SIGNAL POST TELEPHONE SYSTEM

for use on
physical or carrier circuits

technical handbook

STC Standard Telephones and Cables Limited
Data Equipment and Systems Division

a British
associate of
ITT

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SIGNAL POST TELEPHONE SYSTEM FOR USE ON PHYSICAL OR CARRIER CIRCUITS

Technical Handbook

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an associate of ITT

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CONTENTS

CONTENTS

LIST OF ILLUSTRATIONS

SIGNAL POST TELEPHONE SYSTEM

INTRODUCTION

The Signal Post Telephone system provides means of communication between a controlling signalman and train crews in his area of responsibility. Basically the system comprises groups of up to 20 Signal Post Telephone (SPT) way stations connected via single pairs of telephone lines to the signalman's control station.

When calling, each SPT transmits a unique sequence of signals which result in its identity code being displayed on an indicator panel in the control station. The signalman is thus provided with a positive identification of any calling SPT. The circuitry of the system is so arranged that a call, once connected, seizes the circuit to exclude all other SPT from access to the line. This ensures that the SPT which transmitted the displayed code is the only SPT connected to the control station, and precludes the passing of information to the wrong location. A call made whilst the line is seized will produce an ENGAGED indication at the calling SPT. Operation of the SPT is independent of verbal identification, door switches or sequenced operations. It cannot be permanently engaged by leaving the telephone off the hook.

The SPT equipment comprises a micro-telephone handset, and associated circuitry mounted in a weather-proof cabinet of cast aluminium construction. A calling push-button and 'engaged' indicator lamp are mounted on an interior front panel of the instrument case. A test switch associated with the 'engaged' condition is accessible from the bottom of the instrument.

At the control station the equipment comprises the telephone instrument, the display system and associated switching. The equipment may be supplied as single-circuit, double-circuit or multiple circuits to customers specification. Certain versions are equipped with a facility allowing the use of ring-back tone in the system when a tone source is available from the users installation.

EQUIPMENT DESCRIPTION

1. Construction and Finish

The telephone set is enclosed in a die-cast aluminium instrument cabinet equipped with side-hinged door and mounting clips suitable for attachment to round or square posts of varying dimensions. With the door closed the equipment is completely weatherproof and dust-excluding.

With the door opened immediate access is obtained to the telephone hand-set, push-button, and the engaged lamp.

Cable entry for external connexions is provided in the bottom of the cabinet, and a 'test' switch is accessible via a hole adjacent to the cable entry. Access to the circuit components, fuses, relays, drive motor and associated switching etc. is obtained by removal of a sub-panel secured by slotted screws to the interior of the cabinet. The sub-panel carries the telephone receiver 'hook', operating instruction paster, and the extensible telephone cord termination.

The lower section of the cabinet is covered by a screwed detachable cover plate protecting the external connexion terminal panel and 'test' switch etc.

External finish is stoved hammer finish, light metallic grey with distinctive black-and-white diagonals facia.

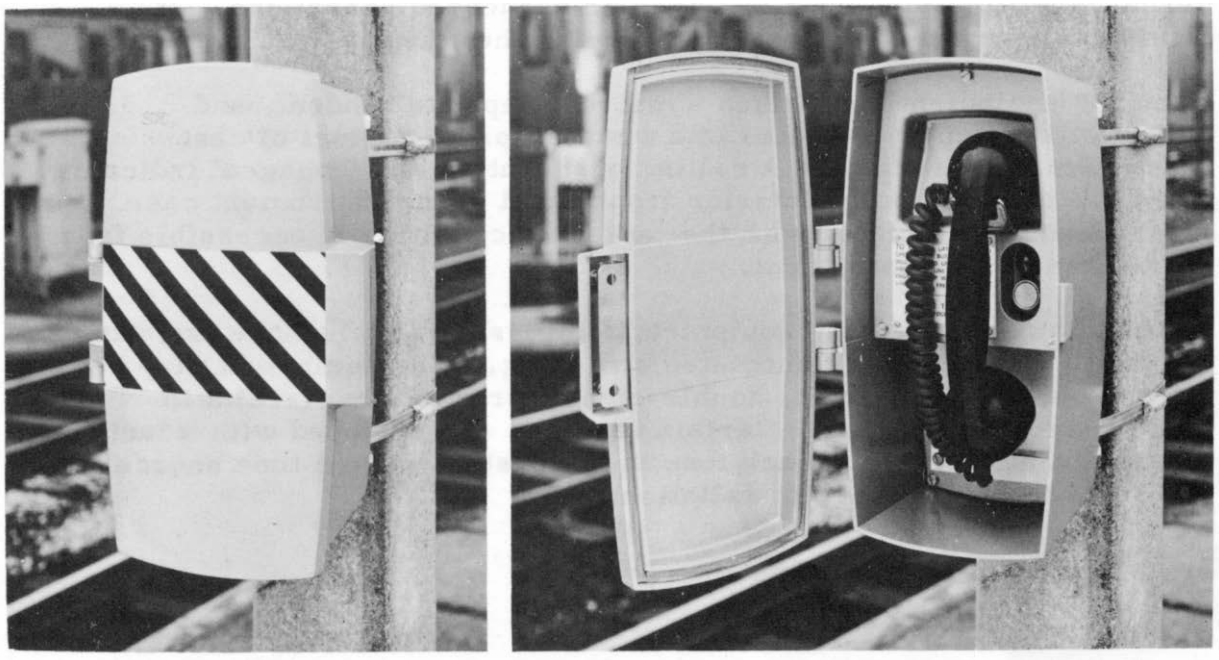


Figure 1. Signal Post Telephone Set.

IE 2035/2

2. Principal Dimensions

Overall dimensions of the instrument cabinet are:

Height 14in (35.6cm). Width 8.5/8in (21.9cm). Depth 8.5/8in (21.9cm).

FUNCTIONAL DESCRIPTION

3. 'Call' Push-button

When the 'Call' push-button is pressed two switches (PM1 and PM2 on Fig. 3) are operated.

Switch PM2 closes the a.c. circuit to start the synchronous MOTOR and PM1 connects the 'calling' circuit to the signal cabin lines.

4. Identifying Code

When 'calling' the SPT generates and transmits to the signal box a unique pulsed code by which it alone may be identified and indicated to the signalman.

5. Motor and Switch Assembly

A pulse will be produced when a d.c. circuit across the lines L1, L2 (Fig. 3) is interrupted. The function of the motor and switch assembly is to operate the switching necessary to produce that particular series of pulses which make up the identity code of its SPT.

The motor rotates an impulse wheel at a speed of about 8 r.p.m. The motor switching is so arranged that the motor, after being switched on runs for one revolution of the impulse wheel and is then automatically switched off. Power is applied to the motor winding primarily by the push-button switch PM2, and maintained until the impulse wheel has completed one revolution, by the Off/Normal micro-switch. The micro-switch is then operated to Off by the action of a striker pin protruding at right angles from the face of the impulse wheel. The motor is dead-beat in action and stops immediately the power is cut-off, i.e. stops with the pin raising the switch actuating lever to the Off position.

In all other positions of the striker pin (i.e. impulse wheel) the Off/Normal micro-switch is On.

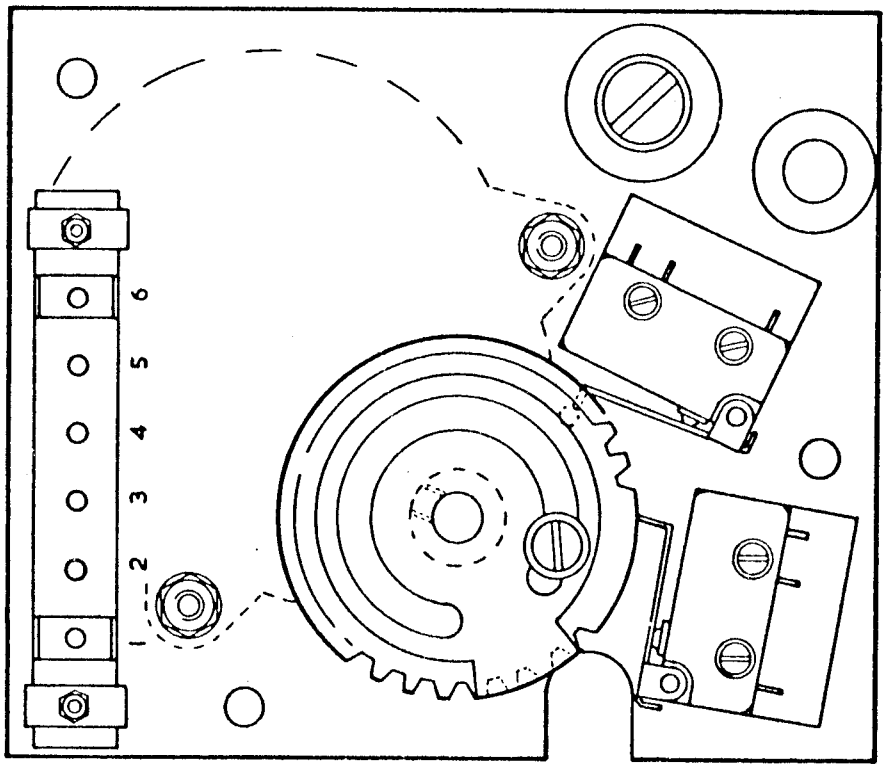


Fig. 2. SPT Code Setting (Push-button Call)

6. Impulse Wheel and Impulsing Micro-switch

The impulse wheel is similar in form to a 32 tooth spur-gear blank in which five of the teeth are left uncut. The pitch of the cut teeth is such as will allow a switch-actuating lever to follow their contour as the wheel rotates and thereby operate the contacts of the Impulsing micro-switch to Off as the actuating lever falls into the gaps between teeth, and to On as it rises to the crests of each tooth, on the wheel periphery.

The respective positioning of the Impulsing and Off/Normal switches is such that the Off/Normal switch is operated to Off at the point where the Impulsing switch has just been closed by the uncut segment of the impulse wheel.

To produce a series of pulses in the order required to identify its particular SPT therefore it is only necessary to blank-off a three tooth segment of the impulse wheel in the appropriate position (a segment shaped 'shading cam' is supplied for this purpose), so that when the impulse wheel is rotated the first pulse of the first digit of the identity code will be produced as the line loop (completed by the Impulsing switch) is opened by the gap between the uncut segment and the first tooth, and so on similarly for each tooth until the blanking cam closes the Impulsing switch.

This completes the transmission of the first digit. As the blanking cam then leaves the Impulsing switch, the first pulse of the second part of the code is produced by the first gap following the cam, and so similarly the remaining pulses, until the uncut segment is again reached and the motor is switched off by the Off/Normal switch.

CIRCUIT DESCRIPTION

7. 'Calling' Circuit

When the calling push-button is pressed it applies a.c. power to start the MOTOR (Fig. 3) and at the same time closes a circuit, via relay JCL and MR1, across the lines L1 (= -ve) and L2 (= +ve).

Relay JCL operates and is locked on by a mechanical latch which may be released only by operation of relay JCR.

Failure of the motor to run normally e.g. loss of local a.c. supply or faulty motor, will not prevent the call to the signal-box being established although the calling SPT's identification code would not be transmitted. In such conditions the signalman would be careful to establish verbally the identity of the caller and also to ensure that only one SPT was connected to the line.

The effect of the loop on the lines is to cause the signal cabin equipment to reverse the polarity of the potential applied to the lines. This polarity reversal due to the routing diodes de-energises relay JCL (which remains operated) and for the same reason transfers the line loop made from L2 via PM1, to that made by the impulsing micro-switch (still closed by the uncut segment of the impulse wheel) via R3, JCL3, MC, JCL2 and MR3, to L1. This circuit will thus produce a series of pulses, i.e. line loops, in the required order as the impulsing micro-switch reacts to the rotation of the impulse wheel.

The specific position at which the inter-digital pause occurs will cause the appropriate identity number of the calling SPT to be displayed at the signal cabin. Appropriate action by the signalman will remove his call circuit from line and replace it with his speech circuit.

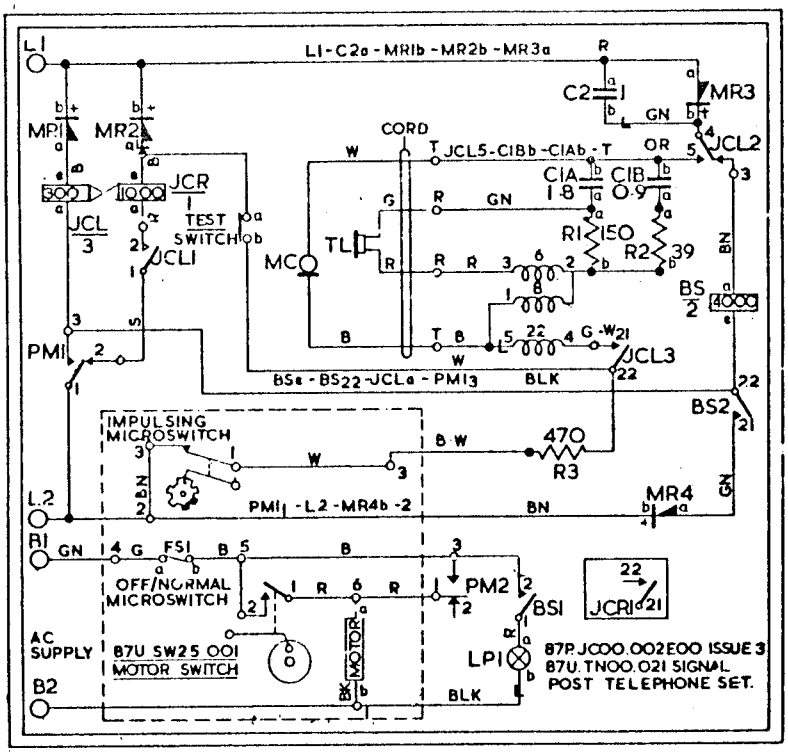


Fig. 3. Circuit Schematic SPT (Push-button Call)

8. Speech Circuits

The speech circuit at the SPT is completed when the motor is at rest, i.e. after the identity code has been transmitted, the striker pin has raised the Off/Normal switch to Off and the uncut segment of the impulse wheel has again raised the impulsing switch to 'closed'. The circuit is from L2 via the impulsing micro-switch, R3, JCL3, coil 4-5, MC, JCL2 and MR3 to L1 for transmitting and similarly but via coil 1-2-3, TL, the resistor capacitor network R1-R2, CIA-CIB and C2 for receiving. The coil coupling provides side-tone to allow the user to hear his own speech when using the microphone.

When the call is terminated the signalman operates a switch causing the line polarity to revert to normal, i.e. L1 = -ve and L2 = +ve. The effect of this at the SPT is to energise relay JCR, via MR2, JCL1 and PM1 back. This relay operates, releasing the mechanical latch to release relay JCL and thereby to open its own energising circuit at JCL1 which effectively returns the SPT to normal with all relays released and lines L1-L2 open.

9. Line Engaged Circuit

If the line is engaged when a call is attempted the line polarity will already have been reversed due to the other SPT looping the line.

In this case when the push-button is pressed the only line loop circuit available (due to the routing diodes) is via PM1, relay BS and MR3. The winding of relay BS is of comparatively high resistance and the resultant loop will have little effect on the use already being made of the line. Relay BS operates and maintains the loop when the push-button is released from L1 via MR3, JCL2 back, BS a-e, BS2, and MR4 to L2. Contacts BS1 close the a.c. supply to light the ENGAGED lamp LP1. (The impulsing circuit is opened at JCL3 and although the motor starts and runs as usual, it is completely ineffective and gives no indication at the signal cabin that a call has been attempted. It is therefore essential, if the call is to be made, that the push-button be pressed again after the ENGAGED light goes out). The engaged lamp supply will be cut off when the signalman terminates the existing call by returning the line polarity to normal. This will release relay BS due to MR3 and open the lamp supply circuit at BS1.

10. Test Switch (LINE ENGAGED)

A TEST SWITCH is provided on the SPT which when operated loops the line via the impulsing switch, resistor R3 and diode MR2. Operation of the switch simulates the 'line engaged' condition and thus allows the function of the 'engaged' circuit to be checked independently at each signal post instrument.

11. Power Supplies

The d.c. supply, for the speech circuit and for relay operation is fed over the line from the 50volts line battery at the Signal Cabin.

The synchronous motor and the ENGAGED lamp are operated from a 12volts a.c. supply derived from the local signal supply.

It should be noted that a failure of the local a.c. supply will mean that the calling SPT will be unable to display its identity nor can it receive an ENGAGED lamp signal. The essential function however, of calling the signalman and establishing a unique speaking connection with him, remains effective.

CONTROL STATION EQUIPMENT

EQUIPMENT DESCRIPTION

1. Console Display Panels

In a modern signal-box a large number of SPT circuits must be concentrated in convenient form on Console Display Panels. An Optical (in line) Indication is provided for each circuit showing a three digit number for the calling Signal Post Telephone. Possible misinterpretation due to indicator lamp failure is precluded by the use of all three digits of the number indicator the blank spaces of numbers of less than three digits being indicated by illuminated asterisks.

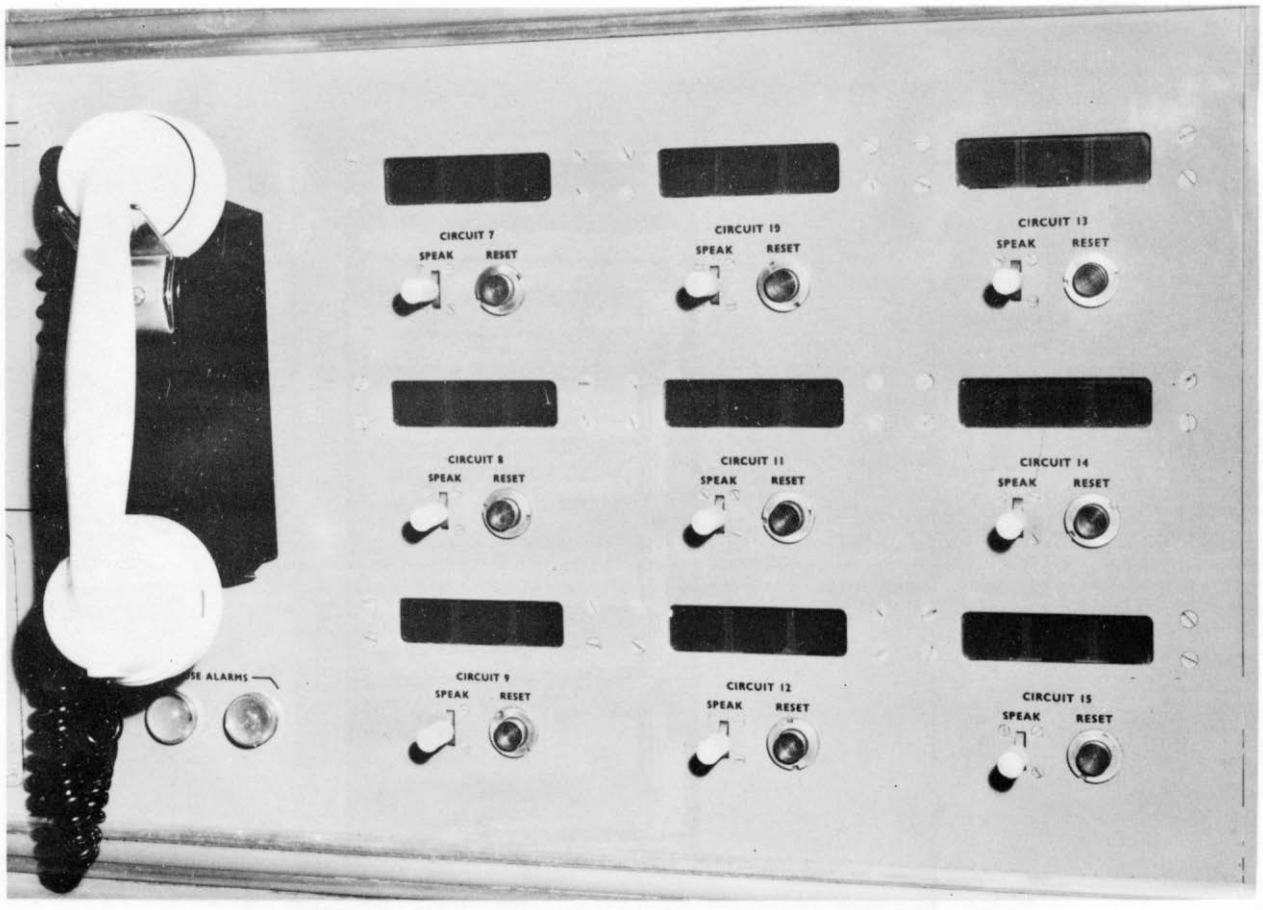


Fig. 4. Control Console Panel, Optical Indicators
(9 SPT Circuits)

IE 2035/2

2. Controls and Facilities

The console operator's Speak and Line Circuit RESET keys are mounted on the indicator panel, together with a pendant telephone set and two fuse-alarm lamps. The Speak key may be a three-position switch providing facilities for simultaneous communication when control station operators handset positions are duplicated. Access to the second Speak circuit is usually via a Post Office type jack situated on the console desk, the associated apparatus being mounted either behind the console panel or on a separate apparatus panel within the console.

3. Apparatus Cubicle or Rack

The equipment associated with each SPT line is mounted on standard jack-in relay apparatus units and these, together with common equipment such as alarm relays, fuses and terminals may be housed either in steel apparatus cubicles, or on open racks (Fig. 5 and Fig. 6).

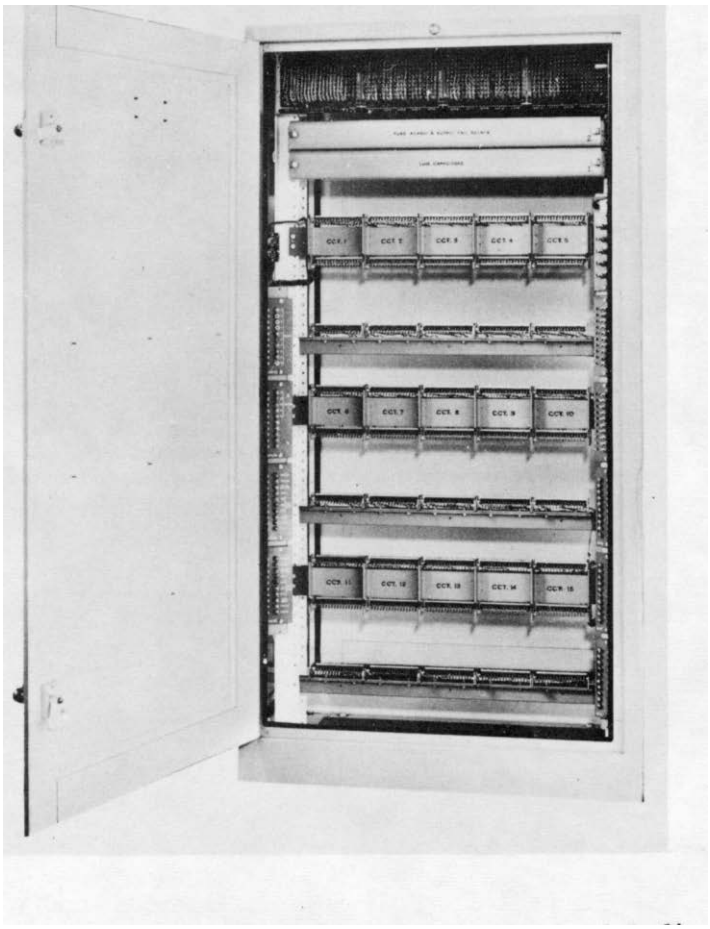


Fig. 5. Apparatus Cubicle, 15 Way Optical Indicator

4. Line Battery Connections

For use in electrified traction areas where line isolation may be a requirement, separate line battery connections are provided which must be connected to the batteries as specified.

Where there is no requirement for isolation the Line Battery 'U' points on the shelf jack must be connected to the Internal Battery (U73 to U32 and U123 to U31).

Line relay sets have been equipped with alternative connections for use directly to the 'physical' SPT lines or via carrier links, to a distant carrier/physical conversion unit, which, in turn, will have direct access to the SPT line.

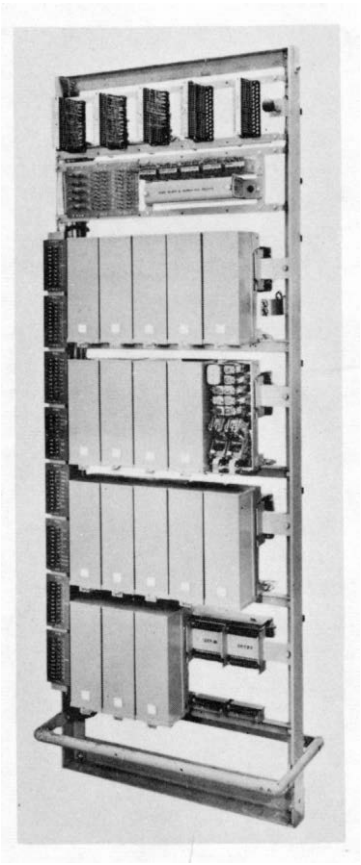


Fig. 6. Apparatus Rack, 20 way Optical Indicator

FUNCTIONAL DESCRIPTION (Schematic, Figure 7a & 7b)

5. Line Loop

A calling SPT applies a loop to the line to complete a circuit which effects reversal of line-circuit polarity, to lock-out all other SPT's on the same line. The call is indicated by a warning lamp in the associated RESET key circuit and the common calling buzzer on the indicator panel at the control station.

6. Selector Switches

The pulses of the first digit are received via selector switch SA. During the following inter-digital pause the impulsing circuit is switched from SA to SB. The pulses of the second digit are recorded via SB and the impulsing relay is then left in the energised condition.

7. Constant Total Code

Figure 7a shows that switch banks SA4 and SA5 are respectively associated with hundreds and tens, whilst switch bank SB4 deals with units. The sum of the pulses contained in both digits of the received code must always be a constant, the constant total being 25 for this equipment. Any other quantity will fail to illuminate the display. If the sum of the impulses is correct, switch banks SA3 and SB3 will finish in alignment, to complete the indicator supply circuit.

The constant total principle provides a high degree of protection against the possibility of a wrongly identified call being accepted.

8. Indicator Display

Optical indicators are required to provide a three digit display in all conditions when illuminated. This is to guard against wrong interpretation of a displayed number in the event of a lamp failure. If the SPT number consists of less than three digits the blank positions display an illuminated asterisk e.g. **9 denotes SPT No. 9.

9. Speak Keys and Reset Keys

Operation of the Speak key completes the speech circuit and silences the audible alarm. Simultaneous operation of two speak keys to the same signalmans telephone circuit will inhibit all speech connexion. When the call is finished, operation of the reset key releases the line relay set circuit to return the line polarity to its normal state. This releases the relay at the SPT to break the line loop, which in turn allows all activated circuit components in the console equipment to de-energise and extinguishes the reset and display lamps. The speak key is then returned to its normal position. If the speak key is returned before the reset key is operated, the reset lamp will not be extinguished and the audible alarm will sound, to indicate that the operator has omitted to reset the equipment. The situation will be restored by operating the Reset key.

10. Reset Lamp

Fault conditions occasioning a permanent loop on the line will cause the reset lamp to remain alight after the reset key has been operated and the speak key has been returned to Off.

An automatic clearance will be effected when the fault is remoted. Momentary loops on the line will cause the reset lamp to light. Operation of the reset key will extinguish the lamp.

11. Relays, Selectors and Coils

The following table details the functions of the dynamic components in the optical indicator equipment as designated in Drg. L214953 Sheets 2 & 3.

TABLE 1

CIRCUIT DESIGNATION	COMPONENT FUNCTION
Relay 1R	responds to line impulses from the SPT.
Relay B	reverses the polarity of the line current following the first operation of relay IR.
Relay C	operates at the commencement of the code and remains energised during impulsing due to the effect of its slow-to-release winding. During the inter-digital pause (equivalent to seven impulses) relay C releases, and is again operated during the second digit.
Relay DC	is energised on release of relay C to switch the impulsing circuit from selector switches SA to SB.
Relay G	is a slow-to-release relay which remains energised during normal impulsing and the inter-digital pause. The function of this relay is to prevent a permanent circuit being made to either selector switch in the event of a momentary pulse on the line.
Relay H	is the line circuit reset relay.
Relay A	operates in series with the signalling lines and the SPT relay, on operation of reset relay H, and releases when the series circuit is opened by the tripping of the SPT relay.
Relay RBT	Ring-back tone relay.
Selector Switch SA	Steps one position for each complete operation of relay IR i.e. IR release and re-operate (for the first digit).
Selector Switch SB	Following the inter-digital pause, selector SB records the number of impulses contained in the second digit by stepping one position for each complete operation of relay IR.

CIRCUIT DESIGNATION	COMPONENT FUNCTION
Coil TR	There is no DC connection between the telephone sets, speech being coupled to line via the Coil TR.

CIRCUIT DESCRIPTION

12. Line Lock-out and Associated Relay Circuits

Drawing L214953 shows the circuit schematic of signal cabin equipment in the Signal Post Telephone System. This schematic covers both the line connections to be used with a direct physical line to the SPT's, and also the alternative connections which are required to work over any standard carrier link to a distant physical SPT circuit. Consider first the case where the line circuit is connected straight through to a physical pair of lines (see Note 1 of the schematic). The alternative connections for carrier operation will be considered later. The outlets LA and LB are terminations of an external line-pair being similarly connected to corresponding outlets L1, L2 on each signal-post telephone set in the group. The system d.c. supply is shown connected to these outlets (via windings of relay IR and relay contacts) so that the potential at LA is negative and at LB positive. This is the condition which obtains on a 'clear' line and it may be noted at this point that line polarity plays an all important part in the operation of line lock-out.

With the line polarity as shown in Drawing L214953 any SPT in the group may 'call' the signal cabin and be connected. A call made by an SPT is equivalent to applying a d.c. circuit (line-loop) across the line terminations LA and LB, and therefore any SPT calling will complete a circuit which will energise relay IR in the signal cabin equipment. The circuit for this is from supply negative via IR, winding e-d, contacts H4, B3 to terminal LA and continued via the external line to the calling SPT (outlet L1). From L1 of the SPT via the SPT 'call' circuit to L2 and from there back via the return external line to signal cabin line-termination at terminal LB, thence to positive supply via contacts B6 and relay IR winding b.a.

With the line polarity inverted from that shown in Drawing L214953 i.e. LA positive LB negative, no SPT in the group, because of their susceptibility to line polarity, can make contact with the signal cabin. If therefore, a SPT calls the signal cabin on a 'clear line' i.e. with polarity as in Drawing L214953 the call will be connected but if immediately this occurs, the polarity of the line be then inverted, no other SPT can have access to the line whilst this condition persists. The contacts B3 and B6 perform this function of polarity inversion when relay B is operated and this will occur immediately a calling SPT loops the line via the following circuit.

A calling SPT on a 'clear' line will apply a line loop across the signal cabin line terminations LA, LB to complete the 'operate' circuit of relay IR. Contacts IR1 close to operate relay A directly from supply positive and contacts A1 of this relay close to operate relay B from positive supply via contacts H2 and H3 (back). The make-before-break contacts B3 and B6 changeover and invert the polarity applied to the line at LA, LB. This gives the 'line engaged' condition in which all other SPT are locked-out from access to the line for as long as the condition persists. At the same time the common alarm bell is energised via the diode D1.

Relay IR being in series with the 'line' will operate in conjunction with the pulses applied to the line from the SPT. The second contacts IR2 of this relay close a circuit from positive supply via SB2 wiper arm to operate the slugged relay G. The slow-release characteristic of relay G is such that it will remain operated during the normal impulsing and the inter-digital pause.

The remaining contacts (A2) of relay A close to light the Reset lamp immediately the line is looped by a calling SPT, and under normal signalling conditions contacts of relay A operate conjointly with those of relay IR.

Relay B has six contact sets. Contacts B1 provide a supply hold alternative to A1 (which is subject to line impulsing during the signalling period). Contacts B2 are in series with the pulse-recording circuit explained later, and contacts B4 provide a positive supply alternative to A2 to the reset lamp. Contacts B3 and B6 are those contacts already mentioned which invert the line polarity when the first loop is applied to the line by a SPT. Contacts B5 cause operation of relay RBT to connect ring-back tone to the line.

Contacts G2 of relay G complete a third circuit to the Reset lamp, (under line reset conditions). Contacts G1 are inserted as a protection against prolonged application of an energising current to the uniselector coils SA and SB, such as could occur in a line short-circuit condition.

13. Selector Switch SA

The beginning of the first impulse of the signalling code releases IR to complete the selector switch SA25 energising coil circuit from -ve, via DC2, G1, B2, H1, IR2/21-22 to SB2 + ve, and allows slow release relay C to be energised from -ve via H5, B2, H1, IR2 to SB2 +ve. Relay C is slugged sufficiently for the relay to remain operated during pulsing and thus to hold the +ve supply to the impulsing circuit at C1. At the end of the first impulse, relay IR is again operated allowing relay G to renew its hold, and at the same time to open the impulsing circuit which will allow selector switch SA to take its first step (to position 2). The sequence is then restarted by the next impulse and in this way relay IR is alternately energised and de-energised, relay G delay period is restored, and selector switch SA steps-on through one position for each impulse of the first digit of the impulse code.

14. Inter-digital Pause

During the pause which separates the first and second digit, relay IR remains energised. The hold period of relay C is less than the duration of the pause and as its energising circuit is opened at IR2, the relay releases before the end of the pause period. The selector switch SA25 having stepped once for each impulse of the first digit, is off-normal, and thus with relay C released, a circuit is completed via A1, SA2 and C2 to energise relay DC. This relay is locked by DC1/1-2 via B1, and the impulsing circuit is switched from selector switch SA to selector switch SB by DC2. Switch levels SA4/SA5 have now completed their function and have assumed the position corresponding to the first digit of the impulse code.

15. Selector Switch SB

At the conclusion of the pause period IR is again released, relay C is again energised and selector switch SB is energised via DC2/4-5. The impulses of the second digit step SB in a manner similar to that in which SA was stepped by the impulses of the first digit.

16. End of Signalling

The end of the signalled code will leave selector switch SB in the position corresponding to the second digit of the impulse code, and relay IR energised via the SPT handset. Relays C and G will eventually release but with IR energised, relays A, B and DC remain operated. Provided that the signalled code has complied with the constant total requirement, the two switch banks SA3 and SB3 will be in complementary positions and so the lamp supply NX will be connected through to the three switch banks SA4, SA5 and SB4.

The three groups of 20 contacts each from these switches are taken out of the relay set via the U points 1-20, 51-70, and 101-120. The corresponding U points on the shelf jack of any particular SPT circuit will be connected in accordance with the code strapping chart to the terminals associated with the three optical indicators.

The connections from SA4 are strapped according to the hundreds digit of the signal post number.

The connections from SA5 are strapped according to the tens digit of the signal post number.

The connections from SB4 are strapped according to the units digit of the SP number.

It will be seen, therefore, that the internal wiring of all Line Relay Sets is standard as they must be interchangeable. The cable connections to all optical indicators is also standard and only the strapping between the shelf jack and the adjacent terminal block need to be specific to each circuit.

17. Speak Key Circuits

Associated with each console panel there are two signalman's telephones and each of these is capable of connection to any one of the SPT circuits on that panel. For each SPT circuit there is a double throw lever key and since the key must be operated to opposite directions for the two signalman's circuits, it is mechanically impossible to connect one line to both operators at the same time.

In order to prevent two SPT lines from being connected to one operator the SS relay associated with each operators speech circuit is connected through a double chain via all the line keys. If one key is operated then the SS relay feed is taken from positive on the last key, through back contacts of all unoperated keys to the right of the chosen key, a front contact of the chosen key, and then through back contacts of all keys to the left and finally to the winding a-b of relay SS. It will be seen that in the event of a second key being operated this circuit would be interrupted. After passing through the winding a-b of relay SS this circuit proceeds via the induction coil 4/5, the transmitter and winding d-e of the relay SS to negative.

The relay SS must be operated to connect the operators telephone circuit via contacts SS1 and SS2 and a chain of line key contacts to the terminals A and B of the selected line.

If two line keys were operated in error, the relay SS would not be operated so the operators telephone circuit would not be connected to any line and furthermore, the balanced line connecting circuits would not give any coupling between lines.

When any call is received from an SPT the operation of relay B also operates the relay RBT over back contacts of the two line keys for that circuit, contacts RBT2 and 3 connect the common tone supply to the calling line and if necessary contacts RBT1 can be used to start the tone generator. When either of the line keys are operated to accept the call, the relay RBT will be released to remove the tone from the line.

18. Speech Connexion

The speech connexion between SPT and signal cabin is transformer coupled and there is thus no DC connexion. Power for the signal cabin handset is supplied from the internal batteries via relay SS, and for the SPT handset the power is supplied via the coil windings of relay IR from the line battery.

19. Reset and Line Release

At the conclusion of the call the reset key is operated to clear down the line. This completes a circuit to energise relay H via terminal R (jackpoint 77).

Contacts H5/25-26 complete the relay C operate circuit via B1, whilst contacts C3 lock relay H to +ve. With relays C and H operated there is a drive circuit available to return the selector switch SA to the number 1 (home) position, to switch the drive circuit to selector SB, and to drive SB to its home position. The circuit driving SA is via C3, H2, SA1, SA INT, SA25 a-e, to -ve. The drive circuit is then switched to SB via SA1 home and SB is driven home via SA1, SB INT, SB25 a-e, and -ve. When both selector switches reach home, the relay B is released, restoring the normal polarity of the line. The contacts H4 and H6 transfer the line circuit from relay IR to relay A so that IR is released followed by G.

The relay A will remain operated as long as the line circuit to the SPT is closed through the releasing winding JCR of the latch relay. Contacts A1 and H5 will hold relay C which in turn holds relay H via contacts C3 and H3. While the circuit is in this state, the reset lamp is still on and if the signalman restores the line key which releases SS then the alarm bell will sound again thus providing a check on the successful release of the SPT.

When the latch relay in the SPT is released by JCR then the line loop will be broken and the relays A, C and H will all release, so restoring the complete circuit to normal in readiness to receive the next call.

FAULT CONDITIONS

20. Short Duration Line Loop

If a short duration loop is applied to the line, relay IR will operate and release whilst relay B will operate and lock on. This will light the reset lamp via B4, sound the alarm bell, and operate relay C via SB2, IR2, B2, and H5. Relay C is locked on by C1. To clear this condition (recognisable by the absence of SPT code indication) the Reset Key is operated to energise relay H, thereby releasing relay B, and via B1, relay C. Relay C releasing opens the circuit to relay H at C3, and the lamp is extinguished. Relay A will not operate if the line loop has gone before the reset key is operated.

21. Long Duration Line Loop

A fault which causes a line loop of long duration will initiate a train of events similar to that of a short duration loop. In the latter case however the loop will keep IR2 closed for as long as it persists and therefore relay C will not be energised. The reset lamp will be lit via B4, and G2 will complete a parallel circuit to the lamp. Operation of the reset key will energise relay H which will energise relay C via H5 and B1. The conditions are now similar to that described for resetting after a normal call. The relay A will be operated over the line loop and will hold the circuit off normal as long as the fault persists.

OPERATION OF AN SPT CIRCUIT OVER CARRIERS

22. Carrier Link Introduction

The standard SPT circuits will generally function satisfactorily from the point of view of speech level and signalling as long as the loop resistance of the physical lines does not exceed 1200 ohms.

When all the SPT's on a circuit are remote from the signal box, it is possible to introduce a carrier link between the signal box and a Sub Control or Carrier Conversion Unit. Schematic Fig. 8.

The physical circuit will then be connected to the sub-control and will receive exactly the same conditions as if the signal box were actually at the site of the sub-control. The distance covered by the carrier link will not introduce any loss of level in the speech or the signalling.

23. Line Relay Sets

The Line Relay Set has been designed so that a single standard set can be used either for direct operation into the physical line as already described or alternatively, to operate via a Carrier link to the remote Carrier Conversion Unit. The choice of physical or carrier is made by means of strapping certain U points on the shelf jack associated with the line in question without any modification inside the relay set. The details of the required U point strapping are given in Note 1b of the schematic.

24. Rack or Cubicle Wiring

The wiring within the Rack or Cubicle for both physical and carrier circuits will be provided as standard. In order to convert a line from physical working to carrier, the five straps between pairs of U points will be omitted or removed, the line wires will not be connected to terminals LA and LB but instead the six wires shown will be connected to the carrier terminal which is adjacent to the signal box and will function as follows:-

(1) The pair of wires CA/CB will be used for speech only and will be connected to the audio circuit of the carrier terminal. Since these wires are connected direct to the line transformer TR they will clearly have access to the signalman's telephone keyboard.

(2) The two wires CM1/CM2 will receive 24 volt signals from the carrier terminal in response to the 'inward' signalling 'M' channel which will operate the IR relay on its d-e winding. The distant Carrier Conversion Unit will be arranged (as described later) to apply this signal in response to a loop on the physical line circuit.

(3) The two wires CE1/CE2 will apply a loop signal to the 'E' wires of the Carrier Terminal in response to the operation of the contacts B3. This will originate the outward signalling channel of the carrier and at the distant Carrier Conversion Unit this will be used (as described later) to reverse the polarity of the local d.c. supply to the physical line.

25. Carrier Operation: Signalling Tone and Carrier Signal

The sequence of operations for an SPT circuit working over carrier is as follows:-

Under normal conditions there is no signal on the carrier.

When a call is originated by an SPT the remote Conversion Unit will apply the 'inward' signal tone over the carrier which will in turn apply 24 volts to the M wires and operate relay IR. In the usual way this will operate relays A & B. The contacts B3 will loop the E wires of the carrier terminal to transmit the 'outward' carrier signal which persists until the call is finally cleared. Receipt of this signal at the Conversion Unit will immediately busy the SPT line and prepare to receive the code.

The code from the SPT will cause the conversion unit to interrupt the 'inward' tone so that relay IR follows the code just as it would for a direct line. Throughout the call both inward and outward signals are on. The ring back tone is applied to the speech pair and so is heard by the distant SPT without any interference with the signalling tones.

26. Reset

At the end of the call the signalman will reset in the usual way. The operation of the contacts H4 and H6 are ineffectual in this case as a result of the missing straps on the U points 22 and 23. However, the IR and A relays still hold over the carrier.

When the relay B is finally released the E signal to the carrier terminal is cut off, which has the effect of restoring the normal polarity on the distant SPT line. Only after the calling SPT has cleared down will the inward carrier signal be removed to finally release relay IR and A. It is clear, therefore, that the response of the overall circuit from the signalman's point of view is identical whether the line is physical or carrier.

27. Carrier Conversion Unit

The schematic of this Unit is shown in Drg. 87URE00001D00. Since this unit normally is mounted adjacent to the distant carrier terminal, in order to accommodate different kinds of equipment practice, the unit is available either as a standard jack in relay set or as a strip mounted with terminals. The drawing shows both forms of termination.

A 50 volt local battery supply is required which will operate the relays in the conversion unit (except for CP) and provide the usual CB feed for the SPT line.

The audio pair from the carrier terminal is coupled through a repeating coil to the SPT line.

The relay IR is the feed relay and responds to loop signals from the line. When an SPT originates a call, the relay IR will be operated and will loop the E wires of the Carrier terminal to send the 'inward' carrier signal.

As already described, this results in the receipt of the outward carrier signal which applies 24 volts to the M wiring and so operates the relay CP. The relay B is then operated over CP1 and IR1 and locked over B1 and A1 (back). The contacts B2 and B4 carry out the usual pole changing function to reverse the polarity in the SPT line which is then 'busy' to all other SPT's. At this stage the relay IR is held over the impulsing contacts of the calling SPT and so will respond to the incoming code. Contacts IR2 repeat the code over the inward signalling channel to the Line Relay Set in the signal box.

During the call relays CP, IR and B remain operated. When the signalman resets the circuit at the end of the call the outward tone will be cut off and relay CP released.

The relay A will then be operated over CP1 and B3.

Contacts A2 and A3 will transfer the line loop from relay IR to relay AA which operates. Contacts AA1 will take over from IR to maintain the inward carrier signal.

Contacts AA2 will provide a holding circuit for relay A.

Contacts A1 having opened the holding circuit, relay B releases after an interval caused by the diode shunt on the winding of B.

Contacts B2 and B4 will restore the normal polarity of the SPT line and the relay AA will now be held in series with the JCR relay at the SPT. Only after the SPT has finally released its latching relay will the relay AA be released to remove the inward carrier signal and so permit the final release of the signal box equipment.

SIGNAL POST TELEPHONE SIGNALLING REPEATER

1. Application

Signalling repeaters are usually inserted in signal post telephone lines where the overall loop resistance of the line exceeds 1200 ohms. The repeater is a self-contained device operating from 50V DC supply and it is used to obviate the risk of dangerous inductive voltage build up over a long length of line running adjacent to the high voltage lines of an electrified system, or to permit operation beyond the specified resistance limit.

2. Functional Description

Codes from the signal post telephones on the distant side of the repeater are monitored by the repeater impulse relay, and repeated by its relay contacts connected in the near side of the line to the signal cabin control circuits. When the call is established speech is passed via the repeater transformer.

CIRCUIT DESCRIPTION (Schematic Drawing 87U RE00 001 C00)

A calling SPT looping the line will energise relay IR via its winding e-d, A1, AA4, B4, L3, -SPT-L4, Bs, AA3 and IR b-a to +ve. The control cabin side of the line is looped via TR 2-1, MR4, TR 6-5, by the closing of IR2 and this effects a reversal of the line polarity up to the transformer TR. The line polarity reversal completes an energising circuit for relay BDA via diode MR2. Contacts BDA1 operate relay BD which holds over BD2 and A3. Contacts BD1 and BD3 close, by-pass MR2 and hold the loop after reversal to allow the pulsing of IR to be repeated in the control station side of the line. Relay B is energised via BD4 and IR1, and locks on via B1. This reverses the line polarity to all SPT via B2 and B4, thus locking-out the line from all other than the calling SPT. At the end of signalling relay IR will remain energised via the SPT speech circuit loop. The speech circuit from the control station is via L2, BD3, C2, IR2, TR 2-1, BD1, TR 6-5 and L1, the two line sections being inductively coupled via TR. When the control station resets to clear down the call, the line polarity at L1-L2 is returned to normal allowing relay A to be energised via diode MR3 and contacts B3. Contacts A3 open the holding circuit of relay BD which then holds over BD2 and A3. Contacts A1 and A3 transfer the line loop from relay IR to operate relay AA. Relay AA operated holds over contacts AA2 and AA3 to the line loop. Contacts AA1 shunting the 200 ohm winding of relay A retain the line holding condition back to the signal box, and permit the (slow)release of relay A (this allowing sufficient time for relay BD to be released). The release of relay B restores the original polarity to the SPT line,

but it is only after the latching relay at the signal post telephone has been tripped that relay AA will be released, and the line to the signal box opened to restore the entire system to its normal 'line free' condition.

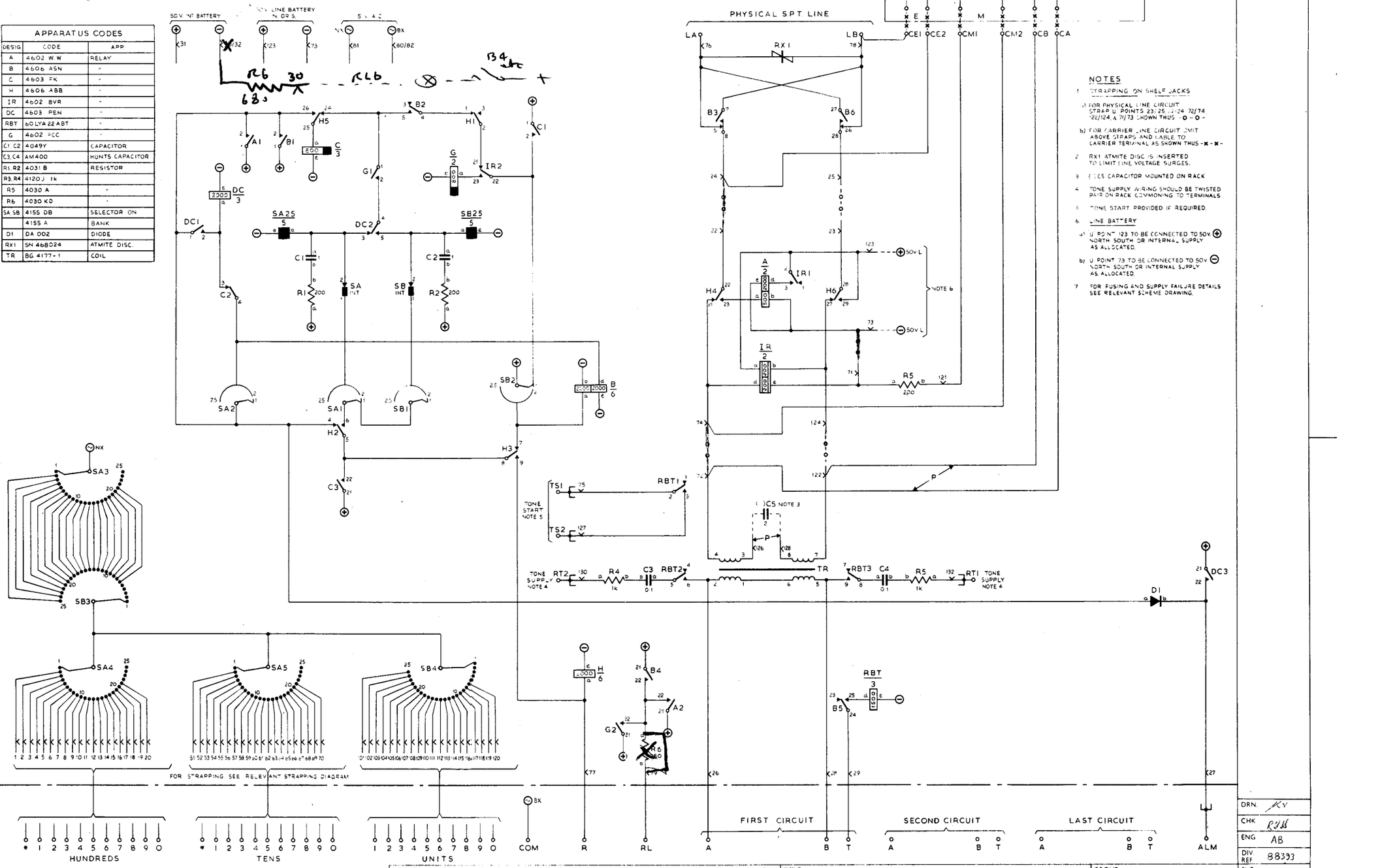
It should be noted that there is no metallic connection between the SPT line and the signal-box line. The repeater therefore may be regarded as a line isolating point in electric traction areas.

CODE L - 214953 | SHT. 2

501 LEU 230705 RELAY SET

ISSUE 1

APPARATUS CODES		
DESIG	CODE	APP
A	4602 W W	RELAY
B	4606 ASN	"
C	4603 FK	"
H	4606 ABB	"
IR	4602 BVR	"
DC	4603 PEN	"
RBT	60LYA22ABT	"
G	4602 FCC	"
C1 C2	4049Y	CAPACITOR
C3,C4	AM400	HUNTS CAPACITOR
R1, R2	4031 B	RESISTOR
R3, R4	4120 J 1k	
R5	4030 A	"
R6	4030 KD	"
SA SB	4155 DB	SELECTOR ON
	4155 A	BANK
D1	DA 002	DIODE
RX1	SN 468024	ATMITE DISC.
TR	BG 4177-1	COIL



NOTES

1. STRAPPING ON SHELF JACKS
   a) FOR PHYSICAL LINE CIRCUIT STRAP 'U' POINTS 23/25, 24/24, 72/74, 72e/124, A 71/73 SHOWN THUS - O - O -
   b) FOR CARRIER LINE CIRCUIT OMIT ABOVE STRAPS AND CABLE TO CARRIER TERMINAL AS SHOWN THUS - x - x -
2. RX1 ATMITE DISC IS INSERTED TO LIMIT LINE VOLTAGE SURGES.
3. C5 CAPACITOR MOUNTED ON RACK
4. TONE SUPPLY WIRING SHOULD BE TWISTED PAIR ON RACK COMMONING TO TERMINALS
5. TONE START PROVIDED IF REQUIRED.
6. LINE BATTERY
   a) 'U' POINT 123 TO BE CONNECTED TO 50V ⊕ NORTH SOUTH OR INTERNAL SUPPLY AS ALLOCATED.
   b) 'U' POINT 73 TO BE CONNECTED TO 50V ⊖ NORTH SOUTH OR INTERNAL SUPPLY AS ALLOCATED.
7. FOR FUSING AND SUPPLY FAILURE DETAILS SEE RELEVANT SCHEME DRAWING.

DISTN EQ

DRN. KV
CHK RJH
ENG AB
DIV REF. 88393
SHT 2

STANDARD TELEPHONES AND CABLES LIMITED
LONDON ENGLAND

TITLE: S.P.T. SCHEMATIC PHYSICAL/CARRIER LINE CIRCUIT LINE RELAY SET

GROUP

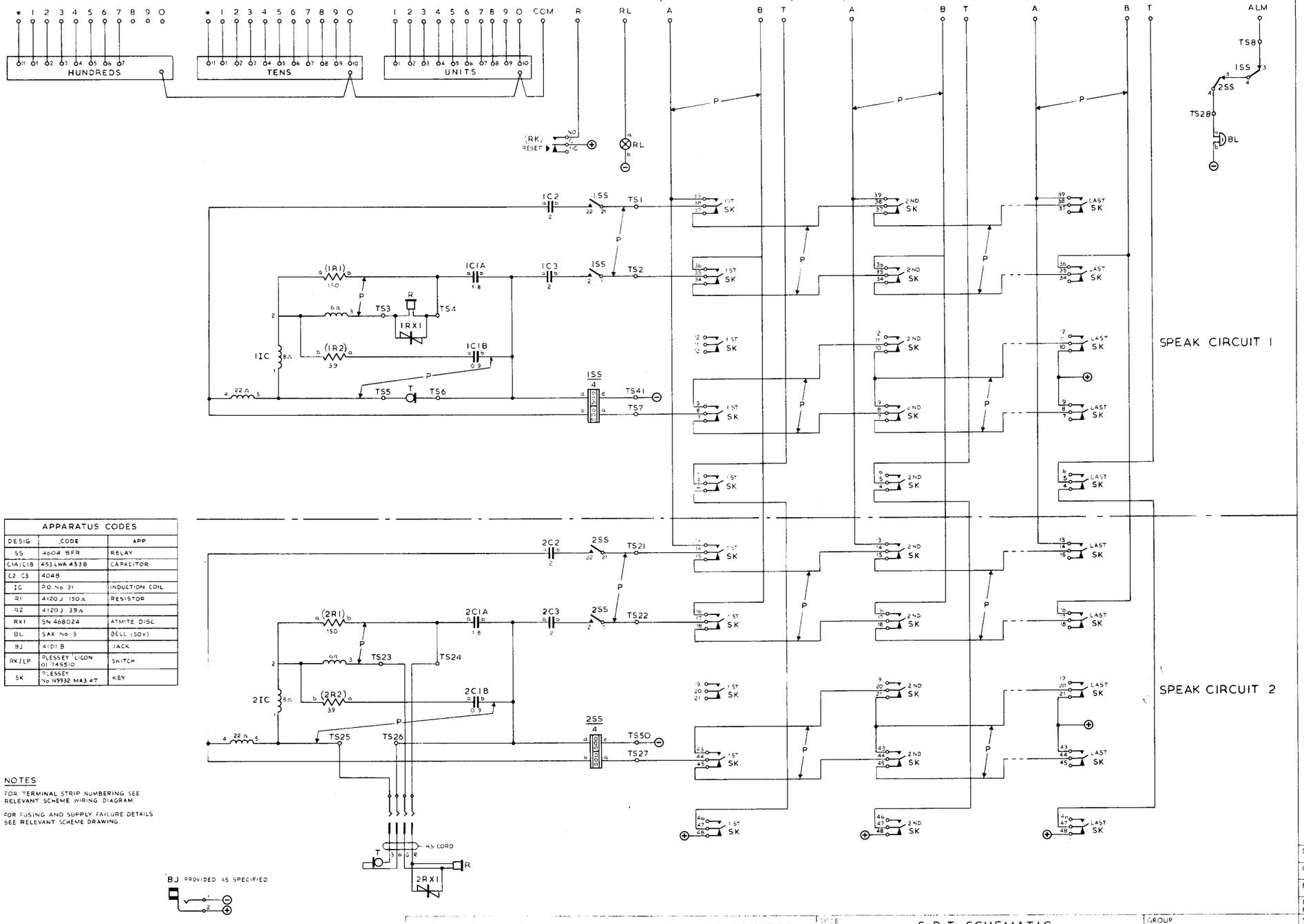
CODE L - 214953

SN 2444 L143783

CODE L - 214953 | SHT. 3

ISSUE 1
29-4-71

DISTN.
EQ



APPARATUS CODES		
DESIG	CODE	APP
SS	4604 BFR	RELAY
C1A/C1B	453 LWA 453 B	CAPACITOR
C2 C3	4048	
IC	P.O. No 31	INDUCTION COIL
R1	4120 J 150Ω	RESISTOR
R2	4120 J 39Ω	
RX1	SN 468024	ATMITE DISC
BL	SAX No 3	BELL (50V)
BJ	4101 B	JACK
RK/LP	PLESSEY 'LICON' 01 745510	SWITCH
SK	PLESSEY No N9932 MA3 4T	KEY

NOTES

1 FOR TERMINAL STRIP NUMBERING SEE RELEVANT SCHEME WIRING DIAGRAM.

2 FOR FUSING AND SUPPLY FAILURE DETAILS SEE RELEVANT SCHEME DRAWING.

DRN. JKW
CHK RJH
ENG AB
DIV REF BB393
SHT 3

STANDARD TELEPHONES AND CABLES LIMITED
LONDON ENGLAND

TITLE S.P.T. SCHEMATIC
PHYSICAL / CARRIER LINE CIRCUIT
CONSOLE

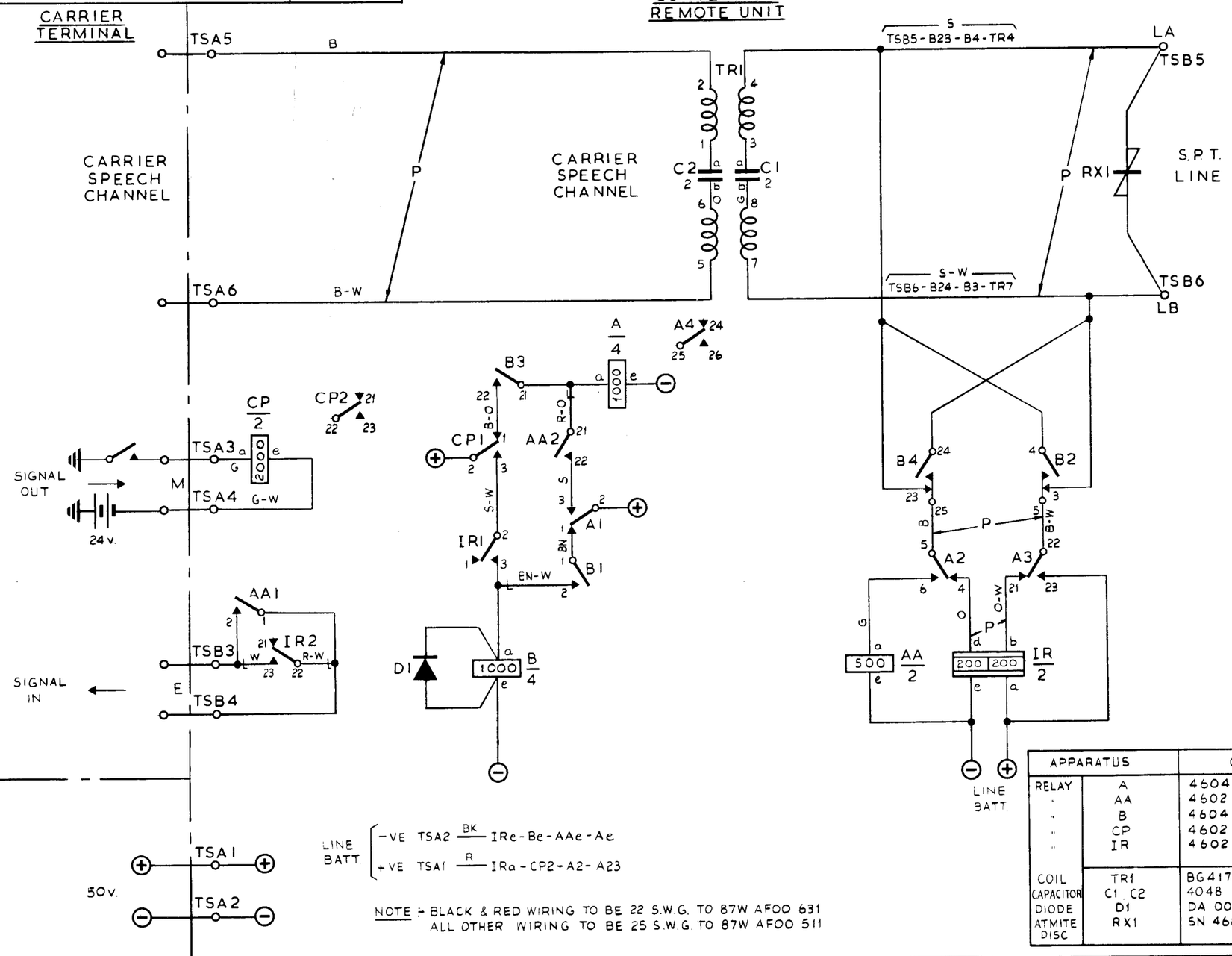
GROUP
CODE L - 214953

SN 7444 L143783

CODE 87U REOO OOI DOO | SHT. 7·1

ISSUE 1. 29-4-71

S.P.T. CARRIER CONVERSION REMOTE UNIT



LINE BATT.
- −VE TSA2 —BK— IRe-Be-AAe-Ae
- +VE TSA1 —R— IRa-CP2-A2-A23

NOTE :- BLACK & RED WIRING TO BE 22 S.W.G. TO 87W AFOO 631
ALL OTHER WIRING TO BE 25 S.W.G. TO 87W AFOO 511

APPARATUS		CODE
RELAY	A	4604 AD
"	AA	4602 AGP
"	B	4604 ACA
"	CP	4602 ACM
"	IR	4602 BVR
COIL	TR1	BG4177-1
CAPACITOR	C1, C2	4048
DIODE	D1	DA 002
ATMITE DISC	RX1	SN 468024

DRN. HKN
CHK.
ENG. AL
DIV.
REV.

DISTN. EQ 88391-2 (RFH)

STANDARD TELEPHONES AND CABLES LIMITED
LONDON, ENGLAND

TITLE S.P.T. CARRIER CONVERSION REMOTE UNIT

GROUP DOO | SHT. 7·1

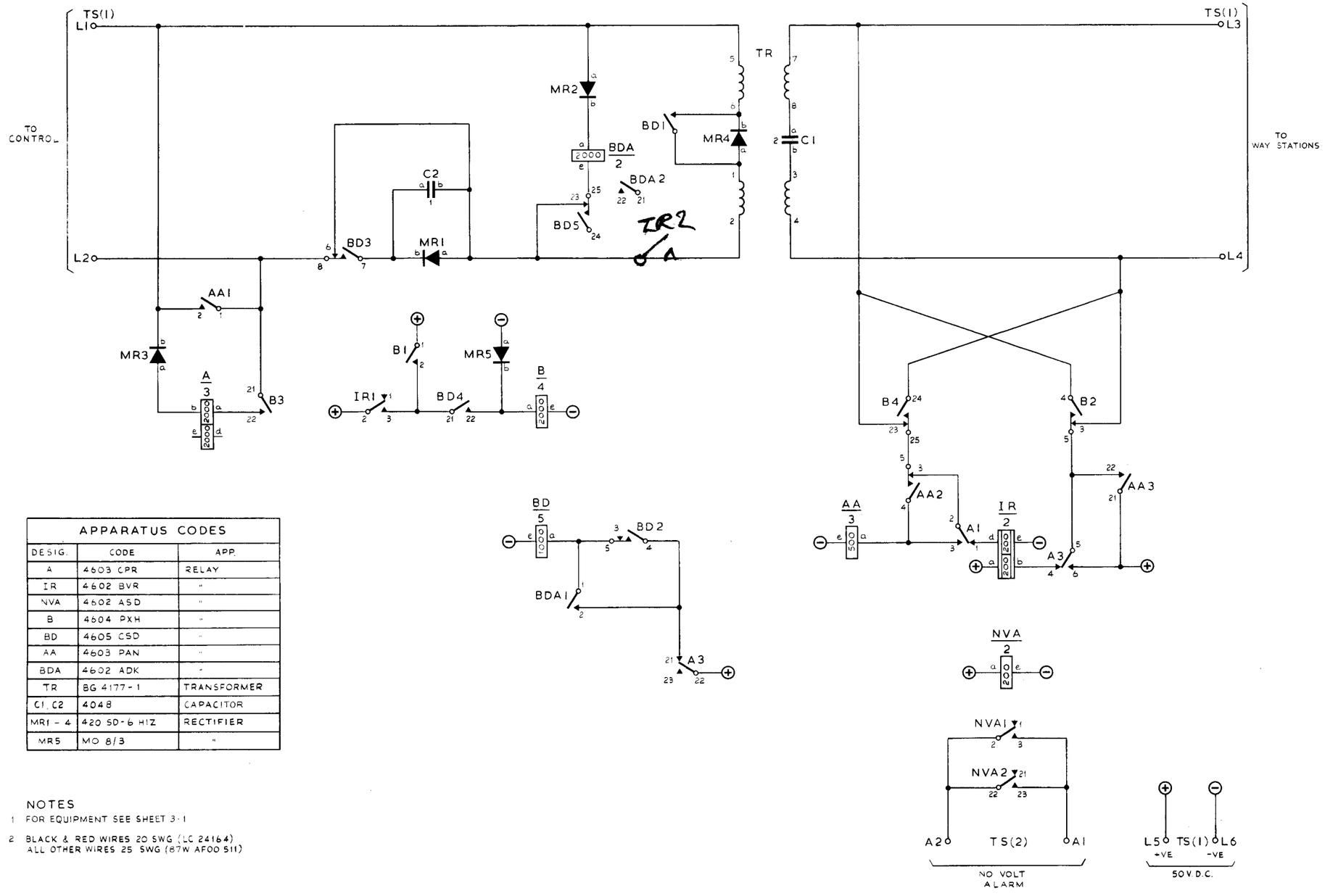
CODE 87U REOO OOI

U.D.O.

SN2441 L143781

CODE 87U REOO 001 COO | SHT 7·1

ISSUE 1
23·4·71



DISTN.
EQ
88391·1
(RFH)

APPARATUS CODES		
DESIG.	CODE	APP.
A	4603 CPR	RELAY
IR	4602 BVR	"
NVA	4602 ASD	"
B	4604 PXH	"
BD	4605 CSD	"
AA	4603 PAN	"
BDA	4602 ADK	"
TR	BG 4177-1	TRANSFORMER
C1, C2	4048	CAPACITOR
MR1 - 4	420 SD-6 HIZ	RECTIFIER
MR5	MO 8/3	"

NOTES

1 FOR EQUIPMENT SEE SHEET 3·1

2 BLACK & RED WIRES 20 SWG (LC 24164)
ALL OTHER WIRES 25 SWG (87W AF00 511)

DRN. JRH
CHKD. RSH
ENG. AB
DIV. REF. 88393

STANDARD TELEPHONES AND CABLES LIMITED
LONDON, ENGLAND

TITLE S. P. T. REPEATER CIRCUIT

GROUP

SHT. 7·1

CODE 87U REOO 001 COO

SN 2443 L143782