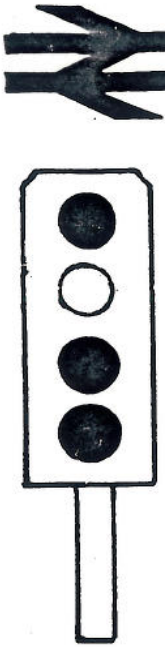
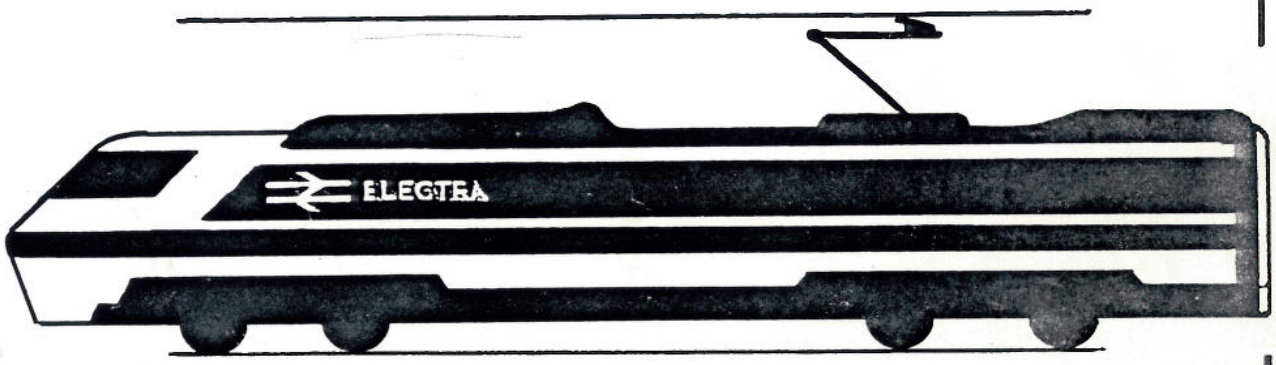
British Rail

Regional Signal
and
Telecommunications
Engineers Department





C1 (T) BASIC INSTALLATION

Training School
Eastern Region

York

Contents

British Rail

Course C.1. (T) Basic Installation.

Section ONE.

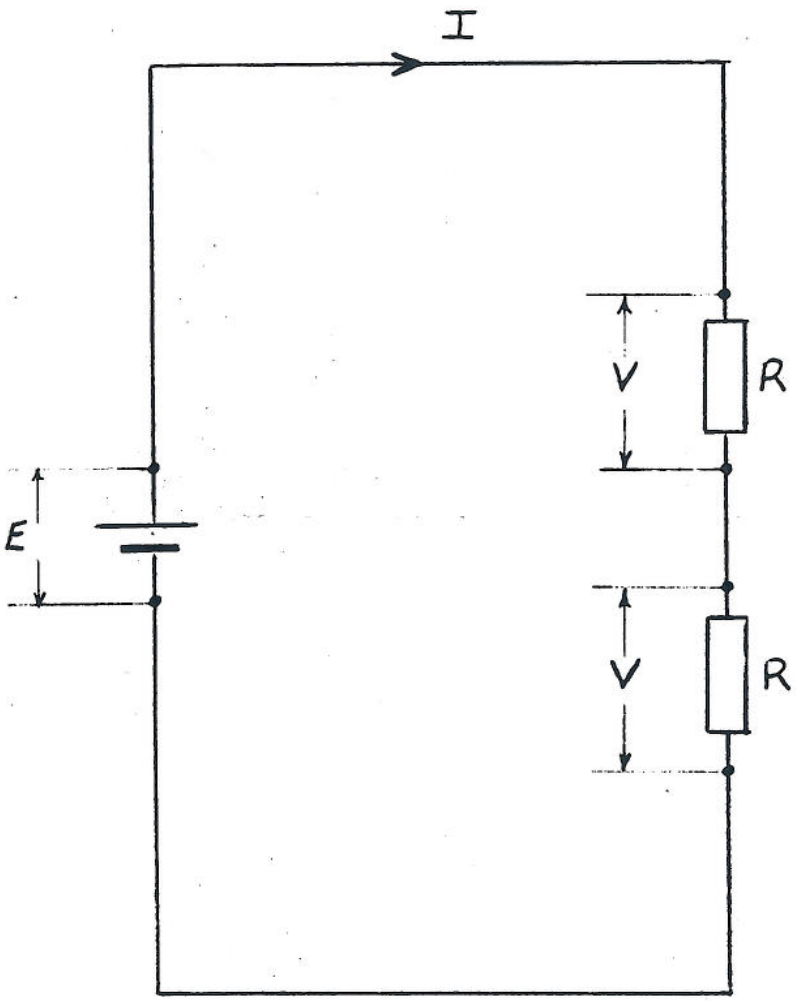
Content Basic Circuit Principles.
(Units of Electricity)
Use of A.V.O. Meter.

R.S. & T. E. Department

Training School **York**

BASIC CIRCUIT PRINCIPLES

UNITS OF ELECTRICITY



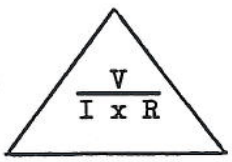
VOLTAGE, CURRENT, RESISTANCE, POWER.

Electro-motive force (E. volts) drives electron flow-current (I amperes) through, but resisted by - resistance (R ohms), causing a voltage drop or potential difference (V volts) dissipating power (P watts).

OHMS LAW

Current (I) measured in amps is proportional to Voltage (V) for a fixed value of Resistance (R). From any two given values, using ohms law the third can be found, i.e. :-

$$I = \frac{V}{R} \quad R = \frac{V}{I} \quad V = I \times R$$ or using the



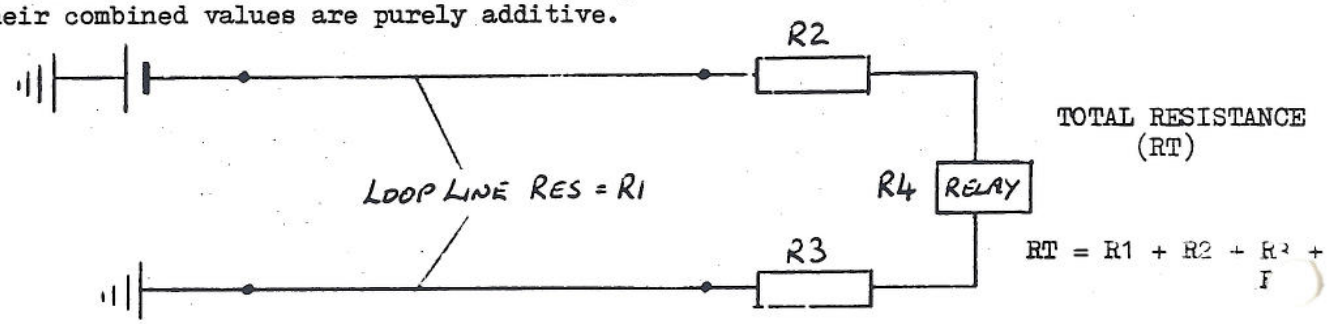
triangle - cover the unknown value, to reveal the required formula to get it.

RESISTANCE

Resistance, to state the obvious, resists the flow of current and can come in various forms such as a fixed resistor, a relay, an inductor, even the cable lines and perhaps the most unwanted, bad connections. Ignoring bad connections, when calculating ohms law all resistances have to be taken into account.

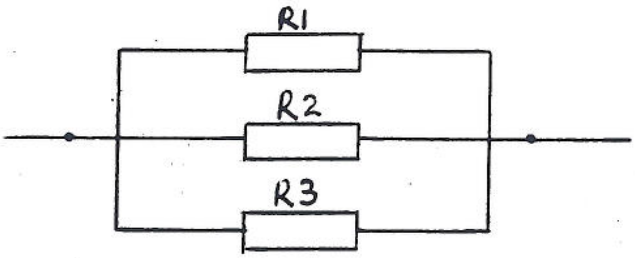
SERIES CIRCUIT

The resistance in a series circuit has only one current flow path to resist and their combined values are purely additive.



PARALLEL CIRCUIT

In a parallel circuit there is more than one currentflow path and the overall resistance to current flow, will always be less than any individual path. Because current is shared proportionally between the number of parallel circuits the overall resistance is calculated in the following manner.



eg. if R1 = 2 R2 = 5 R3 = 10

$$\frac{1}{Rp} = \frac{1}{R1} + \frac{1}{R2} + \frac{1}{R3}$$

$$= \frac{1}{2} + \frac{1}{5} + \frac{1}{10}$$

$$= \frac{5 + 2 + 1}{10} = \frac{8}{10}$$

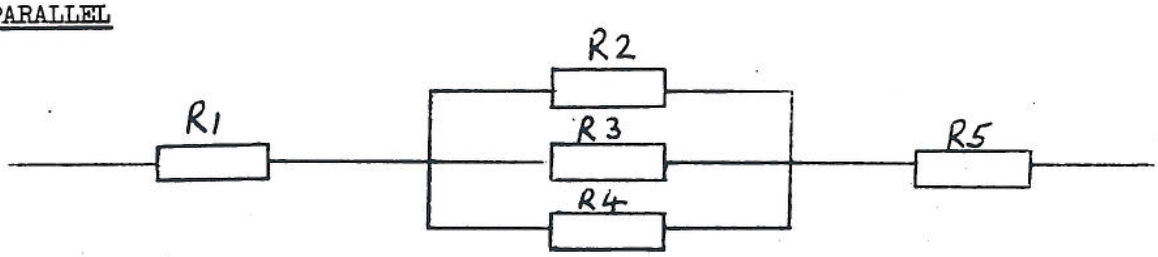
$$\therefore \quad Rp = \frac{10}{8} = \underline{\underline{1.25\ \Omega}}$$

ALTERNATIVELY

If all parallel resistors are equal divide the value of the resistor by the number of resistors in the parallel group.

C1	1.0	3

SERIES PARALLEL



In this circuit the parallel resistance is worked out first, the value then becomes additive to the other resistors as in the series circuit.

ie. $\left(\frac{1}{R_p} = \frac{1}{R2} + \frac{1}{R3} + \frac{1}{R4}\right) + R1 + R5 = \text{TOTAL RESISTANCE (RT)}$

POWER

$$P = VI = I^2 R = \frac{V^2}{R}$$

CALCULATIONS USING OHMS LAW

With careful use of ohms law, given sufficient known values, the unknown values can be found even in series/parallel circuits.

In the circuit below the colour code for R3 has been obliterated. From the known values calculate:-

10V 1. VD across parallel res

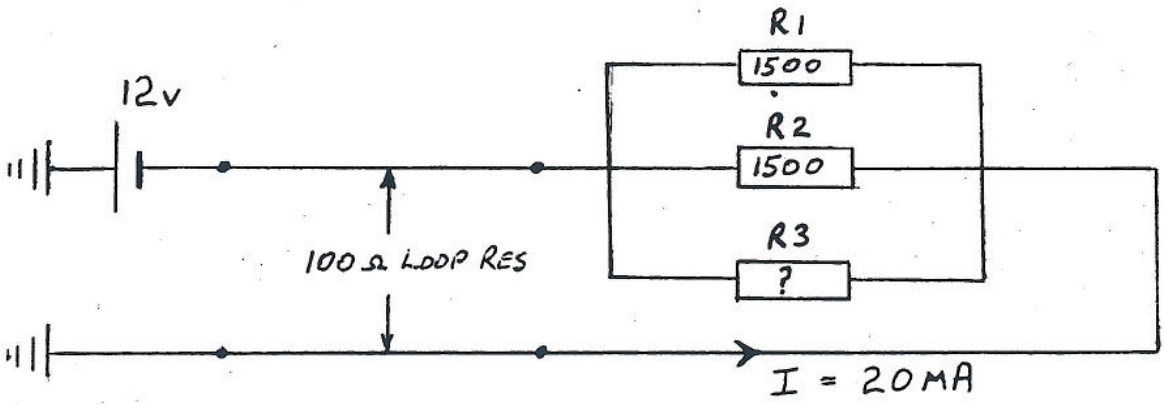
500Ω 1. The overall parallel resistance.

1500 2. The value of R3.

20mA 3. The current through R3.

Inc 4. If R3 became open cct. would the currents through R1 & R2 increase or decrease.

1. VD ACROSS [illegible]
2. VD ACROSS [illegible]
3. CURRENT [illegible]
4. R3 RES.
5. IF R3 [illegible] WOULD [illegible] CURRENT [illegible] R1 & R2 [illegible] OR STAY [illegible]



C1	1.0	4

CARBON RESISTOR COLOUR CODE

BLACK - 0

BROWN - 1

RED - 2

ORANGE - 3

YELLOW - 4

GREEN - 5

BLUE - 6

VIOLET - 7

GREY - 8

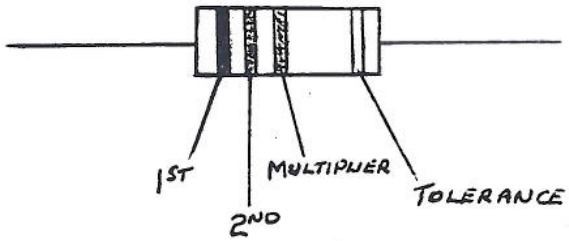
WHITE - 9

TOLERANCE VALUES

NO MARKING ± 20%

SILVER RING ± 10%

GOLD RING ± 5%



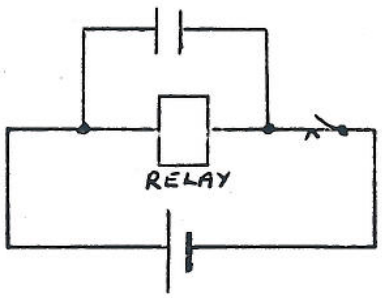
REACTIVE COMPONENTS

CAPACITOR

1. Capacitance is measured in Farads but because even 1 FARAD is a huge figure it is more usual to see a figure of micro-Farads (μF) symbol μ being in millionths 10^{-6} Farads.

2. CAPACITOR IN A DC CIRCUIT - Although a capacitor can be charged and take the form of a low capacity cell it is considered a high resistance to dc current flow.

   eg.



3. CAPACITOR IN AN AC CIRCUIT - A capacitor is considered as low resistance to AC current, the higher the AC frequency the lower the capacitor resistance. The resistance to AC flow is known as impedance.

INDUCTOR

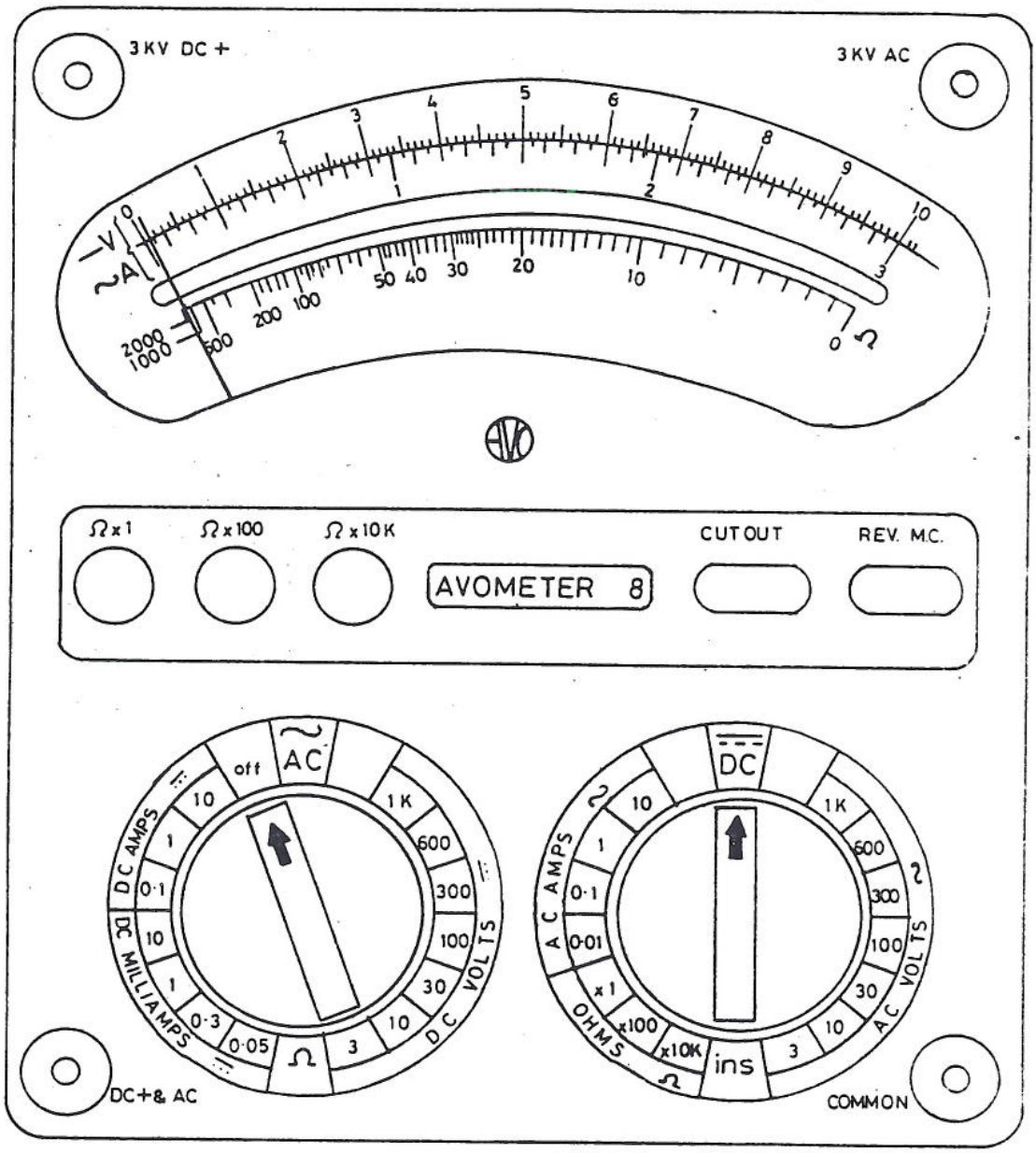
1. Inductance is measured in Henries, again this is a large figure but not quite as large as the Farad in comparison, inductance is commonly measured in milli Henries (mH) symbol in thousandths 10^{-3} Henries.

2. INDUCTOR IN A DC CIRCUIT - even though an inductor creates an initial back e.m.f., it reacts as a purely coiled resistor and is considered as low resistance in a d.c. circuit.

3. INDUCTOR IN AN AC CIRCUIT - the back e.m.f. referred to previously causes high resistance or as stated before, impedance to AC current. The greater the frequency of AC the greater the impedance to current flow.

- Examples of these components in circuits will be seen frequently throughout the course.

MEASUREMENT OF ELECTRICAL UNITS



AVOMETER MODEL 8

1. THE MOVING COIL METER

1.1 GENERAL

The moving coil multimeter is a most versatile electrical measuring instrument, and for general electronic use, the AVO Model 8 is particularly recommended.

It can measure directly AC and DC voltages up to 3000V- AC and DC currents up to 10A and resistance up to 20M Ohms.

2. AVO MODEL 8 (See Diagram)

2.1 Range Controls

The left-hand knob provides all the DC current and voltage ranges (except 3000V) and the right-hand knob the AC ranges (except 3000V) and also the resistance ranges. These knobs are electrically interlocked so that readings can only be made after AC or DC measurement and range has been selected. Resistance tests require the left-hand switch to be set to Ω and the right-hand one to the desired range.

2.2 Polarity Reverse Control

If DC voltage is required both positive and negative to a reference point, or the direction of current flow may be reversed, in order to simplify the matter of lead alteration, a polarity reverse press button (REV. M.C.) is provided.

2.3 General

The meter is intended for use horizontally. If the pointer is not on zero, it may be set using the screw head on the panel. Do not attempt to set this zero position with the instrument set to 'OFF'.

When measuring current or voltage, ensure that the instrument is set to either AC or DC as appropriate and a suitable range before connecting up to the circuit under test. When in doubt, always switch to the highest range and work downwards, there is no necessity to disconnect the leads as the switch position is changed.

Do not switch off by rotating either of the knobs to a blank position.

2.4 Voltage Measurement

When measuring voltage, it is necessary to set the appropriate range of AC or DC and connect the leads across the source of voltage to be measured. If the voltage is unknown, set the instrument to its highest range, connect up and if below 1000V, decrease the ranges step by step until the most suitable range has been selected. If the voltage should exceed 1000V, the instrument should be set to measure 1000V as described above, but the positive lead should be transferred to the appropriate 3000V terminal.

Great care must be exercised when making connections to a live circuit and the procedure should be entirely avoided if possible.

2.5 Current Measurement

To measure current, the instrument should be set to a suitable AC or DC range and then connected in series with the circuit under test.

2.6 Resistance Measurement

There are three self-contained ranges convering from 1 ohm to 20 megohms and provision is made for upward extension of these limits.

On resistance ranges, the meter must have, in addition to the normal instrument zero a resistance zero corresponding to the full scale deflection of the meter. Before carrying out tests for resistance, a check should be carried out to ensure that the meter actually indicates zero ohms irrespective of the condition of the battery.

Resistance tests should never be carried out on components which are already carrying current. Also, when testing a component which is connected in circuit, it may be necessary to disconnect one of its leads thereby ensuring that a false reading is not obtained via parallel connections. On three ranges which utilise the internal source of voltage, a positive potential appears at the negative terminal of the instrument when set for resistance tests.

British Rail

Course C.1. (T) Basic Installation.

Section TWO.
TWO/ONE.
TWO/TWO.

Content

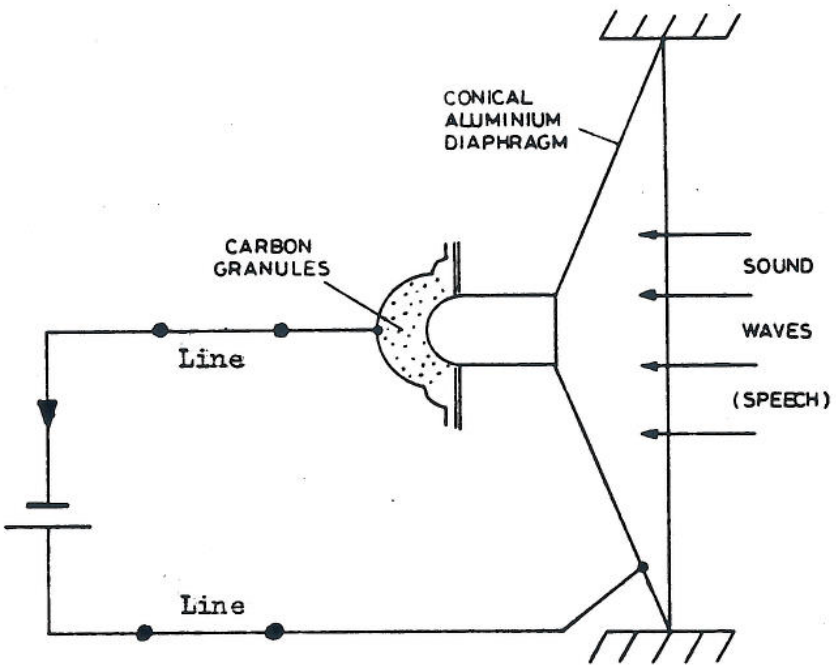
TWO. Components and Basic Circuits of the 700 Series Telephone Instrument.

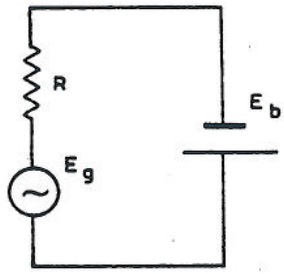
TWO/ONE. Dial Elements and Circuits.

TWO/TWO. Transmittion Bridges.

R.S. & T. E. Department

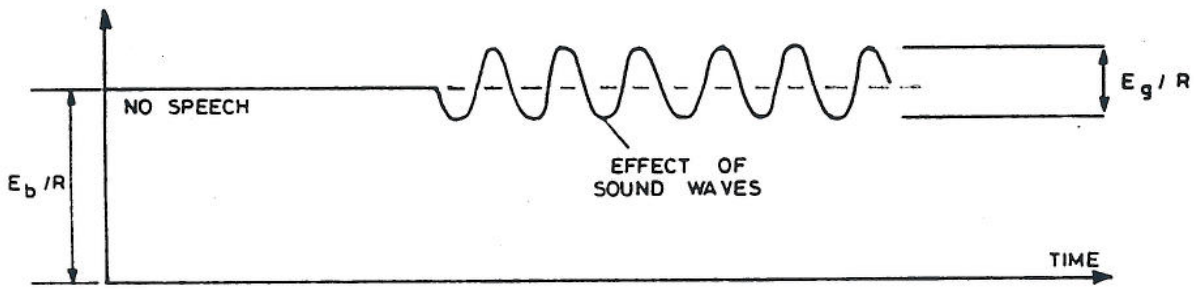
Training School **York**





EQUIVALENT CIRCUIT

CIRCUIT SYMBOL



GRAPH OF CURRENT

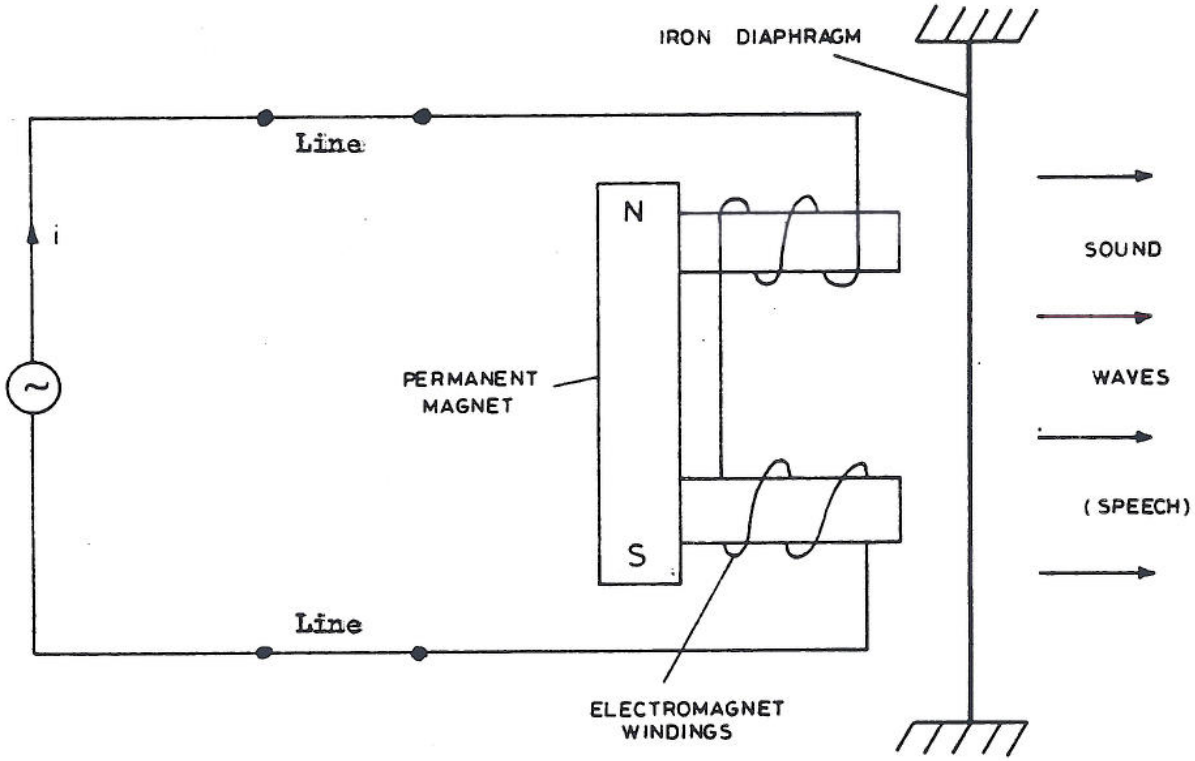
THE PRINCIPLE OF THE TRANSMITTER

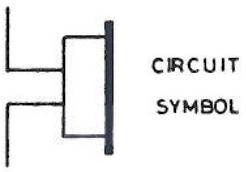
The sound waves cause the diaphragm to vibrate producing resistance variations in the carbon granules and thus fluctuations in the current.

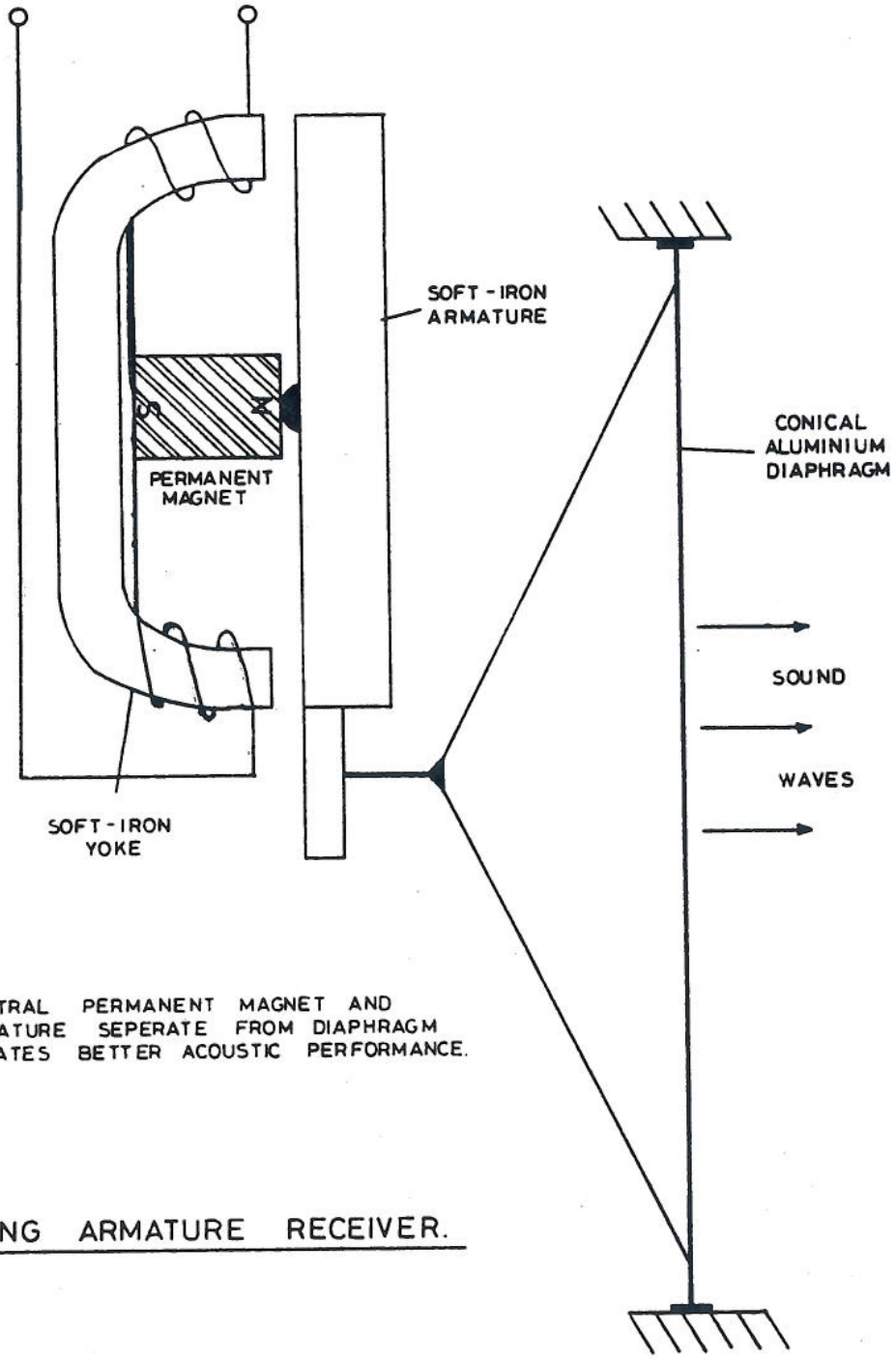
THE VARYING D.C. CURRENT IS BEST CONSIDERED AS : SUPERIMPOSED A.C. ON D.C.

THE PRINCIPLE OF THE RECEIVER

Alternating speech current in the electromagnet windings produces a magnetic flux aiding and then opposing that of the permanent magnet on alternate half-cycles. This varies the pull on the diaphragm which thus vibrates to produce sound waves.





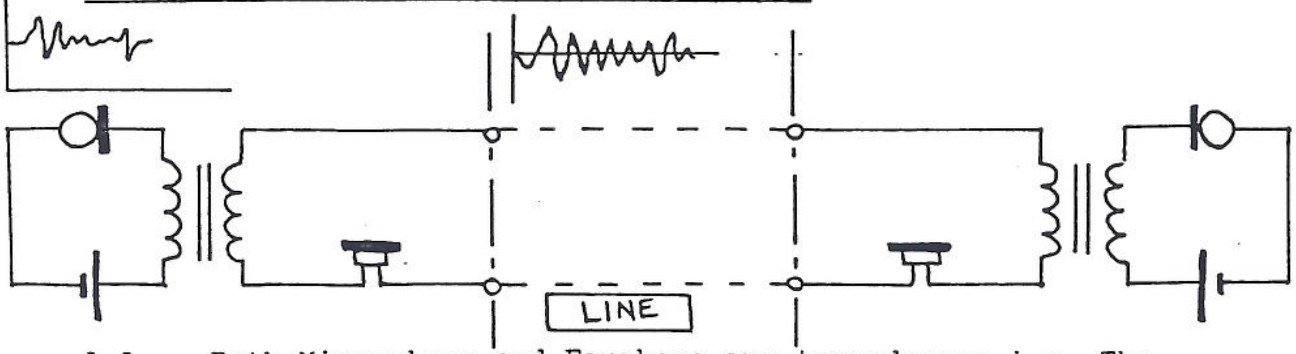


CENTRAL PERMANENT MAGNET AND ARMATURE SEPERATE FROM DIAPHRAGM CREATES BETTER ACOUSTIC PERFORMANCE.

ROCKING ARMATURE RECEIVER.

THE TELEPHONE TRANSMISSION CIRCUIT

1. THE SIMPLE TELEPHONE TRANSMISSION CIRCUIT



1.1. Both Microphone and Earphone are transducers i.e. The Microphone converts the air pressure waves of sound to electrical impulses and vice versa.

1.2. The Induction Coil or Transformer serves:-

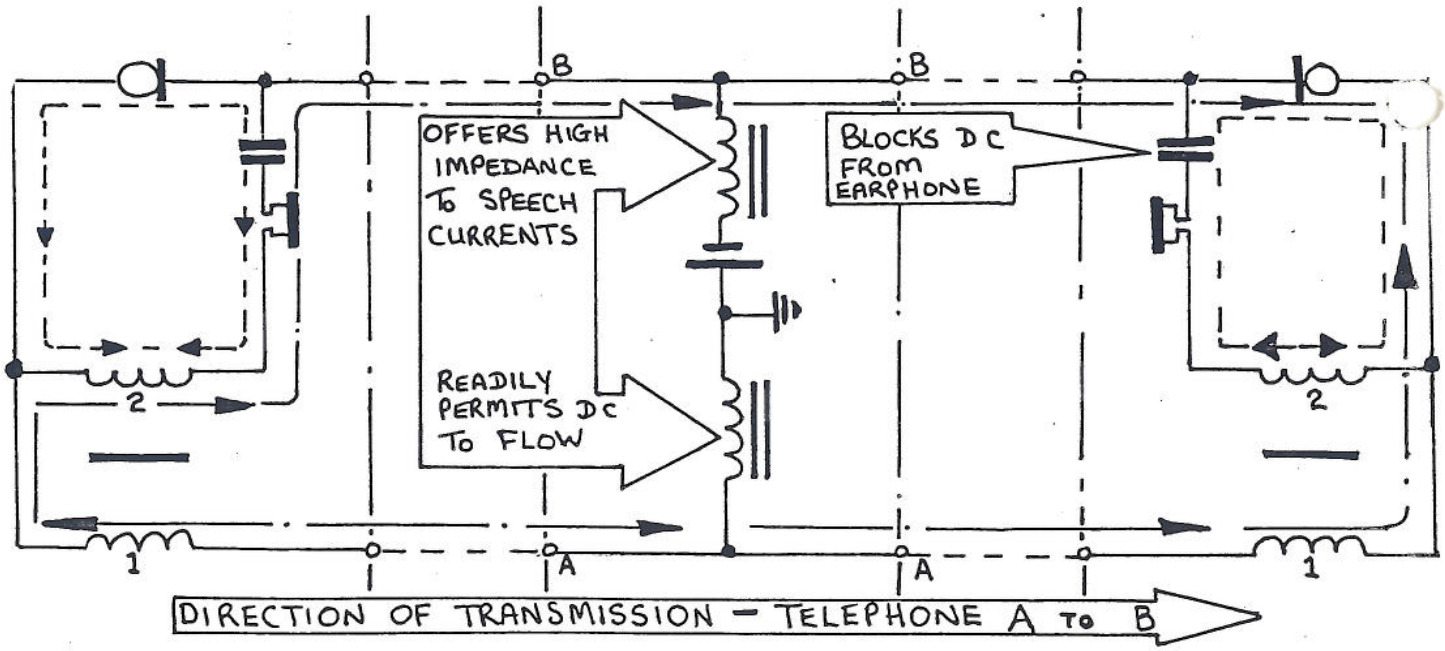
a. To isolate the earphone from the DC battery to avoid reducing its sensitivity.

b. To isolate the microphone from the line; enabling the use of low voltage batteries to energise the microphone.

c. As impedance matching devices to ensure maximum power transfer to line.

1.3. In practice the provision of local batteries at the users premises is not an economical proposition. Therefore, the solution adopted is the provision of one central 50 volt battery at the Telephone Exchange.

2. THE SIMPLE TELEPHONE TRANSMISSION CIRCUIT USING A CENTRAL BATTERY



2.1 Sound waves striking the diaphragm cause a varying potential to be developed across Microphone A, which results in an alternating current flowing through Induction Coil winding 2. This results in series aiding emfs being induced across Induction Coil windings 1 and 2. Consequently the signal is transmitted via the Line and Exchange to Telephone B where it circulates through Induction Coil winding 1 to induce an emf across winding 2. The signal then circulates around Telephone B Earphone circuit, energising the Earphone to convert the electrical signal back to sound energy.

2.2 The turns ratios of the Induction Coil windings ensure both transmitting and receiving efficiency, to and from Line, at Telephones A and B respectively.

2.3 High impedance coils are necessary to prevent the speech currents being shunted through the Exchange Battery.

3 ANTI SIDE TONE INDUCTION COIL (ASTIC) CIRCUIT

3.1 Sidetone is the reproduction of sounds in the local Earphone circuit. Although this gives the Customer the impression that the telephone is alive and functioning correctly. It also causes the following adverse effects -

a. Wastes power in the local Earphone circuit, reducing the telephone transmitting efficiency.

b. Leads to the speaker lowering his voice, again reducing the telephone transmitting efficiency.

c. Lowers the overall receiving efficiency at the distant instrument, causing ear fatigue to the listener.

3.2 To solve the problem a 3 winding Induction Coil and its associated circuit components are fitted in all practical telephones. The design of the circuit still allows a minimum amount of sidetone to maintain customer confidence.

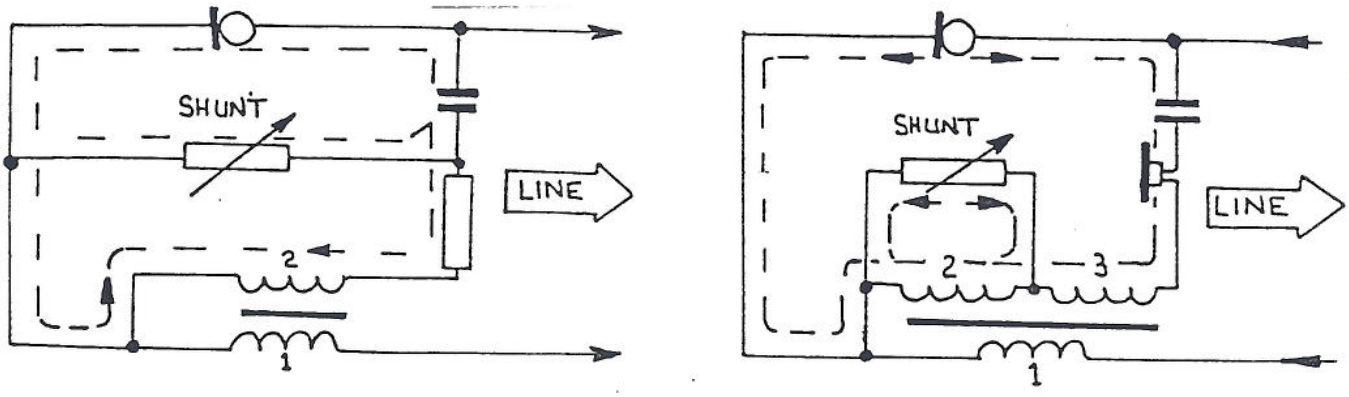
4 THE REGULATOR

4.1 The desirability to extend the upper working limits of telephone lines led to the development of a more efficient Induction Coil and the Receiver 4T, which are both included in the 700 type circuit. This has resulted in economies from the use of smaller gauge line conductors and absorption of smaller telephone exchange areas into larger adjacent areas.

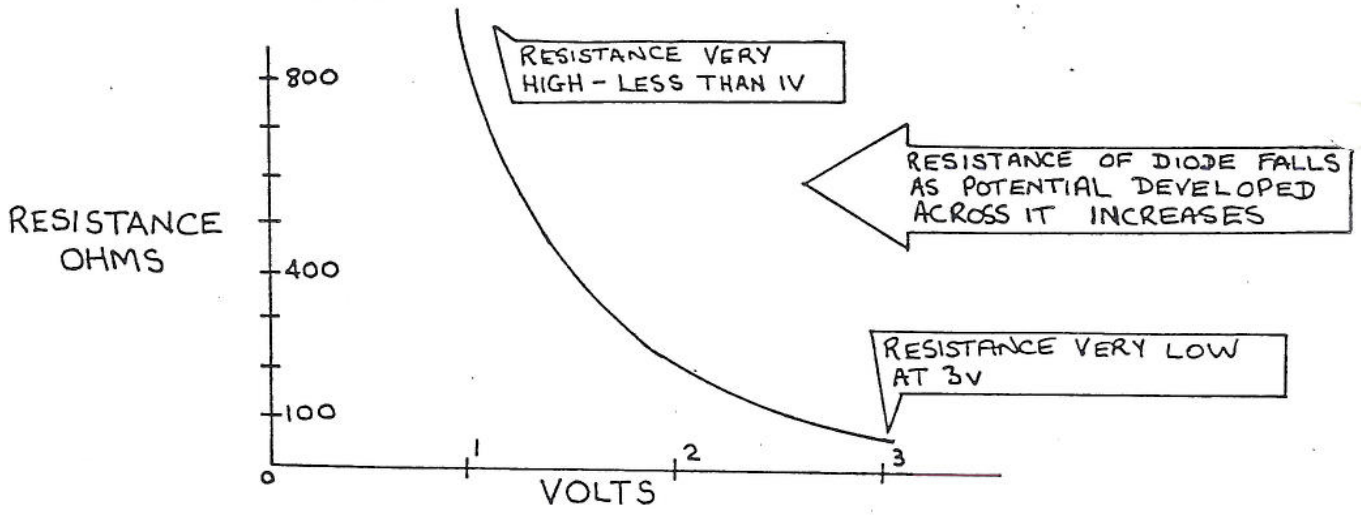
4.2 Under field conditions the performance of the modern telephone circuit was successful on Long Lines, however, it proved to be over sensitive on shorter lines. A device was therefore required to reduce the receiving and sending efficiency on shorter lines but, leave the efficiency of the telephone unimpaired on longer lines of over 650 ohms loop resistance. This is the function of the Regulator ie to automatically degrade the transmission circuit in accordance with the line length.

5 THE PRINCIPLE OF THE REGULATOR

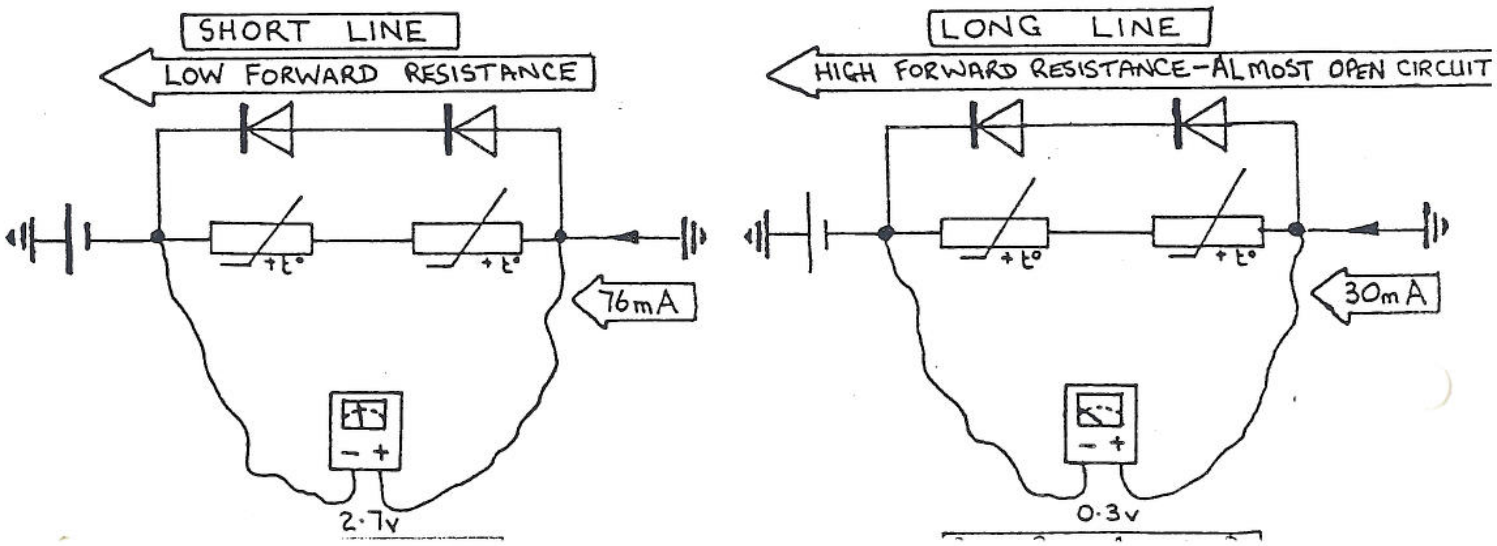
5.1 The Regulator circuit can be considered as 2 variable resistors. One resistor is connected across the Microphone and Induction Coil winding 2, to divert a portion of the Microphone output from winding 2 and ultimately from line. The other resistor connected across winding 2 shunts the output from winding 2 to the Earphone.



5.2 In practice the variable resistors are a pair of selenium rectifiers whose forward resistances are variable ie their resistance is dependant on the potential difference across them.

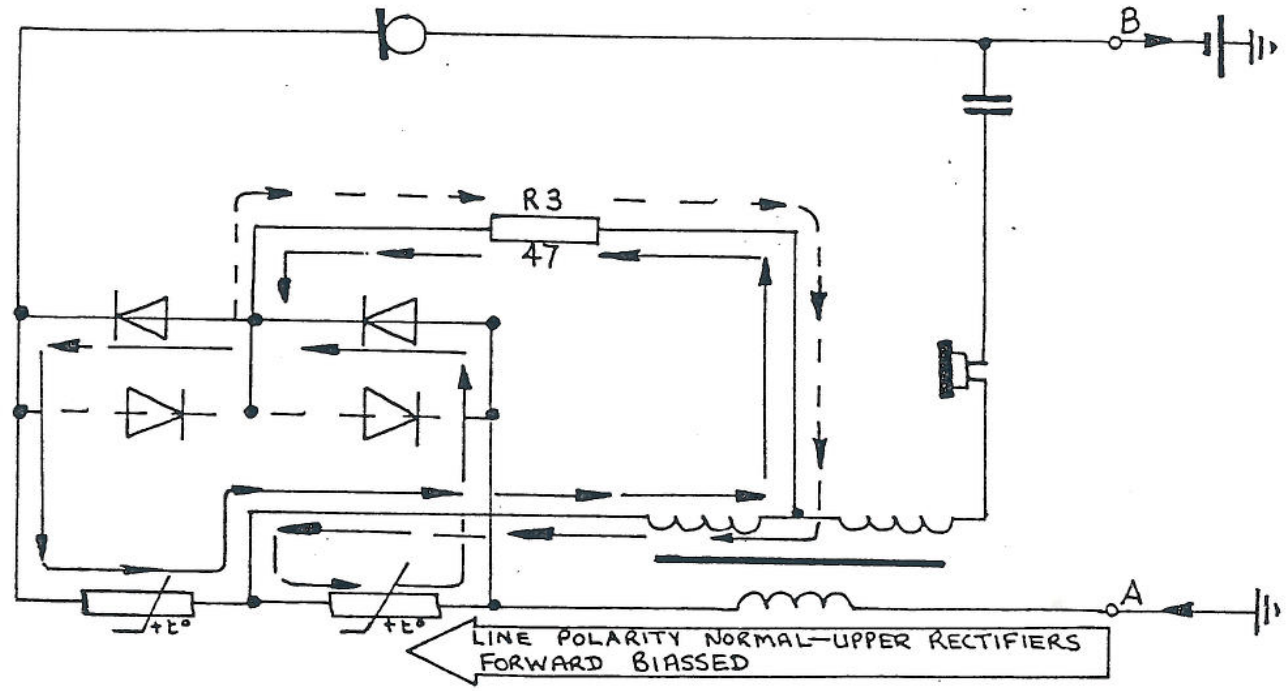


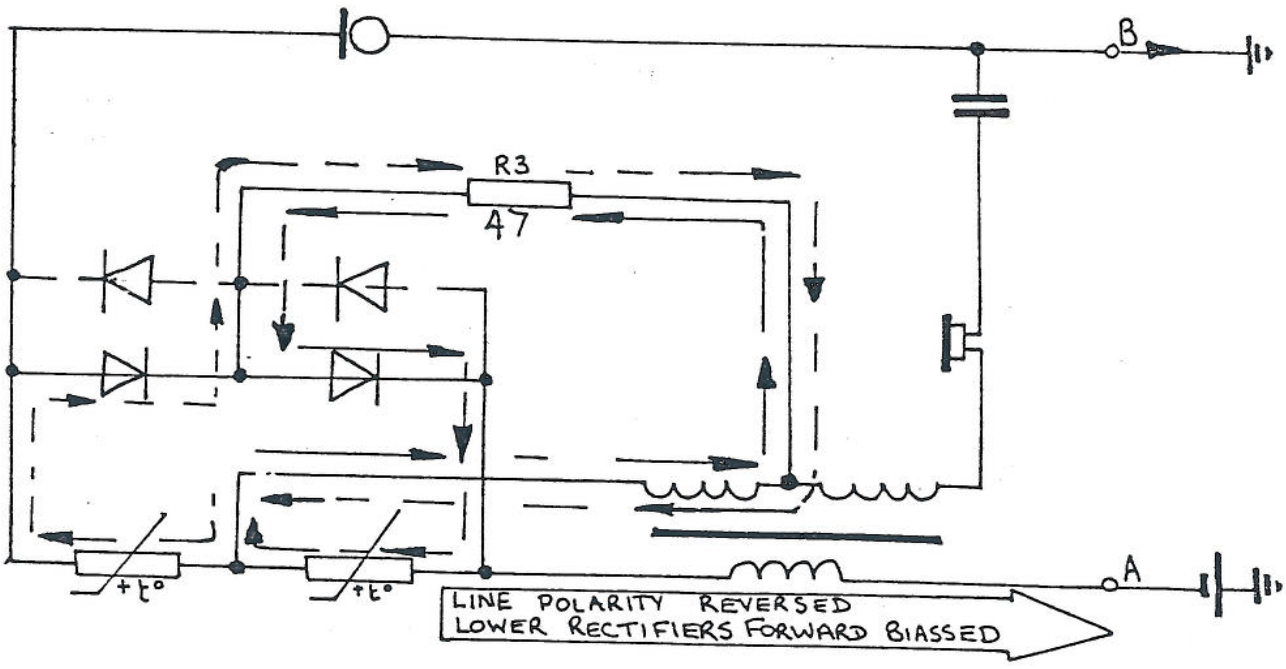
5.3 The potential difference is actually derived from the line current drawn through the tungsten filament lamp, (Resistor Bulb) which has a positive temperature coefficient ie its resistance increases in a non linear manner when the current drawn through it increases. Consequently on a short line with a current of 76 mA the filament resistance increases to 36 ohms, whilst on a long line where the current is reduced to 30 mA the filament resistance falls to 10 ohms.

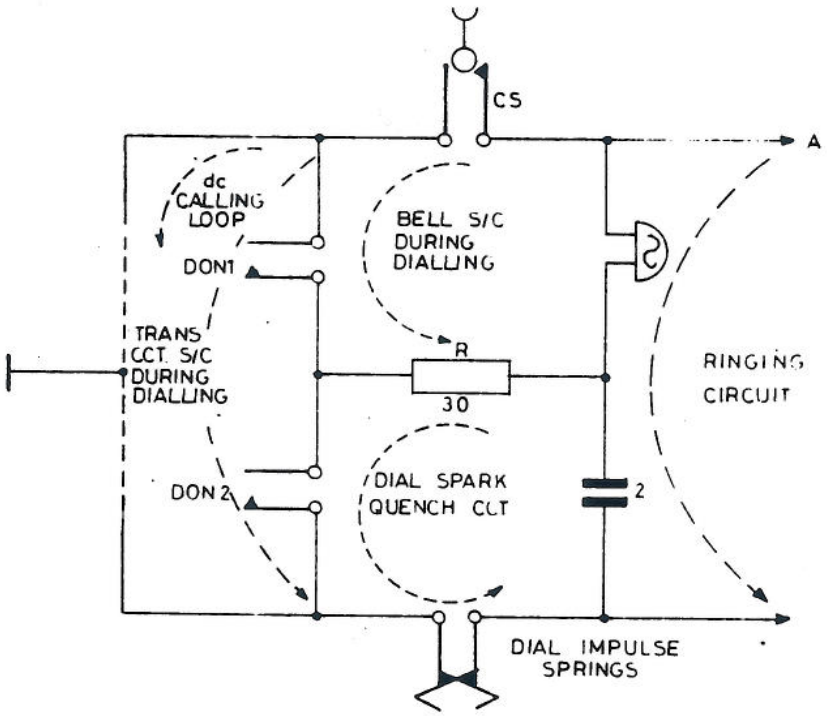


5.4 The greater the potential developed across the tungsten filament, the lower the forward resistance of the selenium rectifiers. Hence, the greater the proportion of speech currents shunted from the transmit and receive circuits.

5.5 To cater for reversals of line polarity, 2 pairs of rectifiers are required for both transmit and receive circuits. The diagram below shows the practical receive circuit. A similar network of rectifiers and a 15 ohm resistor R4 forms the Microphone shunt circuit.







BASIC SIGNALLING CIRCUITS OF AUTOMATIC TELEPHONE.

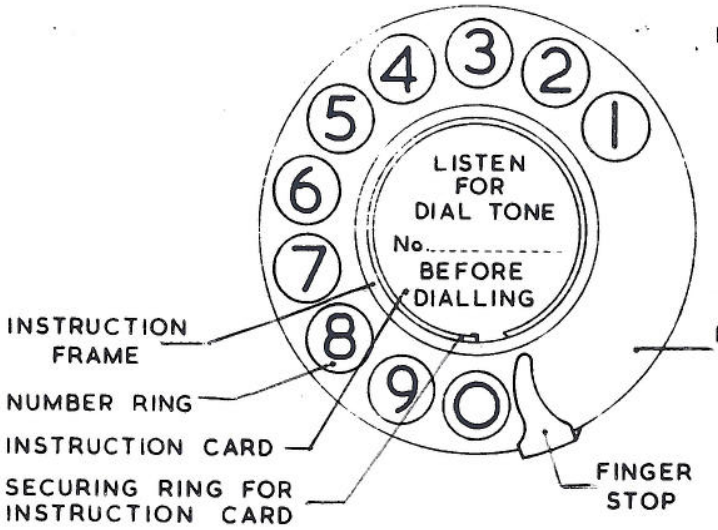


FIG. 1. FRONT VIEW OF DIAL

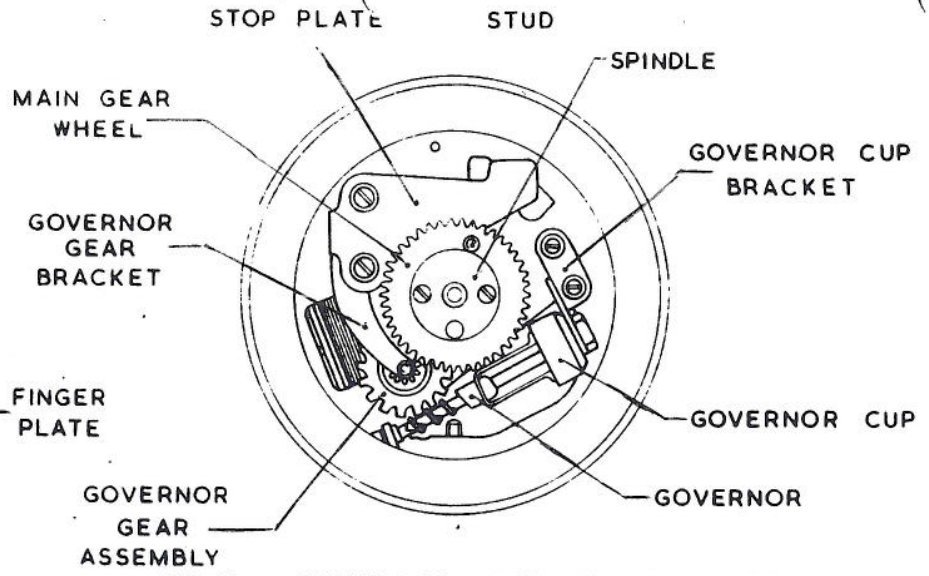
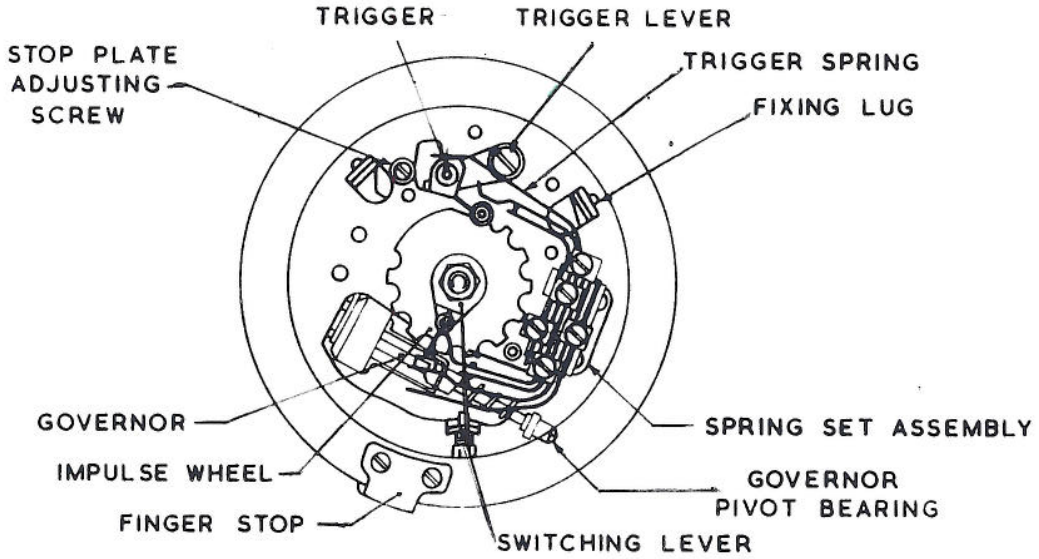
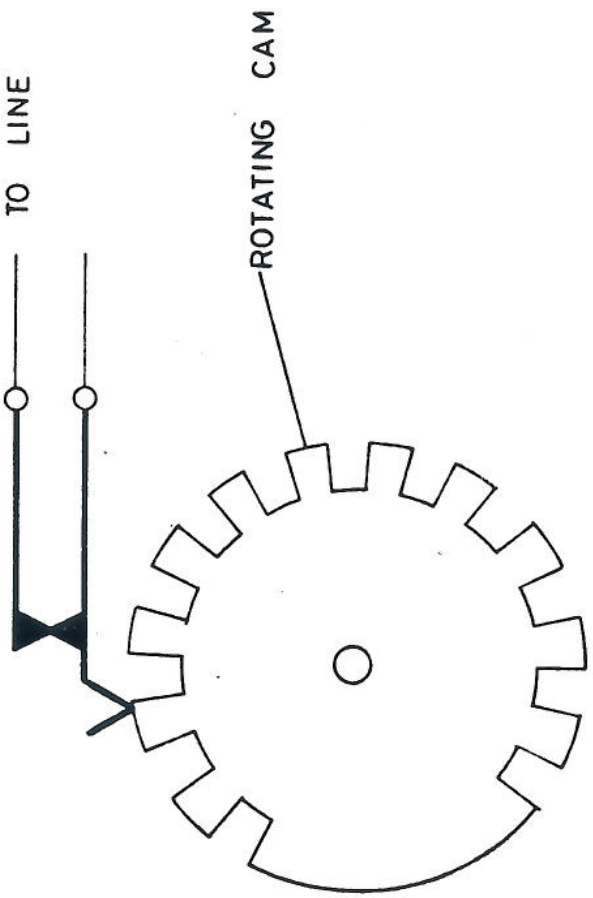
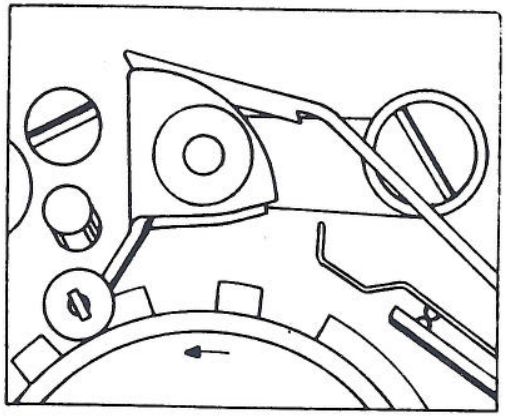


FIG. 2. FRONT VIEW WITH FINGER PLATE AND NUMBER PLATE REMOVED

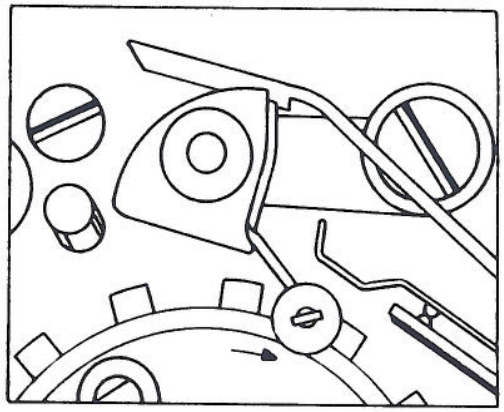




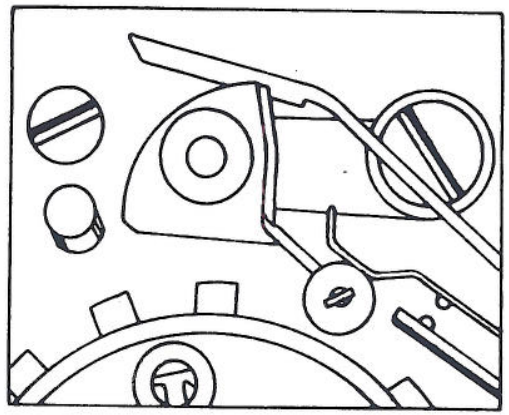
PRINCIPLE OF THE DIAL.



DIAL WOUND, SHOWING TRIGGER IN POSITION PRIOR TO COMMENCEMENT OF INTER-DIGIT PAUSE



SHOWING TOGGLE TURNED OVER AND ALMOST AT END OF INTER-DIGIT PAUSE



END OF INTER-DIGIT PAUSE AND TRIGGER GIVING FIRST IMPULSE

IMPULSE MECHANISM OF THE TRIGGER DIAL

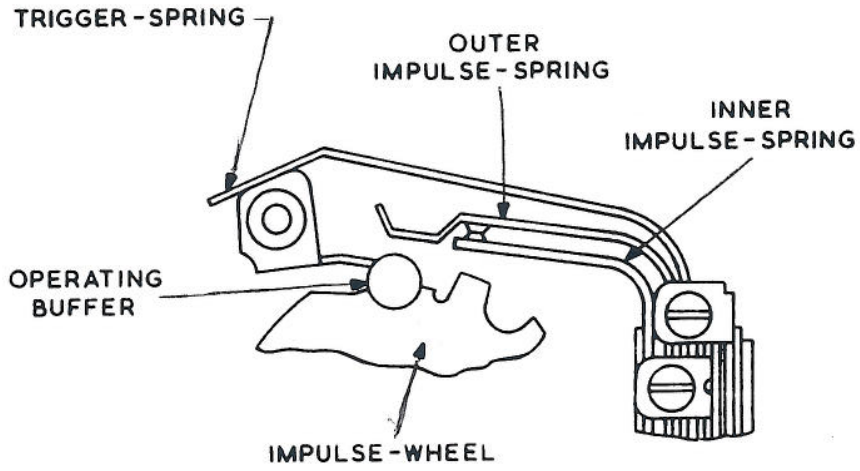


FIG. 4. IMPULSE - SPRINGS

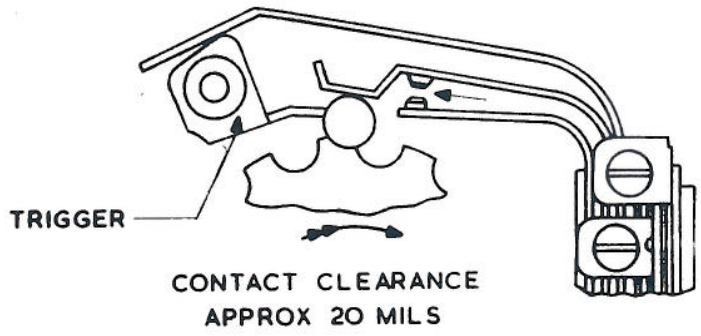


FIG. 5. CONTACT CLEARANCE OF IMPULSE - SPRINGS

IMPULSE - SPRINGS

DIAL SPEED 10 I.P.S. WORKING LIMITS 9 - 11 I.P.S. MTCE. ADJ. LIMITS 9.5 - 10.5 I.P.S.
PULSE RATIO $33\frac{1}{3}$ mS MAKE $66\frac{2}{3}$ mS BREAK
LOST MOTION PERIOD 230 mS APPROX

MIN. INTER DIGITAL PAUSE - WIND UP TIME + LOST MOTION PERIOD - 400/450 M.S.

SPRINGS 1 AND 2 SHALL BE ADJUSTED TO BREAK BEFORE SPRINGS 3 AND 4. TO OBTAIN THIS SEQUENCE THERE SHALL BE A GAP BETWEEN SPRING No. 4 AND THE BUFFER ON SPRING No. 2 WHEN THE DIAL IS OFF NORMAL. (SEE FIG. 6.) THERE SHALL BE A MINIMUM CONTACT SEPARATION OF 10 MILS (0·25mm) WHEN THE DIAL IS NORMAL. (SEE FIG. 7.)

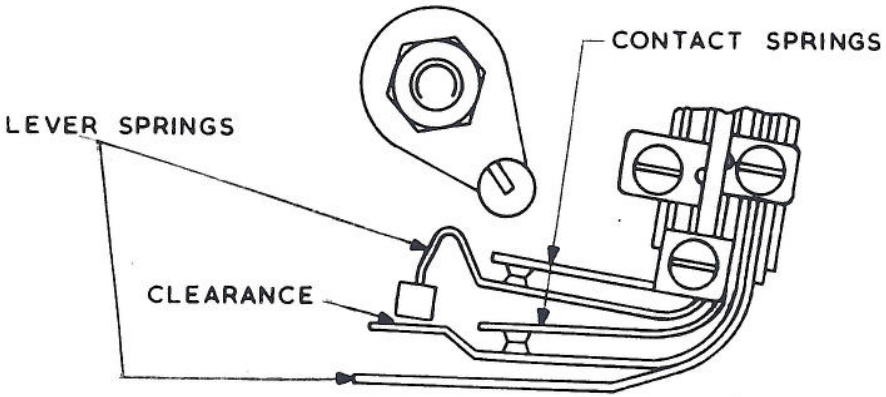


FIG. 6. ADJUSTMENT OF SHUNT SPRING ASSEMBLY

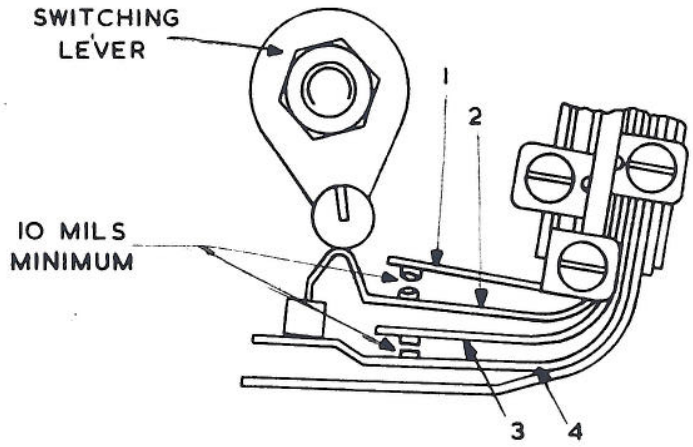
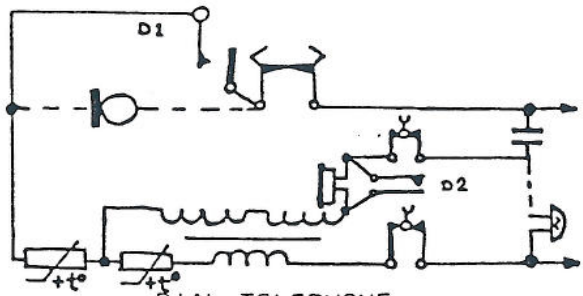


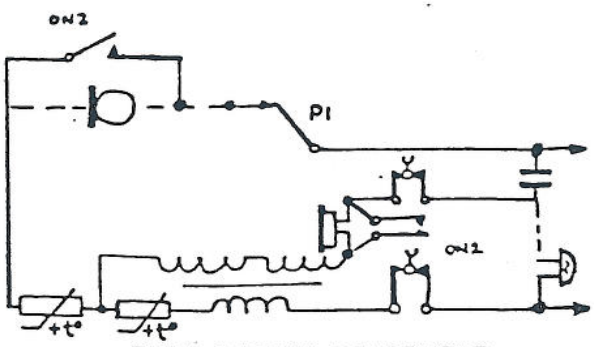
FIG. 7. ADJUSTMENT OF SHUNT SPRING CONTACT CLEARANCES

TC1/2.4.7

PRACTICAL TELEPHONE DIALLING OR KEYING CIRCUIT



DIAL TELEPHONE



PUSH BUTTON TELEPHONE

3.1 When the D1 contact operates, the microphone is short circuited to:-

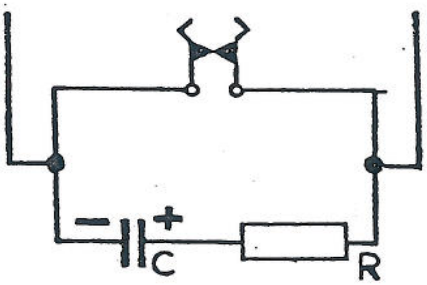
a. Prevent damage to the carbon granules

b. Improve the pulsing performance of the pulse acceptance relay at the exchange

3.2 D2 contact short circuits the earphone to prevent acoustic shock.

3.3 A spark quench circuit is connected across the pulsing contacts to prevent arcing and consequent pitting of the contacts. The spark quench circuit basically consists of a capacitor and resistor connected in parallel with the pulsing contacts

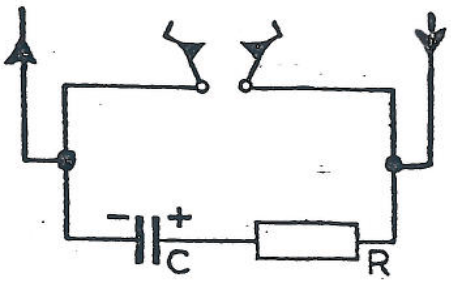
PULSE SPRINGS NORMAL



NETWORK S/C BY PULSING CONTACTS C DISCHARGED

BREAK PULSE

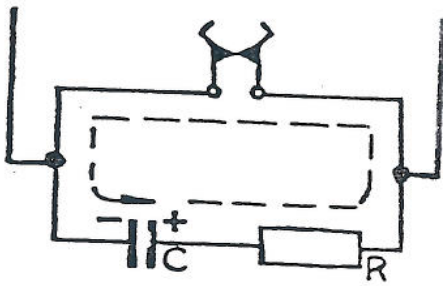
RELEASES PULSE ACCEPTING RELAY WHICH GENERATES BACK E.M.F.



C CHARGES ABSORBING ENERGY THAT WOULD BE DISSIPATED AT PULSING CONTACTS IN FORM OF HEAT

MAKE PULSE

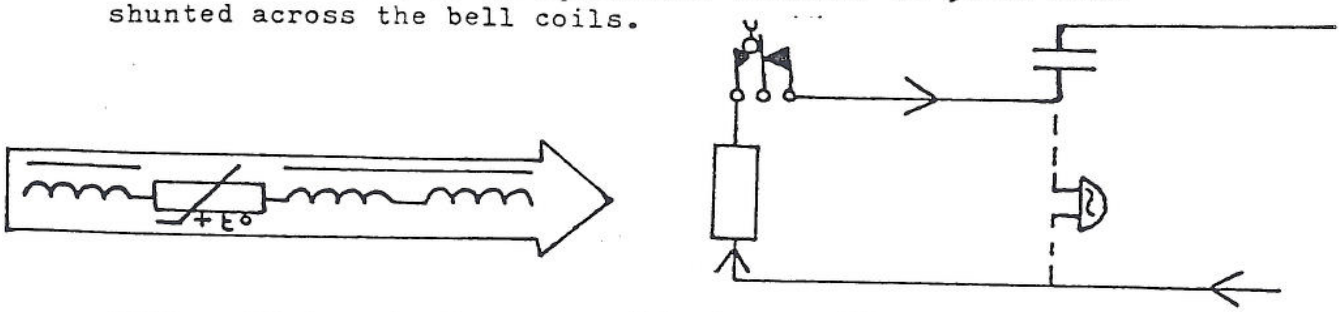
DISCHARGE C READY FOR NEXT BREAK PULSE



C DISCHARGES R LIMITS DISCHARGE CURRENT PREVENTING PULSING CONTACTS BEING WELDED TOGETHER

In practice the spark quench circuit components consist of a capacitor C1 with a resistor bulb and induction coil windings 2 and 3 connected in series to form an equivalent resistor.

3.4. Bell tinkle is prevented at the standard telephone by means of a bell shunt circuit. This consists of the 3 induction coil windings and one of the resistor bulbs connected in series with each other. The whole series connected network of components can be considered as an equivalent resistor of 50-60 ohms shunted across the bell coils.

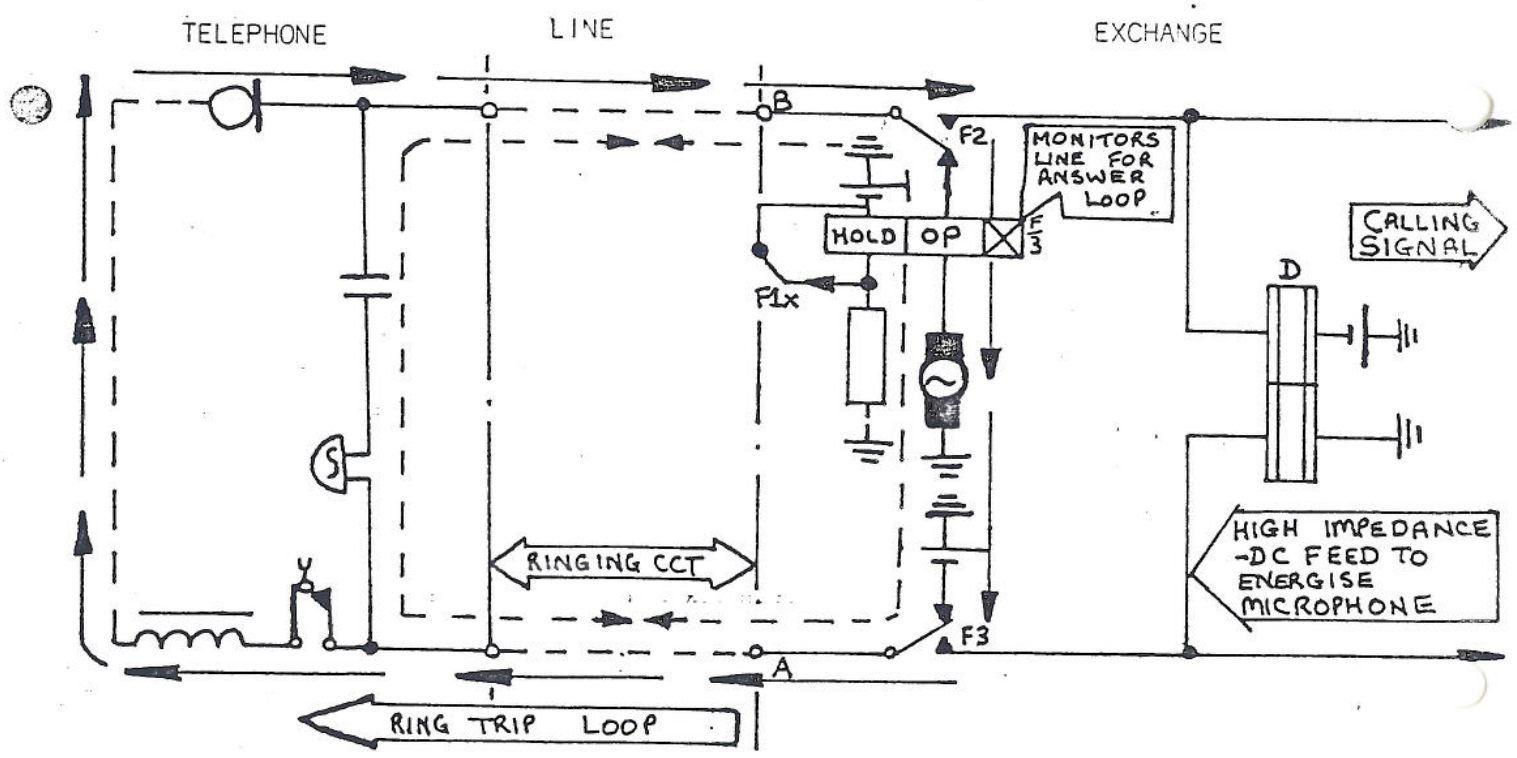


NOTE: It is not always possible to provide a bell shunt circuit. The alternatives are to disconnect the bell circuit when the telephone is in use, usually by means of an auxilliary gravity switch spring, or to connect a thermistor in series with the bell. The thermistor has a negative temperature co-efficient i.e., when cold its resistance is approximately 20K ohms, but when heated by a few cycles of ringing current it falls to approximately 500 ohms.

4. EXCHANGE CALLING SIGNAL (INCOMING RING)

The Exchange calling signal is a 75V, 25Hz, ringing signal connected to the Customers line. The ringing signal is connected to the line via relay F and the Exchange battery. Relay F is designed so that it will not operate, whilst ringing current only is flowing through its coil.

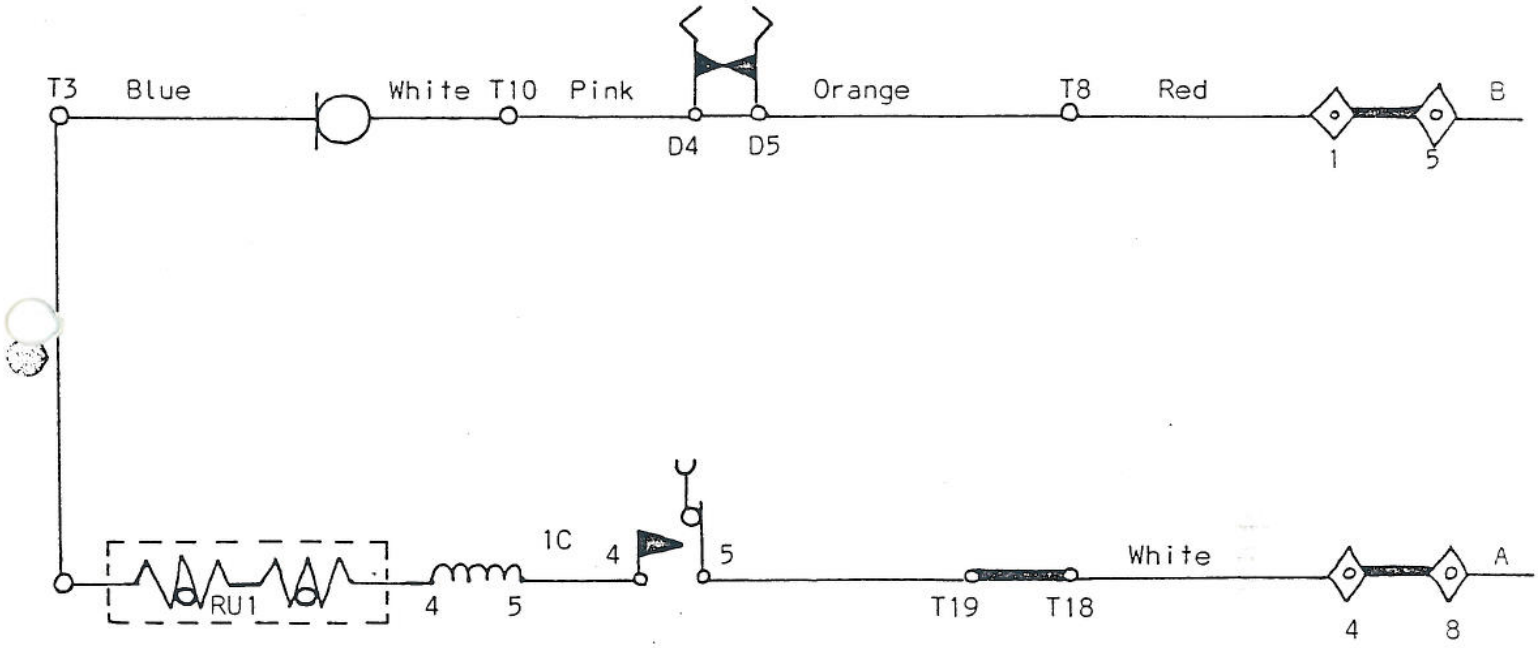
X after relay contact no means to break
Y " " " " " " make



TC1/2 1/9

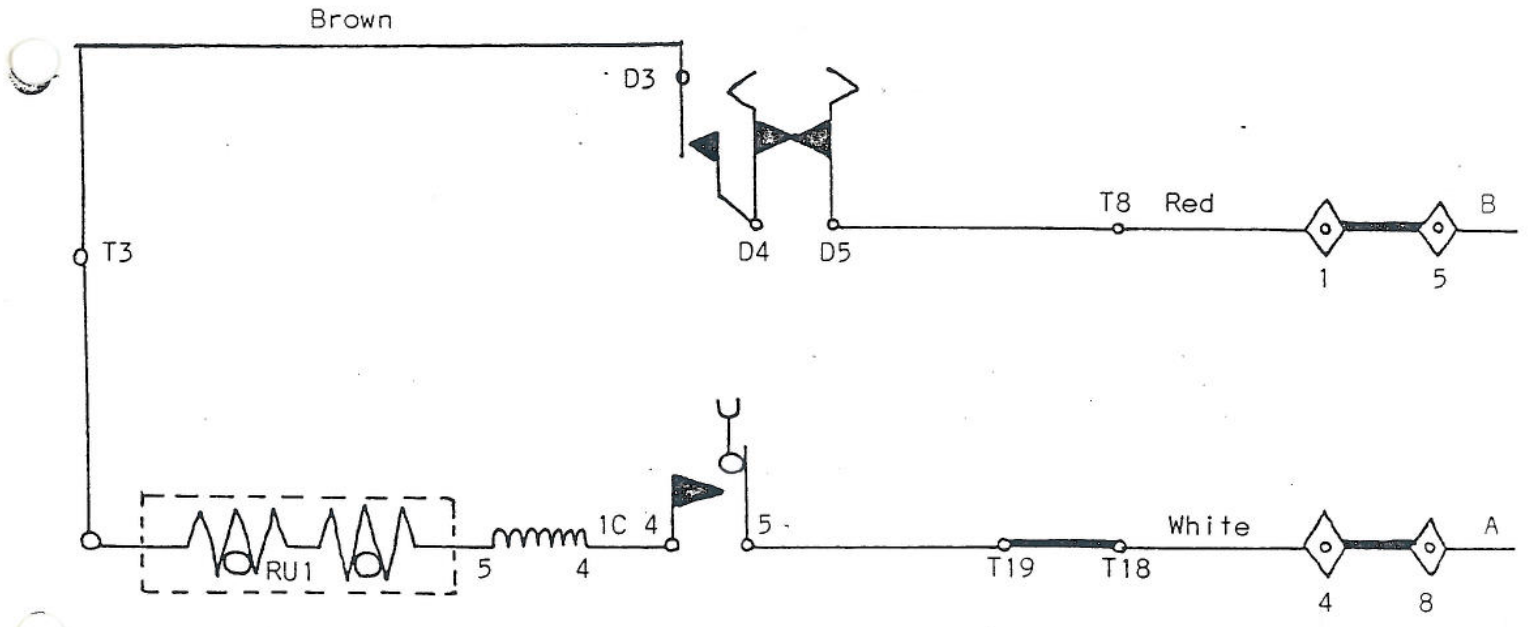
TELEPHONE 746 CIRCUIT ELEMENTS

CALLING AND ANSWERING LOOP



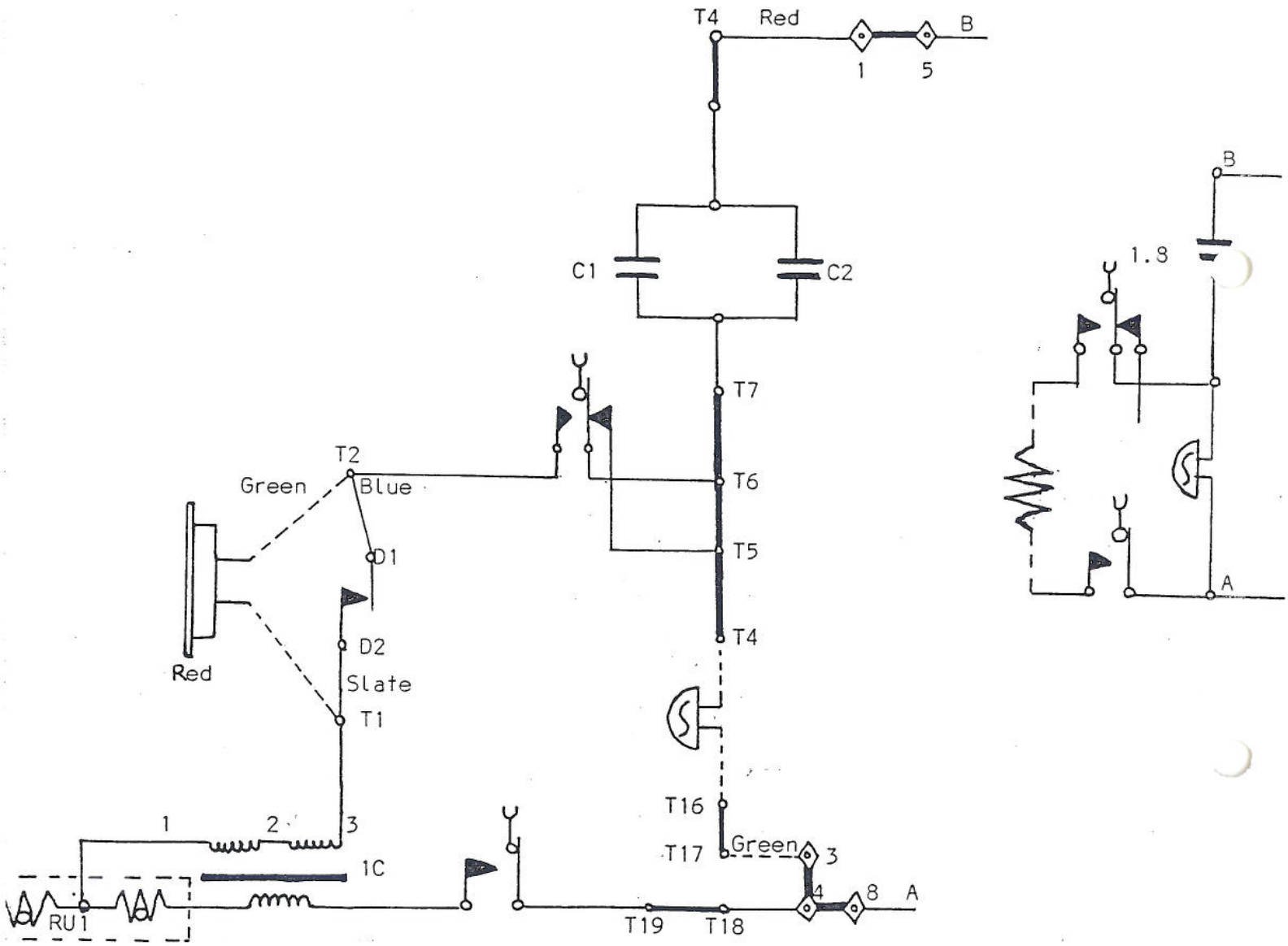
DIALLING LOOP

D3 short circuits the transmitter



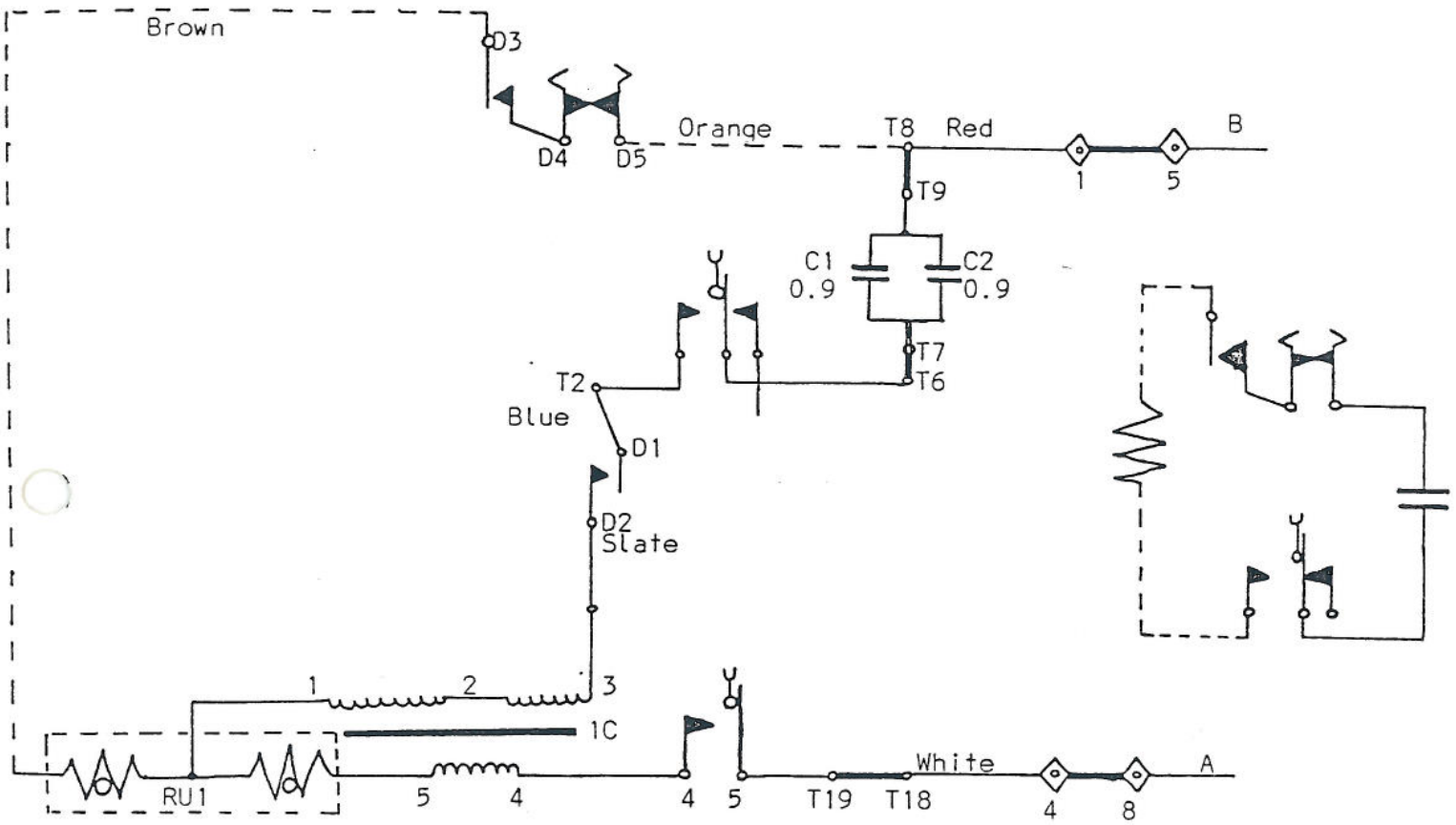
TC1/2·1/10

BELL AND RECEIVER (During dialling) SHUNT CIRCUIT

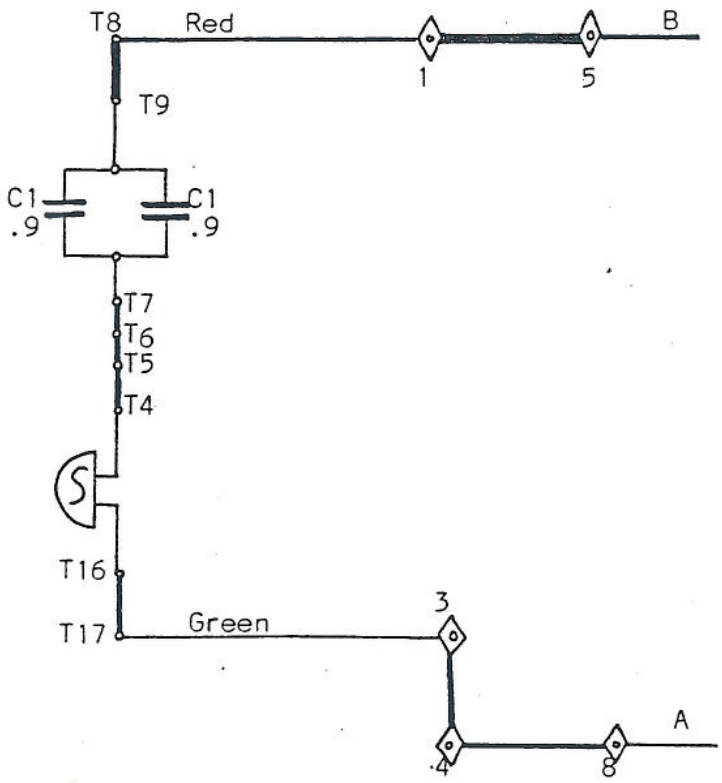


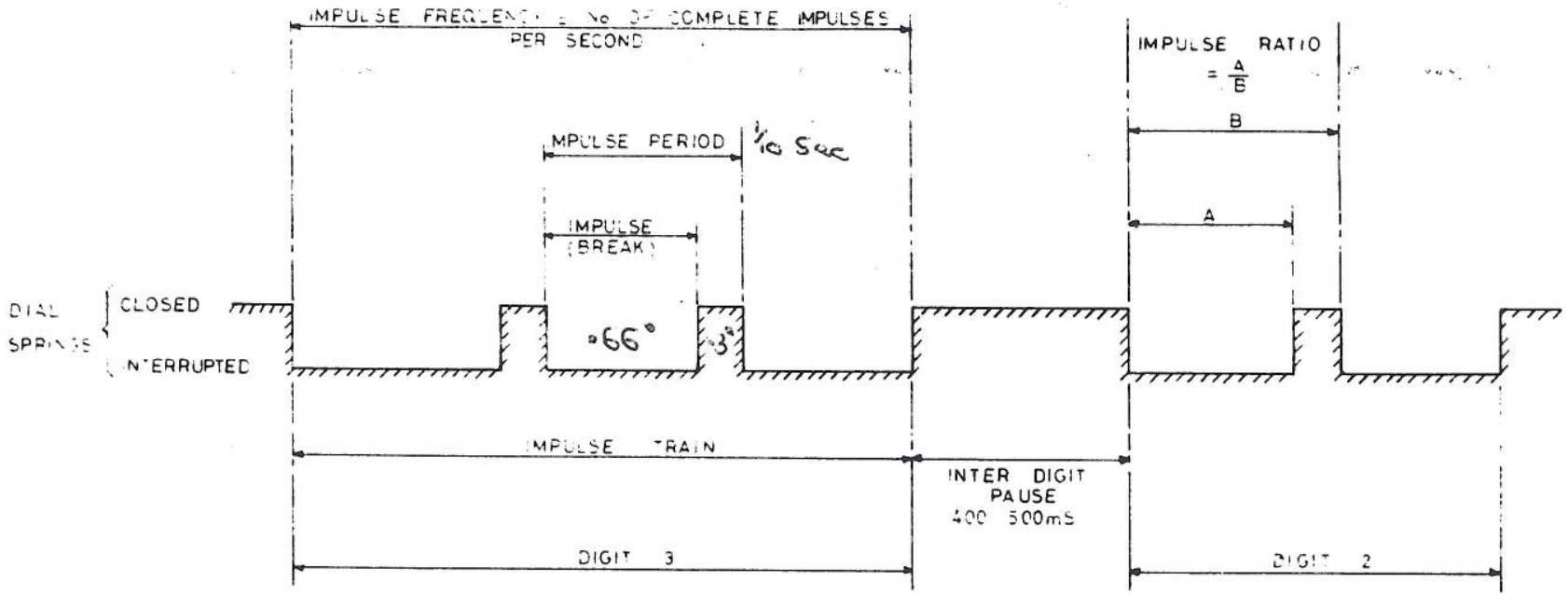
TC1/2-1-11

SPARK QUENCH (During dialling) CIRCUIT

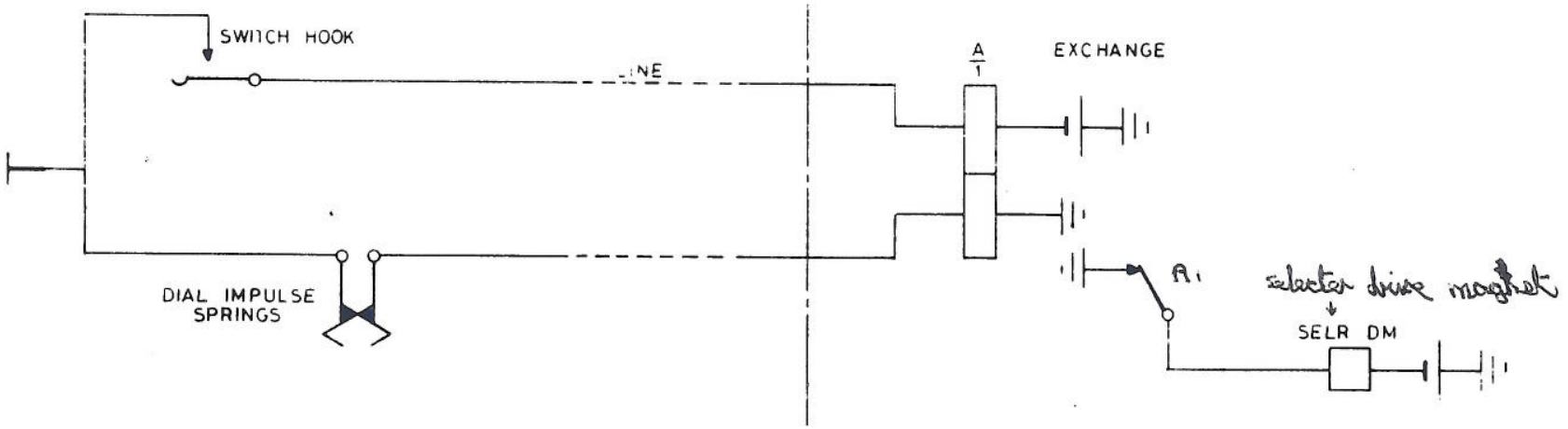


BELL CIRCUIT





IMPULSE TERMINOLOGY.



PRINCIPLE OF LOOP IMPULSING.

TC1 | SECT 2.1 | 12

TONE APPLICATIONS

COMMON SERVICES - RINGING & TONES

N.B. THE TABLE BELOW DEPICTS IDEAL SITUATIONS ONLY.

CONDITION	FREQUENCY	PERIOD OF APPLICATION
DIAL TONE	50 or 33.3 Hz	CONTINUOUS
RING TONE	MIXTURE OF 400 & 450 Hz or 133 Hz (OLDER SYSTEMS)	0.4 SECS ON 0.2 SECS OFF 0.4 SECS ON 2 SEC PAUSE REPEATS
BUSY TONE	400 Hz	0.375 SEC ON) REPEATS 0.375 SEC OFF) or 0.75 SEC ON) REPEATS 0.75 SEC OFF) (OLDER)
N.U. TONE	400 Hz	CONTINOUS
EQUIPMENT ENGAGED TONE (NOT PROVIDED ON ALL EXCHANGES)	400 Hz	0.225 SEC ON) 0.525 SEC OFF) REPEATS 0.4 SEC ON) 0.35 SEC OFF)
RINGING CURRENT	25 or 16.6 Hz	0.4 SEC ON 0.2 SEC OFF 0.4 SEC ON 2 SEC PAUSE REPEATS
INTERRUPTED EARTH	-	0.75 SEC ON) REPEATS 0.75 SEC OFF)
FLICKER EARTH	-	0.2 SEC ON) REPEATS 0.2 SEC OFF)

TELEPHONE TYPES OF TRANSMITTER FEED

The telephone instrument needs a D.C. current to energise its transmitter. This D.C. current can either be fed locally from a supply at the extension instrument, (Local Battery Systems) or from a remote supply or Central Battery, (C.B. Systems).

1) Central Battery System

This system operates by having a battery (usually 50 volts) housed in a central point, (the Telephone Exchange) from which it feeds all the extension instruments.

On lifting the telephone handset, a loop isplaced across the A and B legs of the twisted pair, and this loop is detected at the exchange.

On an automatic exchange, dial tone will be received if the exchange equipment is free.

On a manual exchange or cordless switchboard a lamp will be light to indicate to the operator that a call has been initiated.

The Central Battery system has the advantage that only one battery is used and maintenance is therefore simplified. Due to high current levels on short lines, some regulation is necessary in the telephone.

2) Local Battery System

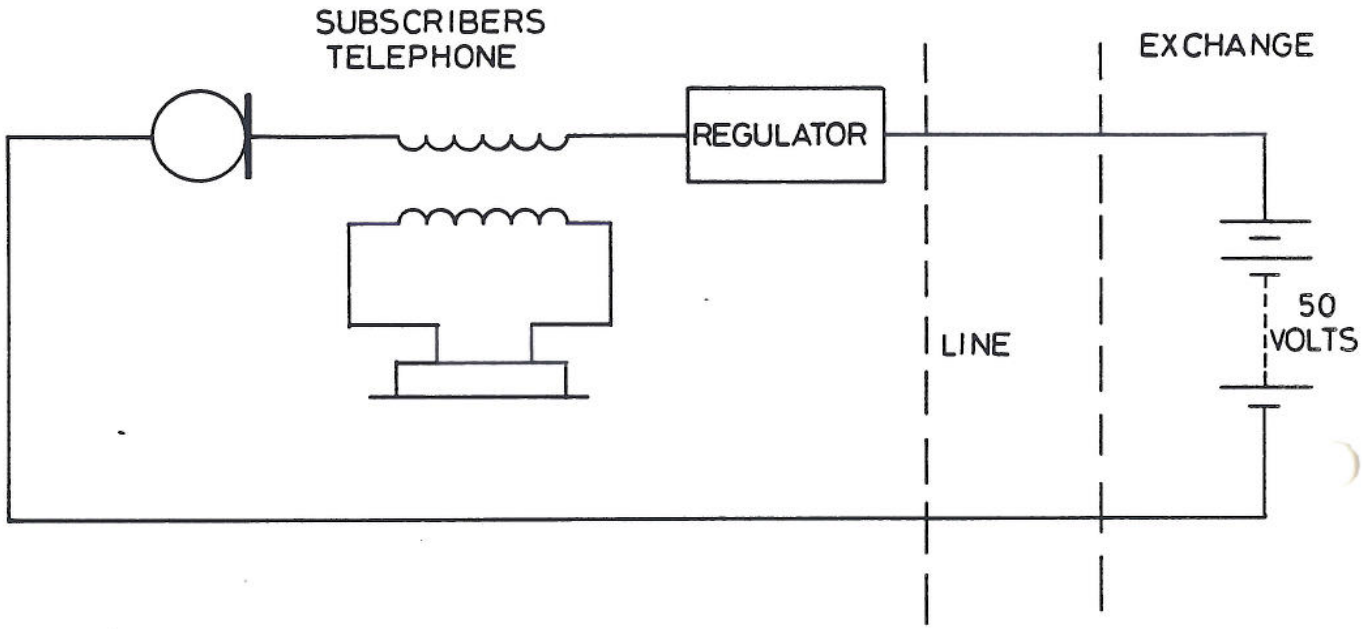
Older systems utilise a local battery system, where the telephone transmitter is energised from a battery at the telephone.

No regulation will now be required, as the transmitter current is independant of the resistance of the line. Maintenance of an acceptable standard of service becomes more difficult, however, due to the necessity to keep the large number of batteries in working condition.

The local battery system is used in omnibus circuits and magneto circuits. The ringing supply for local battery circuits is obtained from a separate battery and can be D.C. as is the case for omnibus circuits, or A.C., obtained from a transistorised inverter on magnet systems.

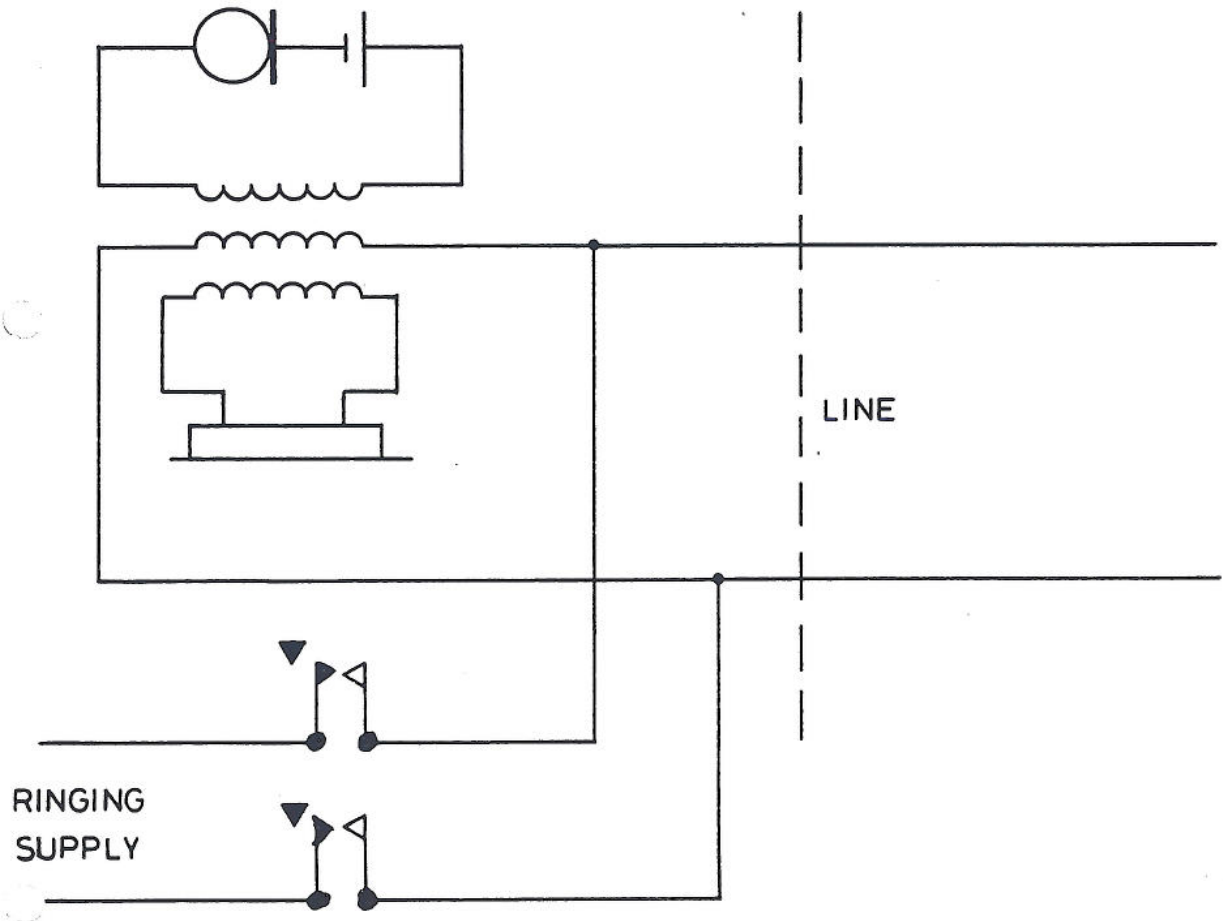
CENTRAL BATTERY SYSTEM

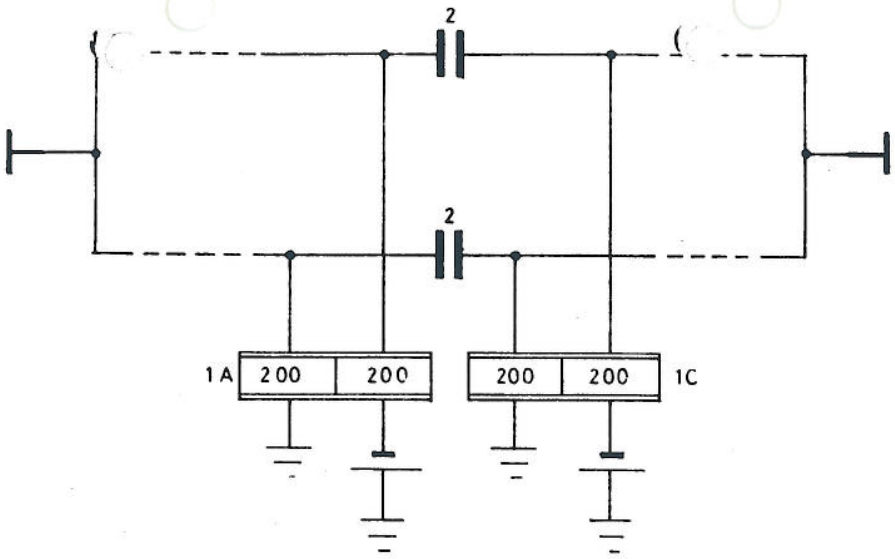
USED ON AUTOMATIC AND MANUAL EXCHANGES.



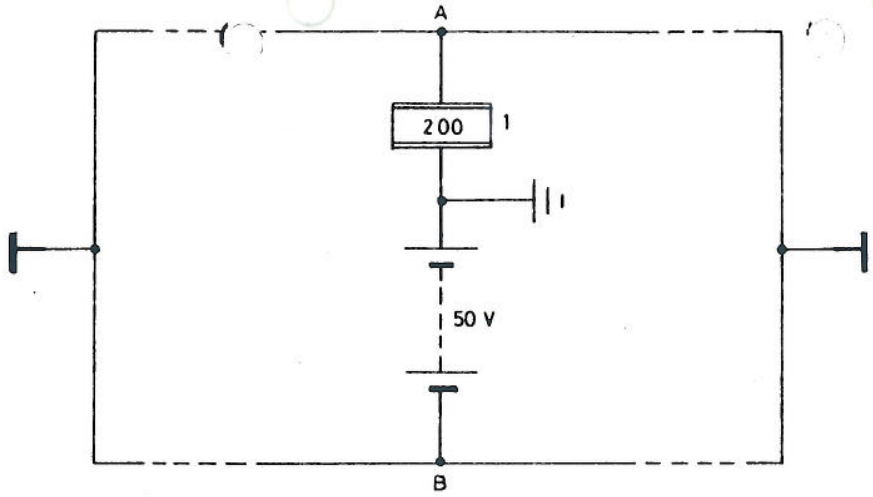
LOCAL BATTERY CIRCUITS

USED ON OMNIBUS AND MAGNETO CIRCUITS

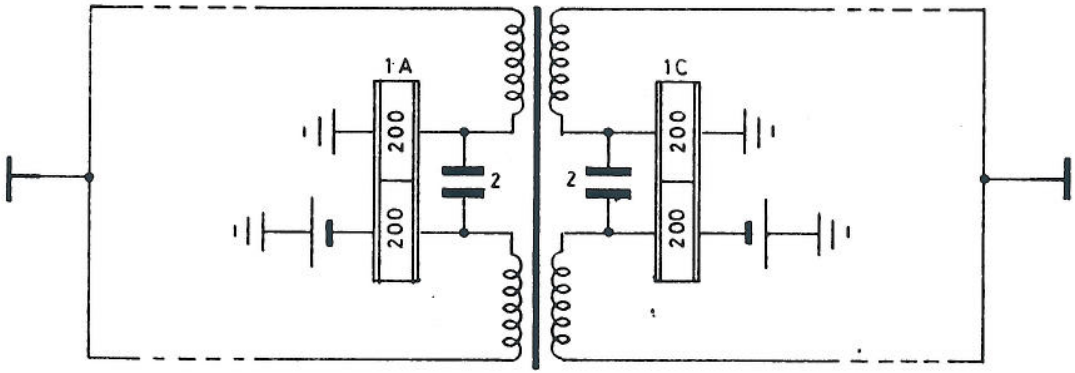




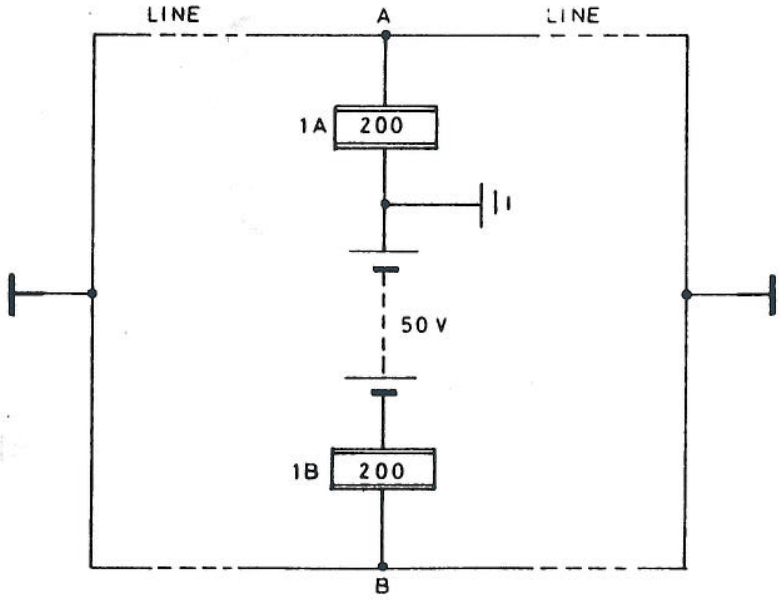
STONE TRANSMISSION BRIDGE.
(ELECTRO - STATIC COUPLING)



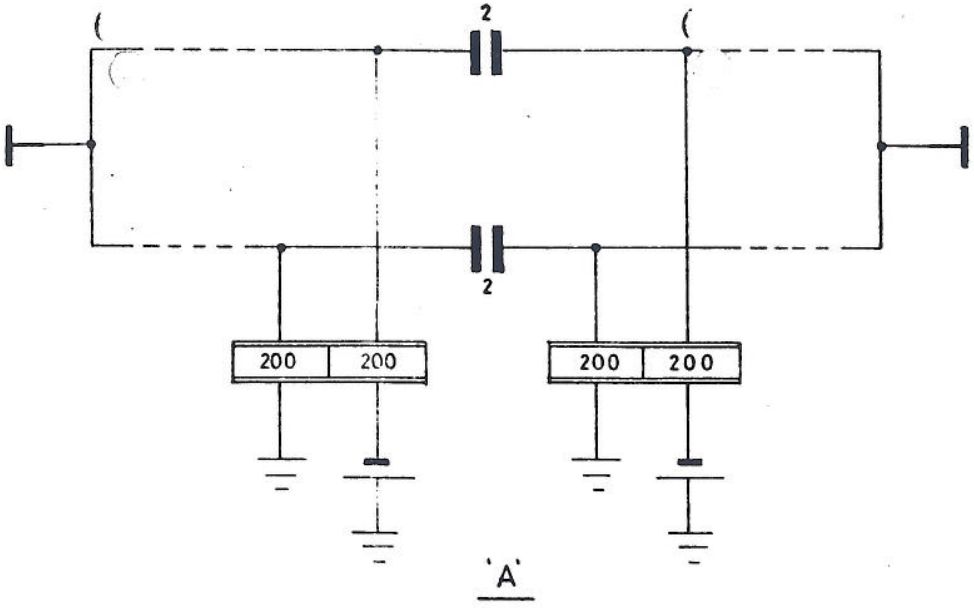
SIMPLE TRANSMISSION BRIDGE.
(UNBALANCED)



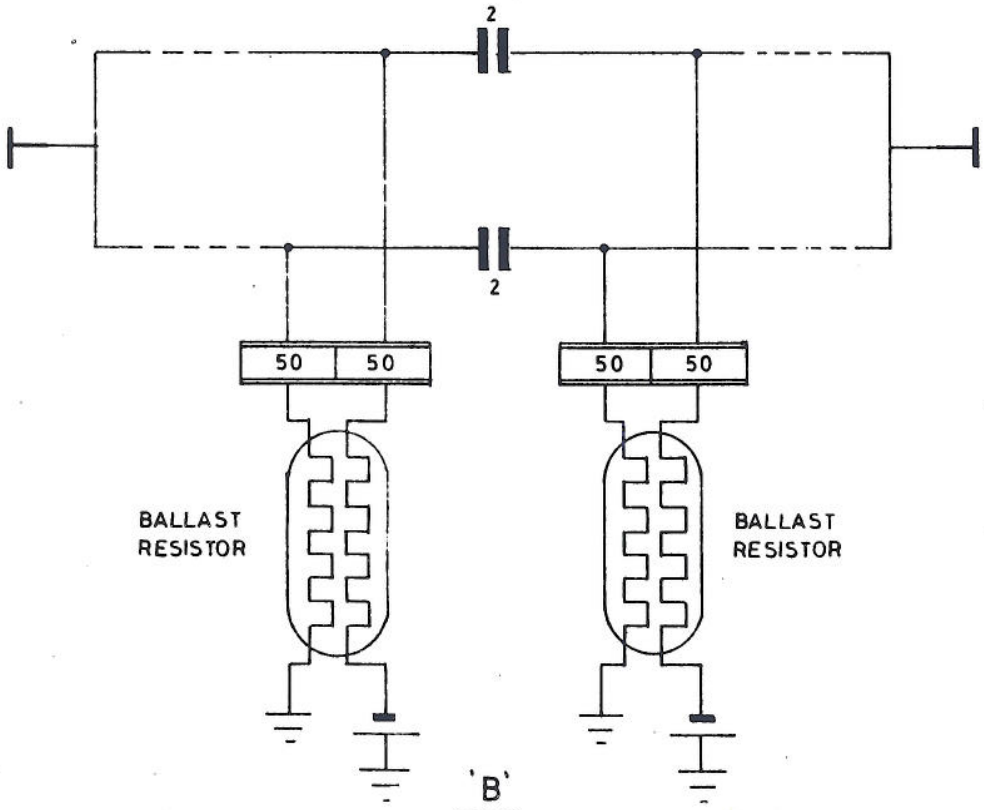
HAYES TRANSMISSION BRIDGE.
(ELECTRO - MAGNETIC COUPLING)



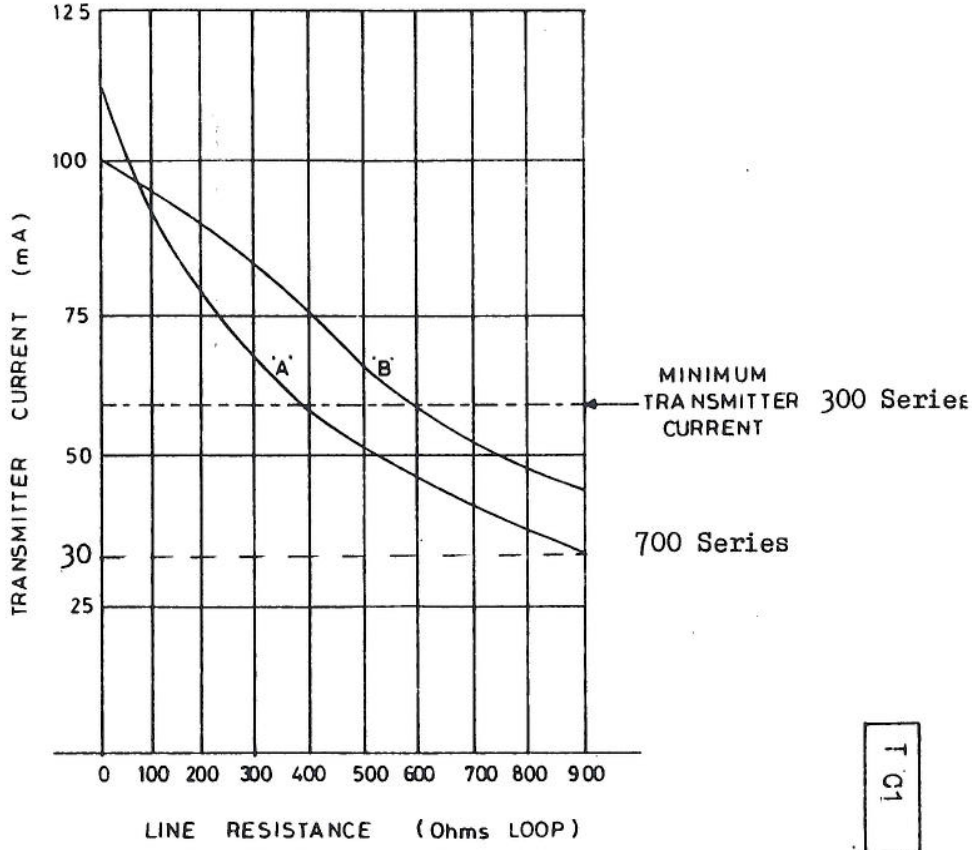
SIMPLE TRANSMISSION BRIDGE.
(BALANCED IMPEDANCE COILS)



'A'



'B'



EFFECT OF LINE RESISTANCE ON TRANSMITTER CURRENT WITH AND WITHOUT BALLAST RESISTORS.

T C1
2.2
4

British Rail

Course C.T. (T) Basic Installation.

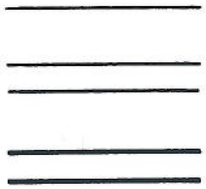
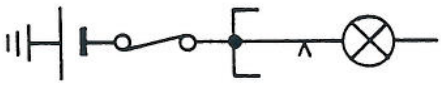
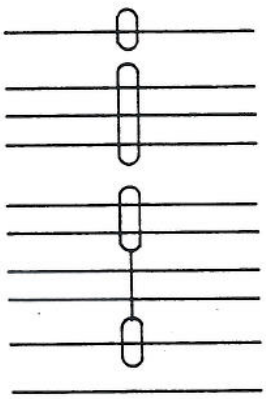
Section THREE.

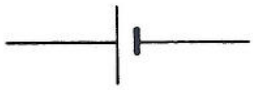
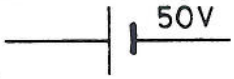
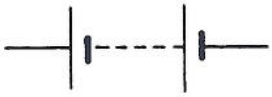
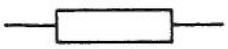
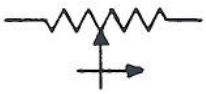
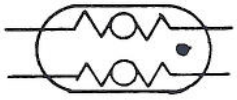
Content Symbols used in Circuit Diagrams.

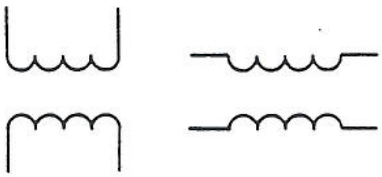
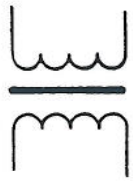
R.S. & T.E. Department

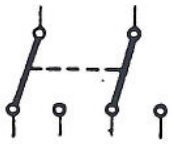
Training School **York**

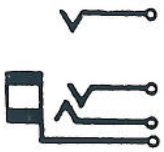
SYMBOLS FOR USE IN CIRCUIT DIAGRAMS

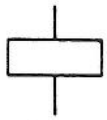
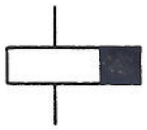
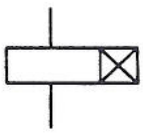
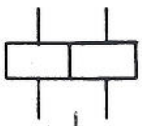
DESCRIPTION	SYMBOL
DIRECT CURRENT	
ALTERNATING CURRENT General Symbol	
CONDUCTOR - General Symbol NOTE The Thickness of the Line indicates the Importance of the Circuit.	
CROSSING OF CONDUCTORS WITHOUT CONNEXION	
CROSSING OF CONDUCTORS WITH CONNEXION, OR TAPPING NOTE Separate Points for each Tapping or Connexion.	
COMMON CONNEXION To Grouped Apparatus	
EXAMPLE	
WIRES IN CABLE EXAMPLES NOTE The Loop shown Dotted thus ⌷ indicates that Bunched Wires may be substituted for cable.	
JUMPER	

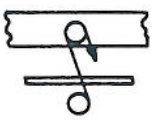
DESCRIPTION	SYMBOL
U-POINT (PLUG-IN POINT) EXAMPLE 	
EARTH	
PRIMARY CELL OR ACCUMULATOR NOTE The Long Line represents the Positive Pole and the Short Line the Negative Pole.	
BATTERY OF PRIMARY CELLS OR ACCUMULATORS	
NOTE Voltage shown where necessary EXAMPLE 	
	
RESISTOR OR RESISTANCE General Symbol (Can be Used for Impedance where Confusion will Not arise)	
	
POTENTIAL DIVIDER VARIABLE An Added Directional arrow indicates the effect of clockwise rotation of the operating control thus: 	
DEVICE WITH PRONOUNCED POSITIVE RESISTANCE/TEMPERATURE CHARACTERISTIC	
" Ballast Resistor	 SEE VACUUM OR GAS FILLED ENVELOPE - NOTE 1 ON FIG 16
" Ballast Resistor with Two Filaments	
DEVICE WITH PRONOUNCED NEGATIVE RESISTANCE/TEMPERATURE CHARACTERISTIC EXAMPLE "Thermistor" Indirectly Heated	
CAPACITOR OR CAPACITANCE General Symbol	

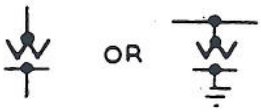
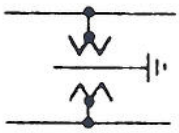
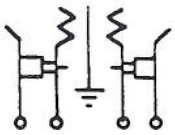
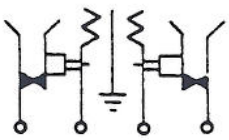
DESCRIPTION	SYMBOL
ELECTROLYTIC NOTE The + and - Signs may be omitted if no Ambiguity as to Polarity will result.	
INDUCTOR OR INDUCTANCE General Symbol	
With Ferromagnetic Core	
TRANSFORMER, WITH AIR CORE General Symbol. (If it is esential to show that Ratio is other than 1:1, the number of Loops shown in the Coils may be altered).	
TRANSFORMER WITH FERROMAGNETIC CORE General Symbol	
PRESS BUTTON Make	

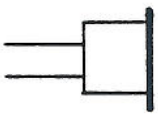
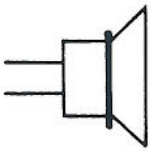
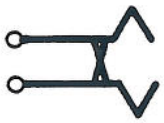
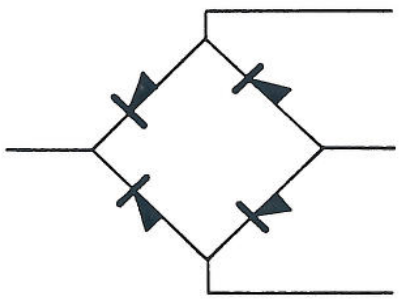
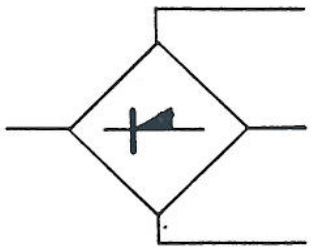
DESCRIPTION	SYMBOL
SWITCH. SINGLE-POLE.	
SINGLE-POLE TWO-WAY.	
MULTI-POLE. EXAMPLES. DOUBLE-POLE TWO-WAY	
KEY. EXAMPLES. NON-LOCKING.	
LOCKING	
LOCKING, MAKE BEFORE BREAK.	
THREE-POSITION.	
JACK SLEEVE (BUSH)	

DESCRIPTION	SYMBOL
JACK (CONTINUED) SPRING. EXAMPLES. THREE POINT JACK	
BREAK JACK.	
MULTI – POINT.	
PLUG (USUALLY CONCENTRIC TYPE) EXAMPLES. NOTE :– THE LONGEST LINE REPRESENTS THE TIP, THE SHORTEST THE SLEEVE.	
MULTI POINT PLUG	
RELAY CONTACTS. EXAMPLES. BREAK	
MAKE.	
MAKE BEFORE BREAK.	
BREAK AND MAKE. (CHANGEOVER)	

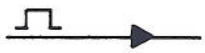
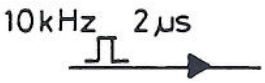
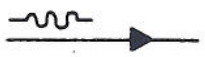
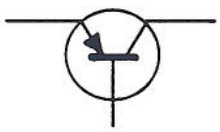
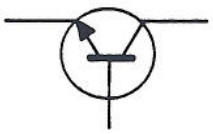
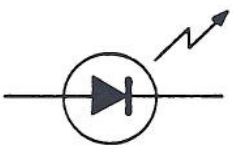
DESCRIPTION	SYMBOL
RELAY COILS General Symbol	
NOTE The Resistance in Ohms of the Winding to be Inserted in the Rectangle if necessary EXAMPLE 1300	
Slow-Releasing	
Slow-Operating	
With Several Windings.	
High Impedance coil	
BELL General Symbol	
Direct Current	
Alternating Current	

DESCRIPTION	SYMBOL
BUZZER General Symbol	
Direct Current	
Alternating Current	
LAMP (SIGNAL)	
CAM-OPERATED CONTACTS <u>EXAMPLE</u> <u>NOTE</u> The Cam-Shaft is assumed to Rotate in a Clockwise Direction unless otherwise stated.	
FUSE General Symbol <u>NOTE</u> The Rated Current in Ampres may be shown.	
With Alarm Contact Example of Alarm Fuse with Bus Bar and Alarm Bar.	 

DESCRIPTION	SYMBOL.
HEAT COIL. COMPRESSION TYPE. EXAMPLE OF USE. 	
BREAK TYPE. EXAMPLE OF USE. 	
LIGHTNING PROTECTOR. ONE WIRE. GENERAL SYMBOL.	
BETWEEN TWO WIRES AND EARTH.	
COMBINED HEAT COIL AND PROTECTOR.	
COMBINED HEAT COIL AND PROTECTOR WITH TESTING FACILITIES.	
RECEIVER REST. SWITCH—HOOK EXAMPLE. NOTE:—THE CONTACTS ARE SHOWN IN THE NORMAL POSITION i.e. WITH THE RECEIVER ON THE HOOK.	
CRADLE SWITCH EXAMPLE. NOTE:-THE CONTACTS ARE SHOWN IN THE NORMAL POSITION i.e. WITH THE HANDSET ON THE CRADLE.	

DESCRIPTION	SYMBOL
MICROPHONE General Symbol	
RECEIVER General Symbol	
LOUDSPEAKER General Symbol	
PULSING SPRINGS	
ELEMENT WITH NON-LINEAR CURRENT/ VOLTAGE CHARACTERISTIC General Symbol, Asymmetrical	
Semi-Conductor, Asymmetrical (e.g. Rectifier). NOTE 1 The Higher Conductivity obtained when the "Triangle" is positive with respect to the "Plate". NOTE 2 Symbol (b) should be used for Designating a Signal Rectifier if it is necessary to Distinguish between Signal Rectifiers and others.	(a)  (b) 
Four Asymmetrical Semi-Conductor Elements, Bridge-Connected	 OR 

FUNCTIONAL SYMBOLS FOR ELECTRONIC CIRCUITS

DESCRIPTION	SYMBOL
LEAD OR PATH CARRING SIGNALS The Arrowhead indicates the Direction of the Signal. If Necessary the Shape, Duration, Frequency etc., of the Signal may be Indicated. EXAMPLES Pulse (General)	 
Pulse (Specific) (1) Positive Going NOTE A Pulse having a P.R.F. of 10kHz and Pulse Duration of 2 μs.	
(11) Negative Going	
A.C. Pulse	
TRANSISTORS Point-Contact or Junction Triode Transistor with N-Type Base. (Arrow on Emitter).	
Point-Contact of Junction Triode Transistor with P-Type Base. (Arrow on Emitter).	
PHOTO DIODE Point-Contact or Junction Photo Diode NOTES 1. If Desired, the Envelope may be Omitted. 2. The Base may be Drawn Horizontally or Vertically as Circuit requirements Dictate. 3. If it is Desired to indicate the Gain or Operation of a Transistor, the Symbol may be marked $\alpha < 1$ or $\alpha > 1$ as appropriate.	
LIGHT EMITTING DIODE (LED)	

British Rail

Course C.1. (T) Basic Installation.

Section FOUR.

Content 700 Series Telephone Types
Switches and Mechanism.

R.S. & T.E. Department

Training School York

TELEPHONE P.O. 706

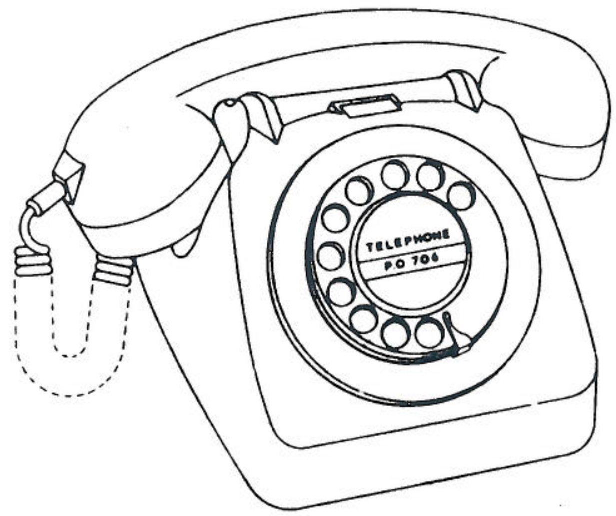


TABLE TELEPHONE - COLOURED GREY OR BLACK

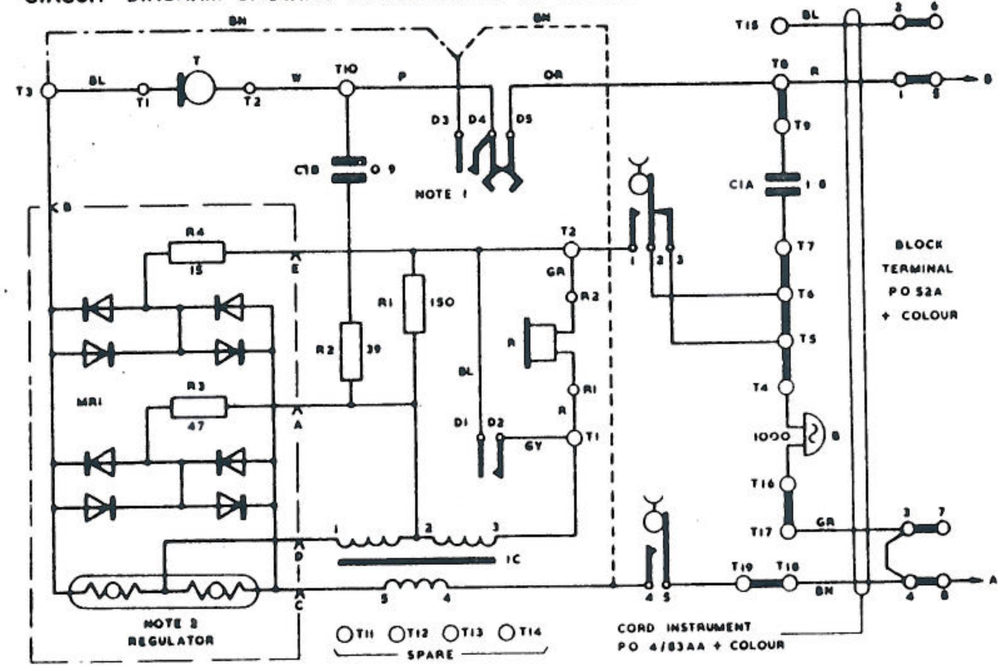
PARTS LIST FOR TELEPHONE 706 AS SUPPLIED

DIAL, AUTO P.O.21FA
RECEIVER, INSET P.O.4T
TRANSMITTER, INSET P.O.16
HANDSET P.O.3
*CORD, INSTRUMENT P.O.4/88AK
BLOCK, TERMINAL P.O.52A
*CORD, INSTRUMENT P.O.4/83AA
*PRESS BUTTON, DUMMY P.O.2/DBU/258

FOR PRESS BUTTONS SEE TN-6849
AUXILIARY UNITS WHICH MAY BE FITTED AS ADDITIONAL ITEMS ARE SHOWN ON TN-6700 & TN-6808

* ITEMS NOT IN BR CATALOGUE

CIRCUIT DIAGRAM SHOWING CONNECTIONS AS ISSUED



NOTES

1. EARLIER ISSUES HAVE DIAL SPRING 3 CONNECTED TO GRAVITY SPRING 4 INSTEAD OF TERMINAL T3
2. THE REGULATOR IS INOPERATIVE WHEN REVERSED IN JACK TO CONNECT B, C & D TOGETHER FOR LOCAL BATTERY SYSTEMS
3. FOR C.B. WORKING REPLACE DIAL WITH DIAL, AUTO. DUMMY P.O.3 AND JOIN THE PINK / ORANGE CONDUCTORS TO CONNECT TERMINALS T8 - T10
4. WHEN EXTENSION BELL IS REQUIRED, REMOVE STRAP 3 - 4 ON BLOCK TERMINAL P.O.52A AND CONNECT BELL TO 7 - 8
5. THE CIRCUIT AS ISSUED IS SUITABLE FOR EXCLUSIVE SERVICE ON DIRECT EXCHANGE LINES OF AUTOMATIC SYSTEMS
6. THE CIRCUIT MAY BE MODIFIED AND EQUIPPED WITH AUXILIARY UNITS FOR EXTENSION PLAN WORKING AS SHOWN ON TN-3000 SERIES WIRING DIAGRAMS

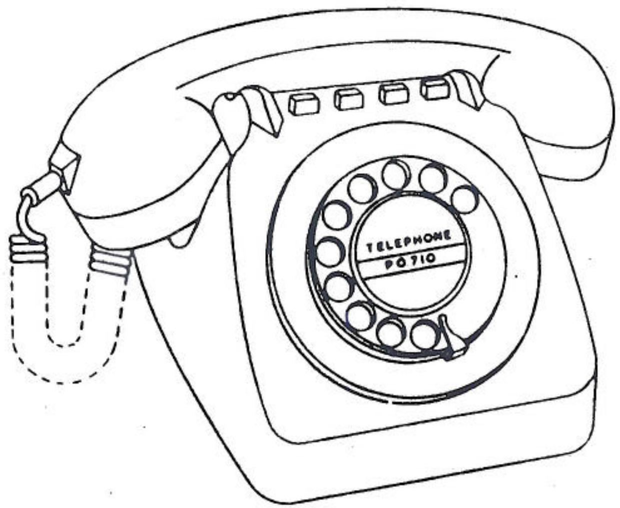
TRAINING U... ONLY

Revisions	British Railways Board Chief Signal and Telecommunications Engineer
TABLE TELEPHONE P.O. TYPE 706 WITH PROVISION FOR 1 PRESS SWITCH	British Rail Chief S & T Engineer No T1990 TN-5706

A2 BR 888/?

TN 6849, & 6808
NOT AVAILABLE: MARCH 1977

TELEPHONE P.O. 710



CIRCUIT DIAGRAM SHOWING CONNECTIONS AS ISSUED

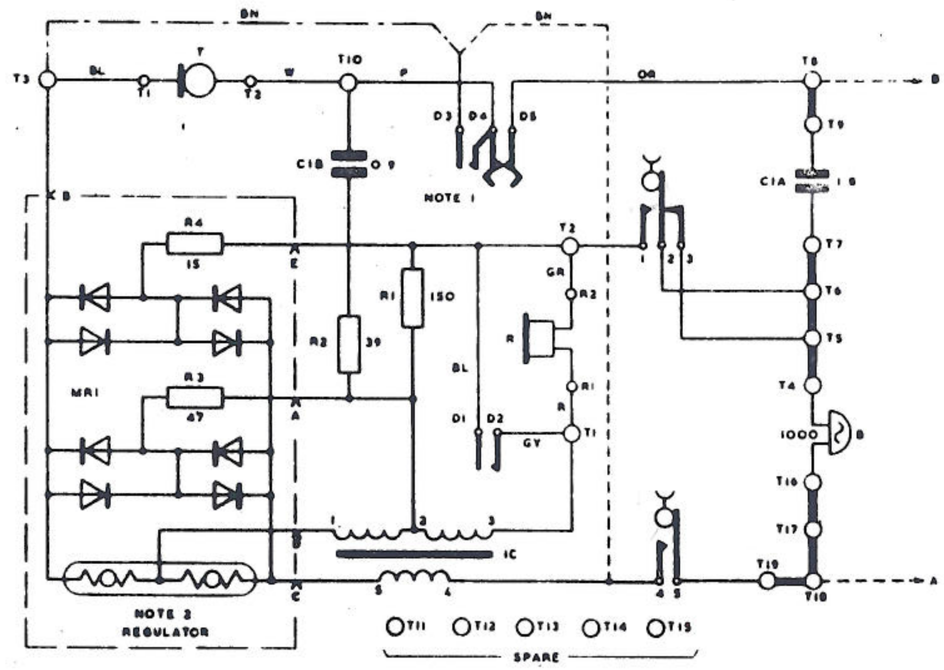


TABLE TELEPHONE – COLOURED GREY OR BLACK
SUITABLE FOR EQUIPPING WITH 1 TO 4 PRESS SWITCHES
AND OTHER AUXILIARY UNITS SHOWN ON TN-6700 & TN-6848

PARTS LIST FOR TELEPHONE 710 AS SUPPLIED

DIAL, AUTO P.O. 21FA
RECEIVER, INSET P.O.4T
TRANSMITTER, INSET P.O.16
HANDSET P.O. 3
*CORD, INSTRUMENT P.O.4/86AK
PRESS BUTTON, DUMMY P.O. 2/DBU/261

FOR PRESS BUTTONS SEE TN-6849

* ITEM NOT IN BR CATALOGUE

NOTES

1. EARLIER ISSUES HAVE DIAL SPRING 3 CONNECTED TO GRAVITY SPRING 4 INSTEAD OF TERMINAL T3
2. THE REGULATOR IS INOPERATIVE WHEN REVERSED IN JACK TO CONNECT B, C & D TOGETHER FOR LOCAL BATTERY SYSTEMS
3. FOR C.B. WORKING REPLACE DIAL WITH DIAL, AUTO, DUMMY P.O. 3 AND JOIN THE PINK / ORANGE CONDUCTORS TO CONNECT TERMINALS T8 - T10
4. THE CIRCUIT MAY BE MODIFIED AND EQUIPPED WITH AUXILIARY UNITS FOR EXTENSION PLAN WORKING AS SHOWN ON TN-3000 SERIES WIRING DIAGRAMS

TRAINING USE
ONLY

Revisions	British Railways Board Chief Signal and Telecommunications Engineer	British Rail
	TABLE TELEPHONE P.O. TYPE 710 WITH PROVISION FOR 1 TO 4 PRESS SWITCHES	Chief S & T Engineer No T1990 | TN-5710

TN 6848 & 6849 NOT AVAILABLE: MARCH 1997

T/C1 Sec. 4.0 3

TELEPHONE P.O. 740

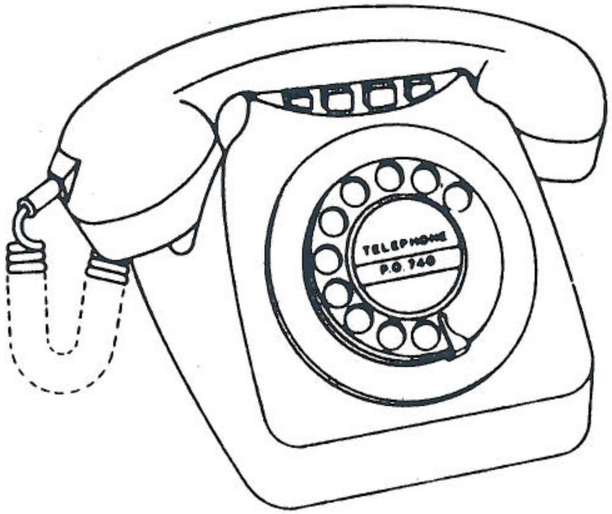


TABLE TELEPHONE – COLOURED GREY ONLY
SUITABLE FOR EQUIPPING WITH 1 TO 4 PRESS. SWITCHES
AND OTHER AUXILIARY UNITS SHOWN ON TN-6700 & TN-6848

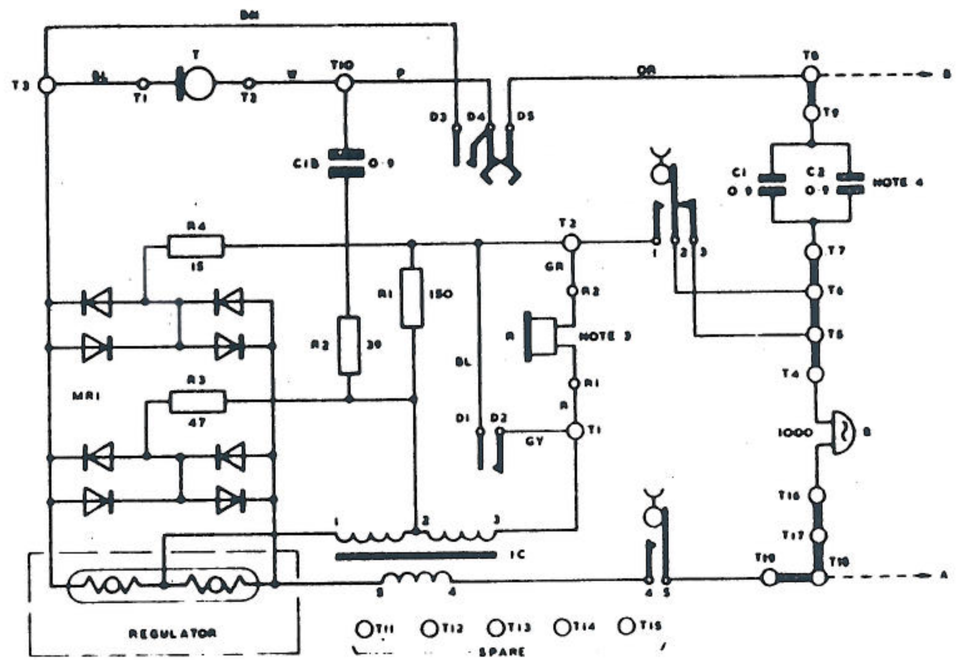
PARTS LIST FOR TELEPHONE 740 AS SUPPLIED

DIAL, AUTO P.O. 21FA
RECEIVER, INSET P.O. 4T
TRANSMITTER, INSET P.O. 16
HANDSET P.O. 3
CORD, INSTRUMENT P.O. 4/11BAX
✳ PRESS BUTTON, DUMMY P.O. 1 TO 4/DBU/375

FOR PRESS BUTTONS SEE TN-6849

✳ ITEMS NOT IN BR CATALOGUE

CIRCUIT DIAGRAM SHOWING CONNECTIONS AS ISSUED



NOTES

1. OTHER THAN THE HANDSET, DIAL AND BELL ALL COMPONENTS ARE MOUNTED ON A PRINTED WIRING BOARD AVAILABLE FOR MAINTENANCE REPLACEMENT AS TELEPHONE, UNIT D92732
2. THE CIRCUIT MAY BE MODIFIED AND EQUIPPED WITH AUXILIARY UNITS FOR EXTENSION PLAN WORKING AS SHOWN ON TN-4000 SERIES WIRING DIAGRAMS
3. RECTIFIER ELEMENT PO No. 205 IS CONNECTED TO TERMINALS T1 & T2 ON LATER ISSUES
4. C1 & C2 MAY BE EQUIPPED AS SHOWN OR AS A SINGLE 1·8uF CAPACITOR

TRAINING USE
ONLY

Revisions	British Railways Board Chief Signal and Telecommunications Engineer	British Rail
	TABLE TELEPHONE P.O. TYPE 740 WITH PROVISION FOR 1 TO 4 PRESS SWITCHES	Chief S & T Engineer No T1990 TN-5740

A2 BR 880/10

TELEPHONE P.O. 746

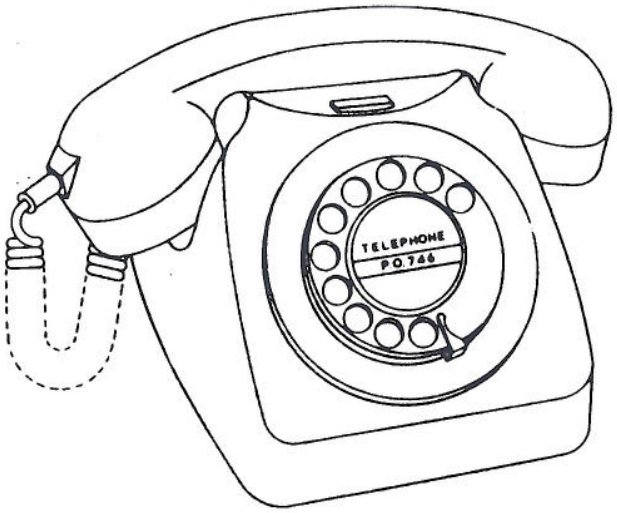


TABLE TELEPHONE — COLOURED GREY & BLACK

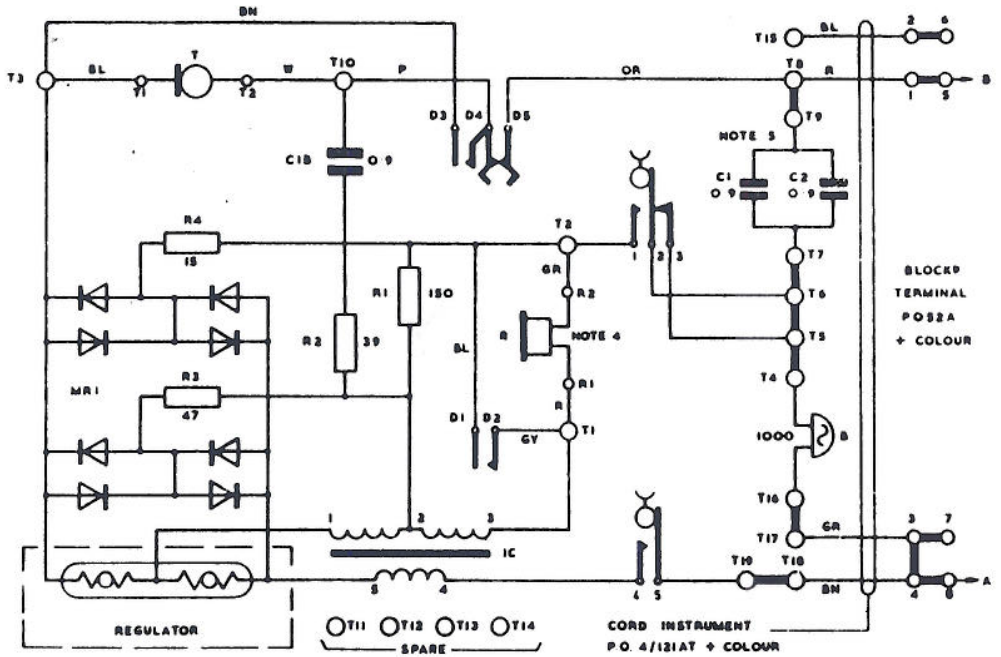
PARTS LIST FOR TELEPHONE 746 AS SUPPLIED

DIAL, AUTO P.O. 21FA
RECEIVER, INSET P.O. 4T
TRANSMITTER, INSET P.O. 16
HANDSET P.O. 3
CORD, INSTRUMENT P.O. 4/116AX
BLOCK, TERMINAL P.O. 52A
CORD, INSTRUMENT P.O. 4/121AT
* PRESS BUTTON, DUMMY P.O. 2/DBU/367

FOR PRESS BUTTONS SEE TN-6849
AUXILIARY UNITS WHICH MAY BE FITTED AS ADDITIONAL ITEMS ARE SHOWN ON TN-6700 & TN-6848

* ITEM NOT IN BR CATALOGUE

CIRCUIT DIAGRAM SHOWING CONNECTIONS AS ISSUED



NOTES

1. WHEN EXTENSION BELL IS REQUIRED, REMOVE STRAP 3-4 ON BLOCK TERMINAL P.O.52A AND CONNECT BELL TO 7-8
2. OTHER THAN THE HANDSET, DIAL AND BELL ALL COMPONENTS ARE MOUNTED ON A PRINTED WIRING BOARD AVAILABLE FOR MAINTENANCE REPLACEMENT AS TELEPHONE, UNIT D92732
3. THE CIRCUIT AS ISSUED IS SUITABLE FOR EXCLUSIVE SERVICE ON DIRECT EXCHANGE LINES OF AUTOMATIC SYSTEMS
4. RECTIFIER ELEMENT P.O. No. 205 IS CONNECTED TO TERMINALS T1 & T2 ON LATER ISSUES
5. C1 & C2 MAY BE EQUIPPED AS SHOWN OR AS A SINGLE 1·8uF CAPACITOR
6. THE CIRCUIT MAY BE MODIFIED AND EQUIPPED WITH AUXILIARY UNITS FOR EXTENSION PLAN WORKING AS SHOWN ON TN-6000 SERIES WIRING DIAGRAMS

Revisions

British Railways Board
Chief Signal and Telecommunications Engineer

British Rail

TABLE TELEPHONE
P.O. TYPE 746
WITH PROVISION FOR
1 OR 2 PRESS SWITCHES

Chief S & T Engineer

File T1990 | TN-5746

T/C11 Sec. 4.0 1

TN 6549, 6849 NOT AVAILABLE: MARCH 67

TELEPHONE P.O. 746R

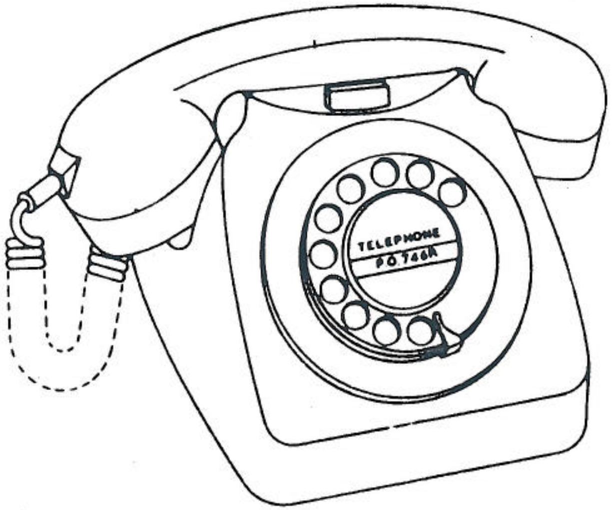
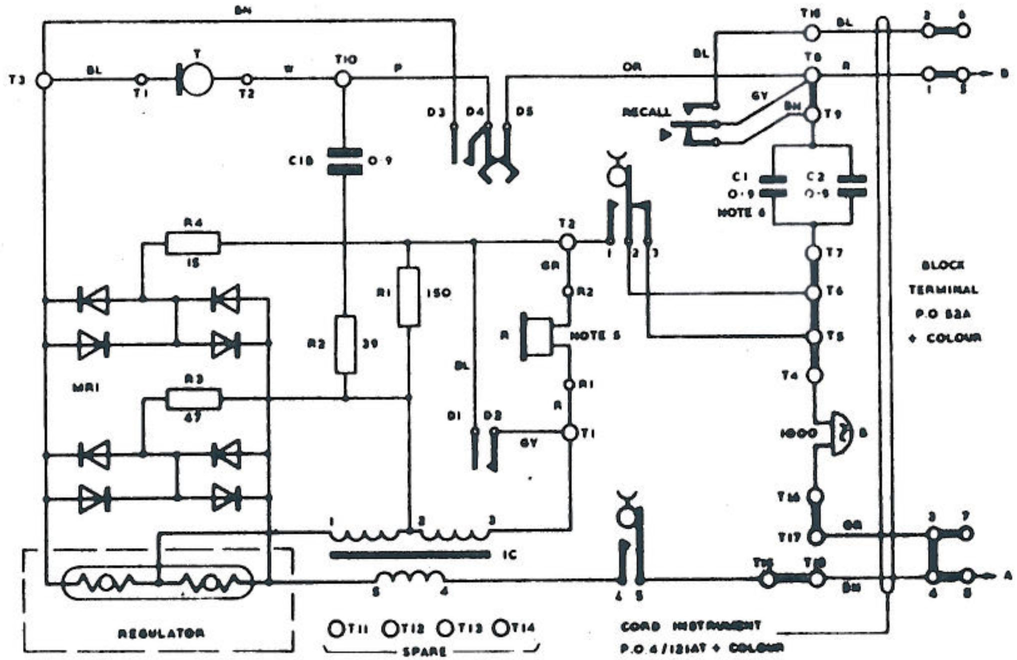


TABLE TELEPHONE – COLOURED GREY & BLACK
EQUIPPED WITH 1 PRESS SWITCH

PARTS LIST FOR TELEPHONE 746R AS SUPPLIED

DIAL, AUTO P.O. 21 FA
RECEIVER, INSET P.O. 4T
TRANSMITTER, INSET P.O. 16
HANDSET P.O. 3
CORD, INSTRUMENT P.O. 4/118AX
BLOCK, TERMINAL P.O. 52A
CORD, INSTRUMENT P.O. 4/121AT
SWITCH P.O. 8A-4
PRESS BUTTON P.O. 4/DBU/362 SEE NOTE 4
PLUNGER P.O. PART 1/DPL/1033
2-PINS P.O. PART 1/DPI/303
AUXILIARY UNITS WHICH MAY BE FITTED AS ADDITIONAL ITEMS ARE SHOWN ON TN-6700 & TN-6848
FOR PRESS BUTTONS SEE TN-6849

CIRCUIT DIAGRAM SHOWING CONNECTIONS AS ISSUED



NOTES

1. WHEN EXTENSION BELL IS REQUIRED, REMOVE STRAP 3-4 ON BLOCK TERMINAL P.O 52A AND CONNECT BELL TO 7-8
2. OTHER THAN THE HANDSET, DIAL, AND BELL, ALL COMPONENTS ARE MOUNTED ON A PRINTED WIRING BOARD AVAILABLE FOR MAINTENANCE REPLACEMENT AS TELEPHONE, UNIT D92732
3. THE CIRCUIT IS FOR USE ON AUTOMATIC SYSTEMS WITH FACILITIES FOR:-
   SHARED SERVICE LINES
   OPERATOR RECALL
   ENQUIRY TRANSFER
   C-WIRE SIGNALLING
   EXTENSION PLAN WORKING
4. PART 4/DBU/362 PRESS BUTTON ENGRAVED 'RECALL' IS SUPPLIED WITH TELEPHONE AND CANNOT BE OBTAINED SEPARATELY. REPLACEMENT PART WILL BE 1/DBU/362
5. RECTIFIER ELEMENT P.O. No. 205 IS CONNECTED TO TERMINALS T1 & T2 ON LATER ISSUES
6. C1 & C2 MAY BE EQUIPPED AS SHOWN OR AS A SINGLE 1·8 uF CAPACITOR
7. THE CIRCUIT MAY BE MODIFIED AND EQUIPPED WITH AUXILIARY UNITS FOR EXTENSION PLAN WORKING AS SHOWN ON TN-4000 SERIES WIRING DIAGRAMS

TRAINING USE
ONLY

Revisions	British Railways Board Chief Signal and Telecommunications Engineer	British Rail
	TABLE TELEPHONE P.O. TYPE 746R WITH ONE PRESS SWITCH	Chief S & T Engineer No. T1990 TN-5747

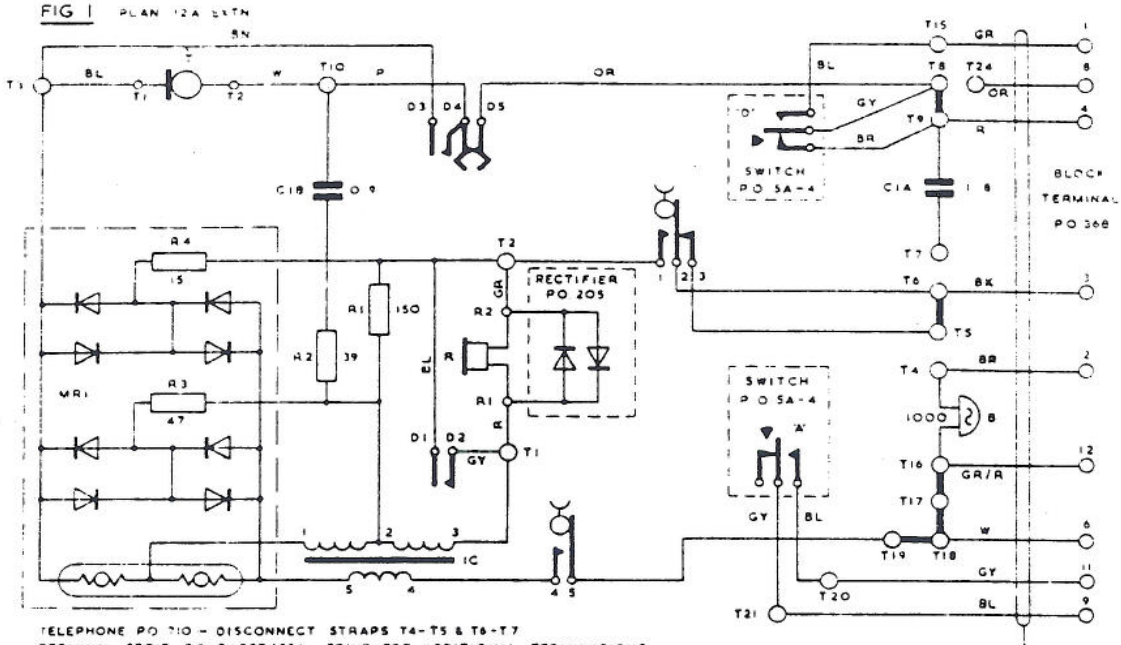
A2 BR 880/10

T/C1 Sec. 40 5

TN6848, 6849
NOT AVAILABLE – MARCH 1977

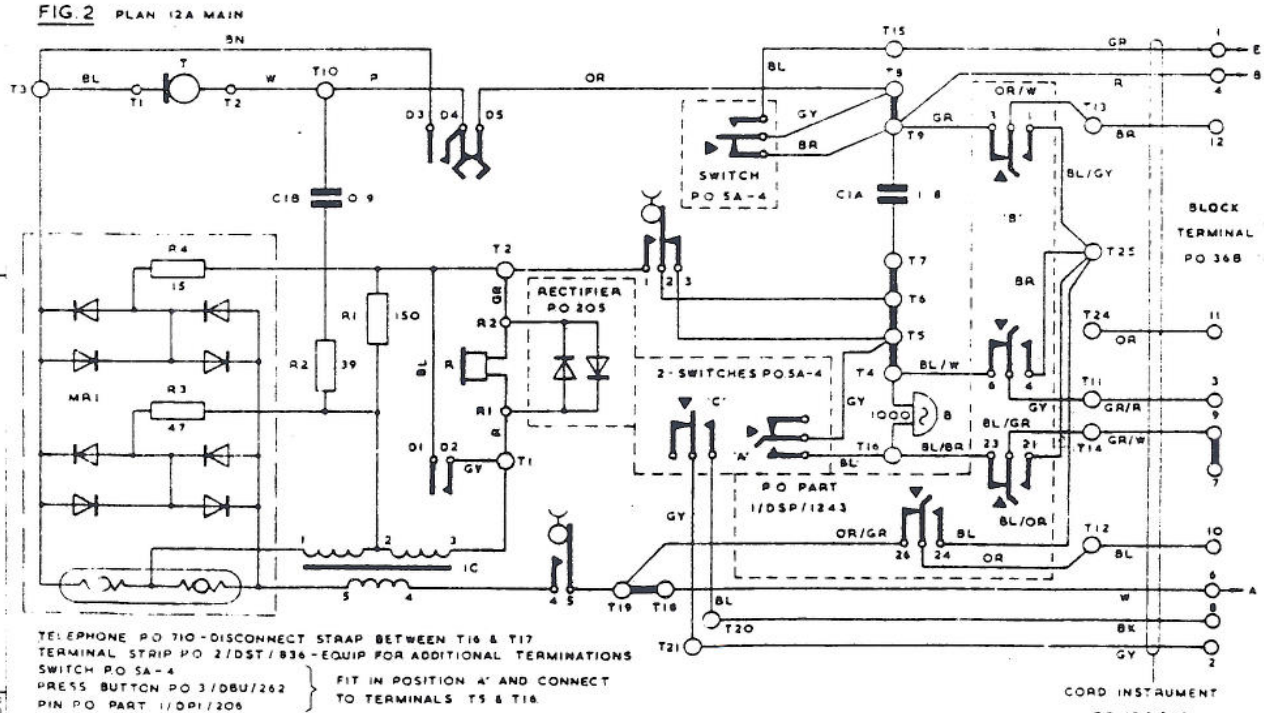
TYPICAL MODIFICATIONS FOR ADDITIONAL SWITCHES AND LATCH SETTINGS.

FIG 1 PLAN 12A EXTN



TELEPHONE PO 710 - DISCONNECT STRAPS T4-T5 & T6-T7
TERMINAL STRIP PO 2/DST/836 - EQUIP FOR ADDITIONAL TERMINATIONS
SWITCH PO 5A-4, PRESS BUTTON PO 24/DBU/260 } FIT IN POSITION 'A' AND CONNECT TO TERMINALS T20 & T21
SWITCH 5A-4, PRESS BUTTON PO 28/DBU/260 } FIT IN POSITION 'D' AND CONNECT TO TERMINALS T8, T9 & T15
RECTIFIER ELEMENT PO 205 - EQUIP TO RECEIVER INSET IN HANDSET
CORD, INSTRUMENT PO 9/21AD, BLOCK, TERMINAL PO 368 } CONNECT AS SHOWN
BELL PO 56A - CONNECT COILS IN PARALLEL
POWER UNIT PO 53A - EQUIP IN SUITABLE LOCATION AND WIRE AS SHOWN
ADJUST LATCHES ON 'A' & 'D' TO SETTING 2 - SEE DGM TN-6648.

FIG. 2 PLAN 12A MAIN



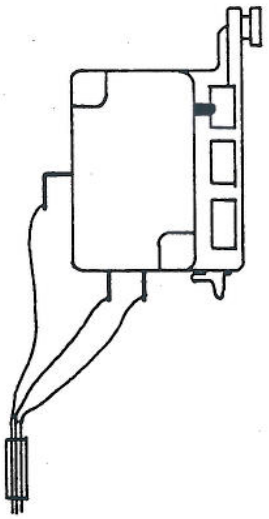
TELEPHONE PO 710 - DISCONNECT STRAP BETWEEN T16 & T17
TERMINAL STRIP PO 2/DST/836 - EQUIP FOR ADDITIONAL TERMINATIONS
SWITCH PO 5A-4, PRESS BUTTON PO 3/DBU/262, PIN PO PART 1/DPI/206 } FIT IN POSITION 'A' AND CONNECT TO TERMINALS T5 & T16
SWITCH PO 1/DSP/1243, PRESS BUTTON PO 33/DBU/260 } FIT IN POSITION 'B' AND CONNECT TO TERMINALS T4, T9, T11 TO T14, T16, T19 & T25
SWITCH PO 5A-4, PRESS BUTTON PO 23/DBU/260 } FIT IN POSITION 'C' AND CONNECT TO TERMINALS T20 & T21
SWITCH PO 5A-4, PRESS BUTTON PO 28/DBU/260 } FIT IN POSITION 'D' AND CONNECT TO TERMINALS T8, T9 & T15
RECTIFIER ELEMENT PO 205 - EQUIP TO RECEIVER INSET IN HANDSET
CORD, INSTRUMENT PO 12/15AD - CONNECT AS SHOWN AND CUT BACK SPARES
BLOCK, TERMINAL PO 368 - STRAP 7 TO 9
BELL PO 56A - CONNECT COILS IN PARALLEL
ADJUST LATCHES ON 'A' & 'D' TO SETTING 3 'B' TO 1 AND 'C' TO 2 WITH 'X' & 'Y' LATCHES AT SETTING 4 - SEE DGM TN-6648

MODIFICATIONS TO TELEPHONES P.O. TYPES 706 & 710 FOR EXTENSION PLAN WORKING

No TN-3008

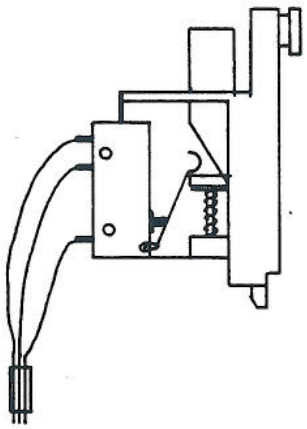
A2 A4 ISSUE 1 10-3-75

SWITCH TYPES

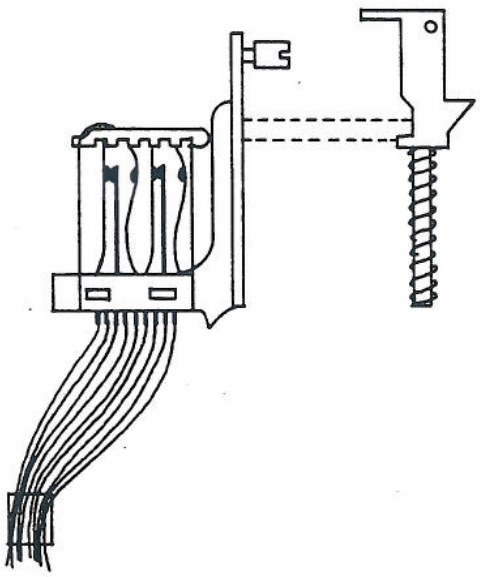


NON LOCKING
TWO POSITION

UNAFFECTED
BY SWITCH
AND CRADLE
SETTINGS



LOCKING
TWO POSITION

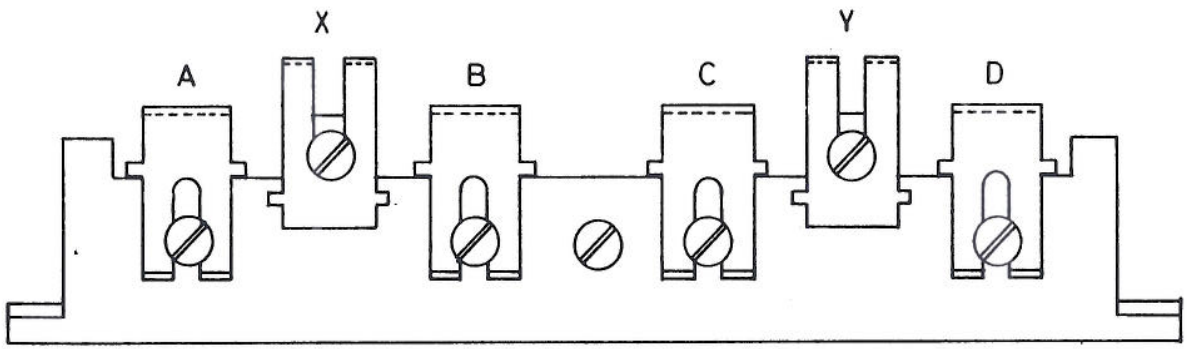


MULTI SWITCH

SEE SWITCH POSITION
AND SETTINGS

A,B,C & D ARE KEY LATCHES

X & Y ARE GRAVITY SWITCH LATCHES

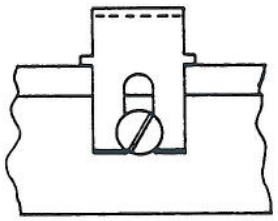


A,B,C & D LATCHES IN SETTING 1

X & Y LATCHES IN SETTING 4

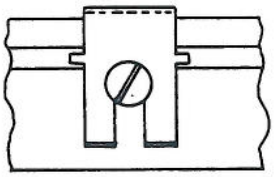
TELEPHONE 710 & 740 LATCH PLATE MECHANISM TYPICAL EXAMPLE

SETTING 1
A, B, C OR D



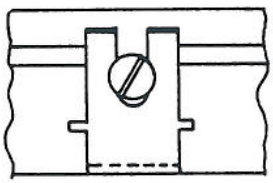
Key plunger locks down when pressed and releases any previous locked plunger.

SETTING 2
A, B, C OR D



Key plunger does not lock, but when pressed will release any previously locked plunger.

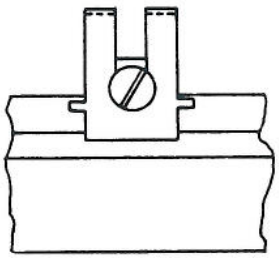
SETTING 3
A, B, C OR D



Key plunger does not lock and its operation does not effect the condition of any other plunger.

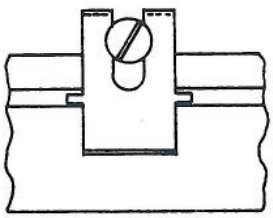
FACILITY

SETTING 4
X AND Y



Replacing the handset trips the latch plate and released any locked key plunger.

SETTING 5
X AND Y



Replacing the handset does not affect the latch plate.

TELEPHONE 710 & 740 LATCH PLATE SETTINGS.

British Rail

Course C.1. (T) Basic Installation

Section FIVE.

Content Main Distribution Frames and Connections.

R.S. & T.E. Department

Training School **York**

MAIN DISTRIBUTION FRAMES

All external cables are terminated on terminal blocks which in some cases contain fuses in series with each leg of each pair of wires. At buildings and large installations, terminal blocks are arranged together on one distribution frame.

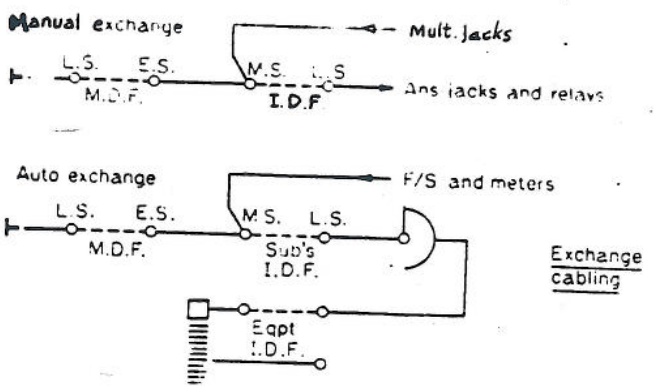
Various types of terminal blocks, fuse mountings and arrangements of termination tags have been used over the years but all provide a testing facility.

Some terminations afford the facility of testing the "line" side disconnected from the "exchange side" whilst others only offer the "through" test position (i.e. a monitor mode) without disconnecting the circuit.

Where possible, all cable testing must be carried out from the line-side of the main distribution frame (M.D.F.) with the fuses removed or with the exchange side disconnected by some other means, (i.e. "break-type" jacks).

In certain telephone exchanges a wall-mounted test set is provided which enables preliminary line tests and exchange tests to be performed. In larger exchanges, this test facility may take the form of a complete test desk.

The test equipment is permanently wired to the main distribution frame and various systems of test lead provide access to the disconnection points or fuse mountings.



CONNECTING EXTERNAL CABLES ON M.D.F.

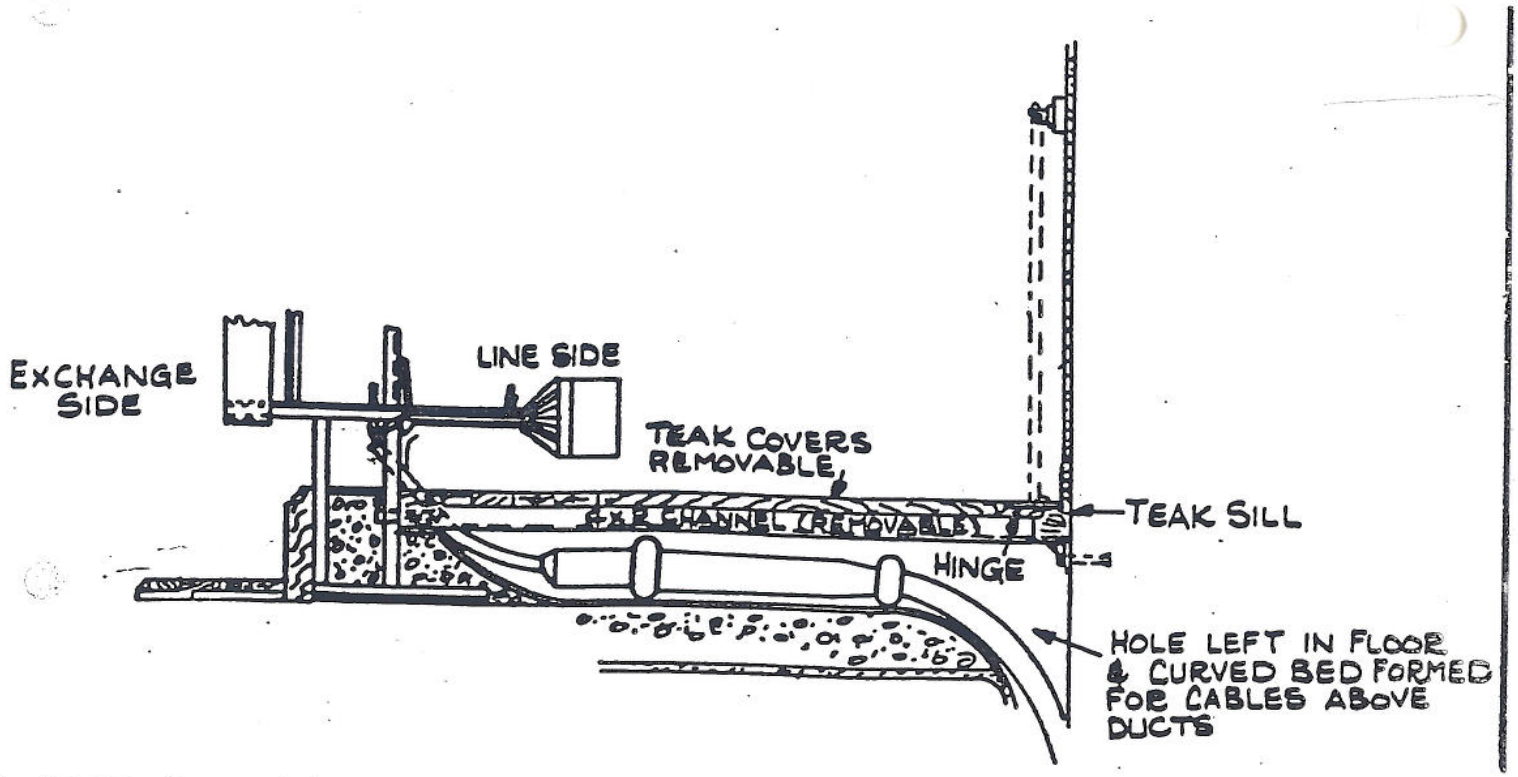
LOCATION OF M.D.F.

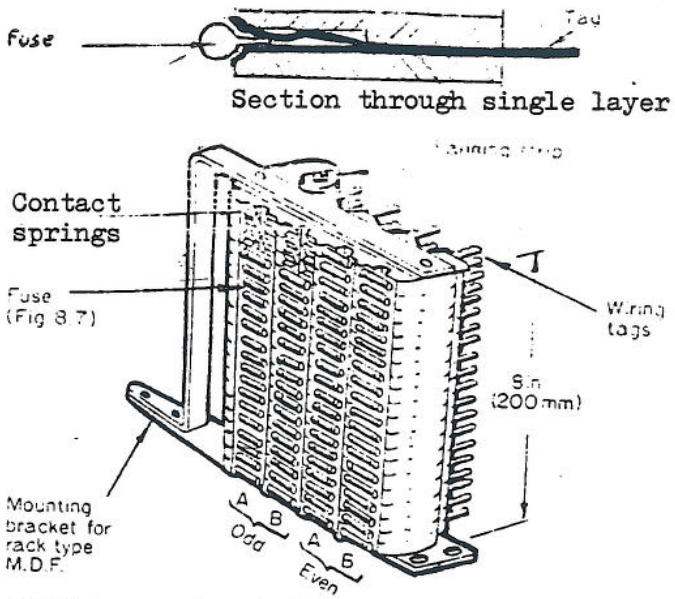
The M.D.F. should be located in such a position that the external cables can be led to it by a direct route but it should also be of easy access to the maintenance staff. The most suitable position is on the ground floor directly over a basement cable chamber which is so placed as to afford the shortest and most convenient route of entry to the majority of the external cables. This may be impracticable where the exchange itself is on an upper floor; in such cases the position should be chosen to give a convenient and short route for the terminating cables and yet be close to the exchange equipment.

As it may not be practicable to have a cable chamber immediately beneath the M.D.F. an alternative is to provide a shallow trough for the terminal joints. The trough may be formed by means of a raised floor, as in sketch.

LEADING IN OF CABLES

If the frame is on an upper floor the external cables are led up the wall of the building or through a shaft or shafts into a trough made in or on the floor. Brackets should be provided to support the cables. Tacking bar's should be provided to support the cables vertically. Lead cables all plumbed by small fillet wipe and polyethylene cables secured by strips and clips binding. The constructional details of these leading-in arrangements are not shown on the diagrams as they will vary with the local building and cabling conditions. Whereever practical the cable chamber method should be used, since the floor trough provides only a limited cabling space and not being easy to keep clean becomes a dust trap and hiding place for vermin.





M.D.F. fuse mounting unit. This provides for eighty fuses, serving forty circuits.

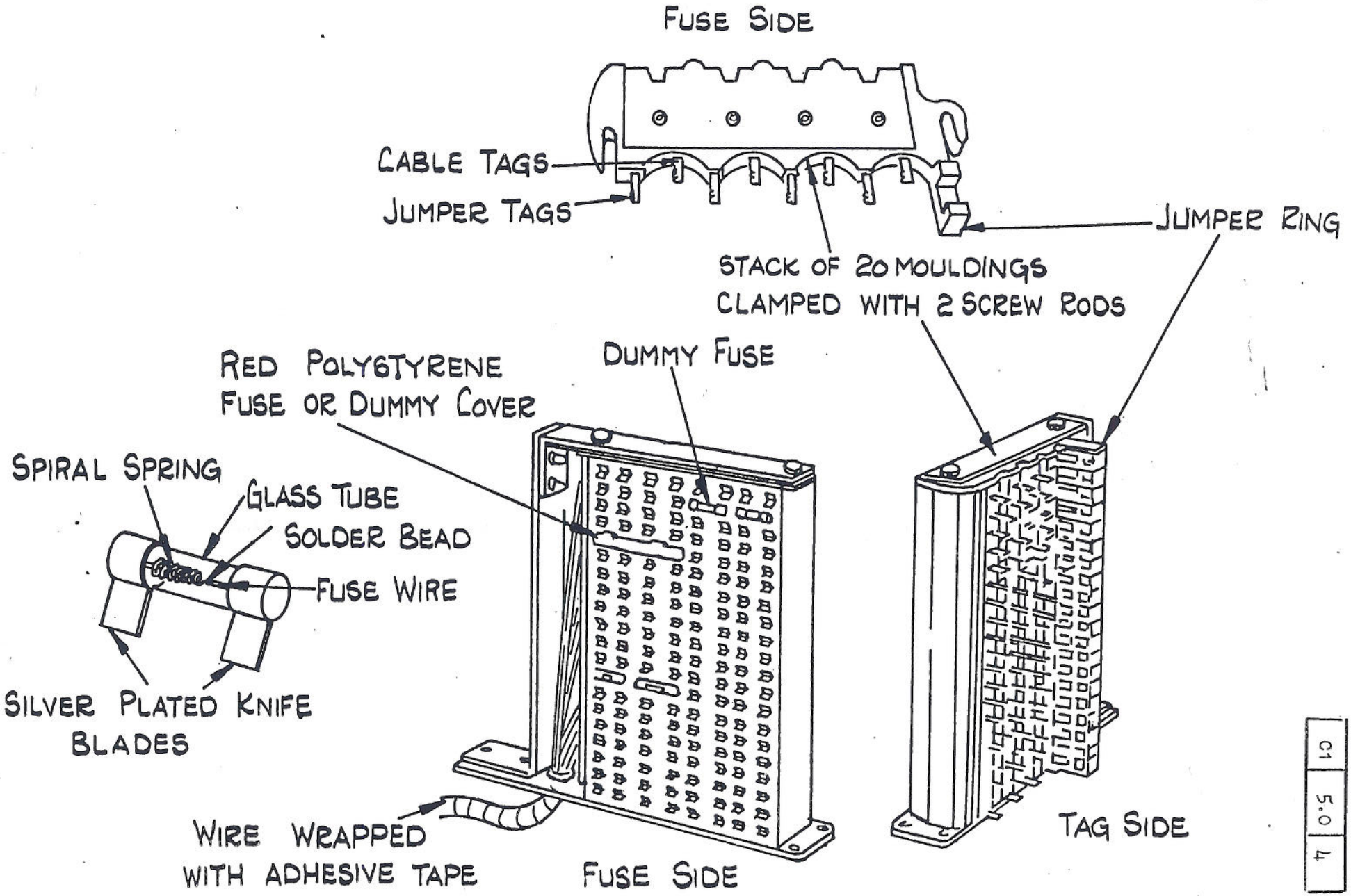
FUSE MOUNTING 8064

Prior to 1960, spark gap electrodes for lightning discharges, heat coils for prolonged low current contacts and fuses for current overload were provided. Since 1960 only a delayed action type fuse is fitted in each leg and this has a combined function of fuse and heat coil. It consists of a length of fuse wire, a bead of solder and a helical spring contained within a glass tube with metal end connections as shown in diagrams. Most of the electrical resistance of the fuse is in the fuse wire which, sufficient current flowing through it, develops enough heat to melt the solder. On the melting of the solder the spring retracts and the fuse is opened circuited. When large currents flow through the fuse, the fuse wire melts and so disconnects the circuit. (See Pages 6 & 7 of this Section).

PROTECTOR MOUNTINGS

The horizontal bars on the exchange side of the M.D.F. are adapted to carry an assembly of lightning protectors and heat coils; each assembly, known as a protector strip, has capacity for 20 circuits. A sectional view of a protector is given on P. 8. The mounting plate carries springs which hold the protective devices, the springs being insulated from the plate and from each other. The springs are designed so that a test plug may be inserted without the heat coils.

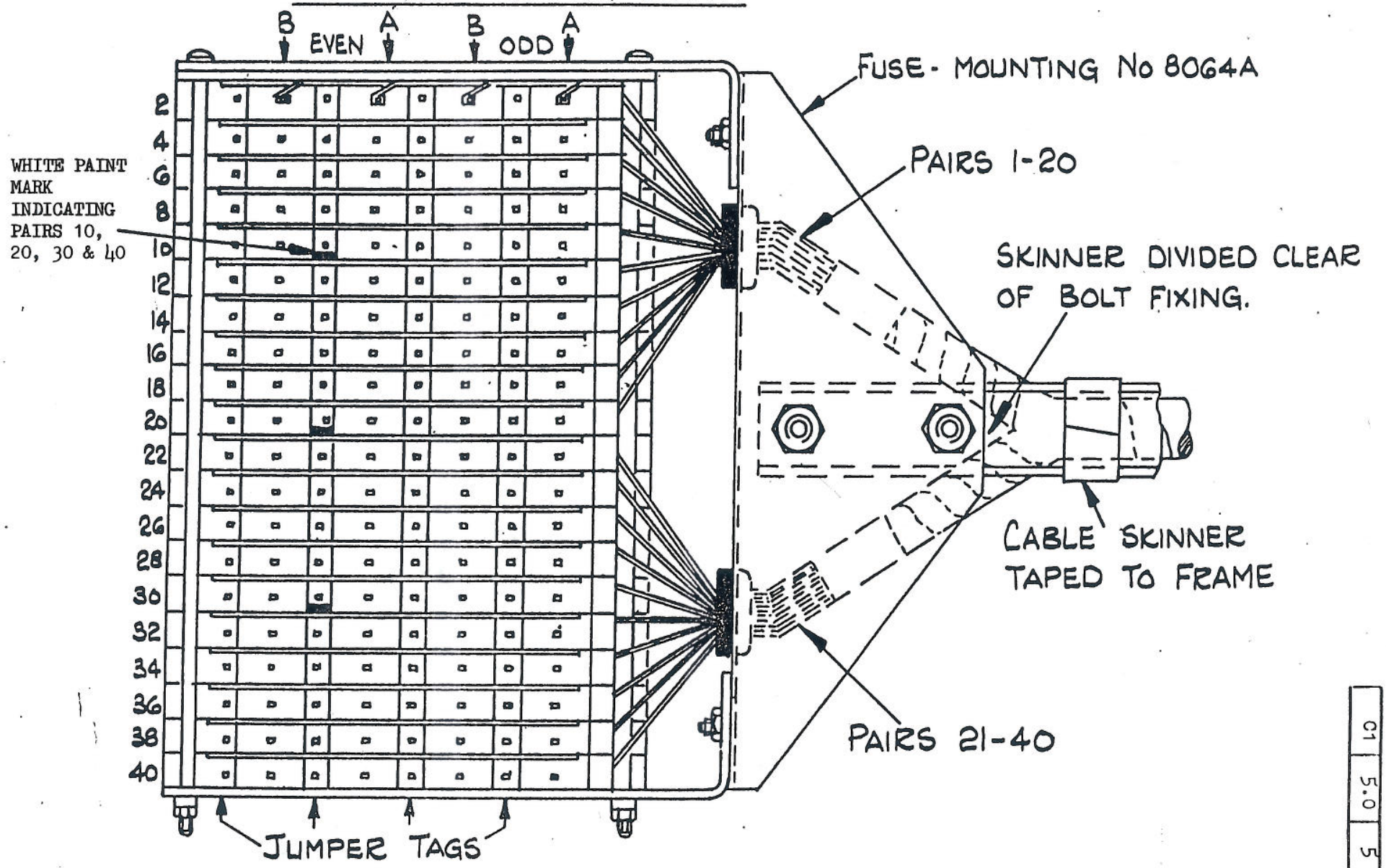
This facility is now outdated with the introduction of the delayed action fuse, as above, but a modern type of overload protection is used on the KRONE type cable connections as will be seen.


FUSE SIDE
CABLE TAGS
JUMPER TAGS
JUMPER RING
STACK OF 20 MOULDINGS
CLAMPED WITH 2 SCREW RODS
DUMMY FUSE
RED POLYSTYRENE
FUSE OR DUMMY COVER
SPIRAL SPRING
GLASS TUBE
SOLDER BEAD
FUSE WIRE
SILVER PLATED KNIFE
BLADES
WIRE WRAPPED
WITH ADHESIVE TAPE
FUSE SIDE
TAG SIDE

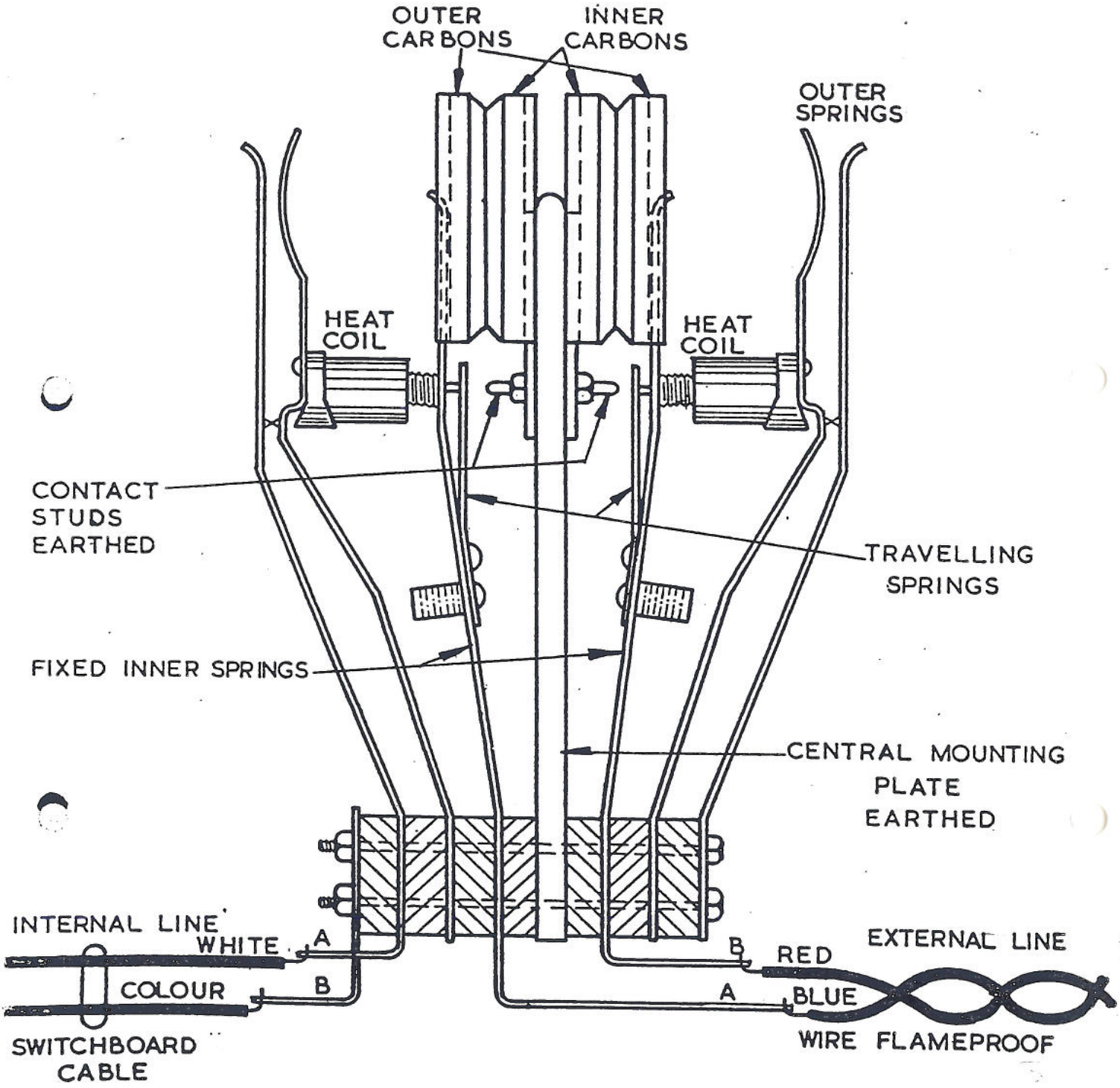
C1
5.0
4

CONNEXION OF EXTERNAL CABLES TO FUSE MOUNTINGS 8064 A & B

FIG 1 FUSE MOUNTING 8064A



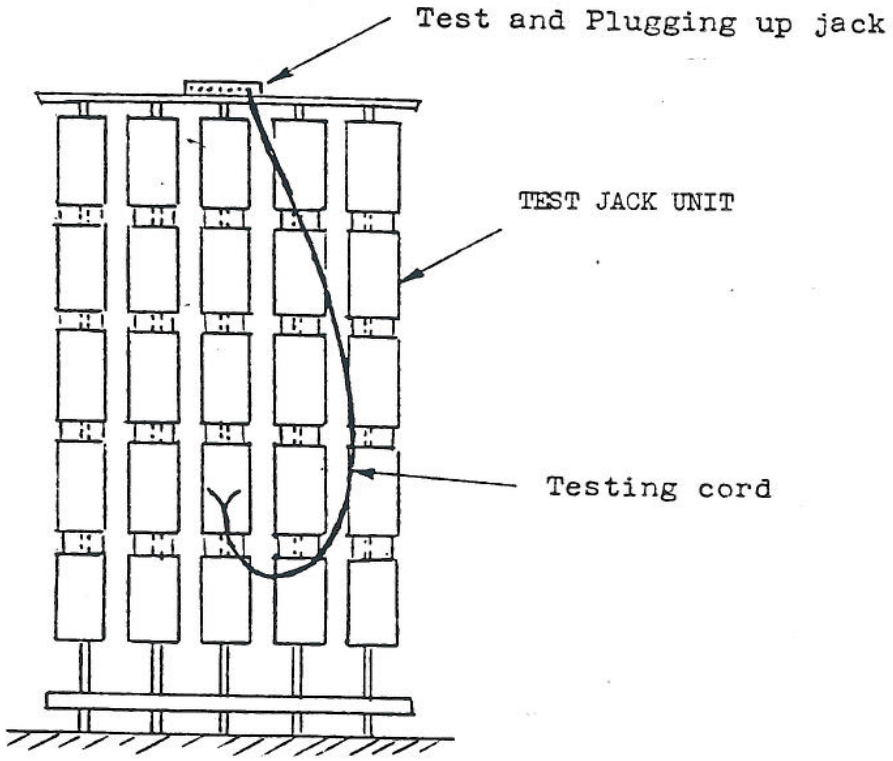
C1	5.0	5


OUTER CARBONS
INNER CARBONS
OUTER SPRINGS
HEAT COIL
HEAT COIL
CONTACT STUDS EARTHED
TRAVELLING SPRINGS
FIXED INNER SPRINGS
CENTRAL MOUNTING PLATE EARTHED
INTERNAL LINE
WHITE
A
COLOUR
B
SWITCHBOARD CABLE
B
RED
EXTERNAL LINE
A
BLUE
WIRE FLAMEPROOF

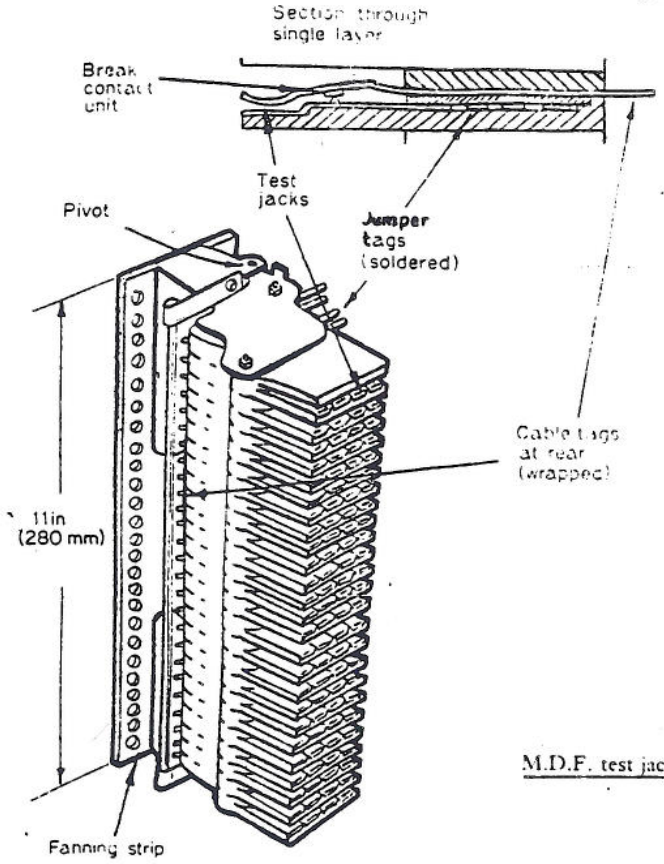
TESTING CIRCUITS

To make certain tests from the main distribution frame facilities are usually provided by means of cords, plugs and jacks. Switchboard plugs are connected to one end of the cords and to the other end is attached a protector or fuse test plug or clip. The Switchboard plugs are inserted into jacks which carry circuits from the test desk to the M.D.F. The protector test plug is inserted between the test springs of the protector of the line under test, thus enabling both internal and external portions of the circuit to be separately tested. Similarly the fuse clip is employed on the line side, the clips being inserted between the springs which normally hold the fuses. Strips of switchboard jacks are usually mounted at the top of the frame or between the verticals.

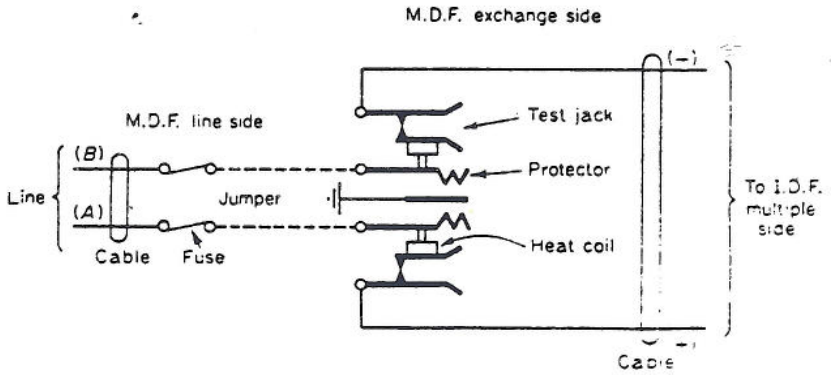
A test jack unit and circuits are shown overleaf.



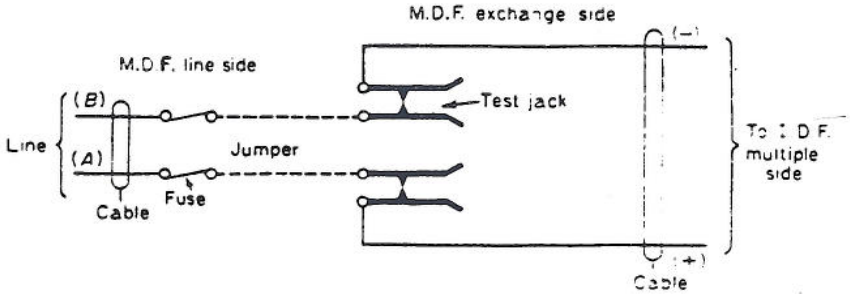
M.D.F. - EXCHANGE SIDE



M.D.F. test jack unit



(a) With heat coils and protectors

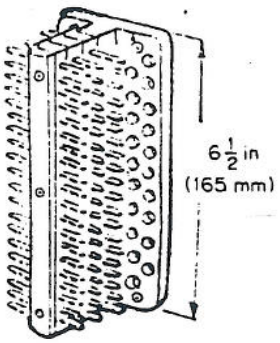


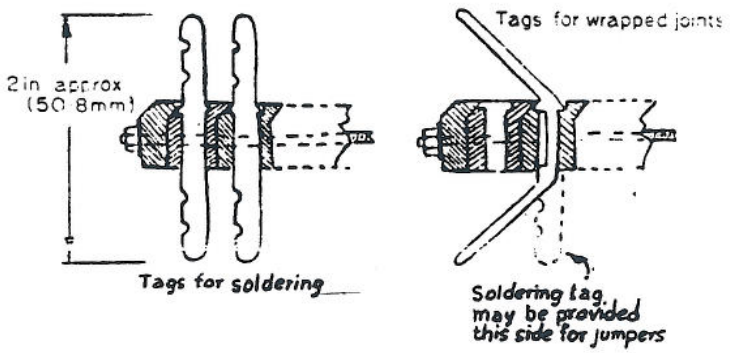
(b) With test jack only

TAGBLOCKS

The tagblocks used on main and intermediate distribution frames are made with 20 or 25 tags per row, and may have two, three, four, five, six or seven rows.

This pattern of tagblock is used on all the main and intermediate frames, the tagblocks being supported by screws into the main vertical bar, except on the vertical (multiple) side of the I.D.F. In this case they are usually fixed to a continuous iron bar.





I.D.F. connexion strips. The tags for wrapped joints are angled forward to allow easy access for the wrapping tool.

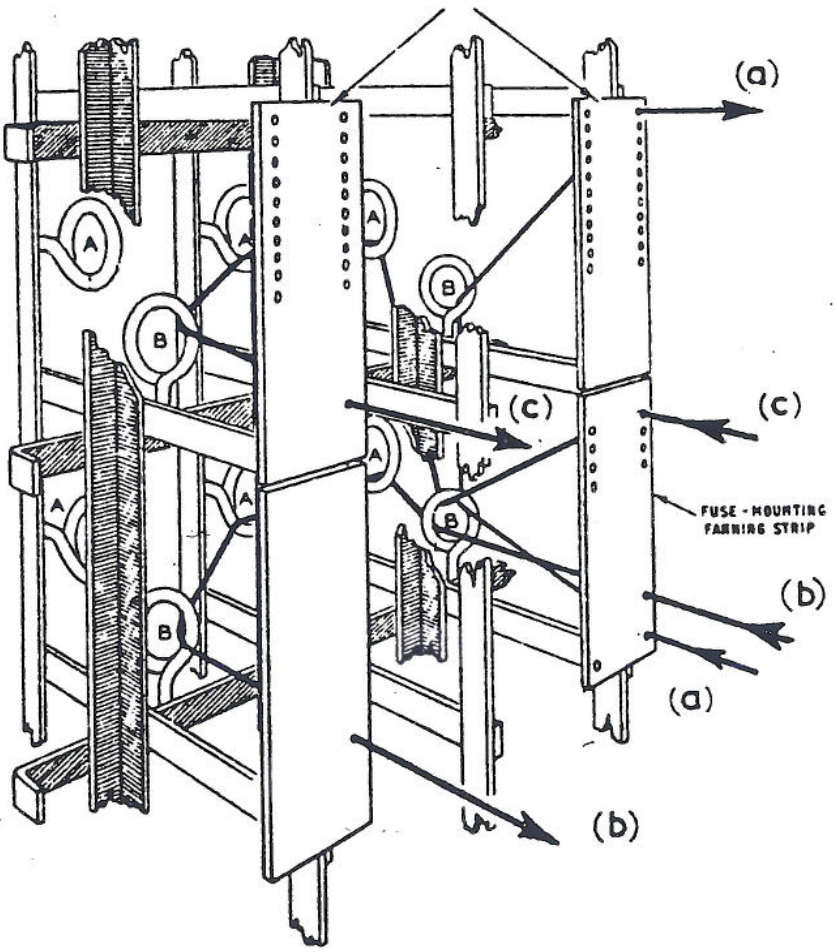
JUMPER WIRES

The facilities for jumpering on the M.D.F. provide an economical and flexible means of making connections between the line and exchange circuits as required.

Below shows typical cross connections on a single sided M.D.F.

Two sets of rings are provided, one set (marked A) in planes at right-angles to the frame and the other rings (marked B) in a plane parallel to the length of the frame.

The jumpers should pass from one terminating point through the appropriate hole in the fanning strip, via one of the routes (a), (b) or (c) to the other terminating point through its appropriate hole in the fanning strip.



ROUTING OF JUMPERS ON SINGLE-SIDED DISTRIBUTION FRAMES

TERMINATING AND SOLDERING

1. GENERAL

1.1 Terminating means providing a connection between a wire and a tag, it includes such items as removing insulation and positioning the wire. Soldering is a means of ensuring that a correctly made termination remains sound.

1.2 Before terminating ensure that tags are clean and free from excess solder. To remove excess solder, a clean, hot soldering iron bit should be applied to the tag and the solder removed on to the bit. The bit should then be cleaned by wiping it on a piece of cloth or rags synthetic.

NOTE: The flicking of surplus solder from tags or soldering irons is dangerous and should be avoided.

1.3 Before stripping the conductor adjust the stripping tool and test it on a spare piece of wire. It should remove the insulation cleanly, and not damage the conductor.

1.4 Always use the correct tools for stripping and terminating wires, the use of incorrect tools will probably result in damage to the conductor or insulation.

2. TERMINATING ON CONNECTION STRIPS

2.1 The first spare notch in the tag should be used i.e. notches nearest the block are used first.

2.2 The wire should not be wrapped more than 1½ times around the tag and should not be wrapped twice on the same notch.

2.3 After termination the surplus wire should be removed by working it to and fro with Pliers.

2.4 The wire should not be crimped into position as damage to the conductor will occur.

2.5 In all cases where terminations are to be soldered ensure that the insulation of the wire is close to but not touching the tag. After soldering the wires should be dressed so that they lay neatly between the tag rows and do not touch other tags.

3. TERMINATING ON COMPONENT TAGS (relays and jacks etc)

3.1 Where a tag has a hole only the wire should be hooked through the hole, soldered and then the surplus wire removed using Nippers.

NOTE: The hole should be completely filled with solder.

C1	5.0	12

"KRONE" TYPE CABLE CONNECTION

METHOD OF CONNECTING WIRE

The Inserter Wire is placed in the tag slot, as shown in Fig 1 and steady pressure applied to the handle.

The terminating and cutting head will start to move forward under this pressure, until the tool's internal collapse action mechanism takes over, to terminate and cut off the excess wire.

The excess of wire is then removed.

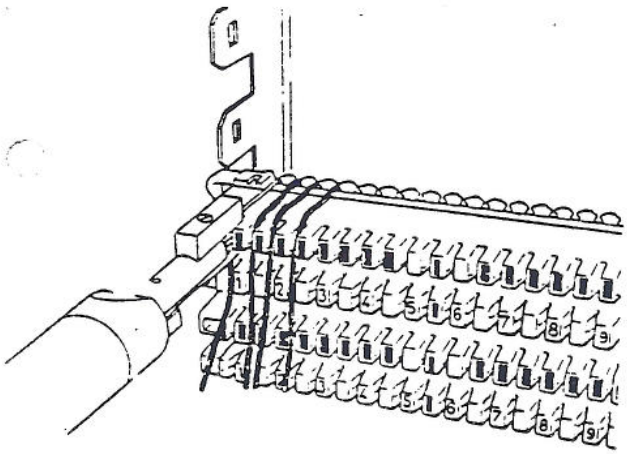


Fig. 1

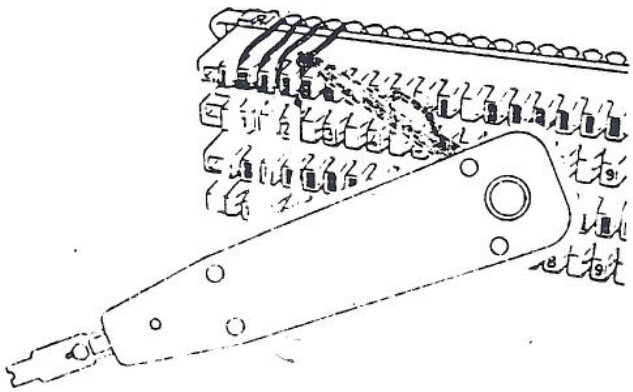


Fig. 2

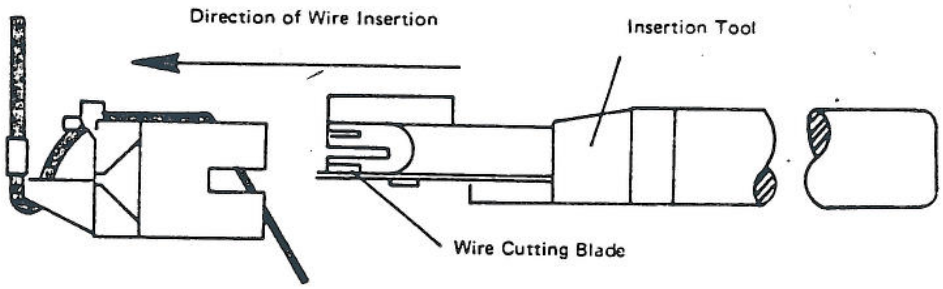
Method of Disconnecting Wire

The wiring tool has a hooked blade folded in the handle, this is used to remove a wire from a connexion strip. The hook should be placed behind the wire at the point where it enters the bifurcated tag slot and the wire pulled out in the opposite direction to the way the tool inserted it.

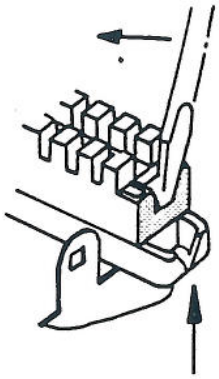
This is the only way a wire should be disconnected, the wire is liable to break if pulled in any other way.

N.B.

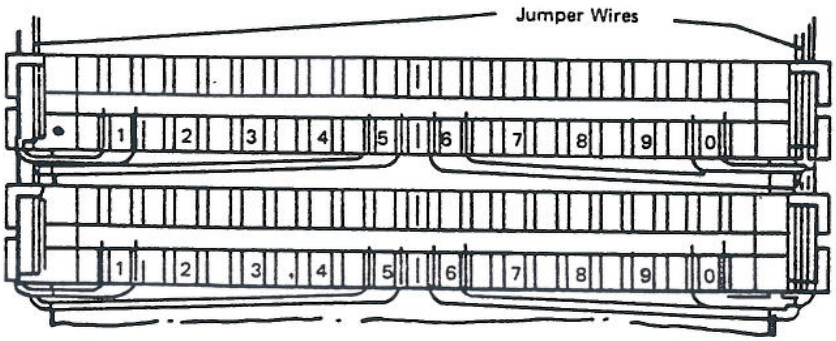
The illustration in Fig 2 is shown for convenience.
The hooked blade would normally be fully extended.



a) Making the Wire Connections



b) Removing Connection Module



c) Running of Jumper Wires

Each "Krone" strip has facility to terminate 10 pairs of wires numbering from pair 1 to 0.

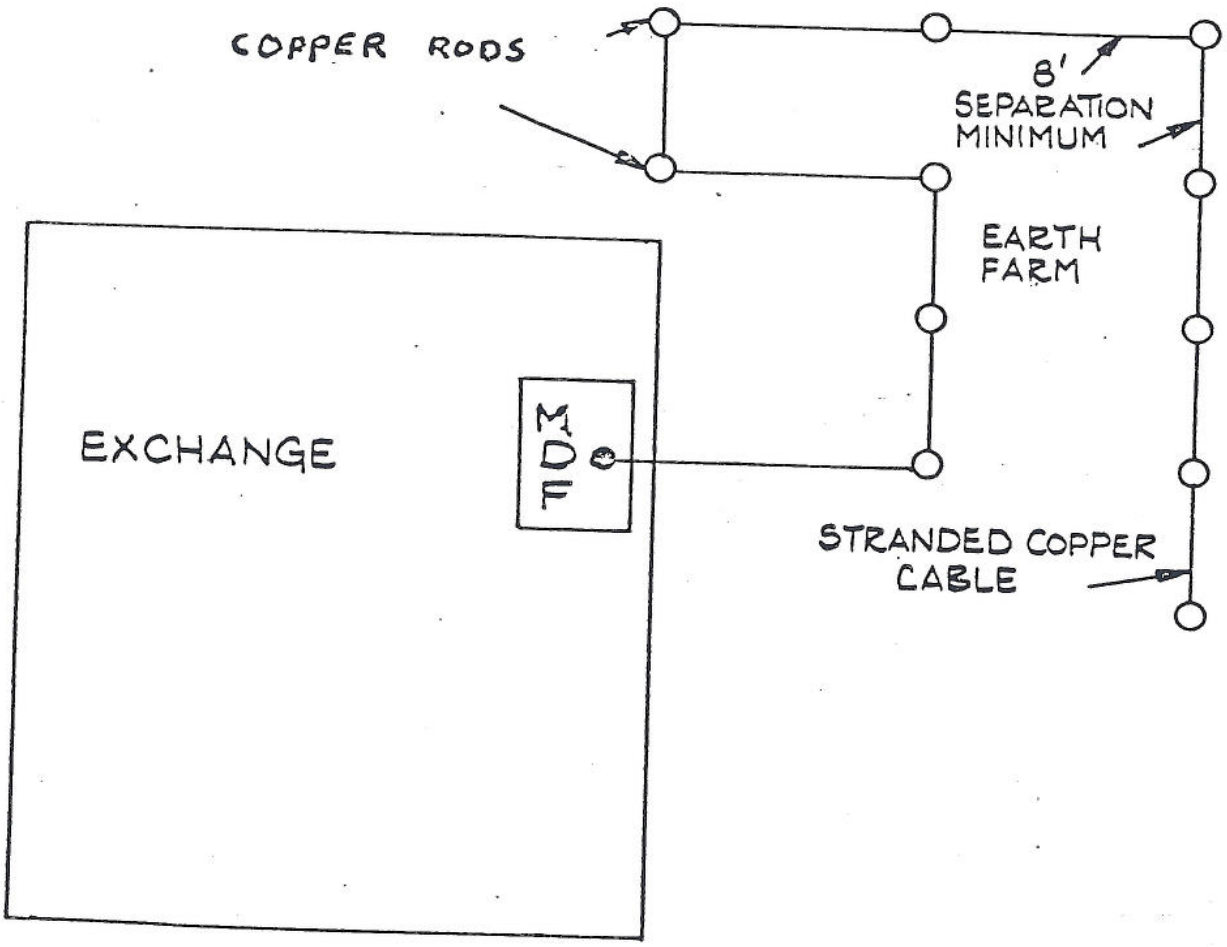
EARTHING ARRANGEMENTS FOR

MAIN DISTRIBUTION FRAME

An earth connection is necessary to avoid the risk of shock should apparatus come into contact with high voltage equipment and to complete a circuit for equipment. The earth for an exchange and M.D.F. does not rely on the mains earth but must have an 'Exchange Earth'.

NON-ELECTRIFIED AREAS

The normal exchange earth system consists of a number of lengths of copper rods driven into the ground. The pipes are connected together by means of a stranded copper cable which is led into the exchange via the cable chamber and is terminated on the M.D.F. See sketch below.



The resistance of an earth system should not exceed 8 ohms, and in most cases is very much less than this.

As an alternative to earth spikes a large galvanized iron earth plate maybe sunk when site space is limited.

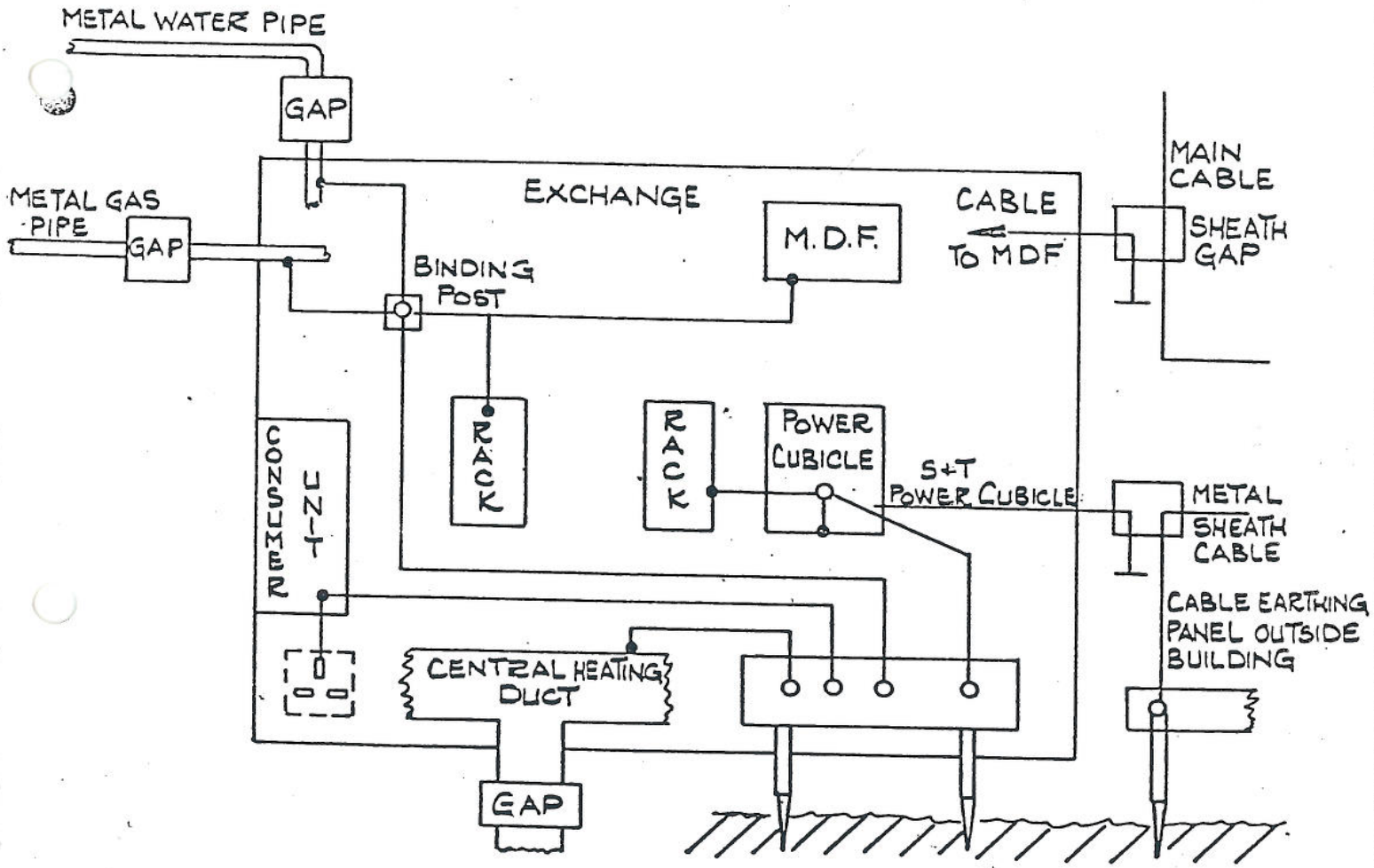
The earthing arrangements on the M.D.F. consists of a copper bar fitted at the top or bottom of the frame.

ELECTRIFIED AREAS

The earth for the M.D.F. is isolated and independent from any other earth system. The sheaths of any external cables entering the exchange where the M.D.F. is located are gapped or insulated so that continuity cannot exist between the two.

All metallic objects, equipments must be earthed to the exchange system, for example:

Metal lighting
Conduit fittings
Also see sketch



COLOUR CODE - 20 Pair Cable

Pair No.	A Leg	B Leg
1	White	Blue
2	"	Orange
3	"	Green
4	"	Brown
5	"	Slate
6	"	Blue/White
7	"	Blue/Orange
8	"	Blue/Green
9	"	Blue/Brown
10	"	Blue/Slate
11	"	Orange/White
12	"	Orange/Green
13	"	Orange/Brown
14	"	Orange/Slate
15	"	Green/White
16	"	Green/Brown
17	"	Green/Slate
18	"	Brown/White
19	"	Brown/Slate
20	"	Slate/White

50PR INTERNAL (METRIC)

1. BL----W	26. BL----BL/R
2. O-----W	27. O-----BL/R
3. GN----W	28. GN----BL/R
4. BN----W	29. BN----BL/R
5. S-----W	30. S-----BL/R
6. BL----R	31. BL----BL/BLK
7. O-----R	32. O-----BL/BLK
8. GN----R	33. GN----BL/BLK
9. BN----R	34. BN----BL/BLK
10. S-----R	35. S-----BL/BLK
11. BL----BLK	36. BL----BL/Y
12. O-----BLK	37. O-----BL/Y
13. GN----BLK	38. GN----BL/Y
14. BN----BLK	39. BN----BL/Y
15. S-----BLK	40. S-----BL/Y
16. BL----Y	41. BL----O/W
17. O-----Y	42. O-----O/W
18. GN----Y	43. GN----O/W
19. BN----Y	44. BN----O/W
20. S-----Y	45. S-----O/W
21. BL----BL/W	46. BL----O/R
22. O-----BL/W	47. O-----O/R
23. GN----BL/W	48. GN----O/R
24. BN----BL/W	49. BN----O/R
25. S-----BL/W	50. S-----O/R

British Rail

Course C.1. (T) Basic Installation.

Section SIX.
SIX/ONE.
SIX/TWO.

Content

SIX Extension Plan Arrangements.

SIX/ONE Extension Plan Diagrams 400 Series Modifications.

SIX/TWO 3000 Series Modifications.

R.S. & T.E. Department

Training School **York**

EXTENSION PLAN ARRANGEMENTS

GENERAL

When it is necessary to connect telephone instruments, for shared service working, then care must be taken or premature ring trip could result, due to the parallel capacitances of the telephone bell circuits offering such a low impedance that the "F" relay in the Final Selector operates incorrectly to a large flow of D.C. Current.

To prevent this mis-operation the bell circuits of telephone instruments connected for shared service working are arranged so that their respective bell circuits are wired in series (thereby limiting the bell circuit current) and the speech circuits are connected in parallel.

The above arrangement does have a limitation, as too many telephone bell instruments connected in series will limit the current in the bell circuit so that the telephone bell will not operate at all.

The maximum number of bell circuits that can be connected in series is:

EXTENSION PLANS 1A

1. GENERAL EP1A

1.1 The extension plan 1A consists of a main telephone and one to five extensions.

1.2 It can be fitted on all exchange systems.

1.3 It may be fitted internally.

1.4 It may be only fitted externally under exceptional circumstances.

1.5 Any 700 type telephone may be fitted including the trimphone and push button types (keyphone).

2. FACILITIES

2.1 An incoming ring will ring all the bells in the series.

2.2 The bells at extensions can be switched on or off at will.

2.3 The speech circuits of all the telephones are wired in parallel and an incoming call can be answered at any telephone.

2.4 All telephones can call the exchange direct.

2.5 Neither secrecy or inter-communication between main and extension is provided.

3. Extension Plan 4

3.1 The extension plan 4 consists of one or more portable telephones that can be plugged into any of a number of sockets. The total number of bells must not exceed four or two lines in UAX areas with vibrator ringing.

3.2 It can be fitted on all exchange systems.

3.3 It can be fitted on exclusive or shared service lines.

3.4 It may be fitted internally only.

4. FACILITIES

4.1 One or more table telephones are terminated on a plug or plugs.

4.2 The telephones may be moved from socket to socket as required.

4.3 Incoming calls ring the main bell and also the bell of any telephone connected to a socket and can be answered with any telephone at any socket.

4.4 Outgoing calls can be made with any telephone from any socket.

4.5 Inter-communication is not provided.

4.6 There is no secrecy between telephones.

5. CIRCUIT

5.1 The exchange line is connected in parallel to all sockets.

5.2 A bell set is permanently wired into the exchange line so that on an incoming call with no telephone plugged in a bell will ring. When any telephones are plugged in, the bells in the telephone and bell set are connected in series and on an incoming call all bells ring.

6. PLAN EXTENSIONS 105, 105A, 107 & 107A

Extension plans 105 and 107 consist of a main telephone with 2 "slave" extensions for plan 105 and 1 "slave" extension for the plan 107.

This type of configuration could be used, for example in a situation where a manager wishes his secretary or assistant to receive incoming calls and then pass them on to him, while retaining his access to the exchange.

The 105A and 107A extension plans have the extra facility that a call by an extension to the exchange is not heard by the main extension.

7. FACILITIES

7.1 Incoming calls are normally received at main, but they may be received at the extensions if so desired.

7.2 Exchange calls from main cannot be heard at extensions.

7.3 Extension to exchange calls are not secret from the main or from the other extension on Plan 105 and 107 but they are secret from the main, although not from the other extension, on Plan 105A and 107A.

7.4 The main can hold an exchange call and speak to an extension, without being heard on the exchange line.

7.5 A white lamp at the main shows when the exchange line is in use by an extension. A red lamp at the main shows when the exchange line is being held.

7.6 Press key signalling is provided both ways between the main and the extension (whether this is internal or external), but once a call has been set up between an external extension and the exchange (in either direction) the main cann ot be called in by the extension.

7.7 Internal extensions may call each other and speak without the intervention of the main. External extensions cannot call each other directly but only with the help of the main.

7.8 Extensions may be (a) both internal, (b) both external, or (c) one of each type. Arrangement (c) must have both extensions connected as 2-wire circuits, i.e. as for type (b).

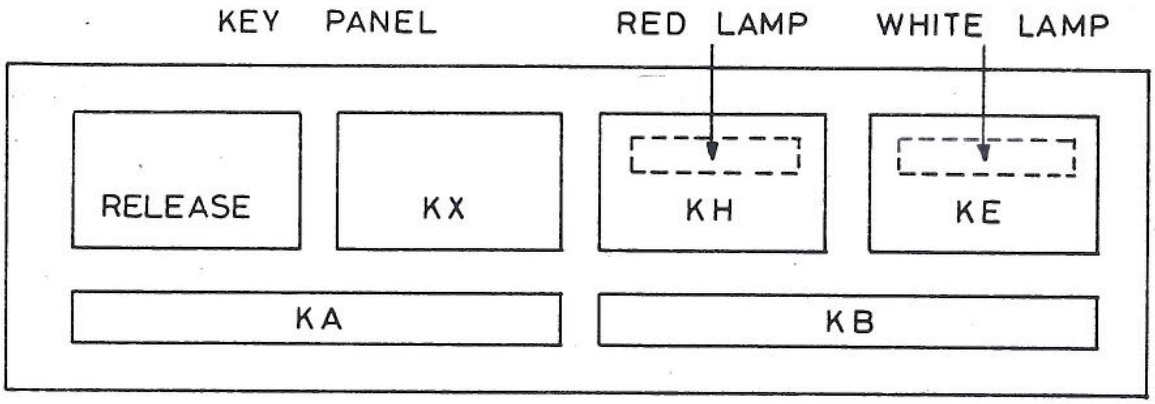
7.9 With the extensions switched through to the exchange, incoming calls ringing the extension telephone bells are also indicated to the main by a bell if the extensions are internal, or by a buzzer if external.

7.10 The main calls an extension by buzzer if internal and by bell if external.

8. GENERAL DESCRIPTION OF PLAN 105, 107

The main telephone consists of a standard 700 sweries instrument mounted on a switching set which also acts as a base.

The layout of the switches on the switching base is as shown below:-



KA & KB (non-locking) Extension calling keys.

Release: Operation releases any operated locking key.

KX (locking) Main: Speak to Exchange.

KH (locking) Main: Speak to Extension Exchange Held.

KE (locking) Extension to Exchange.

The operation of a locking key will release any other previously locked key.

9. PLAN SET N625 TABLE

9.1 A white lamp with a white opal behind the EXTN to EXCH key, acts as an engaged signal and lights if this key is depressed, when the handset at an extension is off its rest.

A white lamp with a red opal behind the SPK EXTN EXCH HELD key lights if this key is depressed when the handset at the main is off its rest, indicating that the exchange line is being held.

10. PLAN SET N625 WALL

10.1 This differs from a table model in the following ways:-

a) A hinged back.

b) Translucent opal keys with black lettering.

c) Supervisory lamps glow through the keys and the lamps are red and white.

10.2 The hinge is double acting to allow the body to stand away from the wall. Access is gained to the plan set by pressing the side bar (with a screwdriver blade) towards the centre and moving the body to the right until the studs dis-engage. The plan set will then swing open.

10.3 The minimum clearance of 305 mm to the right and 152 mm to the left are required for opening the plan set.

10.4 The maximum height at which the apparatus may be fitted is 1371 mm to the centre of the dial. The keys on the plan set should then be at a convenient height, but consult the subscriber before finally fixing the apparatus.

11. CONNECTIONS BETWEEN EXTENSIONS AND PLAN SET 105/107

When the main is in contact with the slave extensions, then the exchange battery is not used, but in order to provide power for speech and signalling a power supply is required.

This is generally provided by the power unit No-53A, or when Plessey E telephones are used, the power unit N23801B.

12. POWER UNIT NO.53A

12.1 The output is 12 volt DC with no load and 10 Volts on load at .25 amps.

12.2 The subscriber must provide a standard 3 pin BS wall socket adjacent to the wall mounting position of the power unit. The connection of the mains supply to the power unit, is a plug suitable for the socket and Cord Flexible PVC 3 Core 0.5 sq mm.

12.3 On mark 2 power units the fixing arrangements have been improved by the addition of fixing screws through the vertical sides of the cover as an alternative to the top and bottom fixing holes where these are not readily accessible.

Some power units are provided with No. 6 Spire Speed Screws x ½". There is the risk that this size screw on the left hand side may pierce the mains input cable. To avoid this risk place the mains input cable in the space between the capacitor and inductor L1 and below the inductor's top plate; this will keep it clear of the output terminals.

12.4 It is essential to ensure that the correct fuses are fitted

a) In the power unit. Input Fuse No. 36A/0.1
Output Fuse No. 36/0.5
and one of each type as spares for replacement.

b) In the mains plug when 13 amp ring main type with flat pins is used. The fuse provided should be 3 amp. This is to guard the PVC cordage between the plug and power unit. The wires when terminated on the plug should have the minimum amount of slack on the live and neutral terminals. The earth termination should have some slack so that if the cable grip fails the earth wire will be the last to pull away. It is important that the minimum of bare wire should be exposed on each termination.

12.5 If no power is available, or if it is impossible to use a suitable mains supply, Eight Cells, Dry R40 in a Box Battery No 10 may be fitted.

12.6 The connection of the 12 Volts supply to the plan set must not be reversed as the transistors will be damaged.

12.7 RINGING CONVERTER NO. 9A

Wall mounted and used for external extensions, Ringing frequency is 20 Hz. Input 12 Volts DC.

12.8 MAINS FAILURE

Under these conditions, intercommunication facilities will be lost although exchange calls may be made or received from all instruments. For these reasons a power unit must not be used at installations serving emergency services.

13. CIRCUIT OPERATION

The circuit operation can be deduced by referring to the attached schematic diagrams which show the operation of the circuit for any of the possible switch combinations required.

14. PLAN 105A/107A - SECRECY

The extension has the facility on the 105A and 107A to make an exchange call without the main overhearing, this is achieved by the following circuit alteration, which has the effect of short circuitingthe receiver in the main instrument. Strap 18-19, 17-24.

15. EXTENSION PLAN 1

This extension arrangement consists of a main telephone and up to 3 extensions. It has the following facilities

All telephones can receive and originate calls but incoming calls are normally answered at the main telephone.

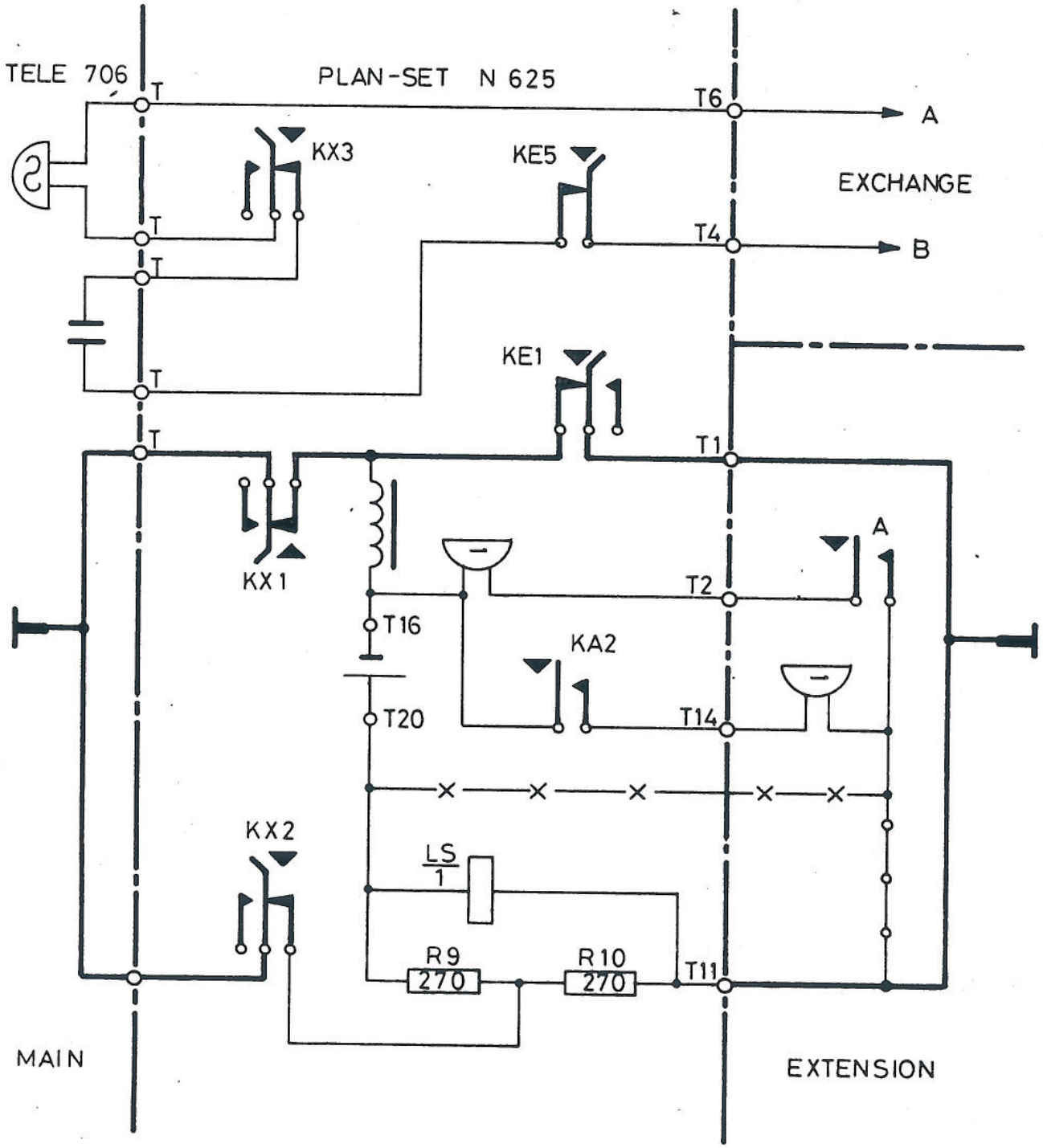
The main may call any extension by operation of a push button.

Enquiry transfer or operator recall achieved by operation of a push button.

Neither secrecy or intercommunication is provided between main and extension telephones.

TO CALL EXTN OP KA/KB

(1) SPEAK TO EXTENSION (ALL KEYS NORMAL)

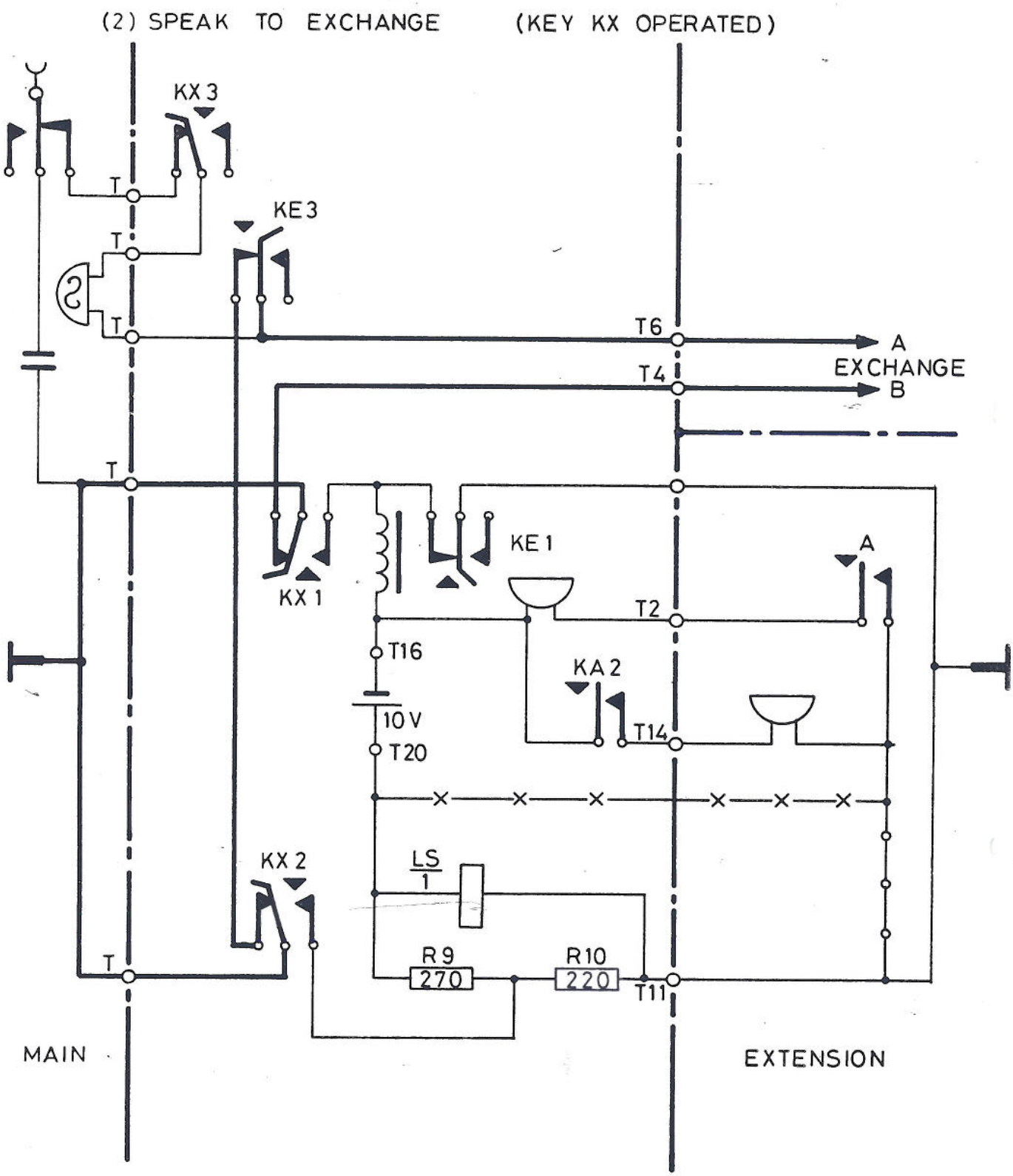


TYPICAL SWITCHING ELEMENTS.

PLAN 107 INTERNAL

NOTE :- | | - DENOTES LOCAL POWER SUPPLY

MAIN ANSWERS CALL

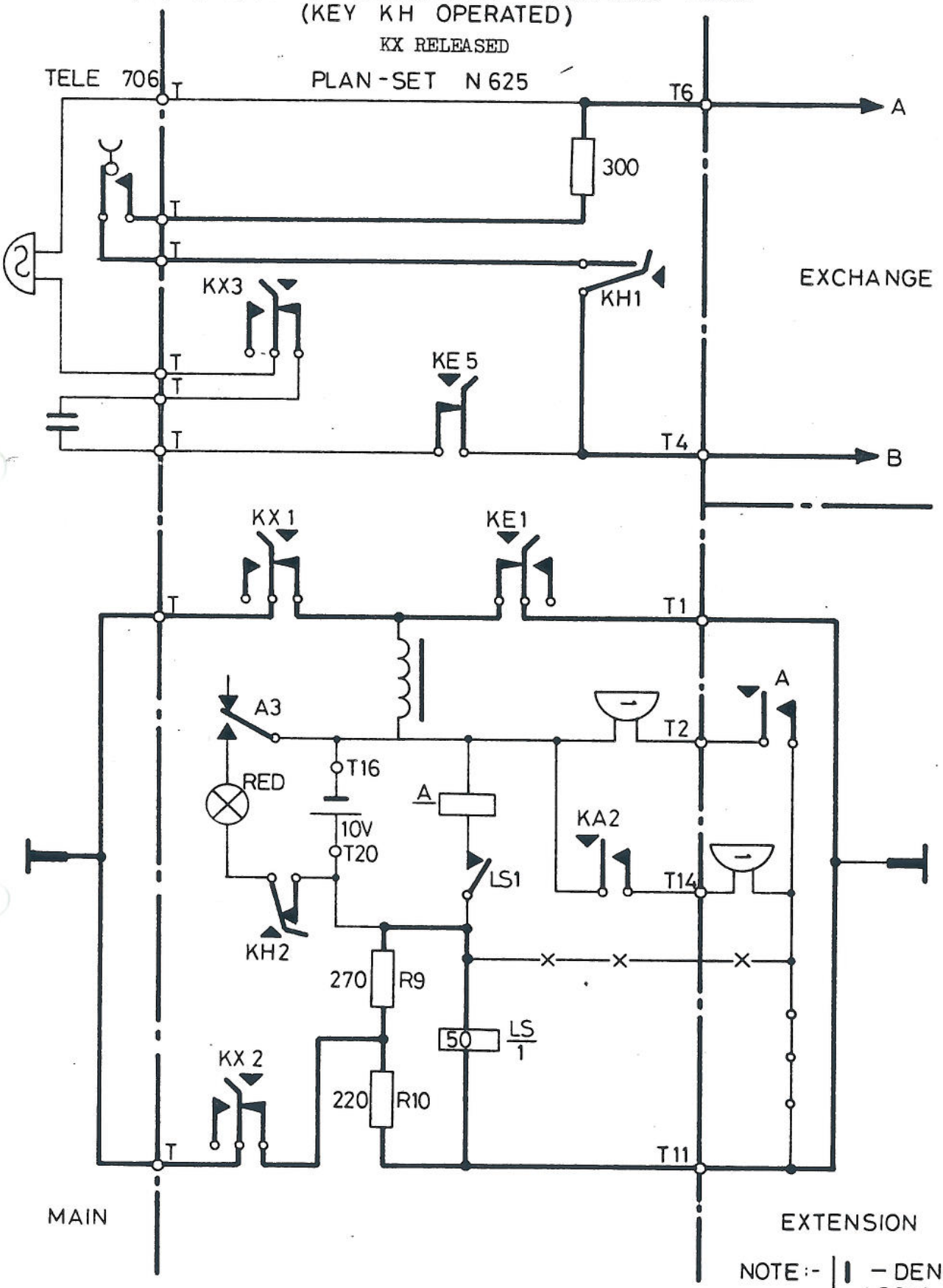


TYPICAL SWITCHING ELEMENTS

PLAN 107 - INTERNAL

NOTE :- | - DENOTES LOCAL POWER SUPPLY

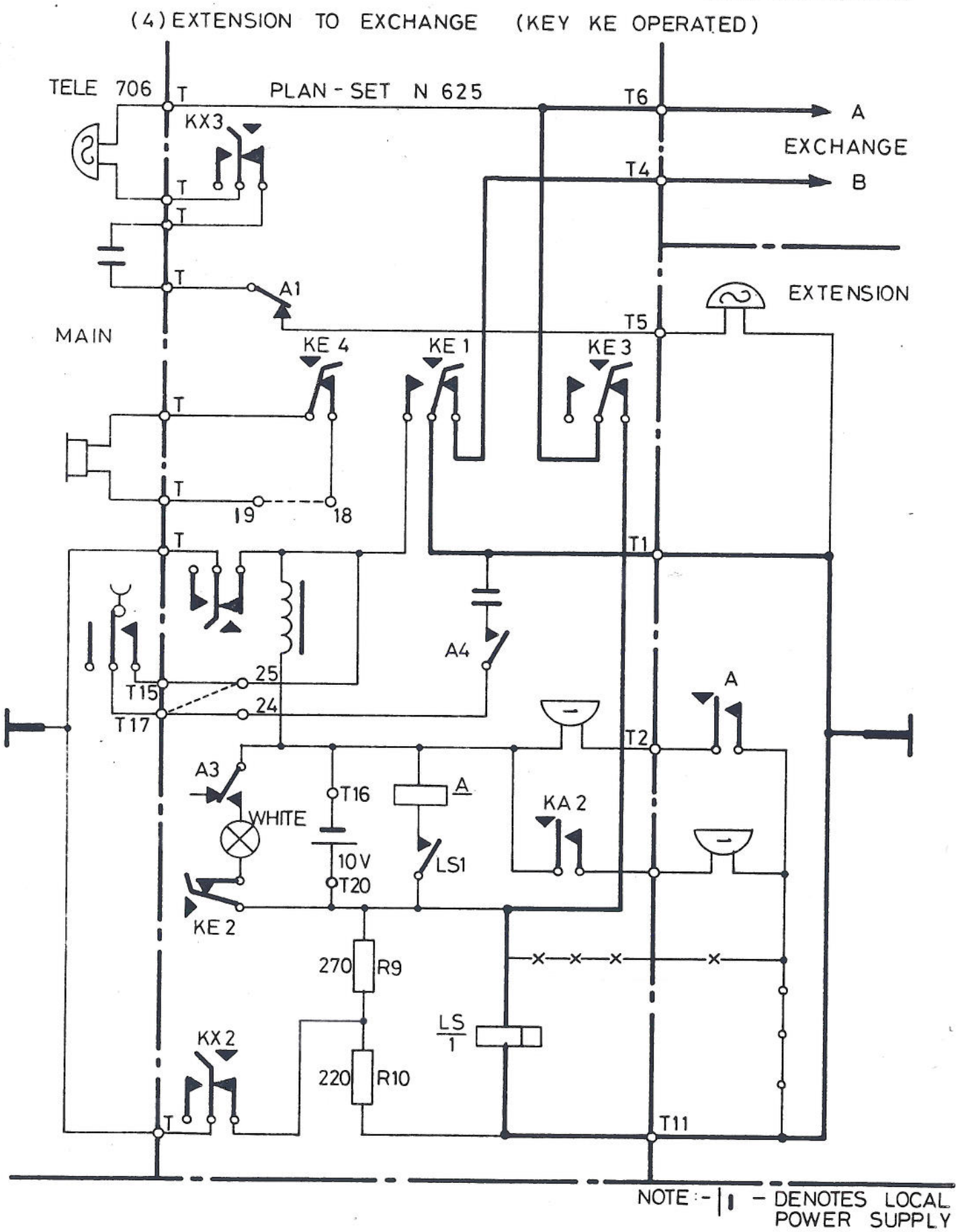
(3) SPEAK TO EXTENSION - EXCHANGE HELD
(KEY KH OPERATED)
KX RELEASED



NOTE:- | | – DENOTES LOCAL POWER SUPPLY

TYPICAL SWITCHING ELEMENTS

PLAN 107 INTERNAL



TYPICAL SWITCHING ELEMENTS.

PLAN 107 INTERNAL

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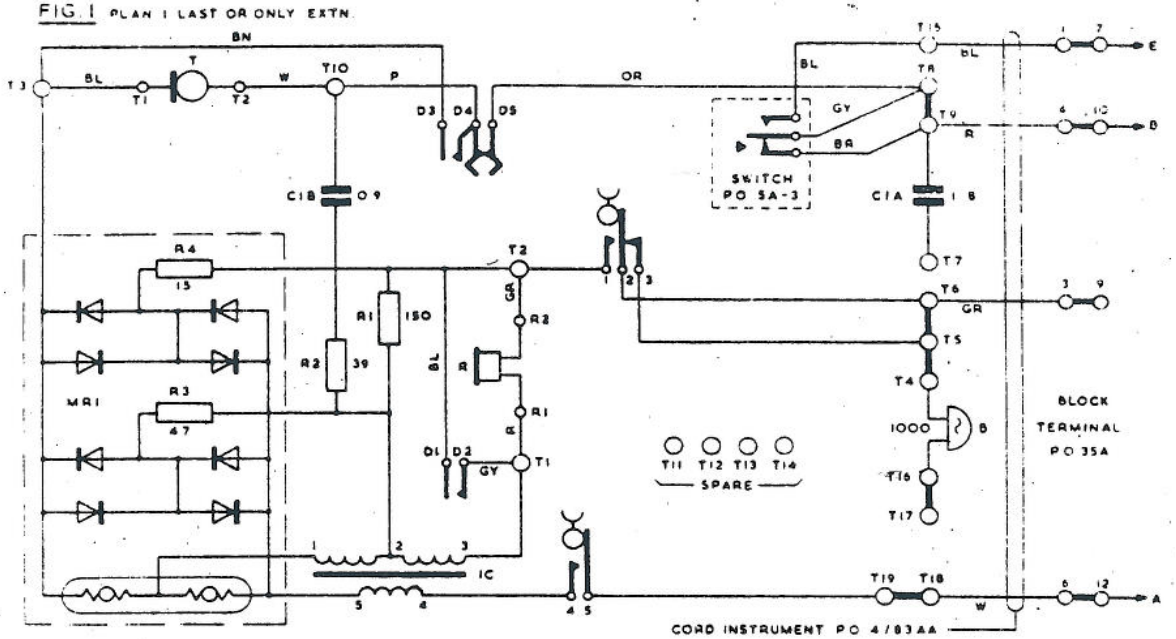
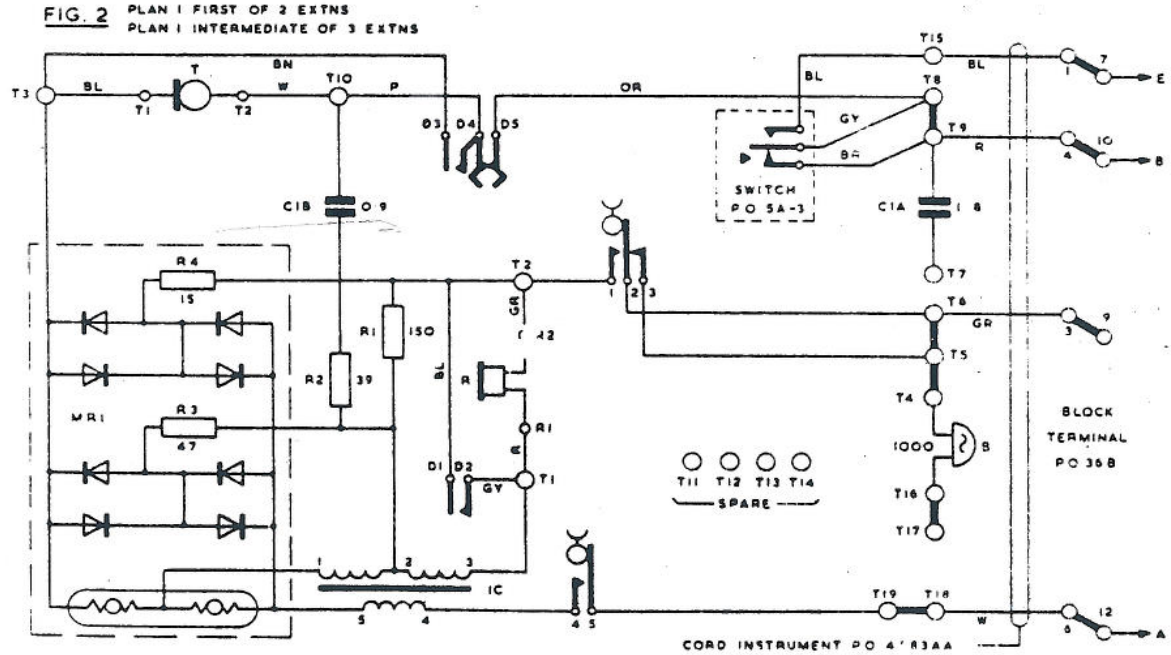
FIG. 1 PLAN 1 LAST OR ONLY EXTN.



TELEPHONE P.O. 706 - DISCONNECT STRAP BETWEEN T6 & T7
SWITCH P.O. 5A-3 } ASSEMBLE AND WIRE TO
PRESS BUTTON P.O. 1/DBU/263 } TERMINALS T8, T9 & T15
CORD, INSTRUMENT P.O. 4/83AA - AS ISSUED BUT CONNECT AS SHOWN
BLOCK, TERMINAL P.O. 35A - STRAP 1-7, 3-9, 4-10 & 6-12
BELL P.O. 56A - CONNECT COILS IN SERIES

FIG. 2 PLAN 1 FIRST OF 2 EXTNS
PLAN 1 INTERMEDIATE OF 3 EXTNS



TELEPHONE P.O. 706 - DISCONNECT STRAP BETWEEN T6 & T7
SWITCH P.O. 5A-3 } ASSEMBLE AND WIRE TO
PRESS BUTTON P.O. 1/DBU/263 } TERMINALS T8, T9 & T15
CORD, INSTRUMENT P.O. 4/83AA - AS ISSUED BUT CONNECT AS SHOWN
BLOCK, TERMINAL P.O. 36B - STRAP 1-7, 3-9, 4-10 & 6-12
BELL P.O. 56A - CONNECT COILS IN SERIES

MODIFICATIONS TO TELEPHONES P.O. TYPES 706 & 710 FOR EXTENSION PLAN WORKING

No. TN-309

BRITISH RLYS (Southern R
SOUTHERN HOUSE, CRO

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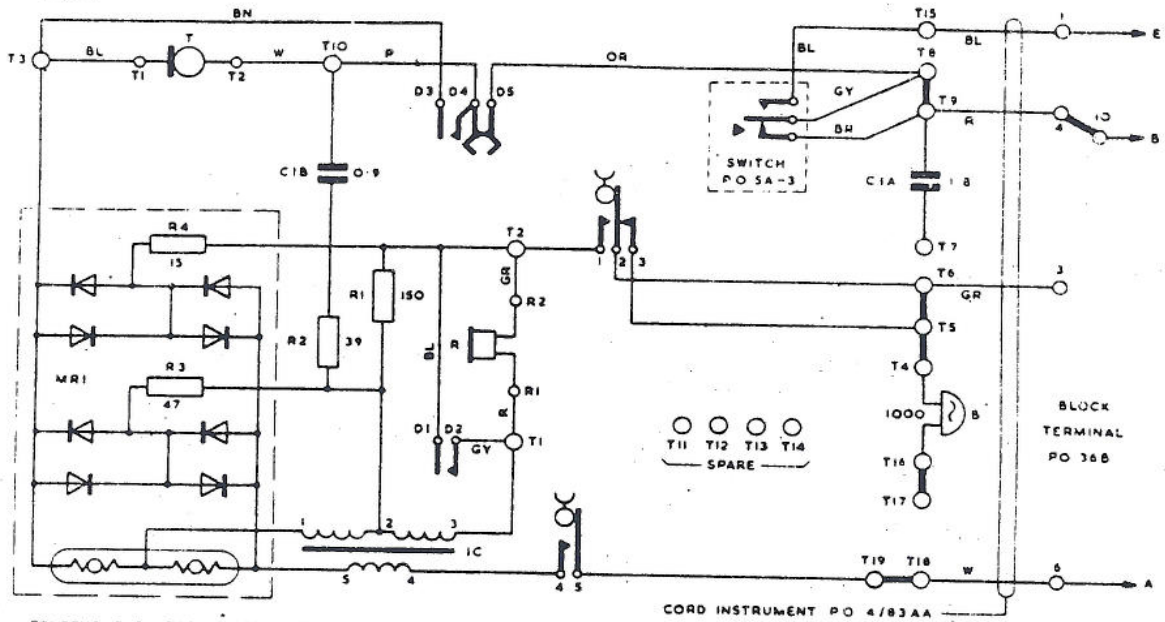
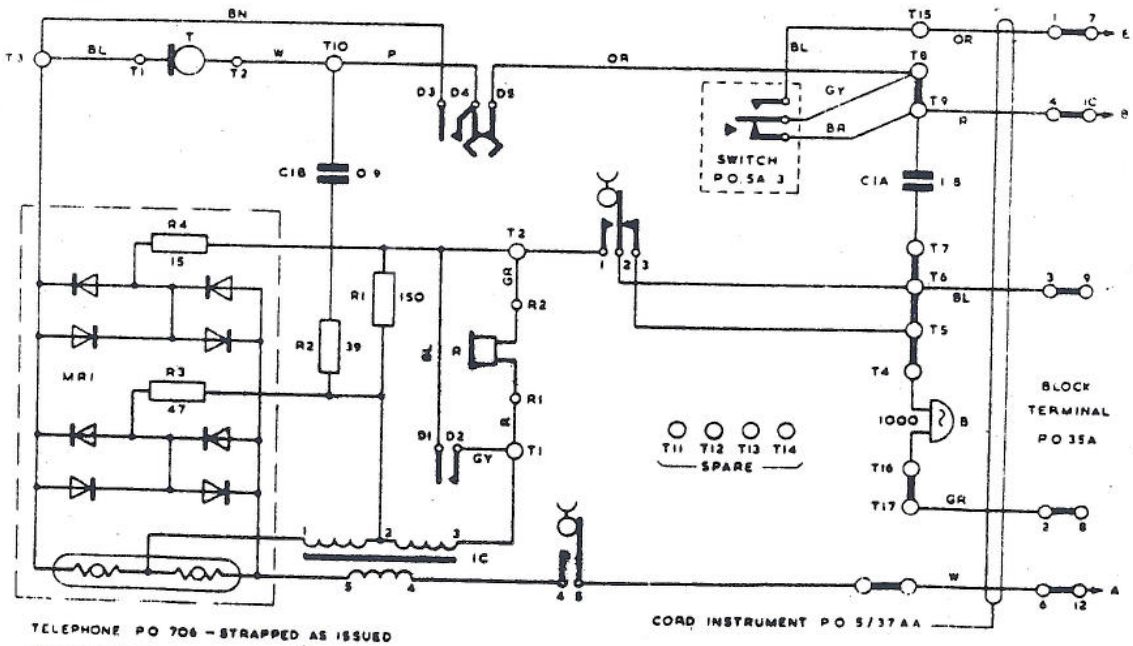
FIG. 1 PLAN 1 FIRST OF 3 EXTNS



TELEPHONE P.O 706 – DISCONNECT STRAP BETWEEN T6 & T7
SWITCH P.O 5A-3 } ASSEMBLE AND WIRE TO
PRESS BUTTON P.O 1/DBU/263 } TERMINALS T8, T9 & T15
CORD. INSTRUMENT P.O 4/83AA – AS ISSUE BUT CONNECT AS SHOWN
BLOCK, TERMINAL P.O 36B – STRAP 4-10 ONLY
BELL P.O 56A – CONNECT IN SERIES

FIG. 2 PLAN 1A MAIN



TELEPHONE P.O 706 – STRAPPED AS ISSUED
SWITCH P.O 5A-3 } ASSEMBLE AND WIRE TO
PRESS BUTTON P.O 1/DBU/263 } TERMINALS T8, T9 & T15
CORD. INSTRUMENT P.O 5/37AA – CONNECT AS SHOWN
BLOCK. TERMINAL P.O 35A – STRAP 1-7, 2-8, 3-9, 4-10 & 6-12

MODIFICATIONS TO TELEPHONES P.O. TYPES 706 & 710 FOR EXTENSION PLAN WORKING

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DATE

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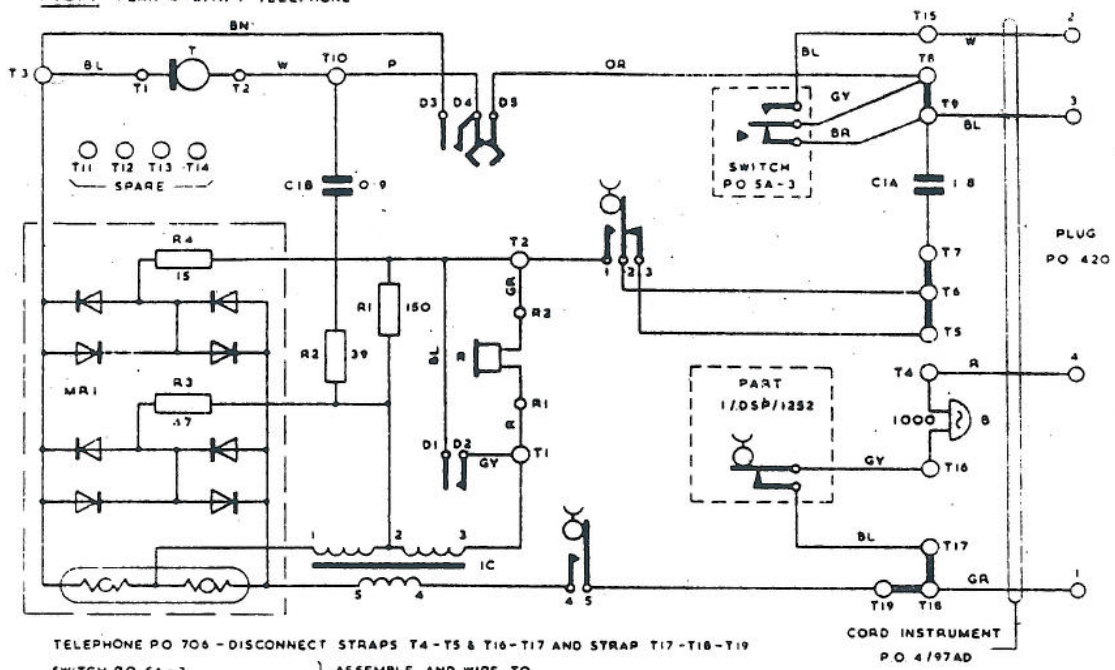
FIG. 1 PLAN 4 WITH 1 TELEPHONE



TELEPHONE PO 706 – DISCONNECT STRAPS T4-T5 & T16-T17 AND STRAP T17-T18-T19

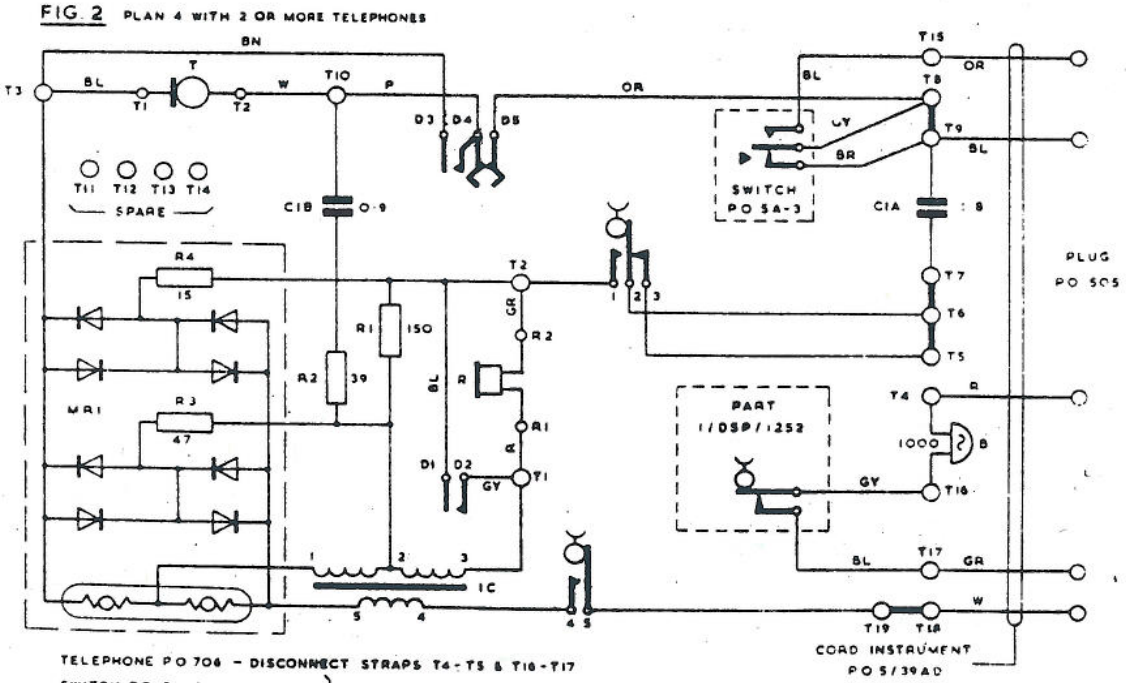
SWITCH PO 5A-3, PRESS BUTTON PO 1/DBU/263 } ASSEMBLE AND WIRE TO TERMINALS T8, T9 & T15

GRAVITY SWITCH PO 1/DSP/1252 – EQUIP AND WIRE TO TERMINALS T16 & T17

CORD, INSTRUMENT PO 4/97AD, PLUG PO 420 } CONNECT AS SHOWN

BELL SET PO 25, JACK PO 95A (MAXIMUM 6) } EQUIP IN SUITABLE LOCATIONS AND WIRE AS SHOWN

FIG. 2 PLAN 4 WITH 2 OR MORE TELEPHONES



TELEPHONE PO 706 – DISCONNECT STRAPS T4-T5 & T16-T17

SWITCH PO 5A-3, PRESS BUTTON PO 1/DBU/263 } ASSEMBLE AND WIRE TO TERMINALS T8, T9 & T15

GRAVITY SWITCH PO 1/DSP/1252 – EQUIP AND WIRE TO TERMINALS T16 & T17

CORD, INSTRUMENT P.O 5/39AD, PLUG PO 505 } CONNECT AS SHOWN

BELL SET PO 26, JACK P.O 96A (MAXIMUM 6) } EQUIP IN SUITABLE LOCATIONS AND WIRE AS SHOWN

MODIFICATIONS TO TELEPHONES P.O. TYPES 706 & 710 FOR EXTENSION PLAN WORKING

BRITISH RLYS (Southern Region) SOUTHERN HOUSE CROYDON

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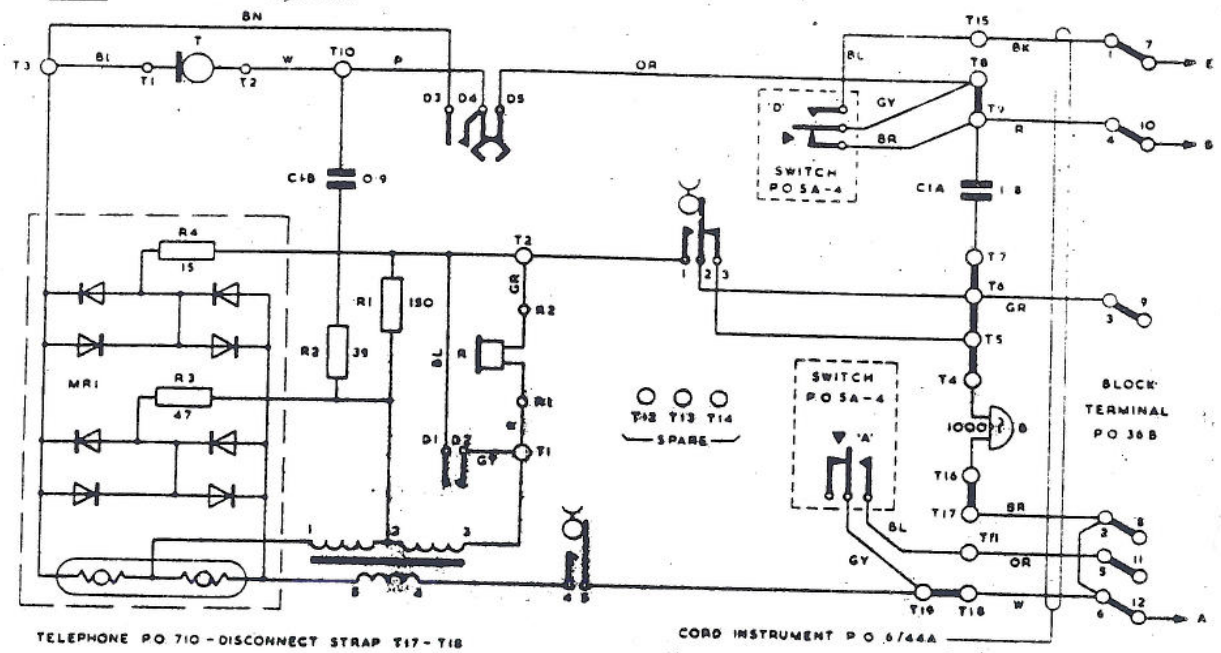
FIG. 1 PLAN 1 MAIN WITH 1 EXTN



TELEPHONE P.O. 710 - DISCONNECT STRAP T17 - T18

SWITCH P.O. 5A-4 / PRESS BUTTON P.O. 23/DBU/260 } FIT IN POSITION 'A' AND WIRE TO TERMINALS T11 & T19

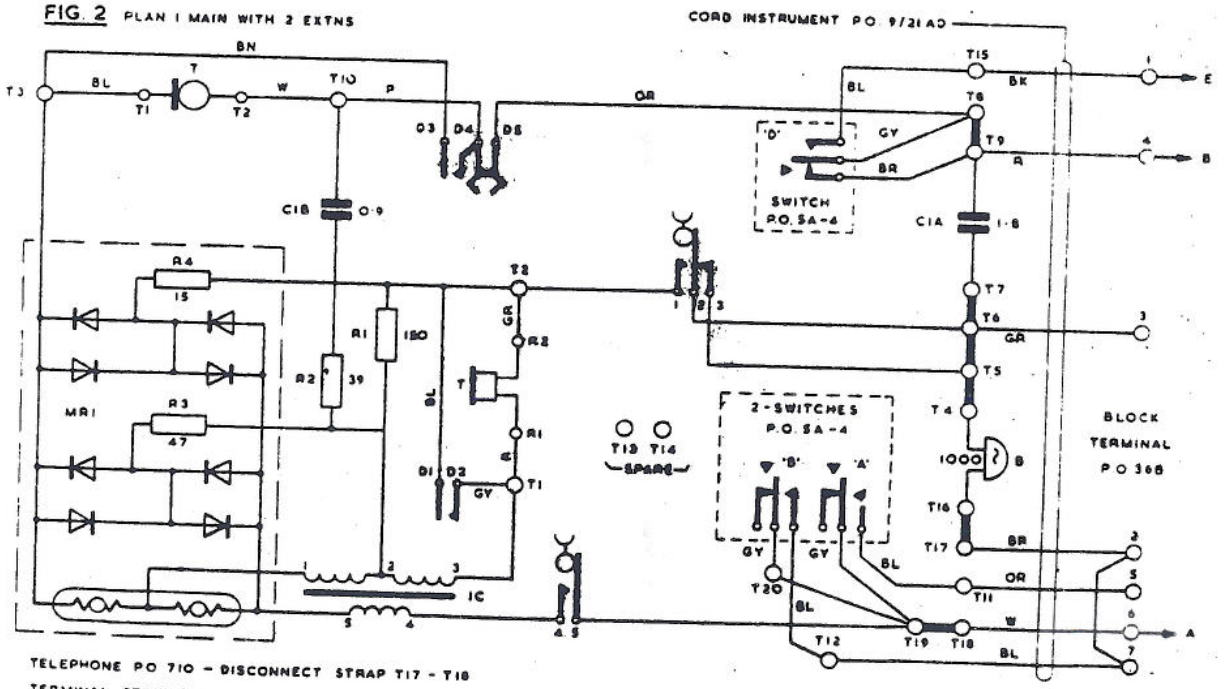
SWITCH P.O. 5A-4 / PRESS BUTTON P.O. 26/DBU/260 } FIT IN POSITION 'D' AND WIRE TO TERMINALS T8, T9 & T15

CORD. INSTRUMENT P.O. 6/44AA - CONNECT AS SHOWN

BLOCK, TERMINAL P.O. 36B - STRAP 1-7, 2-8, 3-9, 4-10, 5-11 & 6-12 ALSO LINK 2-6

ADJUST LATCHES ON 'A' & 'D' TO SETTING 3 WITH 'X' & 'Y' LATCHES AT SETTING 5 - SEE DGM. TN-6848

FIG. 2 PLAN 1 MAIN WITH 2 EXTNS



TELEPHONE P.O. 710 - DISCONNECT STRAP T17 - T18

TERMINAL STRIP P.O. 2/DST/636 - EQUIP FOR ADDITIONAL TERMINATIONS AND STRAP T20 - T19

SWITCH P.O. 5A-4 / PRESS BUTTON P.O. 25/DBU/260 } FIT IN POSITION 'A' AND WIRE TO TERMINALS T11 & T19

SWITCH P.O. 5A-4 / PRESS BUTTON P.O. 26/DBU/260 } FIT IN POSITION 'B' AND WIRE TO TERMINALS T12 & T20

SWITCH P.O. 5A-4 / PRESS BUTTON P.O. 28/DBU/260 } FIT IN POSITION 'D' AND WIRE TO TERMINALS T8, T9 & T15

CORD. INSTRUMENT P.O. 9/21AD - CONNECT AS SHOWN AND CUT BACK SPARES

BLOCK, TERMINAL 36B - LINK 2-7 ONLY

ADJUST LATCHES ON 'A', 'B' & 'D' TO SETTING 3 WITH 'X' & 'Y' LATCHES AT SETTING 5 - SEE DGM TN-6848

MODIFICATIONS TO TELEPHONES P.O. TYPES 706 & 710 FOR EXTENSION PLAN WORKING

BRITISH RLYS (Southern Region) SOUTHERN HOUSE CROYDON

Chief Signal & Telecommunications Engineer

DATE

No. TN-3004

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MODIFICATIONS TO TELEPHONES P.O. TYPES 706 & 710 FOR EXTENSION PLAN WORKING

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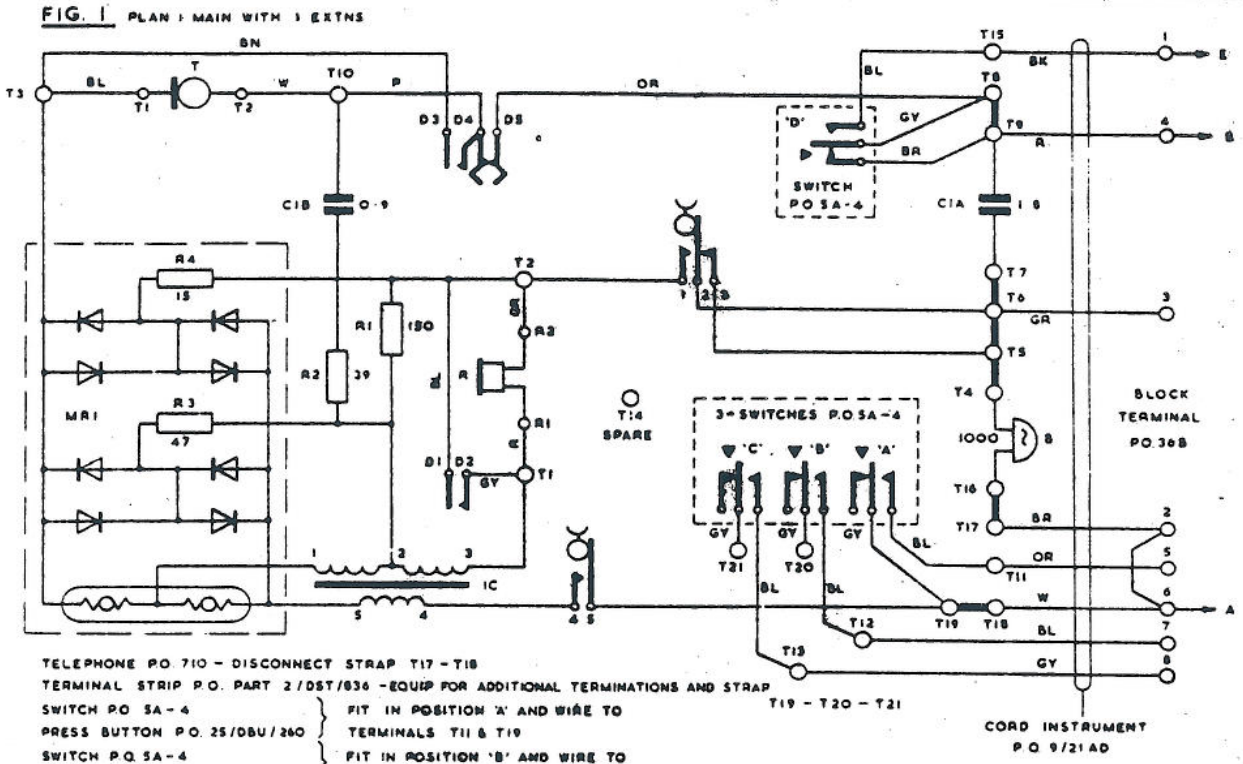
BRITISH RLYS (Southern Region) SOUTHERN HOUSE, CROYDON

FIG. 1 PLAN 1 MAIN WITH 3 EXTNS

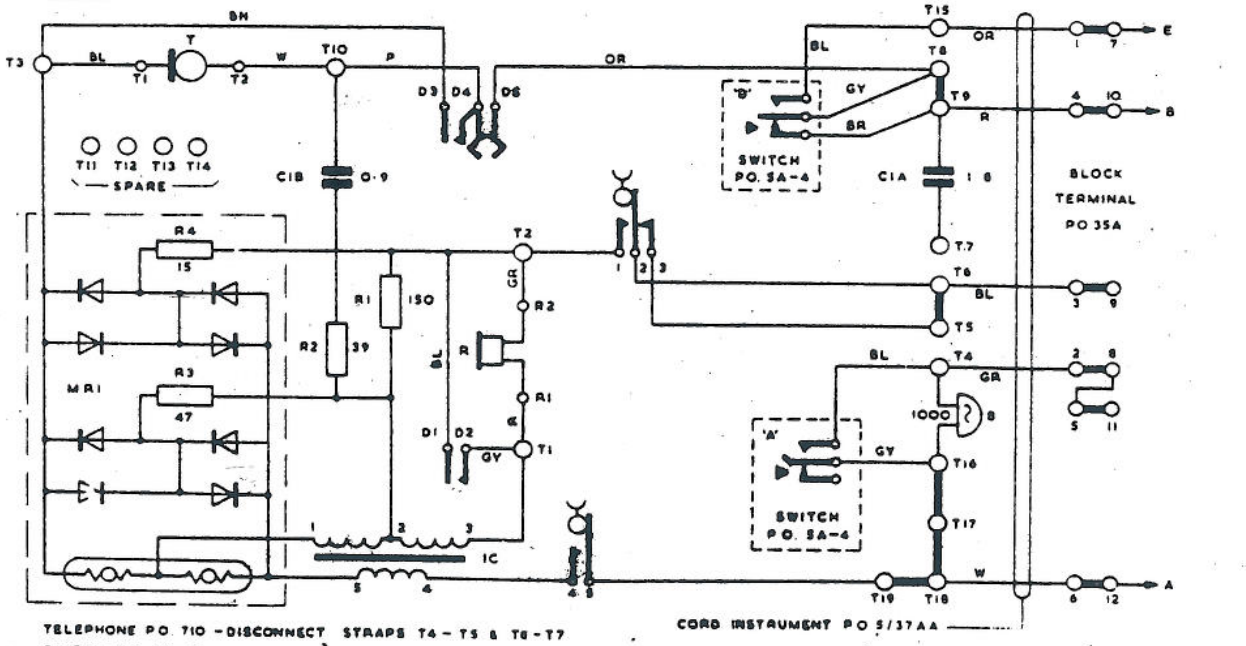


TELEPHONE P.O. 710 – DISCONNECT STRAP T17 – T18
TERMINAL STRIP P.O. PART 2/DST/636 – EQUIP FOR ADDITIONAL TERMINATIONS AND STRAP

SWITCH P.O 5A-4 PRESS BUTTON P.O. 25/DBU/260	FIT IN POSITION 'A' AND WIRE TO TERMINALS T11 & T19
SWITCH P.O. 5A-4 PRESS BUTTON P.O. 26/DBU/260	FIT IN POSITION 'B' AND WIRE TO TERMINALS T12 & T20
SWITCH P.O. 5A-4 PRESS BUTTON P.O. 27/DBU/260	FIT IN POSITION 'C' AND WIRE TO TERMINALS T13 & T21
SWITCH P.O. 5A-4 PRESS BUTTON P.O. 28/DBU/260	FIT IN POSITION 'D' AND WIRE TO TERMINALS T8, T9 & T15

CORD, INSTRUMENT P.O. 9/21AD – CONNECT AS SHOWN AND CUT BACK SPARE
BLOCK, TERMINAL P.O. 36B – LINK 2-6 ONLY
ADJUST LATCHES ON 'A', 'B', 'C' & 'D' TO SETTING 3 WITH 'X' & 'Y' LATCHES AT SETTING 5 – SEE DGM TN-6848

FIG. 2 PLAN 1A LAST EXTN



TELEPHONE P.O. 710 – DISCONNECT STRAPS T4 – T5 & T6 – T7

SWITCH P.O 5A-4 PRESS BUTTON P.O 2/DBU/262 PIN P.O. PART 1/DP1/205	FIT IN POSITION 'A' AND WIRE TO TO TERMINALS T4 & T16
SWITCH P.O 5A-4 PRESS BUTTON P.O. 28/DBU/260	FIT IN POSITION 'D' AND WIRE TO TERMINALS T8, T9 & T15

CORD, INSTRUMENT P.O. 5/37AA – CONNECT AS SHOWN
BLOCK, TERMINAL P.O. 35A – STRAP 1-7, 2-8, 3-9, 4-10, 5-11 & 6-12 ALSO LINK 5-8
ADJUST LATCHES ON 'A' & 'D' TO SETTING 3 WITH 'X' & 'Y' LATCHES AT SETTING 5 – SEE DGM. TN-6848

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TRACED	W.J.
CHECKED	G.B.

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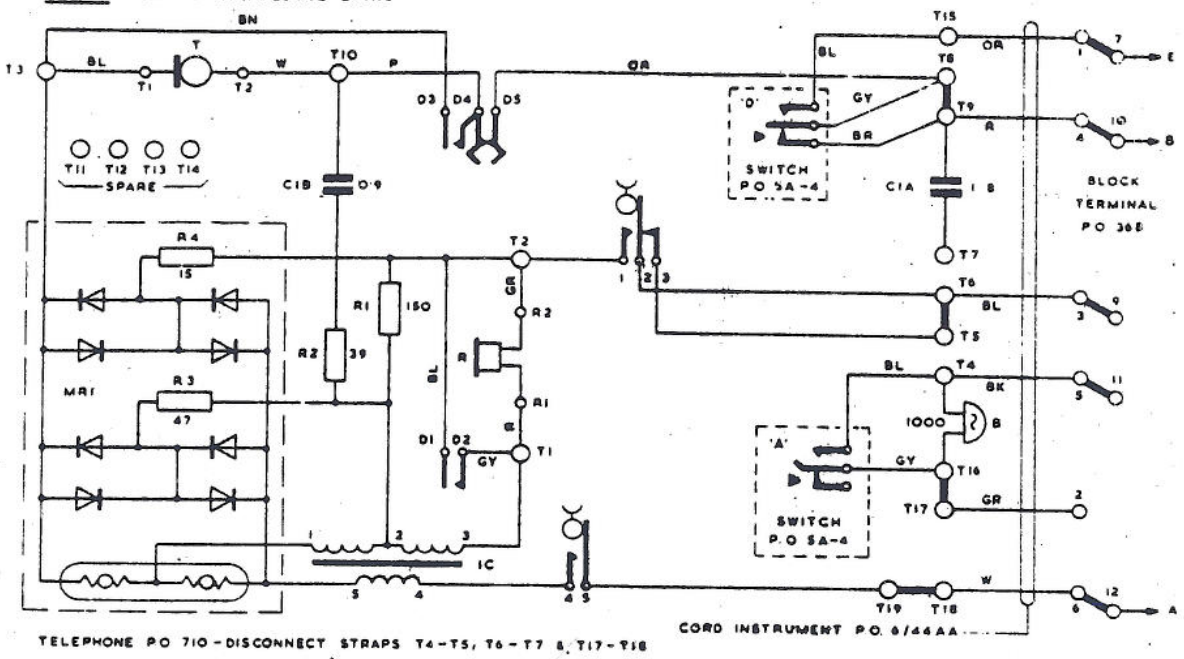
FIG. 1 PLAN 1A INTERMEDIATE EXTNS



TELEPHONE P.O 710 - DISCONNECT STRAPS T4-T5, T6-T7 & T17-T18

SWITCH P.O 5A-4
PRESS BUTTON P.O 2/DBU/262
PIN P.O PART 1/DPI/205
} FIT IN POSITION 'A' AND WIRE TO TERMINALS T4 & T16

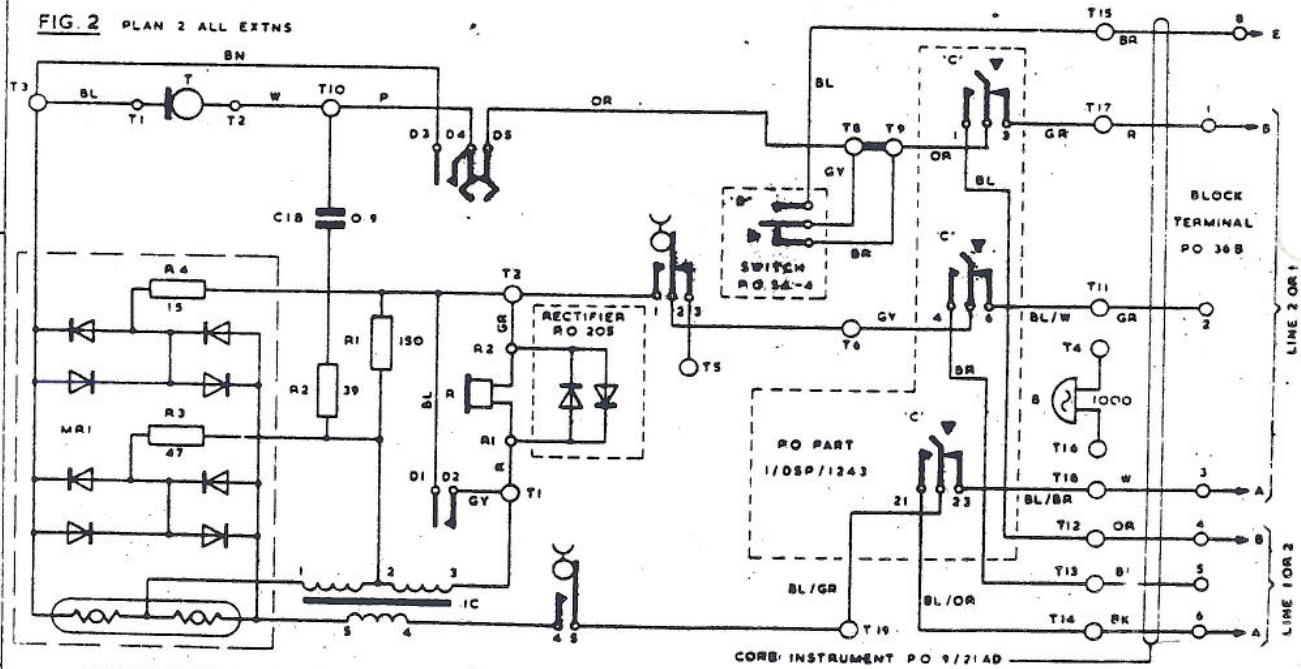
SWITCH P.O 5A-4
PRESS BUTTON P.O 28/DBU/260
} FIT IN POSITION 'D' AND WIRE TO TERMINALS T8, T9 & T15

CORD, INSTRUMENT P.O. 6/44AA - CONNECT AS SHOWN

BLOCK TERMINAL P.O. 36B - STRAP 1-7, 3-9, 4-10, 5-11 & 6-12

ADJUST LATCHES ON 'A' & 'D' TO SETTING 3 WITH 'X' & 'Y' LATCHES AT SETTING 5 - SEE DGM TN-6848

FIG. 2 PLAN 2 ALL EXTNS



TELEPHONE P.O. 710 - REMOVE ALL STRAPS OTHER THAN T8-T9

SWITCH P.O 1/DSP/1243
PRESS BUTTON P.O 37/DBU/260
} FIT IN POSITION 'C' AND WIRE TO TERMINALS T6, T9, T11, T12, T13, T14, T17, T18 & T19

SWITCH P.O. 5A-4
PRESS BUTTON P.O 28/DBU/260
} FIT IN POSITION 'D' AND WIRE TO TERMINALS T8, T9 & T15

RECTIFIER ELEMENT P.O. 205 - EQUIP TO RECEIVER INSET IN HANDSET

CORD, INSTRUMENT P.O. 9/21AD
BLOCK, TERMINAL P.O. 36B
} CONNECT AS SHOWN AND CUT BACK SPARES

ADJUST LATCH ON 'C' TO SETTING 1 AND 'D' TO 3 WITH 'X' & 'Y' LATCHES ON SETTING 4 - SEE DGM TN-6848

MODIFICATIONS TO TELEPHONES P.O TYPES 706 & 710 FOR EXTENSION PLAN WORKING

BRITISH RLYS (Southern Region)
SOUTHERN HOUSE CROYDON

[illegible] Engineer

DATE

No. TN-3006

British Rail

Course C.1. (T) Basic Installation.

Section SEVEN.

Content New Generation Telephones (IXT).

R.S. & T. E. Department

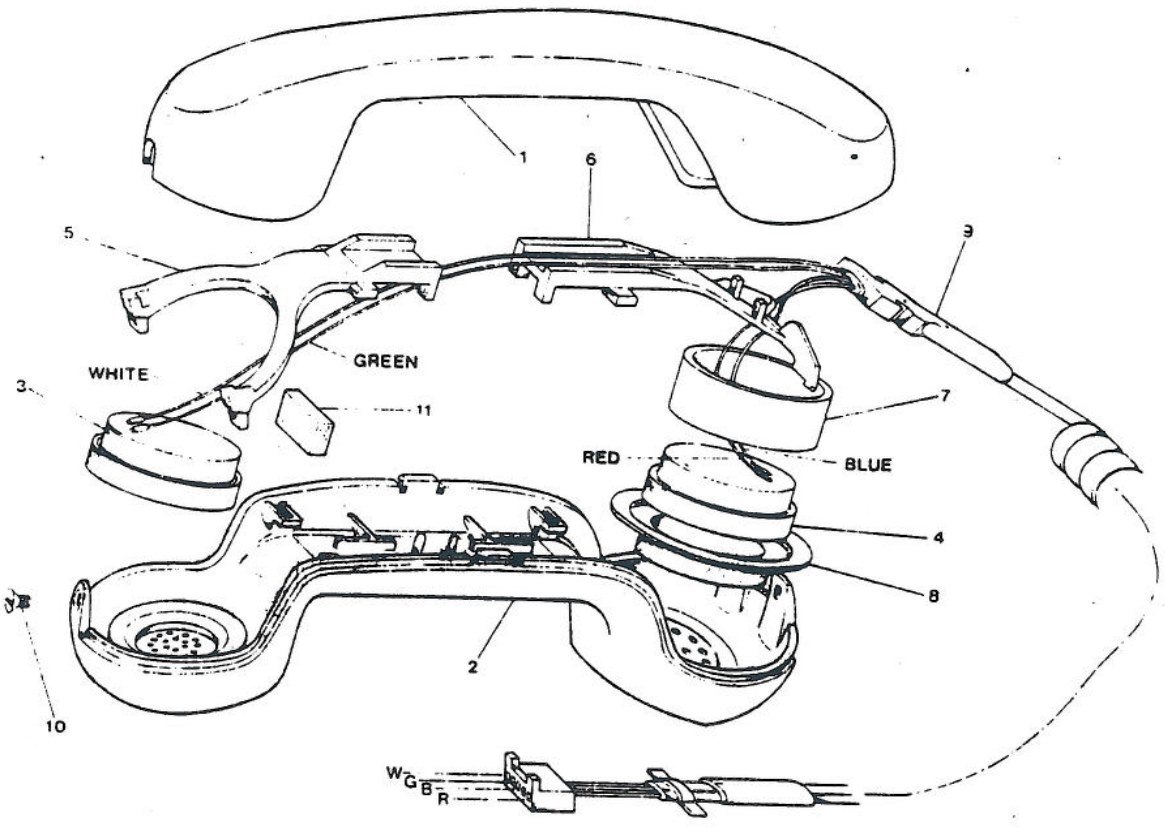
Training School York

THE INEXPENSIVE TELEPHONE (IXT)

The IXT is the first of the NGT's (New Generation Telephones) purchased by BR. It has also been purchased in large numbers by British Telecomm (Type 9003 R) and is also commercially available as the "Stateesman". In conjunction with a Master Jack Socket the IXT is a direct replacement for a 700 series Telephone. Its maximum loop resistance is 1.25 kΩ, hence it has similar limitations to the 700 series phones.

The IXT comprises three major assemblies, the handset, the base instrument, and when mounted on a wall-the wall bracket assembly.

The handset is connected to the base instrument by means of the 250mm handcord. It can be dismantled by removing the screw at the earpiece end and by releasing the mid-section retaining clips to separate the two mouldings. This will reveal the microphone and earphone units and the interconnecting wires.



HANDSET

1. BODY - UPPER. 2. BODY-LOWER. 3. RECEIVER. 4. TRANSMITTER. 5. RECEIVER CLIP. 6. TRANSMITTER CLIP 7. SPACER. 8. LOCATING RING. 9. HANDSET CORD. 10 SCREW. 11. SELF ADHESIVE FOAM.

The base instrument contains the following major sub-assemblies:

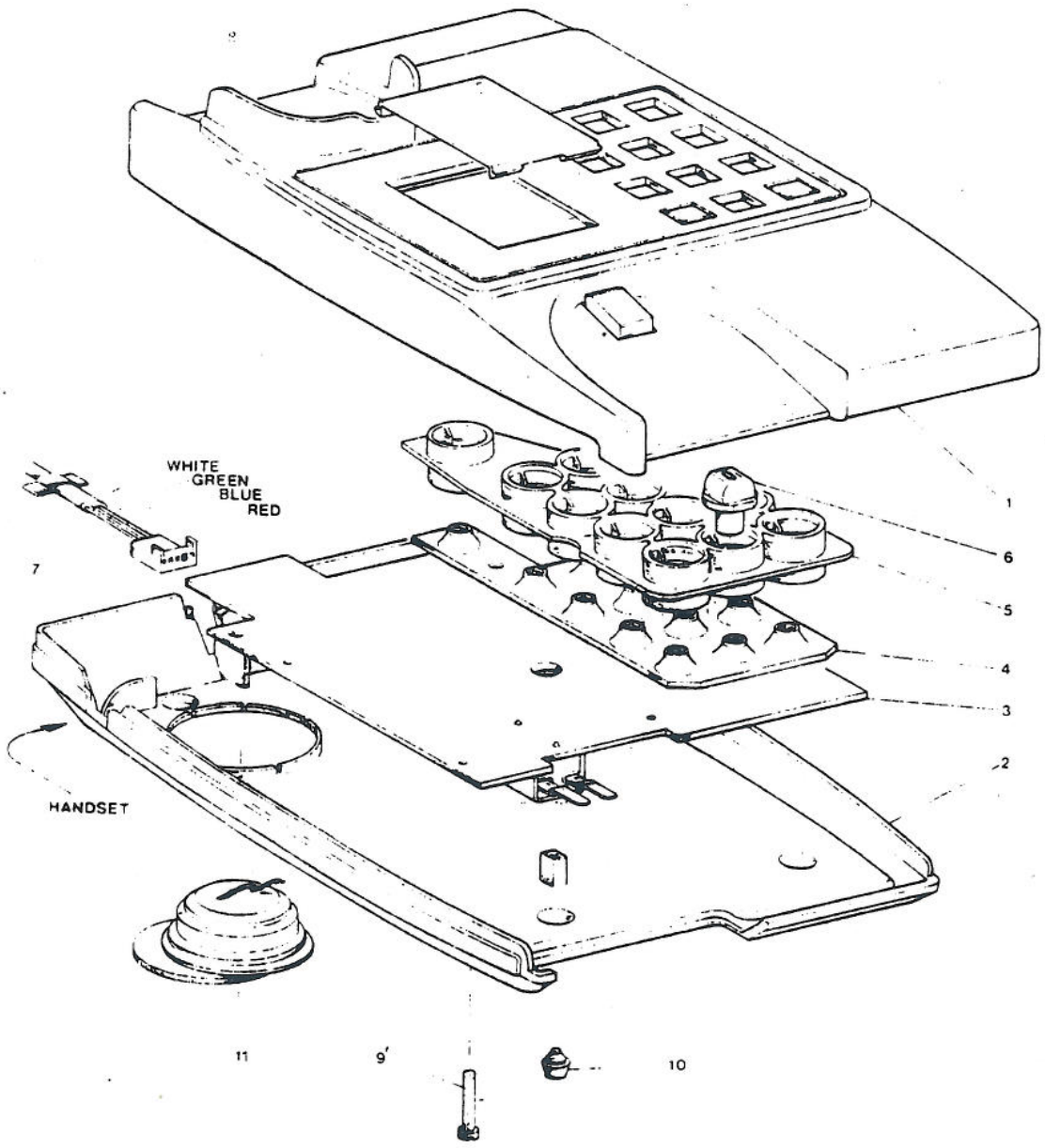
1) Moulded base-containing the rubber mounted feet, telephone tone caller capsule and adjustable volume control.

2) Printed circuit board.

3) Rubber keypad mat.

4) Keyboard (individual pushbutton keys 0 to 9, ✳, ⌗ and R (Recall) with pushbutton guide housing.

5) Upper moulded case.



IXT-BASIC

1. TOP CASE. 2. BOTTOM CASE. 3. PCB ASSY. 4. KEYPAD MAT. 5. BUTTON GUIDE. 6. BUTTONS 0-9. 7. LINE CORD. 8. WINDOW EXCH. CARD HOLDER. 9. SCREW. 10. FOOT 4-OFF. 11. TONE CALLER.

To dismantle the base instrument:

1) Lift off the handset. Turn the base instrument upside down.

2) Remove the base screw and lift off the moulded plastic base.

3) Press back in turn, each of the plastic retaining clips and carefully free the PCB.

4) Lift out the rubber mat.

5) Hold the pushbutton guide housing in the instrument and turn the instrument upright. Lift off the upper case, leaving the keys in the pushbutton guide housing assembly.

The unit is reassembled in the reverse order. Care should be taken to ensure that the keys are replaced in the correct positions, if they are disturbed.

There are two types of IXT available, a LD (Loop Disconnect) and a MF (Multi-Frequency) Version. BR have only purchased the LD version so the following information applies solely to that version.

LD (Loop Disconnect) Version

The PCB is connected to the line via line cord terminal pins:

Pin 1 - Via optional message waiting lamp circuit (Not used on BR)

Pin 2 - B wire

Pin 3 - Bell input

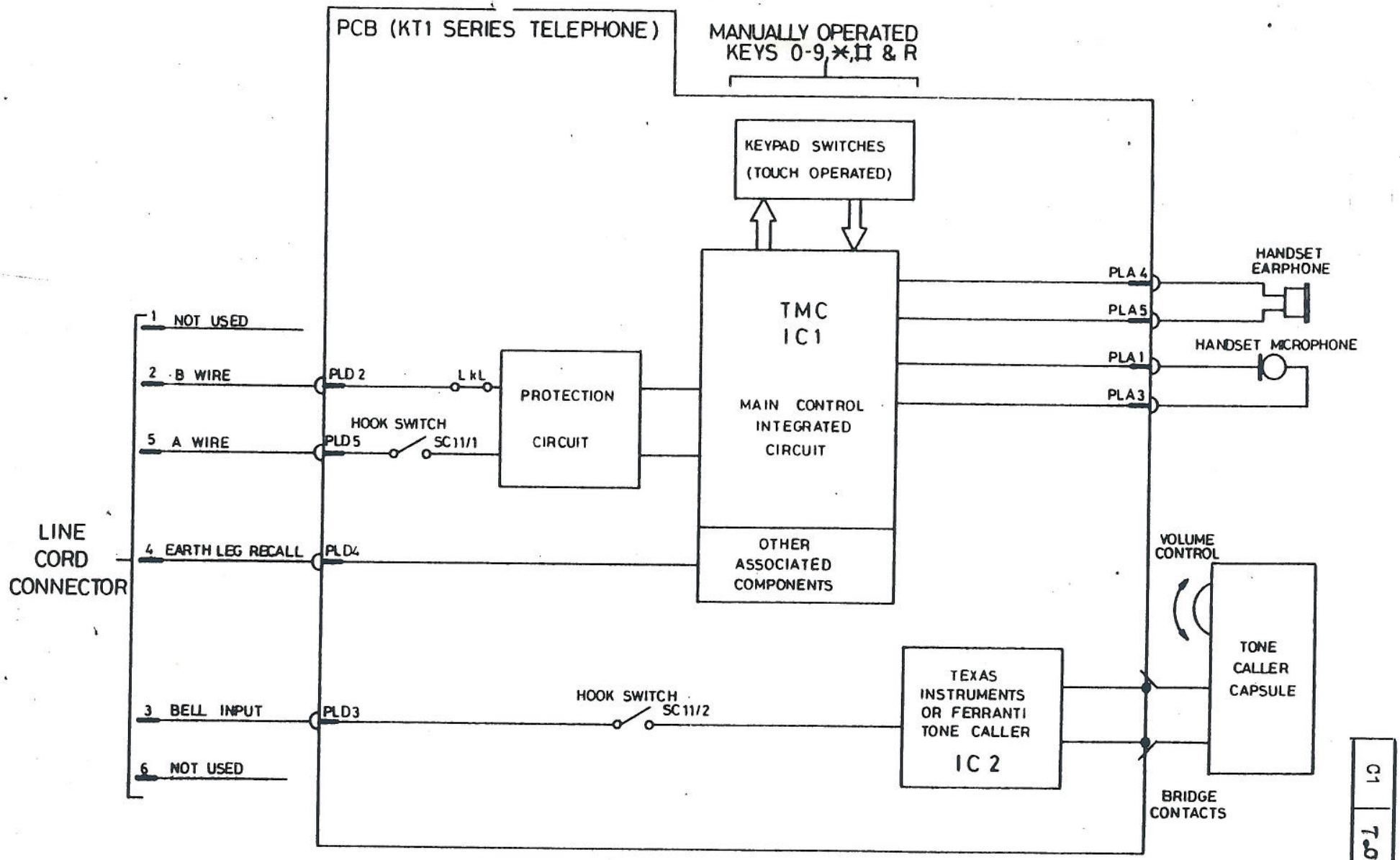
Pin 4 - Earth Leg Recall (return)

Pin 5 - A wire

Pin 6 - Not used

The A and B wires (nominally 24V, 48V or 60V d.c. lines) are routed via Link L and the polarity bridge. The polarity bridge, including surge suppressor, D6, a 130 V Zener diode, also provides transient protection.

The tone caller capsule is fitted to the base of the instrument and connected to the PCB when the instrument is correctly assembled via BC1 and BC2, which are tin plated bridge contacts. The tone caller capsule is fitted with an adjustable volume control (attenuator), which should be turned clockwise (when looking at the base of the telephone) to increase volume.



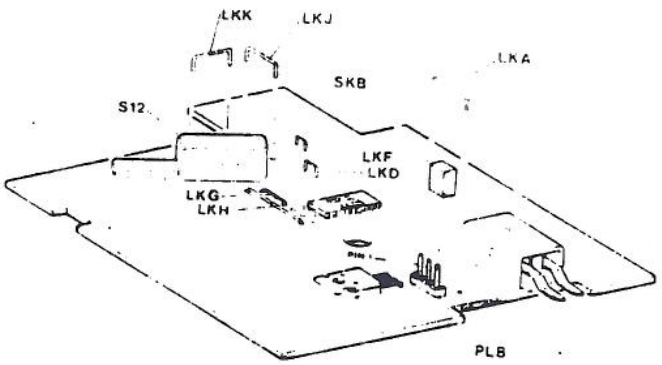
IX T PRINCIPLE OF OPERATION.

C1 | 7-0 | 4

PCB LINKS

Link A	Inserted for normal operation with 200 x 200 ohm feeding bridge. It is removed when additional components are fitted for the 400 x 400 ohm option (as required by some overseas systems)
Link B	Not used
Link C	With RA connected in parallel when alternative Semitron diode is used for D3
Link D	Fitted to give 1.55:1 ratio, 10 i.p.s. (not used on MF version)
Link E	Fitted to give 2:1 ratio, 10 i.p.s. (Link E fitted for −6 to −8 dB MF version)
Link F	Fitted to give 2:1 ratio, 20 i.p.s. (not used on MF version)
Links G, H, J	Fitted for no recall or earth leg recall options (not used on MF version)
Link K	Fitted on MF version when time break recall is not required. Fitted on LD version when time break is required.
Link L	In B wire line
Links M, N, P	Used on special KT4 version

The ratio pin allows a number of different speed and make/break ratios to be selected.



PCB OPTIONS ON IXT BT TELEPHONE WITH MASTER LINE JACK UNIT

OPTIONS

PLB

SKB ACROSS PINS 1&2 = 200 + 200.

SKB ACROSS PINS 2&3 = 400 + 400.

PLC

SKC ACROSS PINS 1&2 = EXTENSION PHONE.

SKC ACROSS PINS 3&4 = MAIN PHONE.

LINKS

BASIC - FIT LKJ : LKK.

ELR - FIT LKJ : LKK : S12.

TBR - FIT LKG : LKH : S12

2:1 RATIO 10 IPS NO LINK.

1.55:1 RATIO 10 IPS FIT LKD.

2:1 RATIO 20 IPS FIT LKF.

INSTALLATION

The PCB link connections and other components selected for various options are shown in the adjacent diagram. The circuits are fitted in the factory before despatch, to suit the site requirements, and should need no further adjustment before installation.

The instrument is normally free-standing on a desk or table, but may be wall-mounted, if required. The wall plate is fixed to the wall by three wood screws and the line cord routed so it can be conveniently plugged into the base instrument. The base instrument itself is attached to the base plate which can then be securely placed into the wall plate housing.

The instrument has a 1½ metre line cord with one of the following end connectors:

1) British Telecom plug 431A (used in conjunction with a British Telecom master line jack unit, containing a bell capacitor).
2) Block Terminal 52A.

BRITISH TELECOM PLUG 431A

To install a telephone set fitted with a British Telephone plug 431A terminal connector:

1) Check that a master line jack unit is already installed on the wall, or install one if necessary. The line jack unit must be fitted with a capacitor across terminals 2 and 3.

2) Connect the 'B' leg of the master line jack unit to terminal 2. Connect the 'A' leg to terminal 5.

3) If more than one telephone set is being installed on site, connect the system as shown in diagram.

4) Connect extension bells, if required, across terminals 3 and 5. Extension bells should be of high impedance, nominally 4k ohms.

Block Terminal 52A

To install a telephone fitted with a block terminal 52A:

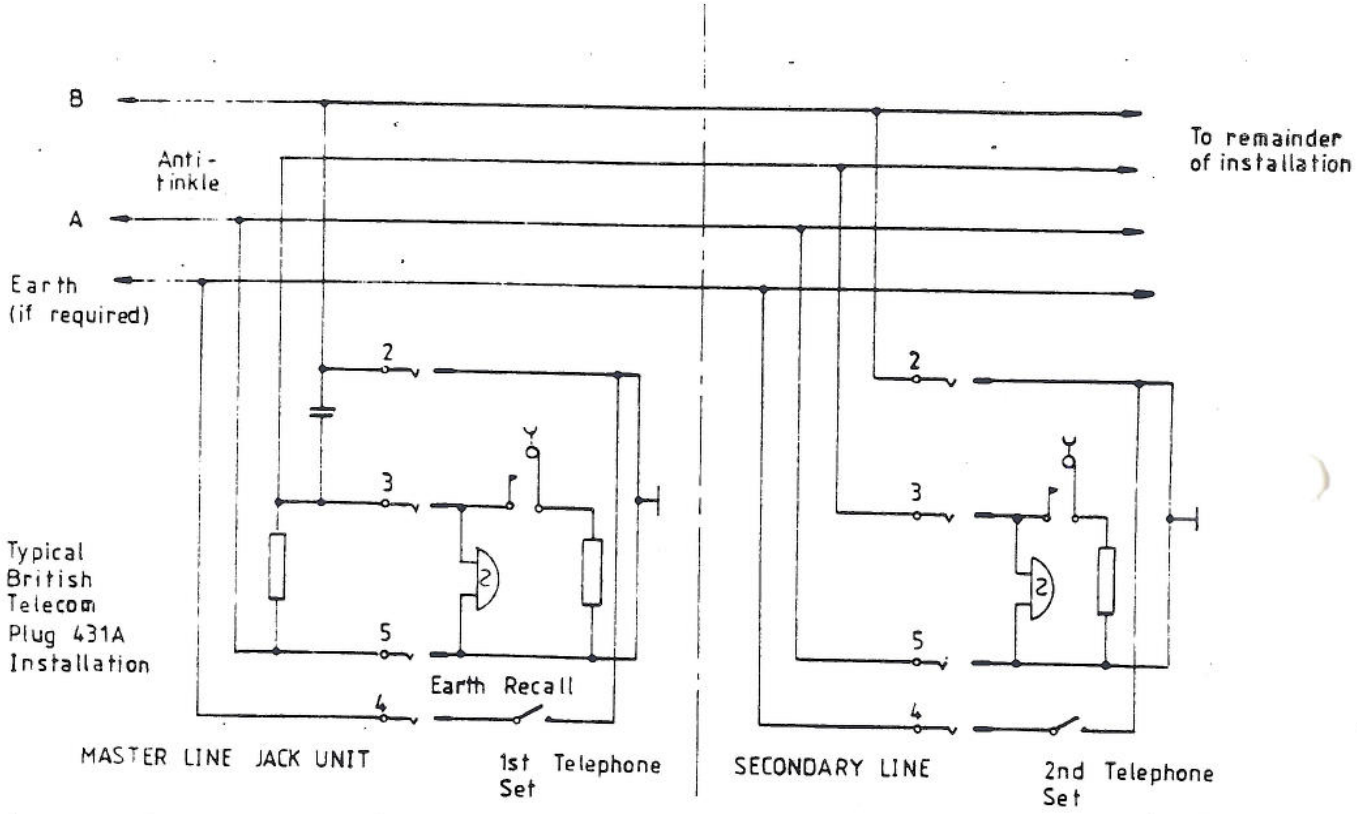
1) Mount the 8-way block terminal to the wall skirting with either wood screws or self-tapping screws.

2) Connect the telephone exchange 'A' and 'B' wires to terminals 8 and 5 respectively, as shown in diagram.

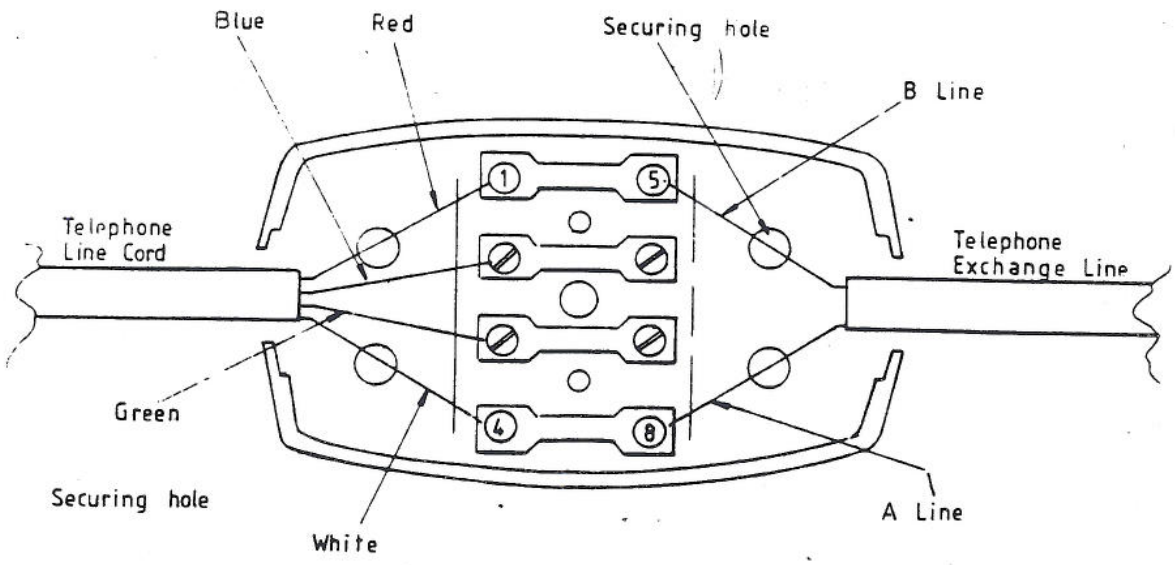
3) If telephone sets are required to be connected in parallel, all telephones other than the main instrument should have link SKC inside the telephone between PLC line 1 and 2 (i.e.with C10 bell capacitor out of circuit) and connected as follows:

a) 'B' leg to terminal 5.
b) Bell wire to terminal 6 if required.
c) Earth leg to terminal 7 if required.
d) 'A' leg to terminal 8.

A



3



INSTALLATION - DETAILS OF CONNECTORS

4) Connect extension bells, if required, across terminals 6 and 8. Extension bells should be of a high impedance (typically 4k ohms).

After installing the telephone sets, carefully remove the transparent cover from the telephone number recess, using a flat-bladed tool such as a nail file. Fit the appropriate label bearing the telephone number and replace the transparent cover.

OPERATION

Tone Caller

An adjustable attenuator/volume control is fitted on the base instrument. Adjust the control as required by turning the indented disk on the right hand side of the base, forward to increase the volume (i.e. clockwise to increase the volume when viewed from the underside).

Dialling

The instrument is active as soon as the handset is lifted from its cradle to operate hook switch SC11. On hearing the dialling tone, simply press the pushbutton keys in the required order. If a recall facility is provided, operation of the R (Recall) pushbutton will give a earth line recall.

After use, replace the handset on its cradle to operate the hook switch.

MAINTENANCE

The use of specially designed integrated circuits have rendered unnecessary many wired-in components and moving parts. The complete unit is therefore, for all practical purposes, simple and robust, and will give many years of trouble-free service without regular maintenance.

FAULT FINDING

Any fault suspected in the unit is most likely to be caused by poor electrical connections. It is advisable to check that all connections are properly made. If dialling difficulty is experienced, dismantle the instrument and check the rubber mat for wear. In the unlikely event of any fault, the unit may be dismantled and the faulty part or board replaced.

No difficulty should be experienced in dismantling or reassembling the handset or base instrument. A faulty part or board can be replaced as part of a first line servicing policy, and the faulty board either returned to the manufacturer for repair, or repaired in the workshop as determined by Regional Maintenance Directives.

Extension Plan Arrangements

Several extension plan arrangements are in use at the present time, utilising 700 series telephones, e.g. Plan numbers 1, 1A, 4, 105, 107 etc, which give different facilities for different requirements.

Plan arrangements using 700 series telephones have two important similarities.

First their 'transmission circuits' - that part of the circuit using the microphone and receiver - are connected in parallel between each telephone, and secondly, the incoming signalling circuit - traditionally called the 'bell circuit' - is a series circuit between the telephones. As far as the circuit efficiency is concerned, they work perfectly well and require no technical improvement although they do present some important inter-related problems.

Because of the relationship between series and parallel connections, detailed design of the telephone circuit must be tailored to the actual position it occupies in the extension plan circuit. For example, an extension plan 4 using a single telephone is wired differently from one using more than one instrument. This means that telephone circuits must be dedicated to fulfill a particular circuit function and cannot therefore be readily interchanged with other telephones in similar circuits. Also, the variation in telephone circuits means that engineers have to use a large number of diagrams which increases the risk of maintenance problems.

Modern practice is to use a "plug and socket" arrangement for telephones, the socket being referred to as a "line jack". In this system the speech and transmission circuit are both wired in parallel, but to prevent the shunt resistance of the bell from falling to too low a value, a 4000 ohm bell or tone sounder circuit is utilised.

As telephones in the new system are plug-ended, and that, unlike the plan 4, no fixed bell is provided as standard, subscriber can if they wish, unplug all telephones in their system. Although callers hear ringing tone, the called customer hears nothing.

Unfortunately this same condition occurs if the called line is disconnected due to a fault on the line, so to prevent unnecessary fault reporting, a permanent circuit was required at the subscribers premises which could not be disconnected when the telephone plug is withdrawn. As only one such circuit is needed for each installation two types of socket are required. The one with the test circuit designated the master socket and the other the secondary socket.

The I.X.T. telephone which is now superceding the 700 series telephone on B.R. is not generally supplied with a capacitor in the tone sounder circuit, as was the 700 series telephone. A master line jack unit is therefore necessary for the telephone to function correctly.

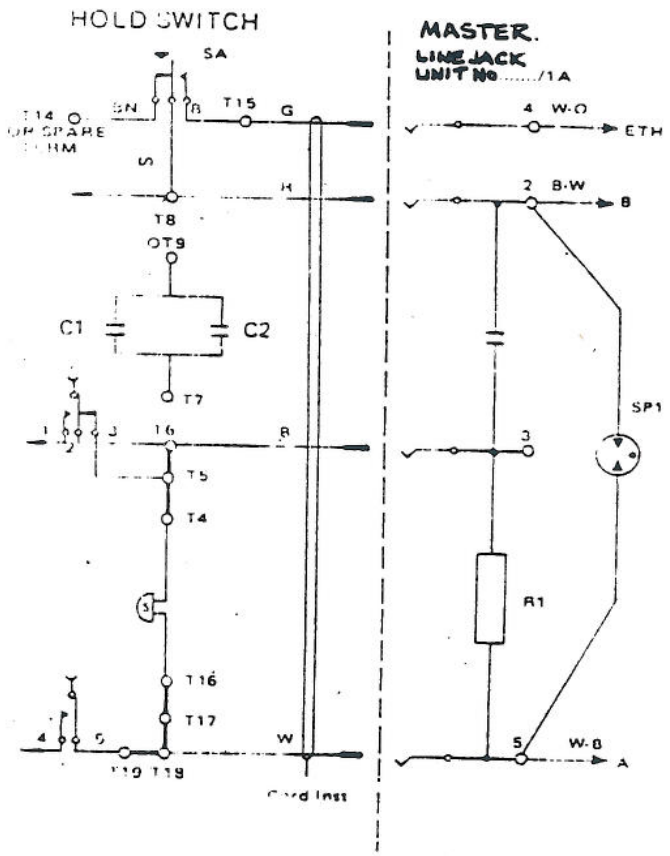
A master line jack is not necessary for K.B.X. 100 terminals, as a capacitor is included in the tone sounder circuit.

C1	7.0	10

TELEPHONE CONNEXIONS – 700 TYPE TELEPHONES

WITH MASTER LINE JACK IN THE INSTALLATION.

STRAP TERMINALS (T4 - T5, - T6) (T16 - T17 - T18 - T19)

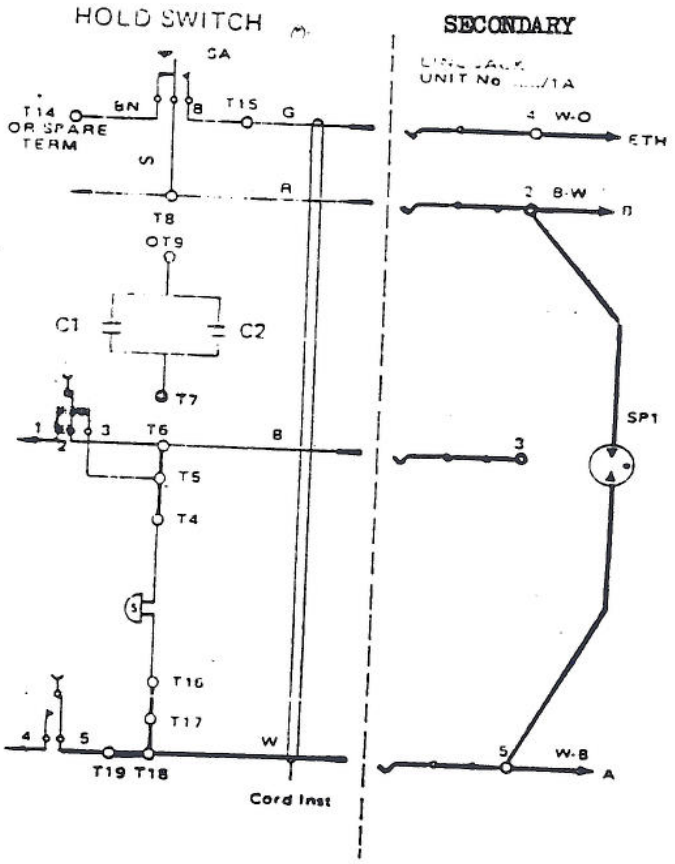


C1	7.0	11

TELEPHONE CONNEXIONS - 700 SERIES TELEPHONE WITH SECONDARY LINE JACK ONLY

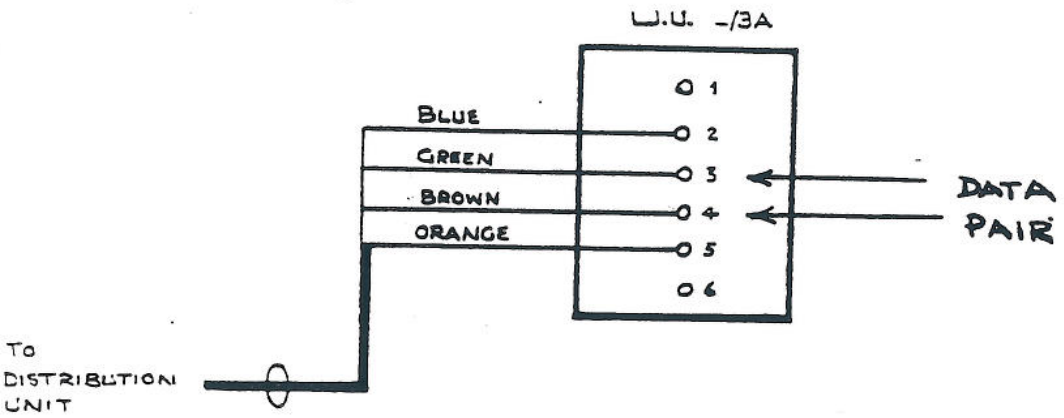
STRAP TERMINALS - (T8 - T9)

(T4 - T5 - T6 - T7) (T16 - T17 - T18 - T19)



C1	7.0	12

New British Telecom Plug, Socket, Cordage and Line Jack Units



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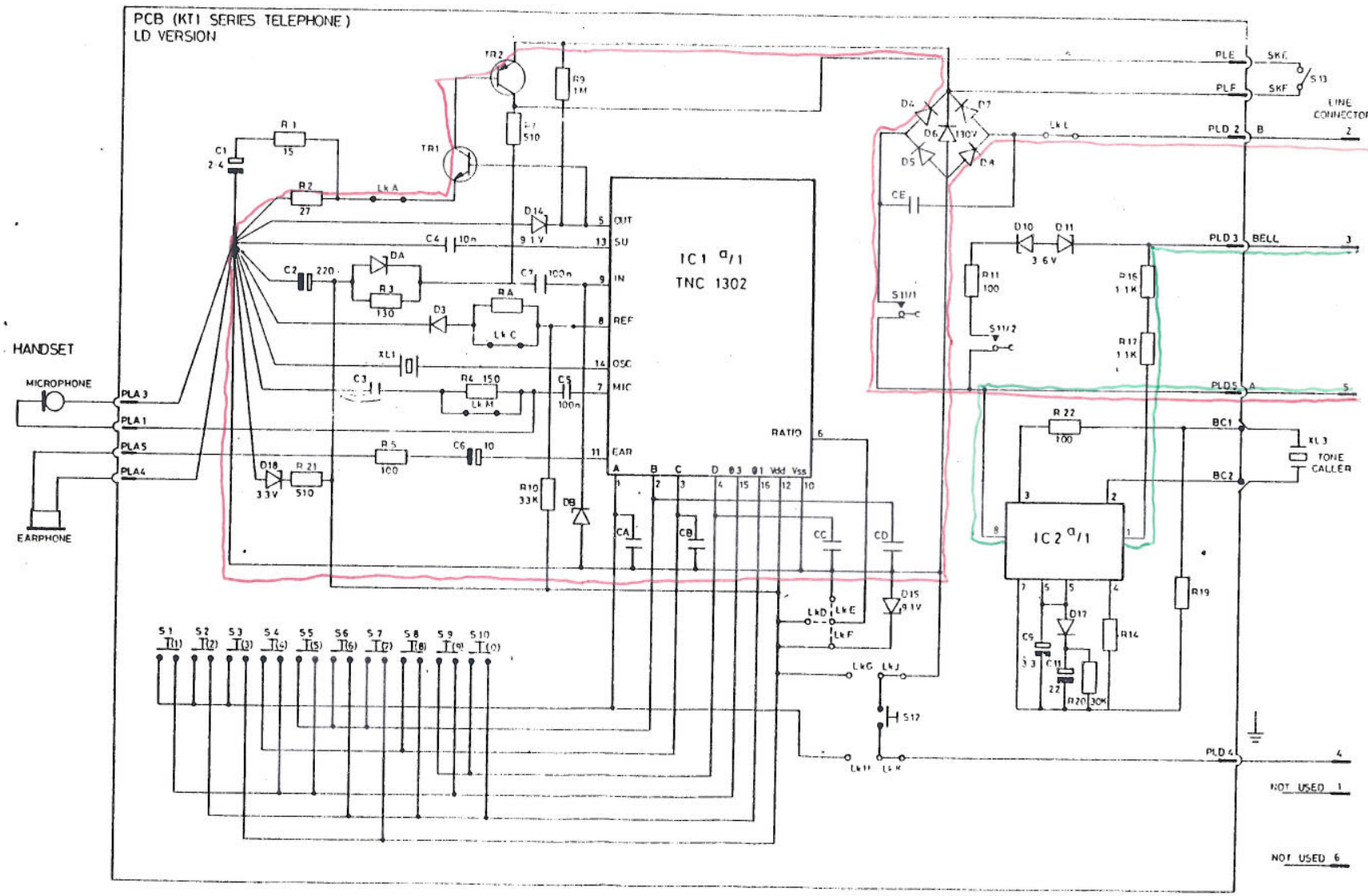
The Post Office Electrical Engineers' Journal



BR LD VERSION CIRCUIT DIAGRAM

NOTE 1 MICROPHONE TO BE ROCKING ARMATURE TYPE
2 FOR INCOMING CALLS ONLY STRAP PLE TO PLF

British Rail

Course C.1. (T) Basic Installation.

Section EIGHT.

Content KBX 3 - 6 Electronic Plan Sets.

R.S. & T. E. Department

Training School **York**

KBX3-6 ELECTRONIC PLAN SETS

INTRODUCTION

The KBX3 and 6 are electronic plan sets which are simple to install, more versatile and easier to use than existing plan sets such as the 105 and 107. As the 700 series telephone instruments become more scarce the electronic plan sets and instruments will replace them. Since the New Generation Telephones and their accessories are virtually maintenance free with plug in and printed circuit boards, the need for complete circuit knowledge has diminished However, for installation and faulting purposes their is a need for technicians to have an overall knowledge of the system facilities and testing points.

With many system operations being identical for KBX3 and KBX6 operation descriptions will apply to both systems unless otherwise stated.

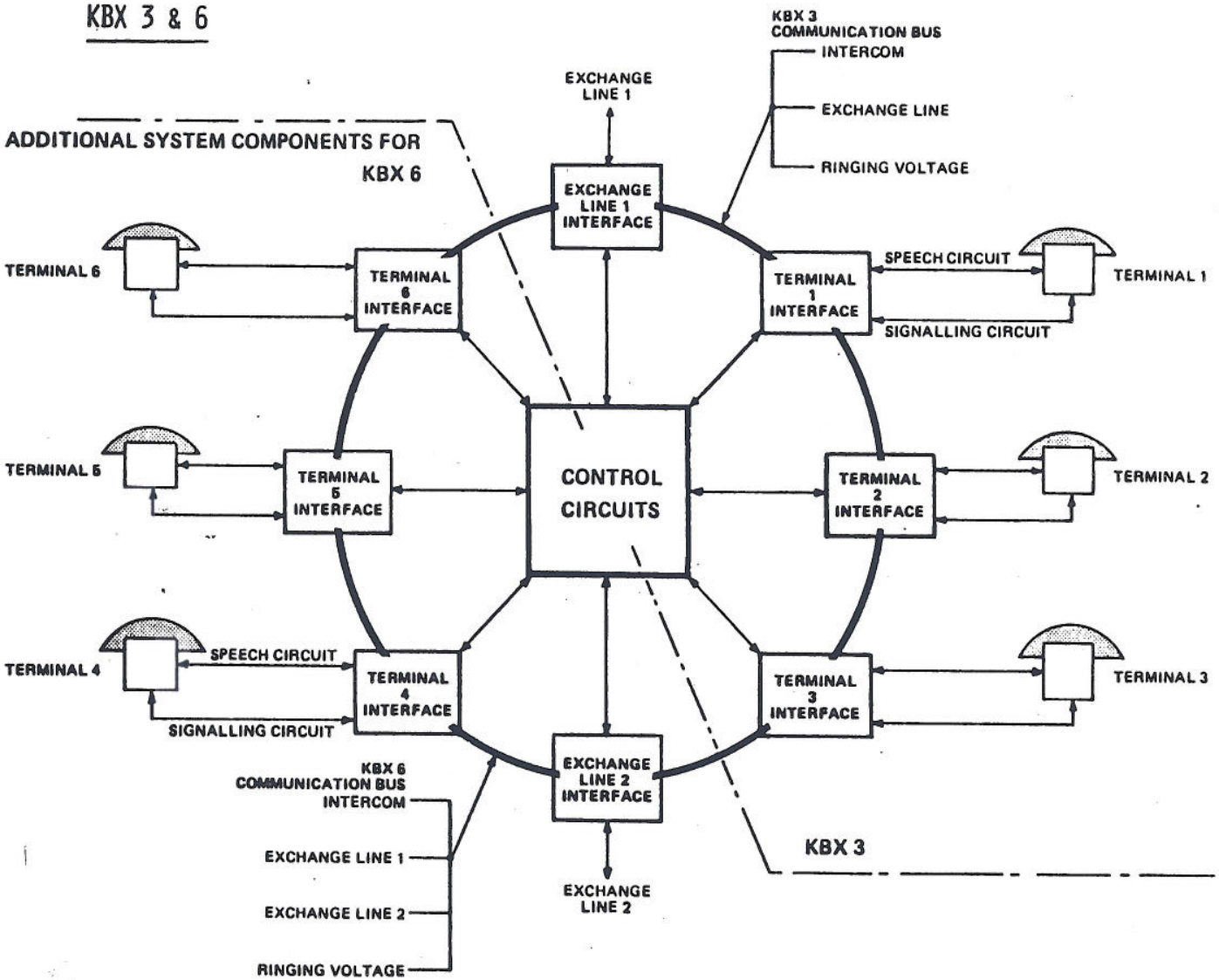
SYSTEM DESCRIPTION

- KBX 3. This provides for up to three independent telephone terminals to be used with one exchange line.
- KBX 6. This provides for up to six independent telephone terminals to be used with two exchange lines.

With the exception of the number of terminals and exchange lines, and one switchable option, both versions offer similar facilities:

- All terminals can communicate with each other via a common intercom circuit.
- Any terminal can make or receive exchange calls.
- An exchange call can be:
  - Held by any terminal; with a KBX 6, both exchange lines may be held by the same terminal.
  - Transferred from one terminal to another as many times as required.
  - Connected as a conference call between any two terminals.
- Exchange lines are independent of and secret from the intercom.
- A power fail terminal is provided for each exchange line.
- In the KBX 6 only, one terminal can have exclusive use of one of the exchange lines.

KBX 3 & 6


ADDITIONAL SYSTEM COMPONENTS FOR KBX 6
KBX 3
KBX 3 COMMUNICATION BUS
INTERCOM
EXCHANGE LINE
RINGING VOLTAGE
EXCHANGE LINE 1
EXCHANGE LINE 1 INTERFACE
TERMINAL 6
TERMINAL 6 INTERFACE
TERMINAL 1 INTERFACE
SPEECH CIRCUIT
SIGNALLING CIRCUIT
TERMINAL 1
TERMINAL 5
TERMINAL 5 INTERFACE
CONTROL CIRCUITS
TERMINAL 2 INTERFACE
TERMINAL 2
TERMINAL 4
SPEECH CIRCUIT
SIGNALLING CIRCUIT
TERMINAL 4 INTERFACE
TERMINAL 3 INTERFACE
TERMINAL 3
KBX 6 COMMUNICATION BUS INTERCOM
EXCHANGE LINE 1
EXCHANGE LINE 2
RINGING VOLTAGE
EXCHANGE LINE 2 INTERFACE
EXCHANGE LINE 2

- Each terminal has a user programmable divert facility enabling incoming calls to be diverted to another designated terminal.

Incoming call signalling is provided by the terminal's internal calling device for intercom calls and an exchange lamp (LED) for each exchange line. Each terminal can be user programmed to receive bell ringing for incoming exchange calls. The exchange lamps are also used to signal all other terminals that an exchange line is busy. These exchange lamps are also used to indicate that a terminal is trying to contact another terminal already engaged on an exchange call.

One or two external extensions may be connected in place of internal terminals. Normally, they can only make and receive calls via a third terminal. In a night service situation, one external extension can gain access to the local exchange.

The KBX 3/6 installation (Figure 1.1) comprises a Central Control Unit and the requisite number of terminals.

The Central Control Unit contains the control, switching ringing and power supply circuits and provides the connection points for the exchange lines and terminals. The design of the Central Control Unit is such that it appears to be virtually transparent to any exchange to which it is connected.

This virtual transparency enables almost any telephone instrument equipped with resistive signalling and whose signalling circuits are compatible with the local exchange, to be used in a KBX 3/6 System.

The modification of a telephone instrument for KBX 3/6 use requires the incorporation of a number of resistive signalling keyswitches (four for a KBX 3 terminal and eight for a KBX 6 terminal) and an exchange lamp for each exchange line. The keyswitches are used to signal the required connection to the Central Control Unit.

The connections to the terminals consist of five wires; the speech circuit pair and the three signalling wires, one for the keyswitches and one for the exchange lamps, plus a common return.

CENTRAL CONTROL UNIT

The Central Control Unit consists of:

- A baseplate on which are mounted the various circuit components and sub-assemblies.
- A two-part cover.
- A mounting plate.

The unit is designed for wall mounting, using the mounting plate, adjacent to the incoming exchange lines.

The components for the control circuits, ringing generator, intercom power and the interface circuits for one exchange line and three terminals are mounted on a single printed wiring board. The control boards for the KBX3 and KBX6 are basically similar. However, they are not interchangeable since the KBX 6 Control Board carries the additional circuit components associated with the connection and use of the second exchange line and three more terminals.

The interface circuits for the second exchange line and the second group of three terminals in a KBX 6 are carried on an extension board.

The control board is attached to the baseplate by two hinges and secured by spring clips. This allows the board to be swung out for servicing.

The extension board is mounted on the control board by means of hinges and connected to it by a flex strip, allowing the extension board to swing out for access during servicing.

The power supply unit is mounted on the right-hand side of the baseplate.

The printed wiring boards, the power supply unit and their connections are protected by the upper cover. This cover is located on tabs and fitted with anti-tamper catches to discourage unauthorised access.

The lower cover, secured by two captive screws, protects the exchange line and terminal connectors, the option switches, and mains connector and fuse.

TERMINALS

The only special requirements of a telephone to be used with a KBX 3 or a KBX 6 System are that it is compatible with the local exchange, and is fitted with the pushbutton switches required for terminal signalling and an LED indicator for each exchange line. Therefore, only the pushbutton switches and LED indicators, as fitted to a Type 1746 Telephone, are described.

POWER SUPPLY
180V to 260V, 50Hz (30W) or 90V to 130V, 50Hz, (30W).

Input voltage determined by mains transformer.

LINE CONDITIONS

Total dc loop resistance between local exchange and any one terminal not greater than 1250 ohms with a local exchange battery voltage of 45V to 52V.

C1	8.0	5

Total dc loop resistance between Central Control Unit and any one terminal not to exceed 250 ohms; this may be increased to 1000 ohms for limited facility external extensions.

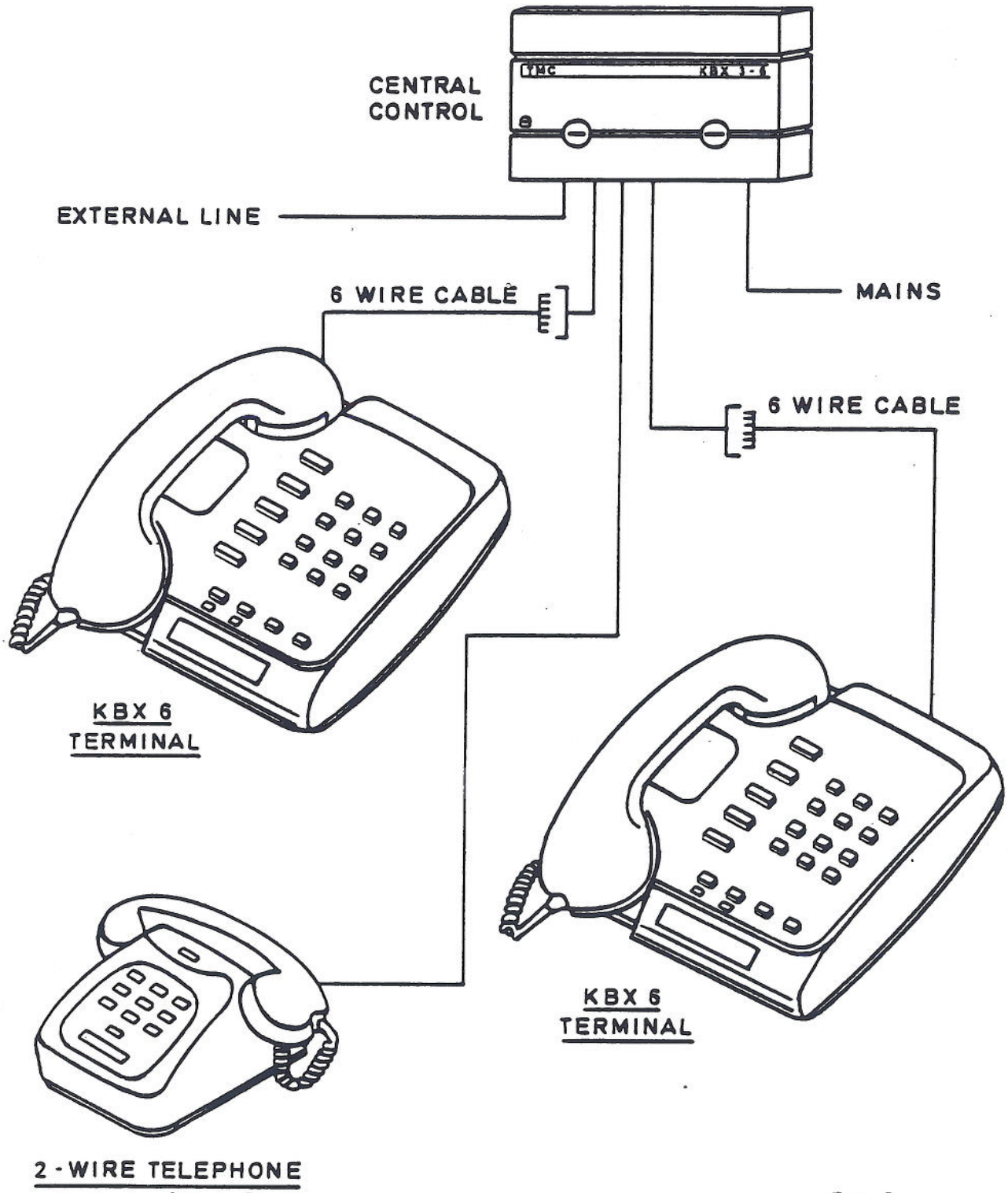


FIG 2

KBX 3-6 ELECTRONIC PLANSET

KBX 3 offers several 'PLANSET' arrangements using KBX 3 terminals and 2 wire telephones.

There is no re-transmission of signalling within the KBX 3, so standard instruments can be incorporated into the system.

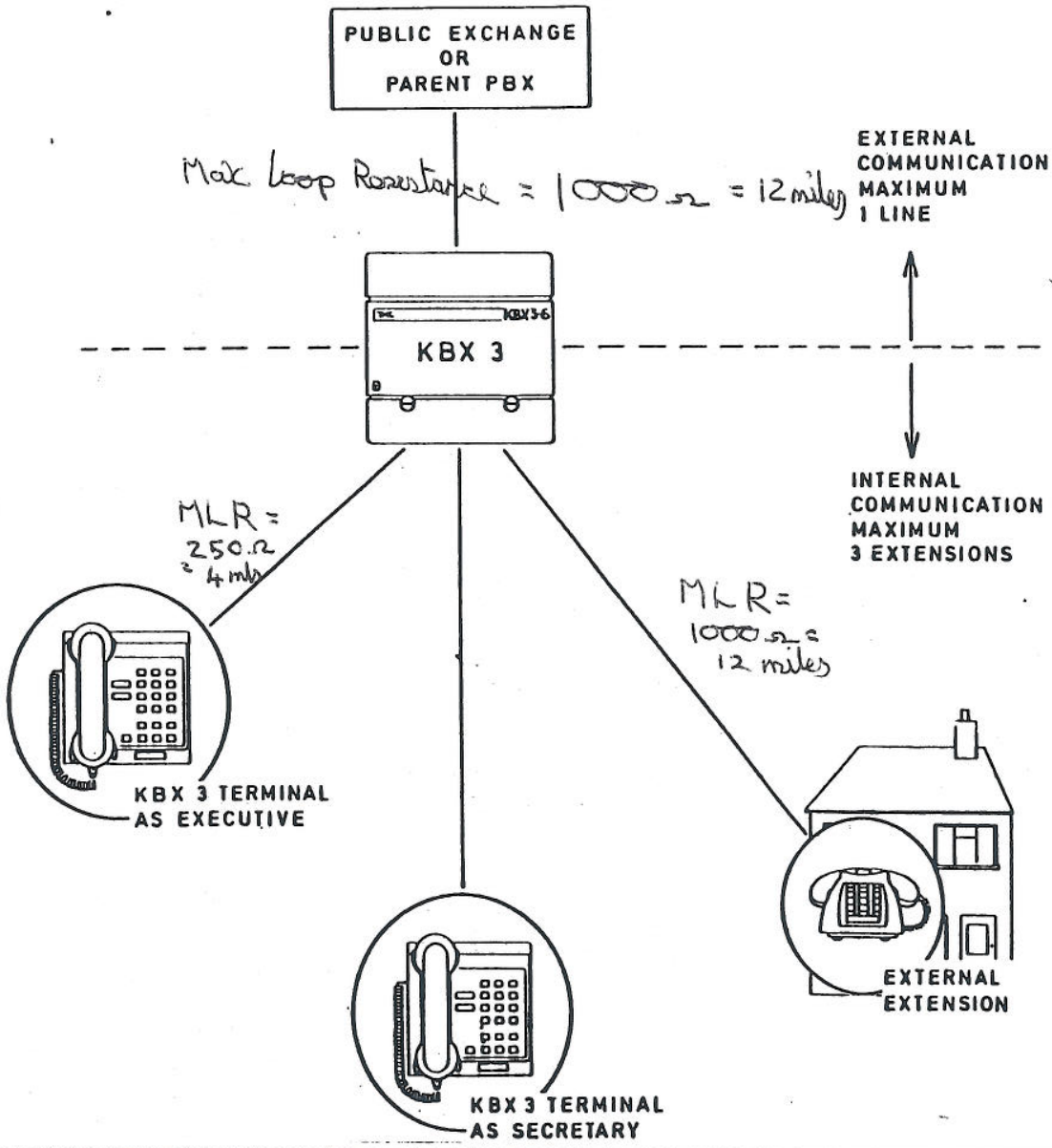


FIG 3

C1 8.0 7

KBX 6 offers several 'PLANSET' arrangements using KBX 6 terminals, KBX 3 terminals and 2-wire telephones.

There is no re-transmission of signalling within the KBX 6, so standard instruments can be incorporated into the system.

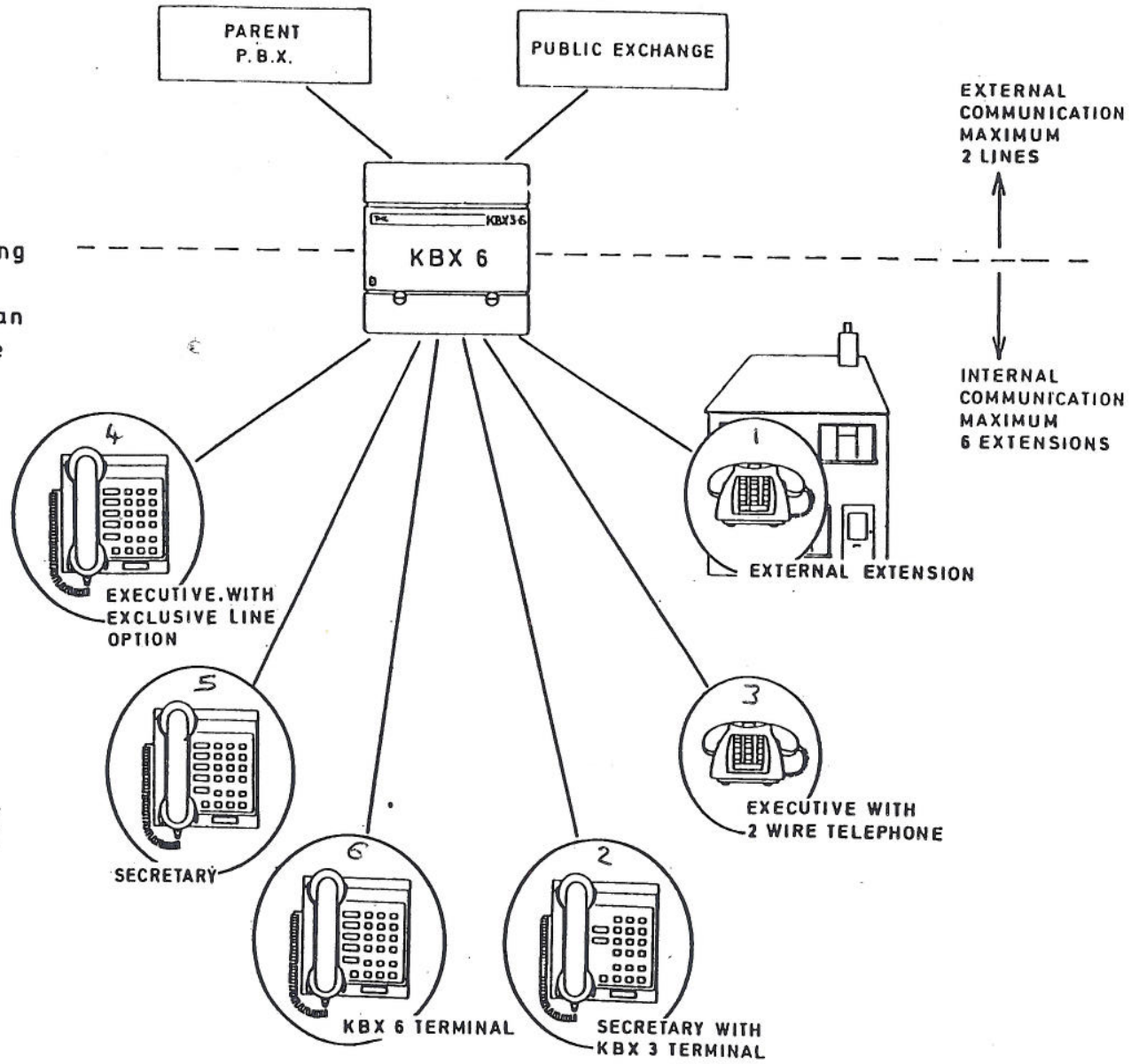


FIG 4

C1 | 8.0 | 8

each terminal is a KT2

KT 2 BUTTON OPTIONS

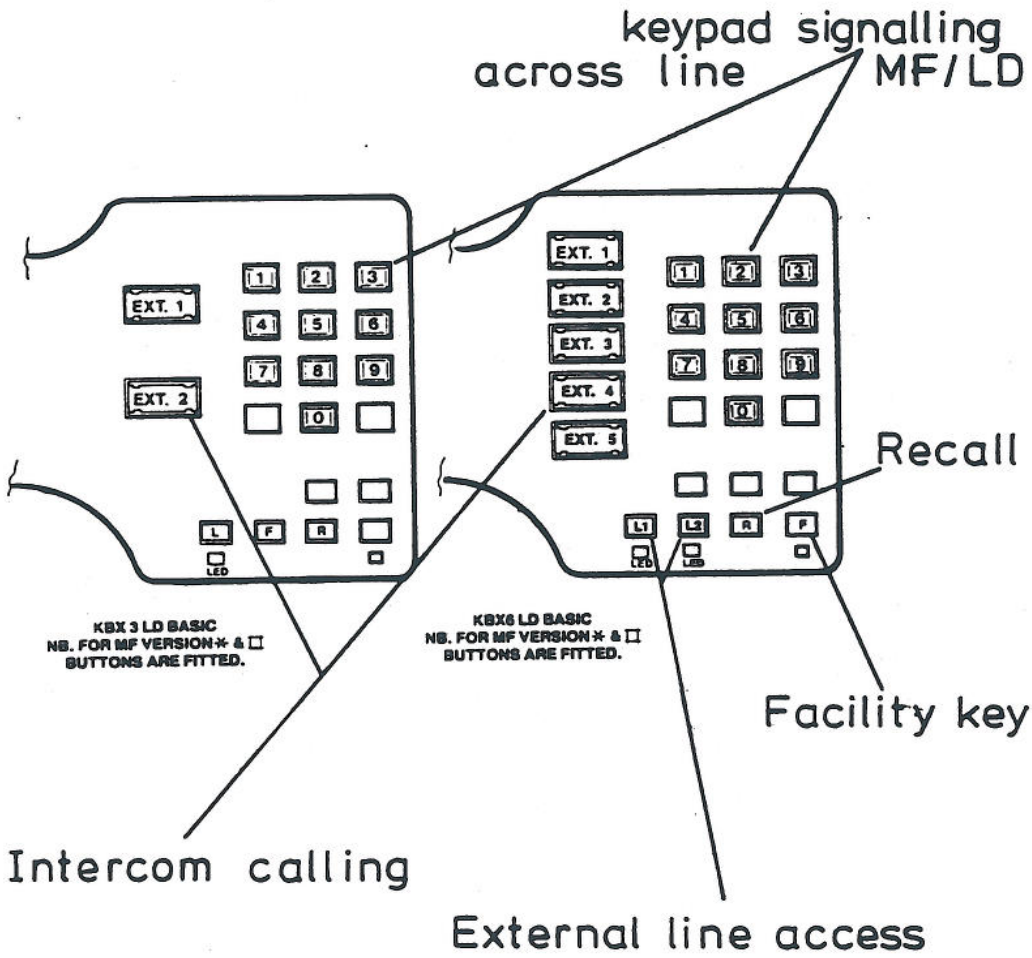


FIG.

FACILITY KEY

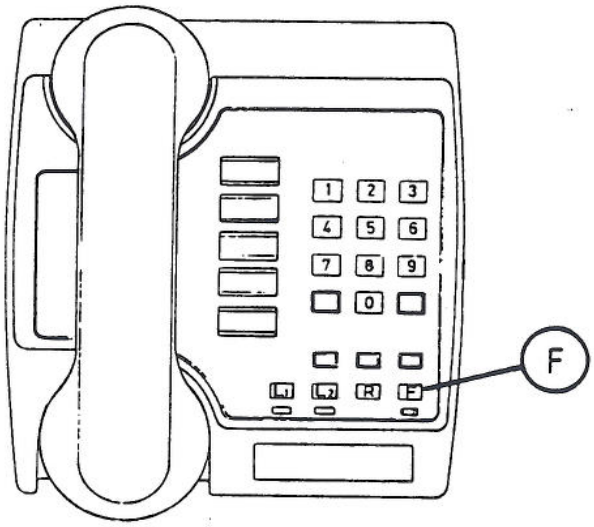


FIG 6.1

EXCHANGE RINGING

Any terminal may be programmed to receive incoming exchange ringing on its calling device, in addition to the flashing Exchange lamp signalling.

Lift the handset, press the F button followed by the EXCH button for which ringing is required and replace the handset. Repeat the procedure for the other EXCH button if ringing is required from both exchange lines.

Programmed exchange ringing is cancelled by lifting the handset, pressing the F button twice and replacing the handset. Under Power Fail conditions Exchange Line 1 is connected to Terminal 1 and Exchange Line 2 is connected to Terminal 4 automatically.

FACILITY KEY

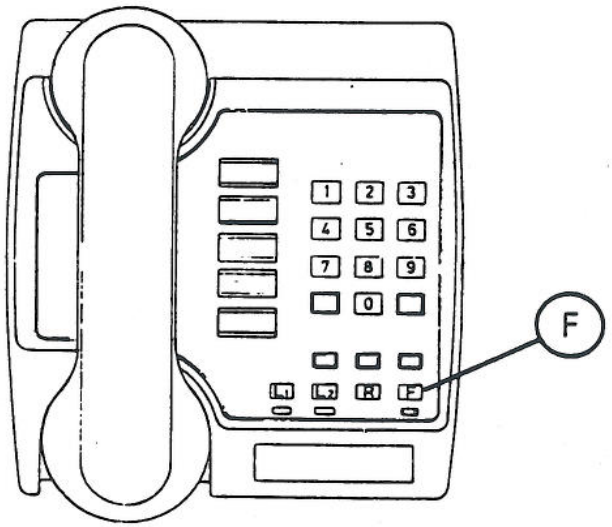


FIG 6.2

CONFERENCE CALLS

This facility enables any two terminals to be connected to an exchange call.

With an exchange call in progress, press the required Extension button (this holds the exchange call). When the called Extension answers, press the F button to connect both terminals to the held exchange call and to free the intercom.

The conference call set up is cleared when both terminals have replaced their handsets.

Transfer Call, full facility

With an exchange call in progress, press the required extension button. Replace handset when extension answers.

IXT

Push button again before replacing handset

FACILITY KEY

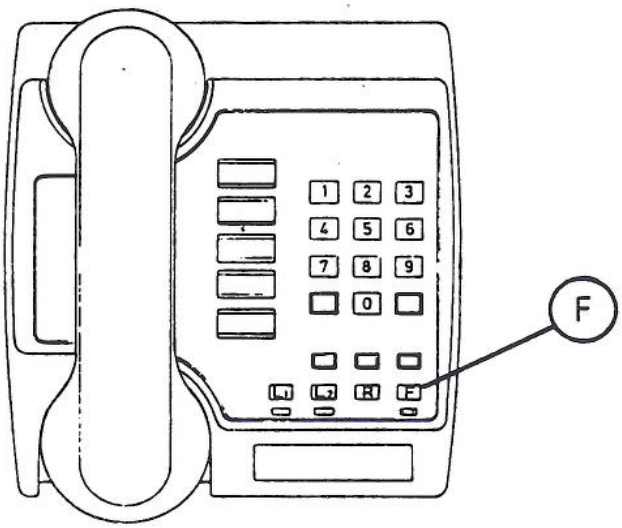


FIG 6.

DIVERT

Any terminal can divert all incoming calls to another terminal as shown below:

*Terminal 1 to Terminal 2
*Terminal 2 to Terminal 1
Terminal 3 to Terminal 1
Terminal 4 to Terminal 2
*Terminal 5 to Terminal 6
*Terminal 6 to Terminal 5

*Where a pair of terminals can only divert to each other, only one terminal at a time can use the Divert facility.

To initiate a Divert, lift the handset, press th F button, followed by the Extension 1 button and replace handset. All calls will now be diverted to the terminal as above.

The Divert facility is cancelled by lifting the handset, on the Diverting terminal, pressing the F button followed by the Extension 2 button, and replacing the handset.

EXCHANGE LINE LED INDICATION

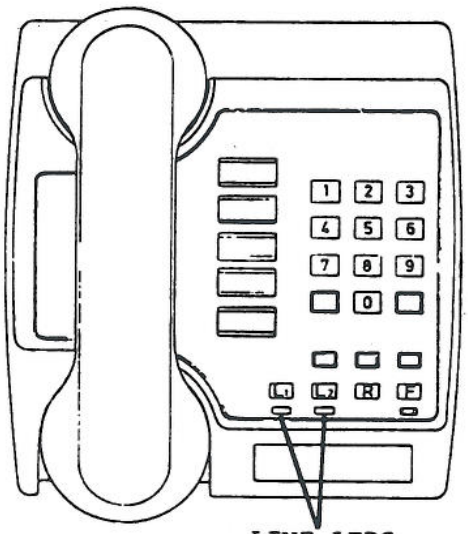
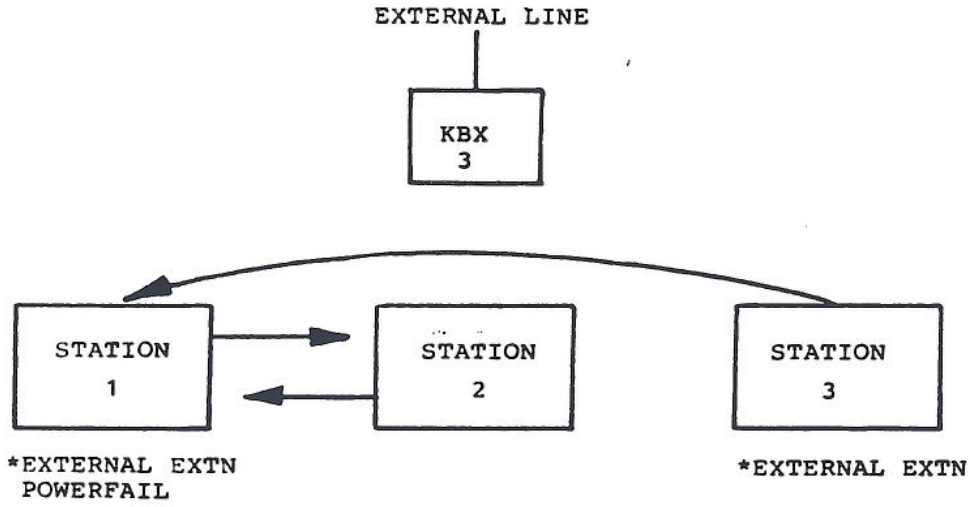


FIG 7

STEADY OFF	ON OFF	LINE FREE (ALL TERMINALS)
STEADY ON	ON OFF	LINE ENGAGED (ALL TERMINALS)
FAST FLASH	ON OFF	LINE HELD (HOLDING TERMINAL)
SLOW FLASH	ON OFF	INTERCOM CALLING WHILE CONNECTED TO EXCHANGE LINE (TWO TERMINALS)
IN TIME WITH EXCHANGE RINGING	ON OFF	INCOMING EXCHANGE CALL

KBX 3-6 DIVERSION ROUTING & OPTIONS



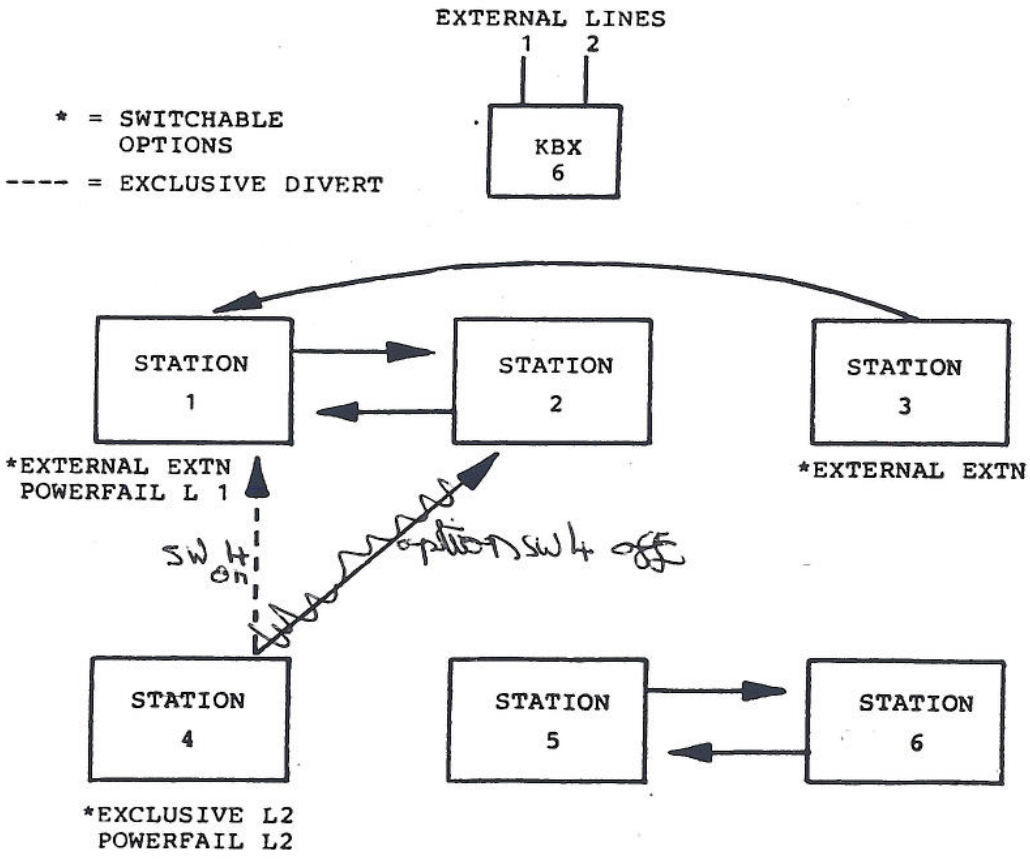
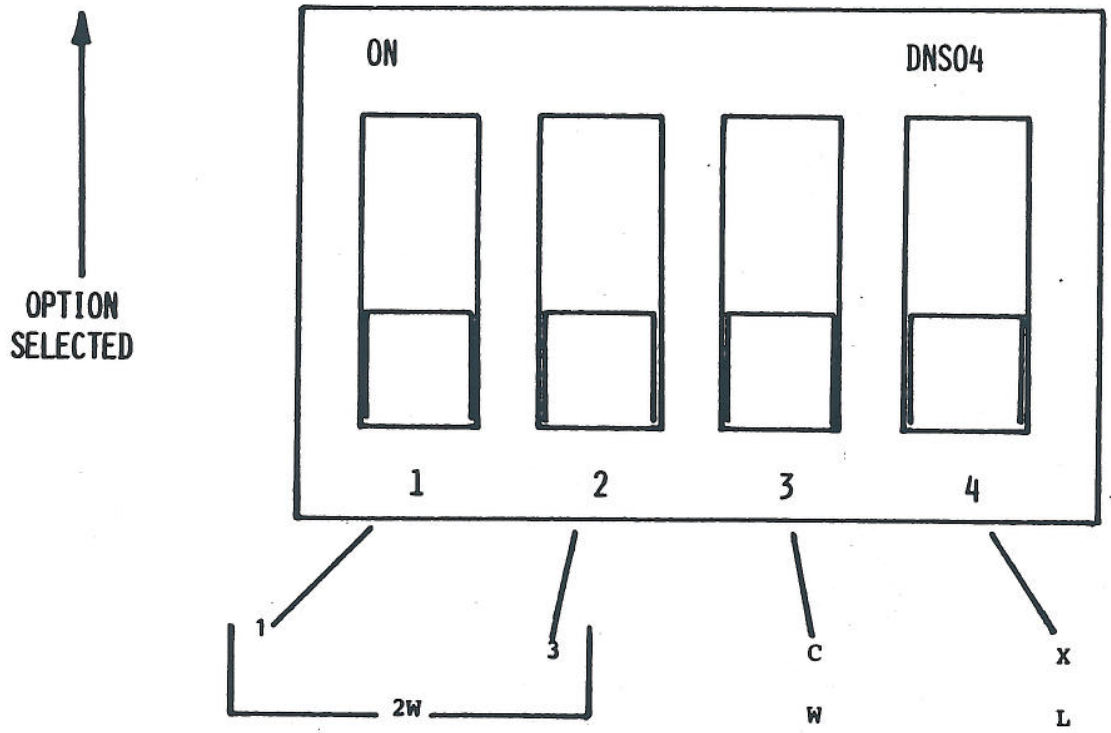


Fig 8

KBX 3 - 6 OPTION SWITCH



Station 1 = External Extn.

Station 3 = External Extn.

C Wire Signalling

Station 4 having exclusive use of line 2 subject to divert.

Fig 9

OPTION 1 switch 4

EXCLUSIVE LINE (KBX 6 ONLY)

A) TERMINAL 4 HAS EXCLUSIVE USE OF EXCHANGE LINE 2. switch no 4 on

B) IT IS POSSIBLE TO TRANSFER CALLS ON EXCHANGE LINE 2 ONCE AN EXTERNAL CALL HAS BEEN SET UP.

C) TWO DIVERSION MODES ARE POSSIBLE:-

1) DIVERT ALL CALLS TO TERMINAL 1

   Lift handset, press F button followed by Extension 1 button.

2) DIVERT EXCHANGE LINE 1 CALLS TO TERMINAL 1
   EXCHANGE LINE 2 CALLS/REMAIN AT TERMINAL 4.
   and all intercom
   Lift handset, press F button followed by Extension 3 button.

   TO CANCEL DIVERT:

   Press F button followed by Extension 2 button.

OPTION 2 sw 1&2

EXTERNAL EXTENSIONS

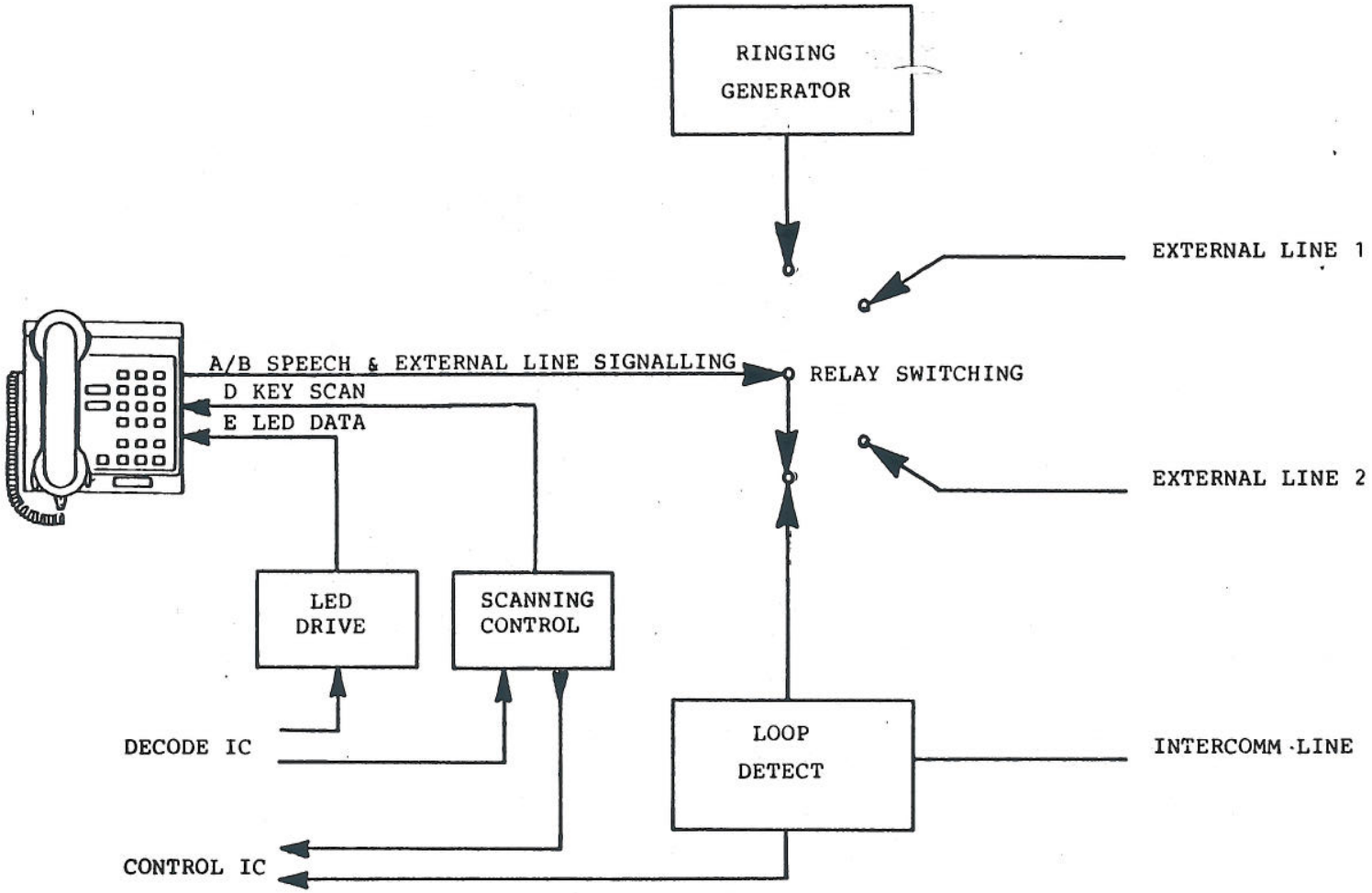
External Extensions with limited facilities may be fitted in place of Terminals 1 and/or 3.

During normal (daytime) use, lifting the handset connects the External Extension to Terminal 2. The call can then be connected to another KBX Terminal (Terminal 2 rings the terminal and replaces the handset when the call is answered or transfers the External Extension to an Exchange Line - presses a free exchange button, ~~and replaces the handset~~ when the Exchange Line is connected), press ext button & replace handset
If Terminal 2 fails to answer within 15 seconds, an External Extension connected in place of Terminal 1 will be automatically connected to a free Exchange Line. switch 1 only, terminal 1 only

OPTION 3

C-WIRE SIGNALLING

C-wire signalling may be implemented by operation of Option Switch No. 3.



KBX 3/6 CALL CONNECT

Fig 10

KBX 3 SIMPLIFIED BLOCK DIAGRAM

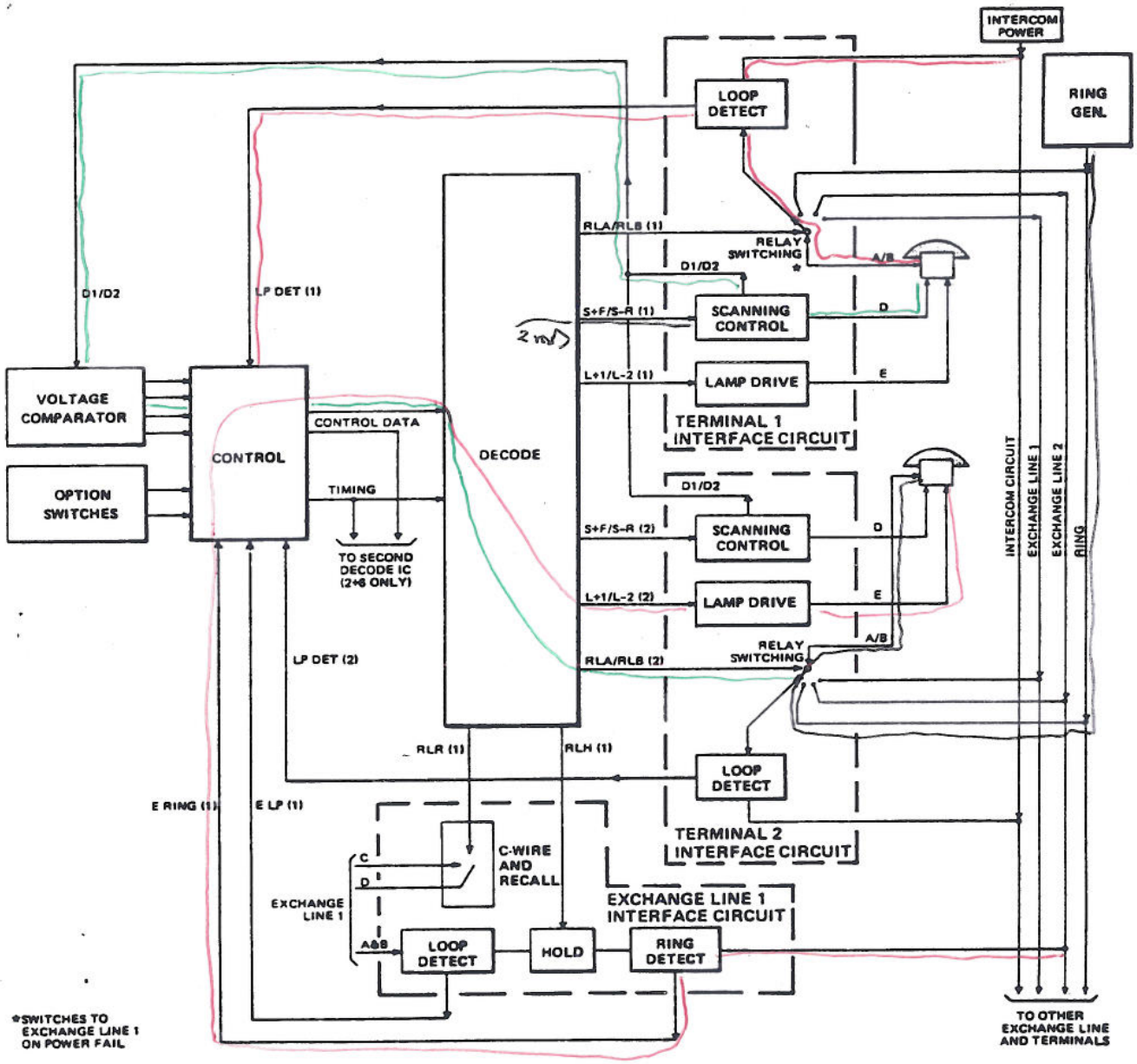


Fig 11

TERMINAL SIGNALLING BLOCK DIAGRAM

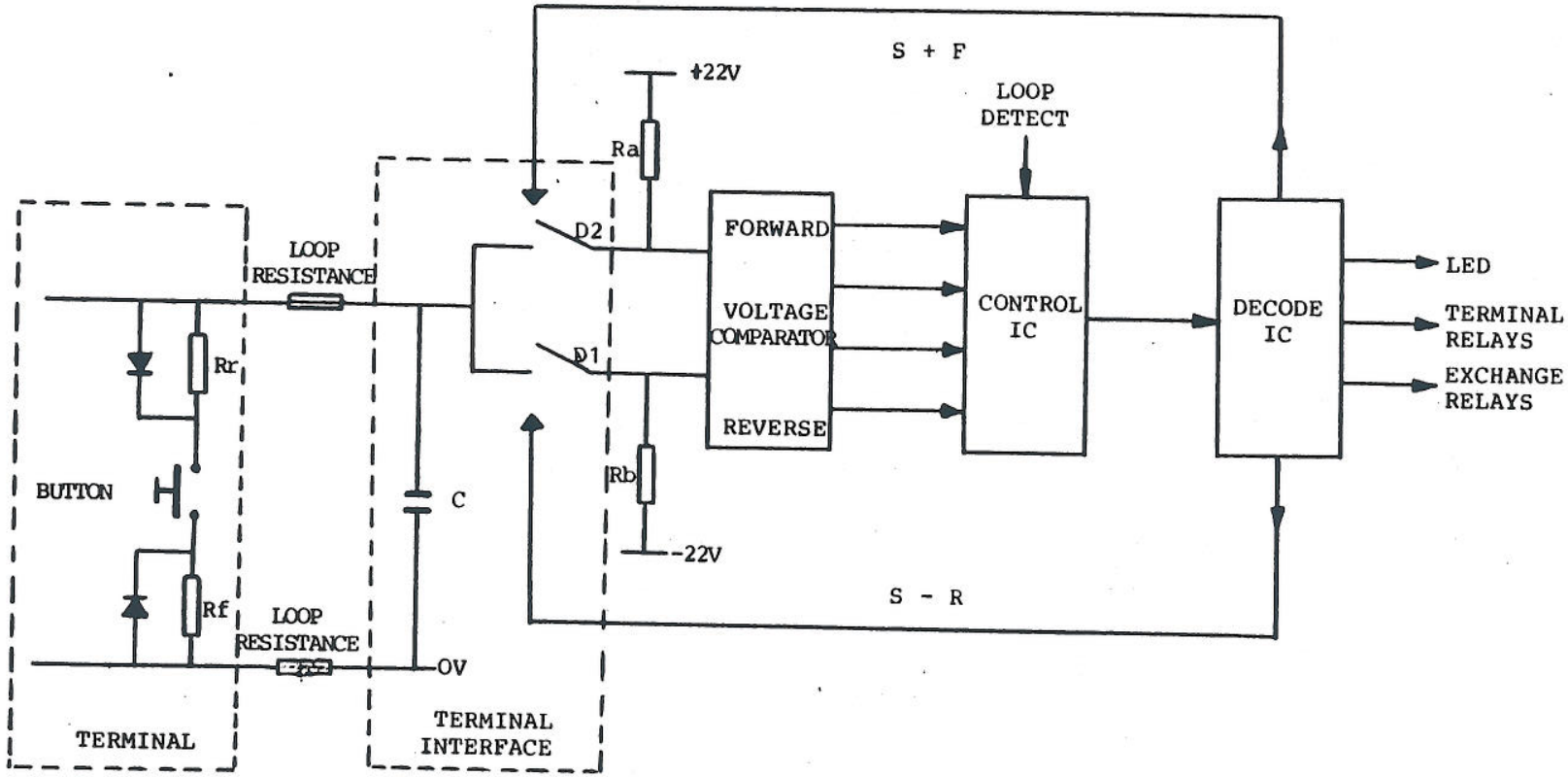


FIG 12

NOTE: Rr, D1, S-R, Rb/-22V and Reverse Voltage Comparator are not applicable to a KBX 3.

MAINTENANCE & FAULTING

GENERAL

This section of the handbook gives instructions for the removal, replacement and, where applicable, the testing of component parts of a KBX 3/6 with the exception of the speech circuits in the terminals. Reference should be made to the appropriate handbook for maintenance and fault diagnosis information on the type of terminal fitted in a particular KBX 3/6 installation.

CAUTION:
THE MOS INTEGRATED CIRCUIT MAY BE DAMAGED BY INCORRECT TESTING AND REPAIR METHODS.
Unless workshop facilities for handling this type of equipment are available, it is strongly recommended that the instrument should be returned to the manufacturer for repair or that the manufacturers be approached for advice on how this type of maintenance is carried out.

REPAIR POLICY

On-site fault diagnosis and repair should be limited to the location of the fault to a sub-assembly and the renewal of the complete sub-assembly.

These sub-assemblies are as follows:

CENTRAL CONTROL UNIT

- Mains transformer
- Power supply printed wiring board
- Control board in a KBX 3
- Control board and Extension board in a KBX 6 constitute one sub-assembly
- Miscellaneous items
  - Both covers
  - Mounting plate

Damage to the base plate of the Central Control Unit should be rectified by renewal of the complete Central Control Unit to keep repair time on site to a minimum.

TERMINALS

- Keyswitch sub-assembly
- Individual exchange lamps (LED)
- All other components and sub-assemblies as recommended in the maintenance and repair instructions for that type of terminal.

Before removing a faulty sub-assembly from the customer's site, it should be labelled with its fault symptoms. Instruments repaired at the Maintenance Centre should also be checked for other possible faults before being passed as serviceable.

Maintenance work on faulty sub-assemblies should be performed at a suitably equipped Maintenance Centre with workshop facilities and the necessary test equipment for the diagnosis of circuit faults. Whether minor repairs and replacements are done on subscriber's premises or at the Maintenance Centre will depend upon the operating Authority's practice.

RENEWAL OF CENTRAL CONTROL UNIT SUB-ASSEMBLIES

WARNING: Disconnect the mains supply to the KBX 3/6 System before proceeding.

Access

Loosen the two large headed screws securing the lower cover and remove the cover. Release the upper cover catches and lift the cover off its upper locating tabs.

Mains Transformer

CAUTION:
RENEWAL OF THE MAINS TRANSFORMER REQUIRES THE REMOVAL OF THE CENTRAL CONTROL UNIT FROM ITS MOUNTING PLATE. BEFORE PROCEEDING, IDENTIFY AND LABEL THE EXCHANGE AND TERMINAL LINE CONNECTIONS AND DISCONNECT THEM FROM THE CENTRAL CONTROL UNIT.

Loosen the screw securing the Central Control Unit to its mounting plate. Lift the Central Control Unit off its mounting plate. Remove the small plate on the rear (lower left-hand corner) of the Central Control Unit, secured by a single cross-headed screw and identified by a High Voltage Warning Label. Disconnect the two wires from the mains transformer (primary winding) at the fuse holder and mains connector.

Disconnect the three wires from the upper connector strip on the transformer (secondary winding). Remove the four bolts securing the transformer to the base plate. Carefully lift the transformer, pulling the two primary winding wires through the hole in the bulkhead.

Replacement is the reverse of the removal procedure.

Power Supply Printed Wiring Board

Disconnect the three connections to the mains transformer. Disconnect the 5-way connector from the rear of the printed wiring board. Remove the four cross-headed screws securing the printed wiring board to the baseplate and remove the board.

Replacement is the reverse of the removal procedure.

KBX 3 Control Board

Disconnect the exchange line and terminal connections to the Control Board at the terminal blocks. Unclip the right-hand edge of the Control Board and swing the board fully to the left. Disconnect the 5-way connector at the Power Supply printed wiring board and unclip its cable from the baseplate: this cable and connector forms part of the Control Board Assembly. Remove the hinge pins from the two hinges, supporting the board as the pins are removed.

Replacement is the reverse of the removal procedure.

NOTE: If access to the rear of the Control Board is required for in-situ servicing, the board may be unclipped and swung to the left without disconnecting any of the cables.

KBX 6 Control and Extension Boards

These items should be removed as a single item.

Disconnect the exchange line and terminal connections to the Extension Board at the terminal blocks. Unclip the right-hand edge of the Extension Board and swing it to the left.

Disconnect the exchange line and terminal connections to the Control Board (lower board) at the terminal blocks. Unclip the right-hand edge of the Control Board and swing it fully to the left. Disconnect the 5-way connector at the Power Supply printed wiring board and unclip its cable from the baseplate: this cable forms part of the Control and Extension Board Assembly. Remove the hinge pins from the Control Board hinges, supporting the Control and Extension Boards as the pins are removed.

Replacement is the reverse of the removal procedure.

NOTE: If access to the front and rear of the Control and Extension Boards is required for in-situ servicing, both boards may be unclipped and swung to the left without disconnecting any of the cables.

RENEWAL OF TERMINAL COMPONENTS

The following paragraphs provide general principles on the renewal of the keyswitch block and the exchange lamps as fitted to a Type 1746 Terminal. Specific details depend on the type of terminal in use. Reference should be made to the appropriate terminal Maintenance Handbook for access details and the renewal of all other terminal components.

Keyswitch Block

The keyswitch block is normally fitted in a special mounting bracket in front of the cradle switch. It is held securely in place by a spring clip.

Note the connections and dressing of the two wires connecting the keyswitch block to the terminal's connecting block, and the orientation of the keyswitch block. Disconnect these wires and lift the keyswitch block clear of its mounting bracket.

Insert the new keyswitch block, correctly orientated, into its mounting bracket and secure with the spring clip; undue force should not be necessary. Connect the two wires to the terminal's connection block using the dressing and connections previously noted.

Exchange Lamps

These LED are normally secured to the side of the cradle switch mounting using clips or special brackets. When correctly fitted, they should show clearly through the lenses mounted in the cover of the terminal.

Note the connections and dressing of the two wires connecting the single LED (KBX 3) or dual LED (KBX 6) to the terminal's connecting block. Disconnect these wires and remove the LED and wiring from the terminal.

Replacement is the reverse of the removal procedure.

FAULT LOCATION AND RECTIFICATION

The following table provides a guide to the rapid location of a fault to a renewable sub-assembly. Once located, the faulty sub-assembly should be renewed and the faulty item returned to a Maintenance Centre for repair together with full details of the fault symptoms and action taken.

When using the table, the possible faults and actions should be considered in the order given.

WARNING: Many of the following actions require the operation of the Central Control Unit with mains applied and the covers removed.

Testing the Terminal Keyswitches

The following tests provide a rapid check on the correct operation of the terminal keyswitches without dismantling of the terminal.

SYMPTOM	POSSIBLE FAULT	ACTION
1. System only functions on night service.	A. Loss of power supply	(i) Check fuse. (ii) Check incoming mains supply. (iii) Check mains transformer. (iv) Check outputs of Power Supply printed wiring board.
	B. Control Circuit failure	(i) Renew Control board (including Extension board if fitted).
2. System does not function on night service.	A. Interface Circuit failure	(i) Renew Control board (including Extension board if fitted).
3. Speech or signalling fault on one terminal.	A. Terminal Speech circuit	(i) Check the terminal as detailed in its Maintenance Handbook. (ii) Check the terminal to Central Control Unit cabling and connections.
	B. Central Control Unit Control or Extension board line switching circuit	(i) Renew Control board (including Extension board if fitted).
4. Speech or signalling fault on all terminals.	A. Power supplies	(i) Check fuse. (ii) Check incoming mains supply. (iii) Check mains transformer. (iv) Check outputs of Power Supply printed wiring board.
	B. Control circuits	(i) Renew Control board (including Extension board if fitted).

Table 1 System Fault Location

KBX 3

Disconnect the C (blue) and D (black) signalling wires from the terminal at the wall mounted terminal block. Connect an ohmmeter to these two wires. Operate each of the terminal keyswitches in turn and verify that the indicated resistance is as shown in Table 2. Any deviation from these readings indicates that the keyswitch assembly must be renewed.

KEYSWITCH	RESISTANCE ± 5%
EXCH	100
EXT 1	1K3
EXT 2	3K6
F	8K2

Table 2 KBX 3 Keyswitch Resistance Values

KBX 6

Disconnect the C (blue) and D (black) signalling wires from the terminal at the wall mounted terminal block. Connect an ohmmeter to these two wires. Operate the keyswitches in turn and verify that the indicated resistance for each switch is as shown in one of the resistance columns of Table 3. Reverse the ohmmeter connections and verify that the indicated resistance for each switch is now as shown in the other resistance column of Table 3. Any deviation from these readings indicates that the keyswitch assembly must be renewed.

KEYSWITCH	RESISTANCE ± 5%	RESISTANCE ± 5%
EXCH 1	100	100
EXCH 2	100	3K6
EXT 1	1K3	1K3
EXT 2	3K6	3K6
EXT 3	3K6	100
EXT 4	1K3	100
EXT 5	3K6	1K3
F	8K2	8K2

Table 3 KBX 6 Keyswitch Resistance Values

INSTALLATION INSTRUCTIONS

These instructions should be read carefully before proceeding with the installation of a KBX 3/6.

General

The Central Control Unit is wall mounted, using a special mounting plate, adjacent to the incoming exchange lines and a suitable power point. Before commencing the installation, check that the Central Control Unit is suitable for the local mains supply, 90V to 130V, or 180V to 260V, 50Hz to 60Hz.

Terminals

The terminal blocks should be mounted in suitable positions adjacent to the terminals, using woodscrews or self-tapping screws. The wiring connections for the terminal blocks are shown on Figure 5.1.

Install the cables between the terminal blocks and the Central Control Unit position.

Central Control Unit

Secure the mounting plate to the wall using suitable woodscrews or self-tapping screws. The fixing centres for these screws are shown on Figure 5.2. The Central Control Unit may be fixed directly to the wall or mounted on battens depending on the nature of the wall.

Remove the lower cover from the Central Control Unit by unscrewing the two large-headed captive screws and lift-off the cover. There should not be any need to remove the upper cover during installation.

NOTE: If required, the upper cover is removed by releasing the catches at the lower corners of the cover and lifting the cover off the upper locating tabs. The cover is replaced by seating it correctly on the locating tabs and pushing home the catches. See Figure 5.3.

Locate the Central Control Unit on the tabs of the mounting plate and secure with the fixing screw, Figure 5.3.

(a) Using BT Master Line Jack Unit

Connect line jack units to central unit as per table, using 3 pair cable.

Central Control Unit Extension Connections			LJU Connections
WH	A	Speech & Line	2
BL	B		5
OR	C		4
GN	D	Key scan	1
BR	E	LED	6

(b) Using Western Electric Sockets

Connect Western Electric Sockets to central unit as per table, using 3 pair cable

Central Control Unit Extension Connections	Western Electric Socket Connections
A	4
B	3
C	5
D	1
E	6

Terminal Block Connections

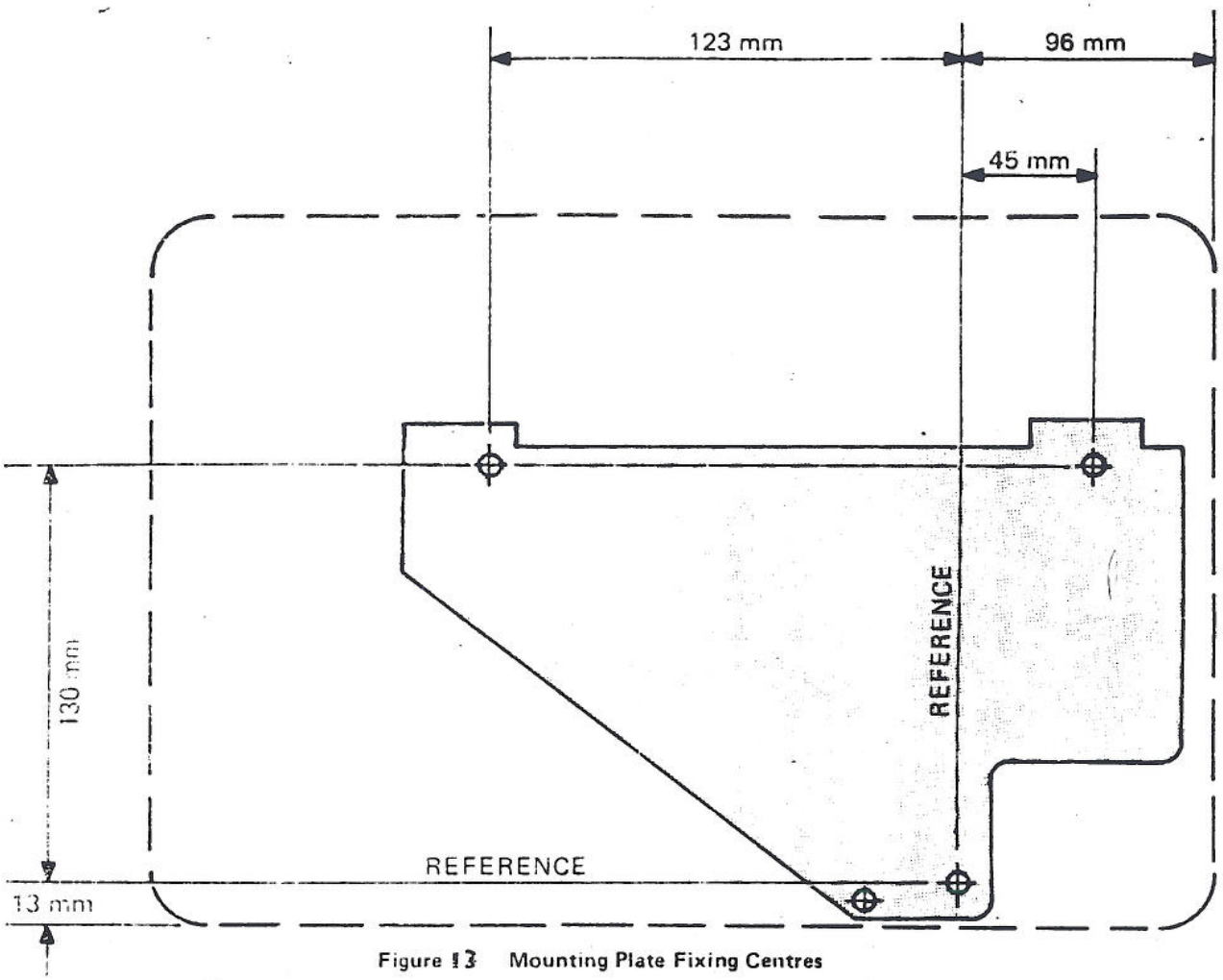
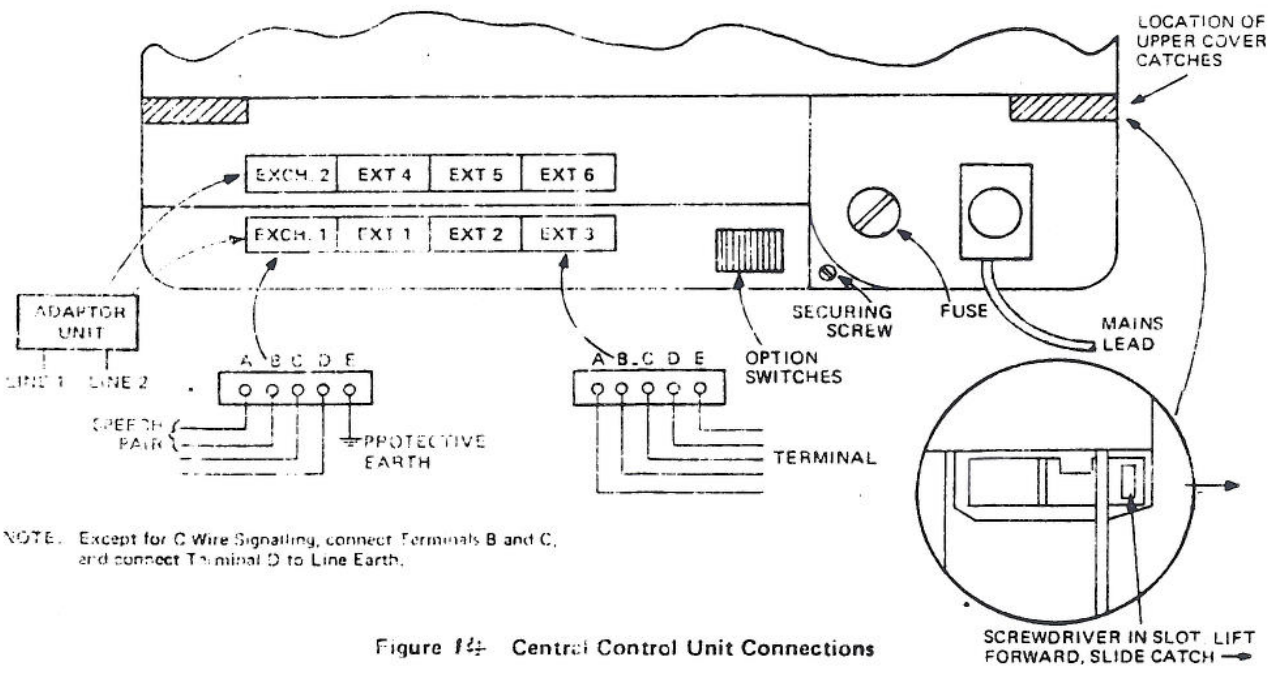


Figure 13 Mounting Plate Fixing Centres



NOTE: Except for C Wire Signalling, connect Terminals B and C, and connect Terminal D to Line Earth.

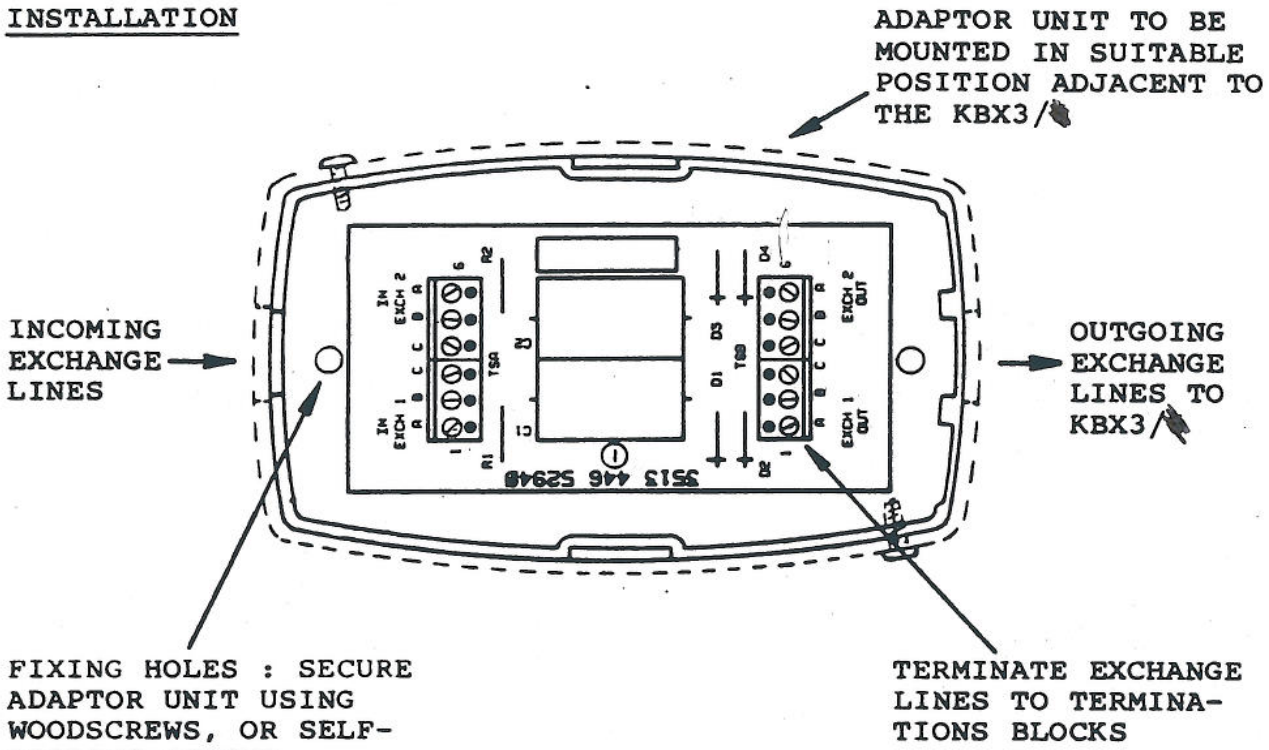
Figure 14 Central Control Unit Connections

KBX3/ MAINTENANCE HANDBOOK - ADDENDUM

Details of Adaptor Unit (Code 3513 442 63800) shown in Figure 5.3 of the KBX3/ Maintenance Handbook HK 1120 Edition 2.

FIGURE 15

INSTALLATION



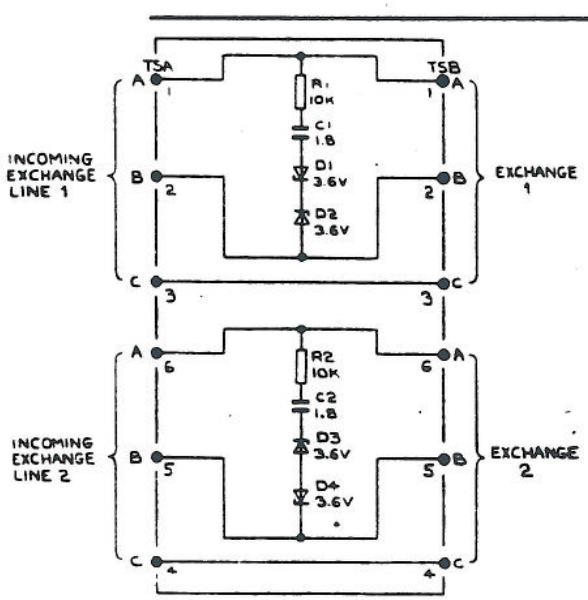


FIGURE 16

CIRCUIT DIAGRAM

EXTENSION PLAN I

FOR INTERNAL USE ONLY ON ALL · - WIRE PBX SYSTEMS WITH ENQUIRY TRANSFER OR OPERATOR RECALL FACILITIES

CONSISTS OF A MAIN TELEPHONE WITH 1, 2 OR 3 EXTENSIONS CONNECTED IN PARALLEL TO ONE EXCHANGE LINE

1 EXTENSION SHOWN ON THIS SHEET
2 EXTENSIONS SHOWN ON TN-0102
3 EXTENSIONS SHOWN ON TN-0103

FACILITIES

ALL TELEPHONES CAN RECEIVE AND ORIGINATE CALLS BUT INCOMING CALLS ARE NORMALLY ANSWERED AT THE MAIN TELEPHONE

THE MAIN MAY CALL ANY EXTENSION BY OPERATION OF A PUSH BUTTON

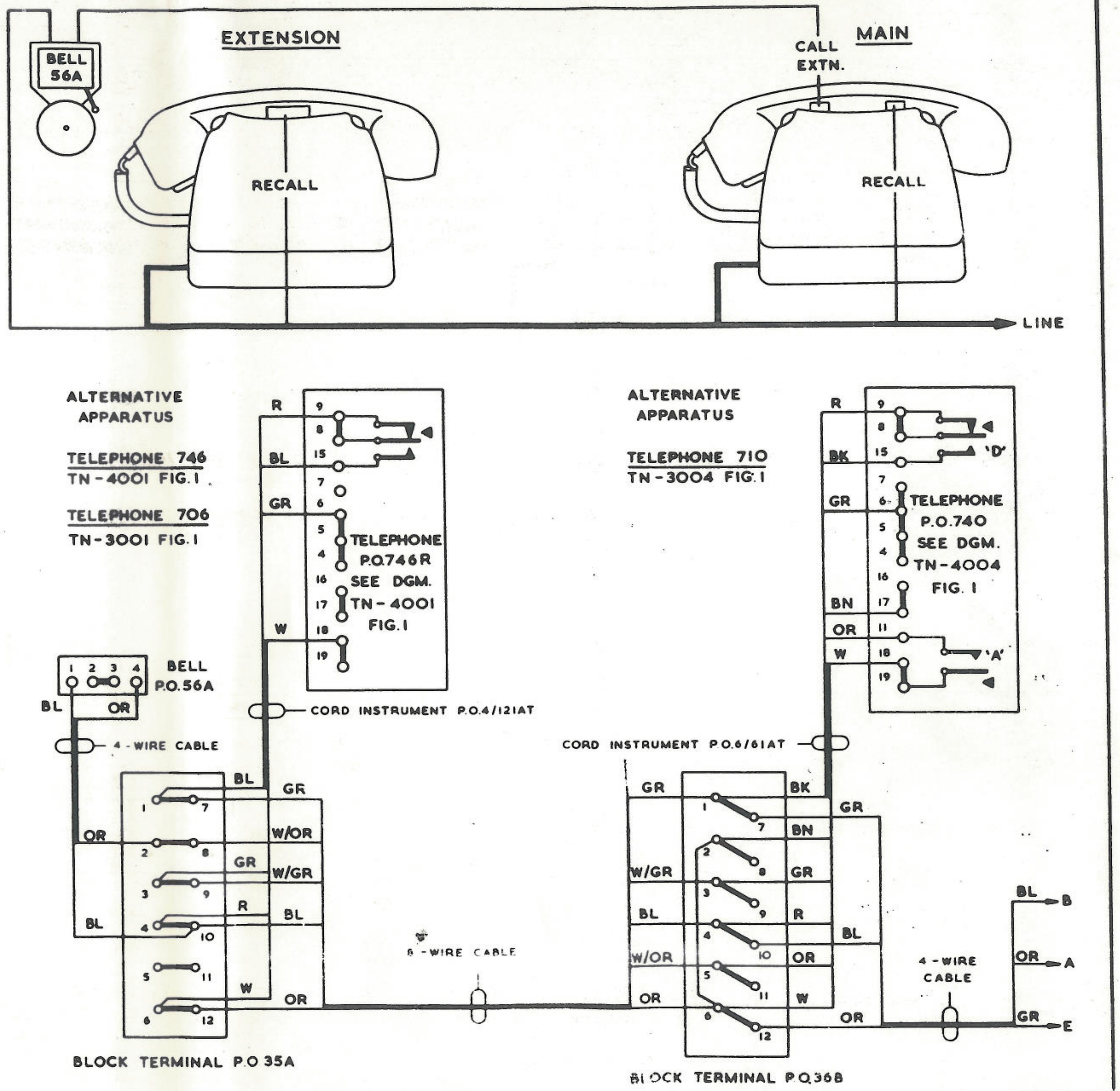
ENQUIRY TRANSFER OR OPERATOR RECALL ACHIEVED BY OPERATION OF A PUSH BUTTON

NEITHER SECRECY OR INTERCOMMUNICATION IS PROVIDED BETWEEN MAIN AND EXTENSION TELEPHONES

NOTES

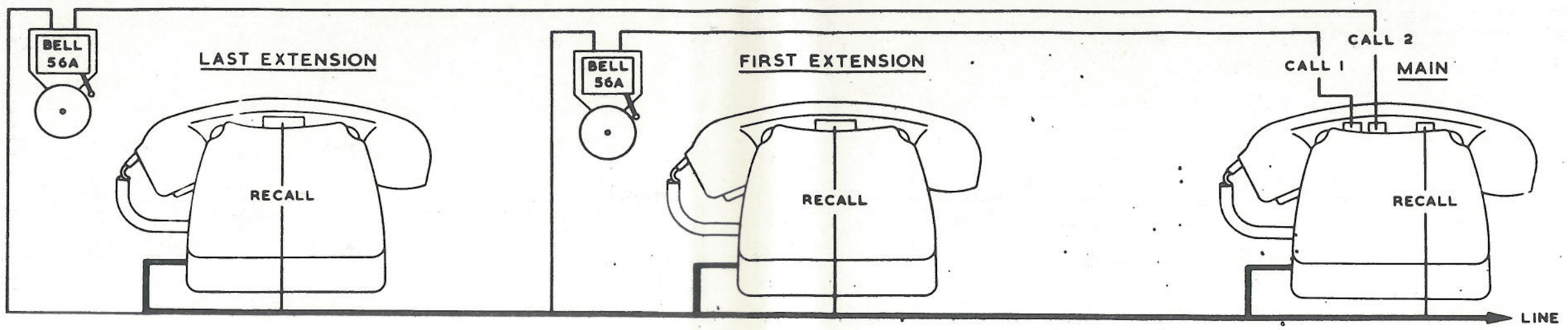
WHEN AN EXTENSION BELL IS REQUIRED, IT SHOULD BE CONNECTED IN PLACE OF STRAP 2 - 6 ON THE BLOCK, TERMINAL AT THE MAIN TELEPHONE

TELEPHONES ARE SHOWN EQUIPPED FOR 'EARTH LOOP' RECALL, FOR 'ONE LINE EARTH LOOP DISCONNECTION' RECALL REMOVE STRAP T8 - T9



Revisions A 16.1.78 MINOR AMDTS	DEC 1.3.77	British Railways Board Chief Signal and Telecommunications Engineer EXTENSION PLAN 1 ON 2-WIRE PBX SYSTEMS WITH ENQUIRY TRANSFER OR OPERATOR RECALL FACILITIES FOR MAIN AND 1 EXTENSION	British Rail Chief S & T Engineer No TR/CI TN-0101 C1 6-1 01

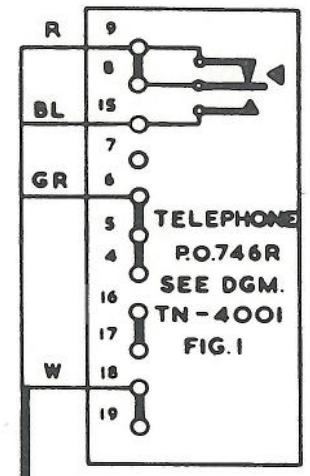
A2 B R 888/10

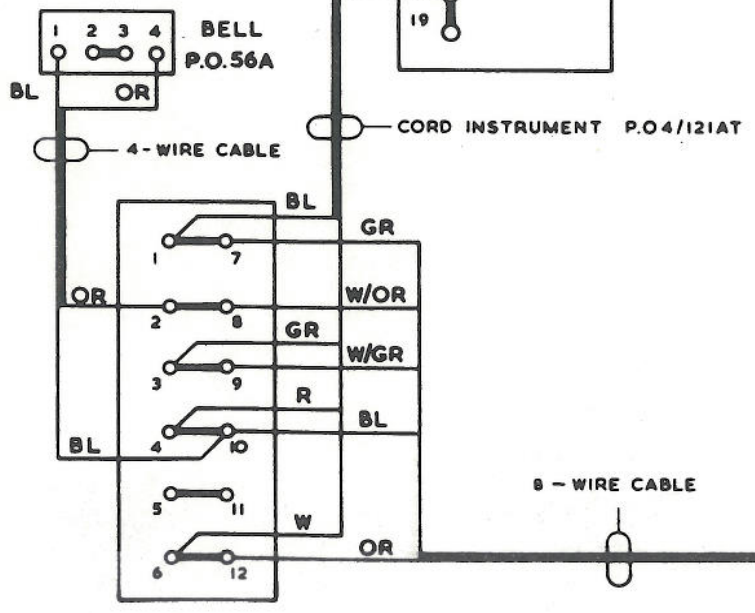


ALTERNATIVE APPARATUS

TELEPHONE 746
TN-4001 FIG.1

TELEPHONE 706
TN-3001 FIG.1

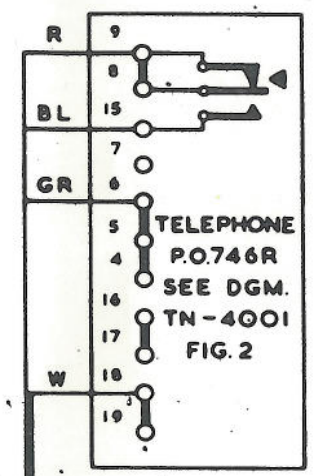


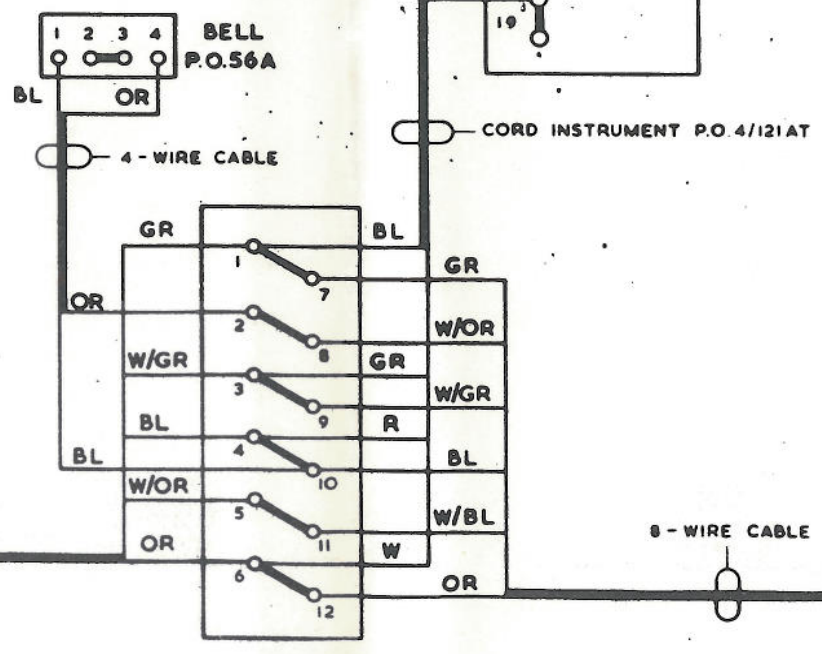


ALTERNATIVE APPARATUS

TELEPHONE 746
TN-4001 FIG.2

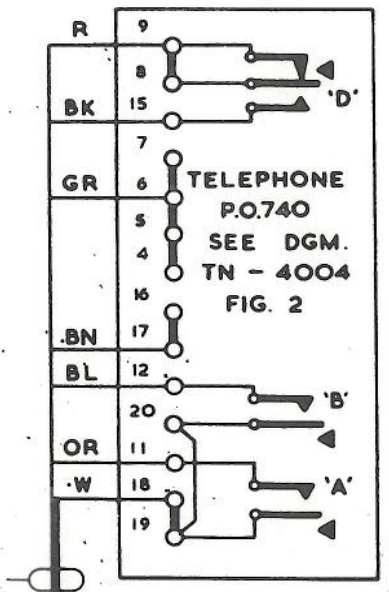
TELEPHONE 706
TN-3001 FIG.2

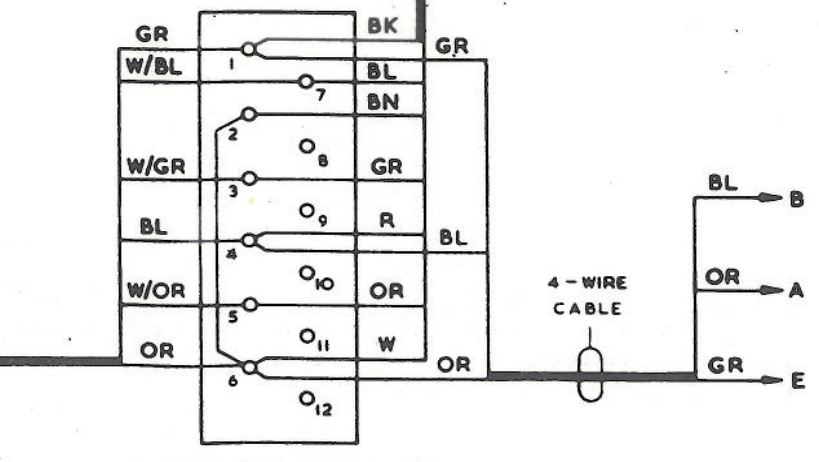




ALTERNATIVE APPARATUS

TELEPHONE 710
TN-3004 FIG.2





FOR FACILITIES AND NOTES SEE DGM. TN-0101

Revisions
A 16-1-78
MINOR AMDTS

DEC. 1-9-77

British Railways Board
Chief Signal and Telecommunications Engineer

EXTENSION PLAN 1
ON 2-WIRE PBX SYSTEMS
WITH ENQUIRY TRANSFER
OR OPERATOR RECALL FACILITIES
FOR MAIN
AND 2 EXTENSIONS

British Rail

Chief S&T Engineer

No TR/CI TN-0102

C1 | 6-1-1 | 0|2

EXTENSION PLAN 1A

FOR USE ON ALL 2 WIRE PBX SYSTEMS WITH ENQUIRY TRANSFER OR OPERATOR RECALL FACILITIES.

CONSISTS OF 1 MAIN TELEPHONE WITH 1 TO 5 EXTENSIONS CONNECTED IN PARALLEL TO ONE EXCHANGE LINE.

FACILITIES

ALL TELEPHONES CAN RECEIVE AND ORIGINATE CALLS.

BELLS AT EXTENSION TELEPHONES MAY BE SWITCHED OFF BY OPERATION OF A PUSH BUTTON.

ENQUIRY TRANSFER OR OPERATION RECALL ACHIEVED BY OPERATION OF A PUSH BUTTON.

NEITHER SECRECY OR INTERCOMMUNICATION IS PROVIDED BETWEEN MAIN AND EXTENSION TELEPHONES.

NOTES

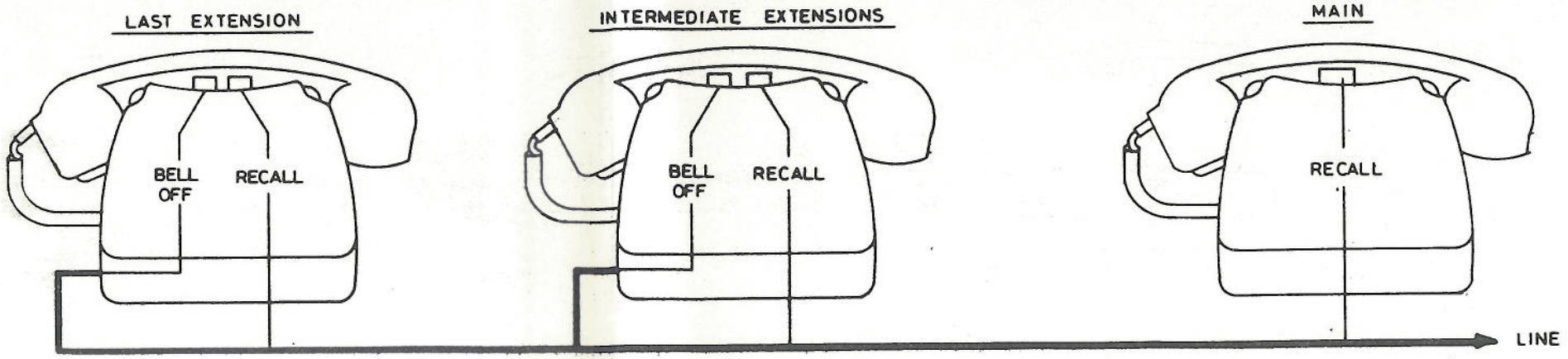
WHEN AN EXTENSION BELL IS REQUIRED, IT SHOULD BE CONNECTED IN PLACE OF STRAP 2-5 ON THE BLOCK, TERMINAL AT THE MAIN TELEPHONE OR LAST EXTENSION.

A TOTAL OF 6 BELLS MUST NOT BE EXCEEDED.

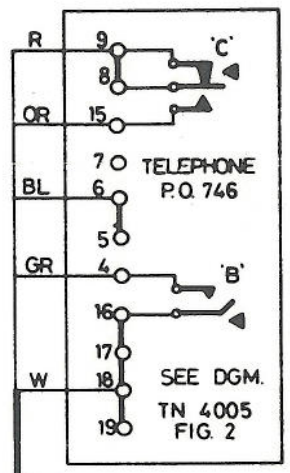
TELEPHONES ARE SHOWN EQUIPPED FOR "EARTH LOOP" RECALL, FOR "ONE LINE EARTH LOOP DISCONNECTION" RECALL REMOVE STRAP T8-T9.

EXTERNAL EXTENSIONS MAY BE PROVIDED WITH A LOCAL EARTH SO THAT BLOCK, TERMINALS CAN BE CONNECTED BY 4-WIRE CABLES.

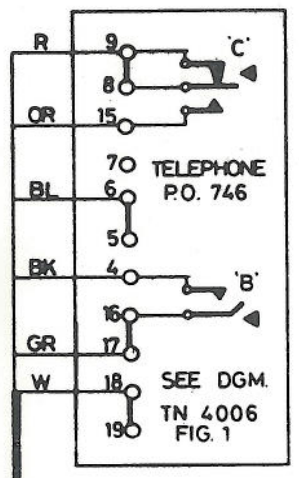
THIS DIAGRAM IS SUITABLE FOR MAINTENANCE USE ON EXISTING EXTENSION PLAN IC INSTALLATIONS WHICH ARE SIMILAR, OTHER THAN EXTENSION TELEPHONES ARE NOT EQUIPPED WITH BELL CUT-OFF PUSH BUTTONS.



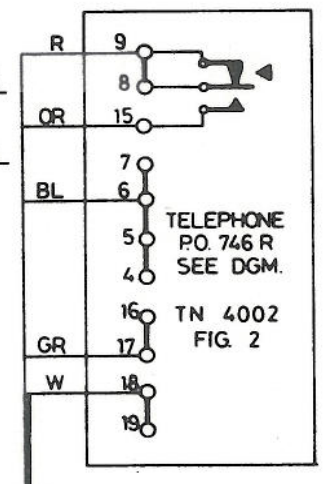
ALTERNATIVE APPARATUS
TELEPHONE 710
TN-3005 FIG. 2



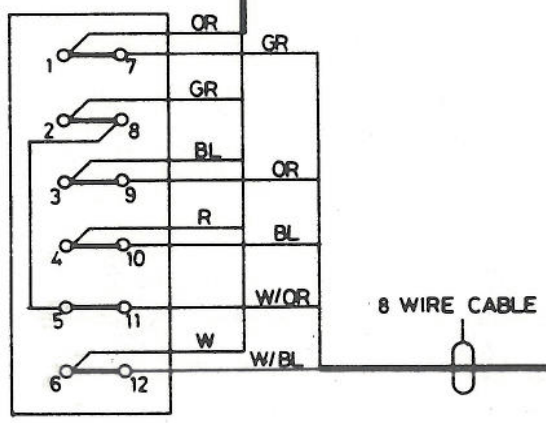
ALTERNATIVE APPARATUS
TELEPHONE 710
TN-3006 FIG. 1



ALTERNATIVE APPARATUS
TELEPHONE 746
TN-4002 FIG. 2
TELEPHONE 706
TN-3002 FIG 2



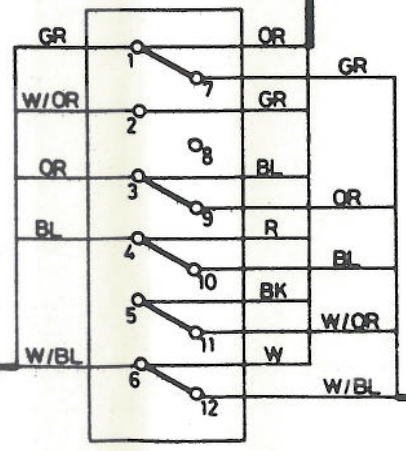
CORD INST. P.O. 6/61AT



BLOCK TERMINAL 35A

8 WIRE CABLE

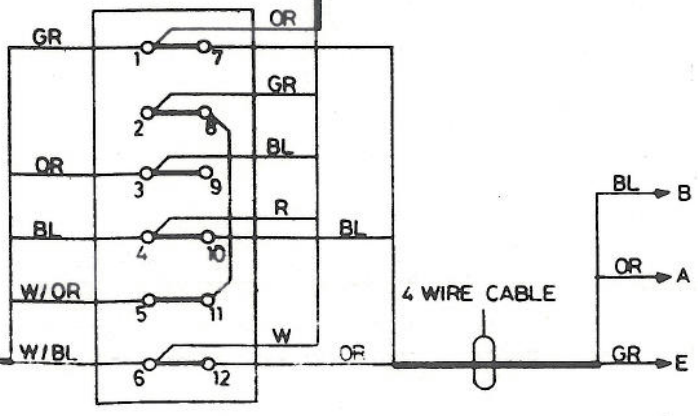
CORD INST. P.O. 6/61AT



BLOCK TERMINAL 36B

8 WIRE CABLE

CORD INST. P.O. 6/61AT



4 WIRE CABLE

BLOCK TERMINAL 35 A

Revisions

British Railways
Chief Signal and Telecommunications Engineer

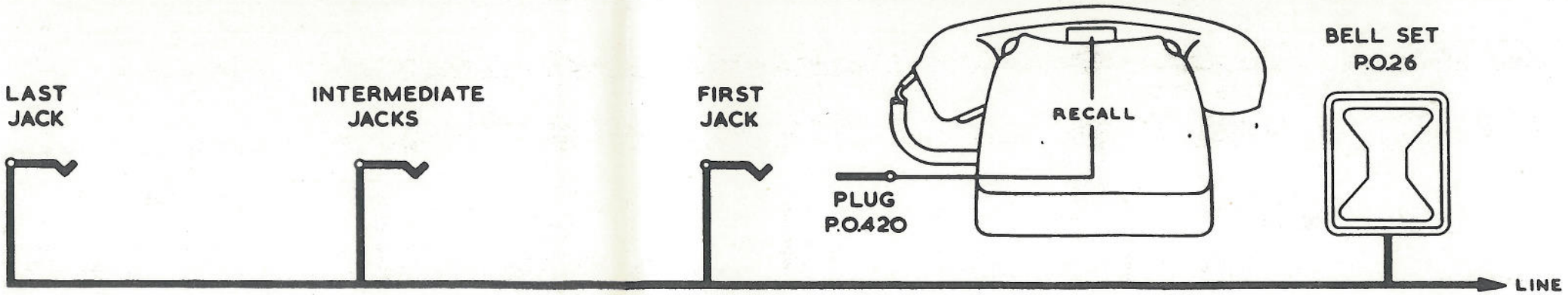
British Rail

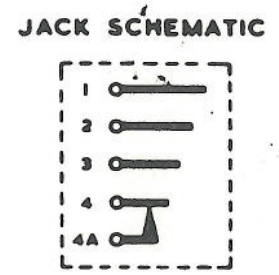
EXTENSION PLAN 1A
ON 2 WIRE PBX SYSTEMS WITH ENQUIRY TRANSFER OR OPERATOR RECALL FACILITIES
FOR MAIN AND 1 TO 5 EXTENSIONS

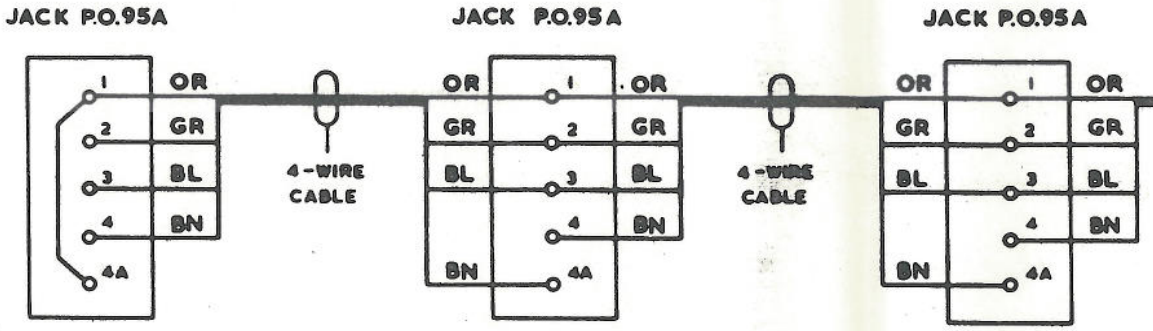
Chief S & T Engineer

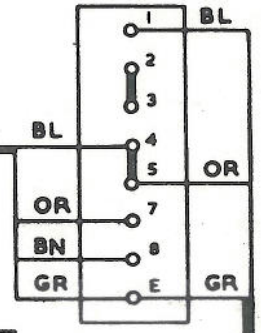
No. TR C1 TN 0111

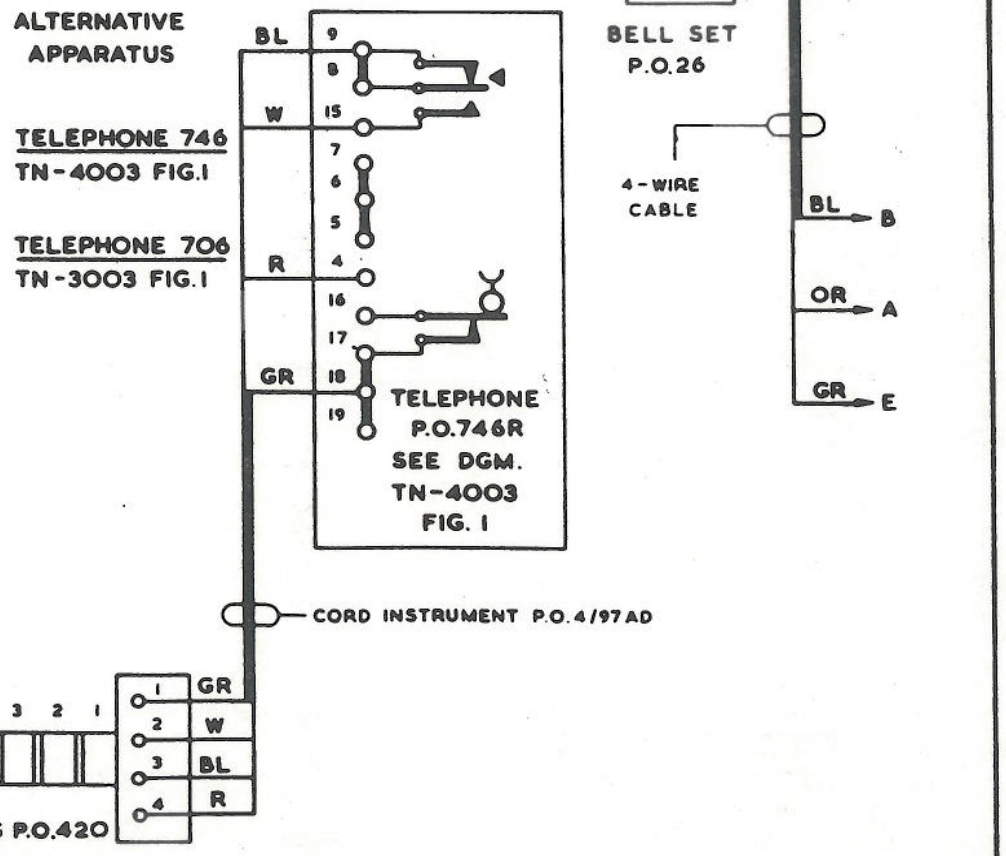
C1 61 03











EXTENSION PLAN 4

FOR INTERNAL USE ONLY ON ALL 2-WIRE PBX SYSTEMS WITH ENQUIRY TRANSFER OR OPERATOR RECALL FACILITIES

CONSISTS OF ANY NUMBER OF SOCKETS CONNECTED IN PARALLEL TO EXCHANGE LINE, TO SERVE 1 OR MORE PORTABLE TELEPHONES (6 MAXIMUM)

1 TELEPHONE SHOWN ON THIS SHEET
2 TELEPHONES SHOWN ON TN-0402

FACILITIES

TELEPHONES ARE TERMINATED ON PLUGS FOR CONNECTION WITH ANY SOCKET AS REQUIRED

INCOMING CALLS RING THE MAIN BELL AND THE BELL OF ANY TELEPHONE CONNECTED TO A SOCKET

CALLS MAY BE RECEIVED AND ORIGINATED AT ANY SOCKET

ENQUIRY TRANSFER OR OPERATOR RECALL ACHIEVED BY OPERATION OF A PUSH BUTTON

NEITHER SECRECY OR INTERCOMMUNICATION IS PROVIDED BETWEEN PORTABLE TELEPHONES

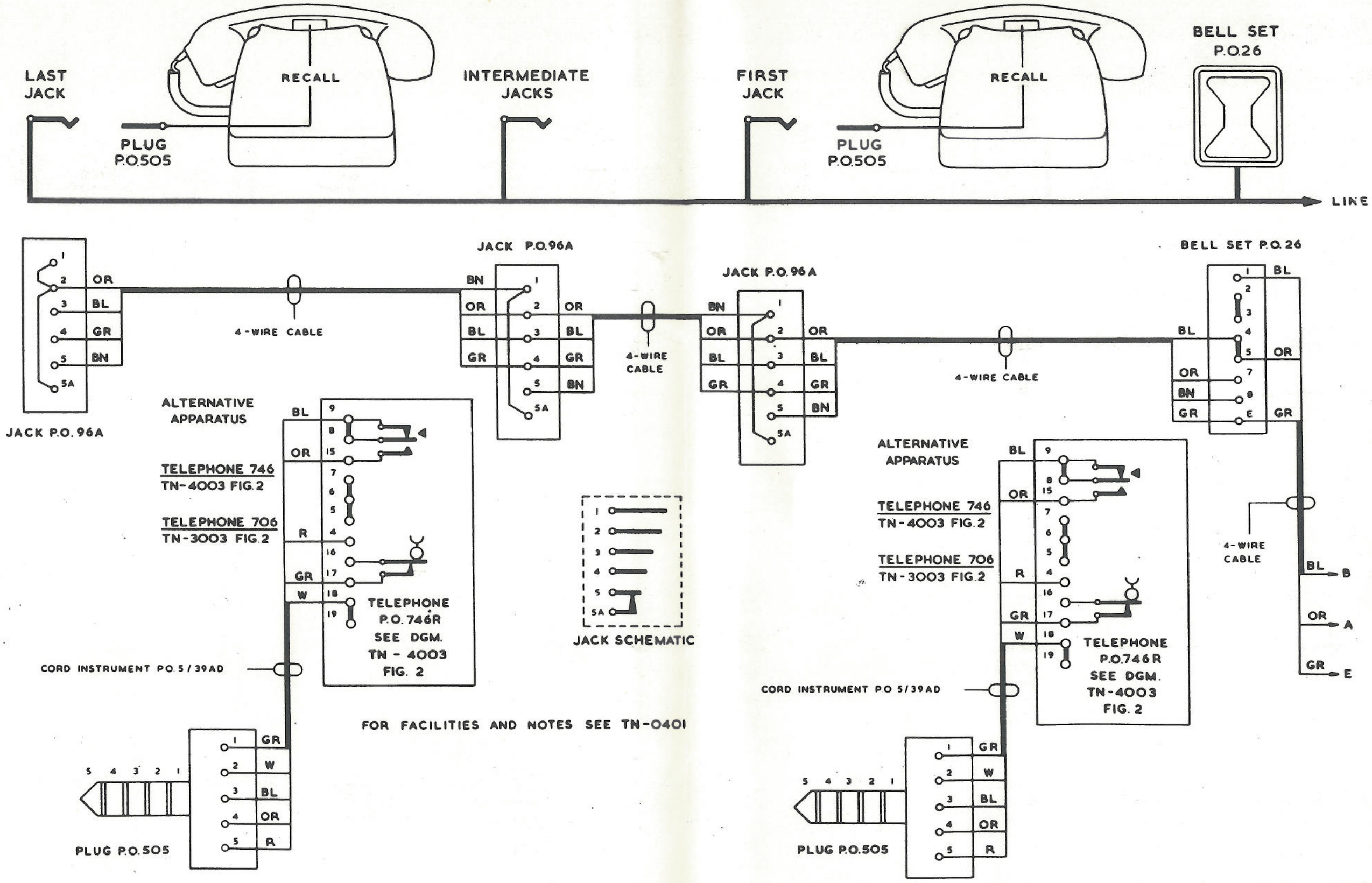
NOTES

WHEN AN EXTENSION BELL IS REQUIRED, IT SHOULD BE CONNECTED IN PLACE OF STRAP B2 - B3 ON MAIN BELL

TELEPHONES ARE SHOWN EQUIPPED FOR 'EARTH LOOP' RECALL, FOR 'ONE LINE EARTH LOOP DISCONNECTION' RECALL REMOVE STRAP T8 - T9

Revisions		British Railways Board Chief Signal and Telecommunications Engineer	British Rail
A 16·1·78 MINOR AMDTS	DEC 1·3·77	EXTENSION PLAN 4 ON 2-WIRE PBX SYSTEMS WITH ENQUIRY TRANSFER OR OPERATOR RECALL FACILITIES FOR 1 TELEPHONE	Chief S & T Engineer No TR/CI TN-0401 C1 6-1 04

A2 BR 888/19



Revisions		British Railways Board Chief Signal and Telecommunications Engineer	British Rail
A 16·1·78 MINOR AMDTS		EXTENSION PLAN 4 ON 2-WIRE PBX SYSTEMS WITH ENQUIRY TRANSFER OR OPERATOR RECALL FACILITIES FOR 2 OR MORE TELEPHONES	Chief S & T Engineer No. TR/CI TN-0402 C1 6-1 05
	DEC 1·3·77		

A2 BR 888/19

EXTENSION PLAN 105 & 105A

FOR INTERNAL USE ONLY ON 2-WIRE PBX SYSTEMS WITH ENQUIRY TRANSFER OR OPERATOR RECALL FACILITIES

CONSISTS OF A MAIN TELEPHONE ON A PRESS KEY SWITCHING UNIT WITH TWO EXTENSIONS HAVING INTER-COMMUNICATION AND ACCESS TO ONE EXCHANGE LINE

FACILITIES

THE MAIN TELEPHONE WILL NORMALLY RECEIVE AND ORIGINATE CALLS BUT, BY OPERATION OF A PRESS KEY, THE EXTENSION TELEPHONES CAN BE SELECTED TO PERFORM BOTH FUNCTIONS

EXCHANGE CALLS FROM THE MAIN CANNOT BE HEARD AT THE EXTENSIONS AND, BY OPERATION OF A PRESS KEY, THE MAIN MAY HOLD SUCH CALLS TO SPEAK TO AN EXTENSION WITHOUT BEING HEARD ON THE EXCHANGE LINE

EXCHANGE CALLS FROM EXTENSIONS ARE NOT SECRET ON PLAN 105 BUT, ON PLAN 105A, THEY WILL BE SECRET FROM THE MAIN ONLY

AT THE MAIN A WHITE LAMP WILL SHOW WHEN THE EXCHANGE LINE IS ENGAGED BY AN EXTENSION AND A RED LAMP WILL INDICATE THE EXCHANGE LINE HELD BY THE MAIN

ENQUIRY TRANSFER OR OPERATOR RECALL ACHIEVED BY THE OPERATION OF A PUSH BUTTON FITTED TO ALL TELEPHONES

INTERCOMMUNICATION AND BOTHWAY SIGNALLING IS PROVIDED FOR MAIN TO EXTENSION AND EXTENSION TO EXTENSION

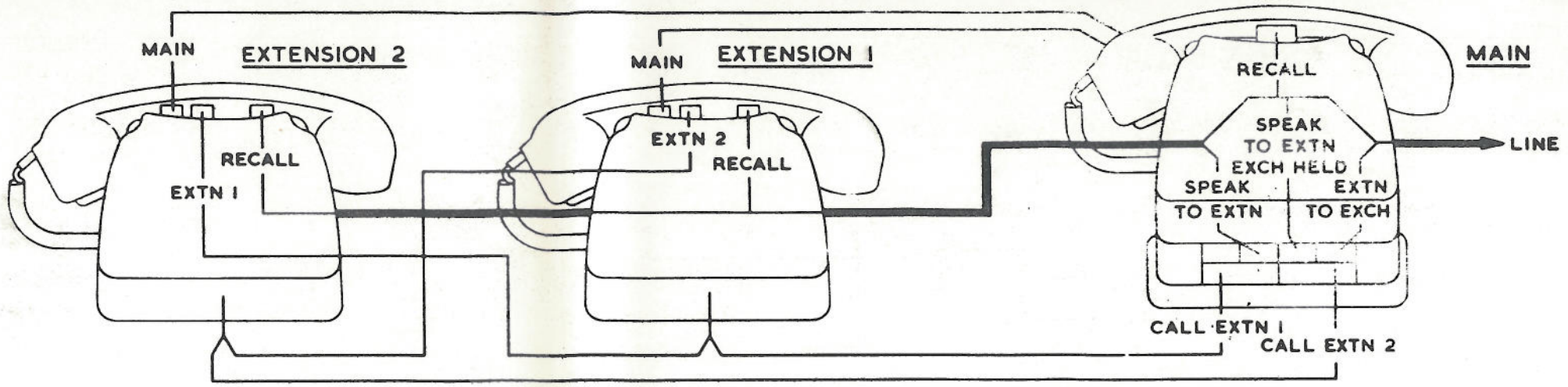
NOTES

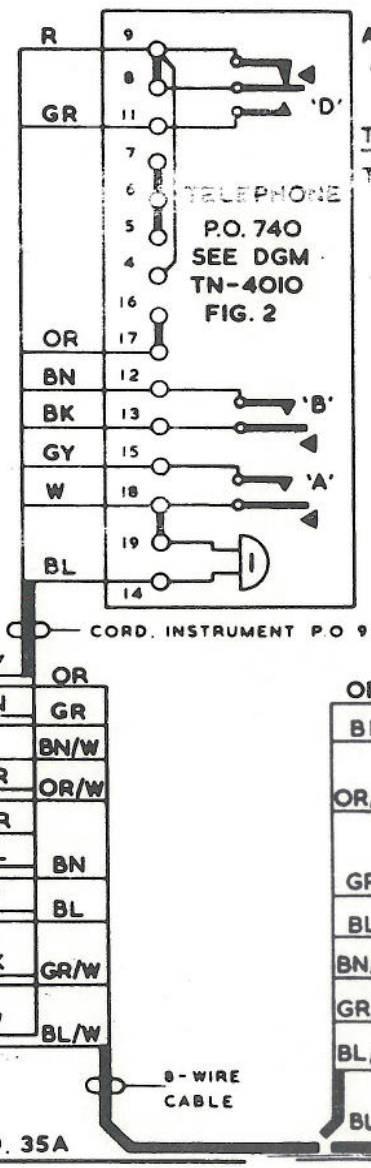
TELEPHONE ARE SHOWN EQUIPPED FOR 'EARTH LOOP' RECALL. FOR 'ONE LINE EARTH LOOP DISCONNECTION' REMOVE STRAP T8 - T9

WHEN AN EXTENSION BELL IS REQUIRED AT THE MAIN REMOVE THE STRAP ON PLAN-SET TERMINALS 6-7 AND CONNECT BELL TO BLOCK TERMINALS 6 & 7

WHEN EXTENSION REQUIRES AN ADDITIONAL BELL IT SHOULD BE CONNECTED IN PLACE OF STRAP 2-3 ON THE BLOCK TERMINAL

FOR THE CONVERSION OF PLAN 105 TO 105A SEE DGM TN-1057 SHEET 2

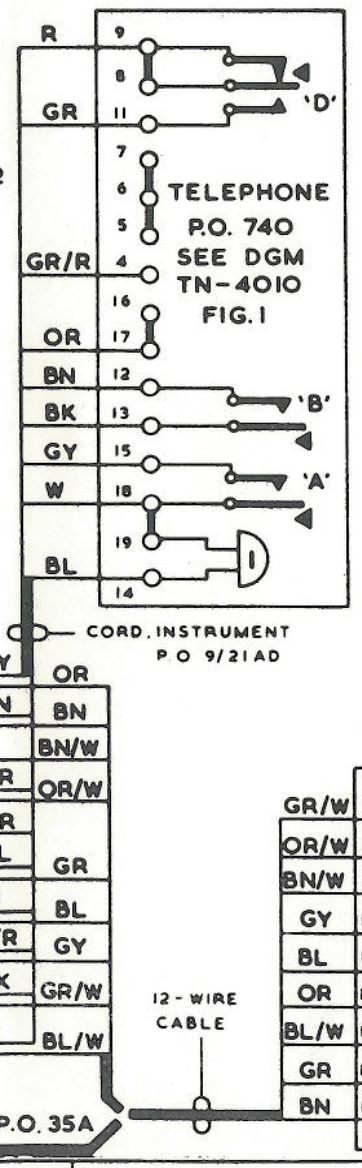


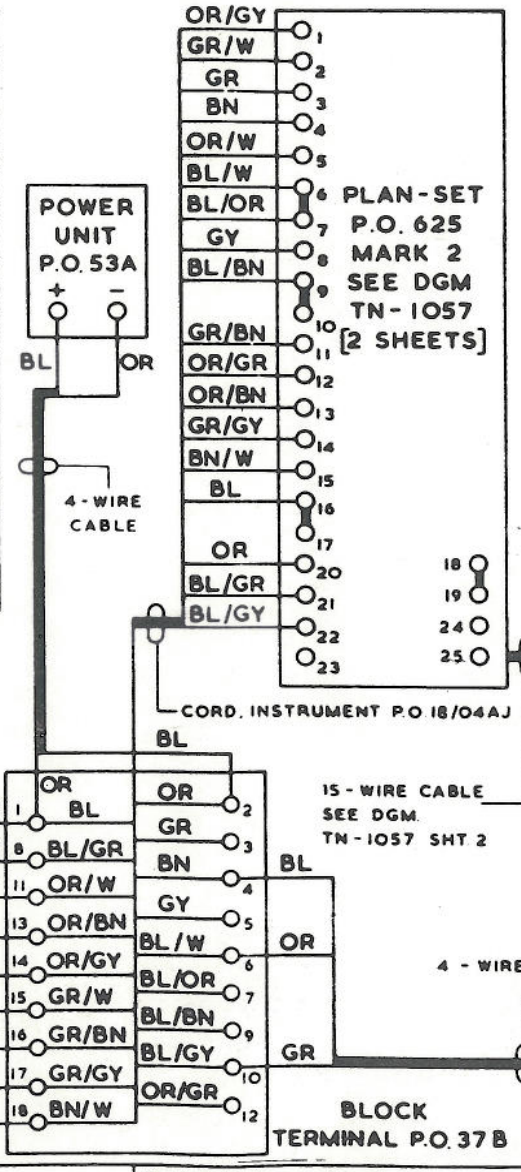


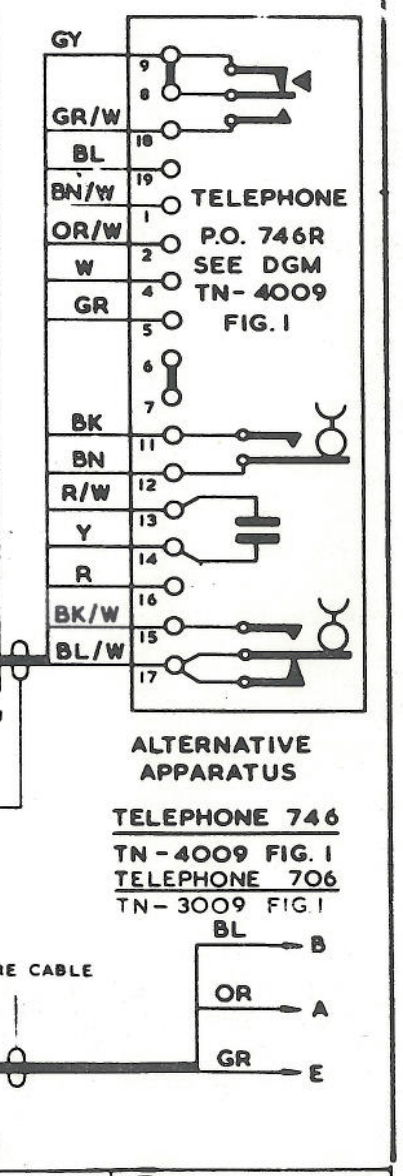
ALTERNATIVE APPARATUS

TELEPHONE 710

TN-3010 FIGS. 1 & 2







ALTERNATIVE APPARATUS

TELEPHONE 746

TN-4009 FIG. 1

TELEPHONE 706

TN-3009 FIG. 1

Revisions					
A 6.2.78 MINOR AMDTS.					
			DEC	1.3.77	

British Railways Board
Chief Signal and Telecommunications Engineer

EXTENSION PLAN 105 & 105A
ON 2-WIRE PBX SYSTEMS WITH ENQUIRY TRANSFER OR OPERATOR RECALL FACILITIES
FOR MAIN AND 2 EXTENSIONS

British Rail

Chief S & T Engineer

No TR/C TN-1050

C1 6-1 06

A2 R.R. 888/39

EXTENSION PLAN 107 & 107A

FOR INTERNAL USE ONLY ON 2-WIRE PBX SYSTEMS WITH ENQUIRY TRANSFER OR OPERATOR RECALL FACILITIES

CONSISTS OF A MAIN TELEPHONE ON A PRESS KEY SWITCHING UNIT WITH ONE EXTENSION HAVING INTER-COMMUNICATION AND ACCESS TO ONE EXCHANGE LINE

FACILITIES

THE MAIN TELEPHONE WILL NORMALLY RECEIVE AND ORIGINATE CALLS BUT, BY OPERATION OF A PRESS KEY, THE EXTENSION TELEPHONE CAN BE SELECTED TO PERFORM BOTH FUNCTIONS

EXCHANGE CALLS FROM THE MAIN CANNOT BE HEARD AT THE EXTENSION AND, BY OPERATION OF A PRESS KEY, THE MAIN MAY HOLD SUCH CALLS TO SPEAK TO THE EXTENSION WITHOUT BEING HEARD ON THE EXCHANGE LINE

EXCHANGE CALLS FROM EXTENSION WILL BE SECRET FROM THE MAIN ONLY WHEN PLAN 107A IS USED

AT THE MAIN A WHITE LAMP WILL SHOW WHEN THE EXCHANGE LINE IS ENGAGED BY THE EXTENSION AND A RED LAMP WILL INDICATE THE EXCHANGE LINE HELD BY THE MAIN

ENQUIRY TRANSFER OR OPERATOR RECALL ACHIEVED BY THE OPERATION OF A PUSH BUTTON FITTED TO BOTH TELEPHONES

INTERCOMMUNICATION AND BOTHWAY SIGNALLING IS PROVIDED AND CONTROLLED BY PRESS KEYS

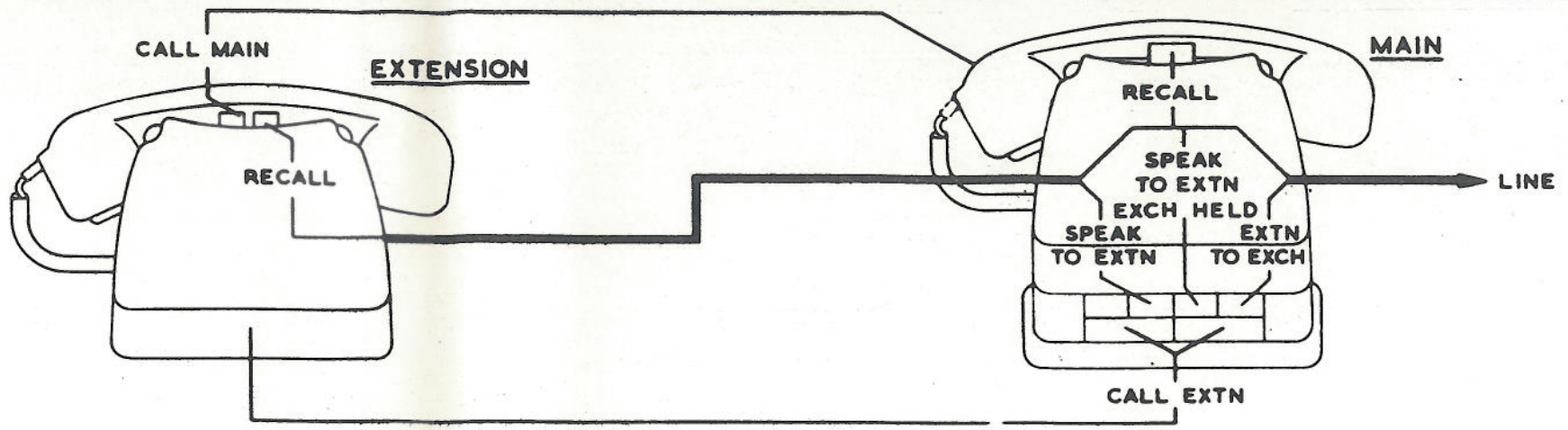
NOTES

TELEPHONES ARE SHOWN EQUIPPED FOR 'EARTH LOOP' RECALL. FOR 'ONE LINE EARTH LOOP DISCONNECTION' REMOVE STRAP T8-T9

WHEN AN EXTENSION BELL IS REQUIRED AT THE MAIN REMOVE THE STRAP ON PLAN-SET TERMINALS 6-7 AND CONNECT BELL TO BLOCK TERMINALS 6 & 7

WHEN EXTENSION REQUIRES AN ADDITIONAL BELL IT SHOULD BE CONNECTED IN PLACE OF STRAP 5-11 ON THE BLOCK TERMINAL

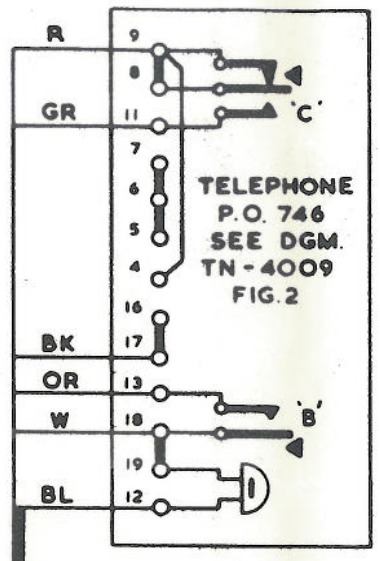
FOR THE CONVERSION OF PLAN 107 TO 107A SEE DGM. TN-1057 SHEET 2

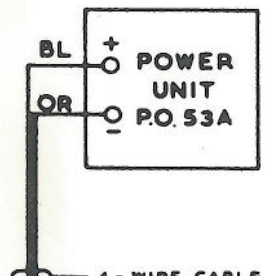


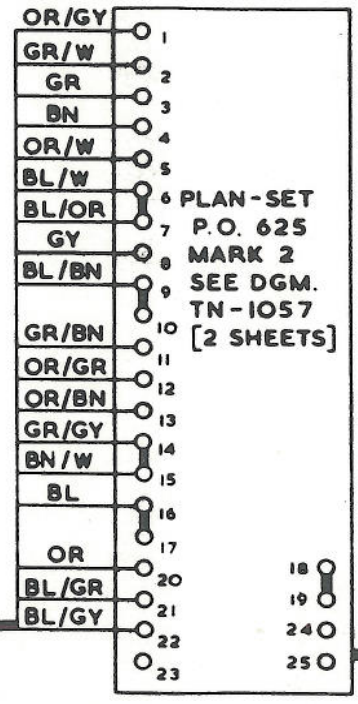
ALTERNATIVE APPARATUS

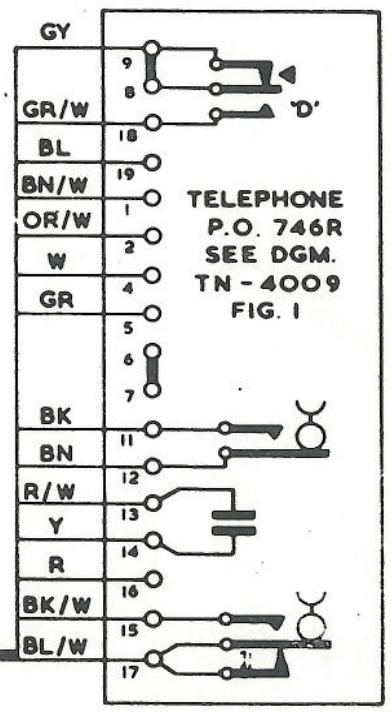
TELEPHONE 710

TN-3009 FIG.2









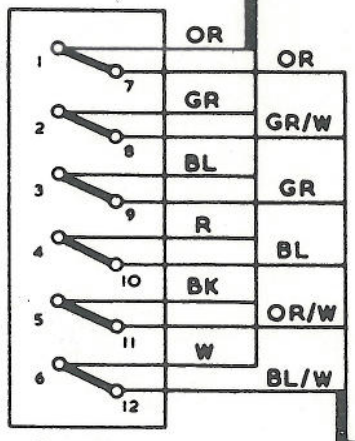
ALTERNATIVE APPARATUS

TELEPHONE 746

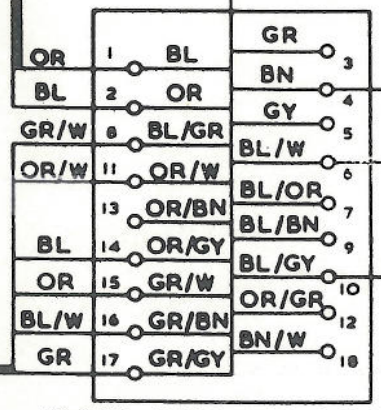
TN-4009 FIG. 1

TELEPHONE 706

TN-3009 FIG 1



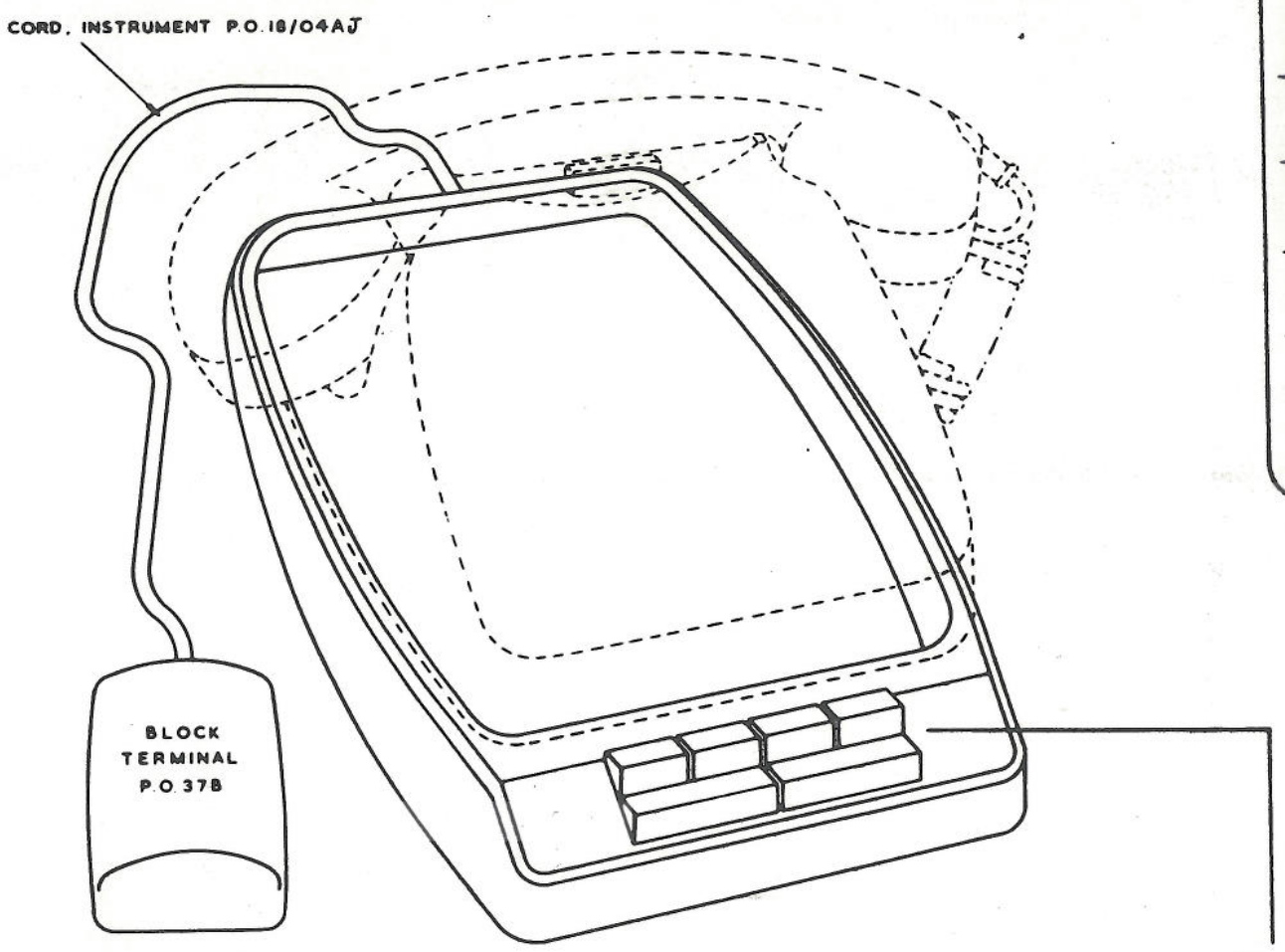
BLOCK TERMINAL P.O.35A



BLOCK TERMINAL P.O.37B

Revisions			British Railways Board Chief Signal and Telecommunications Engineer	British Rail
A 17-1-78 MINOR AMDTS.			EXTENSION PLAN 107 & 107A ON 2-WIRE PBX SYSTEMS WITH ENQUIRY TRANSFER OR OPERATOR RECALL FACILITIES FOR MAIN AND 1 EXTENSION	Chief S & T Engineer No. TR/CI TN-1070 C1 6-1 07
	DEC 1-3-77			

PLAN - SET P.O.625 MK.2 TABLE TYPE PRESS KEY SWITCHING UNIT FOR EXTENSION PLAN 105 & 107 AS SHOWN ON DGMS TN-1050 & TN-1070



METHOD OF FITTING TELEPHONE P.O.746 MODIFIED AS SHOWN ON TN-4009 FIG.1

RECOVER THE INSTRUMENT CORD & TERMINAL BLOCK

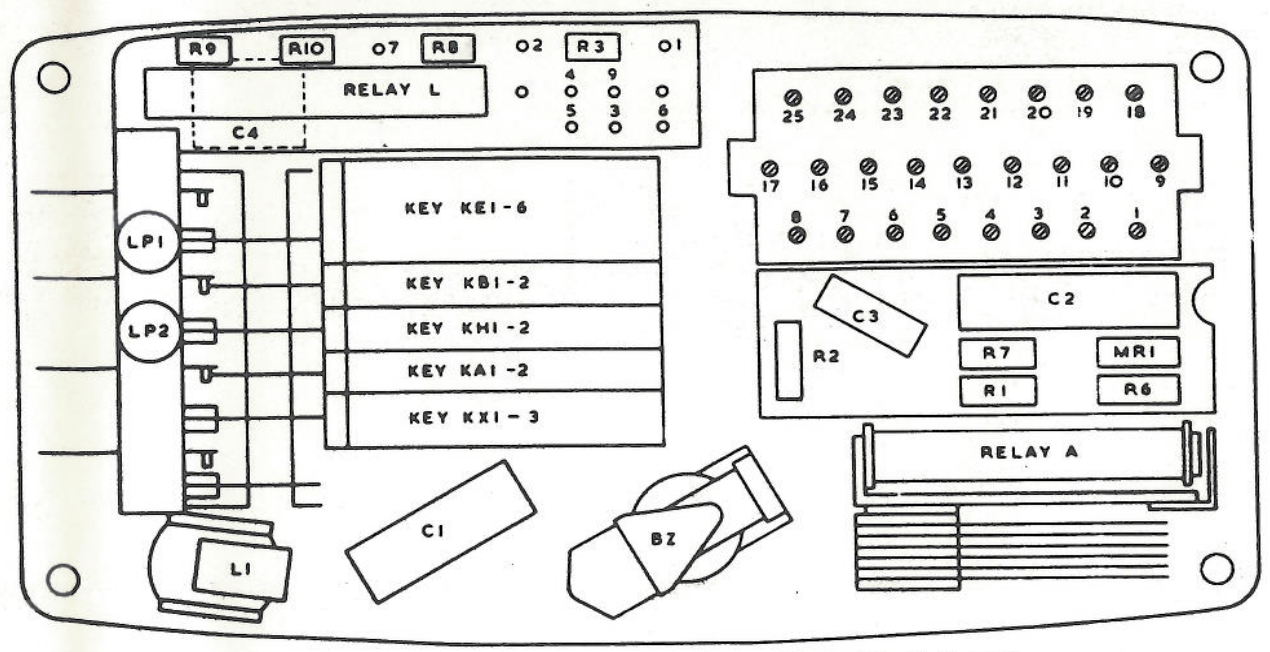
REMOVE THE FOUR RUBBER FEET

REMOVE THE ONE LARGE AND THREE SMALL KNOCK-OUTS FROM THE BASE

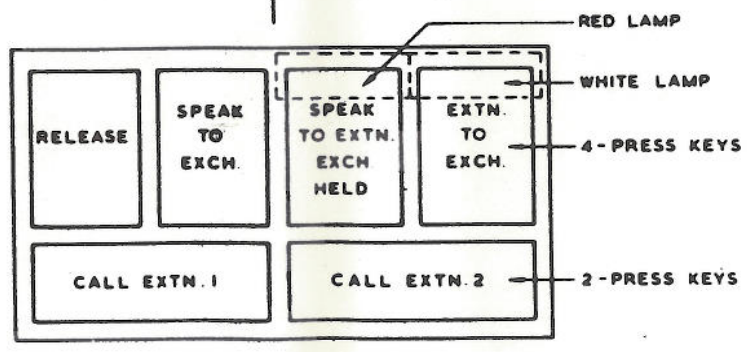
INSERT THE 15-WAY CABLE OF THE PLAN-SET VIA THE LARGE KNOCK-OUT

FIX THE BASE OF THE TELEPHONE TO THE PLAN-SET WITH THE THREE SCREWS PROVIDED, HAVING FITTED THE THREE LARGE WASHERS BETWEEN THE TWO UNITS

POSITION OF APPARATUS VIEWED FROM UNDERSIDE



BLOCK, TERMINAL P.O. 37B
CORD, INSTRUMENT P.O. 18/04AJ
BUZZER BZ P.O.32A
CAPACITOR C1 P.O. 7532 PAPER
CAPACITOR C2 PLESSEY ELECTROLYTIC CE21152/13 150/12 VOLTS
CAPACITOR C3 P.O. 1313/0·1 CERAMIC
CAPACITOR C4 P.O. 8023B
KA 1 & 2
KB 1 & 2
KEY UNIT KE 1-6 P.O. PART 1/DSP/1257
KH 1 & 2
KX 1-3
INDUCTOR L1 P.O. COIL 171B
LAMPS LP1 & LP2 P.O. 41B
RECTIFIER MR1 P.O. CV44B
RESISTORS R1, R2, R6 & R7 P.O. 26GC
RESISTOR R3 P.O. COIL 40
RESISTORS R8-10 P.O. 26KC
RELAY 'A' GEC DRG. 95021 ASSEMBLY 3 OR EQUIVALENT
RELAY 'L' P.O. 337A



POSITIONS OF PRESS KEYS & LAMPS

Revisions
A 16·1·78
MINOR AMDTS

DEC 1977

British Railways Board
Chief Signal and Telecommunications Engineer

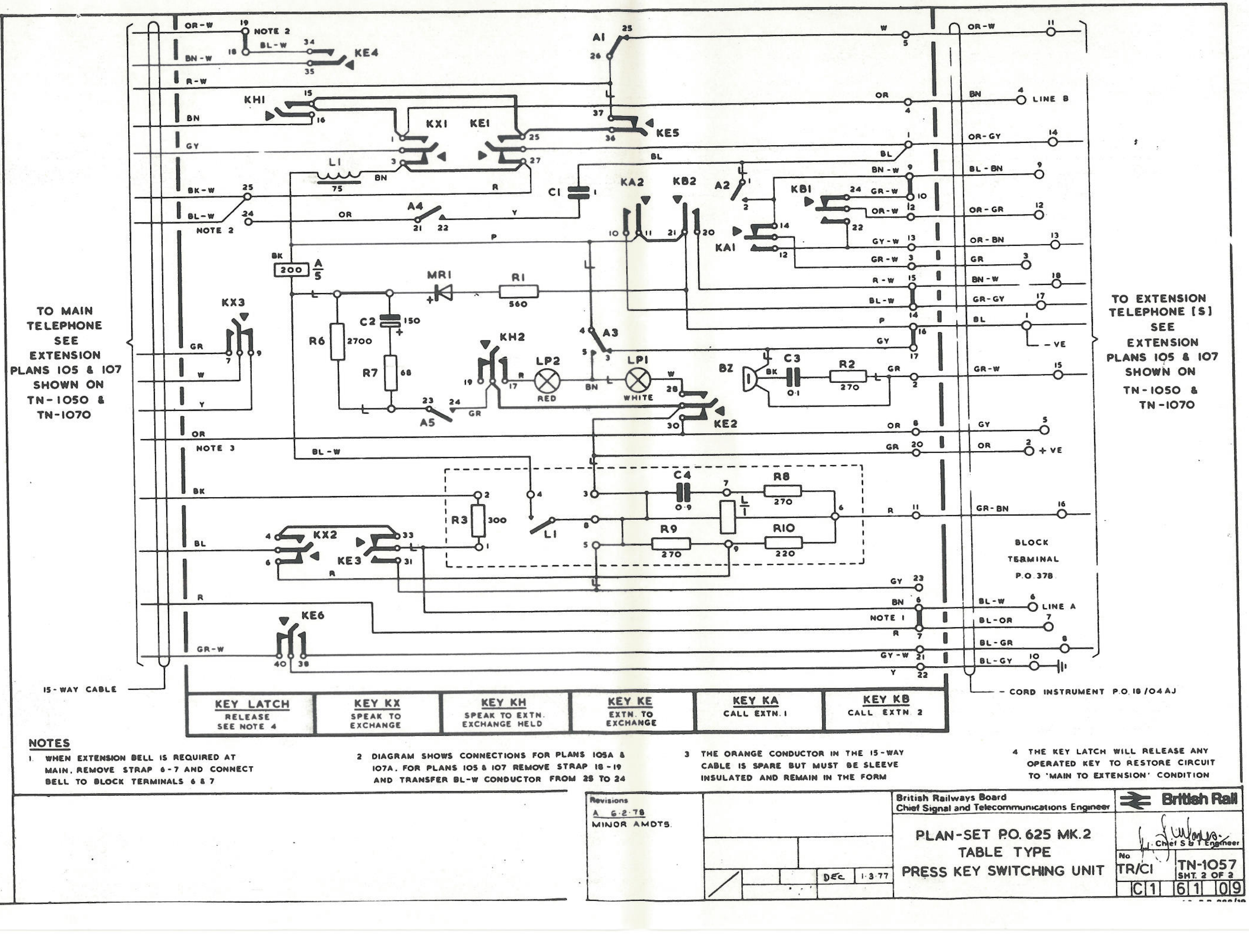
British Rail

PLAN-SET P.O. 625 MK.2 TABLE TYPE PRESS KEY SWITCHING UNIT

Chief S & T Engineer

No. TR/CI TN-1057 SHT. 1 OF 2

C1 | 6+1 | 08



NOTES

1. WHEN EXTENSION BELL IS REQUIRED AT MAIN, REMOVE STRAP 6-7 AND CONNECT BELL TO BLOCK TERMINALS 6 & 7
2. DIAGRAM SHOWS CONNECTIONS FOR PLANS 105A & 107A. FOR PLANS 105 & 107 REMOVE STRAP 18-19 AND TRANSFER BL-W CONDUCTOR FROM 25 TO 24
3. THE ORANGE CONDUCTOR IN THE 15-WAY CABLE IS SPARE BUT MUST BE SLEEVE INSULATED AND REMAIN IN THE FORM
4. THE KEY LATCH WILL RELEASE ANY OPERATED KEY TO RESTORE CIRCUIT TO 'MAIN TO EXTENSION' CONDITION

Revisions
A 6·2·78 MINOR AMDTS.

DEC 1·3·77

British Railways Board
Chief Signal and Telecommunications Engineer

British Rail

PLAN-SET P.O. 625 MK.2
TABLE TYPE
PRESS KEY SWITCHING UNIT

Chief S & T Engineer

No TR/CI TN-1057 SHT. 2 OF 2

C1 61 09

TELEPHONE P.O. 706

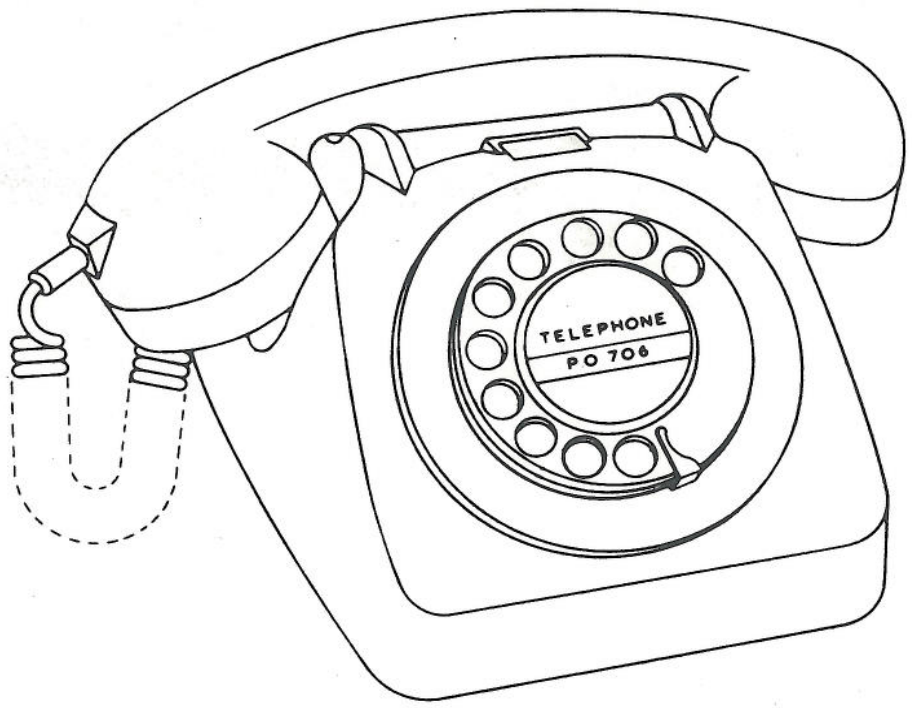


TABLE TELEPHONE – COLOURED GREY OR BLACK

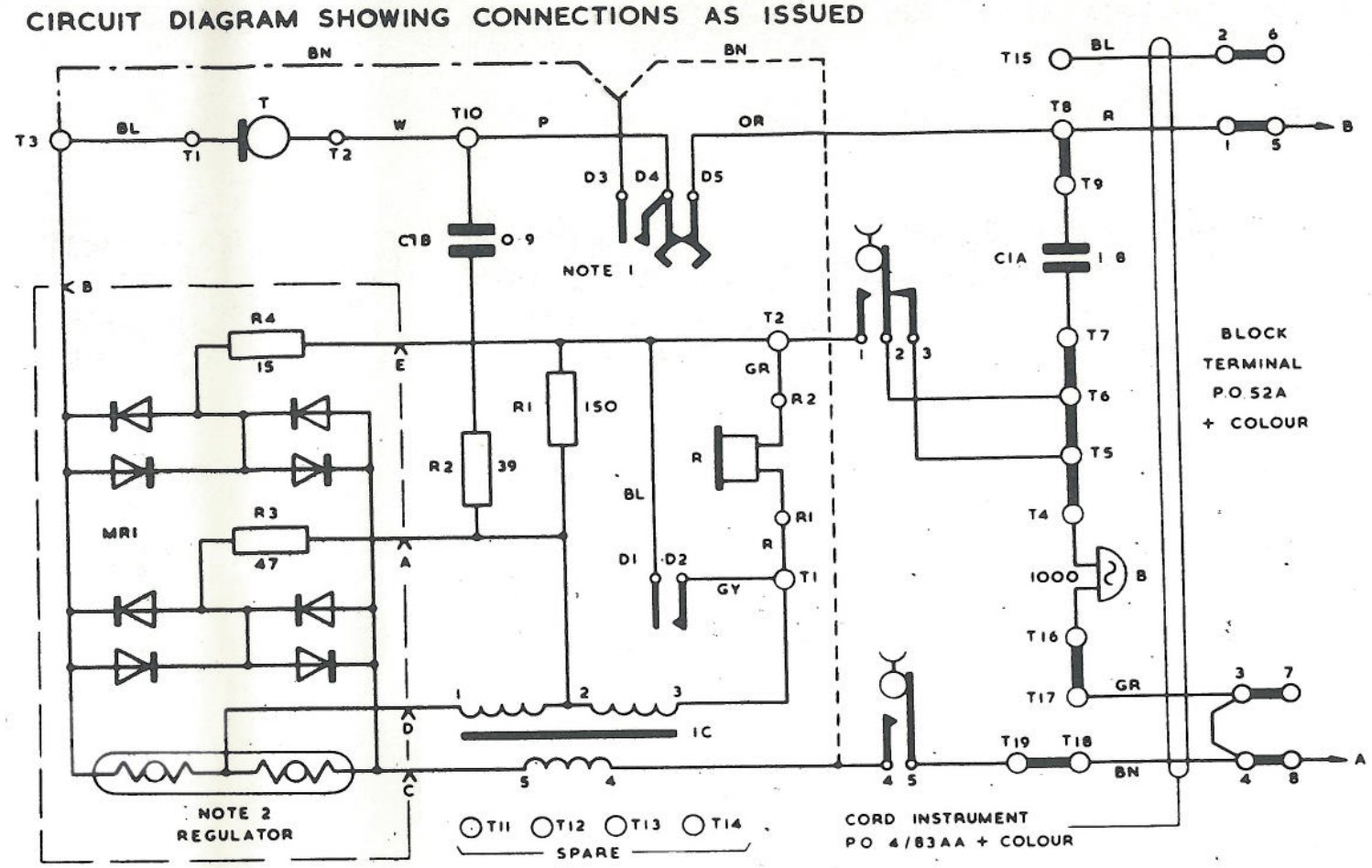
PARTS LIST FOR TELEPHONE 706 AS SUPPLIED

DIAL, AUTO P.O.21FA
RECEIVER, INSET P.O.4T
TRANSMITTER, INSET P.O.16
HANDSET P.O. 3
CORD, INSTRUMENT P.O.4/88AK
BLOCK, TERMINAL P.O.52A
CORD, INSTRUMENT P.O.4/83AA
PRESS BUTTON, DUMMY P.O. 2/DBU/258

FOR PRESS BUTTONS SEE TN-6849
AUXILIARY UNITS WHICH MAY BE FITTED AS ADDITIONAL ITEMS ARE SHOWN ON TN-6700 & TN-6808

TN 6849 & 6808

CIRCUIT DIAGRAM SHOWING CONNECTIONS AS ISSUED



NOTES

1. EARLIER ISSUES HAVE DIAL SPRING 3 CONNECTED TO GRAVITY SPRING 4 INSTEAD OF TERMINAL T3
2. THE REGULATOR IS INOPERATIVE WHEN REVERSED IN JACK TO CONNECT B, C & D TOGETHER FOR LOCAL BATTERY SYSTEMS
3. FOR C.B. WORKING REPLACE DIAL WITH DIAL, AUTO. DUMMY P.O. 3 AND JOIN THE PINK / ORANGE CONDUCTORS TO CONNECT TERMINALS T8 – T10
4. WHEN EXTENSION BELL IS REQUIRED, REMOVE STRAP 3–4 ON BLOCK TERMINAL P.O. 52A AND CONNECT BELL TO 7 – 8
5. THE CIRCUIT AS ISSUED IS SUITABLE FOR EXCLUSIVE SERVICE ON DIRECT EXCHANGE LINES OF AUTOMATIC SYSTEMS
6. THE CIRCUIT MAY BE MODIFIED AND EQUIPPED WITH AUXILIARY UNITS FOR EXTENSION PLAN WORKING AS SHOWN ON TN-3000 SERIES WIRING DIAGRAMS.

Revisions		British Railways Board Chief Signal and Telecommunications Engineer	British Rail
A 7·2·78 MINOR AMDTS		TABLE TELEPHONE P.O. TYPE 706 WITH PROVISION FOR 1 PRESS SWITCH	Chief S & T Engineer No TR/C1 TN-5706 C1 6+1 10
	DEC 1·3·77		

TELEPHONE P.O. 710

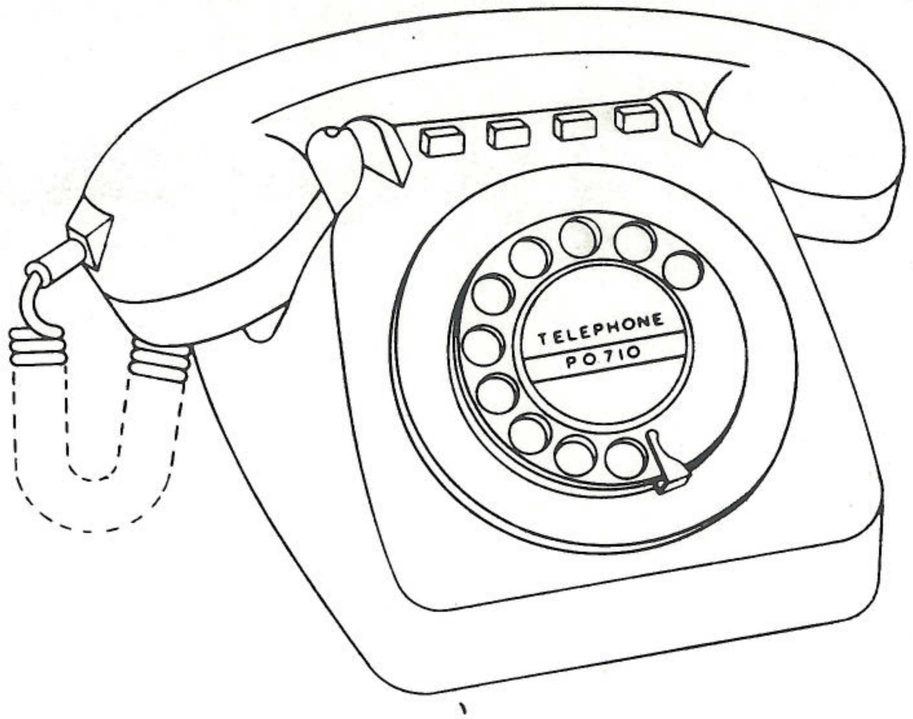


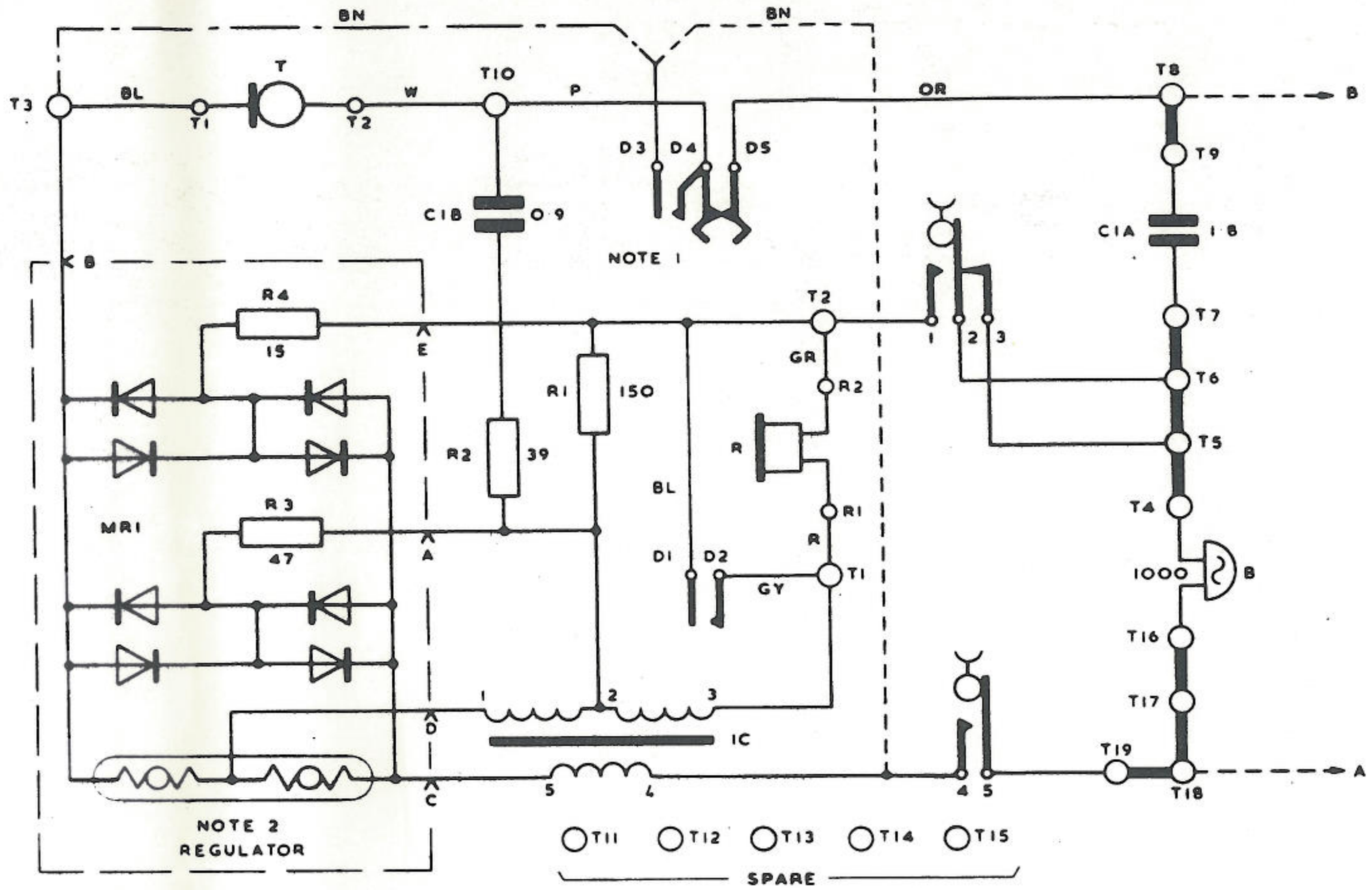
TABLE TELEPHONE – COLOURED GREY OR BLACK
SUITABLE FOR EQUIPPING WITH 1 TO 4 PRESS SWITCHES
AND OTHER AUXILIARY UNITS SHOWN ON TN-6700 & TN-6848

PARTS LIST FOR TELEPHONE 710 AS SUPPLIED

DIAL, AUTO P.O. 21FA
RECEIVER, INSET P.O. 4T
TRANSMITTER, INSET P.O. 16
HANDSET P.O. 3
CORD, INSTRUMENT P.O. 4/88AK
PRESS BUTTON, DUMMY P.O. 2/DBU/261

FOR PRESS BUTTONS SEE TN-6849

CIRCUIT DIAGRAM SHOWING CONNECTIONS AS ISSUED



NOTES

1. EARLIER ISSUES HAVE DIAL SPRING 3 CONNECTED TO GRAVITY SPRING 4 INSTEAD OF TERMINAL T3
2. THE REGULATOR IS INOPERATIVE WHEN REVERSED IN JACK TO CONNECT B, C & D TOGETHER FOR LOCAL BATTERY SYSTEMS
3. FOR C.B. WORKING REPLACE DIAL WITH DIAL, AUTO. DUMMY P.O. 3 AND JOIN THE PINK / ORANGE CONDUCTORS TO CONNECT TERMINALS T8–T10
4. THE CIRCUIT MAY BE MODIFIED AND EQUIPPED WITH AUXILIARY UNITS FOR EXTENSION PLAN WORKING AS SHOWN ON TN-3000 SERIES WIRING DIAGRAMS

Revisions		
A 7·2·78 MINOR AMDTS	Dee	1·3·77

British Railways Board
Chief Signal and Telecommunications Engineer

British Rail

TABLE TELEPHONE
P.O. TYPE 710
WITH PROVISION FOR
1 TO 4 PRESS SWITCHES

Chief S & T Engineer

No TR/C1 TN-5710

C1 6-1 11

TELEPHONE P.O. 740

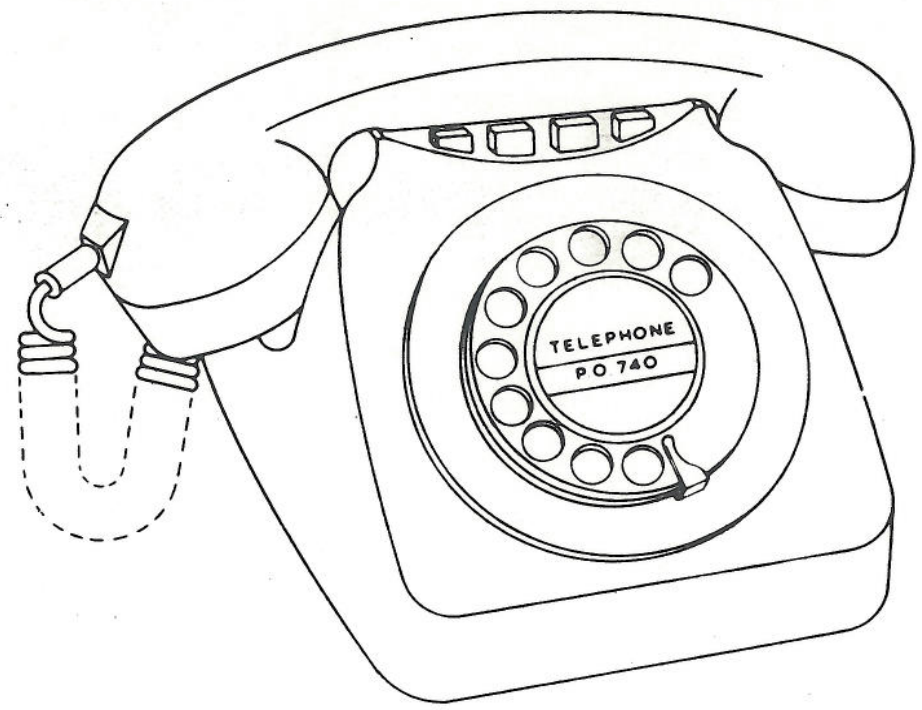


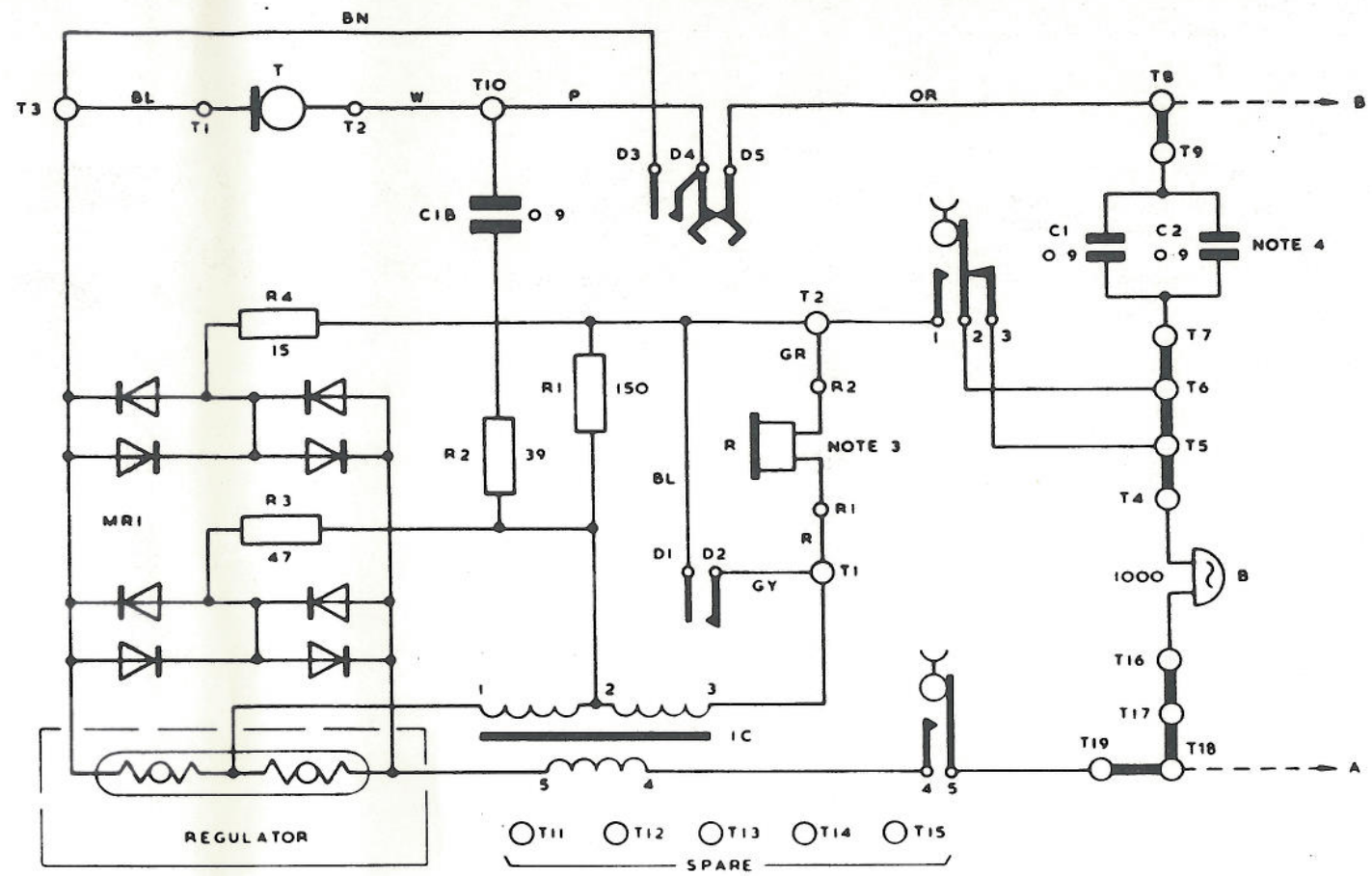
TABLE TELEPHONE – COLOURED GREY ONLY
SUITABLE FOR EQUIPPING WITH 1 TO 4 PRESS SWITCHES
AND OTHER AUXILIARY UNITS SHOWN ON TN-6700 & TN-6848

PARTS LIST FOR TELEPHONE 740 AS SUPPLIED

DIAL, AUTO P.O. 21FA
RECEIVER, INSET P.O. 4T
TRANSMITTER, INSET P.O. 16
HANDSET P.O. 3
CORD, INSTRUMENT P.O. 4/118AX
PRESS BUTTON, DUMMY P.O. 1 TO 4/DBU/375

FOR PRESS BUTTONS SEE TN-6849

CIRCUIT DIAGRAM SHOWING CONNECTIONS AS ISSUED



NOTES

1. OTHER THAN THE HANDSET, DIAL AND BELL ALL COMPONENTS ARE MOUNTED ON A PRINTED WIRING BOARD AVAILABLE FOR MAINTENANCE REPLACEMENT AS TELEPHONE, UNIT D92732
2. THE CIRCUIT MAY BE MODIFIED AND EQUIPPED WITH AUXILIARY UNITS FOR EXTENSION PLAN WORKING AS SHOWN ON TN-4000 SERIES WIRING DIAGRAMS
3. RECTIFIER ELEMENT (MR2) P.O. 205 CONNECTED TO TERMINALS T1 & T2 ON LATER ISSUES
4. C1 & C2 MAY BE EQUIPPED AS SHOWN OR AS A SINGLE 1·8uF CAPACITOR

TN 6848 & 6849 NOT AVAILABLE: MARCH 1977

Revisions		British Railways Board Chief Signal and Telecommunications Engineer	British Rail
A 7·2·78 MINOR AMDTS	DEC 1·3·77	TABLE TELEPHONE P.O. TYPE 740 WITH PROVISION FOR 1 TO 4 PRESS SWITCHES	Chief S & T Engineer No TR/C1 TN-5740 C1 6-1.1.2

A2 B R 888/19

TELEPHONE P.O. 746

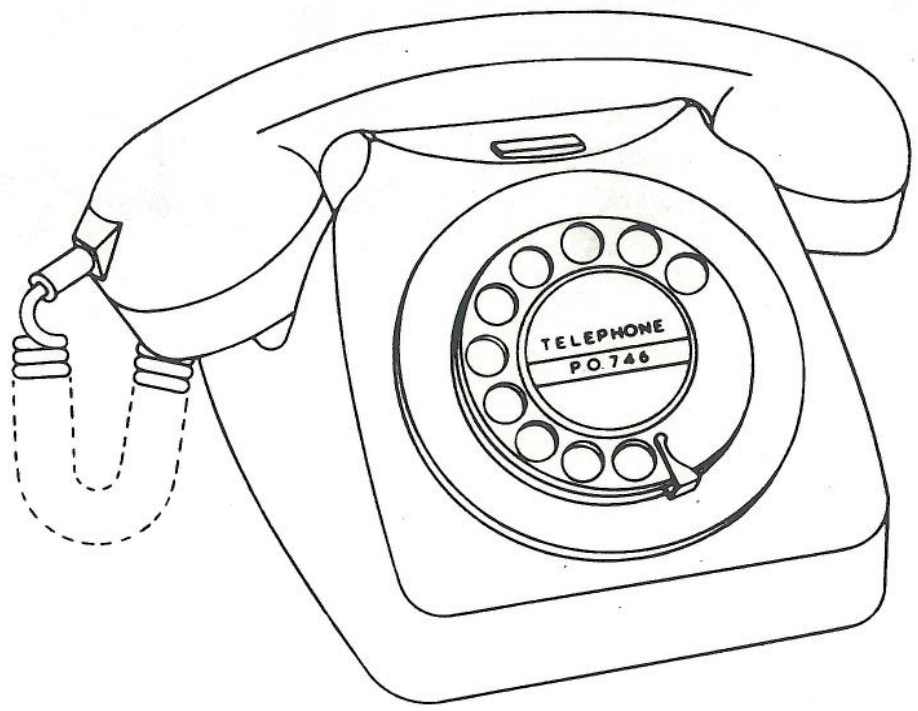


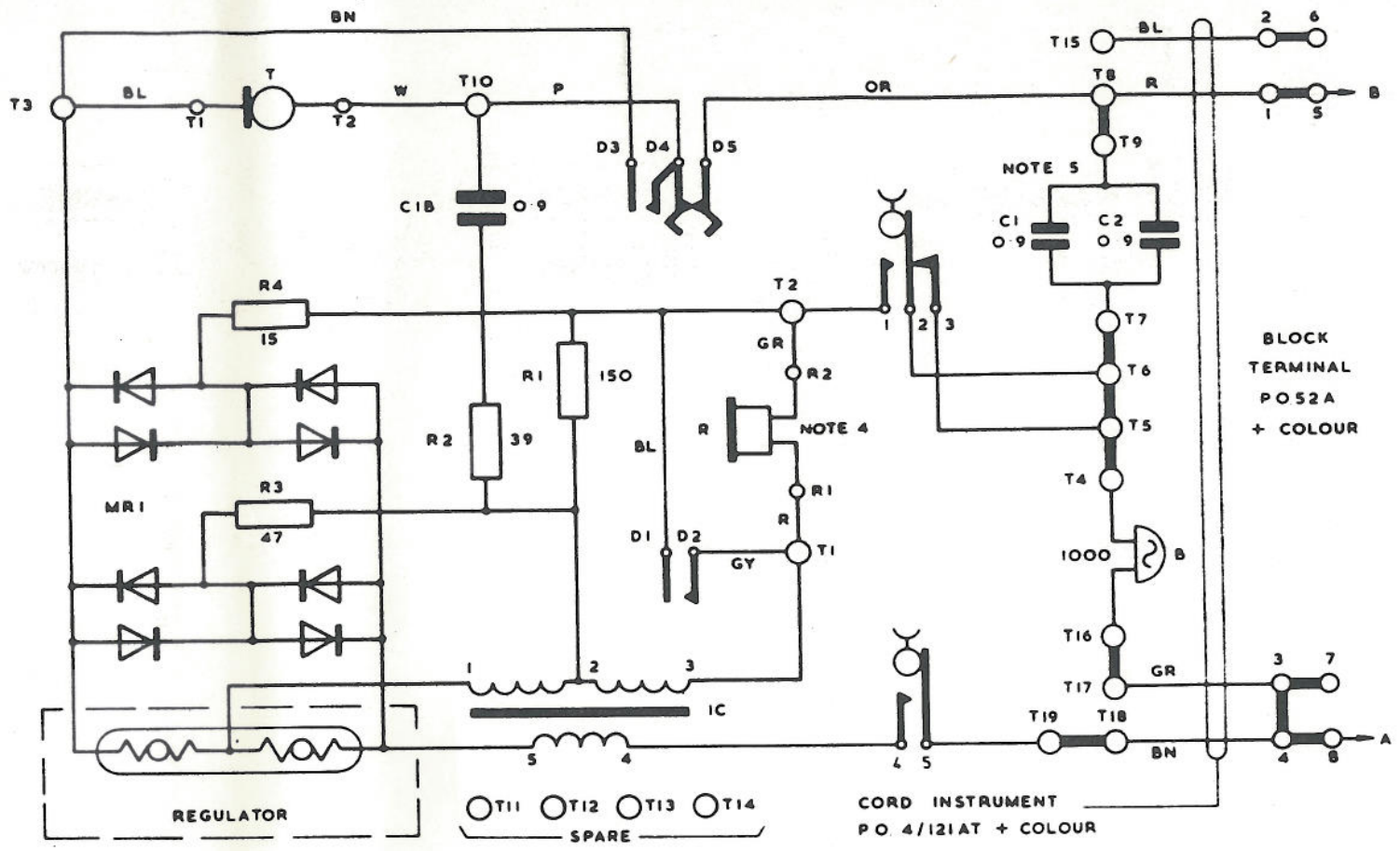
TABLE TELEPHONE – COLOURED GREY & BLACK

PARTS LIST FOR TELEPHONE 746 AS SUPPLIED

DIAL, AUTO P.O. 21FA
RECEIVER, INSET P.O. 4T
TRANSMITTER, INSET P.O.16
HANDSET P.O. 3
CORD, INSTRUMENT P.O.4/118AX
BLOCK, TERMINAL P.O. 52A
CORD, INSTRUMENT P.O.4/121AT
PRESS BUTTON, DUMMY P.O. 2/DBU/367

FOR PRESS BUTTONS SEE TN-6849
AUXILIARY UNITS WHICH MAY BE FITTED AS ADDITIONAL ITEMS ARE SHOWN ON TN-6700 & TN-6848

CIRCUIT DIAGRAM SHOWING CONNECTIONS AS ISSUED



NOTES

1. WHEN EXTENSION BELL IS REQUIRED, REMOVE STRAP 3-4 ON BLOCK TERMINAL P.O.52A AND CONNECT BELL TO 7-8
2. OTHER THAN THE HANDSET, DIAL AND BELL ALL COMPONENTS ARE MOUNTED ON A PRINTED WIRING BOARD AVAILABLE FOR MAINTENANCE REPLACEMENT AS TELEPHONE, UNIT D92732
3. THE CIRCUIT AS ISSUED IS SUITABLE FOR EXCLUSIVE SERVICE ON DIRECT EXCHANGE LINES OF AUTOMATIC SYSTEMS
4. RECTIFIER ELEMENT (MR2) P.O. 205 CONNECTED TO TERMINALS T1 & T2 ON LATER ISSUES
5. C1 & C2 MAY BE EQUIPPED AS SHOWN OR AS A SINGLE 1·8uF CAPACITOR
6. THE CIRCUIT MAY BE MODIFIED AND EQUIPPED WITH AUXILIARY UNITS FOR EXTENSION PLAN WORKING AS SHOWN ON TN-4000 SERIES WIRING DIAGRAMS.

TN 6848, 6849 NOT AVAILABLE: MARCH 1977

Revisions			British Railways Board Chief Signal and Telecommunications Engineer	British Rail
A 7·2·76 MINOR AMDTS			TABLE TELEPHONE P.O. TYPE 746 WITH PROVISION FOR 1 OR 2 PRESS SWITCHES	Chief S & T Engineer
		DEC 1·3·77		No TR/C1 TN-5746
				C1 6+1 3

A2 BR 888/10

TELEPHONE P.O. 746R

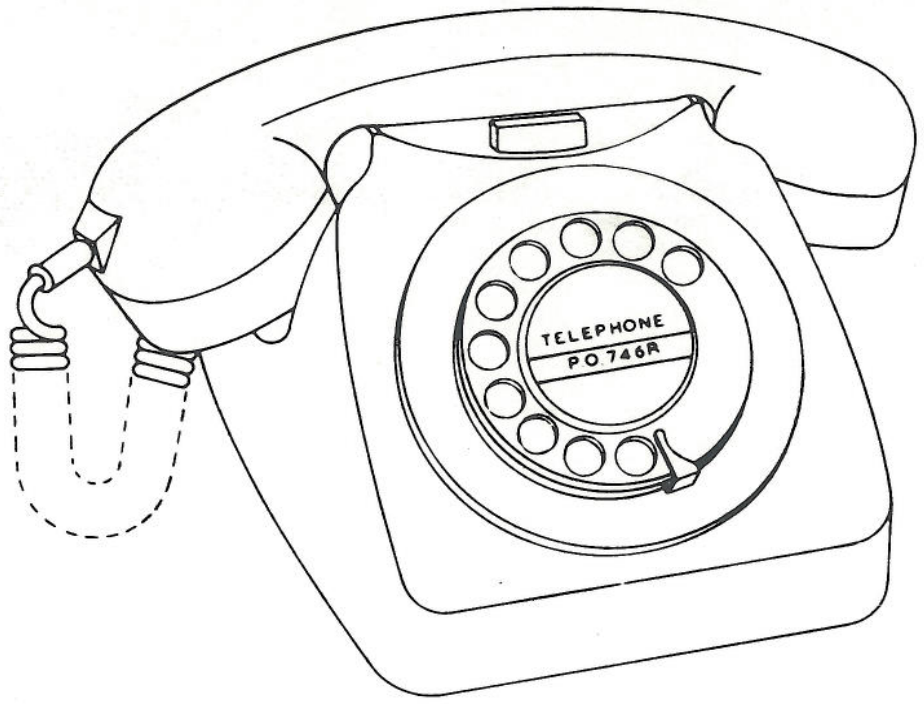


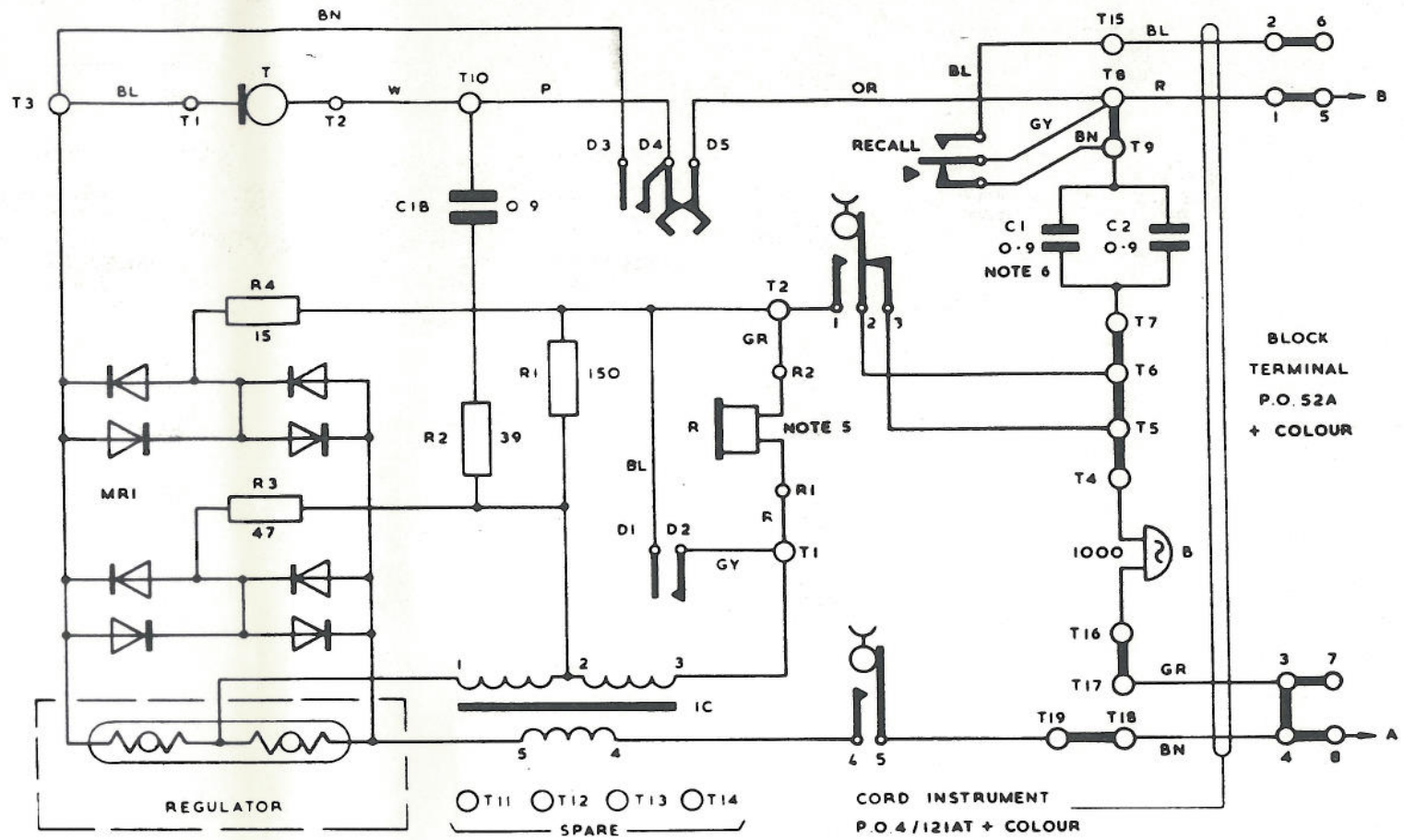
TABLE TELEPHONE – COLOURED GREY & BLACK
EQUIPPED WITH 1 PRESS SWITCH

PARTS LIST FOR TELEPHONE 746R AS SUPPLIED

DIAL, AUTO P.O. 21FA.
RECEIVER, INSET P.O. 4T
TRANSMITTER, INSET P.O. 16
HANDSET P.O. 3
CORD, INSTRUMENT P.O. 4/118AX
BLOCK, TERMINAL P.O. 52A
CORD, INSTRUMENT P.O. 4/121AT
SWITCH P.O. 5A-4
PRESS BUTTON P.O. 4/DBU/362 SEE NOTE 4
PLUNGER P.O. PART 1/DPL/1022
2-PINS P.O. PART 1/DPI/203
AUXILIARY UNITS WHICH MAY BE FITTED AS ADDITIONAL ITEMS ARE SHOWN ON TN-6700 & TN-6848
FOR PRESS BUTTONS SEE TN-6849

TN6848, 6849

CIRCUIT DIAGRAM SHOWING CONNECTIONS AS ISSUED



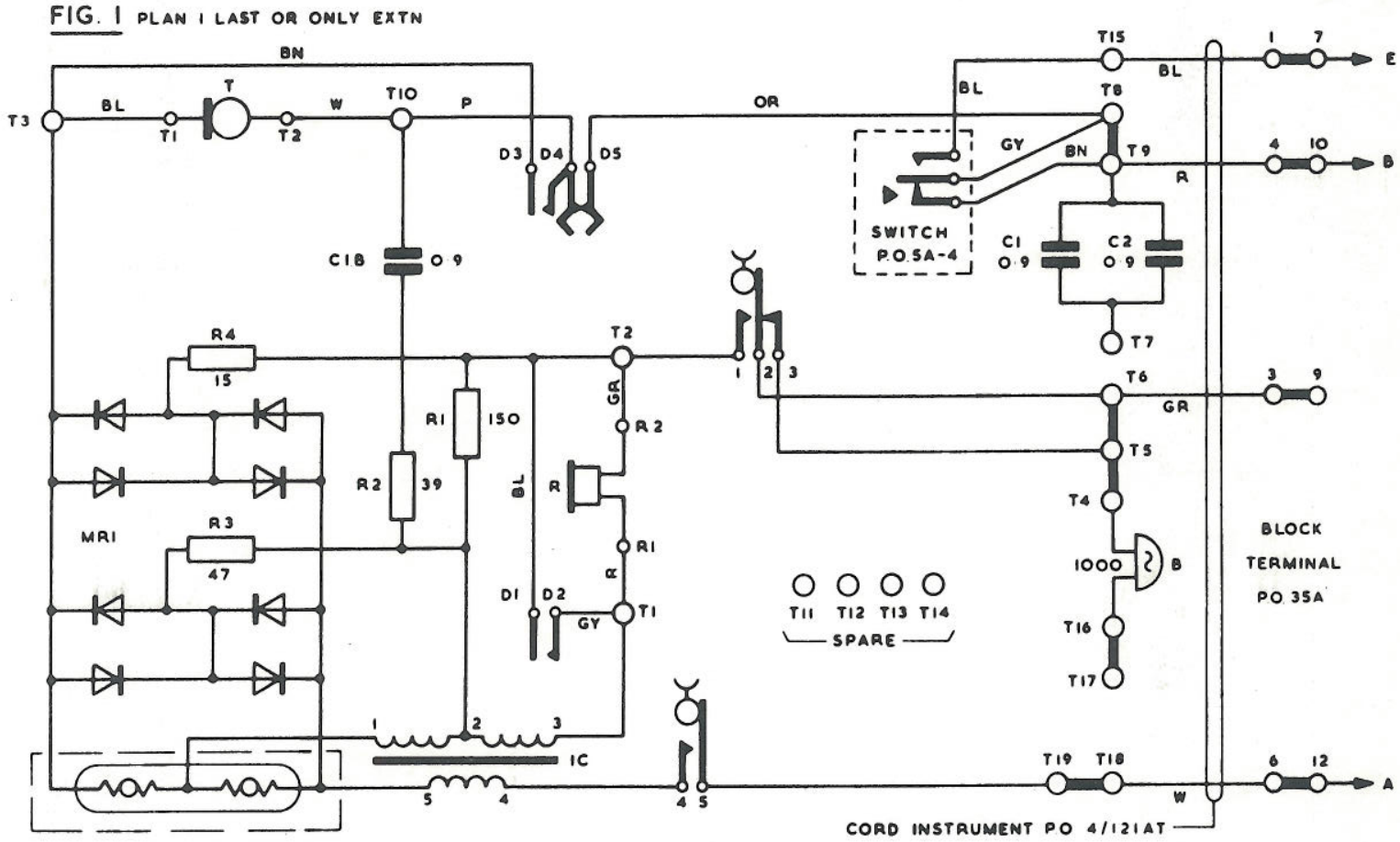
NOTES

1. WHEN EXTENSION BELL IS REQUIRED, REMOVE STRAP 3-4 ON BLOCK TERMINAL P.O. 52A AND CONNECT BELL TO 7-8
2. OTHER THAN THE HANDSET, DIAL, AND BELL, ALL COMPONENTS ARE MOUNTED ON A PRINTED WIRING BOARD AVAILABLE FOR MAINTENANCE REPLACEMENT AS TELEPHONE, UNIT D92732
3. THE CIRCUIT IS FOR USE ON AUTOMATIC SYSTEMS WITH FACILITIES FOR :-
   SHARED SERVICE LINES
   OPERATOR RECALL
   ENQUIRY TRANSFER
   C-WIRE SIGNALLING
   EXTENSION PLAN WORKING
4. PART 4/DBU/362 PRESS BUTTON ENGRAVED 'RECALL' IS SUPPLIED WITH TELEPHONE AND CANNOT BE OBTAINED SEPARATELY. REPLACEMENT PART WILL BE 1/DBU/362
5. RECTIFIER ELEMENT (MR2) P.O. 205 CONNECTED TO TERMINALS T1 & T2 ON LATER ISSUES
6. C1 & C2 MAY BE EQUIPPED AS SHOWN OR AS A SINGLE 1·8 uF CAPACITOR
7. THE CIRCUIT MAY BE MODIFIED AND EQUIPPED WITH AUXILIARY UNITS FOR EXTENSION PLAN WORKING AS SHOWN ON TN-4000 SERIES WIRING DIAGRAMS

Revisions		British Railways Board Chief Signal and Telecommunications Engineer	British Rail
A 7·2·78 MINOR AMDTS		TABLE TELEPHONE P.O. TYPE 746R WITH ONE PRESS SWITCH	Chief S & T Engineer
	DEC 1·9·77		No. TR/C1 TN-5747 C1 6-1 3 4

A2 S.R. 888/19

FIG. 1 PLAN 1 LAST OR ONLY EXTN



TELEPHONE 746/746R DISCONNECT STRAP BETWEEN T6 & T7

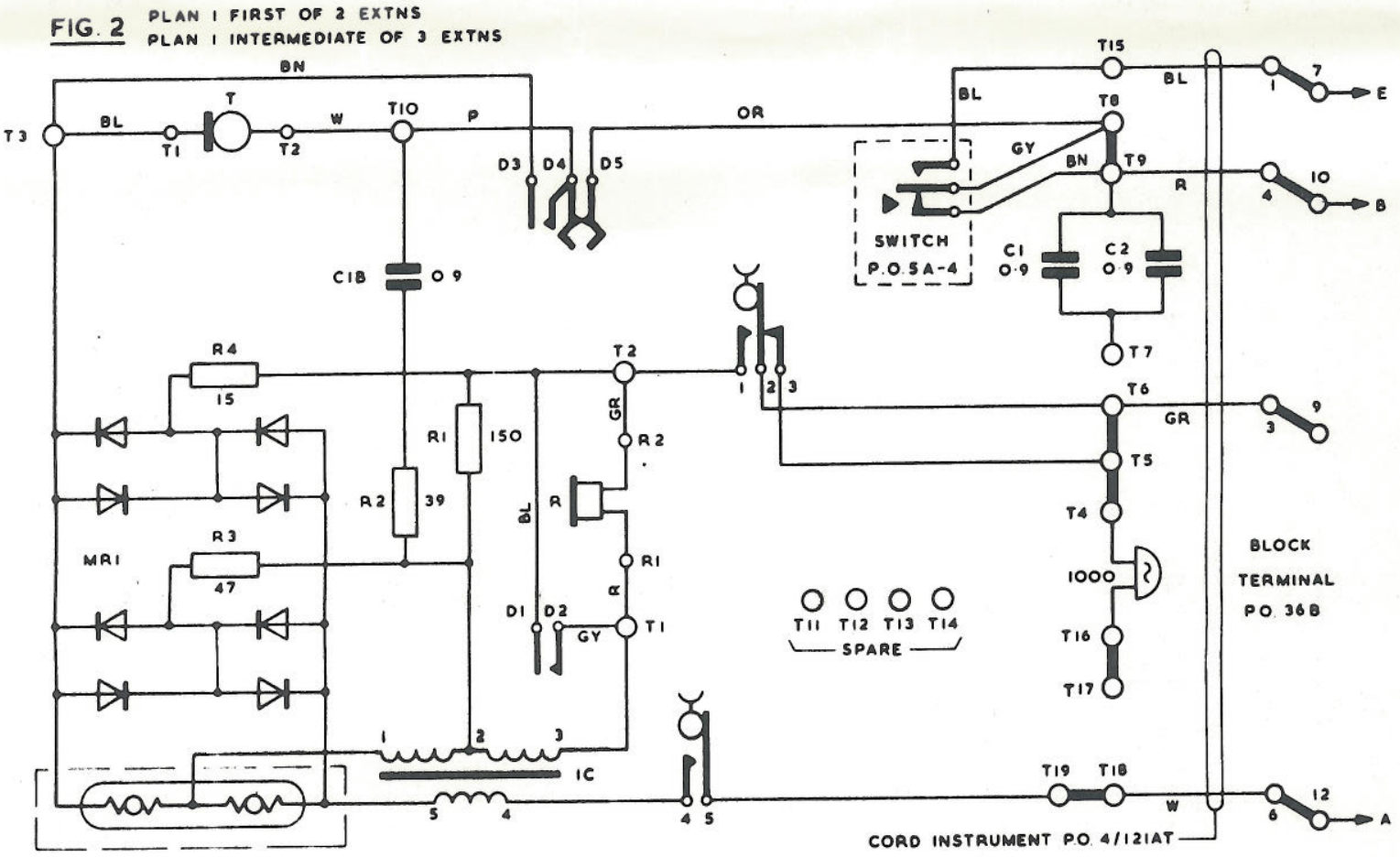
SWITCH P.O. 5A-4
PRESS BUTTON P.O 1/DBU/362
PLUNGER P.O PART 1/DPL/1022
2-PINS P.O. PART 1/DPI/203
} ASSEMBLE & WIRE TO TERMINALS T8, T9 & T15 } FOR TELEPHONES 746

CORD, INSTRUMENT P.O. 4/121AT - AS ISSUED BUT CONNECT AS SHOWN

BLOCK, TERMINAL P.O 35A - STRAP 1-7, 3-9, 4-10 & 6-12

BELL P.O. 56A - CONNECT COILS IN SERIES

FIG. 2 PLAN 1 FIRST OF 2 EXTNS
PLAN 1 INTERMEDIATE OF 3 EXTNS



TELEPHONE 746/746R DISCONNECT STRAP BETWEEN T6 & T7

SWITCH P.O. 5A-4
PRESS BUTTON P.O 1/DBU/362
PLUNGER P.O PART 1/DPL/1022
2-PINS P.O. PART 1/DPI/203
} ASSEMBLE AND WIRE TO TERMINALS T8, T9 & T15 } FOR TELEPHONES 746

CORD, INSTRUMENT P.O. 4/121AT - AS ISSUED BUT CONNECT AS SHOWN

BLOCK, TERMINAL P.O. 36B - STRAP 1-7, 3-9, 4-10 & 6-12

BELL P.O. 56A - CONNECT COILS IN SERIES

Revisions
A 6.2.78
MINOR AMDTS

DFC 13.7.7

British Railways Board
Chief Signal and Telecommunications Engineer

MODIFICATIONS
TO TELEPHONES
P.O. TYPES 746 & 740
FOR
EXTENSION PLAN WORKING

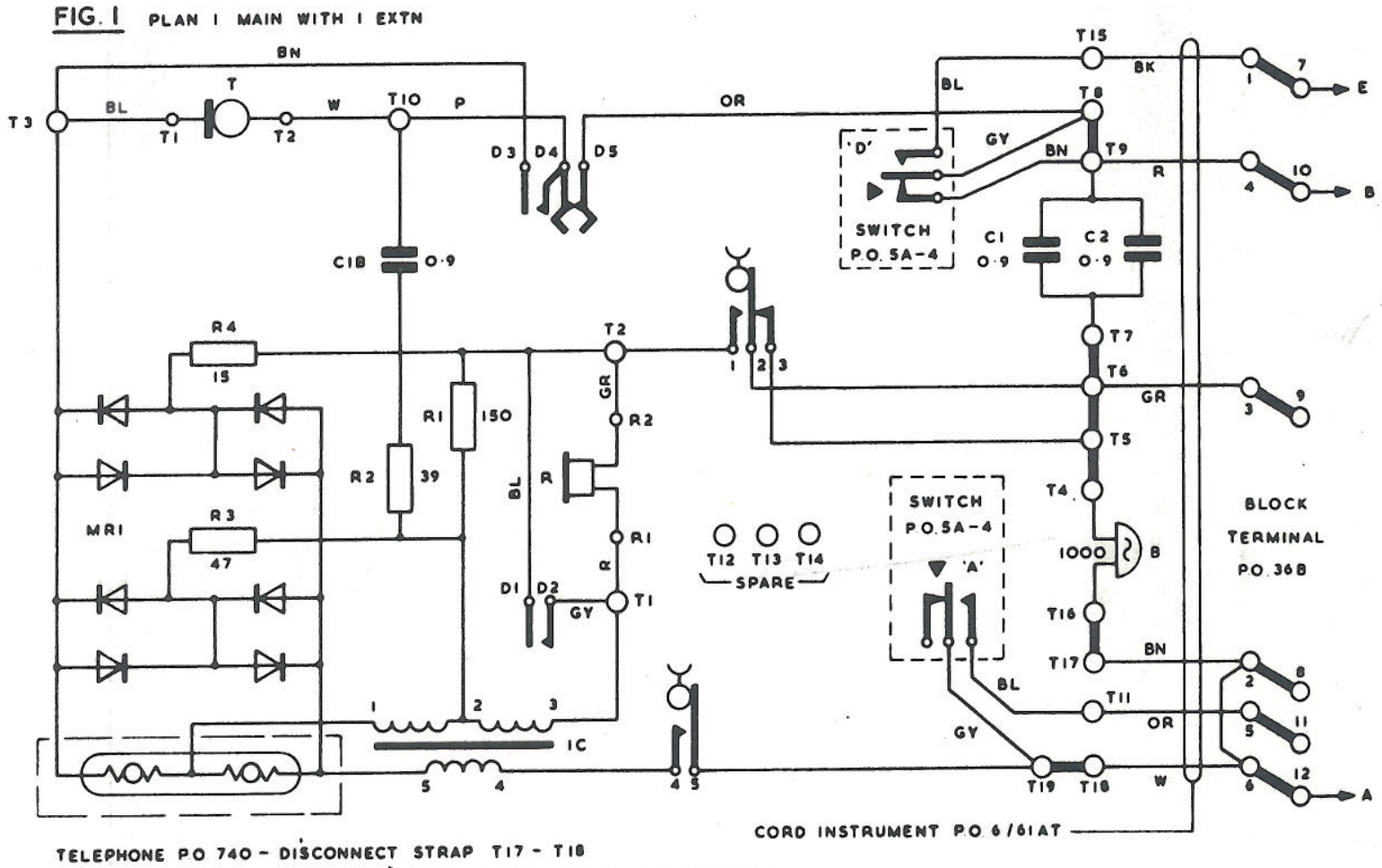
British Rail

No TR/C1 TN-4001

Chief S & T Engineer

C1 6+1 15

FIG. 1 PLAN 1 MAIN WITH 1 EXTN



TELEPHONE P.O 740 – DISCONNECT STRAP T17 – T18

SWITCH P.O.5A – 4 } FIT IN POSITION 'A' AND WIRE TO
PRESS BUTTON P.O.3/DBU/372 } TERMINALS T11 & T19

SWITCH P.O.5A – 4 } FIT IN POSITION 'D' AND WIRE TO
PRESS BUTTON P.O.8/DBU/372 } TERMINALS T8, T9 & T15

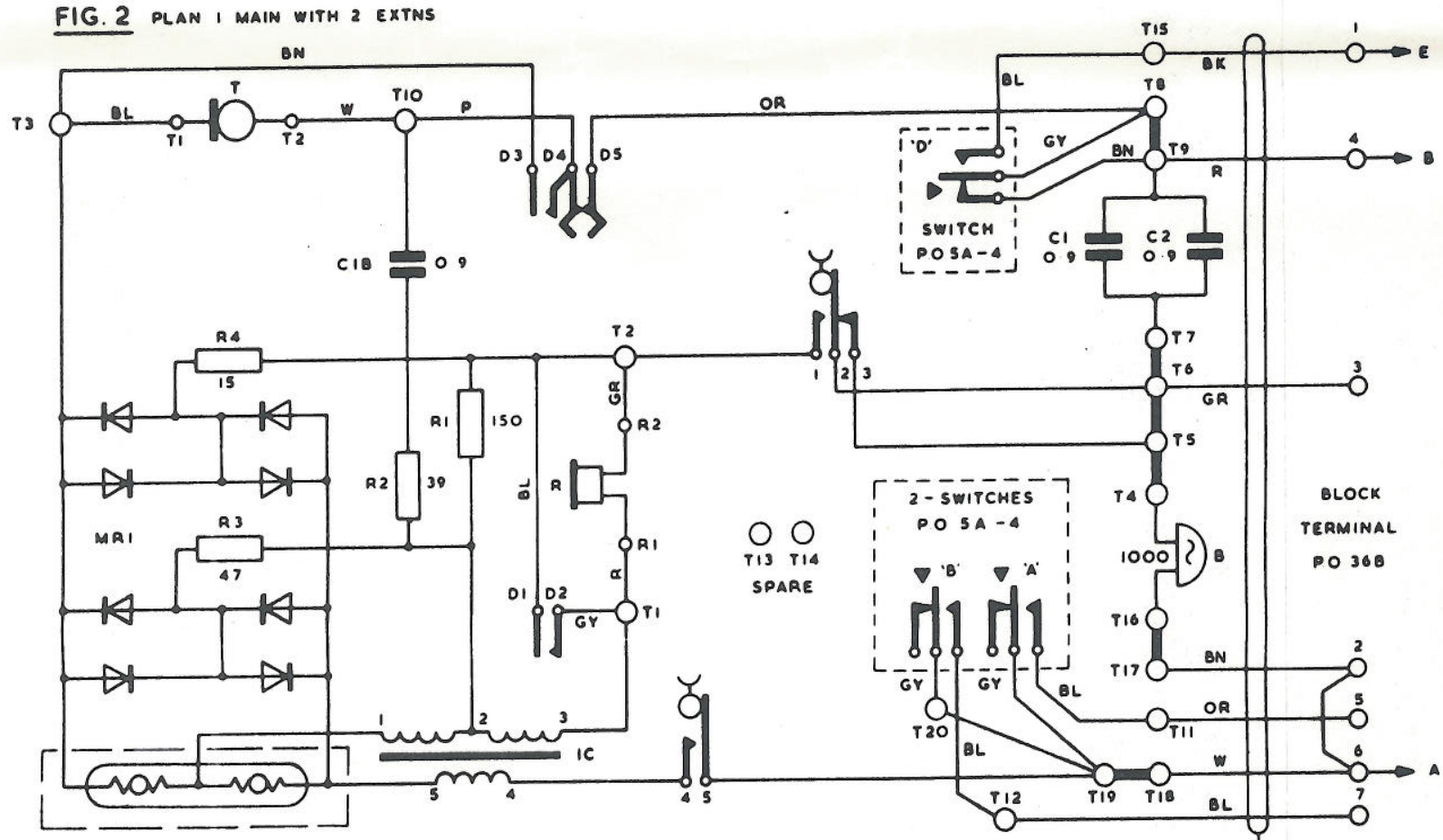
2 – PINS P.O. PART 1/DPI/203 – FIT ONE WITH EACH PRESS BUTTON

CORD, INSTRUMENT P.O.6/61AT – CONNECT AS SHOWN

BLOCK, TERMINAL P.O.36B – STRAP 1–7, 2–8, 3–9, 4–10, 5–11 & 6–12 ALSO LINK 2–6

ADJUST LATCHES ON 'A' & 'D' TO SETTING 3 WITH 'X' & 'Y' LATCHES AT SETTING 5 – SEE DGM TN-6848

FIG. 2 PLAN 1 MAIN WITH 2 EXTNS



TELEPHONE P.O 740 – DISCONNECT STRAP T17 – T18

TERMINAL STRIP P.O. PART 2/DST/836 – EQUIP FOR ADDITIONAL TERMINATIONS AND STRAP T20 – T19

SWITCH P.O.5A – 4 } FIT IN POSITION 'A' AND WIRE TO
PRESS BUTTON P.O.5/DBU/372 } TERMINALS T11 & T19

SWITCH P.O.5A – 4 } FIT IN POSITION 'B' AND WIRE TO
PRESS BUTTON P.O.6/DBU/372 } TERMINALS T12 & T20

SWITCH P.O.5A – 4 } FIT IN POSITION 'D' AND WIRE TO
PRESS BUTTON P.O.8/DBU/372 } TERMINALS T8, T9 & T15

3 – PINS P.O. PART 1/DPI/203 – FIT ONE TO EACH PRESS BUTTON

CORD, INSTRUMENT P.O. 9/21AD – CONNECT AS SHOWN AND CUT BACK SPARES

BLOCK, TERMINAL P.O. 36B – LINK 2–6 ONLY

ADJUST LATCHES ON 'A', 'B' & 'D' TO SETTING 3 WITH 'X' & 'Y' LATCHES AT SETTING 5 – SEE DGM TN-6848

Revisions
A 6.8.78 MINOR AMDTS

DFC 1.3.77

British Railways Board
Chief Signal and Telecommunications Engineer

MODIFICATIONS TO TELEPHONES P.O. TYPES 746 & 740 FOR EXTENSION PLAN WORKING

British Rail

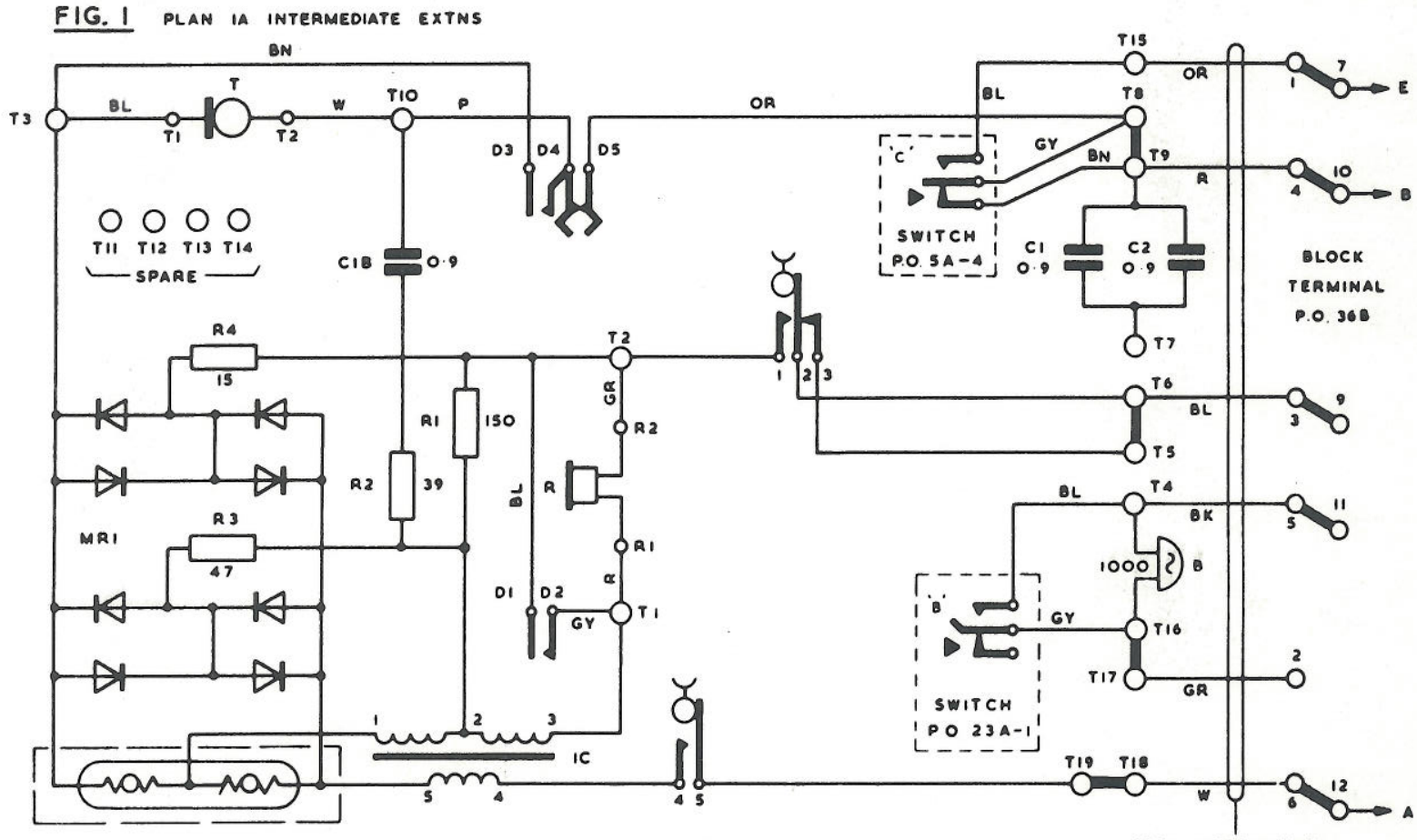
No. TR/CI

C1 6+1 116 TN-4004

Chief S & T Engineer

A2 BR 888/19

FIG. 1 PLAN 1A INTERMEDIATE EXTNS



TELEPHONE P.O. 746 - DISCONNECT STRAPS T4-T5, T6-T7 & T17-T18

SWITCH P.O. 23A-1 } FIT IN POSITION 'B' AND WIRE TO
PRESS BUTTON P.O. 2/DBU/363 } TERMINALS T4 & T16

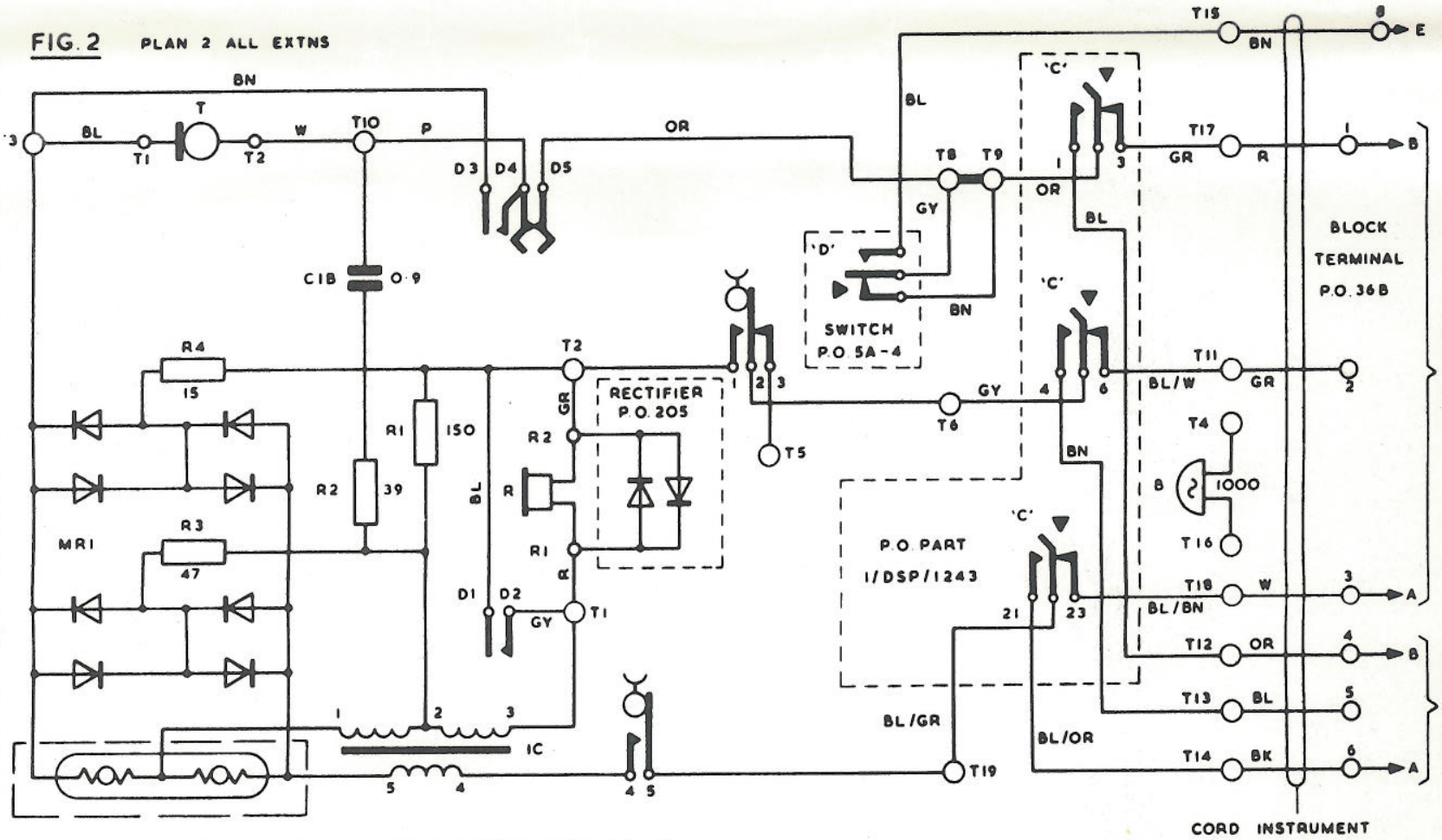
SWITCH P.O. 5A-4 } FIT IN POSITION 'C' AND WIRE TO
PRESS BUTTON P.O. 7/DBU/363 } TERMINALS T8, T9 & T15

2 - PINS P.O. PART 1/DPI/203 - FIT ONE TO EACH PRESS BUTTON

CORD, INSTRUMENT P.O. 6/61AT - CONNECT AS SHOWN

BLOCK, TERMINAL P.O. 36B - STRAP 1-7, 3-9, 4-10, 5-11 & 6-12

FIG. 2 PLAN 2 ALL EXTNS



TELEPHONE P.O. 740 - REMOVE ALL STRAPS OTHER THAN T8 - T9

SWITCH P.O. 1/DSP/1243 } FIT IN POSITION 'C' AND WIRE TO TERMINALS
PRESS BUTTON P.O. 6/DBU/372 } T6, T9, T11, T12, T13, T14, T17, T18 & T19

SWITCH P.O. 5A-4 } FIT IN POSITION 'D' AND WIRE TO
PRESS BUTTON P.O. 8/DBU/372 } TERMINALS T8, T9 & T15

2 - PINS P.O. PART 1/DPI/203 - FIT ONE TO EACH PRESS BUTTON

RECTIFIER ELEMENT P.O. 205 - EQUIP TO RECEIVER INSET IN HANDSET WHEN NOT SUPPLIED WITH TELEPHONE

CORD, INSTRUMENT P.O. 9/21AD } CONNECT AS SHOWN AND CUT BACK SPARES
BLOCK, TERMINAL P.O. 36B }

ADJUST LATCH ON 'C' TO SETTING 1 AND 'D' TO 3 WITH 'X' & 'Y' LATCHES ON SETTING 4 - SEE DGM TN-4006

Revisions
A 6.2.78 MINOR AMDTS
DEC 1.3.77

British Railways Board
Chief Signal and Telecommunications Engineer

MODIFICATIONS TO TELEPHONES P.O. TYPES 746 & 740 FOR EXTENSION PLAN WORKING

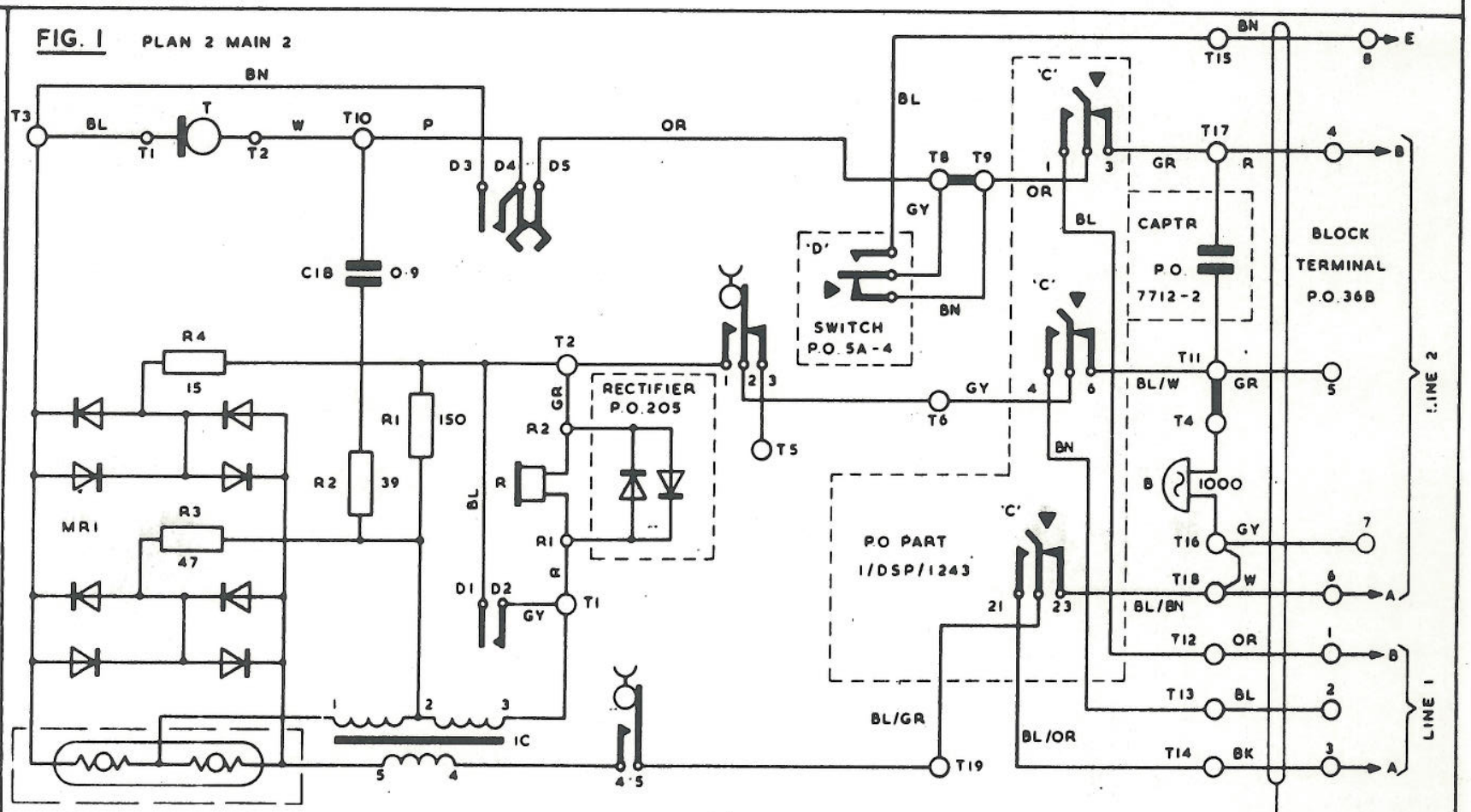
British Rail

No. TR/CI C1 6+1 117 TN-4006

Chief S & T Engineer

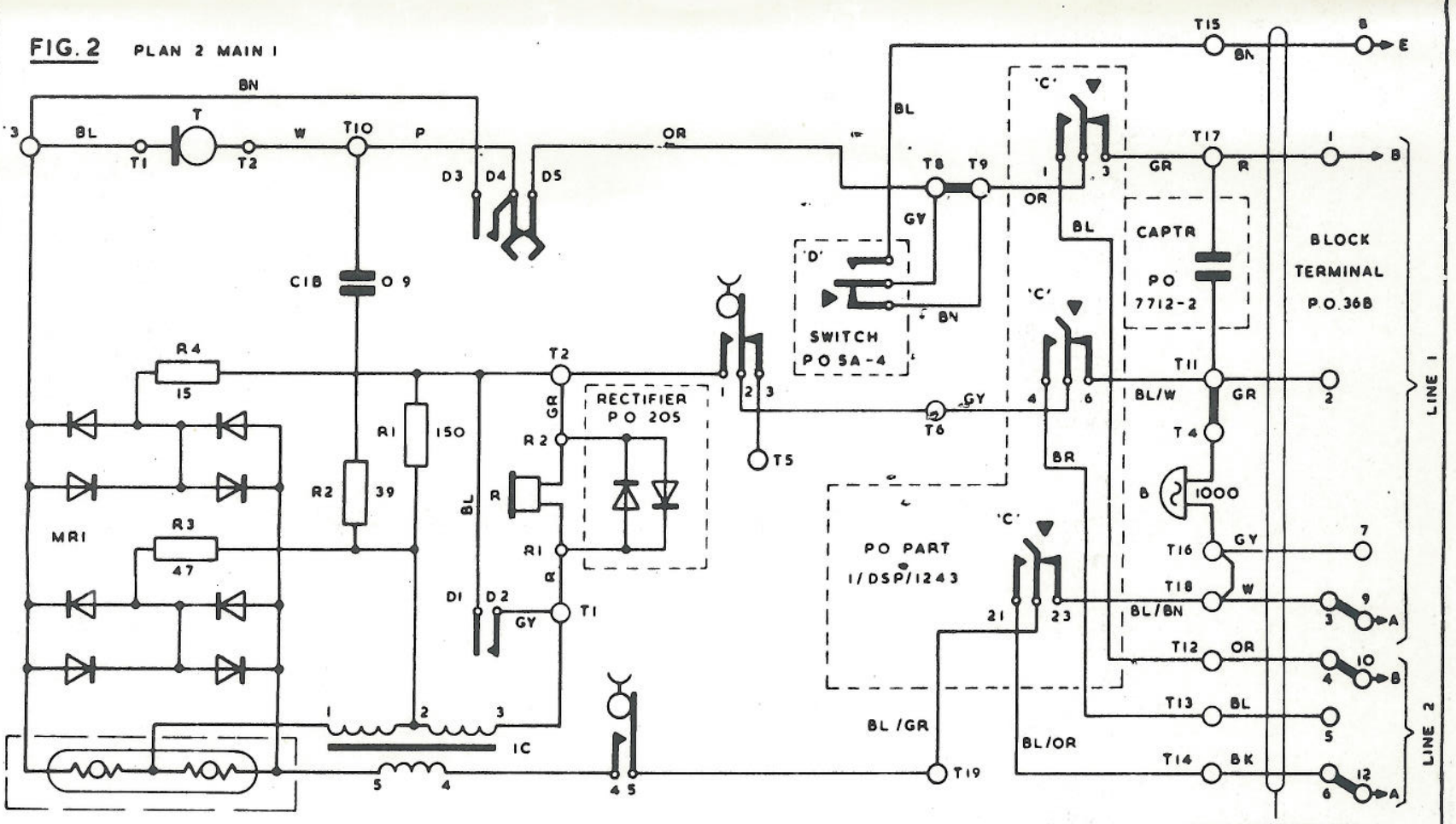
A2 BR 888/19

FIG. 1 PLAN 2 MAIN 2



TELEPHONE P.O 740 – REMOVE ALL STRAPS OTHER THAN T8 – T9 THEN LINK T4 – T11 & T16 – T18
SWITCH P.O 1/DSP/1243, PRESS BUTTON P.O.6/DBU/372 } FIT IN POSITION 'C' AND WIRE TO TERMINALS T6, T9, T11, T12, T13, T14, T17, T18 & T19
SWITCH P.O. 5A – 4, PRESS BUTTON P.O 8/DBU/372 } FIT IN POSITION 'D' AND WIRE TO TERMINALS T8, T9 & T15
2 – PINS P.O PART 1/DP1/203 – FIT ONE TO EACH PRESS BUTTON
RECTIFIER ELEMENT P.O 205 – EQUIP TO RECEIVER INSET IN HANDSET WHEN NOT SUPPLIED WITH TELEPHONE
CAPACITOR, PAPER P.O 7712-2, CLIP P.O 90 } ASSEMBLE AND WIRE TO TERMINALS T11 & T17
CORD, INSTRUMENT P.O.9/21AD, BLOCK, TERMINAL P.O 36B } CONNECT AS SHOWN AND CUT BACK SPARE
ADJUST LATCH ON 'C' TO SETTING 1 AND 'D' TO 3 WITH 'X' & 'Y' LATCHES ON SETTING 4 – SEE DGM TN-6848

FIG. 2 PLAN 2 MAIN 1



TELEPHONE P.O. 740 – REMOVE ALL STRAPS OTHER THAN T8 – T9 THEN LINK T4 – T11 & T16 – T18
SWITCH P.O. 1/DSP/1243, PRESS BUTTON P.O.6/DBU/372 } FIT IN POSITION 'C' AND WIRE TO TERMINALS T6, T9, T11, T12, T13, T14, T17, T18 & T19
SWITCH P.O. 5A – 4, PRESS BUTTON P.O.8/DBU/372 } FIT IN POSITION 'D' AND WIRE TO TERMINALS T8, T9 & T15
2 – PINS P.O. PART 1/DPI/203 – FIT ONE TO EACH PRESS BUTTON
RECTIFIER ELEMENT P.O 205 – EQUIP TO RECEIVER INSET IN HANDSET WHEN NOT SUPPLIED WITH TELEPHONE
CAPACITOR, PAPER P.O 7712-2, CLIP P.O 90 } ASSEMBLE AND WIRE TO TERMINALS T11 & T17
CORD, INSTRUMENT P.O. 9/21AD – CONNECT AS SHOWN, AND CUT BACK SPARE
BLOCK, TERMINAL P.O. 36B – STRAP 3 – 9, 4 – 10, & 6 – 12 ONLY
ADJUST LATCH ON 'C' TO SETTING 1 AND 'D' TO 3 WITH 'X' & 'Y' LATCHES ON SETTING 4 – SEE DGM TN-6848

Revisions
A 6.2.78 MINOR AMDTS.

British Railways Board
Chief Signal and Telecommunications Engineer

MODIFICATIONS
TO TELEPHONES
P.O. TYPES 746 & 740
FOR
EXTENSION PLAN WORKING

No.	Dec.
C1	1.3.77

TR/C1

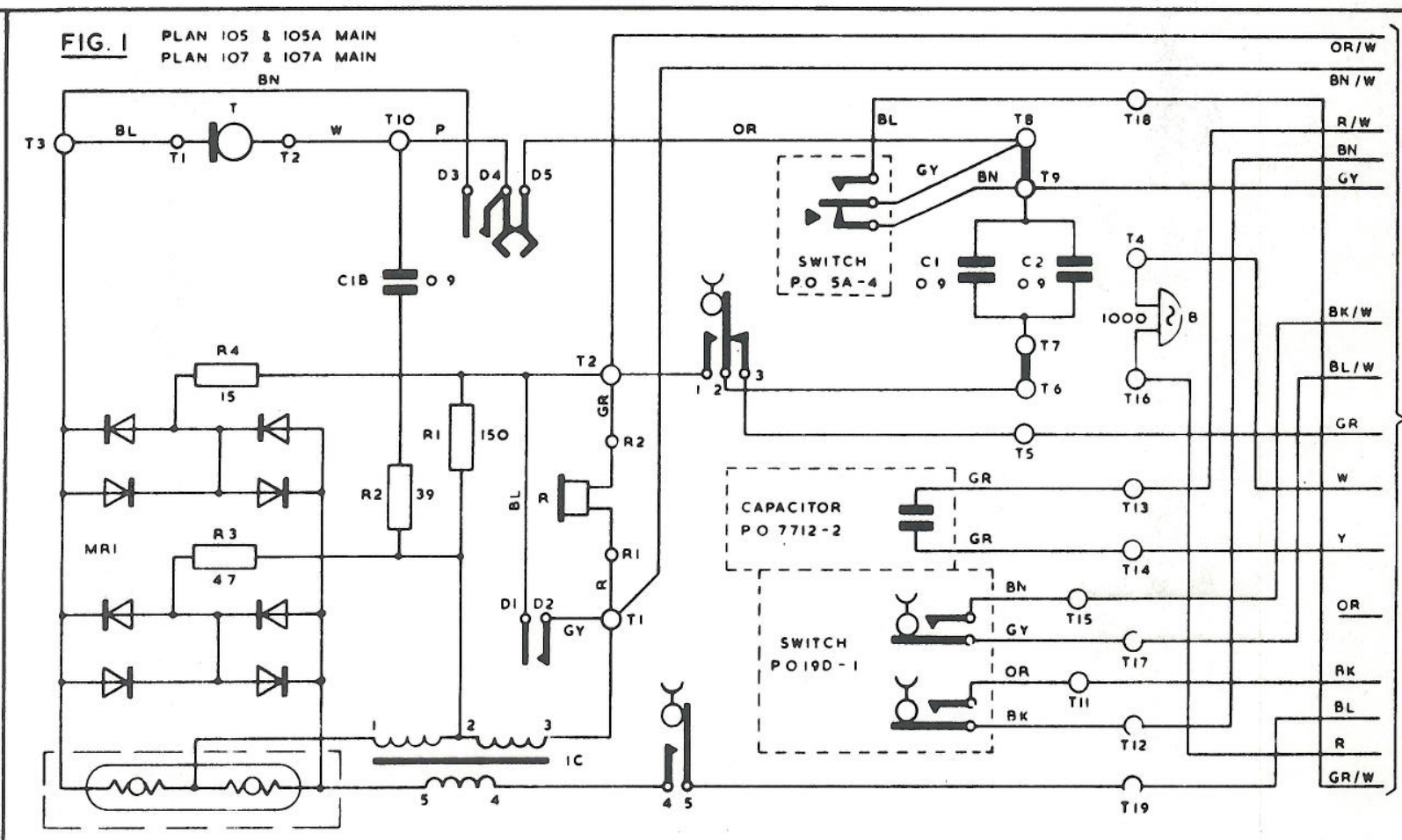
TN-4007

British Rail

for Chief S & T Engineer

A2 BR 888/19

FIG. 1 PLAN 105 & 105A MAIN PLAN 107 & 107A MAIN



TELEPHONE P.O. 746 – DISCONNECT STRAPS BETWEEN T4 – T5 – T6, T16 – T17 & T18 – T19

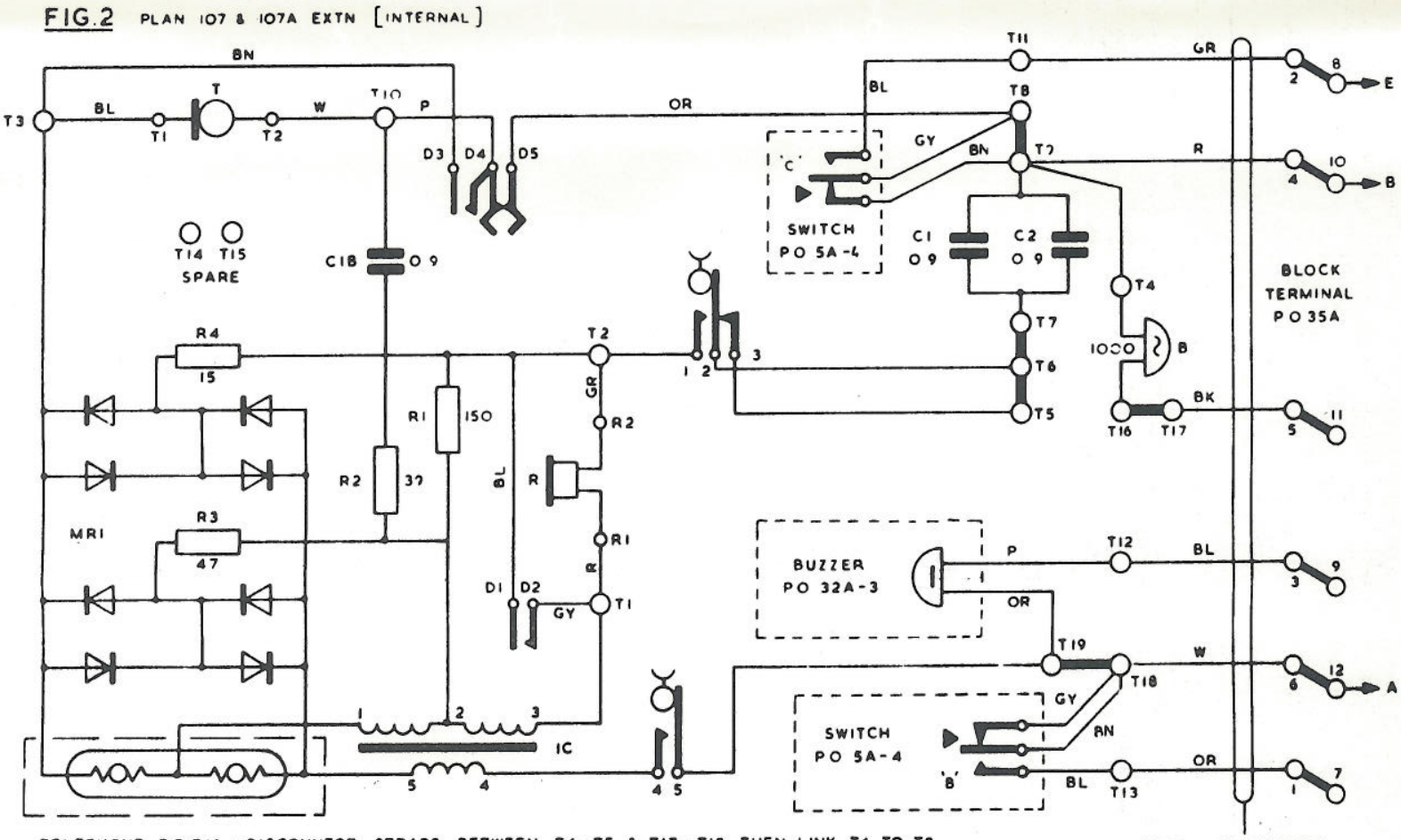
SWITCH P.O. 5A-4
PRESS BUTTON P.O. 1/DBU/362
PLUNGER P.O. PART 1/DPL/1022
2-PINS P.O. PART 1/DPI/203
} ASSEMBLE AND WIRE TO TERMINALS T8, T9 & T18

MICRO-SWITCH 19D-1 EQUIP AND WIRE TO TERMINALS T11 & T12, T15 & T17

CAPACITOR, PAPER P.O. 7712-2
CLIP P.O. 90
} ASSEMBLE AND WIRE TO TERMINALS T13 & T14

REMOVE INSTRUMENT CORD & TERMINAL BLOCK TO PERMIT CONNECTION TO PLAN-SET P.O. 625 WITH 15-WAY CABLEFORM PROVIDED

FIG. 2 PLAN 107 & 107A EXTN [INTERNAL]



TELEPHONE P.O. 746 – DISCONNECT STRAPS BETWEEN T4 – T5 & T17 – T18 THEN LINK T4 TO T9

SWITCH P.O. 5A-4
PRESS BUTTON P.O. 4/DBU/363
PIN P.O. 1/DPI/203
} FIT IN POSITION 'B' AND WIRE TO TERMINALS T13 & T18

SWITCH P.O. 5A-4
PRESS BUTTON P.O. 7/DBU/363
PIN P.O. 1/DPI/203
} FIT IN POSITION 'C' AND WIRE TO TERMINALS T8, T9 & T11

BUZZER P.O. 32A-3 FIX TO BELL GONG AND WIRE TO TERMINALS T12 & T19

CORD, INSTRUMENT P.O. 6/61AT CONNECT AS SHOWN

BLOCK, TERMINAL P.O. 35A – LINK 1-7, 2-8, 3-9, 4-10, 5-11 & 6-12

Revisions
A 6.2.78. MINOR AMDTS.

No.	Dec.
C1	1-3-77

British Railways Board
Chief Signal and Telecommunications Engineer

MODIFICATIONS TO TELEPHONES P.O. TYPES 746 & 740 FOR EXTENSION PLAN WORKING

British Rail

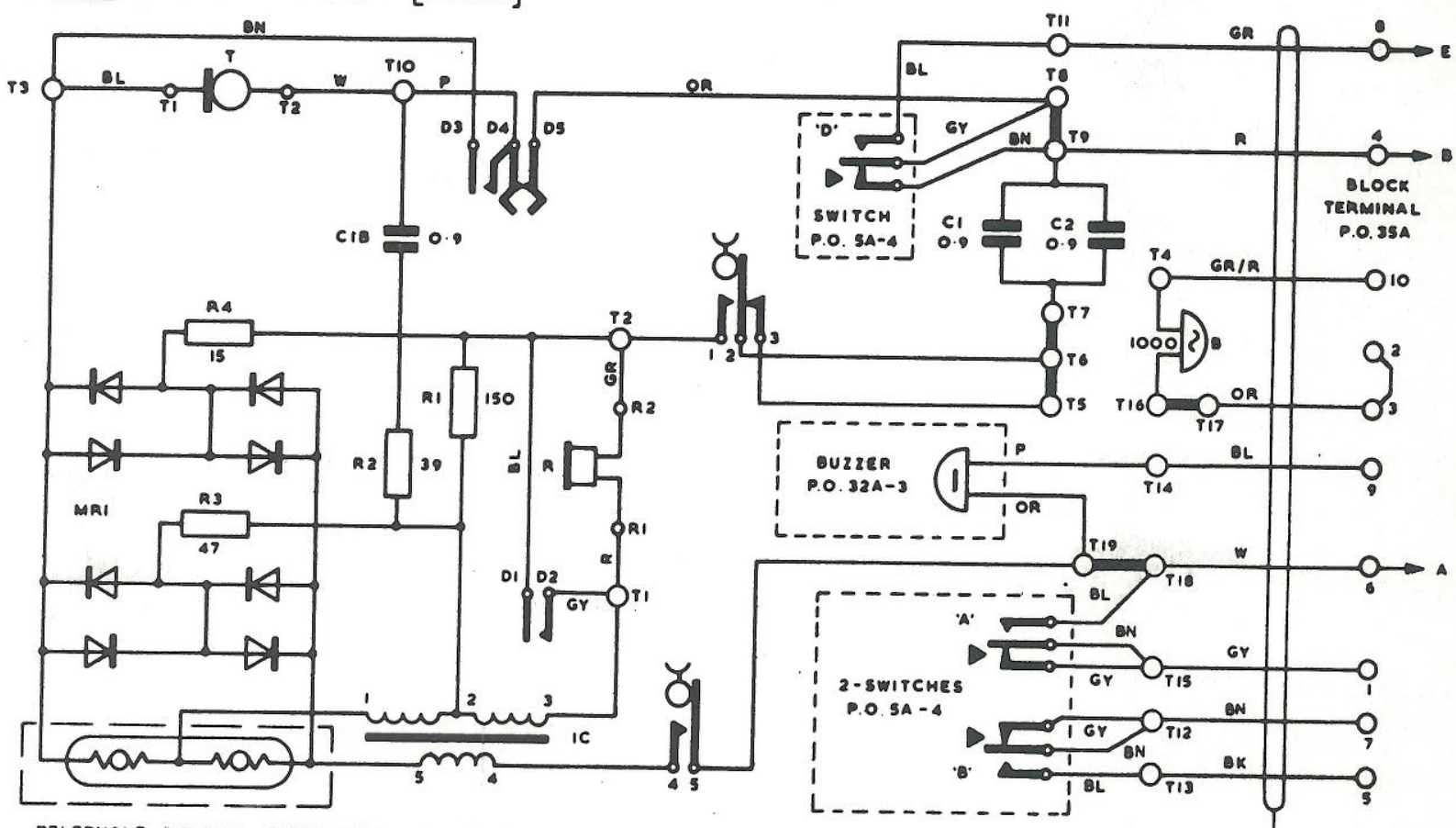
TR/C2, TN-4009

C1 6+1 119

Chief S & T Engineer

A2 B R 888/19

FIG. 1 PLAN 105 & 105A EXTN. 1 [INTERNAL]



TELEPHONE P.O. 740 - DISCONNECT STRAPS BETWEEN T4-T5 & T17-T18

SWITCH P.O. 5A-4
PRESS BUTTON P.O.4/DBU/372
PIN P.O. 1/DP1/203
} FIT IN POSITION 'A' AND WIRE TO TERMINALS T15 & T18

SWITCH P.O.5A-4
PRESS BUTTON P.O.3/DBU/372
PIN P.O. 1/DP1/203
} FIT IN POSITION 'B' AND WIRE TO TERMINALS T12 & T13

SWITCH P.O.5A-4
PRESS BUTTON P.O.8/DBU/372
PIN P.O 1/DP1/203
} FIT IN POSITION 'D' AND WIRE TO TERMINALS T8, T9 & T11

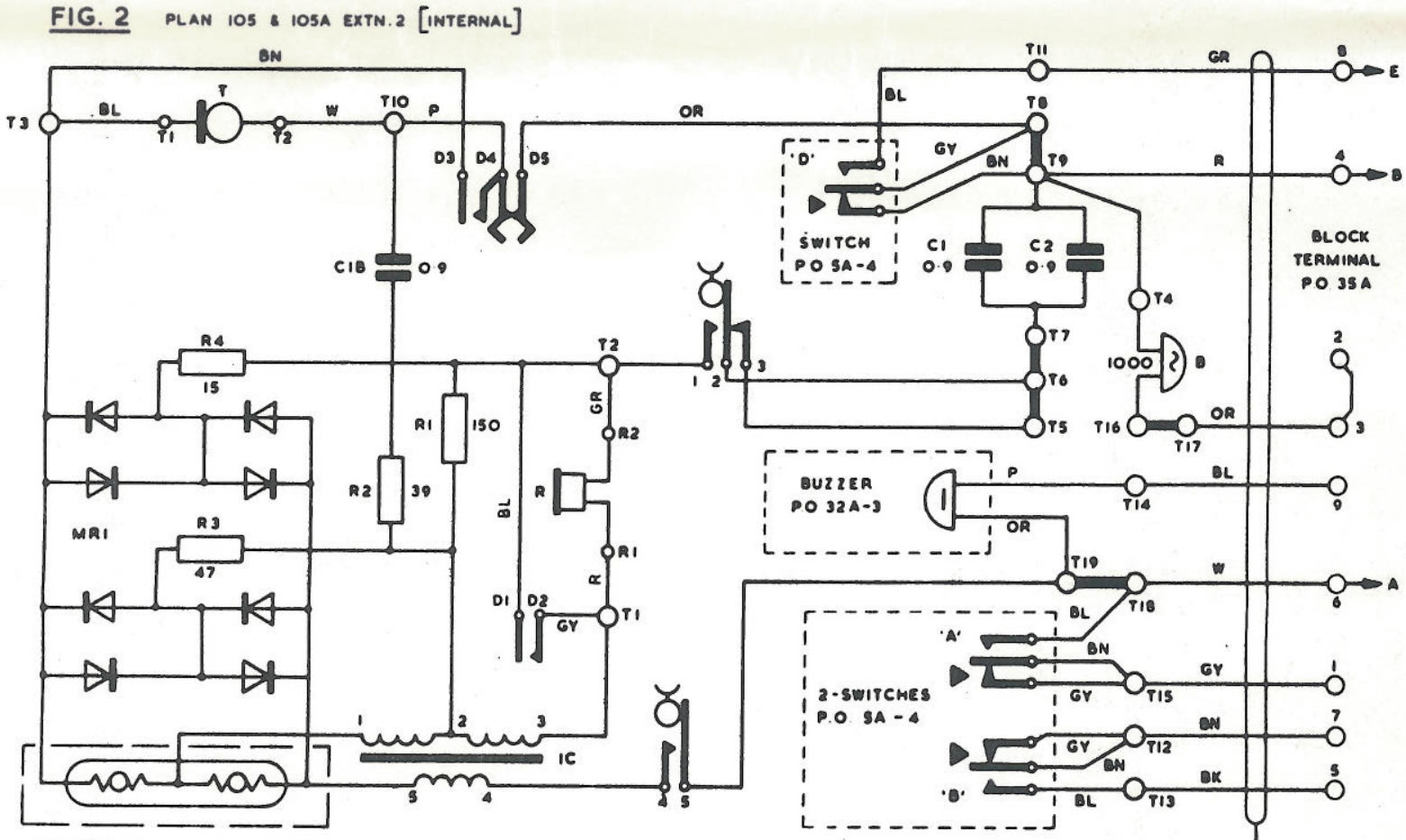
BUZZER P.O. 32A-3 FIX TO BELL GONG AND WIRE TO TERMINALS T14 & T19

CORD. INSTRUMENT P.O 9/21 AD - CONNECT AS SHOWN

BLOCK. TERMINAL P.O. 35A - LINK 2-3 ONLY

ADJUST LATCHES ON 'A', 'B' & 'D' TO SETTING 3 WITH 'X' & 'Y' LATCHES AT SETTING 5 - SEE DGM. TN-6848

FIG. 2 PLAN 105 & 105A EXTN. 2 [INTERNAL]



TELEPHONE P.O. 740 - DISCONNECT STRAPS BETWEEN T4-T5 & T17-T18 THEN LINK T4-T9

SWITCH P.O. 5A-4
PRESS BUTTON P.O. 4/DBU/372
PIN P.O. 1/DP1/203
} FIT IN POSITION 'A' AND WIRE TO TERMINALS T15 & T18

SWITCH P.O. 5A-4
PRESS BUTTON P.O. 3/DBU/372
PIN P.O. 1/DP1/203
} FIT IN POSITION 'B' AND WIRE TO TERMINALS T12 & T13

SWITCH P.O. 5A-4
PRESS BUTTON P.O. 8/DBU/372
PIN P.O. 1/DP1/203
} FIT IN POSITION 'D' AND WIRE TO TERMINALS T8, T9 & T11

BUZZER P.O. 32A-3 FIX TO BELL GONG AND WIRE TO TERMINALS T14 & T19

CORD. INSTRUMENT P.O. 9/21AD - CONNECT AS SHOWN AND CUT BACK GR/R SPARE

BLOCK. TERMINAL P.O. 35A - LINK 2-3 ONLY

ADJUST LATCHES ON 'A', 'B' & 'D' TO SETTING 3 WITH 'X' & 'Y' LATCHES AT SETTING 5 - SEE DGM. TN-6848

Revisions
A 6.8.78 MINOR AMDTS.

DFC 1.3.77

British Railways Board
Chief Signal and Telecommunications Engineer

MODIFICATIONS TO TELEPHONES P.O. TYPES 746 & 740 FOR EXTENSION PLAN WORKING

British Rail

No TR/C2 TN-4010

C1 6-1 210

Chief S & T Engineer