RAILWAY SIGNAL POST TELEPHONE SYSTEM

APPARATUS AND MAINTENANCE HANDBOOK

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Edition 2

Standard

SIGNAL POST TELEPHONE SYSTEM

NOTES ON APPARATUS AND HINTS ON MAINTENANCE

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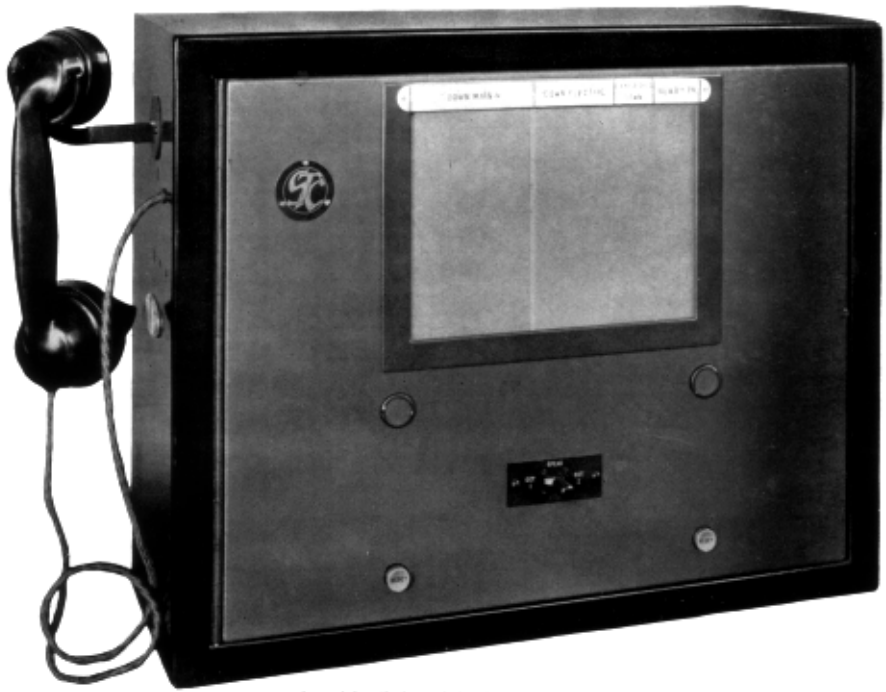


Double Cabin Display Cabinet.

Signal Post Unit

RAILWAY SIGNAL POST

TELEPHONE SYSTEM

NOTES ON APPARATUS AND HINTS ON MAINTENANCE

GENERAL

This booklet is issued for the use of Linemen and others responsible for the maintenance of Signal Post Telephones.

It is not considered that adjustments to relays and selectors should be made on site, but rather that they should be carried out by someone skilled in the art in the repair shops, since it is essential that the correct tools should be em-ployed.

DETAILED CIRCUIT DESCRIPTION

(See inset at end of book)

The sequence of the operations of the various parts of the system when a call is made, is as follows **:-**

Calling from a Signal Post Telephone With Line Free.

When the engineman turns the Selector Key in the signal post unit and then releases it, the impulse wheel makes one complete revolution.

During this revolution Springs 1 and 2 first open circuit and the long impulsing spring (3) makes contact with the impulse wheel without opening the impulsing circuit. The impulsing contacts 2 and 3 are subsequently opened once for each impulse in the first digit, kept closed for a period equivalent to 3 impulses, opened once for each impulse in the second digit and then kept closed until the end of the code.

When the long spring first makes contact with the impulse wheel, a circuit is provided for relays IR and LT as follows :-

From positive, a-b winding of IR, contact B6, line B through impulse wheel, 300 ohm winding of relay LT, rectifier RD, line A, B3, H4, d-e winding of relay IR, to negative.

SIGNAL POST TELEPHONE
(Relay inspection plate removed)

Relays IR and LT are both operated and relay LT is mechanically locked, so that it will remain operated until it is tripped by the energisation of coil fk.

Relay A in the signal cabin is thus operated :-

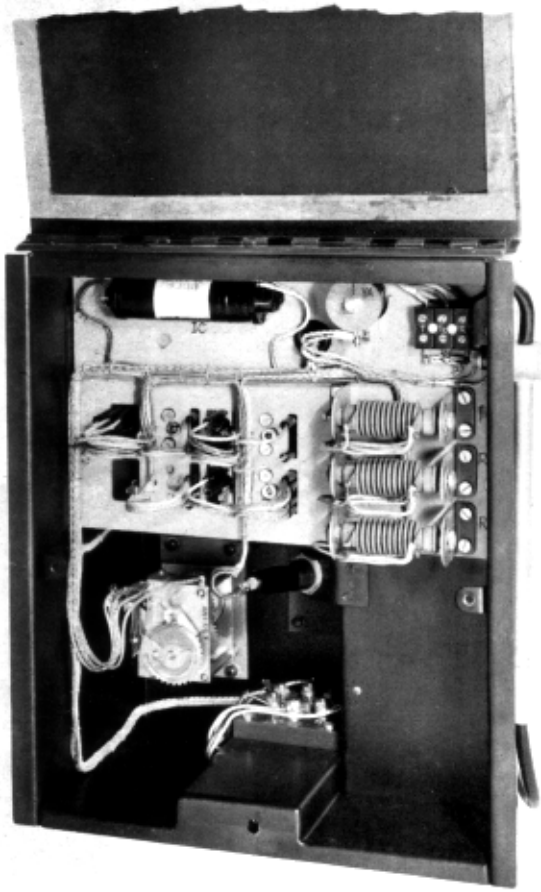
From positive, home contacts of switch banks SA2, or SB2, contacts IRI, winding of relay A to negative.

Relay B is thus operated :-

From positive, contacts A1, H2, H3 winding of relay B to negative.

The contacts B3 and B6 reverse the polarity of the current which is fed to the line, but do not reverse the current through relay IR, which remains operated :-

From positive, a-b winding of IR, contact B6, line A, rectifier RB, contact LT2 through transmitter of hand-microtelephone, contact LT3, resistance YA, impulsing contact of selector key, line B, contacts, B3, H4, d-e winding of IR to negative.



REAR VIEW OF INNER BOX
(Signal Post Telephone)

It will be seen that the circuit depends on the impulsing contacts, so that the relay IR will be released and re-operated once for each impulse in the two digits.

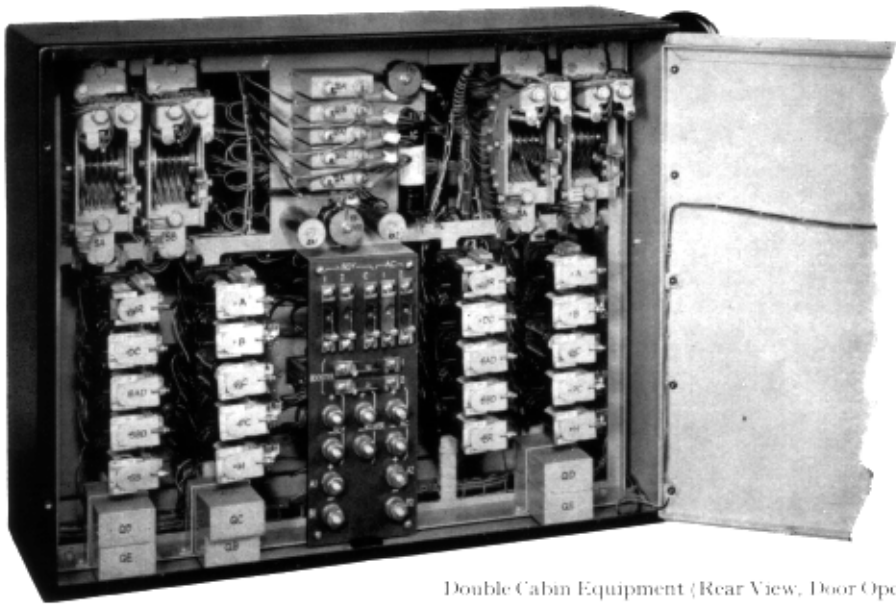
When the relay IR is released for the first impulse of the first digit, relay C and the switch magnet SA are tnergised in parallel :-

From positive, home contacts of switch banks SA2 and SB2 contacts IR1, H1, B2 through contacts DC1 and the winding of switch SA to negative, in parallel with contacts H5, and the winding of relay C to negative.

The C relay is sufficiently slow in release to hold over the impulses of a digit, but not sufficiently slow to hold during the inter-digital pause.

Relay B is held operated over its own contact B1, H2, H3 to negative.

When the switch magnet SA is energised, the driving ratchet of switch SA is caused to engage with the nest tooth of the ratchet wheel, and when the magnet is released on the re-operation of relay IR, the switch takes one step



Double Cabin Equipment (Rear View, Door Open)

Double Cabin Equipment (Rear View, Door Open)

for each impulse in the first digit. During the inter-digital pause the relay C is released, whereupon a circuit is provided for the relay DC :—

From positive contacts B1, switch bank SA4 in any position other than home, contact C2, winding of relay DC to negative.

The relay DC is subsequently locked over contact DC2 so that it remains operated independently of the switch SA or the relay C.

When the relay IR is released for the first impulse of the second digit, the relay C is re-operated as before and the switch magnet SB, instead of SA, is energised over contacts DC1 (operated).

When the switch magnet SB steps away from home the impulsing positive is maintained over contacts C3 so that the switch takes one step for each impulse in the second digit.

It should be noted that the impulsing wheel of all selector keys carries an adjustable cam for shading out 3 teeth to provide the inter-digital pause. It follows, therefore, that all codes have the same total impulses in the two digits.

This constant total principle is introduced in order that it shall be impossible for any mutilation of a code to produce another acceptable code.

The switch banks SA3 and SB3 feed current from 12 volt A.C. supply to a series of lamps, so arranged that a lamp will be illuminated only when the first and second digit add up to the selected total-for example, if the constant total of **11** is employed and the code 5-6 received, switch A will stop in position; Y, and switch B in position 6 and a circuit will then be provided over switch banks SA3 and SB3 for lamp **N o** 5 ; lamp No. 5 is so placed that it illuminates a stencil bearing the designation of the signal post which sends the code 5-6.

At the beginning of the code, the alarm bell rings :—

From positive, contacts A1 or RI, SSI, winding of bell to negative.

When the Signalman hears the alarm bell and sees the designation of the calling signal post, he lifts his hand-microtelephone to accept the call. The relay SS is then energised :-

From positive, contact Al or B1, a-b winding of SS, through the transmitter of the hand-microtelephone, contacts of switch hook, d-e winding of Relay SS to negative.

The operation of contacts SS1 stops the bell.

The Signalman and the Engineman are now connected in a speech circuit :—

Signalman's hand-microtelephone set, contacts of switch-hook, condenser QB, contacts H4, B3, line B, contacts of selector key, resistance Y!, contact LT3, Engineman's hand-microtelephone, contact LT2, condenser QB, line A contact, B6, condenser QC to Signalman's hand-microtelephone set.

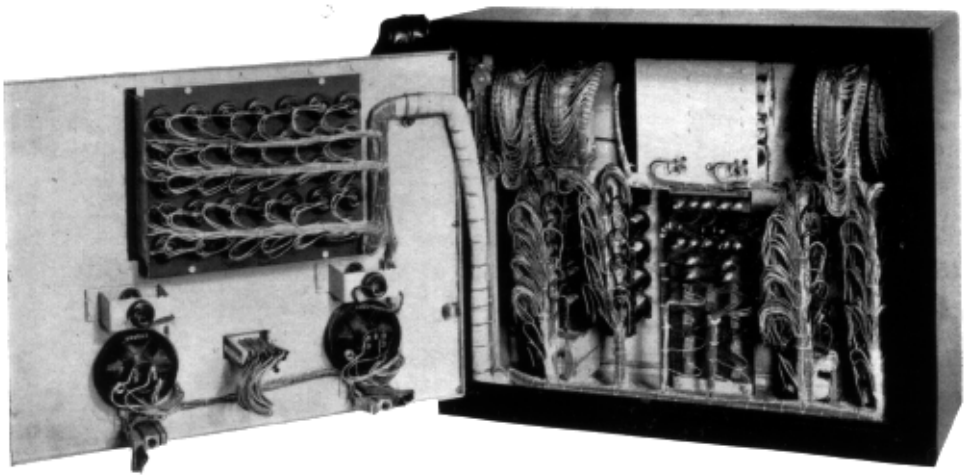
It will be seen that there is no DC connection between the telephone sets, speech being passed through condensers QB and QC. The two transmitters are fed from battery through the two relavs SS and IR. It will be seen that the recti-fier RB is shunted by a 1....F condenser in order to maintain a satisfactory speech circuit.

Calling from a Signal Post Telephone with Line Engaged.

If an Engineman turns his selector key when the line is engaged, the polarity of the battery applied to the line will already have been reversed so that the relay LT will be prevented from operating by the rectifier RD. The busy relay BS, will, however, be operated :-

From positive applied to line A, the rectifier RB contact LT2, winding of BS, through impulse wheel and long impulsing spring to line B, which is connected to negative.

The relay BS will operate and lock itself independently of the selector key through rectifier RC. The relay BS, therefore, is held energised until the line polarity is reversed when the rectifiers RB and RC will prevent further current



Double Cabin Equipment (Wiring Side)

flowing through it The " Engaged " lamp BL is operated over the contacts BS1 from a local supply.

Release at the end of a Call.

The relay H is operated :-

From positive, switch banks SA2 or SB2 contact RK, winding of relay H to negative.

The relay C is re-operated positive, A1 or B1 , H5, winding of relay C to negative.

On the release of the key RK, relay H is held :-

From positive, contacts C**l,** H3, winding of relay H to negative.

The relay SAD operates :-

From positive, contacts B1, H2, interrupter, contact of the switch A, switch bank SA1 in any position other than home, winding of relay SAD to negative.

Contacts SAD1 energise the switch magnet SA.

The operation of the switch armature opens the interrupter contact SA dm. which in turn disconnects relay SAD Contact SAD1 releases the switch magnet SA and the switch makes one step. This cycle of operation will be repeated until the switch reaches the home position, when the circuit for the relay SAD will be finally interrupted.

In the same way, the switch SIB is driven home in conjunction with relay SBD The operation of contacts H3 left the relay B dependent on switch banks SA2 and SB2 for its holding circuit, so that, when both switches reach their home positions, the relay B is de-energised. When relay B releases, a circuit is provided for relay A and the trip coil LT.

From positive, a-b winding of relay IK, contacts B6, lineB, impulse springs of selector key contact LT1, winding of coil LT, rectifier RA, line A, contacts, B3, H4 winding of relay A to negative.

When the mechanically locked relay LT trips contact LT1 will open the line circuit described above, thus releasing relay A, which in its turn releases relays C and H so that all the apparatus is restored to normal.

ADJUSTMENTOFRELAYS

In the following pages two sets of limits are quoted, known respectively as test and re-adjust. Test limits are wider than re-adjust limits, and are used for acceptance testing and, in maintenance, to ascertain whether the relay is adjusted satisfactorily. When a relay is found to be outside the test limits, it should be readjusted to the closer re-adjustment limits to ensure that it will have a satisfactory life before again falling outside the test limits.

For convenience in ordering spares, the part numbers of the common components are shown in figure 1.

Relays are usually adjusted to mechanical requirements which completely cover their performance, and when so adjusted, automatically satisfy the current requirements unless their coils are faulty. A certain amount of adjustment within the mechanical limits may, however, be necessary and on certain codes spring pressures and residual gaps have to be specially adjusted to meet current tests. The customer's marking label indicates whether or not special adjustments of this kind are required.

Labels.

The customer's marking label shown in the figure 1 is either red, green or white. A white label indicates that the relay has 14 mm. springs and must be strictly adjusted to the standard mechanical requirements, in which condition it should satisfy the electrical requirements.

A green label indicates that the relay has 12 mm. springs and must be adjusted in the same way as the white label relay, except that the buffer spring pressure conforms to the lighter standard.

As shown in figure 1, the customer's marking label may bear a letter X and a number. The letter X indicates that one of the contacts functions before the remainder and the relay has an armature travel of 43 mm. The number is the value in mm. of the residual air gap.

White and green label relays are absolutely standard except for the presence or otherwise of X contacts and the adjustments of the residual screw, Since

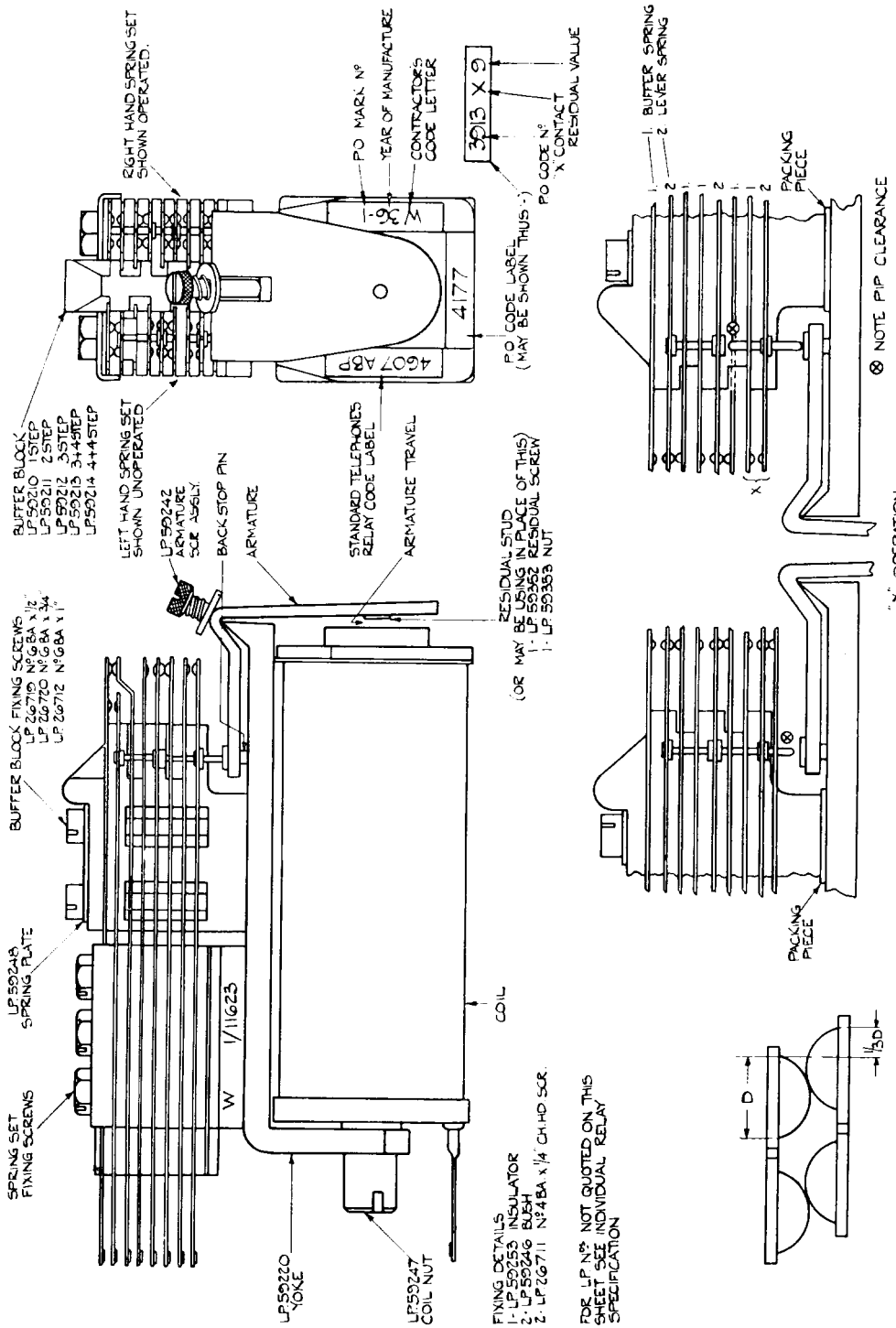

RIGHT HAND SPRING SET SHOWN OPERATED.
PO MARK Nº
YEAR OF MANUFACTURE
CONTRACTOR'S CODE LETTER
PO CODE Nº
X CONTACT RESIDUAL VALUE
PO CODE LABEL (MAY BE SHOWN THUS :-)
BUFFER BLOCK LP59210 1STEP LP59211 2STEP LP59212 3STEP LP59213 3+4STEP LP59214 4+4STEP
LEFT HAND SPRING SET SHOWN UNOPERATED
LP59242 ARMATURE SCR ASSLY
BACK STOP PIN
ARMATURE
STANDARD TELEPHONES RELAY CODE LABEL
ARMATURE TRAVEL
RESIDUAL STUD
(OR MAY BE USING IN PLACE OF THIS)
1 - LP59362 RESIDUAL SCREW
1 - LP59353 NUT
BUFFER BLOCK FIXING SCREWS
LP26719 Nº6BA x 1/2
LP26720 Nº6BA x 3/4
LP26712 Nº6BA 1"
LP59249 SPRING PLATE
SPRING SET FIXING SCREWS
W 1/11623
COIL
LP59220 YOKE
LP59247 COIL NUT
FIXING DETAILS
1 - LP59253 INSULATOR
2 - LP59246 BUSH
2 - LP26711 Nº4BA x 1/4" CH.HD SCR.
FOR LP Nºs NOT QUOTED ON THIS SHEET SEE INDIVIDUAL RELAY SPECIFICATION
BUFFER SPRING
LEVER SPRING
PACKING PIECE
⊗ NOTE PIP CLEARANCE
"X" OPERATION
PACKING PIECE
D
1/3D
MAXIMUM OVERLAP OF CONTACT POINTS

Figure 1

these features are indicated on the label, reference to the individual specifications is unnecessary.

For maintenance purposes, current tests on white and green label relays rnay be omitted.

A red label indicates that some of the features of the relay are special, and that some spring tensions may have to be adjusted to suit requirements other than those given in the standard specification. These relays should not be re-adjusted without checking the current requirements.

Residual Air Gap.

The residual air gap is defined as the shortest air gap between the poleface and the inner surface of the armature when the relay is operated. It is provided by means of a stud or screw and lock nut. Measurement is made by placing the holed end of the feeler, with the stud or screw passing through the hole, so that the pole-face is covered. With the relay operated and the armature held on to its knife edge, the minimum limit feeler must be free to move while the maximum limit feeler should be gripped by the armature.

It is unnecessary to check stud residuals unless the relay gives faulty holding or release performance.

TABLE 1

Nominal Stud Length	Max. Gap	Min. Gap
20	18	11
4	6	2
12	13	6

When screw residuals are fitted to white or green label relays, the value of the gap is given on the customer's marking label.

On certain codes of relay which may have red, white or green labels, it is necessary to vary the residual gap to suit timing or electrical requirements. The re-quired value, which may differ from the nominal figure shown in the specifica-tion, is marked on the label and enclosed in brackets thus :- (7).

The limits for screw residuals are given in Table 2.

TABLE 2

Nominal	Re-adjust		Test	
	Max.	Min.	Max.	Min.
3	4	2	5	2
4	5	3	6	2
5	6	4	7	3
6	8	4	9	3
Over 6	+2	-2	+3	-3
(3)	4	2	5	2
Bracketed figures above (4) and over.	+1	-1	+2	-2

Armature Travel.

Armature travel is the amount of available movemen of the armature measured at the residual stud (or screw). Travel is varied by bending the armature.

The amount of travel is gauged by successively inserting feelers in the air gap to cover the residual stud or screw but not to touch the armature itself. The armature should be held on to its knife edge with the back stop pin resting against the polepiece and the minimum limit feeler should be loose in the gap. The maximum limit feeler should either be gripped or fail to enter the gap.

White or green label type relays have a travel of 31 mm. and with an X contact 43 mm. travel.

Red label relays may have special travels but, where 31 or 43 mm, travel is used, the standard limits quoted in Table 3 apply unless otherwise specified in the individual relay specification.

TABLE 3

Nominal Travel	Label	Re-adjust Tolerance mm.	Test Tolerance mm.
31	White or Green	+2 -1	+3 -2
43	do.	+2 -1	+3 -2
31 or 43	Red	+2 -1 unless otherwise specified	+3 -2 unless otherwise specified
Values other than 31 or 43	Red	See Relay Spec.	See Relay Spec.

Spring Pressures

Contact pressure is determined by the pressure with which the buffer springs bear upon the buffer block. The pressure is measured by applying a tension gauge to the tip of the spring in line with the contacts. A gauge set to the minimum value should not cause the spring to lift clear from the buffer block. A gauge set to the maximum tension should cause the spring to lift from the buffer block.

Contact pressure is measured when the contacts are open, i.e. in the case of break contact when the armature is operated and in the case of make contacts when the armature is at rest.

Lever springs (i.e., those which bear directly or through the lifting pins of other springs on to the armature) are also individually adjusted to tension requirements.

The measurement is made by applying the tension gauge finger to the contact and noting the pressure necessary to lift the lifting pin or kermot stud off the support beneath it. While making the measurements the pressure of other springs normally bearing on the one under consideration must be removed by holding the springs away with a small screwdriver.

In the case of the lever springs of break or change-over contact units, the lever spring pressure has to exceed the buffer pressure of the back springs by the specified amount. This excess pressure (re-adjust 5-8 grammes) is measured by applying the tension gauge finger to the back of the back-spring in line with the contact. The application of the minimum pressure may *neither* lift the lifting pin or kermot stud from its support *nor* close up the buffer spring lift of the back contact. The application of maximum pressure must *either* lift the lifting pin *or* kermot stud from its support or close up the buffer spring lift of the back contact.

The Table 4 gives the pressure limits in grammes allowed for re-adjust purposes, except in the special cases detailed in Section 10.

TABLE 4

Component	14 mm.springs white labels		12 mm. springs green labels	
	Max.	Min.	Max.	Min.
Buffer springs tensioned against buffer block	20	16	15	11
Lever springs of make contacts against armature stud or lever below	8	5	8	5
Excess pressure of break contact lever springs, above that of break buffer springs	8	5	8	5

In cases where an individual specification necessitates the adjustment of lever springs to fulfill current tests, the minimum test limit is 4 grammes, but no maximum is imposed.

Contact Clearance.

On relays with standard armature travel the minimum contact clearance is 12 mm. (re-adjust) and 10 mm. (test). On relays with reduced travel the re-adjust limit is 7 mm. min. and the test limit 5 mm. min.

Contact clearance is measured with the relay operated in the case of break contacts and unoperated in the case of make contacts.

Contact Sequence.

The standard contact sequence is as follows :-

Group 1.- All Break Contacts, including break portion of change-over contacts. These contacts may function in any order amongst themselves, but must all operate before any contacts in group 2.

Group 2.— Comprises all make contacts including the make portion of change-over contacts.

Group 3.- Make-before-Break Contacts. There is no requirement governing the sequence of these contacts in relation to any contacts on the relay other than " X " contacts.

Group 4.- " X " Contacts. When an " X " contact forms part of a relay an " X " is included in the customer's marking. " X " contacts must function before the pip clearance between the " X " contact and the break or changeover contact above it, is closed up, and also before the pip clearance of the break or change-over contact in the opposite pile-up is closed. It is also required that they function before any other contacts.

Spring Lift.

When contacts are closed, buffer springs should be lifted from the buffer by means of the lever spring. The re-adjust limit is 4 mm. min. and the test limit is 2 mm. min.

Pip Clearance.

The pip clearance required on " X " action is limited to 4 mm. min. (re-adjust) and 2 mm. min. (test). The position of the pip clearance in a typical relay with an " `X " make contact is shown in the figure.

Tensioning of Springs in Special Cases.

There are two cases where springs are not tensioned to the requirements quoted in the table giving " spring pressure" These are :-

(1) Top Springs of make-before-break units.

In adjusting a make-before-break action the buffer spring is tensioned against the buffer block to the standard pressure. The top spring is then sufficiently tensioned against the buffer spring to lift the latter approximately 5 mm. away from the buffer block. The lever spring has standard tension.

(2) Break or changeover springs above " X " contacts.

Mechanical Adjustment of 4619 Type Relay.

The locking unit must be so adjusted that the latch functions when a 3 mm feeler is inserted between the core and residual screw and fails to function when a 6 mm. feeler is employed.

In a similar manner the release unit should function with a 4 mm. feeler and fail with an 8 mm. feeler.

In making the above tests the side play in the armature must be taken into account, and all front contacts should be lifted clear of the buffer block by at least 2 mm.

The Residual gap on the lock unit is normally 6 mm. and on the Release unit 10 mm.

The armature travel is the standard 43 mm. for each unit.

GENERAL REQUIREMENTS

(1) **Springs.-**Springs must be adjusted to appear straight, when examined with the armature at approximately half stroke. To obtain spring lift, contact sequence and contact clearance requirements, the portion of the spring between the contacts and the lugs or lifting pins may be slightly set. When setting springs in this manner care must be taken to share the total set between the springs concerned in order that the set on any individual spring is as small as possible.

(2) **Armature.-**The armature must be free throughout its stroke and held down on the knife edge by the armature fixing screw and spring, so that the spring will restore it if it is slightly displaced.

(3) **Contact Alignment.** - Contacts must not bc out of alignment by more than 2of the contact diameter. See figure 1.

(4) **Twin Contacts.-**Twin contacts of springs must function simultaneously and as closely as can be judged by visual inspection. The individual ends of the springs are adjusted to secure this condition, the lever spring being adjusted so that the two forks are co-planer.

(5) **Spring Clearance**. - Clearance of not less than 10 mm. must exist between the surfaces of springs not intended to be in contact.

Adjustment.

In adjusting the relay, the following order of procedure is recommended : -

(a) If a residual screw is fitted, set this to the required value by means of screwdriver and spanner 421 8

(b) Set the armature to the required armature travel.

(c) Tension the buffer springs against the buffer block to the required tensions. If the relay is unmounted or is otherwise easily accessible, bent nosed pliers may be used. For mounted relays the spring bender, No. 4292A Tool, is usually more convenient.

(d) Adjust the lever springs individually to the tension requirements beinning with those nearest to the armature.

(e) Examine the relay for spring lift and contact sequence : correct where necessary either by straightening the springs, or by slightly setting the ends of the springs (between the contact and lifting pin only).

(f) Ascertain that twin contacts open and close simultaneously and, if necessary, correct by bending one or other of the twin contact tongues by means of tongue bender tool No. 4293A.

(g) Apply the current tests. In the case of white and green label relays, on readjustment should be necessary to satisfy these. If any more than slight restriction of the mechanical requirements is imposed by the current test on such a relay, the coil should be changed. In the case of red label relays restriction of the range of spring pressure may be necessary. In the latter case a note will appear on the individual relay specification calling for the lever springs to be re-adjusted to current requirements.

Contact Cleaning.

This should very rarely be necessary owing to the use of twin contacts, but when found desirable, contacts should be cleaned with the 4258 Contact Cleaner and pure clean carbon tetrachloride. The tool and the liquid must be kept scrupulously clean.

Replacement of Parts.

The assembly of the relay is simple and will be understood by examination. It should be noted, however, that spring sets are secured to the yoke by the two end screws. The centre screw holds the pile-up together as a unit and is not threaded into the yoke.

A coil may be changed without dismounting the relay, by removing the armature and core nut and unsoldering the tags. The coil can then be withdrawn from the front. Coils are denoted by an LP number, but as a given coil may be used on many relays the paper label on the front cheek will not be supplied unless the coil is ordered as :-

LP... . . . .coil labelled for use on

No. . . . . Relays.

When a relay has its residual value shown on the label in brackets, the fitting of a new coil necessitates the re-determination of the residual gap to omit the current or timing requirements given in the individual specification. This new value should be marked on the label. New labels can be conveniently made on a typewriter and secured by clear cellulose varnish.

When either a new armature or coil is fitted, the armature travel requires re-adjustment and the adjustment of the remaining features should be checked and corrected where necessary.

ADJUSTMENT OF SELECTOR

1. **Armature Lever Back Stop.**

The armature lever back stop should be adjusted so that the tips of the wipers are flush (within +- .005 in) with the entering edges of the first bank contacts. (Gauge by eye).

NO TE-To obtain this adjustment, set the armature lever stop and wipers so that the wiper tips aye off the contacts, then gradually move the armature lever back stop downwards until the wipers have moved forward to the correct position Use No. 4267-A Tool. Check that the tips of bridging wipers aye not less than .020 in clear of the previous bank contacts.

2. **Armature Lever Forward Stop.**

Make certain that when the armature lever is operated by hand, the pawl is just prevented from dropping over the second tooth of the ratchet wheel by the armature lever forward stop If this requirement is not obtained, the armature lever stop must be changed.

3. **Driving Pawl.**

The tip of the driving pawl should engage squarely in the ratchet notch.

4. **Detent Spring.**

The detent spring must be adjusted to drop into each rotary notch without allowing more than perceptible back lash in the wiper assembly. This back lash must not be such that the tips of the wipers, when lightly forced backwards, move more than .005 in. (Gauge by eye and feel)

The tip of the detent spring should rest squarely and firmly in the root of the ratchet notch. Re-adjust with No. 4267-A Tool.

5. **Pawl Stop.**

The paw1 stop must be adjusted so that, with the armature in its normal position, there is a slight forward rotational play in the wiper assembly. This play must not be such that the tips of the wipers, when lightly forced forward, will move more than .020 in. (Gauge by eye and feel). Re-adjust with No. 4267-A Tool. (This adjustment must not affect the detent spring adjustment No. 4).

6. **Bank.**

Rotate the wiper assembly by hand to the 25th bank contact. The non-

bridging wipers must now occupy the same relative position on this contact as they occupied on the 1st bank contact. (See adjustment No. 1).

NO TE - Should the wipers not occupy this position, adjust the position of the mechanism by means of the mechanism positioning gland until the wiper position is correct

7. **Brushes.**

Test each brush for tension. This should be 3 5 grammes ± 10 grammes when measured at the extreme tip. The tension should be measured when the wipers are standing on the 11th bank contact and the tool applied to the tip of the brush. Test with So. 4270-R and No. 4271-G Tools.

8. **Wipers.**

When the wipers are standing on the 1st bank contact, the opposite ends must be in alignment with the bank levels, within the thickness of the bank contacts (.015 in). (Gauge by eye). Now check the alignment of the wipers with the 1st bank contact.

NO TE - If the alignment is bad, loosen the two top mechanism securing screws and adjust the position of the mechanism so that the wipers enter the bank levels with no more than .015 in side movement. Re-tighten the mechanism securing screws.

The wiper springs must be flared outwards from the hub to the heels, but when the wipers are standing on the 23rd bank contact the opposite ends must clear the brushes by 10 mm. miminum when the wiper assembly is moved sideways on the spindle

NO TE - Care must be taken to ensure that when the wipers are standing on the 25th bank contact, the heels at the opposite ends do not touch the 1st bank contact when the wiper assembly is moved sideways on the spindle.

The wipers should be so adjusted for tension that they exert a pressure on the bank contacts of 30 grammes +- 10 grammes : this is to be measured when the wipers are standing on the 25th bank contact. Test using No. 4270-B and No. 4271-E Tool applied with the tip of the latter in engagement with the centre of the wiper prong at the bend nearest the heel of the wiper.

Each end of the wipers, when not in contact with the bank, must be so adjusted that the outermost contact points only of each pair are touching. There must be a gap of approximately 4 mm. between the innermost contact points. This is to ensure that the wipers make good contact with the bank terminals. (Gauge by eye).

9. **Armature Restoring Springs.**

The tension of the two armature restoring springs must be evenly distributed by adjustment of the spring adjustment screw. The tension must be such that the wipers will positively step on to the bank contacts on the release of the armature when retarded by hand. Excess tension must be avoided.

10. **Magnets.**

The position of the magnet coils must be adjusted by means of the magnet glands so that the armature strikes both magnet cores simultaneously and the pawl steps between the limits of 13 and 12ratchet teeth. (Gauge by eye)

NO TE-To check this adjustment the armature must be operated electrically with the interrupter springs short circuited. Rotation of the wipers by operating the armature lever by hand should be avoided as it is possible that under these conditions the armature may become displaced

11. **Interrupter Springs.**

The interrupter springs must have good contact alignment. The lever spring must be tensioned to give a contact pressure of 150 grammes ±50 grammes. The contacts must break just as the pawl drops over the first forward tooth of the ratchet wheel. (Gauge by eye).

NO TE-The point of interruption must in all cases be adjusted by bending the interrupter spring operating lever.

12. **Pointer.**

The position of the pointer shall indicate the " HOME " position when the wipers are on the home contacts.

13. **Screws.**

Test all screws for tightness but do not strain them

14. **Running Test.**

When testing or adjusting a switch for running, always see that the proper spark quench circuit is used.

(a) The wipers must rotate smoothly and reliably at a running speed within 65 to 100 R.P.M.

(b) The wipers must rotate smoothly and reliably with a test voltage of 46 across the magnet coils and a test resistance of 12 1/2 ohms in series.

(c) The wipers of all homing selectors shall home reliably and stop accurately on the home position.

15. **Lubrication.**

Oil dag shall be applied sparingly to :-

(a) All teeth of the ratchet wheel.

(b) The back of pawl where it strikes the pawl stop

High grade clock oil to be applied sparingly to :

(a) Both ends of the wiper spindle.

(6) Top of springs immediately above the felt inserts

(c) Armature knife edge bearings.

Oil dag will be applied as above to ratchet wheels when clean.

Subsequent lubrication to be carried out as follows :

A small stiff bristle brush should be moistened with high grade clock oil and worked down into the roots of the teeth in order to work up the remaining graphite into a suitable consistency and to distribute the lubricant. Where insufficient graphite remains or where the lubricant is dirty, the ratchet should be cleaned by means of the bristle and clock oil (the detent springs being removed). The brush should be pressed well down on to the roots of the teeth in order to remove as much of the old lubricant as possible, and the brush should, during this process, be wiped on a piece of rag. When the ratchet has been cleaned, oil dag should be applied sparingly to all teeth by means of a soft sable brush.

K E Y S

General Requirements.

The governor springs shall be so adjusted that the impulse wheel will make one complete revolution in 7½ to 8 seconds, although for test purposes, this time margin is increased to 6½ to 8½ seconds.

All contacts to be making with the key in the normal position and with spring No. 3 resting on the insulator cam.

As the impulse wheel rotates and spring So. 3 moves off the insulator, springs 1 and 2 must open (before contact is made with the metal impulsing wheel) and

remain open until the home position is again reached. Springs 2 and 3 must then open and close once for each tooth and space.

To set key for a given code.

In setting the keys, each closure and opening of the contacts 2 and 3 count one.

When keys leave the factory two metal shading cams are fitted, these are supplied so that codes totalling either 11 or 2.3 as required may be set up on any key. If a code of 25 (total) is desired the larger of the two cams should be removed and the smaller one set so that the number of impulses obtained between the first tooth and the cam (counting one for each tooth and space in a clockwise direction) corresponds to the first number in the code : the second number of the code will then be automatically obtained provided that the insulator cam is in its correct position.

Should the code total only 11 then the larger cam should be fitted to shade out the 14 impulses not required and the small cam employed to separate the two numbers in the code as before.

Ensure that there is sufficient contact follow on spring 1 when the key returns to normal. Keys should be mounted with the governor cup at the top.

T E S T S O N A P P A R A T U S

W e give below suggestions for testing under two headings, viz. :

(I) Periodic Tests ; (2) Tests after failure to operate correctly

If the Periodic Tests are made regularly, this will largely reduce the necessity for making the other tests.

(1) **Periodic Tests, etc.**

Test l. - Test (every two weeks) the potential of the 5 0 V should be within ± 4 volts.

Test 2. - Test (once a week) by operating a post key, and check the regular stepping of selectors.

Test 3. - Test (once a month) the time of one complete operation of each k e y . The time should be within 6 and 81/2 seconds. If not, adjust the governor springs to make it so.

(2) **Test after failure to operate correctly.**

When testing the equipment, continuous reference should be made to the circuit description contained in the front of the booklet.

The following causes of trouble are unlikely but are given to show the type of fault to look for when the symptoms are known.

Symptoms	Probable Causes
Contiuous Busy at Signal Post	A Latch relay failing to unlatch
L.T. relay latching and tripping simultaneously	Key springs 1 and 2 making out of home position
Bell on cabin unit failing to stop ringing after reset	Sticking line switch or LT relay failing to trip

HINTS ON LINE AND WIRE TROUBLES

When a wire goes down or becomes open in any other way, the line as a rule becomes noisy and the stations beyond the break cannot call. A ll stations however can usually call up to the break.

LISTOFADJUSTINGTOOLS

Tool.	*Switchboard Tool No.*	*Use*
Spanner.	4218	Residual Nut.
Feelers	4290-A items 0, 2, 3-18.	Measuring contact clear ance. stroke and residual.
Tension Gauge	4270-B	Pressure. Measurement.
Finger	4271-E & G	Ditto
Contact Cleaner.	4258	Contact cleaning.
Spring Bender.	4292-A	Tensioning. Springs.
Tongue Bender.	4293-A	Contact alignment.
Crank Box Spanner	4267-A	Switch adjusting.

Standard Telephones and Cables Limited

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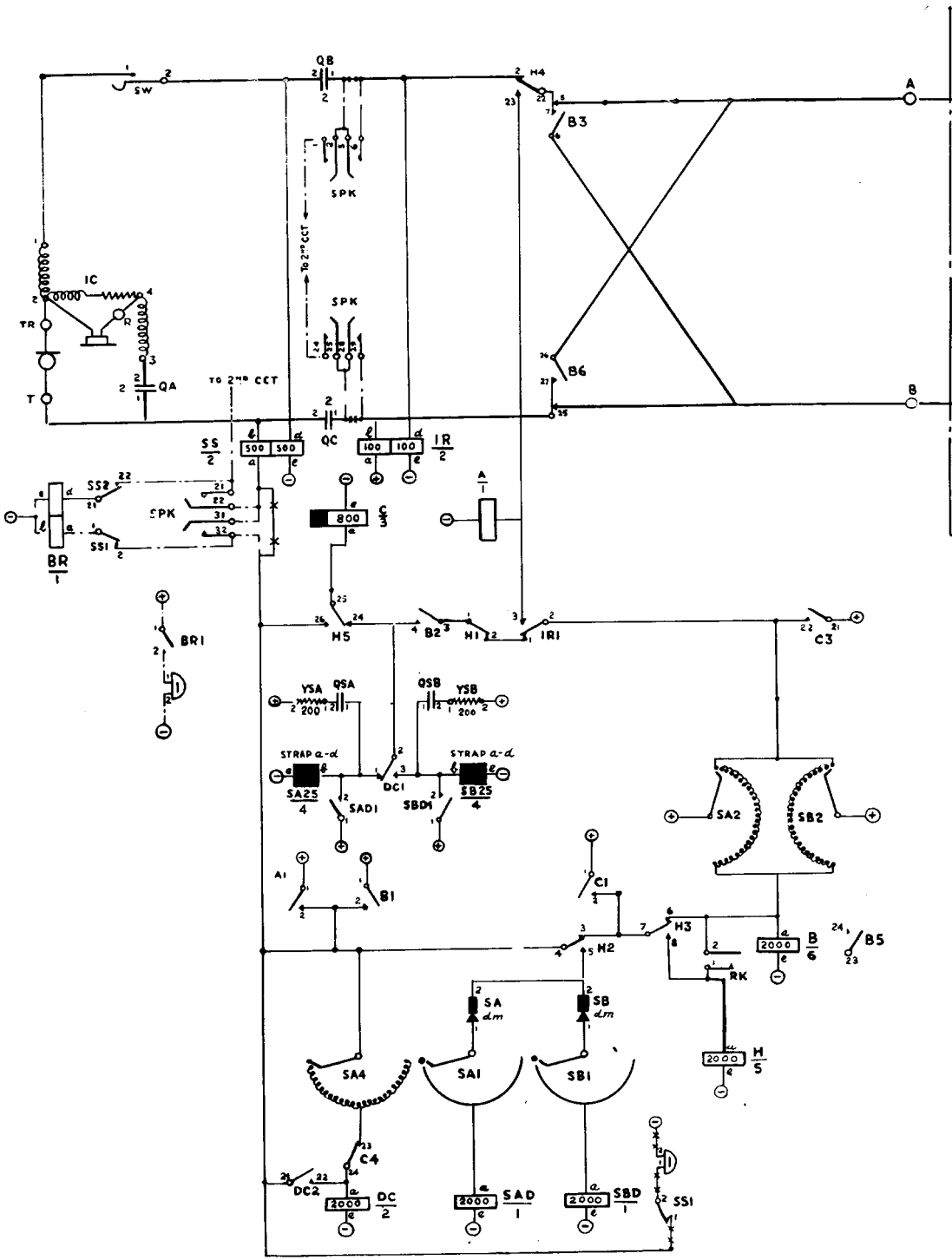
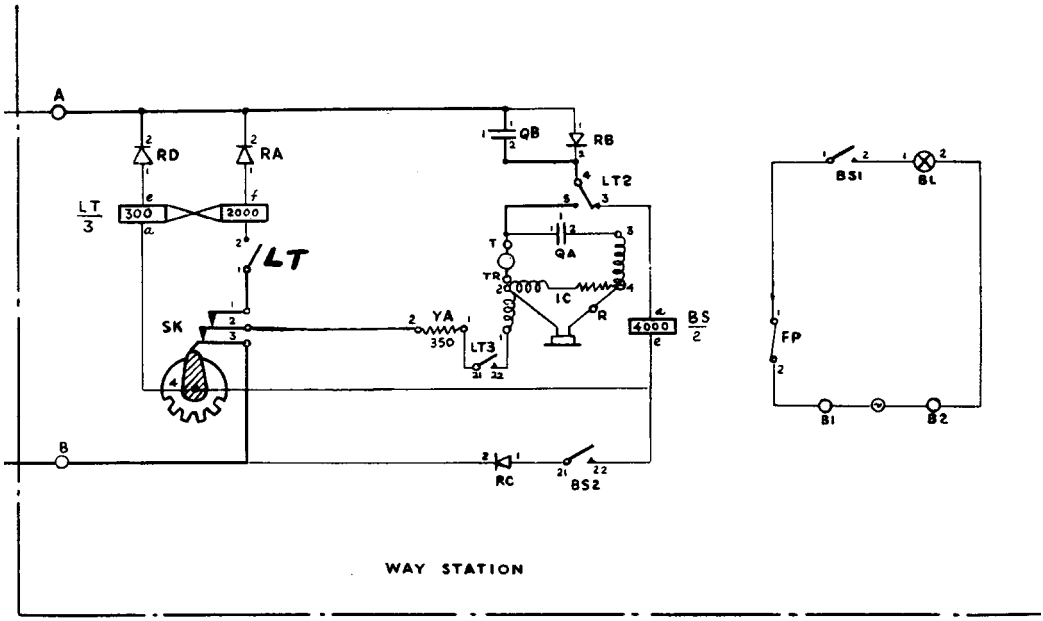
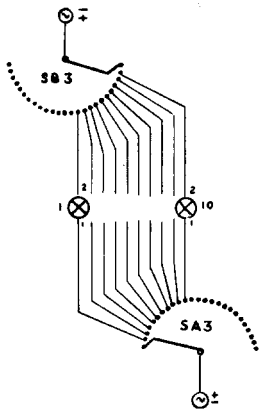
NATAL
NORTHERN RHODESIA (Copper belt of)
ORANGE FREE STATE
SARAWAK
SOUTHERN RHODESIA Bulawayo District
SYRIA
TANGANYIKA
THAILAND
TRANSJORDAN
TRAVANCORE
TURKEY
W. AFRICAN COLONIES
ZANZIBAR



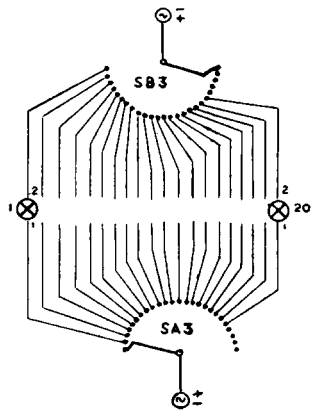
CONTROL STATION



WAY STATION



FOR USE WITH 11 IMPULSE CODE



FOR USE WITH 25 IMPULSE CODE

NOTE:—

WHEN SINGLE CABIN EQUIPMENT IS REQUIRED ADD WIRING SHOWN —x—x— AND DELETE WIRING SHOWN — - — - —

WHEN DOUBLE CABIN EQUIPMENT IS REQUIRED ADD WIRING SHOWN — — — — AND DELETE WIRING SHOWN —x—x— & - - - - -