

FTR 6E PABX

Federal Telephone and Radio Corporation

CLIFTON, NEW JERSEY

FTR 6E PABX

INDEX

NS-1800	FTR 6E PABX - 6 Line PBX
NW-1800-1	Wiring Diagram for FTR 6E PABX
NSE-120113	FTR 6E PABX Outside Connections
NSE-59882	Wiring Diagram Symbols Relays, Res., Cond. & Induction Coils
NSE-97800	Wiring Diagram Symbols (For Maintenance)

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1. PURPOSE OF THE CIRCUIT

- 1.1 To provide connection between local PABX stations.
- 1.2 To provide a connection between all unrestricted PABX stations and the city exchange.

2. WORKING LIMITS

- 2.1 The normal operating voltage is 24 volts with permissible limits of from 20 volts to 30 volts.
- 2.2 The maximum loop resistance of a station line including instrument, shall be 150w.
- 2.3 The maximum loop resistance of trunk lines, shall be 700w.
- 2.4 The minimum insulation resistance of stations shall be 30,000^W.
- 2.5 The minimum insulation resistance of trunk lines shall be 10,000^W.
- 2.6 The dial speed may vary between 8 and 12 impulses per second.

3. PRINCIPAL FEATURES

- 3.1 Each trunk is provided with a power failure relay which automatically connects the trunk to a predetermined local station in case of power failure.

3.2 Calls between PABX stations are entirely automatic. Dial tone, interrupted busy tone and ring back tone are provided.

3.3 Call Back

Any local station engaged on an incoming or outgoing city call may hold the trunk connection while he calls another local station for information or other reasons. Upon completion of the local conversation the calling station may again resume the conversation.

3.4 Transfer

An incoming or outgoing trunk connection may be transferred from one PABX station to another, provided the local party is not restricted from trunk connections.

3.5 Instantaneous Busy

Provision is made for making a trunk busy from the city exchange before ringing current is connected. This arrangement provides for control of the trunk from the city exchange when the PABX party releases on an incoming call.

3.6 Restricted Service

Any PABX station may be restricted to local calls only.

4. METHOD OF OPERATION

4.1 Local Call

To initiate a local call the local party removes his receiver, waits for dial tone and then dials the number of the wanted local party.

If the called local party is free interrupted ringing current is connected to the line.

When the called party answers a through connection is established and the conversation takes place. The connection is under control of both the calling and the called party and the link is released when both the calling and the called parties release.

If the called party is busy, an interrupted busy tone is connected to the calling party who restores his receiver and frees the common circuit.

4.2 Outgoing City Call

An outgoing city call may be initiated by any unrestricted local party.

To initiate an outgoing city call, the local party removes the receiver and upon receiving dial tone, depresses the transfer button associated with his set.

If the first trunk is free, the local party is connected to this trunk and the common circuit is released. If the first trunk is busy the second trunk is connected to the local party and the common circuit is released.

If the city exchange is automatic the local party will receive dial tone from the city exchange and he dials the number of the wanted city subscriber.

If the city exchange is manual the PABX station awaits the answer of the city operator and then communicates the wanted number.

If both trunks are busy at the time the local party initiates an outgoing city call, an interrupted busy tone is connected to the calling party, who should replace his receiver and attempt the call latter.

4.3 Incoming City Call

An incoming city call on either the first or the second trunk, operates the common ringer.

Any unrestricted local party may reply to the call by removing the receiver and depressing the transfer button. The answering party should disregard the busy tone which is connected to the circuit at this time.

After the call has been answered the city exchange may be transferred to any unrestricted local party.

When an incoming call signal is received, busy tone is connected to the common circuit. This busy tone informs any parties who may be occupying the common circuit that an incoming call is awaiting an answer. The parties occupying the common circuit should replace their receivers releasing the common circuit so that the incoming call may be answered.

4.4 Call Back

If the local party engaged on a city exchange connection desires to establish a local connection, he may do so by depressing the transfer button associated with his set.

The depression of the transfer button places a hold on the trunk and transfers the local line to the common circuit.

On obtaining dial tone, the calling party dials the number of the wanted local party and the connection is established in the same manner as for a local call.

When the conversation is completed, the calling party may re-establish the trunk connection by momentarily restoring his receiver and then depressing the transfer button the second time.

If the common circuit is engaged on a call back at the time the transfer button is depressed, busy tone is connected to the second party attempting the call back indicating that a call back connection cannot be established at this time.

4.5 Transfer

To transfer a city connection to another local party, a call back is initiated as explained in paragraph 4.4.

If the called party accepts the city connection, the calling party depresses the transfer button the second time before restoring the receiver. The city connection is now transferred to the second party and the first party is released.

5. CIRCUIT DESCRIPTION

5.1 Local Call

5.1.1 Local Party Removes the Receiver.

We will assume that the call is initiated by local station number 2. When the local station removes

his receiver relay Lbr operates:

- (1) Battery, winding Lbr, right middle break contacts of Ax2r and Ax1r, right outer break of Lcr, right breaks of Abr, ADr, Lr, C1r2, L1r2, Str2 and Ftr2, station loop, left breaks of Ftr2, Str2, L1r2 and C1r2, ground.

Relay Lbr operates and completes a circuit for the operation of relays Lr and L1r as follows:

- (2) Battery, winding of L1r and Lr in series, right inner break of Lcr, left make of Lbr, ground.

All the C1r line relays are now connected to the corresponding station lines.

Relay C1r2 operates in the following circuit:

- (3) Battery, winding of C1r2, left make Lr, right breaks of C1r2, L1r2, Str2 and Ftr2, calling station's loop, left break of Ftr2, Str2, L1r2, and C1r2, ground.

Relay C1r2 closes its locking circuit before opening its operating circuit:

- (4) Battery, winding C1r2, right middle make of C1r2, left middle break of C1r1, make of Lbr, ground.

If two local partys should remove their receivers at the same time, only one of the C1r relays may lock, the locking circuit of these relays being connected over series break contacts, so that when one C1r relay operates it opens the locking circuit for the following C1r relays in the chain.

Over it's inner makes C1r2 connects the supervisory relay Asr to the local party's loop. Relay Asr oper-

ates and in turn operates relay Lcr which locks to ground over the left make of Lbr.

Relay Lbr is maintained operated from ground at the right make of Asr, right outer make Lcr, right breaks of Ax1r and Ax2r, winding Lbr to battery.

At its right inner break Lcr opens the circuit for Lr and L1r which release. From now until the end of the selection, the common circuit is made busy to other calling subscribers.

Relay Rcr operates in the following circuit:

- (5) Battery, primary winding Rcr, break of Lxr, Bcr, Bbr, and Aar, left make of Lcr, ground.

Relay Rcr locks in the following circuit:

- (6) Battery, secondary winding Rcr, left inner make of Rcr, break of Rgr, right inner make of Lcr, make of Lbr, ground.

A circuit to operate the buzzer is completed as follows:

- (7) Battery, 80W resistance, primary winding of the buzzer, break contact of the buzzer, left make of Lcr, ground.

In operating the buzzer opens its operating circuit at its break contact and releases. It reoperates again and the cycle repeats itself.

The variation of flux in the primary winding of the buzzer caused by the operation and release of the buzzer induces an alternating voltage in the secondary winding which produces an alternating current that is used as a dial tone and is transmitted to the calling party as follows:

- (8) Ground, secondary winding of the buzzer, non-inductive winding of Dcr, right inner break of Dcr, break of Rtr, right outer make of Rcr, right break of Tgr, 1 MF condenser, left inner make of Clr2, left break of Llr2, Str2 and Ftr2, local party's loop, right breaks of Ftr2, Str2, and Llr2, right inner make of Clr2, primary winding Lxr, secondary winding Axr, battery.

5.1.2 Dialing

Upon receiving dial tone the calling party dials the number of the wanted party, the dial impulses being repeated to the counting relays by relay Asr.

When relay Asr releases on the first impulse from the dial a circuit is completed to operate Aar:

- (9) Battery, winding Aar, right inner breaks of Bar and Bbr, right outer break of Dcr, breaks of Lsr and Asr, right breaks of Cb2r and Cb1r, right inner make of Lcr, make of Lbr, ground.

Relay Lmr operates on the first impulse in parallel with Aar and being slow to release, it remains operated during the train of impulses.

At the end of the first impulse when Asr reoperates, relay Bar operates in series with Aar:

- (10) Battery, winding Aar, left inner make of Aar, winding of Bar, left break of Bbr, left make of Lcr, ground.

The second impulse is received by Abr over a similar circuit. At the end of the second impulse Abr locks in series with Bbr. When Bbr operates it opens the locking circuit of Aar and Abr which release.

The third impulse is received by Acr over the right inner make of Bbr. At the end of the third impulse Acr locks in series with Bcr under control of Bar, and relays Abr and Bbr are released.

The fourth impulse is received by Aar in circuit
(9) and relay Aar now operates Aadr:

- (11) Battery, winding of Aadr, left outer break of Bdr, right outer make of Acr, left outer make of Aar, left outer break of Bar, ground.

At the end of the fourth impulse when Asr re-operates, Aar locks in series with Bar under control of Bbr. Relays Acr and Bcr are released. Relay Aadr locks in series with Bdr under control of Lcr.

The fifth impulse is received by relay Abr. At the end of the fifth impulse when Asr re-operates relay, Abr locks in series with Bbr and relays Aar and Bar are released.

The sixth impulse is received by relay Acr. At the end of the fifth impulse when Asr re-operates relay Acr locks in series with Bcr and relays Abr and Bbr release.

The table below shows the counting relays that remain operated for each local party's number dialled.

<u>No. Dialled</u>	<u>Counting Relays Operated</u>
1	Aar, Bar
2	Abr, Bbr
3	Acr, Bcr
4	Aar, Bar, Aadr, Bdr
5	Abr, Bbr, Aadr, Bdr
6	Acr, Bcr, Aadr, Bdr

If a figure above "6" has been dialled in error, the pair of counting relays Aar, and Bar operate for the 7th pulse and remain locked. The 8th and following impulses cannot be stored the circuit for Abr being opened at the right inner break of Bcr which remains operated in series with Acr over a make of Bdr.

At the end of the series of impulses Lmr releases and completes a circuit for the operation of relay Dcr:

- (12) Battery, primary winding Dcr, right middle make of Rcr, break of Lmr, make contact of one of the counting relays, left make of Lcr, ground.

Relay Dcr locks over its left inner make to ground at the make of Lbr and opens the operating circuit for the counting relays at its right outer break. Over its left outer make Dcr completes a circuit to operate relay Lrr. Relay Lrr at its make contacts bridges the break contacts of the Clr relays and thereby prepares a locking circuit for each Clr relay independent of the Clr relay of the preceeding circuit.

5.1.3 Test of Called Party

Assuming that line number 6 is being called relay Rtr will test the line:

- (13) Ground, left make of Lcr, make of one of the counting relays, break of Lmr, right middle make of Rcr, winding of Rtr, right inner make of Bdr, right inner break of Aar, right make of Bcr, right outer breaks of Ftr6, Str6 and Llr6, winding Clr6, battery.

5.1.4 Called Line Free

If the called line is free none of the relays Ftr6, Str6 and Llr6 will be found operated and relay Rtr will operate in circuit (13). Relay Rtr has a high resistance winding and this prevents relay Clr6 from operating in circuit (13).

5.1.5 Ringling

Ringling current is produced by the regular reversals of current in the primary and secondary windings of transformer RC. The current reversals are produced by connecting ground alternatively to the primary and secondary windings.

The circuit to operate Ar is closed as follows:

- (14) Ground, make contact of Lbr, left inner make of Dcr, left middle make of Rcr, primary winding of Ar, battery.

The same ground is connected over the break of Ar to the primary winding of transformer RC. When Ar operates in circuit (14) it transfers the ground from the primary to the secondary winding of transformer RC and also completes a circuit to operate relay Br which is a slow releasing relay. When Br operates it closes a circuit for the secondary winding of Ar. The primary and secondary windings of Ar are connected opposing and Ar releases. When Ar releases it opens the operating circuit of Br which releases slowly. When Br opens its make contact Ar re-operates and the cycle is repeated. The continuous operation and release of Ar produces a variable flux in the primary and secondary windings of transformer RC. This variable flux induces an alternating voltage in the tertiary winding of transformer RC, which is used for ringling.

Periodic interruptions of ringling current are produced by relay Dir which operates and releases slowly under the influence of a 400 MF condenser connected in series with its primary winding.

When relay Rcr operates and connects ground to relay Dir, the two windings of this relay, connected opposing, create opposing flux of even value and relay Dir does not operate. However, the flux created by the primary winding gradually decreases due to the slow charge of the electrolytic condenser. At a moment the difference between the constant flux created by the secondary winding and the decreasing flux created by the primary winding becomes sufficient to operate Dir. The latter opens its break contact and permits the slow discharge of the electrolytic condenser. Dir is thereby maintained energized, the two windings being connected in series aiding.

When the flux produced by the condenser discharge current has decreased to such a value that Dir cannot be maintained operated, the latter releases and the cycle of operation repeats itself.

When Dir operates it short-circuits the tertiary winding of transformer RC by connecting battery over its right make to the tertiary winding. During the silent period battery from the right make of Dir is connected to the called station. The duration of the ringing period is approximately 1 second and that of the silent period approximately 2 seconds.

The ringer of the called party is operated as follows:

- (15) Battery, tertiary winding of transformer RC, winding Rgr, left middle make of Dcr, left inner break of Bar, right inner make of Acr, right outer make of Bdr, right outer break Lir,

(15) Cont'd

right breaks of Clr6, Llr6, Str6 and Ftr6, ringer of called party, left breaks of Ftr6, Str6, Llr6 and Clr6, ground.

At the same time the ringing tone is transmitted to the calling party as follows:

- (16) Battery, tertiary winding of transformer RC, winding Rgr, 1/10 MF condenser, make of Rtr, right outer make of Rcr, right break of Tgr, 1 MF condenser, left makes of Clr2, Llr2, Str2 and Ftr2, calling line loop, right inner breaks of Ftr2, Str2, Llr2 and Clr2 primary winding Lxr, secondary winding Asr, battery.

5.1.6 Reply of the Called Party

When the called party answers, relay Rgr operates in circuit (15) and opens locking circuit (6) for relay Rcr, which releases and in turn releases relays Ar and Br stopping the production of ringing current.

At its left break Rcr short-circuits the winding of Rtr which releases and relay Clr6 operates in circuit (13).

Relay Llr, operates in the following circuit:

- (17) Battery, winding Llr2, right outer make of Clr2, left outer breaks of Bx1r and Bx2r, right breaks of Fcr and Rcr, break of Lmr, left outer make of Bcr, left make of Lcr, ground.

Relay Llr6 of the called line operates in a circuit similar to circuit (17).

Relays Llr2 and Llr6 transfer the calling and called parties from the common circuit to the link circuit operating relay Lsr which completes a locking circuit for Llr2 and Llr6.

When Llr2 and Llr6 operate, they open the circuit for Asr which releases and in turn releases all relays of the common circuit. When relay Lcr of the common circuit releases it opens the locking circuit for Clr2 and Clr6 and these relays release.

Talking battery is supplied through the winding of relay Lsr and the conversation between the called and the calling parties takes place.

When after the conversation both parties release, relay Lsr releases and causes the release of both relays Llr.

5.1.7 Called Line Busy

If the called line is found busy, relay Rtr will not operate as circuit (13) will be open at either Ftr, Str or Llr. The ringing circuit (15) will also be opened at either Ftr, Str or Llr and interrupted busy tone will be connected to the calling party:

- (18) Ground, secondary winding of the buzzer, non-inductive winding of Dcr, right outer break of Dir, right make of Dcr, break of Rtr, right outer make of Rcr, break of Tgr, 1 MF condenser to the "a" wire of the calling station loop.

The busy tone is interrupted by relay Dir as explained in paragraph (5.1.5). On hearing the busy tone the calling party should replace the receiver and may attempt to complete the connection after a while.

5.2 Outgoing City Call

5.2.1 Origination of a Call

To initiate an outgoing call the local party removes the receiver and waits for dial tone from the common circuit. The local party then depresses the transfer button causing the operation of the differentially wound relay Lxr from direct ground.

If the first trunk is found free, a circuit is closed for operating relay Rl1r:

- (19) Battery, winding Rl1r, left break of To1r, right inner break Cx2r, right inner make of Rcr, right make of Lxr, right outer breaks of Bcr and Bbr, left break Aar, left make of Ler, ground.

Relay Rl1r closes circuits for all the Ftr relays to the Clr relays but only Ftr2 will operate as follows:

- (20) Ground, winding Ftr2, right middle make of Rl1r, left outer make of Clr2, battery.

Relay Ftr2 transfers the local party's loop from the common circuit to the first trunk circuit and relay Ts1r operates over the local loop. Relay Ts1r operates Tb1r which completes a locking circuit for Ftr2:

- (21) Ground, winding of Ftr2, left outer make of Ftr2, left outer break of Ftr, right middle break of Tr1r, right make Tb1r, battery.

Relay Tb_{1r} also completes a circuit to operate relay To_{1r}. When relay To_{1r} operates, it opens the operating circuit of Rl_{1r} and makes the first trunk busy for other outgoing calls.

5.2.2 First Trunk Busy

If the first trunk is found busy when the outgoing call is initiated, relay To_{1r} is found operated and at its left make transfers the circuit to the second trunk causing the operation of Rl_{2r} as follows:

- (22) Battery, winding of Rl_{2r}, break of To_{2r}, left make of To_{1r}, right inner break of Cx_{2r}, right inner make of Rcr, right make of Lxr, right outer breaks of Rcr and Bbr, left break of Aar, left make of Lcr, ground.

Relay Rl_{2r} completes a circuit from the Str relays to the Clr relays but only Str₂ will operate in the circuit:

- (23) Ground, winding of Str₂, right middle make of Rl_{2r}, left outer make of Clr₂, battery.

Relay Str₂ transfers the local party's loop from the common circuit to the second trunk circuit and relay Ts_{2r} operates over the local loop. Relay Ts_{2r} operates Tb_{2r} which completes a locking circuit for Str₂:

- (24) Ground, winding of Str₂, left outer make of Str₂, left outer break of Str₁, right break of Tr_{2r}, right make of Tb_{2r}, battery.

Relay Tb_{2r} also completes a circuit to operate relay To_{2r}. Relay To_{2r} opens the operating circuit of Rl_{2r} and makes the second trunk busy for outgoing calls.

5.2.3 Both Trunks Busy

If both trunks are busy when an outgoing call is initiated, relay Tgr operates:

- (25) Battery, primary winding of Tgr, left make of Lxr, right inner make of To1r, left outer make of To2r, ground.

Relay Tgr locks over its secondary winding to ground at the left make of Lcr and over its right make connects busy tone to the calling party:

- (26) Ground, secondary winding of buzzer, non-inductive winding of Dcr, right outer break of Dir, 1/10 MF condenser, right make Tgr, 1 MF condenser to the "a" wire of the calling party's loop.

The interruptions of the busy tone are produced by relay Dir from the left make as described in paragraph 5.1.5.

On hearing the busy tone, the calling party should replace the receiver and may attempt to complete the connections after a while.

5.2.4 Releasing the Common Circuit

Assuming that one of the trunks is free, either relay Ftr2 or Str2 will operate and transfer the calling party's line to the free trunk circuit. The circuit of Asr of the common circuit is thereby opened and the common circuit is released.

5.2.5 Call Originated at the Exchange

When the first trunk is seized by a calling party relay Tx1r is operated.

- (27) Battery, secondary winding Ts1r, primary winding of differentially wound relay Tx1r, right make Ftr2, "a" wire of calling party's loop, ground on the "b" wire at the transfer button.

As soon as the transfer button is released, relay Ts1r is released and a circuit is closed for the operation of relay Lx1r:

- (28) Battery, left inner break of Bx1r, left break of Tx1r, right inner break of Lx1r, winding Lx1r, left make of Tb1r, break of Th1r, ground.

When Lx1r operates it locks over its right inner make, and the non-inductive winding of To1r to battery. Over its left middle make it completes a circuit to maintain To1r operated.

The call is originated at the exchange by a loop closed as follows:

- (29) "a" wire of trunk line, right inner make of Em1r, left outer make of Lx1r, 200W retardation coil, left make of Ts1r, right outer make of Lx1r, left inner make of Em1r, "b" wire of trunk line.

5.2.6 Local Party Dial City Subscriber's Number

If the central office is automatic, the local party awaits dial tone and upon receiving it he dials the number of the wanted subscriber. Relay Ts1r follows the dial impulses and repeats them to the central office. Relay Tb1r is a slow release relay and holds the circuit during dialing. While dialing impulses are being repeated, the

left make contact of Ts₁r is shunted by a IMF condenser in series with the 100W non-inductive winding of Ax₁r.

If the central office is manual the city operator requests thenecessary information from the calling party and completes the connection.

5.2.7 Release of the Connection

At the end of the conversation when the calling party restores his receiver the local loop is opened, relay Ts₁r releases and in turn releases Tb₁r and Lx₁r which opens the loop towards the central office. If the central office is automatic theconnection is released immediately. If the central office is manual a signal indicating the end of the conversation is given.

5.2.8 Call Initiated by a Restricted Party

If a restricted party endeavors to obtain an outgoing city connection, relays Ftr and Str of the calling party's line cannot operate and a city connection is therefore unobtainable..

5.3 Incoming City Call

5.3.1 Instantaneous Busy

When a trunk is seized at the city exchange the reversal of polarity in the city exchange causes the operation of relay Bh₁r.

- (30) Battery, "b" wire of trunk left inner make of Em₁r, right outer break of Lx₁r, winding Bh₁r, ground.

Over its make Bh₁r operates To₁r which transfers the common circuit lead from the first trunk to the second trunk making the first trunk busy to outgoing calls.

5.3.2 Incoming Call Signal

The calling signal is given by ringing current applied to the line causing relay Tc₁r to operate.

Relay Cx₁r operates in turn and locks in the following circuit:

- (31) Battery, secondary winding Cx₁r, left inner make of Cx₁r, left break of Tb₁r, break of Th₁r, ground.

Relay Cx₁r completes a circuit to ring the common bell and at the same time operates relay Tg₁r which connects busy tone to the common circuit. Should a local party be busy in a call back connection, he is invited to free the common circuit and permit the answering of the incoming call.

After each ringing period when relay Tc₁r releases a circuit is completed to the thermostatic relay Th₁r.

- (42) Battery, winding Th₁r, non-inductive winding of Cb₁r right middle make of Cx₁r, break of Tc₁r, ground.

If the call is not answered and is given up at the city exchange, relay Th₁r will operate and release Cx₁r freeing the circuit.

5.3.3 Reply to the Call

A local party replies to an incoming call by

removing his receiver and depressing the transfer button. If the call is originated over the first trunk, relay Ftr of the calling line is caused to operate and transfers the calling line from the common circuit to the trunk circuit.

As soon as the trunk connection is established and the loop is closed to the exchange in circuit (29), the ringing is tripped and the through connection is established.

The call may now be transferred to the wanted party as described in paragraph 5.5

If the call is originated over the second trunk, relay Cx2r instead of Cx1r is found operated. Rl2r instead of Rl1r operates when a local party replies to the call and connects thereby the answering party to the second trunk even though the first trunk may be free at this time.

The connection is established as previously explained and relay Cx2r releases as soon as Tb2r operates.

5.4 Call Back

5.4.1 Origination of a Call

When a local party, during the course of an exchange connection, desires to obtain information from another local party he may place a "hold" on the trunk and then set up a local call.

To establish a call back connection the local party depresses the transfer button associated with his set. By so doing he connects a direct ground to the "b" wire, short-circuiting the secondary winding of Tx_{1r} (if the connection is over the first trunk) or Tx_{2r} (if the connection is over the second trunk). Relay Tx_{1r} operates over its primary winding in series with the secondary winding of Ts_{1r}. Relay Tx_{1r} operates Ax_{1r}:

- (33) Battery, left inner break of Bx_{1r},
left make of Tx_{1r}, winding Ax_{1r}
left inner make of Lx_{1r}, ground.

When the transfer button is released relay Ax_{1r} locks in series with Bx_{1r}:

- (34) Battery, winding Bx_{1r}, right outer
make of To_{1r} left middle make of
Ax_{1r}, winding Ax_{1r}, left inner make
of Lx_{1r}, ground.

5.4.2 Common Circuit Free

Relay Cb_{1r} operates in the following circuit:

- (35) Ground, left outer break of Cb_{2r},
primary winding Cb_{1r}, right outer
make of Bx_{1r}, right make of Tb_{1r},
battery.

The local party's line is now disconnected from the trunk and the trunk is held by the 200W retardation coil:

- (36) "a" wire of trunk, right inner make
of Em_{1r}, left outer make of Lx_{1r},
200W retardation coil, right inner
make of Bx_{1r}, left inner make of
Em_{1r}, "b" wire of the trunk.

The local party's line circuit is now connected to the common circuit:

- (37) "a" wire of local party's line, left inner make of Ftr, 2MF condenser, right outer make of Ax₁r, right middle make of Cb₁r, "a" wire of common circuit. "b" wire of local party's line, right inner make of Ftr, 2 MF condenser, right middle make of Bx₁r, right inner make of Cb₁r, "b" wire of common circuit.

Relay Fcr of the common circuit operates in the following circuit:

- (38) Battery, right break of Lbr, winding Fcr, left outer make of Cb₁r, ground.

Relay Fcr locks to battery over its left middle make. Over its right outer make Fcr bridges the break of Lsr and prepares the registering circuit for the counting relays. Fcr also operates Lbr and Lcr.

Relay Rcr operates in circuit (5) and causes the operation of the buzzer in circuit (7). Dial tone is transmitted to the calling party over the "a" wire of the common circuit and the 2 MF condenser.

On receiving dial tone the local party dials the number of the wanted party. The dial impulses are repeated by relay Ts₁r and cause the operation of the counting relays in the following circuit:

- (39) Ground, right break of Ts₁r, right outer make of Cb₁r, right outer break of Cb₂r, left break of Asr, right outer make of Fcr, right outer break of Dcr, right inner breaks of Bbr and Bar, winding Aar, battery.

The counting relays are operated in succession in the same way as described in paragraph 5.1.2.

The connection is established in the same way as for a local call with the exception that talking battery for the calling party is supplied from relay Ts₁r and for the called party from relay Asr. The trunk circuit is connected to the common circuit over two 2 MF condensers as described in circuit (37).

The right middle break of Fcr opens the operating circuit of Ll₁r and prevents its operation.

When at the end of the call back connection the local party wishes to re-establish the trunk connection, he momentarily depresses the switchhook causing the release of relay Ts₁r and Tb₁r. Relay Lx₁r is maintained operated in the following circuit:

- (40) Battery, non-inductive winding of Tc₁r, right inner make of Lx₁r, winding Lx₁r, left inner make of Ax₁r, break of Th₁r, ground.

Relay Lx₁r maintains relays Tc₁r, Ax₁r and Bx₁r operated whereas relay Cb₁r, controlled from Tb₁r, releases and in turn releases Fcr and the common circuit relays. When the switchhook is released, the local party depresses the transfer button for a second time operating

Tx_{1r} as previously described and releasing Ax_{1r} by short-circuiting its winding:

- (41) Ground, left inner make of Bx_{1r},
make of Tx_{1r}, winding of Ax_{1r}.

Relay Bx_{1r} remains operated from ground at its left inner make under control of Tx_{1r}.

When the transfer button is released relay Tx_{1r} releases and opens the circuit for Bx_{1r} which also releases and re-establishes the trunk connection. The conditions of the circuit now are the same as before the call back was made.

5.4.3 Common Circuit Busy

If the common circuit is engaged on a call back connection originated from the second trunk the operating circuit of Cb_{1r} is opened at the left outer break of Cb_{2r}, therefore Cb_{1r} cannot operate and busy tone in connected to the local party attempting the call back:

- (42) Ground, secondary winding of the buzzer, non-inductive winding of Dcr, right outer break of Dir, 1/10 MF condenser, left inner make of Cb_{2r}, right outer make of Ax_{1r}, 2 MF condenser, "a" wire of local party's loop.

The busy tone serves as an indication to the local party that the call back cannot be established.

5.5 Transfer

When a local party engaged on a city connection desires to transfer the call to another local party, he

establishes a "call back" as described in paragraph 5.4. If the called subscriber accepts the call and provided he is not restricted from exchange service, the transfer takes place as described below.

When the call back connection has been established and the called party has replied, the calling party depresses the transfer button, without having previously depressed the switchhook. Relay Trlr operates when the transfer button is depressed:

- (43) Battery, winding Trlr right inner break of Axlr, left middle make of Cblr, right inner make of Fcr, make of Asr, ground.

It should be noted that Trlr will operate only if the called party has answered which is indicated by the operation of relay Asr. Relay Trlr locks under control of Cblr and operates Rlr. Relay Rlr completes a circuit for operating Ftr of the called party's line. At the same time relay Ftr of the calling party's line releases its locking circuit being opened at the right middle break of Trlr.

When the transfer button is released relay Txlr releases and opens the circuit to Bxlr which releases slowly. The release of Bxlr releases Cblr which opens the circuit of Trlr. Relay Trlr in releasing opens the circuit for Rlr which releases slowly, to insure that the locking circuit for Ftr is closed before its operating circuit is opened.

Relay Ts₁r is re-operated from the called subscribers loop and Tb₁r remains operated.

It should be noted that the release time of Bx₁r is sufficient to prevent an opening of the trunk and release of the city connection.

The conditions of the circuit after the transfer are the same as before. The local party is now connected to the city and may in turn establish a call back, and transfer the city connection.

5.6 Transfer to a Restricted Party

In case the call back connection has been established to a local party that is restricted from city exchange service relay Ftr or Str will not operate when the calling party depresses the transfer button. When a local party is restricted from city exchange service the leads from relays Ftr and Str of the restricted line to the corresponding make contact of Rl₁r or Rl₂r are opened.

Should a local party attempt to transfer a city exchange connection to a restricted party, relay Tr₁r in operating opens the locking circuit for relay Ftr of the calling party causing the release of Ftr and Ts₁r. Since no other Ftr relay operates, relay Tb₁r will release and free the trunk circuit.

M.A. BISK
M.A. BISK

Clifton, N.J.
Sept. 12, 1946
U.S.A.
EOC/gr/ag














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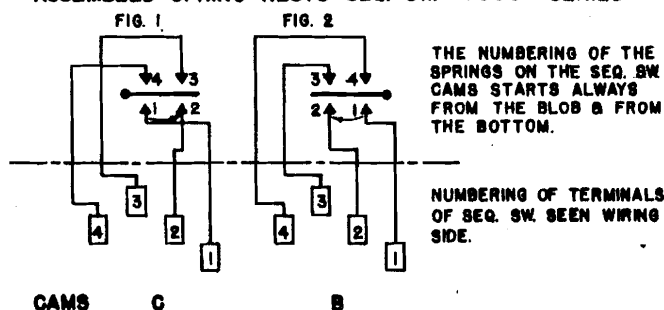
Federal Telephone and Radio Corporation

SWITCHING SYSTEMS DIV. NEWARK, N. J., U. S. A.

DRAWN: <i>M.F.</i>	CHK'D: <i>L.R.H.</i>	CH. DRFT: <i>A.H.</i>
ENGINEER: <i>P.H.</i>		APPROVED: <i>NS. 3-25-43</i>

- INDICATES:**
-  EARTHLUG ON MOUNTING PLATE.
 -  INSULATED PUNCHING ON MOUNTING PLATE.
 -  SELECTOR TERMINAL. FIGURE INSET MEANS THE NUMBER OF THE TERMINAL.
 -  TERMINAL OF TERMINAL STRIP.
 -  TERMINAL PUNCHING.
 -  TOP SET CONTACTS OF APPARATUS.
 -  MIDDLE SET CONTACTS OF APPARATUS.
 -  BOTTOM SET CONTACTS OF APPARATUS. FIGURE NEAR THE CONTACT MEANS THE ACTUAL LOCATION OF THE TERMINAL OF THAT CONTACT.
 -  IN(I) AND OUT(Q) OF WINDINGS.
 -  IN(I) AND OUT(Q) OF INNER(P) AND OUTER(S) WINDINGS.
 -  STRAP 5 OCTS.
 -  TERMINAL OF PANEL.
 -  SCREENED WIRE. (SHIELDED)

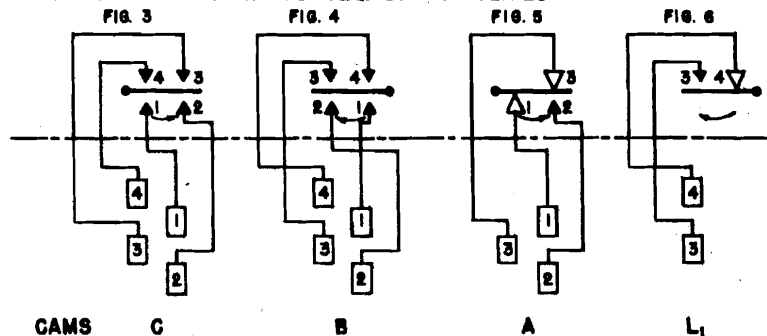
ASSEMBLED SPRING NESTS SEQ. SW. "7000" SERIES



SEQUENCE SWITCH CAMS & SPRING COMB. ARE SHOWN IN SCHEMATIC & W.D. AS IN FIGS. 1, 2, 3, 4, 5, 6, 7.

SPRING NO. 1 LEFT INNER (L.I.)
 " NO. 2 LEFT OUTER (L.O.)
 " NO. 3 RIGHT OUTER (R.O.)
 " NO. 4 RIGHT INNER (R.I.)

MOLDED SPRING NESTS SEQ. SW. "U" SERIES



THE NUMBERING OF THE SPRINGS ON THE SEQ. SW. CAMS STARTS ALWAYS FROM THE BLOB & FROM THE BOTTOM.

NUMBERING OF TERMINALS OF SEQ. SW. SEEN WIRING SIDE.

ISSUED JUNE 1, 1946 *MS/PM*
 ISSUE: 1 MARCH 13, 1948.

WIRING DIAGRAM SYMBOLS
 (FOR MAINTENANCE)

NSE-97800