EDITION IVa

PRIVATE AUTOMATIC EXCHANGE

SYSTEM 27/4

Instruction Manual

A ITT PRODUCT

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C O N T E N T S :

285/H

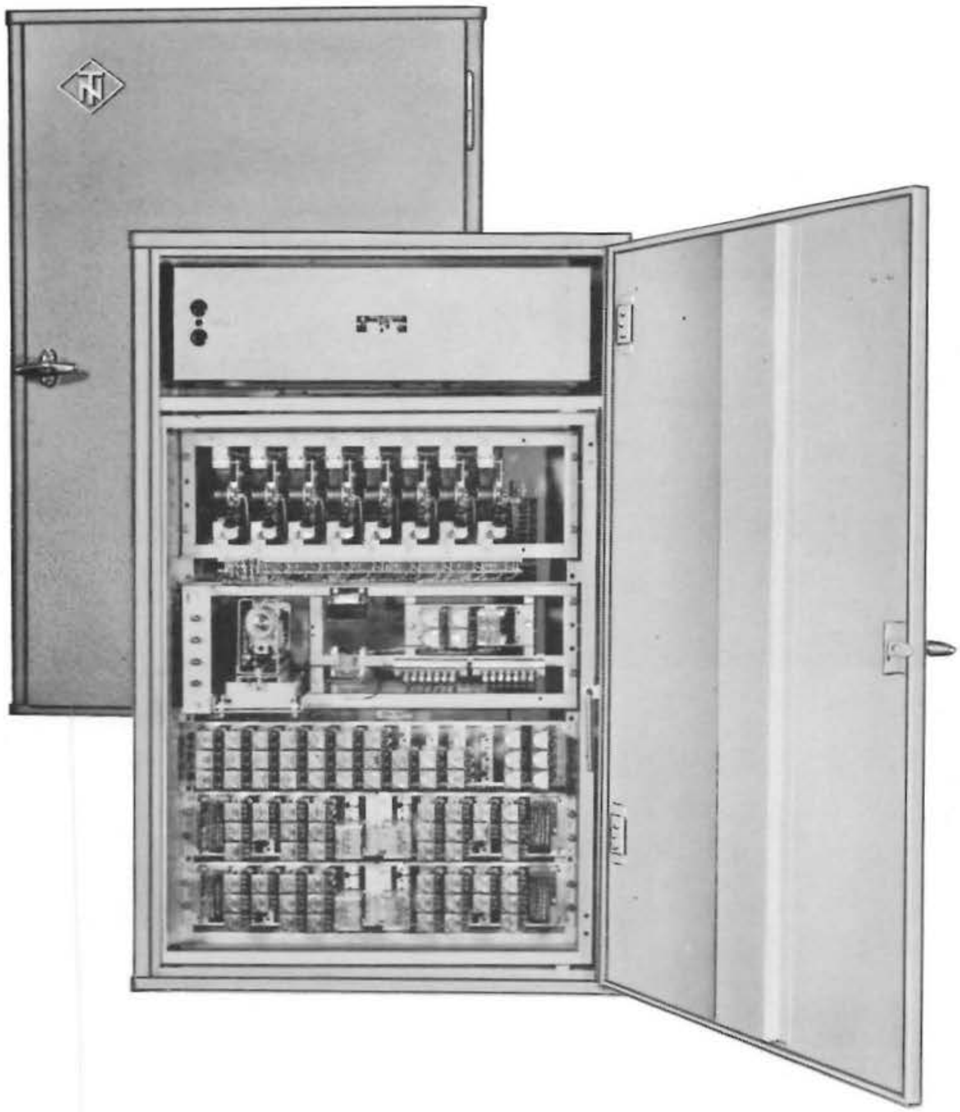


Fig. 1 TN Private Automatic Exchange 27/4
Cat. No. 24022/50
(Door open)

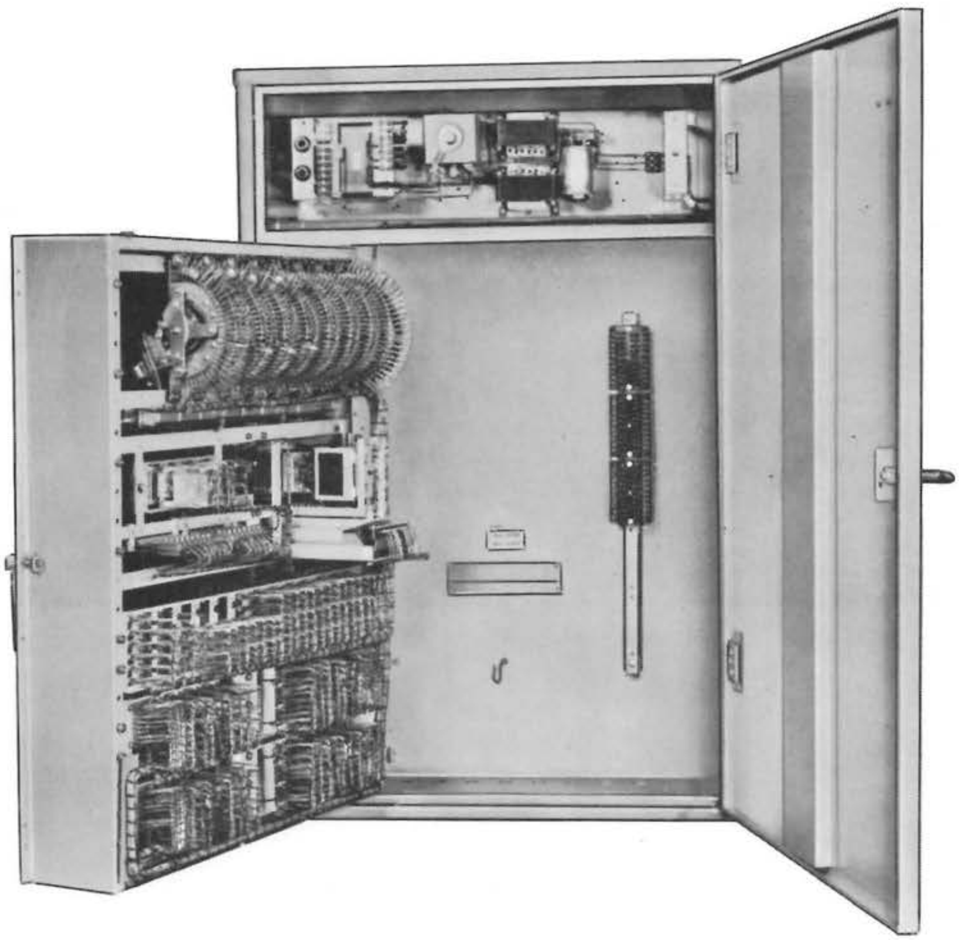


Fig. 2 TN Private Automatic Exchange 27/4
Cat. No. 240022/40
(Relay rack open and cover of battery
eliminator removed)

TN PRIVATE AUTOMATIC EXCHANGE 27/4

A) GENERAL DESCRIPTION

The TN Private Automatic Exchange 27/4, as illustrated in figs. 1 and 2 is equipped to provide automatic telephone intercommunication facilities to a maximum of 27 lines with 4 connecting links allowing a maximum of 4 simultaneous conversations; in other words, of the 27 lines 8 may be engaged in conversations at the same time.

The TN Private Automatic Exchange operates in the same manner as a Public Automatic Exchange and in conjunction with standard dial telephones. The conversations are absolutely secret.

Connections are established as follows:
The calling party lifts the receiver and listens for the dial tone. This dial tone consists of a continuous hum. The calling party then dials the number assigned to the called party. If the called party is engaged, a busy tone is transmitted to the calling party. The busy tone is an intermittent hum (once every half second). The calling party must replace the handset before attempting to dial again. In case the called number is free, ringing current is transmitted immediately after the dialling is completed and every five seconds thereafter. The called phone rings accordingly and a ringing tone is transmitted to the calling party at identical intervals. The ringing current and ringing tone are automatically cut off when the called party lifts its receiver and the connection is established. The equipment releases after both parties replace their handset.

The PAX 27/4 is equipped with optional executive priority. Executives provided with this facility are to be supplied with phones equipped with a priority button. In case that after dialling a party, the station is found to be engaged in a conversation, the executive equipped with a priority phone may, by pressing the priority button, exercise his priority at his discretion and cut in on the existing conversation. The parties involved may be signalled by a ticker signal on the line to prevent "snooping".

The Exchange is pre-wired for remote fuse alarm, group hunting and through dialling.

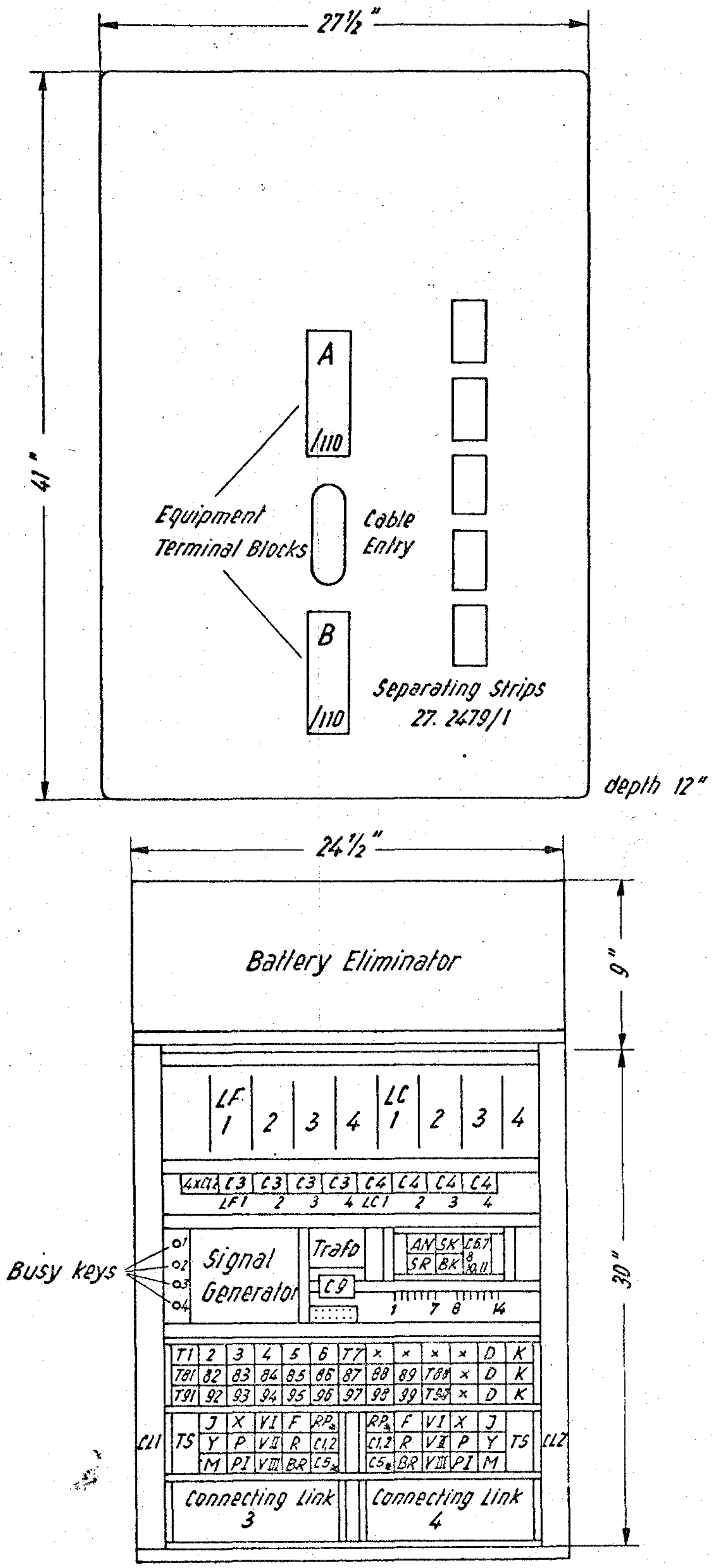
It is furthermore possible to connect:

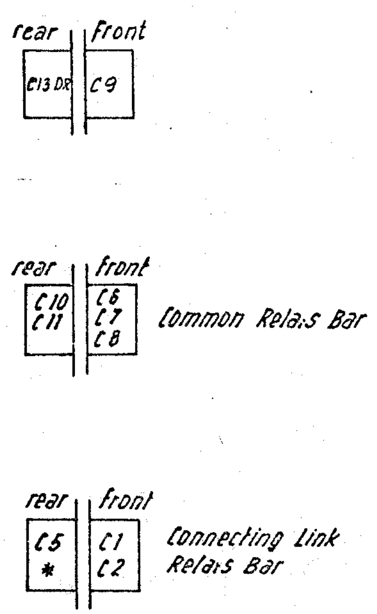
- Executive phones with 10 direct call buttons,
- conference facilities,
- tie-lines to another PAX or PBX,
- automatic paging either by audible and visible signals or through a PA-system,
- watchman control equipment utilizing standard telephone sets as control points.

The equipment is mounted in a metal wall cabinet with an attractive wrinkle lacquer finish. The completely enclosed cabinet also contains the power supply which provides the 24V DC operating current. The power supply may be connected to 110 - 125 - 150 - 220 or 250V, 50 or 60 cycles. For the location of the component parts see drawing 24022/50 A E.

The relays and selectors are mounted on a hinged metal frame and therefore easily accessible.

Each of the connecting links, which are available to all lines, consists of a line-finder, a line-connector and associated relays and is equipped with a terminal strip TS. For the numbering arrangement of this strip see drawing 24022/50 L E. The selectors are mounted on rubber shock absorbers ensuring a smooth and almost silent operation. Therefore, the PAX does not require a closed-in location, but may be installed in a convenient spot anywhere in an office. A patented driving mechanism reduces wear to an absolute minimum.





C1 - C4 = 2 MF C10 = 1 MF
C5 = 4 MF C11 = 0,2 MF
C6 - C8 = 0,1 MF C12 = 0,1 MF
C9 = 4 MF C13 = 1000 MF

* Installed only if required

Issue I	Issue	Date	Issue	Date
Drwn. 18.2.52	II	10/2/64	V	
Chckd.	III		VI	
Appr.	IV		VII	

Private Automatic Exchange for
27 Stations, 4 Connecting Links
Location of Component Parts

24022/50 A II E

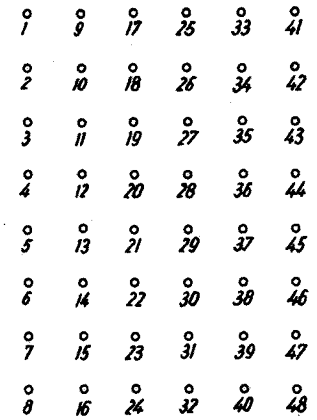
The relays are very sturdy and compact and utilize twin-contacts of precious metal. They are factory adjusted and do not require any additional adjustments.

All audible signals as well as the ringing current are produced by an interchangeable rotating generator which is only in operation when any of the signals or the ringing current are actually required.

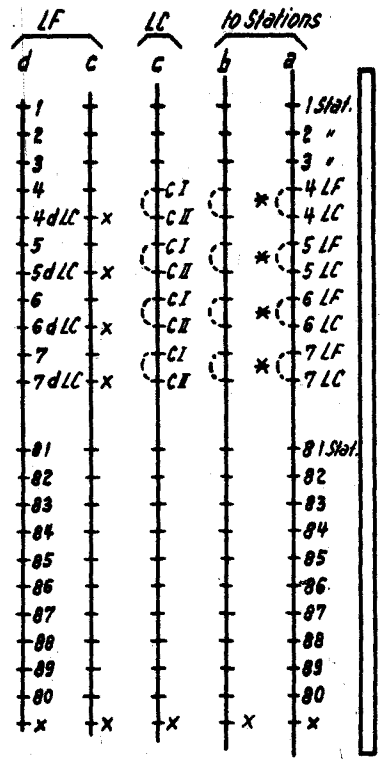
The lines from the telephone instruments are connected to separating strips on the rear wall of the cabinet and from there cross-connected to the equipment terminal blocks A and B (for terminal arrangement see drawing 24022/50 L E). Stations may be removed from service by merely pulling U-links on the separating strips without requiring unsoldering or unscrewing.

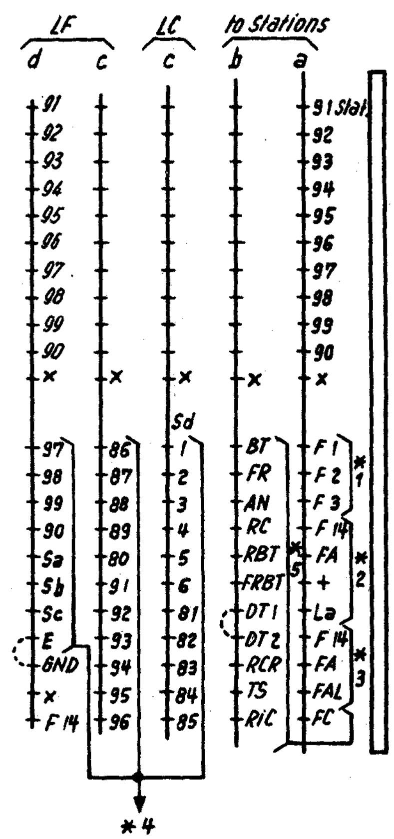
The maximum loop resistance per line is approximately 400 ohms, therefore phones may be connected at a distance of up to 4000 yards from the PAX when utilizing wire No. 22 A.W.G. For longer wire runs a heavier gauge wire is to be used.

The complete unit is unusually compact. It measures approximately 41" x 27" x 12" and weighs, fully equipped, about 210 lbs. A special wall mounting frame is supplied for a solid and reliable installation.



Numbering arrangment of terminal strip "TS" of the connecting links.





* Remove straps for connection of auxilliary equipment (a, b, cII, d from LC for search- seize- or answering numbers.

*1 to busy indicators

*2 to external DC power supply (if used)

*3 to control panel (if used)

*4 to stafflocator with post-dialling

*5 Signals for auxilliary equipment

x free terminals

Issue I	Issue	Date	Chkd.	Is
Drwn. 19.12.58 KR	II			V
Chkd.	III			V
Appr.	IV			V

Private Automatic Exchange fo
27 Stations - 2 Connecting Links
with built-in Battery Eliminator

B) INSTALLATION INSTRUCTIONS

1. Location of the Switchboard

In order to reduce the station wiring to a minimum, it is advisable to locate the switchboard as centrally as possible. The best method is to locate the individual telephones on a floor plan of the building or offices concerned, and after establishing the location of the individual phones, it will not be difficult to find a relatively central location for the switchboard. Care should be taken that the switchboard itself is located in a well ventilated, dry location which is accessible at all times for maintenance. A regular AC outlet should be in the immediate vicinity.

2. Station Wiring

Each regular station requires a single twisted pair between switchboard and telephone. Telephones equipped with a priority button require, in addition to the regular pair, a third wire. This wire may either be connected to the ground terminal of the switchboard or to a common ground, such as cold water pipe, provided the exchange is connected to the same ground.

Where the maximum run between switchboard and station does not exceed 4000 yards, wire gauge No. 22 A.W.G. may be used. Where longer runs are required, it is necessary to use a larger gauge wire in order to keep the loop resistance within the allowed 400 Ohm.

The station wiring should be run in such a manner that it is protected as much as possible from mechanical damage. Needless to say, that for a good installation the wiring should be installed as inconspicuously and neatly as possible. The wiring should also be fastened securely by means of staples at short intervals to prevent the wiring from becoming loose.

The location of the telephone sets should be carefully considered when installing the station wiring and the ultimate users should be consulted to this effect. For example, some persons prefer to have their telephones on the left hand side, other users prefer the telephone set to be located on the right hand side of their desk, or for that matter, on a special telephone table.

The wiring should be installed in such a manner that the connecting cord of a telephone set does not hang on the floor so that people will trip over it thereby damaging same.

When installing wall telephones, the height above the floor should be governed by whether the telephone is to be used from a sitting or from a standing position.

3. Installation of the Switchboard

The switchboard is designed for wall installation, and a special mounting bracket for this purpose is included with every switchboard.

The mounting bracket is to be securely fastened to the wall in such a manner that the notched ends of the U-bars are on the top, facing the switchboard.

After the mounting frame is installed, remove the two machine bolts on the bottom part of the frame. The switchboard is attached to the bracket by lifting it in such a manner that the ears on the rear side of the switchboard slip over the notched ends of the U-bars. After opening the switchboard and swinging out the hinged relay and selector frame, it is possible to insert the two machine bolts in the lower part of the cabinet thereby securing it to the mounting bracket.

4. Connecting the Lines to the Switchboard

The incoming station wires are run between the switchboard and the wall, and should enter the switchboard cabinet through the hole in the rear wall of the switchboard cabinet. From there they are connected pair by pair to the right hand side of the distributing blocks on the right hand side of the back of the cabinet.

After the station wires have been connected, it is possible to cross-connect the station wiring to the equipment terminals on the left hand side of the rear wall of the cabinet.

Before cross-connecting the station wiring, it is advisable to assign the available numbers to the individual stations. The call numbers available are 1 - 7, 80 - 89 and 90 - 99. These numbers appear on the equipment terminal strip as indicated on fig. 3a.

Example:

> The telephone set connected to pair No. 12 of the distribution blocks has been assigned No. 88. The cross-connecting pair is then to be run from pair No. 12 on the left hand side of the distribution blocks through the bridle ring on the bottom center of the rear wall of the cabinet to terminals 88a and 88b of the equipment terminal strip.

Telephone sets with group hunting are to be assigned numbers in the group 1 - 7.

Telephone sets with priority button may be assigned any number in any of the three groups, provided of course, that the third wire is connected to the proper ground.

5. Group Hunting

The switchboard is equipped for group hunting, but in case group hunting is desired, it becomes necessary to adapt the wiring of the line connectors for this purpose. As previously mentioned, group hunting is only available for consecutive numbers in the group 1 - 7. The wiring of the line connectors is to be changed as follows:

a) The first seven terminals of the "e" bank of the line connectors are normally connected with each other by a slate wire.

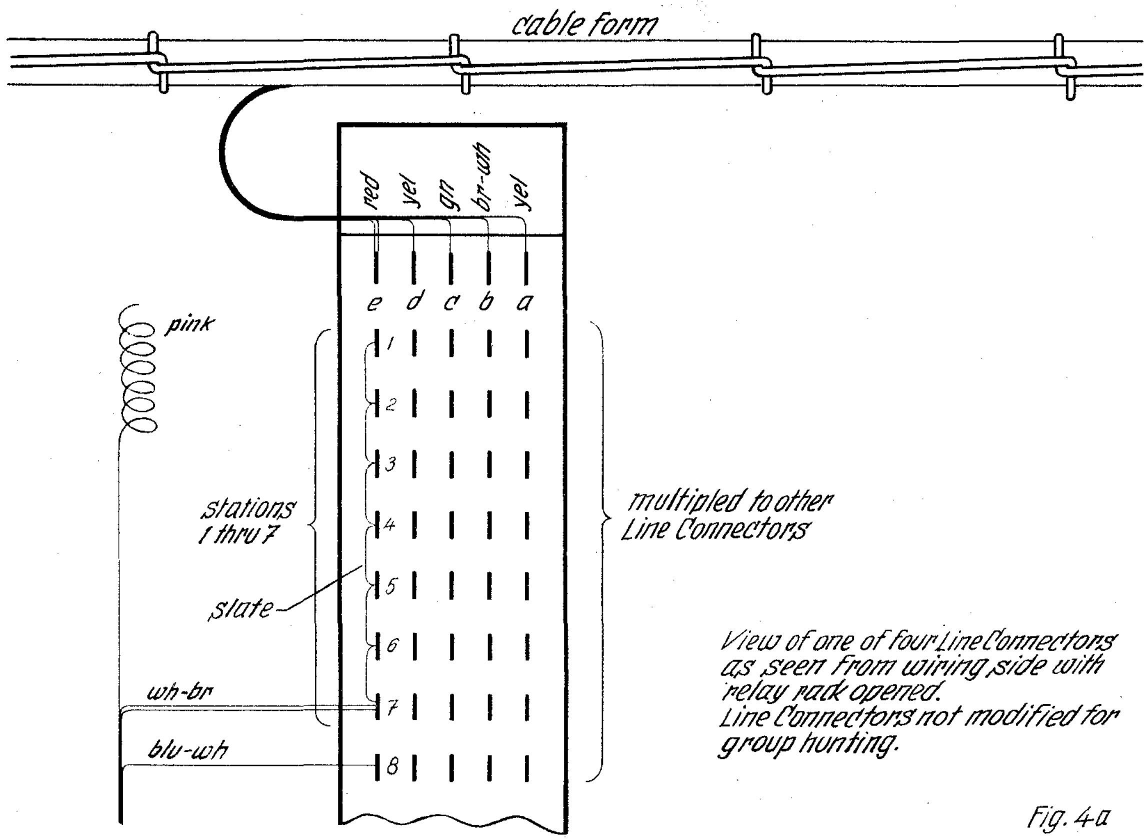
b) Establish the consecutive numbers that are to have group hunting. Remove the jumper wire between the terminals of the "e" bank of the numbers to be connected in group hunting - except the last terminal of the group. Care should be taken that the continuity of the slate wire is not interrupted.

c) Connect the pink wire of the cable form next to the selector bank to the first terminal of the number in the group with hunting facilities and from there to the consecutive terminals of the group except the last one.

d) Repeat the above steps for all line selectors and be extremely careful that no excess solder drops into the selector banks.

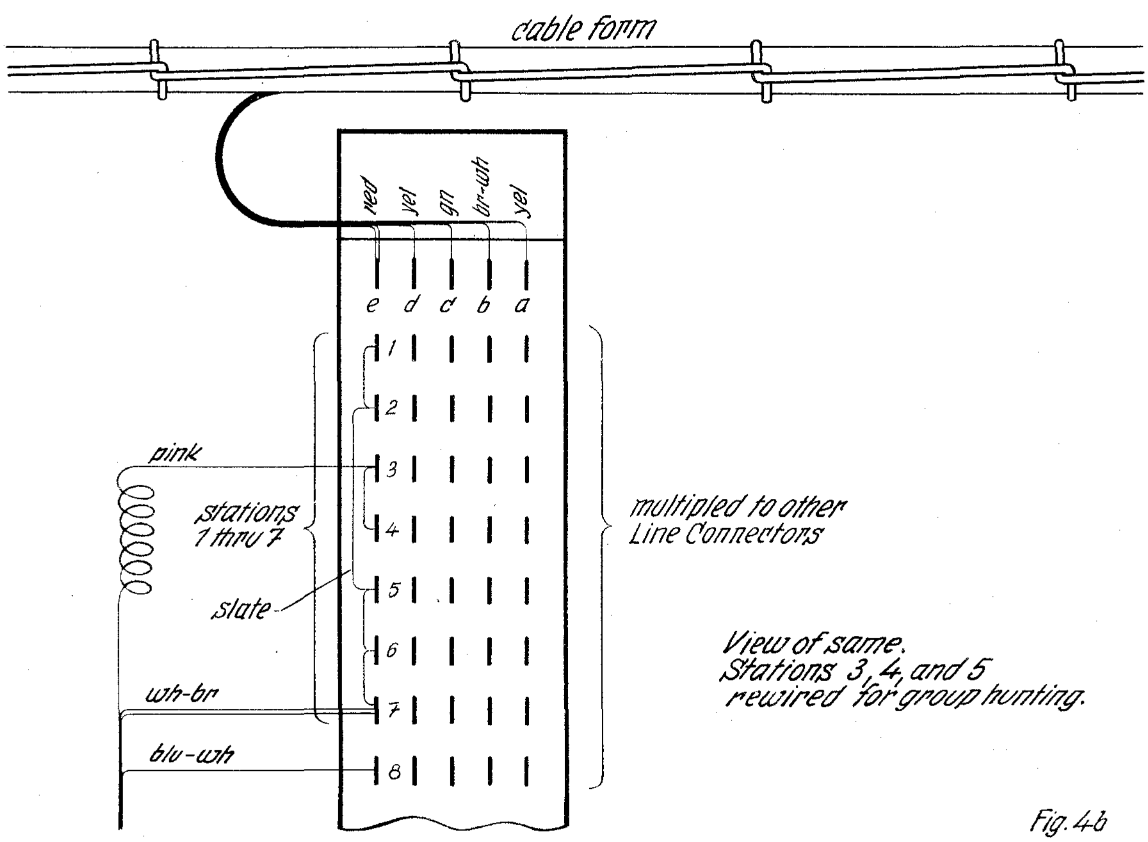
e) Fig. No. 4a and 4b illustrate how stations 3, 4 and 5 are wired for group hunting.

   1. Remove slate jumper from terminals 3 and 4.
   2. Install jumper wire between terminals 2 and 5.
   3. Connect pink wire to terminal 3 and connect terminal 3 to terminal 4.
   4. Repeat this procedure for all line selectors.



View of one of four Line Connectors as seen from wiring side with relay rack opened.
Line Connectors not modified for group hunting.

Fig. 4a



View of same.
Stations 3, 4, and 5 rewired for group hunting.

Fig. 4b

6. Connecting the PAX to the Power Source (see fig. 5)

a) Remove the cover from the built-in battery eliminator.

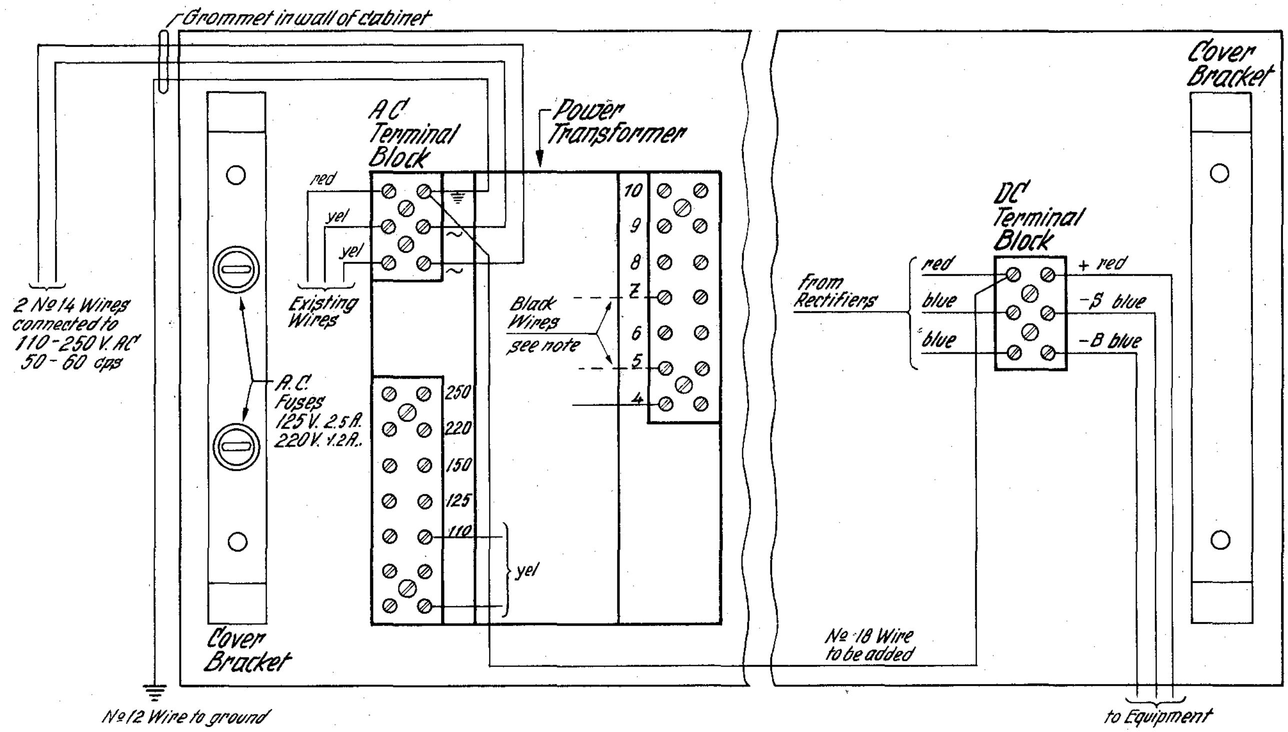
b) Determine the voltage of the AC power source to which the PAX is to be connected. The power supply is wired for 220V AC when leaving the factory. In case the AC power source is 110V, 60 cps, move the yellow wire of the terminal block marked "220" to the terminal marked "110" and replace the line fuses of 220V, 1.25 ampere to 110V, 2.5 ampere. These fuses are included in the shipment.

c) Insert the power cable through the entrance hole in the upper left side of the switchboard cabinet and connect the wires to the terminals marked "N" of the terminal block located on the power transformer which is mounted on the left hand portion of the power supply. Connect the ground terminal marked ⏚ to a solid ground using a No. 12 A.W.G. wire. Install at the same time a No. 18 A.W.G. wire between this ground terminal and the + terminal of the DC terminal block which is mounted on the right hand side of the power supply.

d) Measure the DC voltage between the terminals marked + and - S and between + and - B. The no-load DC voltage should be 30V. The DC voltage may be regulated by moving the black wires on the left hand side of the terminal block of the power transformer and marked 5 - 10 from one terminal to the other. Important: Do not remove wire from terminal "4".

7. Check Operation of completed Installation

a) Test connected lines for opens and shorts.
b) Make sure that all the handsets of the connected stations are in place.



Important: Fuses - For Connection to 110 - 150 V. AC: 2.5 A.
" " " 220 - 250 V. AC: 1.25 A.

Note: Black Wires shown in dotted lines may be moved to terminals 5-10 to obtain the required No-Load-Voltage of 30 V. DC and measured between + and −S + and −B.

Fig. 5

c) Connect the AC power to the switchboard.
d) Block out all connecting links with the exception of link No. 1.
e) Lift handset of a connected station, the first connecting link will be engaged, the ringing and tone generator should start and dial tone will be heard.
f) Dial another connected station. This phone should ring and ring-back tone will be heard in the same rhythem as the called telephone rings.
g) Lift handset of called station, the ringing current and ring-back tone should cease as the ringing and tone generator stops and the connection should be established.
h) Check transmission.
i) Replace handsets of both stations.
j) Lift handset of a telephone.
k) Lift handset of a second telephone.
l) Dial from the first telephone the number of the second telephone, busy tone should be heard.
m) Repeat the same test procedure as described in positions d) to l) with the remaining connecting links by blocking the previous link and unblocking the next link.
n) If installed, check Group Hunting as follows: Lift receiver of first telephone in the group. Dial this first number from another station. The second telephone of the group should then ring. Repeat this procedure until all telephones of the group are busy. Then when dialling the first number of the group, busy tone should be heard.
o) If installed, check executive priority as follows: Establish a conversation between two stations. Dial one of these stations from a telephone equipped with priority button, Busy tone should be heard. Depress priority button momentarily and a three-way conversation should be established.

p) Check every connected telephone instrument by establishing one call and receiving one call and checking of transmission. Mark each telephone with its proper call number.

q) Unblock all connecting links.

8. Complete Switchboard Installation

a) Remove all red painted hardware which is used only during shipping.

b) Replace the cover of the power supply.

c) Restore the hinged relay-rack to its original position and close switchboard cabinet.

d) Remove all excess installation material from the job site.

C. MAINTENANCE

1. Introduction

As in any special field, it is generally considered necessary to use abbreviations. The abbreviations used in the communications' field consist of a number of symbols. Each one of the symbols has a specific meaning and they are used in all drawings and diagrams pertaining to TN equipment.

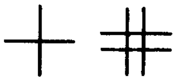
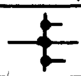
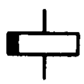
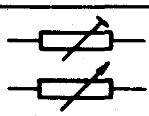
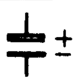
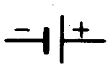
Before attempting to read the equipment diagrams, it is well advised to study the symbols on the next page.

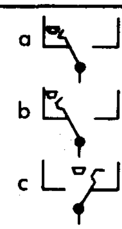
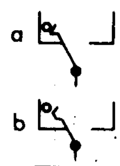
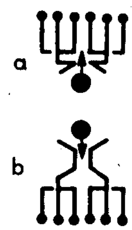
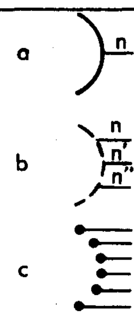
In addition to the symbols it is also necessary to have an understanding of the manner in which the circuit diagrams are to be read.

Relays used in telephone equipment may have one or more windings on the same core. These windings operate a relay independently, they usually function in separate circuits and are indicated in separate locations on the diagram. Sometimes the relays also accommodate non-active windings. These windings do not have any influence on the operation of the relays concerned. The active and non-active windings are identified by a capital letter designating the relay and by its corresponding winding terminals.

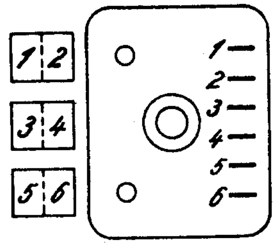
The relay contacts are not drawn according to their physical relation to the relay, but are spread over the drawing in such a manner as to reduce the lines on a diagram to a minimum in order to avoid confusion and to facilitate the tracing of a circuit.

The contacts are identified by a small letter corresponding to the relay designation and the number of the contact spring set.

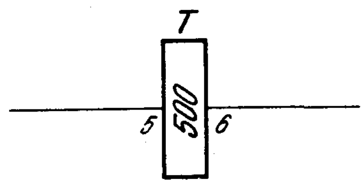
SYMBOL	DESCRIPTION
	CONDUCTORS, GENERAL
	CONDUCTORS, NOT FIXED
	CONDUCTOR CROSSING, W/O CONNECTION
	CONDUCTOR CROSSING, W. CONNECTION
	CONDUCTOR, BRANCHING
	CONDUCTOR, MULTIPLE BRANCHING
	GROUND
	MASS, E. G., METALLIC FRAME
	RESISTOR GENERAL
	RELAY, SLOWRELEASING
	VARIABLE RESISTOR
	REPEATING COIL TRANSFORMER
	CAPACITOR
	ELECTROLYTIC CAPACITOR, POLARIZED
	GALVANIC CURRENT SOURCE (DRY CELL BATT., WET CELL BATT.)
	MAKE CONTACT
	BREAK CONTACT

SYMBOL	DESCRIPTION
	CHANGE-OVER CONTACT
	MAKE BEFORE BREAK CONTACT
	CONTACT (E. G. CHANGE-OVER CONTACT) OF RELAY WHICH NORMALLY IS UNDER CURRENT
	BUTTON SWITCH CHANGE-OVER CONTACT
	BUTTON SWITCH AS CHANGE-OVER CONTACT a) WITHOUT LOCKING POS. b) WITH LOCKING: NORMAL, BUTTON PULLED c) WITH LOCKING: NORMAL, BUTTON PUSHED
	KEY SWITCH a) WITHOUT LOCKING b) WITH LOCKING
	KEY SWITCH WITH TWO POS. a) WITHOUT LOCKING b) WITH LOCKING
	CONTACT BANK a) GENERAL b) WITH SEVERAL GROUPS OF EXITS c) WITH INDICATION OF INDIVIDUAL STEPS
	LAMP
	DRY RECTIFIER

As seen from the rear of the relay, the numbering of the winding terminals and contact spring sets is as follows:

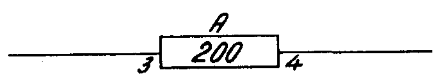


Active windings are indicated as follows:



T identifies the relay. The DC resistance of the winding is 500 ohms and the winding is connected to terminals 5 and 6.

Non-active windings are illustrated as follows:



A identifies the relay. The DC resistance of the winding is 200 ohms and the winding is connected to terminals 3 and 4.

The relay contacts are always drawn in their non-operated position.

In order to locate relay windings and contacts in a diagram, the diagram is sub-divided in squares with numerals from left to right and letters from top to bottom. The square number, giving the location of relay windings and contacts, is indicated in the description in parenthesis after the designation concerned, as well as on the diagram in the following manner:

Relay	Coil #	Square	1 2	Square	3 4	Square	5 6	6 5 4 3 2 1
V	3D-408a/1	H8	m	D13	b	G10	m	F10 G3 H8
		F13	c	C5	b	J9	c	

contact v 4 is located in square C5 and is a "break" contact,

contact v 1 is located in square H8 and is a "make" contact,

contact v 2 is located in square F13 and is a "change-over" contact,

active winding V 1-2 is located in square H8,

non-active winding V 5-6 is located in square F10.

Replacement coils for relays and selectors may be ordered by indicating the coil number applicable to this particular relay or selector. This number is always indicated on the coil.

Selectors and relays are to be adjusted according to factory supplied manuals.

2. Detailed Diagram Description

The diagram S3e - 5/7 VII E illustrates the circuits of a PAX 27/4. The maximum capacity of the switchboard is 27 lines and 4 connecting links. The lines are subdivided in 3 groups of call numbers: 1 - 7, 80 - 89 and 90 - 99. All connecting links are available to all call numbers.

The operating current for the PAX is 24V D.C. and provided by a built-in battery eliminator.

1) Party lifts handset and finds a free connecting link

Relays D 1-2 (F2) and T 3-4/5-6 (D2) operate in series, when station No. 1 lifts handset, via:

> Fuse F1 (E1) - Relay T 5-6 (D2) - Contact t 1 (C2) - a/b loop to station (B/C1) - Contact t 5 (C3) - Relay T 3-4 (D3) - Contact k 5 (E2) - Relay D 1-2 (E/F2) - Contact bk 2 (L1) - Ground.

After the operation of relays D and T they hold over:

> F1 (E1) - D 5-6 (E/F3) - d 6 (E3) - t 2 (D3) - T 3-4 (D3) - k 5 (E2) - D 1-2 (F2) - bk 2 (L1) - ground.

Contact d 2 (H3) closes the circuit for Relay K 5-6 (G3) via:

> Ground (H3) - Contact d 2 (H3) - Relay K 5-6 (G3) - Fuse F1 (E1).

Relay F 1-2 (F5) is energized over:

> Ground (H3) - Contact d 2 (H3) - Contact k 6 (H3) - Busy Key I (H4) - Contact br 2 (H4) - d-Contact LF (G5) - Relay F 1-2 (F5) - Fuse F4 (F4).

Relay VIII 5-6 (F4) is operated at the same time via:

> Ground (H3) - d 2 (H3) - k 6 (H3) - Busy Key I (H4) - br 2 (H4) - r 5 (G4) - VIII 5-6 (F4) - Fuse F4 (F4).

Contact k 2 (E1) connects a direct ground to Relay T 3-4. Relay D 1-2 (E3) releases but relay T holds itself over:

> Fuse F1 (E1) - D 5-6 (E/F3) - k 1 (E3) - t 2 (D3) - T 3-4 (D2) - k 2 (E1) - Ground.

Contact f 4 (H13) closes the circuit for the drive magnet of the line finder, D-LF (F12) in the following circuit:

Fuse F8 (F12) - D-LF (F12) - br 6 (G13) - f 4 (H13) -
j 2 (H13) - vIII 5 (H12) - Ground.

Contact d-LF (G5) opens the circuit for F 1-2 (F5), F releases and contact f 4 (H13) opens the circuit for D-LF (F12). The alternate operation of D-LF and F 1-2 rotates the line finder. After the release of Relay D 1-2 (F2), Relay K 5-6 (G3) is held in the first rotating step of the line finder via the ground connected to the e-wiper of the LF (G4).

Upon arriving on the bank-contacts of the calling number, Relay J 3-4 (D6) operates and Relay F 3-4 (D5) is held in series over:

Fuse F1 (E1) - T 1-2 (D3) - t 6 (C3) - c-wiper LF (C4) -
br 1 (D5) - F 3-4 (D5) - f 2 (D6) - J 3-4 (D6) - ground.

Contact j 2 (H13) opens the circuit for D-LF (F12) and j 4 (G8) removes the short for VI 1-2 (G9) which will now operate over:

Ground (F9) - VI 3-4 (F/G9) - VI 1-2 (G9) - j 4
(G8) - VI 5-6 (F/G8) - Fuse F4 (F4)

Contact vI1(G8) closes the circuit for VII (H8) and it operates via the following circuit:

Ground (I7) - e-wiper LC (I7) - VII 3-4 (H8) -
VII 1-2 (H8) - vI 1 (G8) - VI 5-6 (F8) -
Fuse F4 (F4).

Contact vI 2 and vI 6 (B/C6) connect the a/b loop through, Relay J holds itself and acts as feeding coil for the calling party in the following loop circuit:

Fuse F4 (F4) - X 1-2 (D6) - J 1-2 (C7) - vI 2 (B6) -
pI 2 (B5) - a-wiper LF (B4) - a/b loop (B/C1) -
b-wiper LF (C4) - pI 6 (C5) - vI 6 (C6) -
X 5-6 (C6) - J 3-4 (D6) - ground.

Relay X does not operate because the current runs in opposite directions through the two windings thereby cancelling the magnetic fields.

Contact vI 5 (D9) operates Relay AN (K10) as follows:

Ground (D9) - vI 5 (D9) - y 4 (E9) - an (F9) -
an (I10) - AN 1-2 (K10) - Fuse F12 (L10).

Contact an 6 (M11) starts the signalling generator and dial tone is induced on the line of the calling party through a third winding of Relay J via:

DT (I15) - DT (E7) - r 2 (D8) - J 5-6 (D8) -
j 6 (C8) - vI 4 (C7) - ground.

BR 3-4 (F11) is energized through vII 5 (G11). Contact br 2 (H5) opens the holding circuit for K 5-6 (G3) and transfers the remainder of the group 1 - 7 to the next available connecting link. K releases.

The circuit for Relay F 3-4 (D5) is interrupted by opening contact br 1 (D5) and F releases. T 1-2 (D3) is now held via c-wiper LF (C4), vI 5 (E4) and Ground.

Contact br 4 (G4) prepares a circuit for the next operation of F 1-2 (F5).

2) Party lifts receiver and finds all connecting links engaged

The br 5 (M4/5) contacts of all links are closed when all connecting links are engaged and Relay BK 1-6 (M3) operates.
Relay AN 1-2 (K10) is operated over:

Ground (L2) - bk 3 (L2) - an (I10) - AN 1-2 (K10) -
Fuse F 12 (L10),

and AN will start the signalling generator.
Busy tone is transmitted to the calling party as follows:

Signalling generator (M13) - Busy Tone BT (I13) -
BT (M1) - Condensor C 6 (M1) - bk 2 (L1) - D 1-2 (F2)
T 3-4 (D3) - subscriber loop

and transmitted to the party attempting to place a call.

3) Dialling of a number in the group 1 - 7

The release of the dial on the telephone instrument will cause interruptions in the loop circuit. The number of interruptions correspond with the dialled digit. The interruptions in the loop-circuit will cause Relay J (C/D6) to release and attract the same number of times, and contact j 6 (I5) transfers the dial impulses to Relay F 1-2 (F5) as follows:

Ground (I5) - vI 4 (I5) - j 6 (I5) - vII 6 (H5) -
p 5 (H6) - pI 5 (G6) - br 4 (G4) - d-LF (G5) -
F 1-2 (F5) - Fuse F4 (F4)

Pulsating contact f 4 (H13) will in turn operate the drive magnet of the line connector D-LC (F14) via:

Ground (H12) - vIII 5 (H12) - j 2 (H13) - f 4 (H13) -
br 6 (G13) - D-LC (F14) - Fuse F8 (F12).

During the first step of the line connector, Relay R 1-2 (F7) is activated through the ground on e-wiper LC (I7). This ground was the hold circuit for VII which will now be held for the duration of the impulse series via:

Ground - vIII 5 (I10) - r 1 (I9) - vII 2 (I9) -
f 1 (I8) - VII 3-4 (H8) - vII 1 (H8) - vI 1 (G8) -
VI 5-6 (F8) - Fuse F4 (F4)

because the shortcircuit of VII 1-2 (H8) by vII 1 makes VII slow-releasing.

BR 3-4 (G11) is now held over r 3 (H11) which also provides a permanent ground for the operation of D-LC (F14).

After the impulse series has been received f 1 (I8) will remain open and VII will release slowly. Contact vII 2 (I9) shorts VIII 1-2 (H8), VIII releases slowly and M 3-4 (H9) will now operate.

M 5-6 holds itself in the following circuit:

Ground - m 6 (H10) - y 6 (H10) - M 5-6 (H10) -
j 4 (G8) - VI 5-6 (F8) - F4 (F4).

The released VII closes with its vII 3 contact (D13) the test circuit for the LC before the release of VIII.

4) Dialling a number in the group 81 - 80

The calling party first dials the digit 8 and as described above, the LC will rotate to the 8th step. After dialling the first digit VII releases and M operates.

However VII is energized again before VIII releases completely:

Ground - e-wiper LC (I7) - step 8 - m 1 (H8) -

VII 3-4 (H8) - VII 1-2 (H8) - vI 1 (G8) -
VI 5-6 (G8) - F4 (F4)

and VIII is held.
The calling party dials the second digit and during the impulse series slow-releasing VII remains operated via f 1 (I8). After the second impulse series is received, VII will release and prepare the test circuit for the LC (see 3).

5) Dialling a number in the group 91 - 90

After dialling the first digit the LC will have reached step 9. Before VII releases and M operates, F 1-2 (F5) will operate as follows:

Ground - e-wiper LC (I7) - step 9 - m 2 (H6) - vIII 6 (I6) - d-LC (H6) - p 5 (H6) - pI 5 (G6) - br 4 (G4) - d-LF (G5) - F 1-2 (F5) - F4 (F4).

The alternate operation of f 4 (H13) and d-LC (H6) will rotate the selector automatically to step 19 where the circuit for F 1-2 is interrupted and the selector stops. VII releases, M operates and before VIII can release, VII operates again (see 4) and VIII is held. VII holds itself during the reception of the second digit, via f 1 (I8). After the second digit is received VII will release and prepare the test circuit for the LC (see 3).

6) Testing on the terminals of the dialled number

a) Called party free (not engaged)
After the release of VII, but before the release of VIII, P (D/E12) and T (D3) of the called party will operate via:

Ground - vIII5 (E12) - j 2 (E12) - P 2-3 (E12) - P 1-2 (D12) - vII 3 (D13) - pI 3 (D13) - PI 1-2 (C13) - c-wiper LC (C14) - c-wire (C15) - c-wire (B3) - T 1-2 (D3) - F1 (E1).

Contact p 3 (D12) shorts P 2-3 but the P relay is held through its low resistance winding P 1-2. The low resistance of P 1-2 prevents P relays of other connecting links to operate on the same c-terminal, thereby blocking the engaged number from being seized by a second caller for the duration of the existing conversation.

Immediately after being seized and during the release of VIII ringing current is transmitted to the telephone which has been dialled:

FR (K9) - FR (E10) - vIII 4 (E10) - VII 5-6 (E10) - m 3 (D10) - Y 2-3 (C10) - p 1 (C10)-rp 6 (B11) - b-wiper LC (C14) - b-wire (C15) - b-wire (B3) - loop circuit (B/C1) - a-wire (B2) - a-wiper LC (B14) - p 2 (B10) - Y 5-6 (C10) - F4 (F4).

Correspondingly, Ring Back Tone is transmitted to the calling party through induction on J 1-2 and 3-4 by J 5-6 via:

FRBT (I9) - FRBT (E9) - vIII 2 (E8) - m 4 (D8) - p 6 (D8) - r 2 (D8) - J 5-6 (D8) - j 6 (C8) - vI 4 (C7) - ground.

After the release of VIII, the ringing current as well as the ring back tone is switched by vIII 4 (E10) and vIII 2 (E8) to a source transmitting these signals every 5 seconds.

b) Called number already engaged by another line connector.
In this case P (D/E12) does not receive sufficient current to operate and after the release of VIII (H9) contact vIII 3 (D8) connects busy tone to the third winding of J via:

BT (I13) - BT (F7) - x 6 (D8) - vIII 3 (D8) - p 6 (D8) - r 2 (D8) - J 5-6 (D8) - j 6 (C8) - vI 4 (C7) - ground,

and busy tone is transmitted to the loop of the calling party by induction on J 3-4 and J 1-2.

7) The called number answers

A DC loop circuit is established by the lifting of the handset and the Y relay can now operate in the same circuit as described for the first ring (see 6). Contact y 6 (H10) disconnects M 5-6 (H10), m 3 (D10) opens the circuit for the ringing current and m 4 (D8) for the ring back tone. Y is now held over:

Ground - m 6 (D11) - Y 1-2 (D10) - Y 2-3 (D10) -
p 1 (C10) - rp 6 (B11) - b-wiper LC (C14) -
b-wire (C15) - b-wire (B3) - loop circuit (B/C1) -
a-wire (B2) - a-wiper LC (B14) - p 2 (B10) - Y 5-6
(C10) - F4 (F4).

The talking circuit is through connected by y 1 and y 5 (B/C9).

8) Termination of conversation

a) Calling party replaces handset first.

The DC circuit for J is opened and it releases. Contact j 4 (G8) shorts VI 1-2 (G9) and VI releases. The opening of vI 5 (E4) releases T and the calling party is free to place or receive another call.

If the called party now replaces the handset, it will cause the Y relay to release as the DC circuit for Y is interrupted. Contact y 2 (D12) shorts P 1-2 (D12) and P releases. Contact p 5 (H6) closes the circuit for F 1-2 as follows:

Ground - vI 4 (I5) - r 4 (I5) - d-LC (H6) - p 5
(H6) - pI 5 (G6) - br 4 (G4) - d-LF (G5) - F 1-2
(F5) - F4 (F4).

Contact f 4 (H13) in alternate operation with d-LC (H6) will rotate the LC until in the home position of the LC the ground (I7) for R 1-2 (F7) is disconnected and R releases. Contact r 3 (H11) releases BR 3-4 (F11) and contact br 2 (H4) enables the LF to be seized again for another call.

F 1-2 (F5) and VIII 5-6 (F4) are energized over:

Ground - e-wiper LF (G4) - br 4 (G4) - d-LF (G5)/r 5
(G4) - F 1-2 (F5)/VIII 5-6 (F4) - F4 (F4).

The alternate operation of f 4 (H13) and d-LF (G5) will rotate the LF over:

Ground vIII 5 (H12) and j 2 (H13)

until in the home position the ground (G4) for F 1-2 and VIII 5-6 is interrupted.

b) Called party replaces handset first

Relay Y (C10) releases as the DC circuit is opened by replacing the handset of the called telephone. Contact y 2 (D12) shorts P 1-2 and P releases, contact p 3 (D12) disconnects the ground for T 1-2 (D3).

Busy tone is now transmitted to the calling party by induction on J 1-2 and J 3-4 by J 5-6 via:

BT (K13) - BT (E7) - x 6 (E7) - vIII 3 (D8) -
p 6 (D8) - r 2 (D8) - J 5-6 (D8) - j 6 (C8) -
vI 4 (C7) - ground (C7).

Replacing the handset on the hook by the calling party, opens the DC circuit for J and J releases. VI 1-2 (G9) is shorted by j 4 and it releases. Contact vI 4 (I5) connects ground to F 1-2 (F5) and the LC and LF return to normal as described under 8a.

9) Optional priority facility for predetermined stations

Stations with this facility are to be equipped with a phone with priority button. The connecting links are equipped with X relays (C6/7). The polarity of the windings of this relay is such that, when they are in the loop of a normal conversation, the relay will remain inoperated. In case the dialled number is found to be engaged, the calling party may now depress the priority button on his phone. Depressing of this button will connect ground to the a-wire of the loop and X will now operate. After releasing the button, X will hold itself over x 4 (C6). Contact x 2 (C9) will operate Y 5-6 and contacts y 1 and y 5 (B/C9) connect the calling party to the existing conversation. Contact x 2 (C9) will start the signalling generator. A ticking signal is transmitted to J 5-6 via:

TS (I13) - TS (E8) - x 6 (E8) - vIII 3 (D8) -
p 6 (D8) - r 2 (D8) - J 5-6 (D8) - j 6 (C8) -
vI 4 (C7) - ground,

and induced on J 1-2 and J 3-4 in the loop.

This ticking signal indicates to the parties of the existing conversation that a third party is on the line.

10) Optional facilities which are prewired in the equipment

a) Grouphunting for stations or tielines.

Grouphunting facilities are only available in the number group 1-7. The contacts in the e-bank of the LC (I7) for the first, through the next to the last number of the group with hunting facilities are to be connected to R 5-6 (G7). This rewiring is to be repeated for all LC's. If, for example, call number 5 is to be wired for 3 consecutive lines it is required to connect contacts 5 and 6 of the e-bank to R 5-6 and contacts 4 and 7 are to be bridged. After dialling the number 5, VII (H8) will release and with vII (D13) close the test-circuit for the LC (see 3). The release of VII causes M 3-4 (H9) to operate and M will hold itself over:

Ground - m 6 (H10) - y 6 (H10) - M 5-6 (H10) -
j 4 (G8) - VI 5-6 (F8) - F4 (F4).

If the LC cannot test on step 5 because the number is engaged, F 1-2 (F5) will be energized over:

Ground - e-wiper LC (I7) - step 5 - m 2 (H6) -
vIII 6 (I6) - d-LC (H6) - p 5 (H6) - pI 5 (G6) -
br 4 (G4) - d-LF (G5) - F 1-2 (F5) - F4 (F4),

and f 6 (H9) will immediately open the short circuit for VIII 1-2 before VIII can release and it will hold. At the same time f 4 (H13) will close the circuit for D-LC (F14) and the LC will rotate to the next step. If this line is free, the LC will test in the normal manner and the connection is established. If, however, this line is also engaged, the LC will rotate to the 3rd number in the group and test. If the LC cannot test on this terminal because this line is also engaged, the LC will stop at this step and after release of VIII busy tone is transmitted to the calling party.

b) Through dialling facilities (Paging, Tieline, etc.)

Each connecting link is equipped with a PI relay for through dialling. This relay will operate against an increased test-

current, therefore the corresponding adapter is to be equipped accordingly.
PI (C12/13) will operate after dialling the number of the adapter when the LC tests on increased test current. PI is held over pI 4 (C12) and contact pI 3 (D13) will disconnect P (D/E12). Contact pI 2 and pI 6 (B/C5) provide a metallic circuit to the adapter, by-passing the capacitors C1 and C2 in the normal talking path. Feeding current for the calling party will now be supplied by the adapter. It will also be possible to transmit DC dialimpulses to the adapter. Relay J (C6/7) and relay VI (G9) release and T 1-2 (D3) is now held via pI 1 (D5).

c) Facilities for Rapid Staff Locator

The connection of a Rapid Staff Locator System requires the installation of a RP relay (A12, E14) and a capacitor C 5 (A12) in each of the connecting links.
Sa, Sb and Sc (ABD 16), which appear at the equipment terminal, are to be connected to the corresponding terminals of the Rapid Staff Locator equipment. The Sd terminals (D16) of all the numbers to be included in the Locator System are to be connected to the Locator Equipment. If after dialling a number, this number does not reply, the calling party may, without first replacing the handset, start the locating signals by dialling an additional digit. The dialling of this additional digit will cause the J relay to release momentarily and RP is operated as follows:

Ground - vI 4 (F13) - j 6 (F13) - vII 6 (E13) -
RP 3-4 (E13) - p 4 (D13) - d-wiper LC (D14) -
Terminal Sd (D16) - Staff Locator,

and it will hold itself with RP 5-6 (E14) over rp 5 (D14). Contacts rp 1 and rp 6 (A/B11) connect the talking path to the Staff Locator over the terminals Sa and Sb.
If the called party answers, the Y relay will operate and the connection is established. During the conversation RP is held by RP 1-2 (A12) as y 3 (F14) opens the hold circuit

for RP 5-6 (E14).
Termination of the conversation will release RP and the equipment releases to normal as described in par. 8.

11) Fuse Alarm

The release of heat coil fuses F1, F2, F3, F12, F13 or F14 will operate SK 1-2 (P7) and sk 3 (K7) may be used to operate a visible or audible alarm over FAL or FA (L7), which appear on the equipment terminal. The release of heat coil fuses F4 through F11 will operate SR (K/L12) and BR 1-2 (F11) via:

Ground - BR 1-2 (F11) - Fc (G11) - SR (H11) - SR (I12) - SR 5-6 (K12) - SR 1-2 (L12) - F12 (L10).

Contact br 2 (H4) will block the corresponding connecting link and transfer attempted calls to the next connecting link. Contact sr 4 (P8) will operate SK 1-2 (P7) and contact sk 3 (K7) may be used to operate a visible or audible alarm.

12) Busy Keys for the connecting links

Each connecting link is equipped with a Busy Key which is to be operated manually in case a connecting link is out of order. Contact I (H4-I4) prevents the connecting link from being seized and at the same time connects the calling party to the next available connecting link

13) Ringing and Signalling Generator

The ringing current as well as the different signal tones are generated by the interchangeable generator which is explained separately.

14) Fuses and Spare Parts

The following fuses are to be used for the equipment and power supply of the PAX 27/4.

a) Power Supply:

For connection to 110-125-150 volts AC 2.5 amp. 2.5D DIN 41571
for connection to 220-250 volts AC 1.25 amp.Fl. 25B DIN 41571

b) Equipment:

F1 Line relays T 1 - 7	1.0 amp.	A 0.5 DIN 41584
F2 " " T 81 - 80	" "	"
F3 " " T 91 - 90	" "	"
F4 Relays, connecting link No. 1	" "	"
F5 " " " 2	" "	"
F6 " " " 3	" "	"
F7 " " " 4	" "	"
F8 Selectors, connecting link No. 1	" "	"
F9 " " " 2	" "	"
F10 " " " 3	" "	"
F11 " " " 4	" "	"
F12 Common Relays	1.0 amp.	A 0.8 DIN 41584
F13 Signalling Generator	1.5 "	A 0.5 DIN 41584

The following spare parts are supplied with each PAX 27/4:

3 Resoldering type heat coil fuses	A 0.5 DIN 41584
1 " " " " "	A 0.8 DIN 41584
2 Fuses	2.5D DIN 41571
2 Fuses	T1.25B DIN 41571
1 Armature restoring spring	27.5703
1 Ratchet blocking spring	27.5504
1 Relay spring support	23.7212
2 Screws	23.7213

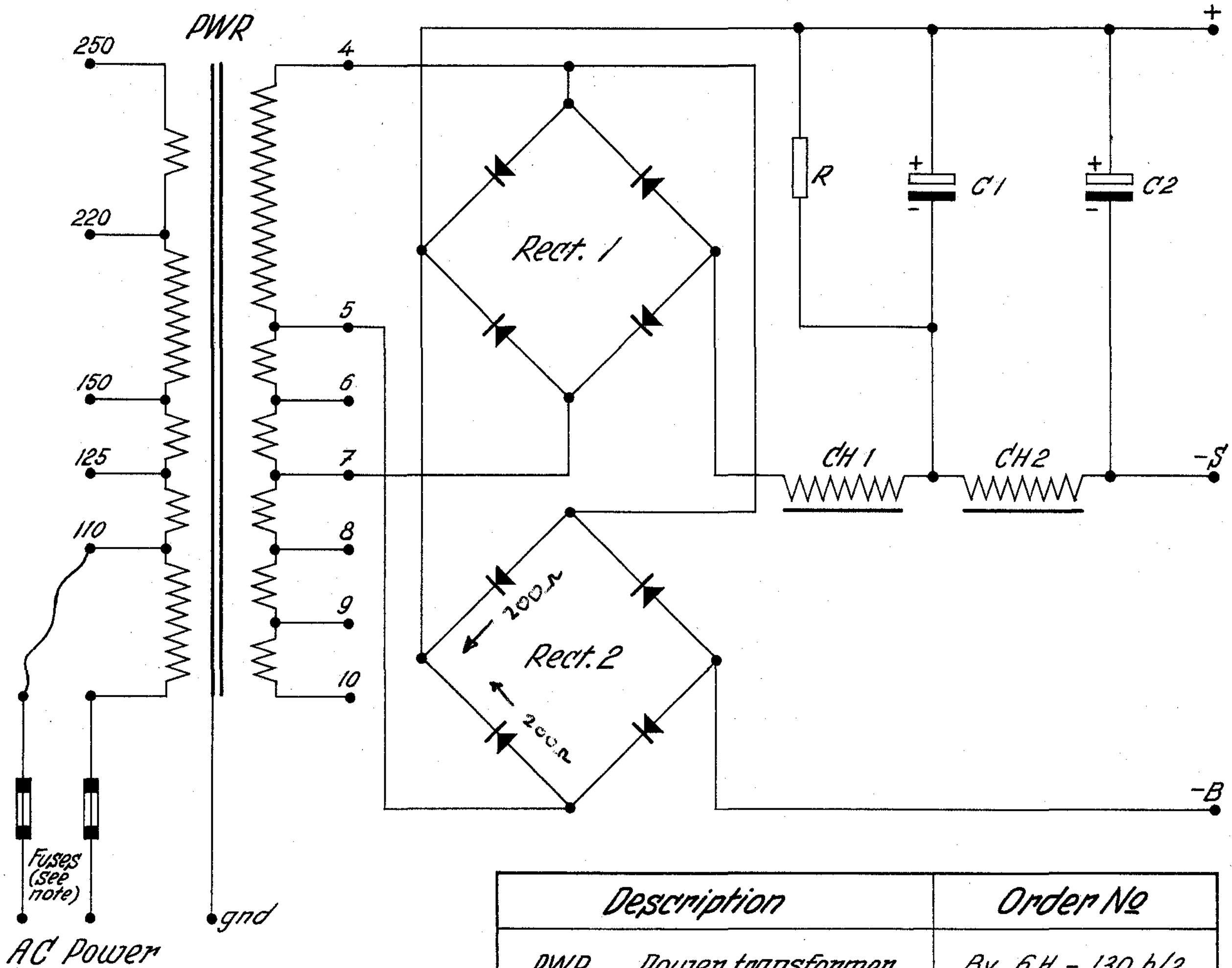
POWER SUPPLY

Fig. 6 illustrates the diagram of the battery eliminator which is incorporated in the cabinet of PAX 27/4.

The battery eliminator provides the DC current for the operation of the switchboard. It is equipped for connection to 110-125-150-220 or 250V AC, 50 - 60 cps. The unit is wired for connection to 125 V when leaving the warehouse. In case the switchboard is to be operated on 220 - 250 V, it will be necessary to replace the 2.5 amp. fuses by fuses for 1.25 amp. These fuses are included in the shipment. It is furthermore required to move the input wire to the correct tap on the primary side of the transformer.

The DC current is obtained at terminals + and - B and at terminals + and - S. The first source provides unfiltered current for the operation of the selectors and the signal generator. The second source provides, through a filter system consisting of choke coils CH 1 - CH 2 and condensers C1 - C2, the filtered current used for the operation of the relays and as feeding current for the telephone sets. The maximum current drain for the unfiltered DC is 3 amp., and for the filtered DC 2 amp.

The no-load DC voltage should in both instances measure 30V. The voltage may be regulated by using different taps on the secondary side of the transformer.



Note: For connection to
110 - 150 V. AC
fuses 2.5 Amp.

For connection to
220 - 250 V. AC
fuses 1.25 Amp.

Description		Order No
PWR	Power transformer	Bv 6H - 130 b/2
CH 1	Choke	Bv 6T - 85 a/3
CH 2	Choke	Bv 6T - 85 a/4
Rect. 1	Rectifier	27. 7915 / 270
Rect. 2	Rectifier	
C 1	Condenser 2000 MF	27. 3429 / 107
C 2	Condenser 2000 MF	27. 3429 / 107
R	Resistor 4 Watt	400 ohms 2 Din 41415

Fig. 6

RINGING CURRENT AND TONE GENERATOR

Fig. 7 illustrates the ringing current and tone generator. The generator is a single armature rotary converter and operated by the DC power supply of the telephone exchange. The generator supplies a ringing current of 25 cps and a tone of 450 cps. The power delivered is 2.5 VA.

The ringing current, as well as the tone signals are controlled by 5 contact sets which are in turn activated by rotary cams. These rotary cams are mounted on an axle which is connected to the axle of the generator by means of a worm gear. The worm gear is incorporated in the generator.

The cams operate the signals as follows (see also fig. 8):

1. Cam 1 produces the control for the ring back tone RBT. The contacts close two times per revolution, or once every 5 seconds.

2. Cam 2 controls the dial tone DT. The dial tone consists of a 450 cps tone transmitted as the morse letter "S" (- - -). This signal is sent five times per revolution or once every 2 seconds.
   NOTE: If a steady dial tone is required, remove the wire between DT1 and DT2 and connect DT1 to FRBT on terminal block B (see drwg. 24022/50 LE).

3. Cam 3 provides an interrupted ground for ringing control Ric. This ground is connected in the same sequence as Cam 1. (1 sec. on - 4 secs. off). Reversed ringing control RCR provides ground when Ric opens and vice versa (4 secs. on - 1 sec. off).

4. Cam 4 provides the interruptions for the busy tone BT. The busy tone is a 450 cps tone with interruptions of 16 times per 10 seconds.

5. Cam 5 provides the control for the ringing current RC. The contacts operate in the same sequence as those of cam 1.

6. Cam 6 equipped with 10 notches to provide control for the ticking signal TS which is required for monitoring control or priority signal and for flashing control FC.

The ringing current of 25 cps is produced by the armature winding and connected to terminals 3 and 4 of the adapter over two slip rings. The transformer TR (L9 drawing S3e. 5/7 VI E) is connected to terminals 3 and 4. This transformer increases the ringing voltage to the required 40V and at the same time avoids a metallic contact between the DC battery and the AC ringing current.

The 450 cps tone is obtained from the tone generator winding. This winding, as well as the exciter winding, is part of the stator. The 450 cps tone is used as dial tone, busy tone and ring back tone.

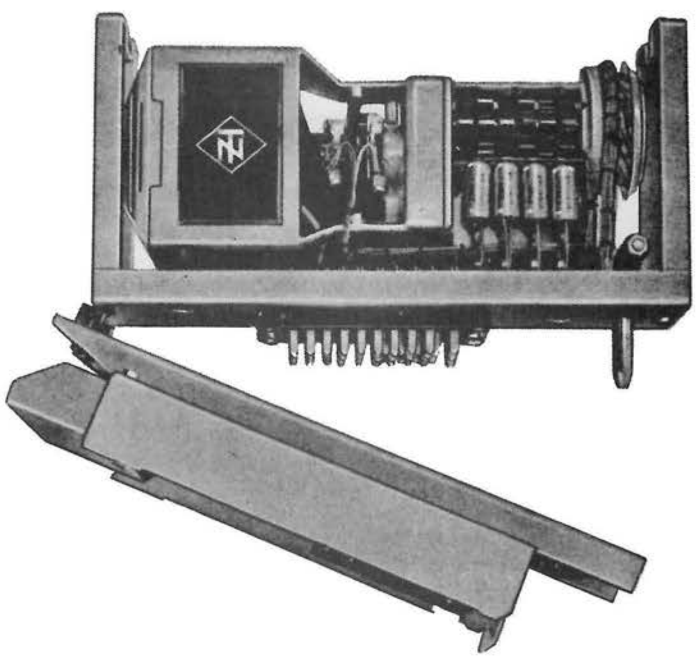
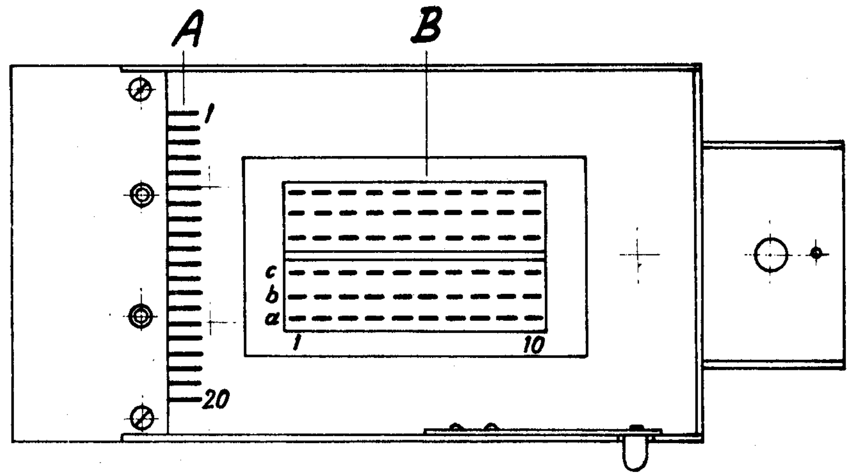


Fig. 7 ringing current and tone generator with adapter.



Numbering arrangement of adapter as seen from bottom side

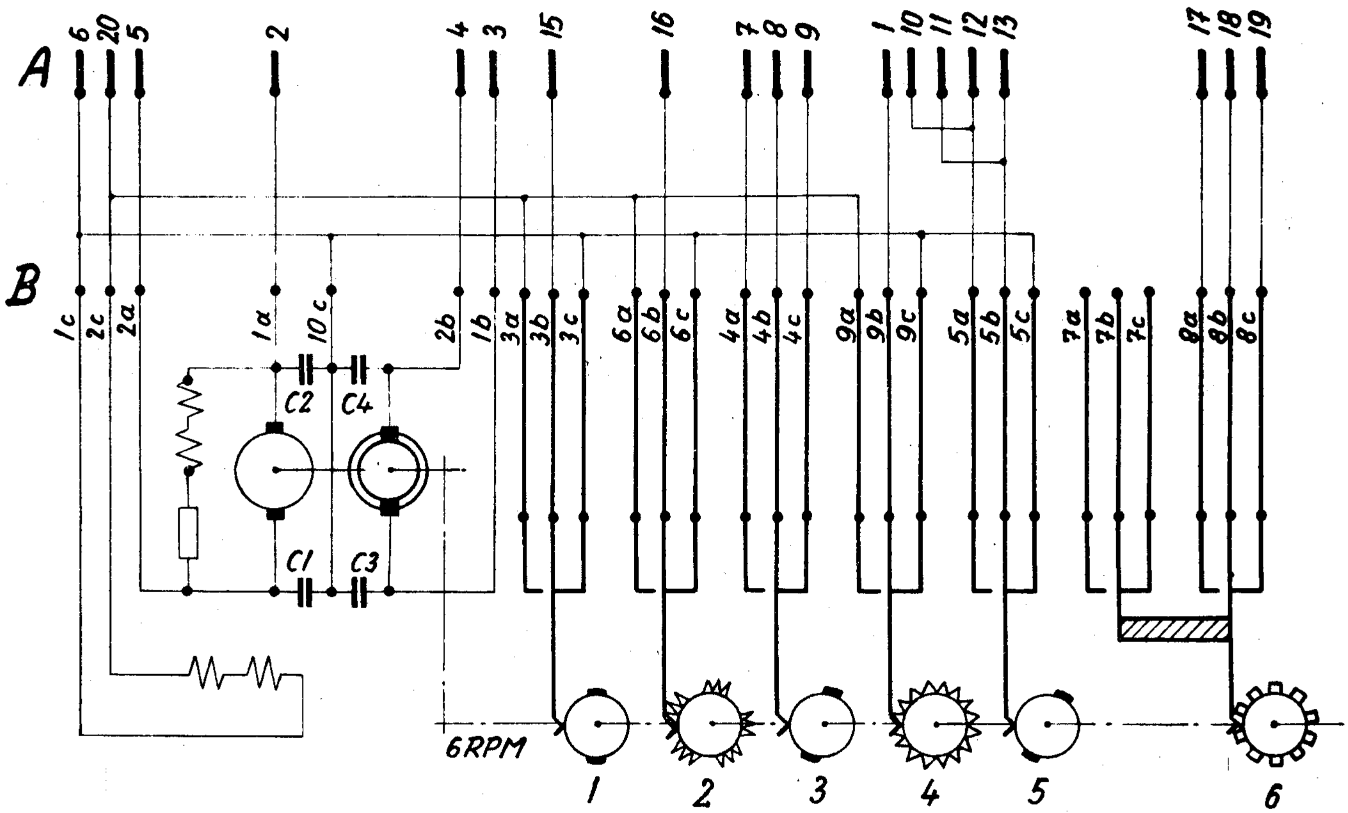
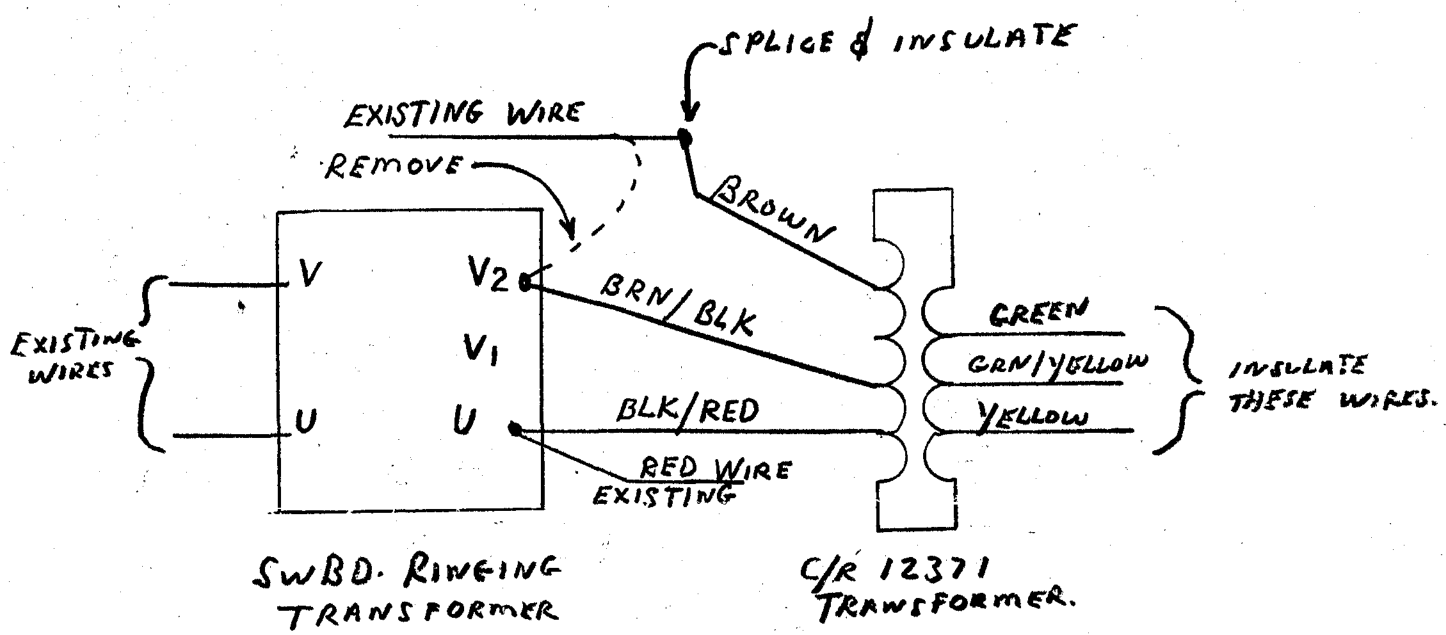


Fig. 8 Diagram of ringing current and signal generator

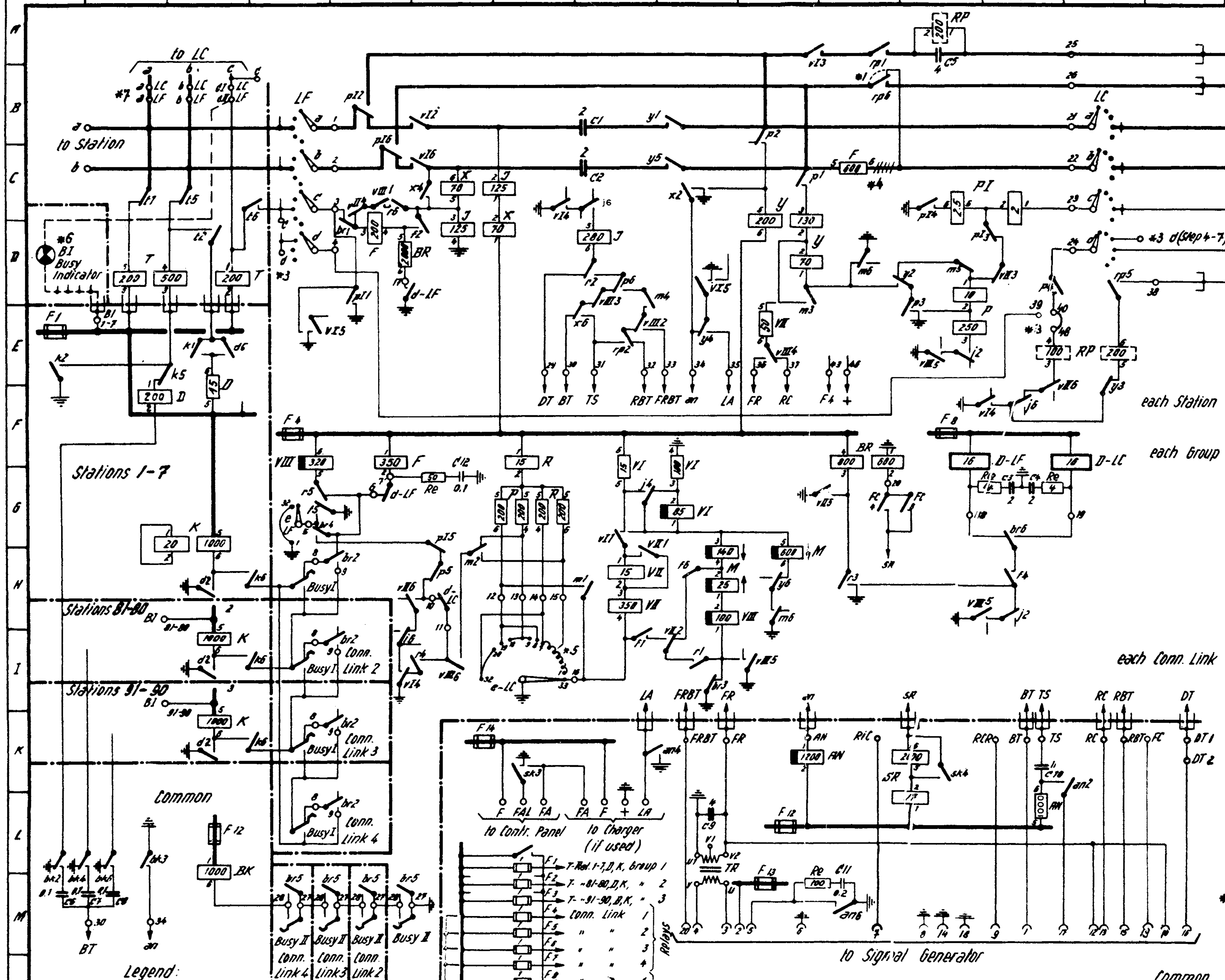
2/5/73

STEP UP FOR RINGING VOLTAGE
FOR TELE-NORM SWITCH BORDS.



NOTE

INSULATE AND TAPE ALL UNUSED WIRES ON TRANSFORMER.



Relay spring sets and winding connections as seen from the rear

○ top spring free
● bottom spring free
× contact or winding free

	Relay	Type	Cont. Square	1/2	Cont. Square	3/4	Cont. Square	5/6	Windings 6 5 4 3 2 1
each Station	T	3E-98/1	C2	b			C3	b	D2 D3 D3
			D3	m			C3/4	m	
each Group	D	3B-59e/1							E/F3 F2
			H3	m			E3	m	
	K	3D-329/2	E3	m			E2	b	G/H,13 G2
			E1	m			H3	m	
each Conn. Link	J	3G-46/1							D8 D6 C7
			E12-H13	c	G8	c	C8-I3-F13	c	
	X	36-7/13							C6 D6/7
			C9	bdm	C6	c	E7	c	
	VI	3V-25a/1	G8	dm	A10	m	E4/D9	dm	G8 G9 G9
			B6	m	I5/H12/C1	c	C6	m	
	VII	3D-408a/1	H8	m	D13	b	G11	m	E10 H8 H8
			I9	c	C5	b	E13-H6	c	
	VIII	3U-16/2	C5	m	B8	b	H12/I10	dm	F4 H9
			E8	c	E10	c	I6	m	
	F	3D-155a/1	I8	m			G4	m	C11 D5 F5
			D6	m	H13	m	H9	b	
	R	3A-12a/1	I9	m	H11	dm	G4	b	G7 F7
			D8	c	I6	m	C5	c	
	M	3W-22/1	H8	m	D10	dm	D12	b	G10 G9 H9
			H6	c	D8	m	H10-D11	c	
	BR	3D-157a/1	C/D5	b	I9	b	H5	m	D5 F11 F11
			H5	c	G4	c	G13	c	
	Y	3G-25/1	B9	m	F14	b	C9	m	D10 C10
			D12	c	E9	c	H10	c	
	P	3F-7a/1	C10	m	D/E12	dm	H6	b	G7 D/E12
			B10	c	D13	m	D8	c	
	PI	3D-64/1	D5	m	C/D13	b	G6	b	C12 C13
			B5	c	C12	m	C5	c	
*	RP	3E-99/1	A11	m			B14	m	E14 E13 H12
			E8	c			B11	c	
Common	AN	3V-9b/3							L13 K10
			K14	m	K8/9	m	M11	m	
	SR	3D-65/1							K12 L12
					G6	m			
	SK	3B-1m/4			K7	dm			P8 D7
					K12	m			
	BK	3B-1/49			L2	m			L/M3
			L1	c	L1	c	L2	c	

Legend:

LC = line connector
LF = line finder
BI = busy indicator
BT = busy tone
DT = dial tone
TS = ticker signal
RBT = ring back tone
FRBT = first ring back tone
FR = first ring
○28 = terminal on "TS"
⅄ = knife contact of signal generator
TR = transformer
RSM = signal generator

RC = ringing current
Re = resistor
F = fuse
Fc = fuse contact
FA = fuse alarm
FAL = fuse alarm lamp
RiC = ringing control
RCR = ringing control reversed
FC = flashing control

* Installed if required only
* 1 Connect if RP Relay not installed
* 3 For connection of Staff locator S 10 e - 74/18 I use c and d terminals, disconnect 40-48 and strap 39-40 (E13)
* 4 Disconnect if called phone should not ring after post dialling when using corresponding staff locator
* 5 Stations 1-7 prewired for grouphunting. Connect first to next before last step of rotary group to Term. 15 and delete connection to Term. 14.
* 6 Visual Busy Indicators 2400 Ohm Cat 27.7702 are to be used as busy line signals, if required.
* 7 Stations 4-7 are prewired for the connection of tie lines or staff locator equipment.

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Chckd.
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Private Automatic Exchange for 27 Stations and 4 Connecting Links with built-in Battery Eliminator

S3e-5/7 VIII E

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