is a cord-type manual PBX. It is most commonly used in a single-position setup. A two-position setup (non-multiple) is available, but its details are not shown on the basic circuit schematic (CS) drawing (nor the source BTL SD drawing).

1.3 Issue number

The integer part of the issue number of this Circuit Description is the issue number of the CS drawing upon which it is predicated. The decimal suffix (starting with 1) reflects successive issues all predicated on that same issue of the CS.

1.4 Figure references

Unless otherwise noted, references here to figures are to figures on the CS drawing, not figures on the underlying SD drawing.

1.5 Options

The CS drawing on which this Circuit Description is based is itself based on BTL drawing SD-66520-01, and assumes that SD Figs. 1, 2, 5, 8, M, and P are provided, as well as wiring options ZT and ZX (and some others).

2 THE CORD CIRCUIT KEYS

Each cord circuit is equipped with a single multifunction key (often described as the “lever key”) and two momentary ringing keys, one for each cord. The multifunction key has a lever handle. The handle can be rotated clockwise, and is locking in thaty position. This aspect is referred to as the *talk and dial key*. The contacts this action operates are labeled on the CS as TDK, and that designation will be used here to refer to that action as well.

When the handle is not turned, that is spoken of as TDK being *non-operated*. When the handle is turned, that is spoken of as TDK being *operated*. When the attendant turns the handle back to the non-operated position, that is spoken of as *restoring TDK*.

If the handle is not rotated, it can be pushed in, and is locking in that position (stays in until pulled out). This aspect is referred to as the *night and through dial key*. The contacts this action operates are labeled on the CS as NTDK, and that designation will be used here to refer to that action as well.

When the handle is not pushed in, that is spoken of as NTDK being *non-operated*. When the handle is pushed in, that is spoken of as NTDK being *operated*. When the attendant pulls the handle back out (to the non-operated position), that is spoken of as *restoring NTDK*.

Those two contact designations are local to the CS, and are not used on the SD.

3 THE ATTENDANT'S TELEPHONE CIRCUIT

The attendant's telephone circuit is shown in Fig. 102.

Induction coil (transformer) C is the heart of an anti-sidetone circuit, functionally a hybrid coil circuit of the "single coil" type. Resistor R1 (implemented as a non-inductive winding of C) is the balancing network. Winding "a" of C is the input to this hybrid, and is fed from the voice signal from the transmitter of the attendant's telephone set (as will be subsequently described).

When any cord circuit's talk and dial key (TDK) is operated (turned to the right), the transmitter of the attendant's telephone set (also connected through a jack set, not shown) is energized by battery through the windings of retard coil (inductor) P, possibly through a resistance lamp, resistor, or a resistance lamp in parallel with a resistor. The voice frequency signal developed by the transmitter is coupled though capacitor P to winding (a) of the induction coil (the input of the hybrid).

The output of the hybrid is between terminals 2 and 5 of C. It goes to the receiver of the attendant's telephone set (through a jack set, not shown). The receiver circuit is only completed when any TDK is operated. This TDK contact closes later than the making of the transmitter battery feed contact of TDK so the attendant will not hear a click when the transmitter battery feed circuit is energized.

When all TDKs are released, the circuit to the receiver of the attendant's telephone set is opened (first) and then the ground side of the battery feed circuit to the transmitter is opened. The contact protection network comprising resistor A and capacitor C prevents a high voltage spike from occurring from the collapse of the magnetic field in inductor P when that circuit is opened..

The operation of the other circuitry in the ground side of the battery feed to the transmitter will be explained later.

4 STATION-TO-STATION CONNECTION

4.1 Calling station goes off-hook

A station comes off-hook, and the loop current operates the line lamp, L (Fig. 203).

The attendant plugs the right cord of an available cord circuit into the line jack. The break contacts on the line jack remove the ground connection to the tip and the path to the line lamp. A make contact on the line jack grounds the jack sleeve.

The ground on the sleeve of the cord (Fig. 1) operates relay S. S operated opens the “straight through” path between the two cords of the cord circuit. and instead substitutes a battery feed and transmission circuit.

Battery feed to the right cord (and thence to the calling station) is though relay RB in the cord circuit. This is not really a relay, but is in inductor in the form of a UA relay. It has no armature nor contacts.

Right cord supervisory relay AS is in series with the ring conductor of the right cord, and operates from the loop current through the calling station.

Relay CS will provide talking battery to the left cord and thence to the called station later. However, at this time talk and dial key (TDK) break contacts open the path to the left cord itself. Capacitors A and B provide for speech transmission between the two cord circuits. Relay CS is also the supervisory relay for the left cord.

The path in the cord circuit from the left cord side of the transmission circuit is broken by break contacts on the talk and dial key (TDK) for this cord circuit, which is operated at this point in time. Leads RT and RR carry the left side of the battery feed and transmission circuit to the position circuit (Fig. 2). Leads LT and LR carry the left cord itself to the position circuit. But in the position circuit, break contacts on relay SP (which is not operated) carry that path through.

In the position circuit, the attendant’s telephone set (leads ATT and ATR) is bridged through capacitor S across leads RT and RR and thus across the left cord side of the transmission circuit. The attendant can now converse with the caller.

4.2 Connecting to the called station

The attendant receives the wanted extension number from the caller and plugs the left cord of the cord circuit of interest into that line jack. As this is a non-multiple board, there is no need for a busy test; each line has only a single jack appearance, and if the line is busy, there will already be a plug in that jack.

The break contacts on the line jack remove the ground connection to the tip and the path to the line lamp. A make contact on the line jack grounds the jack sleeve.

The jack sleeve runs to the winding of relay T, but since the other end of that relay is connected to ground, relay T does not operate.

The attendant rings the station by operating the left cord ringing key (Ring L), applying ringing voltage to the tip conductor of the called line and ringing ground to the tip. The ringing voltage that is supplied is AC only (±) and not interrupted.

We assume the station answers between ringing “bursts”. When the attendant hears the answer, she restores the TDK for that cord circuit (turn the handle vertical). That disconnects the position circuit from that cord circuit. Break contacts on the TDK close and provide a direct path from the left side of the battery feed and transmission circuit to the left cord and thence to the called line.

Loop current through the called station operates left cord supervisory relay CS, which operates.

4.3 At the end of the call

At the end of the call, when the calling party hangs up, loop current in the right cord ceases and relay AS operates. Its break contact lights the right cord supervisory lamp.

When the called party hangs up, loop current in the left cord ceases and relay CS releases. Its break contact lights the right cord supervisory lamp.

The attendant pulls both cords of the cord circuit. All relays release.

If at the end of the call one party hangs up but the other party does not follow suit, the attendant will likely re-operate the TDK for that cord circuit. Her telephone set is now connected for transmission to both cords. She will probably speak to the remaining off-hook party, determining if they did not hang up because they need something further from the attendant.

5 SUPERVISION OPTIONS FOR CONNECTIONS WITH A CO TRUNK

This is covered here since reference to these options will be made in the sections to follow on connections to a central office (CO) trunk.

By way of various circuit and equipment options on the SD, there could be one of these alternative situations regarding supervision on a call involving a CO trunk:

a. Supervision is through on all CO trunk connections. That means that when the PBX station hangs up the central office trunk is released.

b. Supervision is non-through on all CO trunk connections. That means that when the PBX station hangs up. the central office trunk is not released, but is held with a holding bridge. This allows the attendant to “pick up” the connection through the CO and do some business with some person involved with the call.

c. Supervision is through on incoming CO trunk calls, but non-through on outgoing trunk calls. This requires an additional relay (AD, in SD Fig.,H), whose purpose is to discern whether a trunk call is inbound or outbound. and set up the trunk supervisory mahavior accordingly. That optional relay and its wiring are not shown on the CS.

The CS shows on Fig. 101 the wiring options for (a) and (b), above. Also CS Fig. 302 and Ref 301 show, for the newer versions of the cord circuit unit having contacts on frozen relay RB, the arrangements for enacting the options controlling through supervision behavior and as well for setting the resistance of holding bridge resistor A.

In the older version, where RB has no contacts, the trunk supervision options are enacted by the choice of optional Figs. J and K.

6 OUTGOING CALL TO CO TRUNK

6.1 Calling station goes off hook

The process here is identical to that covered in section 4.1

Note that relay AS is operated by the current in the calling line loop. Thus neither the right nor left cord supervisory lamps are lit.

6.2 Connecting to an idle CO trunk

The attendant selects an idle CO trunk. Since this is a non-multiple board, operating on a manual PBX basis, this will be any CO trunk for which there is not already a cord in its jack.

The attendant plugs the left cord of the cord circuit used for this call into the trunk jack, T on Fig. 201.

There is battery through a resistance lamp on the trunk jack sleeve. This operates relay T. This opens the circuit to relay S in the cord circuit, which releases. This replaces the battery feed and transmission circuit in the cord circuit with a “straight through” connection between the two cords.

T operated places a bridge consisting of resistor A (which has a resistance set based on the loop resistance of the CO trunks) and inductor B across the trunk. This seizes that trunk at the CO. The attendant’s telephone set is across the left cord and she hears dial tone from the CO.

In addition, T places a resistor on the winding leads of relay CS that, on a station-to-station connection , would have gone to the tip and ring of the left cord.

T also removes th solid ground that fed the “tip” winding of CS. Cs can now be controlled by ground placed on that point.

At this time, with AS operated, that point is grounded by a make contact on AS. Thus CS operates.

CS operated prevents the left cord supervisory lamp from lighting even if AS should release from the station going on-hook..

If the option for through supervision on trunk connections is in effect, CS operated prepares a holding path for itself through a make contact on CS and a break contact on TDK, but the latter is open at this time.

If the option for through supervision on trunk connections is in effect, CS operated opens the holding bridge. If the option for non-through supervision on trunk connections is in effect, CS operated puts an additional resistance in the holding bridge.

6.3 Through connection to the station

6.3.1 *Station is to dial*

Here we will assume that the *modus operandi* is that the station would then dial the call through the CO. The attendant restores the TDK for that cord circuit (turns the handle vertical) and operates (pushes in) the night and through dial key (NTDK) for the cord circuit (the same handle being manipulated for both).

TDK released disconnects the position circuit from the cord circuit.

NTDK operated releases relay T, which opens the circuit through the holding bridge (if that is present, which would be in its high-resistance state) so that will not prevent the station's dial pulses from reaching the CO. Relay AS will remain operated.

T released opens the path through resistor G that has been operating the CS relay, and CS releases.

NTDK operated also opens the path from the right cord sleeve, so relay S releases. With S released, the cord circuit is "straight through", the station being connected directly to the CO trunk. The station dials and probably converses with someone at the distant end.

A make contact on AS holds CS operated. If the option for trunk supervision in effect is for through supervision, there is a second path through which CS is held operated.

6.3.2 *Attendant is to dial*

In this case, the attendant remains on the cord circuit and dials. The details if the attendant dialing operation are covered in Section 8. When the attendant has finished dialing, she restores the TDK key, and does not operate the NTDK

Relay T remains operated. Relay CS remains operated, in part by way of the holding the through a make contact of CS and a break contact of TDK.

6.4 Station hangs up

6.4.1 *With through supervision*

At the end of the call, the PBX station hangs up, and the loop current through the cord circuit ceases. This releases the trunk. Relay AS releases, and its break contact grounds the lead to the right cord supervisory lamp, which lights.

But CS remains operated though its holding path, and thus the left cord supervisory lamp does not light (the traditional convention regarding trunk connections). CS operated also has opened the holding bridge, and thus the trunk is released

The attendant pulls down both cords and restores NTDK. With the left cord sleeve no longer receiving resistance battery from the trunk jack sleeve, T releases, and opens the path for CS through resistor G, so CS releases. With the right cord open, AS releases. All relays in the cord circuit are now released.

6.4.2 *With non-through supervision*

At the end of the call, the PBX station hangs up, and the loop current through the cord circuit ceases. Relay AS releases, and its break contact grounds the lead to the right cord supervisory lamp, which lights.

The trunk however is not released, owing to the presence of a high-resistance bridge across the loop (it has been there for the entire call).. The loop current through this is sufficient to hold the trunk seized for at least a brief time.

AS released opens the circuit to CS, which releases. CS released reduces the resistance of the holding bridge to its regular value, which will hold the trunk seized “properly” until it is released by the attendant. There is only a brief period ijn which the turnk holding is dependent on the high-restance bridge.

The attendant pulls the right cord and, if she has no business to conduct over the trunk she pulls the left cord as well. That releases the trunk. Wirth the left cord no longer receiving resistance battery for the sleeve of the trunk jack, T releases. That opens the path through CS, which releases. All relays in the cord circuit are now released.

If the attendant has any business to conduct over the trunk, she leaves the left cord up, operates TDK, and speaks over the trunk.

When she is done with her business over the trunk she pulls the left cord and restores TDK. With the left cord out, the trunk is released. With the left cord sleeve no longer receiving resistance battery from the trunk jack sleeve, T releases. All relays in the cord circuit are now released..

7 INCOMING CALL FROM CO TRUNK

7.1 Ringing on the CO trunk

See Fig. 301. Ringing on the CO trunk is applied to a shunt diode rectifier circuit feeding relay R. Capacitor T serves to prevent an DC current flow through this circuit and is also part of the rectifier circuit. The current through the winding of relay T is smoothed by the inductance of that winding.

Varistor F clips the applied voltage to provide a fairly uniform operating current for relay T.

Thermistor T has a high resistance when cold. As the ringing voltage appears, it heats up, which causes its resistance to decrease, and after a short period its resistance is low enough that relay T operates. The purpose of this delay is to prevents relay R from operating on voltage “spikes” that might occur across the line during various switching activities.

Relay R operated cause trunk lamp T to light.

When relay R operates, it locks over a path through its own make contact and through a break contact on the trunk jack, T. Thus T will remain operated, and lamp T will be lit steadily, from then on, even though the ringing voltage is interrupted. In fact, if the call

is abandoned by the caller before ir is answered by the PBX attendant, the trunk lamp will remain lighted.

7.2 Attendant answers the CO trunk

The attendant plugs the left cord of an available cord circuit into the trunk jack and operates its TDK.

The resistance battery on the sleeve of the trunk jack operates relay T. T operated places a bridge consisting of resistor A and inductor B across the trunk. The DC current flowing through this bridge trips the ringing at the CO.

The attendant's telephone set is bridged across the cord path through the position circuit. She speaks to the caller and learn the person of extension to which they wish to be connected.

7.3 Connecting to the called line

The attendant plugs the right cord of the cord circuit of interest into the proper line jack (assuming that this line is not already busy). A line jack make contact places ground on the jack sleeve, but this does not operates relay S since its path is opened by a break contact on relay T, which is operated at this time.

The attendant rings the called station using the right cord ringing key (Ring R). When the station answers, she may announce that there is an incoming call, but in any case restores the TDK for this cord circuit.

With the station off-hook, relay AS operates.

There is a path through one winding of relay CS, resistor G, a make contact of relay T, the other winding of relay CS, and the make contact of relay AS to ground at the line jack sleeve, which operates relay CS.

With TDK released and S not operated, there is a "straight through" path through the cord circuit from the station to the CO trunk. As before, relay AS monitors the loop current.

If the option for through supervision on trunk connections is in effect, CS operated opens the holding bridge. Holding of the trunk is now by the station.

If the option for through supervision on trunk connections is in effect, CS operated puts an additional resistance in the holding bridge. That plus the station now holds the trunk.

The attendant restores TDK. A make contact on AS holds CS operated. If the option for trunk supervision in effect is for through supervision, there is also a path through which CS is held operated until TRK is restored..

7.4 Station hangs up

This is exactly as described above in Section 7.4.

8 DIALING BY THE ATTENDANT

We assume that the attendant has put a left cord into the trunk jack of a CO trunk. T operates, and its make contact places a holding bridge, comprising resistor A and inductor B (Fig. 101), across the left cord and thus the trunk. This seizes the trunk.

The attendant winds up the dial to dial the first digit, As the dial off-normal contacts operate:

a. Dial off normal (DON) break contact W-BB (Fig. 103) opens and opens the path around the winding of relay ON, which operates from the current through the transmitter.

b. ON operated operates relay SP, which locks operated to TDK.

c. Dial off normal (DON) make contact R-BK (Fig. 191) closes and puts a zero-resistance bridge on the CO line. This is to provide the greatest available loop current during pulsing.

With relay ON operated, a make contact on relay ON short-circuits the receiver of the attendant's telephone set so that no click is heard from the next change listed.

Relay SP operated:

d. Splits the direct path in the position circuit between the two cords.

e. Provides talking battery to the station (right cord) through inductor A.

f. Connects winding 3-4 of inductor B, through capacitor A, across the station loop (right cord)

g. Connects resistor B across winding 3-4 of inductor A.

h. Connects winding 1-2 of inductor B across the CO trunk loop (left cord)

Inductor B serves as a transmission transformer allowing the station to hear from ad speak to the CO trunk.

Then, as the dial runs down, dial pulsing contact Y-BK open the loop to the CO for each pulse.

When the dial returns to home, the off-normal contact restore. The result is that actions a-c above are reversed. But when the short circuit returns across the winding of relay ON, the effect is that ON releases slowly. That assures that the receiver of the attendant's telephone set will only be re-enabled after the short-circuit is removed from the CO trunk so no click is heard from that.

The spilt of the position circuit remains until the attendant restores the TDK for the cord circuit. This occurs shortly after dialing is completed.

A make contact on TDK opens and releases SP.

The situation is now just as described at the end of section 6.3.1

9 THE NIGHT AND THROUGH DIAL KEY

9.1 Night connections

Typically, for when the PBX is to be unattended for the night, connections are made between various of the CO trunks and various stations. For example, the first CO trunk (the one that would be one rung for call to the company's listed number if no other CO trunks were in use) is connected to the station in the security office, where the officer on duty would field such calls.

Perhaps the station of the Sales Manager, who often works outside of regular hours, will be connected to another CO trunk. That way, he can make calls via the telephone network, and his family or important customers can reach him by dialing the number for the CO trunk.

Incoming calls on that trunk will ring the station, which can answer them just as on a regular telephone.

A night connection between a certain station and a certain trunk is made with a cord circuit, the right cord going to the station and the left cord to the trunk.

NTDK is operated on that cord circuit. This ensures that the state of the cord circuit will be straight through without any holding bridge .

The attendant, when vacating the PBX for the evening, will typically operate the Battery Off key (not shown on the CS). This removes battery from all PBX circuits, which among other things prevents the right cord supervisory lamps on the cord circuits used for night connections from lighting (which they otherwise would a lot since the stations are, for the most part, on-hook during this period).

9.2 Through dialing on a trunk call

On an outgoing trunk call where the station is to dial, the attendant normally operates the night and through dial key (NTDK) after hearing dial tone on the trunk.

A break contact on NTDK opens the circuit to relay T, which releases. This opens the holding bridge. (It might still be in place owing to various unusual circumstances, or, if the non-through supervision option is in effect, will be in place albeit with an increased resistance.) There is now an unencumbered direct path from the attain to the trunk.

With T released, a break contact on T would seem to operate S at this time, which would not be appropriate. But a second break contact on NTDK opens that path to S so S does not operate.

10 SPLITTING

On some occasions, especially on an incoming call from a CO trunk, the attendant may wish to initially speak to the called PBX station without the party on the CO connection being heard or hearing.

In this case, the attendant, perhaps even before connecting the right cord to the called station, operates the Split key (SPK). This operates relay SP, which:

a. Splits the connection in the way described in Section 8 (during dialing by the attendant).

b. Opens the path from winding 3-4 of inductor B (through capacitor A) to the station loop. This basically prevents speech transmission between the two cords.

c. Short-circuits winding 1-2 of inductor B (which goes to the CO trunk loop). This prevents any incidental speech transmission (due to capacitance unbalance, etc.) between the two cords.

After the “private” conversation between the attendant and the called station is completed, the attendant restores SPK. This re-enables the speech transmission path through inductor B between the two cords. Relay SP remains operated until the attendant restores TDK..

When TDK is restored:

a. Relay ON is released.

b. The intervention of the position circuit in the left cord is removed, leaving the through connection between cords directly in place.

11 SLEEVE VOLTAGE SPIKE PROTECTION

Diodes C and D prevent a high voltage spike from appearing on the left or right cord sleeve when the cord is removed from a jack owing to the collapse of the magnetic field in relay T or S. Such a spike might cause a shock to the attendant if she touches the plug sleeve as the plug is withdrawn. The diodes do not conduct when the voltage across the relay is that of normal operation, but conduct on the voltage that would result from the magnetic field collapse.

Resistors K and L limit the continuous current that would flow through the diodes in the event that the battery supply polarity somehow got reversed.

12 BUSY TEST WITH A CORD TIP

12.1 Introduction

In the usual use of a 555 PBX, there is no need to make a busy test on a line using the tip of a cord against the sleeve of a line jack, as is done in CO multiple switchboards. The reason is that each line has only a single jack, and if that line is busy it can only be because there is already a cord in that jack, which would make the line’s status evident to the attendant.

Nonetheless, there are apparently installations in which a 555 PBX does have multiple line jacks. And in fact, on either an incoming call from a CO trunk, or a station-to-station call, a busy test of an unoccupied line appearance can be made with the tip of one of the cords (in two of those cases this requiring additional optional circuitry).

12.2 On an incoming call from a CO trunk

We assume that the attendant has connected with the CO trunk with the left cord of a cord circuit, but has not yet plugged the right cord into the wanted line.

In this state, the tip and ring of the left cords (and thus of the CO trunk) go directly though the cord circuit to the tip and ring of the right cord. The bridge comprising resistor A and inductor B is across that tip and ring. Thus current is flowing in the CO trunk loop. Accordingly, the tip conductor of the trunk, and thus of the right cord, is at a voltage away from ground.

If the attendant then takes the tip of that right cord and touches it to the sleeve of an unoccupied appearance of the line of interest, and that line is busy, and thus the jack sleeve is grounded, current will flow through the tip conductor of the right cord, producing a click in the attendant's telephone set.

12.3 SD Fig. M

To provide for a cord tip busy test in the two following scenarios, additional circuitry is needed. This shown as optional SD Fig. M, seen here as Fig. 203.

12.4 On an station-to-station call

We assume that the attendant has answered the calling station with the right cord of a cord circuit. Relay S will be operated. Thus the cord circuit is set up to feed battery and ground to both cords.

At the left cord, the tip will be fed ground through relay CS, and we would expect it at this time to be at ground voltage since there is not yet any loop current from the left cord. However, the path though both windings of inductor A and then through resistors C and D (in Fig. 203) in series will draw current through the windings of the left cord battery feed relay, CS. Because of the voltage drop across the tip winding of CS, the tip conductor of the left cord will be at a voltage a bit away from ground.

If the attendant then takes the tip of that left cord and touches it to the sleeve of an unoccupied appearance of the line of interest, and that line is nonetheless busy, and thus the jack sleeve is grounded, current will flow through the tip conductor of the left cord, producing a click in the attendant's telephone set.

The voltage divider provided by resistors F and E of Fig. 203, whose center (point "X") is tied to the connection between resistors C and D, is not actually relied on in this operation. However, because of the symmetry of the windings of inductor A and resistors C and D, the center point between resistors C and D is also at half battery voltage, so in theory no current flows from the voltage divider, and its presence is thus wholly innocuous.

12.5 With an idle cord

Evidently, there are in some situations of a 555 PBX in a multi-position multiple configuration where it is desirable for the attendant to make a busy test on a line when

there is no connection to that line underway at the position of interest. This test can be made with an otherwise-idle cord circuit.

The attendant chooses an available cord circuit and operates its TDK.

With TDK operated, lead P is grounded. Resistors F and E make a voltage divider, of which the open circuit voltage at point “X” is half the battery voltage.

That voltage proceeds through resistor C and a break contact of relay BT (which is not operated during this operation) through the tip winding of inductor A and thus to the tip of both cords (in the case of the left cord, through a break contact of SP, which is not operated).

If the attendant then takes the tip of either cord (at a voltage of half battery) and touches it to the sleeve of an unoccupied appearance of the line of interest, and that line is nonetheless busy, and thus the jack sleeve is grounded, current will flow through the tip conductor of that cord, producing a click in the attendant’s telephone set.

12.6 Fig. M in the case of a trunk call

However, in the case of a call from a CO trunk, the path though both windings of inductor A and then through resistors C and D in series would provide a bridge across the cord circuit, which would interfere with circuit operation while handling such a call.

Thus, relay BT is provided. If the left cord is in a trunk jack, the resistance battery on the jack sleeve will operate relay BT. Its two break contacts disconnect resistors C and D.

13 CONNECTING BUS SYSTEM

All leads from the position circuit and attendant’s telephone set circuit unit, and each cord circuit unit, are connected by way of an interconnecting bus system.

The heart of this system is a 204A connector, which runs horizontally across much of the width of the switchboard It consists of 16 long metal plates, clamped together in a stack with thin layers of insulating material between them. Thicker metal plates at the top and bottom of the stack make up the “backbone” of the connector.

One of the plates (the fourth from the top) is an electrostatic shield and is grounded. The other 15 plates each have at their far left end (as seen from the rear of the switchboard) a protruding solder lug, and then over the remainder of their length 16 projecting contact tabs, providing 16 locations at which a mating plug can be plugged onto the array of 15 tabs. At each location the tabs are arranged in three vertical columns of 5 tabs each. At each of the plug locations, tabs on the top “backbone” plate serve to align the plug.

All leads from the position circuit and attendant’s telephone set circuit unit, and all leads from each cord circuit unit, are carried by “pigtail” cables each terminating in a 348A plug. The plug from the position circuit and attendants telephone set circuit unit is plugged onto the tabs at the leftmost position of the connector. The plugs from the cord circuit unit are plugged onto the tabs at other locations.

For 10 of the plates, leads from the switchboard common power distribution system are connected to the solder lugs, carrying the respective voltages to all the units as needed. The remaining plates serve to carry leads between the cord circuit units and the position circuit and attendants telephone set circuit unit. (Two of the plates are actually not used.)

The grounded electrostatic shield plate serves to prevent crosstalk between the left cord portion of the active cord circuit (on plates 1 and 3) and the right cord portion (on plates 4 and 5)

14 AN ALTERNATE FORM OF RELAY RB

Later versions of the 555 PBX used relay RB (the right cord battery feed relay) per SD Fig. Q, rather than the version per SD Fig. P, as assumed by the CS.

In this case, RB is a real UA relay, with 4 make contacts. However, its armature is mechanically blocked in the operated position, so all those contacts make, and the relay acts merely as an inductor, just as described above for the RB “relay” per Fig. P.

But each of those 4 make contacts can be individually opened with an insulating sleeve placed over one spring, in order to enact various wiring options. By insulating either one or both of the top contacts, the 3 possibilities regarding supervision on trunk calls (as described in Section 5) can be enacted. By insulating none, either one, or both of the bottom contacts, the 4 possibilities regarding the resistance of the holding bridge (resistor A in the cord circuit) can be enacted.

This arrangement is not reflected on the CS. For its details, refer to the SD.

15 SPECIAL CO TRUNK

Appendix A describes a special CO trunk circuit developed by Will Sherwood for use in a special 555 PBX application.

-#-

Appendix A
Special CO trunk circuit (CS Fig. 401)

A.1 INTRODUCTION

This special CO trunk circuit was developed by Will Sherwood for use in a special 555 PBX application.

With the standard CO trunk circuit shown as Fig. 201 (SD Fig. 9), when ringing is first received relay R operates and locks to a break contact on the trunk jack. R lights the trunk lamp, T.

When the attendant answers the call, that contact on the trunk jack opens and releases R. The trunk lamp is extinguished,

If the call is abandoned before the attendant answers, R will remain operated, and the trunk lamp will remain lit until the attendant plugs into the trunk jack (which of course is profitless in this situation).

In the cited application, it would be more desirable that in such a case R would release (and the trunk lamp would be extinguished) some few seconds after the cessation of ringing.

The CO trunk circuit of Fig. 401 operates that way.

A.2 OPERATION

A.2.1 Ringing on the CO trunk

When ringing is initially received over the CO trunk, relay R2 is operated by a shunt-diode rectifier circuit comprising capacitor T (which also provides DC isolation for the ringing detector circuit) and diode D2. The current through the winding of relay R is smoothed by the inductance of that winding.

When R operates, its make contact completes a circuit to the winding of relay R, which operates and lights the trunk lamp.

The voltage applied to the winding of R also charges capacitor C3 through resistor R***. The purpose of the resistor is to limit the charging current to prevent damage to the contact of R2.

When the first ringing burst ends, R2 soon release, owing the initial operating path for relay R. However, the voltage across capacitor C3 causes current to flow through diode D3 and through the winding of relay R, keeping R operated and the trunk lamp lit.

Under normal circumstances, before the charge on C3 is sufficiently depleted that R would release, there is another ringing burst, R2 is operated, and R is kept operated (and capacitor C3 is recharged).

A.2.2 Answer by the attendant

When the attendant answers the trunk, plugging the left cord of a cord circuit into trunk jack TJ, a break contact on jack TJ opens the path to relay R2, preventing the ringing detection circuit from providing a transmission shunt across the trunk. A second break contact on TJ opens the ground side of the circuit for trunk lamp T, extinguishing it without waiting for relay R to release.

A.2.3 Attendant does not answer

If the attendant does not answer the call, and it is abandoned, ringing ceases, and R2 is not operated again. As soon as capacitor C3 discharges sufficiently, relay R releases, and the trunk lamp is extinguished.

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