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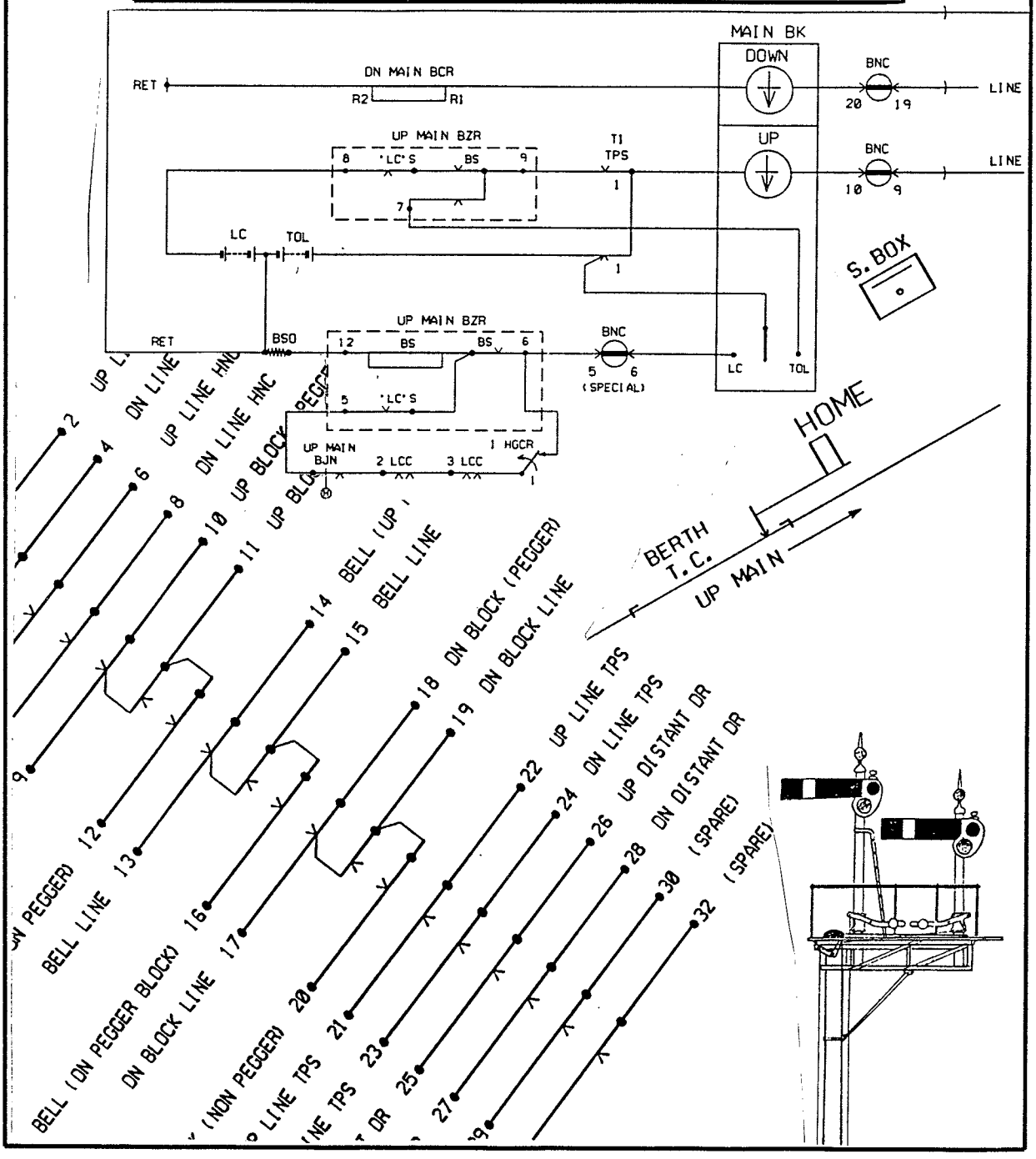
SIGNALLING PROJECTS GROUP

THE ABSOLUTE BLOCK SYSTEM AND ITS ASSOCIATED CIRCUITS



THE ABSOLUTE BLOCK SYSTEM AND ITS ASSOCIATED CIRCUITS

COMMUNICATION BETWEEN SIGNAL BOXES USING THE BLOCK SYSTEM

INTRODUCTION

In the training manual "Introduction to Railway Signalling" and in particular the module "The Department of Transport Requirements" you understood why there is a need to prove the Home and Distant signals "ON" before accepting a train, what "Welwyn Control" means, the purpose of "sequential locking" and why the pegging Block Instrument is controlled to "TOL" by occupation of the berth track circuit.

This module will now attempt to show you how we achieve these controls incorporated into the Block System.

Before looking in detail at the various circuitry involved with block circuits we must first of all understand how the Block Instruments talk to one another.

Figure 9 shows three signal boxes 'A', 'B' and 'C' and their associated Block Instruments which are required to control the block sections safely between the signal boxes.

If you consider FIG 9 and look at Signal Box 'A' who will accept a train from Box 'B' into the block section between the two signal boxes on the Down Main line you can examine how the signalmen give and receive information.

1. Communication by Bell

Signal Box 'B' calls attention to Box 'A' by pressing the "tapper key" on his BlocK Instrument activating the circuit as follows:- from the +ve of the Bell battery a feed passes through the "tapper" at 'B' out onto the block bell line to the tapper at 'A' (proved not to be in operation), through the bell coil and back to 'B"s bell battery -ve terminal via the Block Bell return line. The Block Bells are single stroke and this means one operation of the "tapper" results in one beat of the Block Bell. When 'A' communicates with 'B' by bell the same process is activated using 'A"s Block Bell battery.

2. The Block Needle Indications

2.1 Pegging "Line Clear"

If Box 'A' wishes to accept a train from 'B' he must peg "Line Clear" to 'B' and the following occurs:- starting from the -ve terminal of the Line Clear portion of the Block Battery to the arm of the Down Main BS relay, through 19 LCC's (Home Normal) and 20 HGCR reverse (distant signal ON), on to LC1 on the Block Instrument, through the commutator made in the "Line Clear" position and LC2 via AC TPS energised, through the coil of Down Main BS, BS0 to the +ve terminal of the Line Clear battery.

continued

This circuit complete will now reverse the arm of the Dn Main BS (+ve R2, -ve R1) and "stick out" the Home Normal controls (Home Normal controls will be examined in detail later in this module). Whilst the DN Main BS was energising reverse an alternative path is pursued by the -ve from the arm of AC TPS through PEG K1, down pegger block needle and Peg K then out to the Down Block line to Signal Box 'B'. At 'B' the -ve feed then enters non Peg K1, Dn Main non-pegger block needle, non Peg K and through the coils of Down Main BCR (whose arm will reverse when the circuit is complete i.e. +veR2, -ve R1) and into the BK return line and back to the +ve terminal of the "Line Clear" battery at Signal Box 'A'.
Both needles at Boxes 'A' and 'B' will be showing Line Clear indications ('A"s pegging needle, 'B"s non-pegging needle).

The Block battery serves two functions, a line circuit to the remote box and a local circuit to operate the Block Stick Relay (BS). The BSO (Block Stick Resistor) is provided to ensure the current through the BS is restricted between 10-15 mA. There can be quite a large voltage required to operate the line circuits if boxes are a long distance apart and generally the designer will not be able to calculate the size of the battery required and therefore the value of the BSO, this resistor's value will be determined on site by the installation staff.

2.2 Pegging "Train on Line"

When the signalman at Box 'A' pegs TOL the Line Clear battery is disconnected and the Train on Line battery takes over reversing the current through the coil of Dn Main BS and reinforcing its arm back to the normal position. If the berth Track Circuit AC is clear when the signalman pegs TOL a +ve from the TOL battery also makes its way via the block commutator (TOL 3 &4), AC TPS energised, Peg K1, Dn pegger block needle, Peg K and out to line. At Signal Box 'B' the +ve from Box 'A"s TOL battery passes through Non Peg K1, Dn Main Non Peg needle, Non Peg K, Dn Main BCR (reversing the current and reinforcing the arm of this relay back to normal position) and back to the -ve of the TOL battery via the Block Return line. Both needles at Boxes 'A' and 'B' will be showing TOL indications ('A"s pegging needle, 'B"s non-pegging needle).

If the signalman at 'A' failed to give the 'TOL' indication to Signal Box 'B' and the train arrives at 'A"s berth TC (AC track) which occupies and de-energises AC TPS which in turn routes the +ve from the TOL battery through the Dn Main BS and also out to line via Peg K1, Dn Main pegger block needle, Peg K, Down block line to Signal Box 'B' non peg K1, Dn Main non pegger block needle, non Peg K, through the Dn Main BCR coil (reversing the current) and back to signalbox 'A' TOL battery -ve.

No further line clear's can be given by "A" until "A"s signalman peg's Train On Line.

continued

We have considered just one absolute Block section, the Down Main line between Signal Boxes 'A' and 'B' where 'A' accepts a train from 'B', but all block sections operate similarly and it would be worthwhile examining Fig 9 to determine how the other block sections operate.

REGIONAL CODE OF PRACTICE FOR STANDARD BLOCK AND SIGNAL CONTROLS CIRCUITS EI S/C/041

The circuits that have previously been examined have all been battery fed and generally where Block Instruments are currently in use these circuits are fairly typical of what is to be found in the Wiring Diagrams at Signal Box installations.

However if block circuits are required in future schemes, Spec 930 series relays should be used combined with Standard BRB Block Instruments and a 2 position key switch to replace the mechanical block switch where "switching out" is required. These 50 volt circuits are also to be used where immunisation of the block line circuits is required for any reason (25 KV O/H traction lines running parallel with block lines, parallelism with Electricity Authority high voltage lines etc).

To help in the understanding of the change from one system to another examine Figs 10A and 10B which consider the exact layout referred to in Fig 9 but now in 50 volt form and using series 930 relays.

An important feature of the 50 volt working arrangement is how each block section is electrically isolated from each other (even when "switching out") and therefore allows different forms of transmission to operate either side of a Signal Box if required.

All other circuits associated with block working (Home Normal, One line clear one pull/train, Signalmans General Instruction 7.3 etc) which will be covered later in this module can be reproduced in 50 volt form and these circuits can also be found in the Engineering Instruction S/C/041.

THE TERMS AND CONTROLS ASSOCIATED WITH THE BLOCK SYSTEM

The first information you must obtain when dealing with Block circuits is to determine the "Standard Block Controls" that are required for a particular stretch of railway line and this depends on "Line Classification".

Line classifications can be found in Engineering Instruction S/H/028. There are three classifications 1, 2 and 3. Classification 1 lines will be most important, Classification 2 lines important and Classification 3, freight lines.

Once the Line Classification has been established you can then refer to EI S/H/027 which states:- the minimum standard of block controls to be applied on the London Midland Region to the three line classifications assigned by the Regional Operating Manager is as follows.

continued

CLASS 3 LINE CLASSIFICATION

No control will be provided upon the operation of the block instruments nor will there be any block control provided upon the operation of the signalling equipment.

This means the Block Instruments are used as a pure indication corresponding to the Block commutator and Block bell signals between adjacent Signal Boxes.

CLASS 2 LINE CLASSIFICATION

Equipment and Controls to be provided as follows:-

1. A berth track circuit at the Home signal which will:-

   1.1 Be indicated in the Signal Box i.e. illuminated diagram or T C indicator 215.

   1.2 When occupied place and maintain the block indicator to the "train on line" position irrespective of the position of the commutator (TPS circuit).

   ### TRACK CONTROL OF BLOCK INSTRUMENT

   Automatic replacement of the block instrument to "train on line" and the maintenance of that indication by track circuits until the block section is clear and until action is taken by the signalman to acknowledge it.

   1.3 Where a Starting Signal is provided, when occupied, operate an annunciator for 10 seconds with the Home Signal normal - (annunciator circuit).

   ### BERTH TRACK CIRCUIT ANNUNCIATOR

   To indicate by means of an audible indication that a train has occupied the berth track circuit of the Home Signal with the Home signal lever normal. When a signalman has to put his General Instructions 7.3 into force, this annunciator is very useful, as there is no need for him to stand watching the indicator/illuminated diagram until he sees that the berth track circuit is occupied but can carry on with his other duties until the annunciator sounds.

   The signalman will "pull off" the Home Signal when the bell ceases to ring, informing him that the berth TC has been occupied for approximately 10 seconds, therefore the train should be at or nearly to a stand.

continued

1.4 Be used to compel the signalman to observe the Signalman's General Instructions 7.3.

SIGNALMAN'S GENERAL INSTRUCTIONS 7.3

You might still hear this control referred to as the old Rule C.4.6 or Rule 39(A), it should be identified as above.

If the section ahead is clear and there is no train between the Home Signal and the Starting Signal, the Home Signal is free to be pulled when a line clear is received from the Signal Box ahead as under these conditions all the intervening signals are free to be pulled. If however a line clear has not been received, the Home Signal is locked until an approaching train occupies the berth track circuit for the Home Signal, therefore bringing the train at or nearly to a stand.

1.5 When occupied replace a power operated or colour light distant signal to its most restrictive aspect using the same device that controls the Block Instrument in 1.2 (TPS circuit).

The berth track circuit will be approximately 200 yards long except where track circuiting extends right through the section from the Starting Signal of the Box in rear to the Home Signal, when the length of the berth track circuit will be approximately 100 yards.

2. Track circuiting between the Home and Starting Signals.

3. Sequential interlocking between the Home and Starting Signals.

SEQUENTIAL LOCKING

Interlocking between successive stop signals worked from the same Signal Box to ensure that none can be cleared unless the next ahead has been restored to danger.

4. Line clear release of Starting Signal for one pull of the starting signal or one occupation of a track circuit at or beyond the signal proving the passage of a train into the "block section" (known as "one line clear one pull" or "one line clear one train").

LINE CLEAR RELEASE

This is a release of the section (starting) signal by a line clear given by a signalman at a Signal Box in advance.

continued

The control can be applied in two different ways:-

(a) it allows for one pull of the section (starting) signal per line clear release given by the Signal Box in advance.

(b) it allows for one train into the Block Section per line clear release given by the Signal Box in advance.

These controls are to satisfy a condition of the absolute block system, in that we only allow one train in section between two adjacent Signal Boxes.

You will identify this control on a signalling plan by the letter "B" on the signal post of a section (starting) signal.

5. Arm repeating of Starting Signal.

6. When the signalman accepts a train into the block section the Line Clear given requires his home and distant signal arms and levers normal and locked (where lever locks and arm repeating provided).

   The lamps of colour light home and distant signals must also be proved alight.

HOME NORMAL CONTROL (HNC)

This control is to prevent the signalman at Signal Box 'B' giving a line clear to Signal Box 'A' unless his Home Signal is proved at danger and the lever of the Home Signal is proved normal and locked.

You will identify this control on a signalling plan by the letters "HNC" placed next to the Home Signal.

NORMAL CONTACT (NC)

The prevention of a signalman giving a line clear release to the Signal Box in rear unless the arm of the distant signal is properly at caution. You will identify this control on a signalling plan by the letters "NC" placed next to the distant signal.

CLASS 1 LINE CLASSIFICATION

In addition to the controls for Class 2 line, "Welwyn" control will be provided to ensure train movement through the section. A hand screw or plunger operated time release with an operating time of approximately 30 seconds will be provided for "Line Clear" cancelling purposes.

continued

WELWYN CONTROL

Prevention of a line clear release being given unless a previous line clear release has been properly cancelled or a train has passed through the block section. It should be noted that this control is not required when track circuits extend back to the section (starting) signal of Signal Box 'A' from the Home signal of Box 'B'. Welwyn can be identified on a signalling plan by "Welwyn" written under the block instrument symbol.

The foregoing has discussed Line Classification and the "controls" to be applied for each class of line. Now we shall look at the circuits that actually generate these "controls" previously mentioned.

TRACK CONTROL (FIGURES 1 AND 2)

It can be seen from Figure 1 that when a train occupies the berth track circuit it will drop the berth TPR and because a front contact of the berth TPR is in the feed to the TPS, it will cause the TPS to become de-energised. When the TPS drops, it automatically places and maintains the block needles to train on line regardless of the position of the block handle (commutator), i.e. if the signalman has forgotten to place his block handle to train on line, the train dropping the TPS will place the needle to TOL. This can be seen in Figure 2. By following the feed from the positive on the TOL battery through the back contact of the TPS, PEG K1, needle, Peg K and then out to line.

Once the TPS has been de-energised, it cannot pick up again until the signalman has placed his block handle to train on line.

ANNUNCIATOR CIRCUIT (FIGURE 3)

When the berth track circuit "TA" is clear a +ve feed is applied over the front contact of "TA" TPR to the +ve on the "TA" TXR. Across the TXR unit +ve to -ve is a capacitor which holds a charge. The circuit is completed from the -ve in the TXR unit to N. When a train occupies "TA" TPR the back contact is made and because the feed to the capacitor is broken, it begins to discharge which makes a front contact "F" to "A" in the TXR unit. As the 19 LCC's are made, (only when the Home Signal lever is normal and locked) the bell rings for the length of time it takes for the capacitor to discharge, approximately 10 seconds.

CLEARANCE OF STOP SIGNALS WHEN NEXT SIGNAL AT DANGER (FIGURE 4)

Section 1.4 says the berth track circuit is to be used to compel the signalman to observe the Signalman's General Instruction 7.3.

continued

When the signalman is not in a position to clear a stop signal, he must not clear the stop signal in rear of it until the train is nearly stopped at such a signal. This does not apply where the stop signal in rear of the signal at danger is a colour light signal capable of exhibiting a yellow aspect which is controlled by the occupation of a berth track circuit or requires the line to be clear up to and including the overlap track circuit of the signal at danger.

The easiest way to try to explain this control is firstly to go through a **simplified operation** of a train passing through a section from one Signal Box to another and then onto a third Box (Figure 4).

Box 'B' gives a line clear to Box 'A'. He accepts and pulls off his Starting Signal. The train passes Box 'A"s Starting Signal and into the block section. The signalman at Box 'B' now gets himself prepared to send the train onto Box 'C' so he requests a line clear from Box 'C'. This he is given and he pulls his signals off in the correct sequence, home, starter and distant. When the driver sees the distant arm in the "OFF" position he knows he is clear through the block section. So the train has gone from Box 'A' to Box 'B' and onto Box 'C'. Now imagine that once again Box 'B' has accepted a train from Box 'A' and for some reason Box 'B' cannot get a line clear from Box 'C'. Because he is unable to get a line clear he cannot pull his Starting Signal off and, as we know, unless he has pulled his Home and Starter signals off, he will not be able to pull his distant signal off. Therefore the driver will pass the distant signal in the "ON" position, this tells him to be prepared to stop at the next signal.

The signalman now decides although he cannot get his starting Signal 'off', he still wants to allow the train past the Home Signal and up to the Starting Signal.

You can now imagine that if we allowed the signalman to pull off the Home Signal and the driver were to see it off, he would begin to "speed up", thinking the Starting Signal will be off, when, in fact it is not. This means the driver will pass the Home Signal "OFF" and then suddenly see the Starting Signal "ON" and because he could be going at speed he might have to brake severely. This is potentially a very rough ride for the passengers, but more importantly very disconcerting for the driver to see the aspect sequence of green to red.

To overcome this we provide a control which says that if the Starter Signal is in the on position and we want to allow the signalman to pull off the Home Signal to allow a train up to the starter we must first bring the train under control by means of the berth track circuit being occupied.

If you follow the circuit in Figure 4, you will see how this is achieved. We prove that:-

1. 3 signal is "ON" - RGCPR energised.
2. Train brought under control - track circuit "C" occupied.
3. Prove there is no other train between the Home and Starter - track circuit "D" clear.
4. That 3 lever is locked and normal - lock proving contacts made.

continued

SEQUENTIAL LOCKING (FIGURE 5)

Sequential locking between all signals compelling any signal lever to be replaced to the normal position before the preceding signal lever can be pulled.

In our example, Figure 5, it can be seen that in the normal lock of Home 2 Signal, we must prove the lock proving contacts of the Starting Signal before we can energise Home 2's electric lock. This quite simply means that the Starting Signal must be normal and locked before he can pull his Home Signal lever reverse.

The reason for this is, if you imagine we had just had a train pass the distant, Home and Starter Signals and now entered the block section ahead and we had no form of locking between the Home Signal and the Starting Signal, the signalman could give the box in rear a line clear first proving the Home Signal lever normal (HNC). Meanwhile leaving the Starting Signal lever reverse and signal off. The train now leaves the box in rear and the signalman only has to pull off his Home Signal and the train is away into the block section in advance without the signalman having to obtain a line clear.

As you can see, this is a very dangerous situation as we could allow many trains into a block section at any one time.

So before he can pull his Home Signal off again, he has to replace the Starting Signal and replacing the Starting Signal means he has got to get a line clear release from the Box in advance before he pulls his Starting Signal off again.

LINE CLEAR RELEASE (FIGURE 6)

(a) An electric lock is provided on the section (starting) signal which is released for either one pull or one train.

As you can see from Figure 6, we are trying to energise (pick) the Starting Signals normal lock, (N)L.

We do this by a feed which passes through an "NA" lever band of the Starting Signal. Through a contact of the "BCR" Relay which is lying to the position of "line blocked". As yet, we have not received a line clear release from Signal Box 'B'. You should take note that the 'BCR' relay is controlled by the block instrument in the Signal Box in advance, in our case Signal Box 'B'. Therefore, the "BS" relay is energised and it sticks up over a front contact of itself. You will see that regardless of what happens to the "BCR" contact the "BS" relay will remain energised over its own contact.

We have now requested a line clear release from Signal Box 'B' and he has obliged us and pegged line clear on his block instrument.

continued

This will energise our 'BCR' relay causing the contact of the 'BCR' relay to move from normal to the reverse position. This destroys the initial pick path to the coils of the 'BS' relay, but as we said earlier, the 'BS' stays energised over a contact of itself.

We now have another path for the feed through the:- "NA" lever band of the Starting Signal, a front contact of the "BS" relay and through a contact in the reverse position of the "BCR" relay, through the catch handle contact which is made when the handle is grasped and so we energise the lever lock which is a normal lock.

Now the signalman at Signal Box 'A' pulls off his Starting Signal. He breaks the "NA" lever band and now disconnects the feed to the whole of the circuit, therefore causing the "BS" relay to drop. The signalman can now only re-energise the "BS" relay if he replaces his Starting Signal lever to the normal position. It is now impossible for him to pull off his Starting Signal unless he gets another Line Clear and so fulfilling the block control requirement of one pull for one line clear release.

It should be noted that the polarised relay in the block line should, of course, be so biased that the lock circuit of the Starting Signal is disconnected when there is no current in the block line. This relay is usually biased to the Train On Line/Normal contact, otherwise if a train had been accepted and then cancelled after the Starting Signal had been pulled, but the train on line not sent, the "BS" relay would not pick up and the Starting Signal would remain locked when a line clear was again received.

(b) The other variant of the "one line clear one pull" circuit is the "one line clear one train" circuit which can be identified in Figure 6 by the Starting Signals "NA" lever band being replaced in the circuit by the Starting Signals overlap track circuit front contact (this is the most common form of "one line clear, one train" circuit although you may encounter a circuit using the berth track circuit to the Starting Signal).

We will consider the circuit using a separate track circuit in advance of the starting signal.

When the line clear from Signal Box 'B' has been received, the Starting Signal can be pulled more than once until a train passes it and occupies the track circuit ahead when the lever is locked normal until a fresh line clear is received with the track circuit clear. This is specially useful where the Starting Signal is a long way away from the Signal Box and requires a wire regulator. If the signal does not come fully off at the first pull, the lever can be replaced and the wire regulated and the lever pulled again without the necessity of obtaining a fresh line clear.

(c) **"LINE CLEAR" THROWBACK (FIGURE 4)**

Under normal conditions if a "line clear" has been received from Box 'C' and the conditions are correct to release Home Signal No 2 plus the berth track circuit TC clear the signalman can pull the Home Signal No 2.

continued

We have also seen that if the Starting Signal No 3 is proved 'ON' we can allow a train down to this signal by allowing the Home Signal No 2 electric lock to be released on occupation of the berth track circuit TC without requiring a "line clear" from Signal Box 'C'.

If the train is standing at the Home Signal No 2 whilst occupying the berth track circuit TC and the Starting Signal No 3 should fail 'OFF' (not proved to be 'ON') the circuit then "throws back" the line clear release onto the Home Signal No 2 which effectively becomes the starting Signal under these conditions.

HOME NORMAL CONTROL (FIGURE 2)

The Home Signal lever is proved normal in the "BS" circuit of the pegging Signal Box, therefore, the home normal contact is compelling the outermost Home Signal at the accepting Signal Box to be at danger before a line clear can be given to the Box in rear.

In Figure 2 we have used an "NA lever band to prove that the Home Signal is normal, but if an electric lock was on the Home Signal the lever band shown can be replaced by a lock proving contact, thus forcing the lever to be correctly locked as well as being in the normal position.

You will notice that there is a contact of the "BS" relay around these conditions. This contact "sticks out" the home normal controls to enable the Home Signal to be pulled off without affecting the block indication, therefore the Home Normal is proved at time of pegging only. Colour light signals would also be proved in a similar manner i.e. Home Signal displaying a red lamp.

NORMAL CONTACT (FIGURE 2)

This proves that the distant signal is "ON" by use of a front contact of the HGCR or the reverse contact of a Polar MI relay when the indicator is in series with the relay coil.

The example illustrated could either be a colour light distant signal (control relay de-energised, lamp proving relay energised will be controlling the HGCR) or a semaphore distant signal (HGCR proving distant arm "ON").

WELWYN CONTROL (FIGURE 7)

With all the circuits so far described, there is a very large measure of proof that all signals and the block instrument are properly operated for every train, but there is one loophole remaining.

continued

If a train has passed the Starting Signal but has not reached the berth track circuit of the outermost Home signal, controlled from the Box ahead, the signalman at the Box ahead can, if he forgets the train, restore his block instrument to line blocked and accept a second train. This may be prevented by track circuiting the whole block section, but this would be very expensive to apply generally throughout the country, so a circuit called "Welwyn Control" was devised. It was named after the place where an accident occurred and was developed from the accident investigator's report recommendations.

For the operation of Welwyn Control read the notes below in conjunction with Figure 7.

BLOCK AT LINE BLOCKED POSITION

The 'LC'S Relay is a 500 ohms slow release relay
The BS is a 200 ohms relay

B10 to t 1 on BZR unit, over BS relay contact Down
over "LC"S relay contact Up

through coil of "LC"S to t 11 thence to N10

Normal position of Relays is BS down and "LC"S up

BLOCK AT LINE CLEAR POSITION

BN Tap on Block Battery through BSO to t 12 on BZR unit through coils of BS relay to arm of "LC"S relay and front contact to t 5 on BZR unit, thence to Up Main BJN 1 Normal contact to 2 LCC/3 LCC, 1 HGCR 1R to t 6 of BZR unit, thence to BNC 5/6 to Block instrument (LC), block commutator in Line Clear position through conmmutator to back contact of TPS to +ve of the TOL Block Battery, this then completes the circuit to pick up the BS.

"LC"S Relay is slow to release (or slugged) long enough to allow the BS relay to firmly establish its own contact for its stick facility.

BS relay has now cut off the feed to "LC"S relay, which was fed over the back contact of BS.

In brief "LC"S relay Down. BS relay Up. Line Clear given by -ve feed from LC battery to t8 "LC"S Arm and Back contact, BS front contact and arm to t 9 to front contact and arm of TPS through "Block" needle to line.

Signalman can now pull off breaking Home Normal contacts and Distant GCR contacts, (Assuming he has obtained a line clear from the next signalbox in advance).

BS relay remains energised sticking over its own contact.

continued

"Train on line" is accepted from box in rear: Signalman turns comutator from Line Clear to Train on Line and this breaks the TOL Battery feed through the Commutator on passing from one position to the other, BS relay has now lost its feed and drops away.

Thence +ve from TOL Block Battery now feeds to TPS back contact through Block commutator to t 7 in BZR unit through back contact and arm of BS to t 9 on BZR unit thence to front contact and arm of TPS Up through "Block" needle out to line.

Train then passes the Home Signal occupying in turn T1 & T2 to re-pick the "LC"S which sticks over its own arm between terminals 1 & 11 in the BZR unit. The signalman will replace his Distant and Home Signals at the appropriate time.

With "LC"S up, BS down and Block commutator at TOL, T1 TPS energises and sticks. The circuit is now restored to its normal condition ready to accept another train and the signalman places the commutator to Normal after sighting the passing train's tail lamp.

If "train on line" has not been received or accepted and train arrives on Berth Track Circuit at the Home Signal TPS drops breaks Block Line from BZR and Block Commutator Contacts and applies +ve from TOL battery over TPS back contact and arm direct to "BK" needle and line irrespective of position of block commutator.

Train passes through clear of T1 track circuit.

The TPS circuit will maintain TOL until B10 over T1 TPR UP, Up Main (TOL) CC made up to t 10 in BZR unit, BS down and "LC"S Up, t 13 to R1 of TPS to N10. TPS energises Up and sticks over its own contact.

"LC"S relay has again been established meantime via B10 to t 1 - 2 (RD), T2 TPR Down, T1 TPS Down to t 4 to "LC"S Arm then to its coil to t 11 to N10.

Thus with "LC"S Up and BS down the signalman having acknowledged the TOL indication on his Block Instrument by pegging to TOL the TPS energises and sticks to restore circuitry ready for next acceptance.

If the signalman has not pegged train on line and left his instrument at line clear but has pulled his signals off (and then for some reason leaves the operating floor) the pick path for the "LC"S is B10 to Up Main BZR t 1 picking up in the normal manner and sticking through "LC"S front contact to t 2 on the Up Main BZR back contact of T1 TPS to t 4 of Up Main BZR and to the coil of "LC"S. The LC's will stay energised via this path until the signalman pegs train on line (TOL).

Train does not enter Block Section

If the signalman accepts a train which for some reason does not enter the Block Section from the Box in rear he must have provision to restore the circuitry to its normal state i.e. "LC"S up, BS down.

continued

This is achieved by the "time screw release" (BJN) which takes approximately 30 seconds of winding time by the signalman to obtain the switch contacts to make between terminals 3 and 4 on the BZR unit.

Thirty seconds gives the signalman sufficient time to consider the action he is taking because he is actually restoring the circuitry to enable him to accept another train into his Block Section.

The time screw contact making energises the "LC"S from B10 fuse via t1 on BZR unit, BS back contact, t3, BJN, t4 to "LC"S coil.

To prove that the signalman will have the required thinking time a contact of the BJN is placed in the "Home Normal" circuit proving the time screw release is at the start of its release cycle before the signalman can peg LC.

It will be appreciated that this control does not cover the case of the train divided when in section. As the first part of the train after occupying and clearing the track circuit will release the control and allow a second line clear to be given with the rear part of the train still in section.

Thus Welwyn Control, although a valuable safety addition to the block instrument, does not exempt the signalman from observing tail lamps; only complete track circuiting of the block section can be relied upon to cover this point.

As with a number of circuits involved in Railway Signalling they have evolved because of actual accidents and the Inspecting Officer's report at the Inquiry. One such accident occurred at Welwyn Garden City on June 15th 1935 and an extract regarding the Welwyn Garden City accident taken from "RED FOR DANGER", by L T C Rolt follows.

Another accident which showed how the human element could defeat the most elaborate safety precautions occurred at Welwyn Garden City on the London and North Eastern main line on the night of 15 June 1935. Three expresses left King's Cross at night for the North in quick succession. The first left at 10.45 pm and passed through Welwyn at speed at 11.20 pm. The second was the Newcastle express consisting of eleven bogies drawn by an " Atlantic" locomotive No 4441 which pulled out at 10.53 pm. Finally, at 10.58 pm, No 4009, a "K3" Class 2-6-0 drew away with the express passenger and mail train to Leeds. The "K3" was a more powerful engine than the "Atlantic" and, although is comprised the same number of vehicles, its load was lighter and it began to overhaul the Newcastle train. Approaching Welwyn at seventy miles an hour, Driver Morris on the "Atlantic" saw the distant at "Caution", shut off steam and applied his brakes. He had slowed to twenty miles an hour when he saw in the distance the Home Signal come off. Imagining that he must be overrunning the train ahead, Driver Morris let his train roll gently forward. There was a "berth " track circuit 200 yards in rear of this Home Signal which, when occupied, sounded a buzzer in Welwyn Signalbox until the block instrument for this section had been placed in the "TRAIN ON LINE" position. But Driver Morris had not reached this track circuit and, in

continued

that brief interval, Welwyn accepted the Leeds express from Hatfield. Driver Morris was still moving slowly when he approached the starting signal, saw that it was clear, "popped" his whistle and then put on steam. Almost immediately he felt the impact of a violent collision in the rear. Running at nearly 70 mph the "K3" had crashed into the rear of Driver Morris's train.

No rolling stock on earth could have withstood the fury of that onslaught. The rear coach of the Newcastle express was completely demolished and no passenger in it survived. Their bodies were found scattered among the debris along the lineside. The crushed frame of the coach wrapped itself round the front of the locomotive while the bogies, together with those of the coach in front of it, were pushed forward by the "K3" for a distance of 140 yards.

It was an all steel vehicle with buck-eye couplings and shock absorbing buffers. There was no telescoping and, although it had lost both its bogies, the buck-eye coupling at its leading end held fast, not only supporting that end, but holding the coach upright and in line until it came to rest. No one of the thirty passengers in it was seriously injured. The rolling stock of the Leeds train was of an older pattern, but, here again, there was no telescoping, while it was to some extent protected by the locomotive, which, despite the terrific force of the collision, never left the rails. In all, thirteen passengers were killed and eighty-one injured in this Welwyn collision.

How had it happened? Clearly the fault must lie with the signalman at Welwyn South, an inexperienced man only recently promoted to that box. In the first place it became clear that the second express was not overrunning the first but had been slowed quite unnecessarily. After its acceptance, a porter at Welwyn Station had rung the south box to ask the signalman to enquire about a missing parcel and the latter had answered the call before pulling off his signals. But what had happened after this was never perfectly clear. Signalman Crowe at Hatfield said that when he received the "out of section" from Welwyn at 11.23 pm he promptly offered the third, Leeds, train which was immediately accepted. He thought this was "rather smart" so he called Welwyn South and asked: "Is that out, Fred?". "Yes," came the simple reply. A few minutes later he received the "obstruction danger" signal. The Welwyn Signalman, on the other hand, maintained that his "out of section" signal referred to the first, the 10.45 express and that he thought Crowe was referring to that train when he rang and asked, "Is that out?"

It would be tedious to detail the complicated evidence of the Welwyn South Signalman and his colleagues at Hatfield and Welwyn North. Suffice it to say that it was conflicting. The Inspector, Colonel Mount, stated that he could not accept the evidence of the Welwyn South Signalman and that he had formed the opinion that he had become thoroughly confused.

He had been passing a train on the Up Line at the time and the Colonel believed that he had been giving and receiving signals and pegging trains on the wrong set of block instruments. He suggested that block instruments might be painted in different colours and the tones of block bells more widely differentiated to guard against such confusion. He also criticised the

continued

porter's telephone call. A busy Signal Box should not be treated as a general enquiry office. But the Colonel also made another suggestion which was to have far reaching results. He proposed that track circuit control over block instruments and signals should be such that acceptance of a second train would be impossible until the first had occupied and cleared the "berth" track circuit approaching the Home Signal. In some cases, to provide an additional margin of safety, this control could be extended to a second track circuit ahead of the Home Signal. Had such an arrangement been in operation that night, it would have meant that the Welwyn signalman could not possibly have cleared his instrument and accepted the Leeds express until Driver Morris had passed the advance starting signal and was well clear of the section. This arrangement, which has since been widely adopted, has become known as the "Welwyn Control".

THE BLOCK SWITCH

When railway traffic is light, such as at night or on Sundays etc some Boxes are closed. The closed Boxes are fitted with "block switches" to join the block lines through to the Boxes that remain open.

Always remember when dealing with "switching out" the length of the block section is increased and therefore sufficient battery capacity has to be available to cater for this occurrence. If volt drops in the block lines are a problem relay switching can be installed at the "switching out" Box to cure the problem.

Figure 9 shows a typical switching out arrangement where Box 'B' switches out and the block section then stretches from Box 'A' to Box 'C'.

Refer to Figure 8 for a typical 16 Bar block switch with the circuits allocated to each switch contact. From this drawing you will notice that some of the switches are "special contacts" and the reason for these contacts are given in the following paragraphs.

BLOCK SWITCH SPECIAL CONTACTS

In the Block circuits you will see two "special" contacts, these are placed in the "one line clear one pull/train" circuit at the receiving Signal Box and in the "Home Normal" line circuit at the pegging Signal Box. The reason for the "special" contacts are as follows:-

(a) "One Line Clear One Pull/Train" Circuit

If the signalman at 'A' clears the starting signal and for some reason requires to replace the signal or an intermittent track failure of the starting signal track (one line clear one train circuit), he must request another "line clear" from Box 'B' but without the special switch in the "BS" circuit he could reset the "BS" by operating his own block switch.

continued

In other words if the "special" contact were not positioned in the "BS" circuit the signalman at Box 'A' could obtain successive "line clears" by operating his block switch to break the "BCR" circuit and reset the "BS" without involving the signalman at Box 'B' who gave the "line clear". The "special" contact prevents the signalman from executing this irregular action by disconnecting the "BS" circuit before the line circuit breaks and therefore the "BS" can only be reset by contacting the signalman at Box 'B' to reset the "BS" circuit in the normal way.

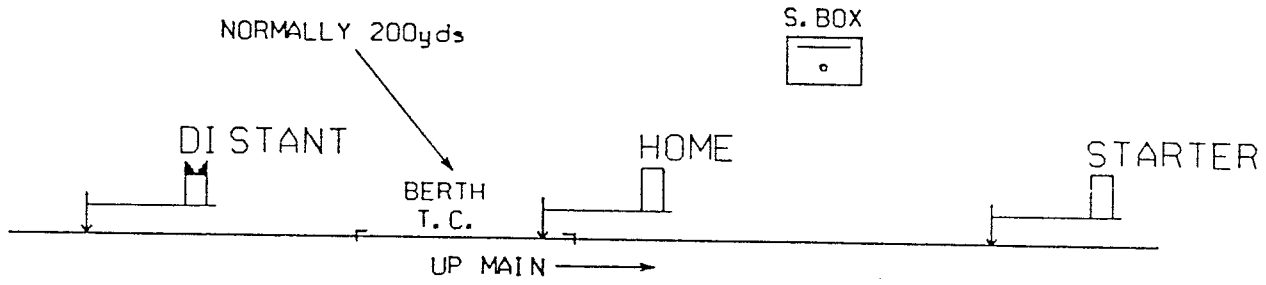
(b) **The "Home Normal" Line Circuit**

Under normal circumstances the signalman at Box 'A' gives a "line clear" to Box 'B' by first of all proving his "home normal" and "normal contact" circuit which then sticks out in the normal manner (to allow him to pull off his own signals). If then for some reason the signalman at Box 'B' requires another "line clear" he requests from the signalman at Box 'A' to repeg a line clear. If the "special contact" was not in Box A's "Home Normal" circuit the signalman at 'A' could just disconnect the block line by breaking the Block Switch contacts in the line circuit, which will normalise the BCR and then re-connecting the block switch, will again re-energise the BCR at Box 'B'. The foregoing incorrect action by the signalman at Box 'A' allowed a "line clear" to be given without the signalman first having proved his signals normal (Distant and Home). The "special" contact breaks the "home normal" line circuit and drops the "BS" and ensures the signalman at 'A' will have to replace his signals every time before giving a LC release and not just operating the block switch to break the line circuit with his signals cleared (an irregular operation) to give another "line clear".

IMPORTANT: **Remember when another "line clear" indication is requested for whatever reason both signalmen have to liaise in order to safely carry out the operation.**

There are various types and sizes of block switches. The type previously described is the most common currently in use on the London Midland region, other Regions may have standardised with a different type, so beware of this.

continued



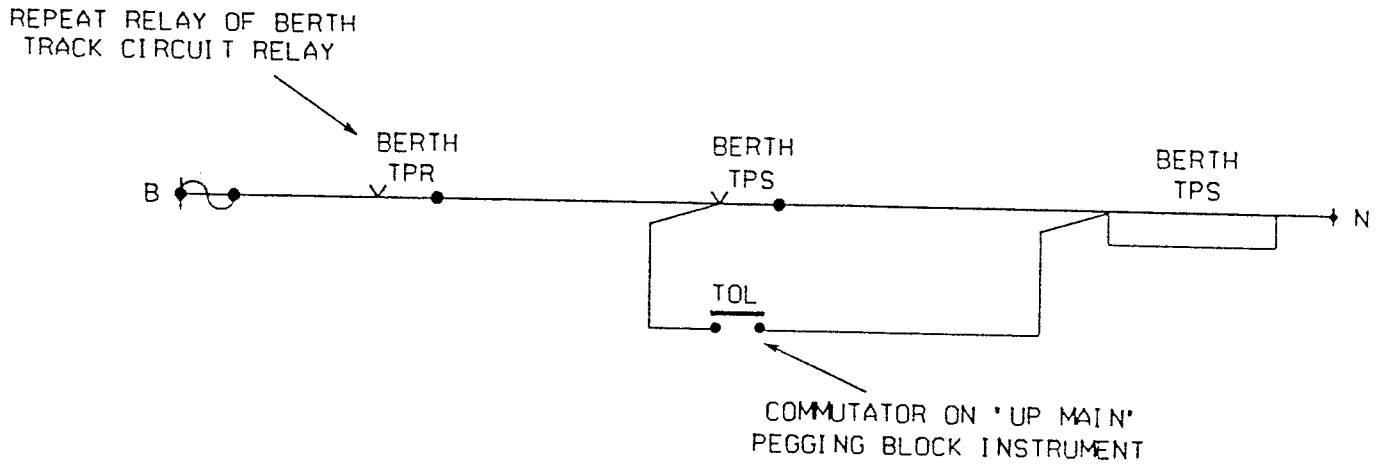


FIGURE 1.(TRACK CONTROL).

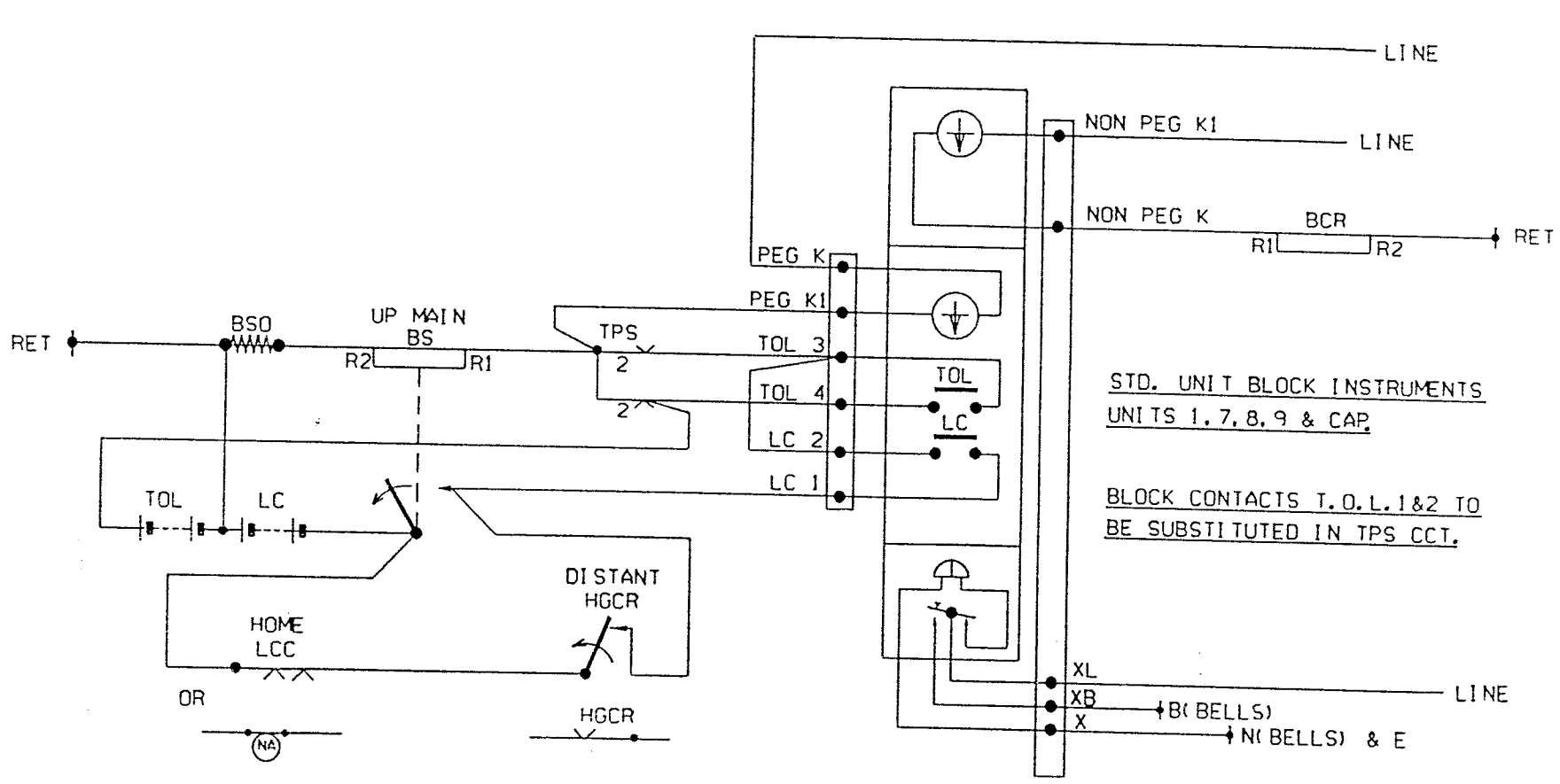
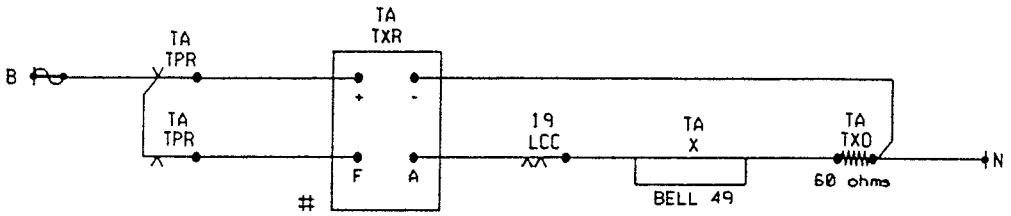


FIGURE 2.(BERTH TC CONTROLLING THE BLOCK, HNC & NC).

continued

THE ABSOLUTE BLOCK SYSTEM AND ITS ASSOCIATED CIRCUITS



ANNUNCIATOR UNIT TO DRAWING TD 55031

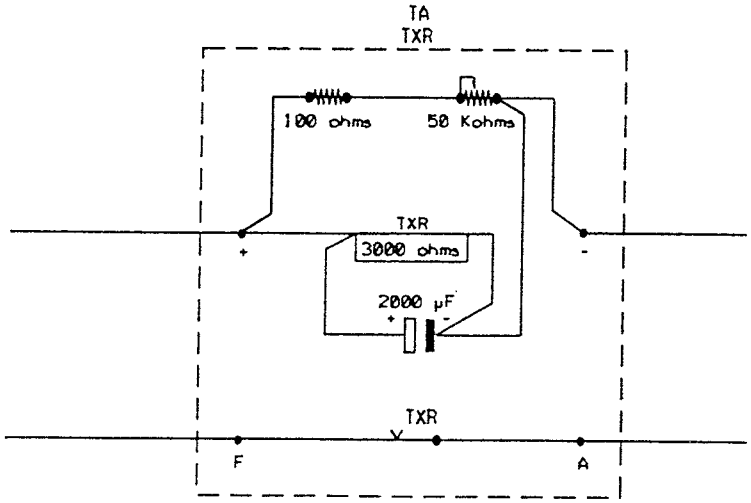


FIGURE 3. (ANNUNCIATOR CIRCUIT).

continued

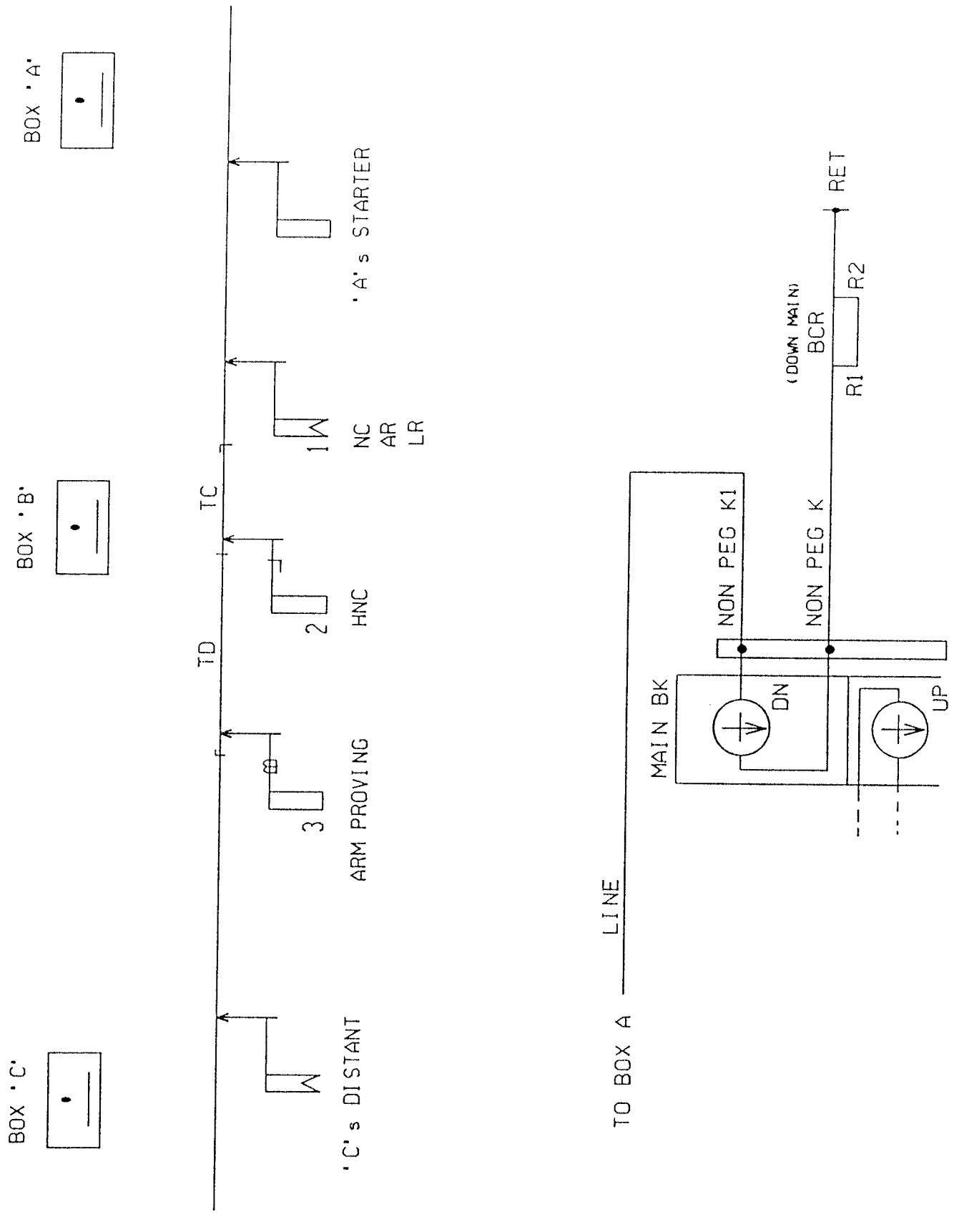


FIGURE 4.(CLEARANCE OF STOP SIGNAL WHEN NEXT SIGNAL AT DANGER).

continued

THE ABSOLUTE BLOCK SYSTEM AND ITS ASSOCIATED CIRCUITS

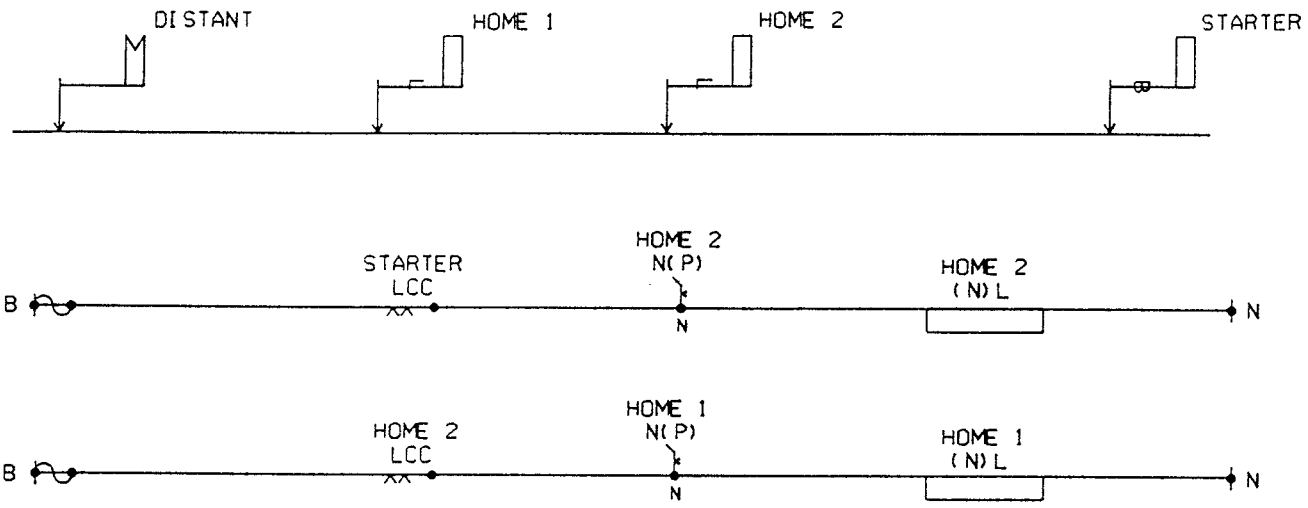


FIGURE 5. (SEQUENTIAL LOCKING).

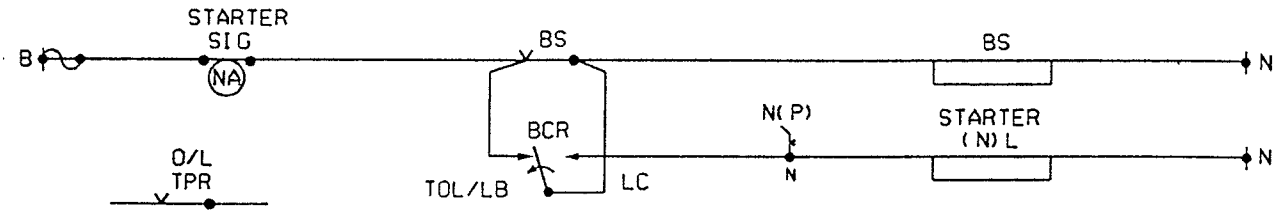
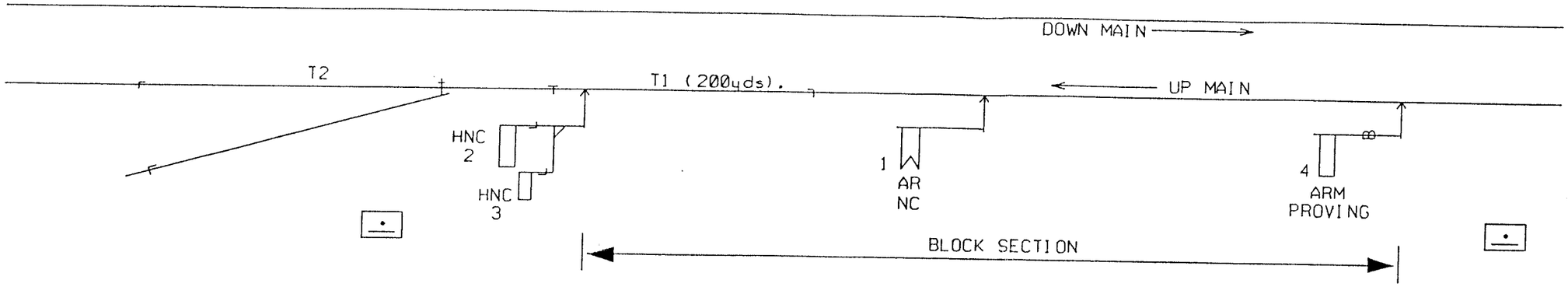
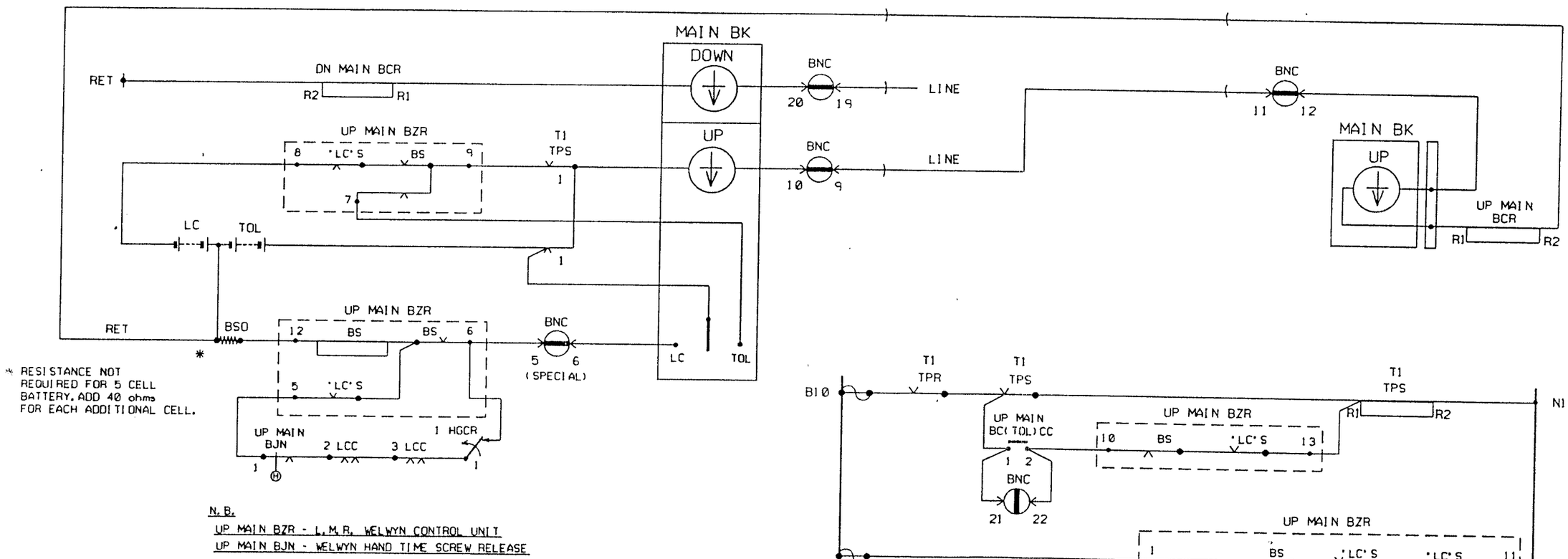


FIGURE 6.(LINE CLEAR RELEASE).

continued

THE ABSOLUTE BLOCK SYSTEM AND ITS ASSOCIATED CIRCUITS





N.B.
UP MAIN BZR - L.M.R. WELWYN CONTROL UNIT
UP MAIN BJN - WELWYN HAND TIME SCREW RELEASE

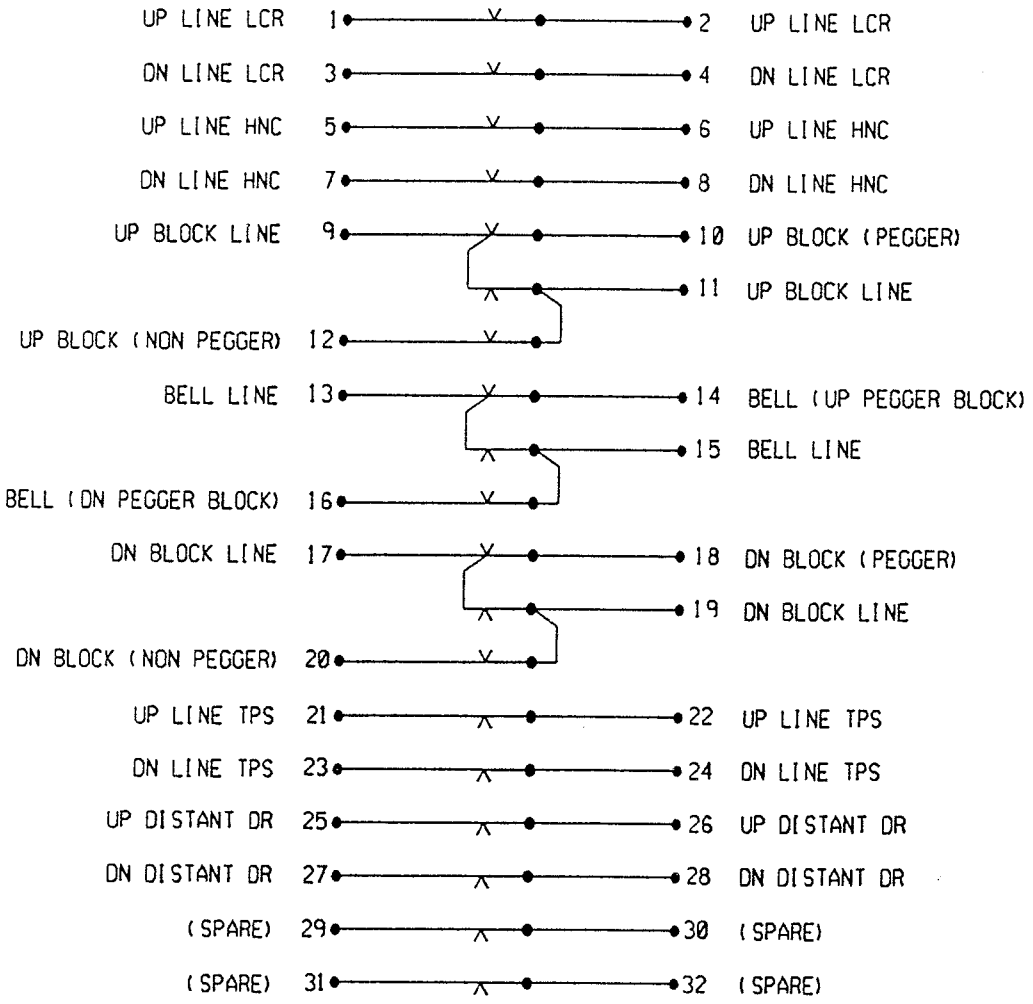
FIGURE 7. WELWYN CONTROL.

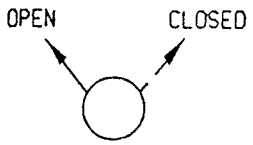
continued

THE ABSOLUTE BLOCK SYSTEM AND ITS ASSOCIATED CIRCUITS

BLOCK SWITCH MECHANISM. (16 BAR 2 POSITION).

CATALOGUE No 88/79819





FRONT CONTACTS MADE WHEN BLOCKSWITCH IS IN OPEN POSITION.

BACK CONTACTS MADE WHEN BLOCKSWITCH IS IN CLOSED POSITION.

CONTACTS 1-2 TO 7-8 TO BREAK BEFORE AND MAKE AFTER CONTACTS 9-10 TO 19-20.

FIGURE 8. (TYPICAL BLOCK SWITCH).

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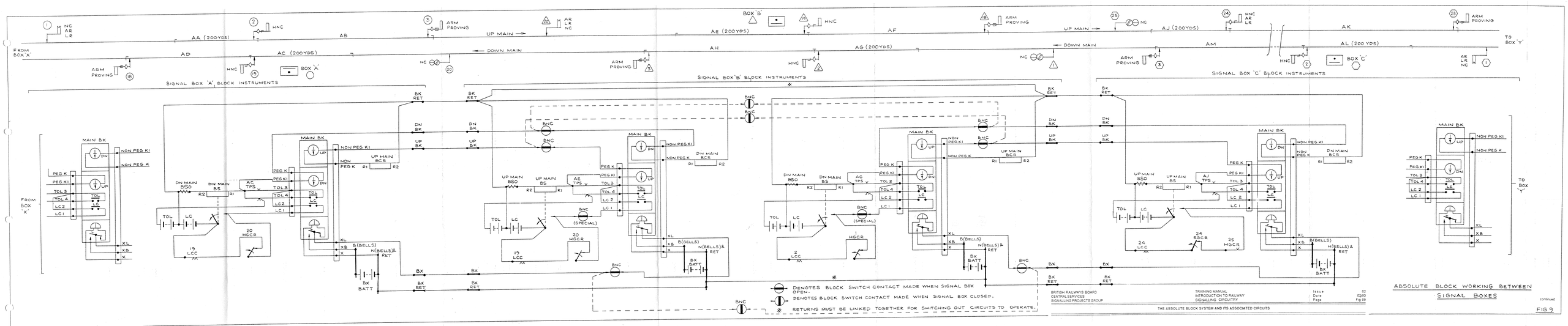

ABSOLUTE BLOCK WORKING BETWEEN SIGNAL BOXES

continued

FIG 9

50 VOLT BLOCK WORKING

continued

FIG 10

BRITISH RAILWAYS BOARD
CENTRAL SERVICES
SIGNALLING PROJECTS GROUP

TRAINING MANUAL
INTRODUCTION TO RAILWAY
SIGNALLING CIRCUITRY

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THE ABSOLUTE BLOCK SYSTEM AND ITS ASSOCIATED CIRCUITS

※1 BLOCK BELL UNIT TO BE MODIFIED IN WORKSHOP TO INCLUDE EXTRA TERMINAL TO FACILITATE RELAY RINGING.

※2 RELAYS TO BE OF A QUICK ACTING TYPE. IMMUNISATION WHEN REQUIRED TO BE PROVIDED BY USE OF SCREENED CABLES OR IMMUNE LINE RELAYS.

※3 RELAYS TO BE OF A QUICK ACTING TYPE.

※4 930 SERIES BIASED RELAY, AC IMMUNE WHEN REQUIRED.

※5 930 SERIES NEUTRAL RELAY.

※6 930 SERIES MAGNETICALLY LATCHED NEUTRAL RELAY.

"A" BOX

"B" BOX

"C" BOX

50 VOLT BLOCK WORKING

end

FIG 10 (CONT)