

P.B.X. SYSTEMS
P.B.X. NO. 750A
TONE, RINGING, ALARM AND
COMMON TIMING CIRCUITS

CHANGES

A. CHANGED AND ADDED FUNCTIONS

- A.1 Provides for flashing the trunk lamps on incoming calls.

B. CHANGES IN APPARATUS

- B.1 Added

1 - R575 Relay (LF)

D. DESCRIPTION OF CIRCUIT CHANGES

- D.1 The R575 relay (LF) and W wiring was added to provide for flashing the trunk lamps on incoming calls.
- D.2 The rating was changed from A. T. & T. Co. Standard to Mfr. Disc.

All other headings under "Changes", no change.

1. PURPOSE OF CIRCUIT

- 1.1 This circuit provides dial tone, busy tone, audible ringing tone, interrupter ringing current a timing circuit for the trunk visual signals, and audible and visual alarm signals for the 750A P.B.X.

2. WORKING LIMITS

- 2.1 Maximum conductor loop resistance of ringing leads to central office, 650 ohms.

- 2.2 Maximum external circuit loop for (BY) relay, 430 ohms.

3. FUNCTIONS

- 3.01 To provide dial tone.
- 3.02 To provide line busy tone.
- 3.03 To provide all trunks busy tone.
- 3.04 To provide all links busy tone.
- 3.05 To provide audible ringing tone.
- 3.06 To interrupt continuous ringing current from the central office or from the ringing machine and to furnish interrupted ringing with silent period battery to the link circuits.
- 3.07 To give an audible and visual alarm when a circuit fuse operates.
- 3.08 To give an audible and visual alarm when there is trouble in the power circuit.
- 3.09 To extend the alarms to the central office when required.
- 3.10 To provide means for cutting off the audible alarm signal manually.
- 3.11 To provide means to hold the trunk circuit visual signals operated during the silent interval of central office machine ringing and to release them if the call is abandoned.
- 3.12 Provides for flashing the trunk lamps on incoming calls.

4. CONNECTING CIRCUITS

- 4.1 750A P.B.X. line and link circuits.
- 4.2 750A P.B.X. trunk circuits.
- 4.3 750A P.B.X. station circuits.
- 4.4 750A P.B.X. power charge and discharge circuit.
- 4.5 Extension alarm circuit at central office.
- 4.6 Ringing leads circuit.

DESCRIPTION OF OPERATION

5. RINGING AND COMMON TIMING CIRCUIT - FIGURE 1

When a link circuit connects ground to the "RS" lead the "B" relay is energized on its primary winding in series with the (B) and (D) resistances under control of the (A) relay. The secondary winding of the (B) relay is also energized momentarily while the (G) condenser charges in series with that winding of the relay and the (A) and (C) resistances. As the momentary current in the secondary winding of the (B) relay opposes the current in the primary winding, the relay does not operate until the (G) condenser is charged. The operation of the (B) relay operates the (A) relay which reverses the current through the primary winding of the (B) relay and reverses the charge on the (G) condenser. The charging current of the (G) condenser, which is now in the opposite direction to the previous charging current, energizes the secondary winding of the (B) relay and the relay does not release until the (G) condenser is charged. The release of the (B) relay releases the (A) relay which reverses the current through the primary winding of the (B) relay and again reverses the charge on the (G) condenser. The above cycle is then repeated as long as ground is maintained on the "RS" lead. If "W" apparatus and wiring is used the operation and releasing of the (A) relay operates and releases the (LF) relay which flashes the trunk lamps on incoming calls. Grounds on the "RS" lead also operates the (R) relay which connects ringing current and ground to the "M" and "N" leads, respectively, of the link circuits.

The first operation, of the (A) relay also operates the (W) relay which locks to the ground on the "RS" lead. The (Z) relay does not operate at this time as its winding is short circuited through a front contact on the (A) relay. When the (A) relay releases it removes the short circuit from the (Z) relay and that relay operates. The second time the (A) relay operates it releases the (W) relay which operates the (WL) relay. When the (A) relay releases the second time it releases the (Z) relay which operates the (Zl) relay by

removing the short circuit from its winding. The operation of the (Z1) relay releases the (R) relay which disconnects ringing current from the link and connects tripping battery to the link. The third operation of the (A) relay reoperates the (W) relay. On the third release of the (A) relay the (Z) relay operates and on the fourth operation of the (A) relay the (W) relay releases, releasing the (W1) relay by short circuiting it under control of front contacts on the (Z) and (Z1) relays. The release of the (W1) relay operates the (W2). The fourth release of the (A) relay releases the (Z) relay which releases the (Z1) relay. The release of the (Z1) relay operates the (Z2) relay by removing the short circuit from its winding. The fifth operation of the (A) relay operates the (W) relay which operates the (W1) relay under control of the (Z2) relay from ground on a back contact of the (Z) relay. The fifth release of the (A) relay operates the (Z) relay which operates the (Z1) relay. The sixth operation of the (A) relay releases the (W) relay which releases the (W1) relay. The release of the (W1) relay releases the (W2) relay. The sixth release of the (A) relay releases the (Z) relay which releases the (Z1) relay. The release of the (Z1) relay releases the (Z2) relay. With the (Z1) and (W2) relays released the (R) relay again operates to connect ringing to the link circuit. The same cycle of operations will be repeated, the (R) relay operating and releasing the supply interrupted ringing current and audible ringing tone to any link as long as ground is connected to the "RS" lead. The (AR) vacuum tube is used to provide the audible ringing tone. In order to keep the trunk lamps functioning during the silent interval of central office machine ringing, ground is maintained on the "LK" lead as follows:

On a call from central office, ground which is connected to the "R" lead by the trunk circuit during the ringing period operates the (LK) relay. The operation of the (LK) relay (a) operates the buzzers or subsets (B) to indicate that a trunk is being called, (b) connects ringing current to the "M" lead which connects to the trunk circuit, and (c) opens the operating and locking circuits of the (W3) and (W4) relays. Ground is also connected to the "R1" lead by the trunk circuit but this ground is ineffective at this time. Ground which is connected to the "ST" lead by the trunk circuit starts the interrupter relays (A) and (B) which function as previously described. Ground

from the back contact of the (Z4) relay the "LK" lead holds the relay and lamp in the trunk locked. At the end of the central office ringing period, the (LK) relay releases closing a circuit to operate the (W3) relay from ground on the "R1" lead provided the (Z) relay is operated at this time. The position of the (Z) relay at this time depends on the time when the (A) and (B) relays begin to function. These may have been started by ground on the "ST" lead when central office ringing started or may have started from a ground on the "RS" lead from a link circuit, as described above. When the (Z) relay does operate, however, the (W3) relay operates and when the (Z) relay releases the (Z3) relay operates. The next operation of the (Z) relay releases the (W3) relay. The release of the (W3) relay operates the (W4) relay. When the (Z) relay releases it releases the (Z3) relay which operates the (Z4) relay. The next operation and release of the (Z) relay operates the (W3) and (Z4) relays as before and the next operation of the (Z) relay releases the (W3) relay which releases the (W4) relay. With the (W4) relay released and the (Z4) relay operated, ground is opened from the "LK" lead. However, the time elapsed between the release of relay (LK) and the opening of the ground on the "LK" lead will be sufficient to cover the silent period of the central office machine ringing. When the second ringing period is started the (LK) relay is reoperated which opens the operating and locking circuits to the (W3), (Z3), (W4) and (Z4) relays, restoring them to normal. In the event that the call has been abandoned the opening of the ground to the "LK" lead will release the relays in the trunk and restore this circuit to normal.

6. TONE CIRCUIT - FIGURE 2

6.1 Dial Tone

When ground is connected to the "DTS" lead by the link circuit the (T) relay operates and releases on its "P" winding in a self-interrupted circuit. The "S" winding of the (T) relay will then have a tone induced in it which will be transmitted to the link through the (B) and (H) condensers and the (B) repeating coil over the "DT" lead.

6.2 Line Busy

On a call to a busy line, lead "BTS" is grounded by the link, causing the (Tl) relay to operate. The operation of the (Tl) relay, (a) operates the interrupter relays (A) and (B), (b) operates the (T) relay and (c) closes a circuit to the "BT" lead from the secondary winding of the (T) relay through a contact on the (A) relay. The (A) relay operating and releasing interrupts the tone supplied by the secondary winding of the (T) relay to the link circuit direct or by operating and releasing the (LF) relay which provides this function.

6.3 Trunk Busy

When a station selects a busy trunk, ground is connected to the "BT" lead by the trunk circuit, operating the (BY) relay which operates the (Tl) relay. The (Tl) relay then starts the tone relay and interrupter circuit as described above to supply busy tone through the (A) condenser to the trunk circuit over the "BT" lead.

6.4 All Links Busy

When all links become busy, ground is connected to the "LB" lead, operating the (LB) relay. The operation of the (LB) relay connects ground to the (Tl) relay and busy tone is supplied as before through the (D) condenser to one winding of the (A) repeating coil. The tone is then induced in the other winding and is connected to the line circuits over lead "LG".

7. ALARM CIRCUIT - FIGURE 3

When a link fuse operates, battery is connected through the (A), (B) or (C) fuse to the "F1", "F2", or "F3" lead according to which fuse has been operated. Battery will then be connected by the link circuit to the "AL" lead of this circuit, operating the (F) relay. The operation of the (F) relay, (a) lights the (F) lamps to give a visual alarm, (b) operates the (A) subset to give an audible alarm, (c) connects leads "WCT" and "VCR" together in order to give an alarm in the central office and (d) connects ground to the "CT" lead in order to start the ringing machine.

If the (A), (B) or (C) fuse in lead "F1", "F2", or "F3", operates after the corresponding link fuse has operated, battery will be connected to the (F) relay, operating it and giving an alarm.

The (A) key is provided in order that the (A) subset may be silenced. The operation of the (A) key operates the (CO) relay which looks under control of the (F) relay and disconnects ringing current from the subset. The alarm lamp will remain lighted and the alarm leads to central office will remain closed until the operated fuse is removed. Battery for the (F) lamp and the (CO) relay is provided over the "BB" lead.

If a fuse other than a link circuit fuse operates the (F) relay operates and functions as described above. If trouble occurs in the charge and discharge circuit, battery is connected to the "PG" lead and also causes the (F) relay to operate.

If the (D) fuse also operates no alarm is given.

BELL TELEPHONE LABORATORIES, INC.

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P.B.X. SYSTEMS
NO. 750A
TONE, RINGING, ALARM
AND COMMON TIMING SYSTEMS

CHANGES

C. CHANGES IN CIRCUIT REQUIREMENTS OTHER THAN THOSE APPLYING TO
ADDED OR REMOVED APPARATUS

- C.1 Reissued to change test clip data for (LK) relay to facilitate adjusting.

All other headings, no change.

DEVELOPMENT

1. PURPOSE OF CIRCUIT

- 1.1 This circuit provides dial tone, busy tone, interrupter ringing current, a timing circuit for the trunk visual signals, and audible and visual alarm signals for the 750A P.B.X.

2. WORKING LIMITS

- 2.1 Maximum conductor loop resistance of ringing leads to central office, 650 ohms.
- 2.2 Maximum external circuit loop for (BY) relay, 430 ohms.

OPERATION

3. FUNCTIONS

- 3.01 To provide dial tone.
- 3.02 To provide line busy tone.
- 3.03 To provide all trunks busy tone.
- 3.04 To provide all links busy tone.
- 3.05 To interrupt continuous ringing current from the central office or from the ringing machine and to furnish inter-

rupted ringing with silent period battery to the link circuits.

- 3.06 To give an audible and visual alarm when a circuit fuse operates.
- 3.07 To give an audible and visual alarm when there is trouble in the power circuit.
- 3.08 To extend the alarms to the central office when required.
- 3.09 To provide means for cutting off the audible alarm signal manually.
- 3.10 To provide means to hold the trunk circuit visual signals operated during the silent interval of central office machine ringing and to release them if the call is abandoned.

4. CONNECTING CIRCUITS

- 4.1 750A P.B.X. line and link circuits.
- 4.2 750A P.B.X. trunk circuits.
- 4.3 750A P.B.X. station circuits.
- 4.4 750A P.B.X. power charge and discharge circuit.
- 4.5 Extension alarm circuit at central office.
- 4.6 Ringing leads circuit.

DETAILED DESCRIPTION

5. RINGING AND COMMON TIMING CIRCUIT - FIGURE 1

When a link circuit connects ground to the "RS" lead the (B) relay is energized on its primary winding in series with the (B) and (D) resistances under control of the (A) relay. The secondary winding of the (B) relay is also energized momentarily while the (G) condenser charges in series with that winding of the relay and the (A) and (C) resistances. As the momentary current in the secondary winding of the (B) relay opposes the current in the primary winding, the relay does not operate until the (G) condenser is charged. The operation of the (B) relay operates the (A) relay which reverses the current through the primary winding of the (B) relay and reverses the charge on the (G) condenser. The charging current of the (G) condenser, which is now in the opposite direction to the previous charging current, energizes the secondary winding of the (B) relay and the relay does not release until the (G) condenser is charged. The release of the (B) relay

releases the (A) relay which reverses the current through the primary winding of the (B) relay and again reverses the charge on the (G) condenser. The above cycle is then repeated as long as ground is maintained on the "RS" lead. Grounds on the "RS" lead also operates the (R) relay which connects ringing current and ground to the "M" and "N" leads, respectively, of the link circuits.

The first operation of the (A) relay also operates the (W) relay which locks to the ground on the "RS" lead. The (Z) relay does not operate at this time as its winding is short circuited through a front contact on the (A) relay. When the (A) relay releases it removes the short circuit from the (Z) relay and that relay operates. The second time the (A) relay operates it releases the (W) relay which operates the (W1) relay. When the (A) relay releases the second time it releases the (Z) relay which operates the (Z1) relay by removing the short circuit from its winding. The operation of the (Z1) relay releases the (R) relay which disconnects ringing current from the link and connects tripping battery to the link. The third operation of the (A) relay reoperates the (W) relay. On the third release of the (A) relay the (Z) relay operates and on the fourth operation of the (A) relay the (W) relay releases, releasing the (W1) relay by short circuiting it under control of front contacts on the (Z) and (Z1) relays. The release of the (W1) relay operates the (W2). The fourth release of the (A) relay releases the (Z) relay which releases the (Z1) relay. The release of the (Z1) relay operates the (Z2) relay by removing the short circuit from its winding. The fifth operation of the (A) relay operates the (W) relay which operates the (W1) relay under control of the (Z2) relay from ground on a back contact of the (Z) relay. The fifth release of the (A) relay operates the (Z) relay which operates the (Z1) relay. The sixth operation of the (A) relay releases the (W) relay which releases the (W1) relay. The release of the (W1) relay releases the (W2) relay. The sixth release of the (A) relay releases the (Z) relay which releases the (Z1) relay. The release of the (Z1) relay releases the (Z2) relay. With the (Z1) and (W2) relays released the (R) relay again operates to connect ringing to the link circuit. The same cycle of operations will be repeated, the (R) relay operating and releasing to supply interrupted ringing current to any link as long as ground is connected to the "RS" lead.

In order to keep the trunk lamps lighted during the silent interval of central office machine ringing, ground is maintained on the "LK" lead as follows:

On a call from central office, ground which is connected to the "R" lead by the trunk circuit during the ringing period operates the (LK) relay. The operation of the (LK) relay (a) operates the buzzers or subsets (B) to indicate that a

trunk is being called, (b) connects ringing current to the "M" lead which connects to the trunk circuit, and (c) opens the operating and locking circuits of the (W3) and (W4) relays. Ground is also connected to the "R1" lead by the trunk circuit but this ground is ineffective at this time. Ground which is connected to the "ST" lead by the trunk circuit starts the interrupter relays (A) and (B) which function as previously described. Ground from the back contact of the (Z4) relay to the "LK" lead holds the relay and lamp in the trunk locked. At the end of the central office ringing period, the (LK) relay releases closing a circuit to operate the (W3) relay from ground on the "R1" lead provided the (Z) relay is operated at this time. The position of the (Z) relay at this time depends on the time when the (A) and (B) relays begin to function. These may have been started by ground on the "ST" lead when central office ringing started or may have started from a ground on the "RS" lead from a link circuit, as described above. When the (Z) relay does operate, however, the (W3) relay operates and when the (Z) relay releases the (Z3) relay operates. The next operation of the (Z) relay releases the (W3) relay. The release of the (W3) relay operates the (W4) relay. When the (Z) relay releases it releases the (Z3) relay which operates the (Z4) relay. The next operation and release of the (Z) relay operates the (W3) and (Z4) relays as before and the next operation of the (Z) relay releases the (W3) relay which releases the (W4) relay. With the (W4) relay released and the (Z4) relay operated, ground is opened from the "LK" lead. However, the time elapsed between the release of relay (LK) and the opening of the ground on the "LK" lead will be sufficient to cover the silent period of the central office machine ringing. When the second ringing period is started the (LK) relay is re-operated which opens the operating and locking circuits to the (W3), (Z3), (W4) and (Z4) relays, restoring them to normal. In the event that the call has been abandoned the opening of the ground to the "LK" lead will release the relays in the trunk and restore this circuit to normal.

6. TONE CIRCUIT - FIGURE 2

6.1 Dial Tone

When ground is connected to the "DTS" lead by the link circuit the (T) relay operates and releases on its "P" winding in a self-interrupted circuit. The "S" winding of the (T) relay will then have a tone induced in it which will be transmitted to the link through the (B) and (H) condensers and the (B) repeating coil over the "DT" lead.

6.2 Line Busy

On a call to a busy line, lead "BTS" is grounded by the link, causing the (T1) relay to operate. The operation of

the (T1) relay, (a) operates the interrupter relays (A) and (B), (b) operates the (T) relay and (c) closes a circuit to the "BT" lead from the secondary winding of the (T) relay through a contact on the (A) relay. The (A) relay operating and releasing interrupts the tone supplied by the secondary winding of the (T) relay to the link circuit.

6.3 Trunk Busy

When a station selects a busy trunk, ground is connected to the "BT" lead by the trunk circuit, operating the (BY) relay which operates the (T1) relay. The (T1) relay then starts the tone relay and interrupter circuit as described above to supply busy tone through the (A) condenser to the trunk circuit over the "BT" lead.

6.4 All Links Busy

When all links become busy, ground is connected to the "LB" lead, operating the (LB) relay. The operation of the (LB) relay connects ground to the (T1) relay and busy tone is supplied as before through the (D) condenser to one winding of the (A) repeating coil. The tone is then induced in the other winding and is connected to the line circuits over lead "LG".

7. ALARM CIRCUIT - FIGURE 3

When a link fuse operates, battery is connected through the (A), (C) or (B) fuse to the "F1", "F2" or "F3" lead according to which fuse has been operated. Battery will then be connected by the link circuit to the "AL" lead of this circuit, operating the (F) relay. The operation of the (F) relay, (a) lights the (F) lamps to give a visual alarm, (b) operates the (A) subset to give an audible alarm, (c) connects leads "WCT" and "WCR" together in order to give an alarm in the central office and (d) connects ground to the "CT" lead in order to start the ringing machine.

If the (A), (C) or (B) fuse in lead "F1", "F2" or "F3" operates after the corresponding link fuse has operated, battery will be connected to the (F) relay, operating it and giving an alarm.

The (A) key is provided in order that the (A) subset may be silenced. The operation of the (A) key operates the (CO) relay which locks under control of the (F) relay and disconnects ringing current from the subset. The alarm lamp will remain lighted and the alarm leads to central office will remain closed until the operated fuse is removed. Battery for the (F) lamp and the (CO) relay is provided over the "BB" lead.

If a fuse other than a link circuit fuse operates the (F) relay operates and functions as described above. If trouble occurs in the charge and discharge circuit, battery is connected to the "PG" lead and also causes the (F) relay to operate.

If the (D) fuse also operates no alarm is given.

BELL TELEPHONE LABORATORIES, INC.

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PLANT DEPARTMENT
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