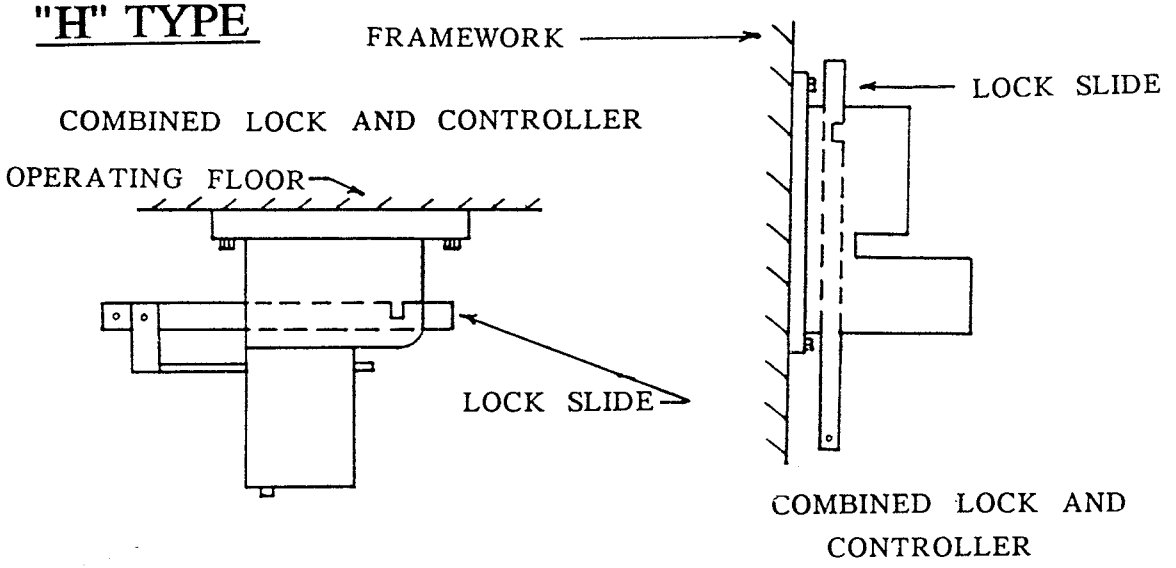
# CENTRAL SERVICES
# SIGNALLING PROJECTS GROUP

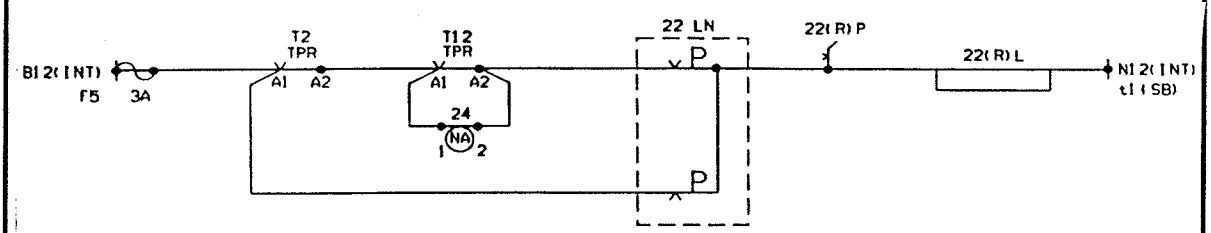
## LEVER LOCK CIRCUITS

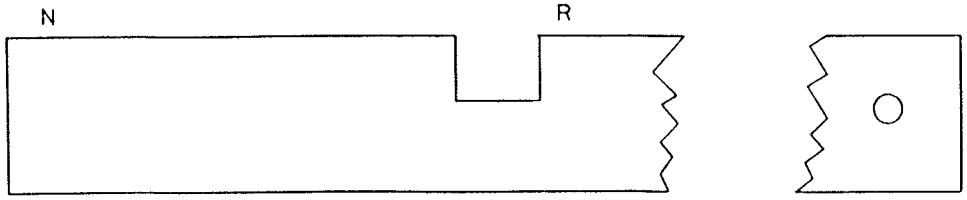
### "H" TYPE




### BANGOR LEVER LOCK CIRCUIT EXTRACT

### "U" TYPE




REVERSE LOCK SLIDE

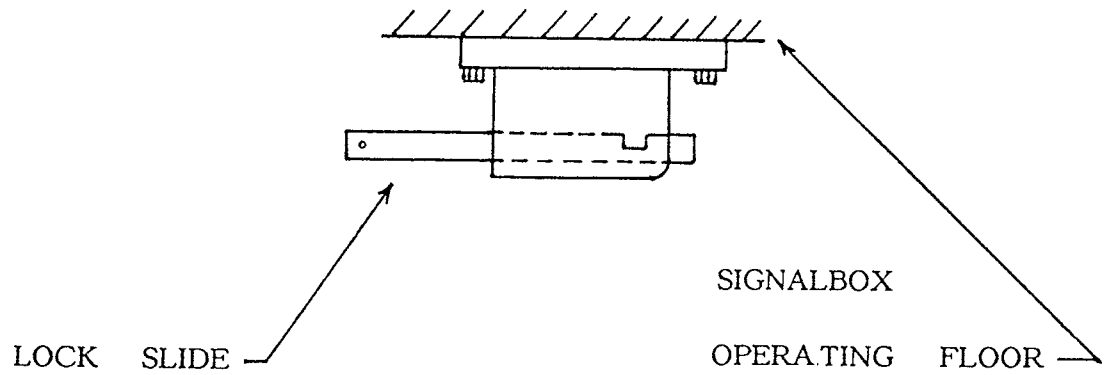
## INTRODUCTION

The interlocking of a layout can be carried out electrically in a number of ways, but it is proposed in this module to deal only with the case where each signalling function is controlled by a separate lever. There are several types of frame which are in current use, all based on the same principle but varying in detail, some of which you will see later. The lever is now locked by means of a device called an electric lever lock.

## THE ELECTRIC LEVER LOCK

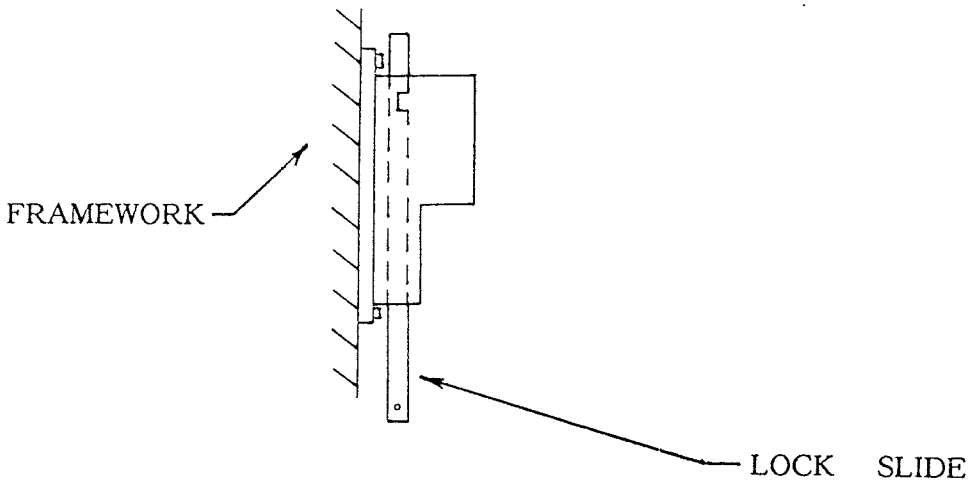
The electric lever lock is a device which allows us to have electrical control of, and electrical control from a mechanical lever frame. The two types in common use on the old London Midland Region are referred to as "U" and "H" types. The following diagrams are examples of a "U" and "H" type lock.

### "H" TYPE LOCK




continued

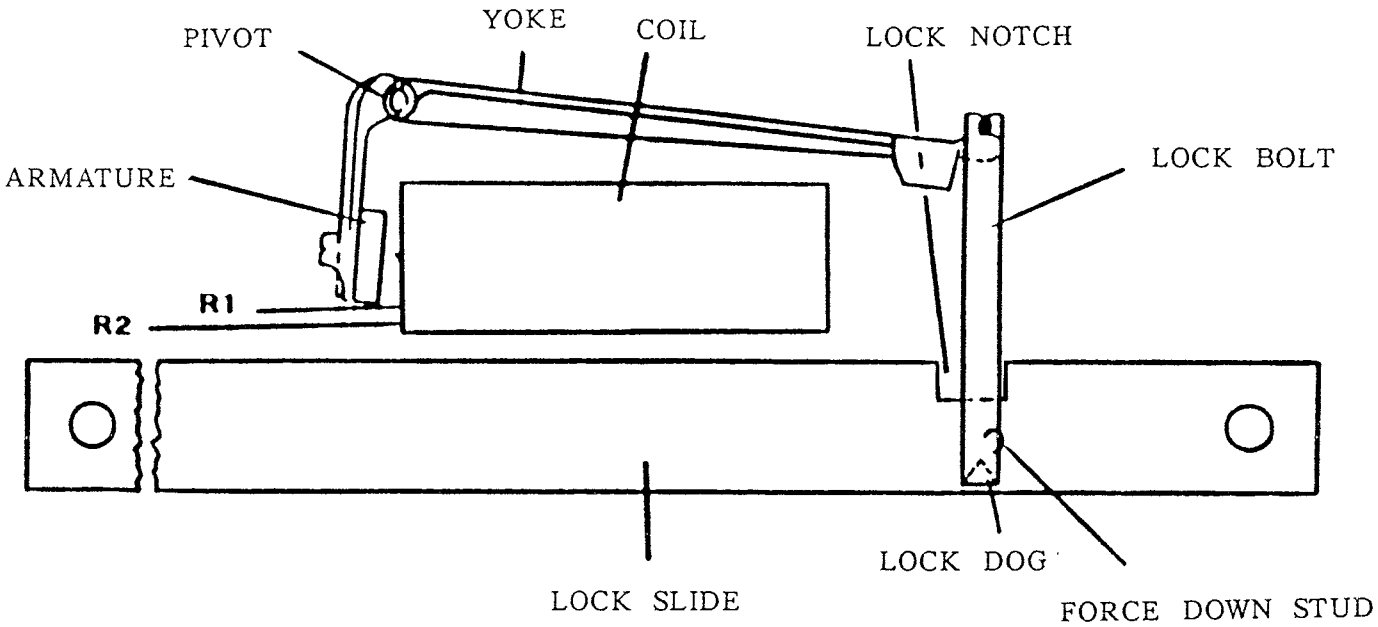
# "U" TYPE LOCK




"H" Type locks are suspended on an ironwork bolted beneath the signalbox operating floor. The slide travels horizontally through the lock body. The "U" Type lock is positioned on a framework beneath the mechanical lever frame. It is placed in various positions all dependent upon the type of lever frame. The slide on a "U" Type lock travels in a vertical or upright plane. The actual lock unit incorporates an armature, yoke and coil to form an electro-magnetic circuit similar in manner to that of a neutral relay. It should be noted that the nominal operating voltage of an electric lever lock is 12 volts D.C.

continued

The diagram below identifies some of the important component parts which go to make the lock unit.




The lock bolt is normally engaged in the lock slide, thus limiting the lever's movement. When the coil is energised, the armature is attracted to the coil thereby moving the yoke. The lock bolt is lifted clear of the lock slide and now the lever is free to move. The lock slide may have various notches cut in it, such as NR or NB or NBDR. Which notches are cut in a lock slide depends on the purpose for which the lock is required. To ensure the lock bolt enters each lock notch, a "force down" feature is incorporated. This consists of a "Lock Dog" and a heavy duty rivet secured through the lock slide called a "force down stud".

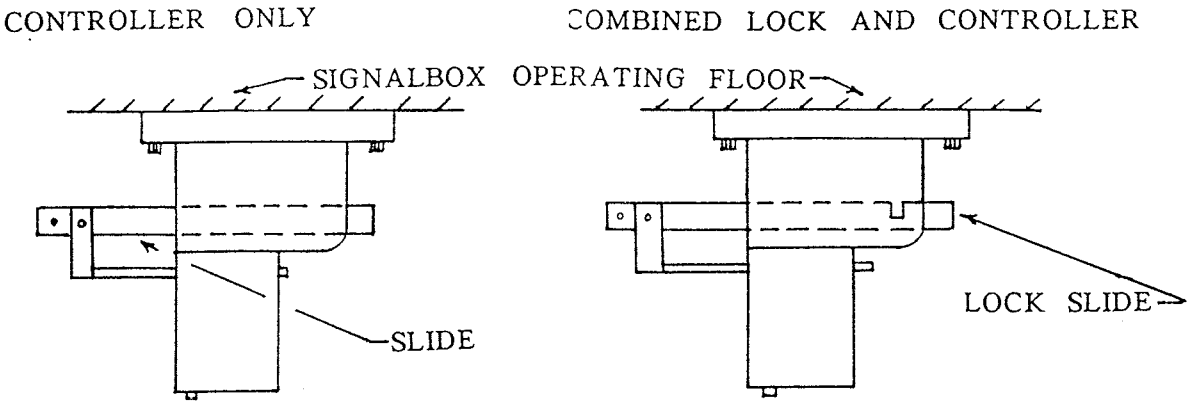
continued

## THE CIRCUIT CONTROLLER

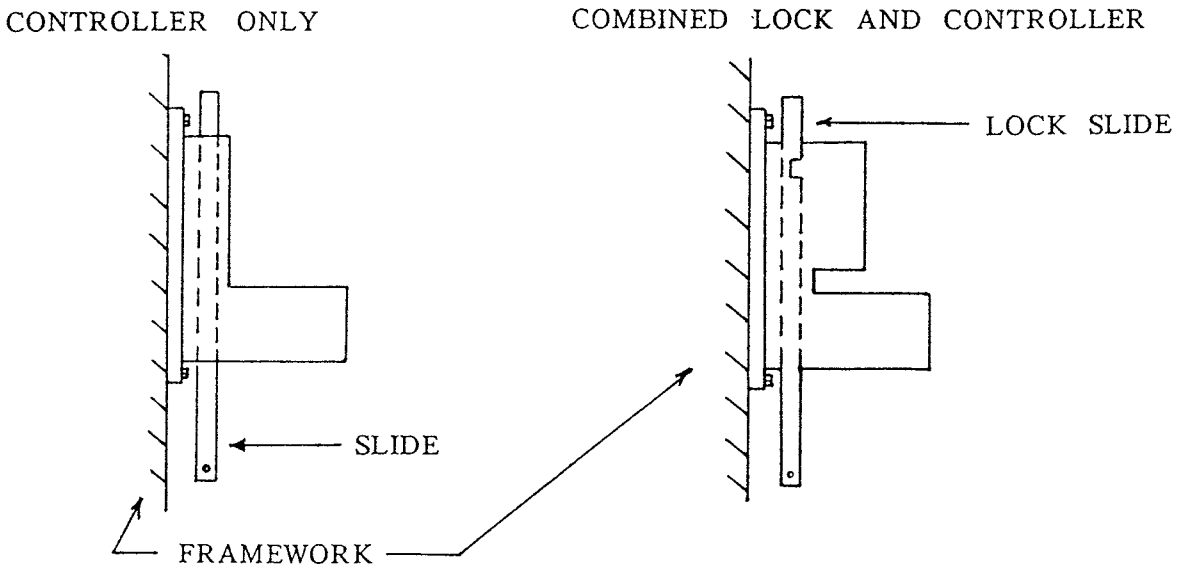
Another piece of equipment associated with the control of, and electrical control from, a mechanical lever frame is the "Circuit Controller". A circuit controller can either be used on its own or in conjunction with an electric lever lock.

The diagrams which follow show examples of "U" and "H" Type controllers and combined electric lever lock and controller.

### "H" TYPES

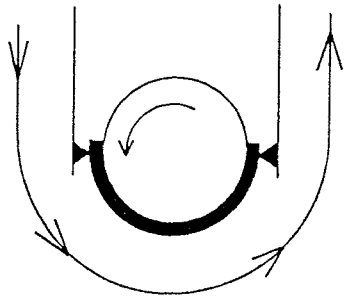



### "U" TYPES




continued

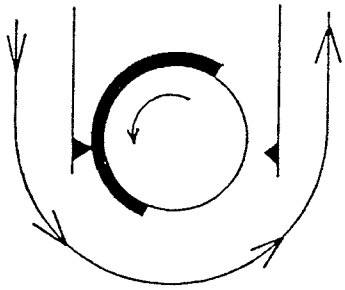
Figure 1 shows a mechanical drawing of a combined lock and circuit controller. It can be seen that the circuit controller is made up of a series of "brass or oil-lite" bands which are mounted on a centre spindle. The spindle is cam driven off the lock slide, which ensures that the bands correspond with the lever position. The bands are mounted on the centre spindle by a screw fitted through an insulating bush. This insulation is essential to prevent earth faults arising. When a circuit requires to prove that a lever is in a certain position a supply is fed over a circuit controller band. For example a "Normal" contact is made when the lever is normal, and the band is fitted in such a position that when the lever is fully normal, the band bridges a pair of contacts and current can flow from one contact, round the band to the other contact as indicated below:-



NORMAL CONTACT WITH LEVER
IN THE NORMAL POSITION

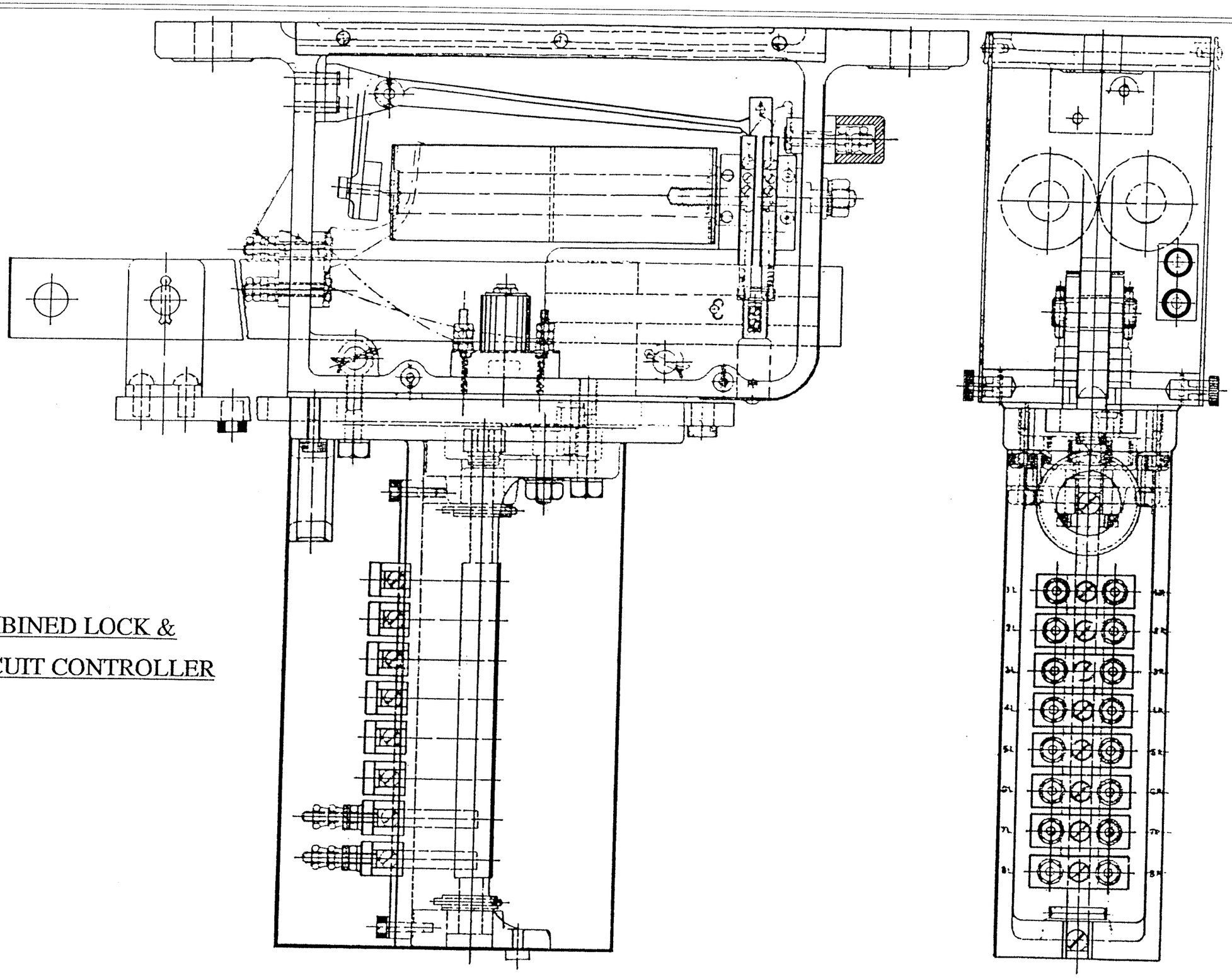
If, however, when the lever is pulled, as soon as it is moved out of the normal position, the contact band moves away from the left hand contact and the circuit is broken.

Similarly with a "reverse" contact, the band is fitted so that when the lever is normal, no current can pass as the band is not in contact with the right-hand contact. When the lever is fully reversed, the band touches both contacts, and the circuit, so far as this lever is concerned, is completed.



REVERSE CONTACT WITH LEVER
IN THE NORMAL POSITION

continued



COMBINED LOCK &
CIRCUIT CONTROLLER

FIGURE 1

continued

## LEVER CONTACT BANDS

The positions a lever passes through when going from normal to reverse or vice-versa are identified as follows:-

**NORMAL—A—B—C—D—E—REVERSE**

and mean the following:-

N - Full normal position of lever,
A - Position where the lever has just cleared the normal position,
B - Normal indication position (Check),
C - Centre Position (Check),
D - Reverse indication position (Check),
E - Position where the lever has just cleared the reverse position,
R - Full reverse position of the lever

The diagram opposite shows the most commonly used lever bands and the thick black line indicates when the lever band contact is made.

Below is a list of some common lever bands and a description of when they are "made":-

**N - NORMAL CONTACT** To break before the lever reaches the normal lock position,

**NA - NORMAL CONTACT** To break just after the lever is in the normal lock position,

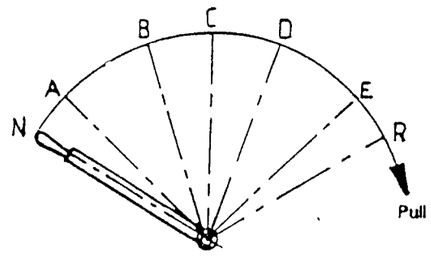
**B - NORMAL INDICATION CONTACT** With the lever moving from reverse to normal to make when the lever is 1 inch from the (B) lock and break when it is a 1/2 inch past the (B) lock,

**D - REVERSE INDICATION CONTACT** With the lever moving from normal to reverse to make when the lever is 1 inch from the (D) lock and break when a 1/2 inch past the (D) lock,

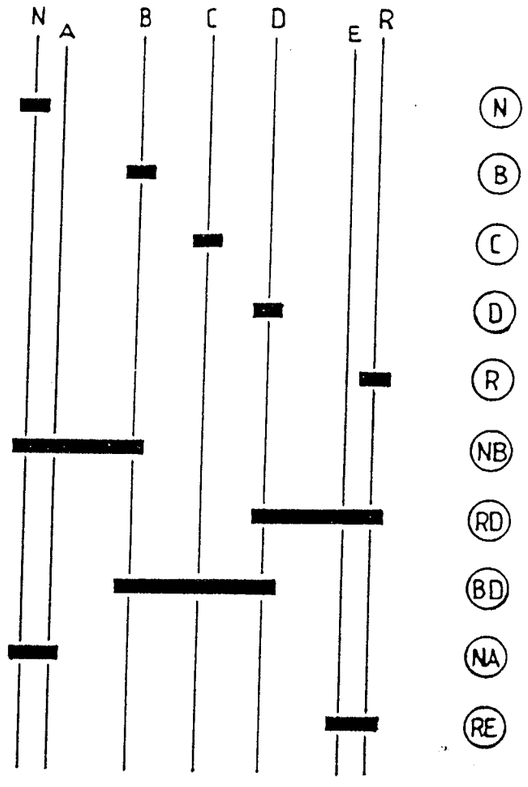
**RE - REVERSE CONTACT** To break just after the lever is in the reverse lock position,

**R - REVERSE CONTACT** To break before the lever reaches the reverse lock position.

It should be understood that a single letter, such as N, indicates the position of a lever when a contact is made whereas two letters, such as RE, indicates the lever positions between which the contact is made.




N = Normal position
C = Central position
R = Reverse position

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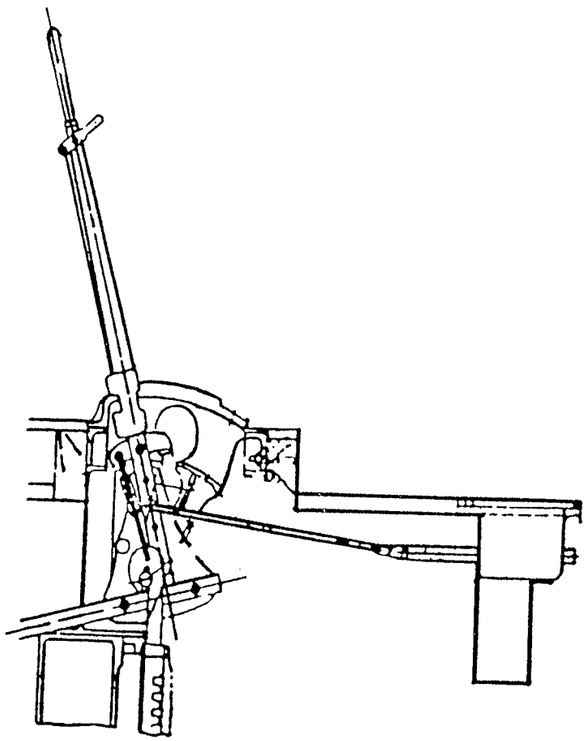
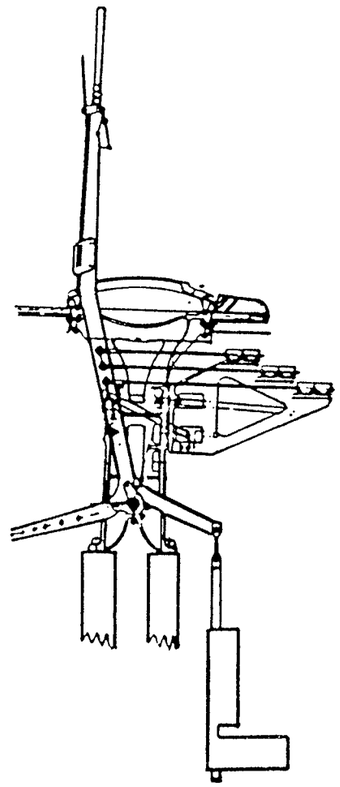
## LEVER LOCK/CIRCUIT CONTROLLER COMBINATIONS

The type of lever lock/circuit controller combination you will have to use is determined by the type of mechanical lever frame it is to work with. There follow four diagrams showing different types of lever frame, LNW Tumbler, Pre-1943 Tappet, Standard 1943 Tappet, McKenzie and Holland and which lever lock/circuit controller combination is applied.

### LNW TUMBLER



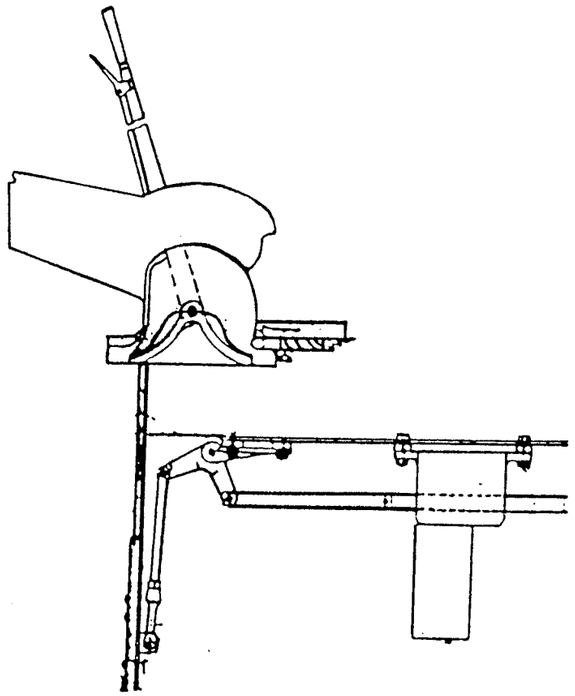
### McKENZIE & HOLLAND



The LNW Tumbler frame opposite employs a H-Type lock/controller combination with the **LOCK SLIDE OUT.** The McKenzie & Holland frame above employs a U-Type lock/controller combination with the **LOCK SLIDE IN.**

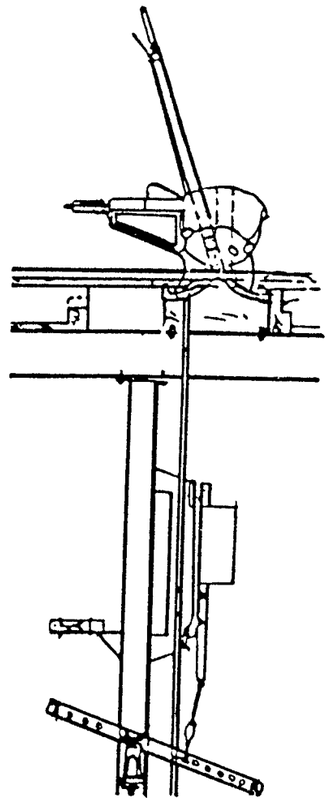
continued

## PRE-1943 TAPPET



The Pre-1943 Tappet frame above employs a H-Type lock/controller combination with the **LOCK SLIDE IN.**

## STANDARD 1943 TAPPET

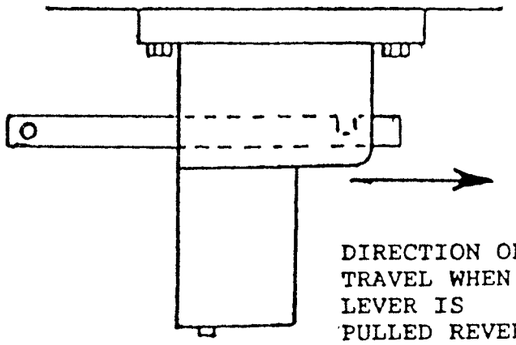


The standard 1943 Tappet frame above employs a U-Type lock/controller combination with the **LOCK SLIDE OUT.**

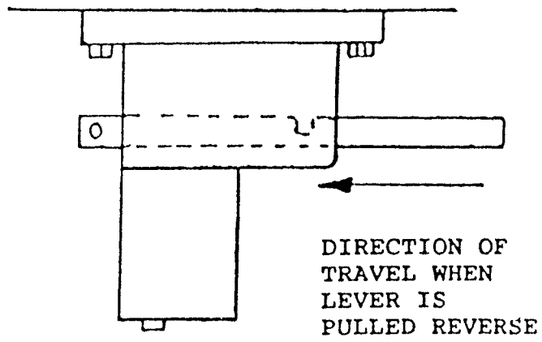
continued

It can be seen from the previous four examples of lever frames some method of determining the slide positions of "U" or "H" Type locks is required. The rule for determining this is that the end remote from the "lock dog" should be taken as the normal slide position when the lever is in the normal position as shown in the following examples:-

## "H" TYPE LOCK

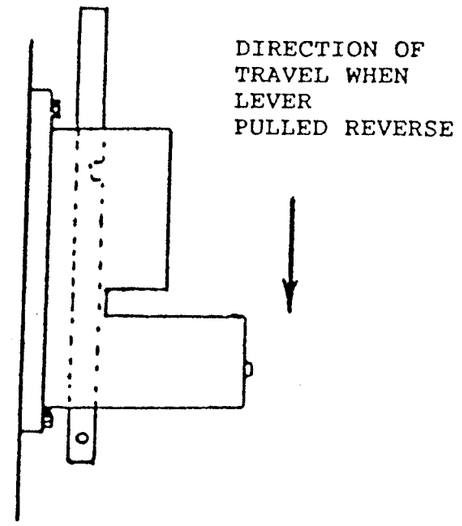



OUT NORMAL (O/N)

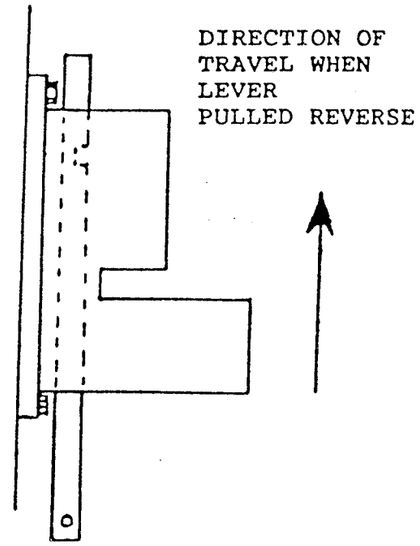



IN NORMAL (I/N)

## "U" TYPE LOCK




IN NORMAL (I/N)




OUT NORMAL (O/N)

continued

## ELECTRIC LEVER LOCK CIRCUITS

Figure 2 shows a typical lever lock sheet taken from Bangor wiring diagrams. Bangor is an electro-mechanical installation and it can be seen there are various types of lock circuits such as (N)L's, (B)L's and (NBDR)L's etc.

In the training course "Introduction to Railway Signalling" we saw how to prevent a signal from displaying a clear aspect until the section ahead of it is clear and the route has been correctly set. In some cases, however, an additional safeguard is provided by preventing the actual signal lever from being reversed until these conditions exist. To do this an electric lock cut in the normal locking position is coupled to the lever, the circuit to the lock magnet being so arranged that the magnet cannot be energised and consequently the lever cannot be moved out of the normal position until the controlling track circuits are clear and the points are in their required position.

In this module we are going to take a look at the following lever lock circuits:-

a) (N) Lock circuit,
b) (NB) Lock circuit,
c) (R) Lock circuit,
d) (NBDR) Lock circuit, and
e) (C) Lock circuit.

continued

## LEVER LOCK CIRCUITS

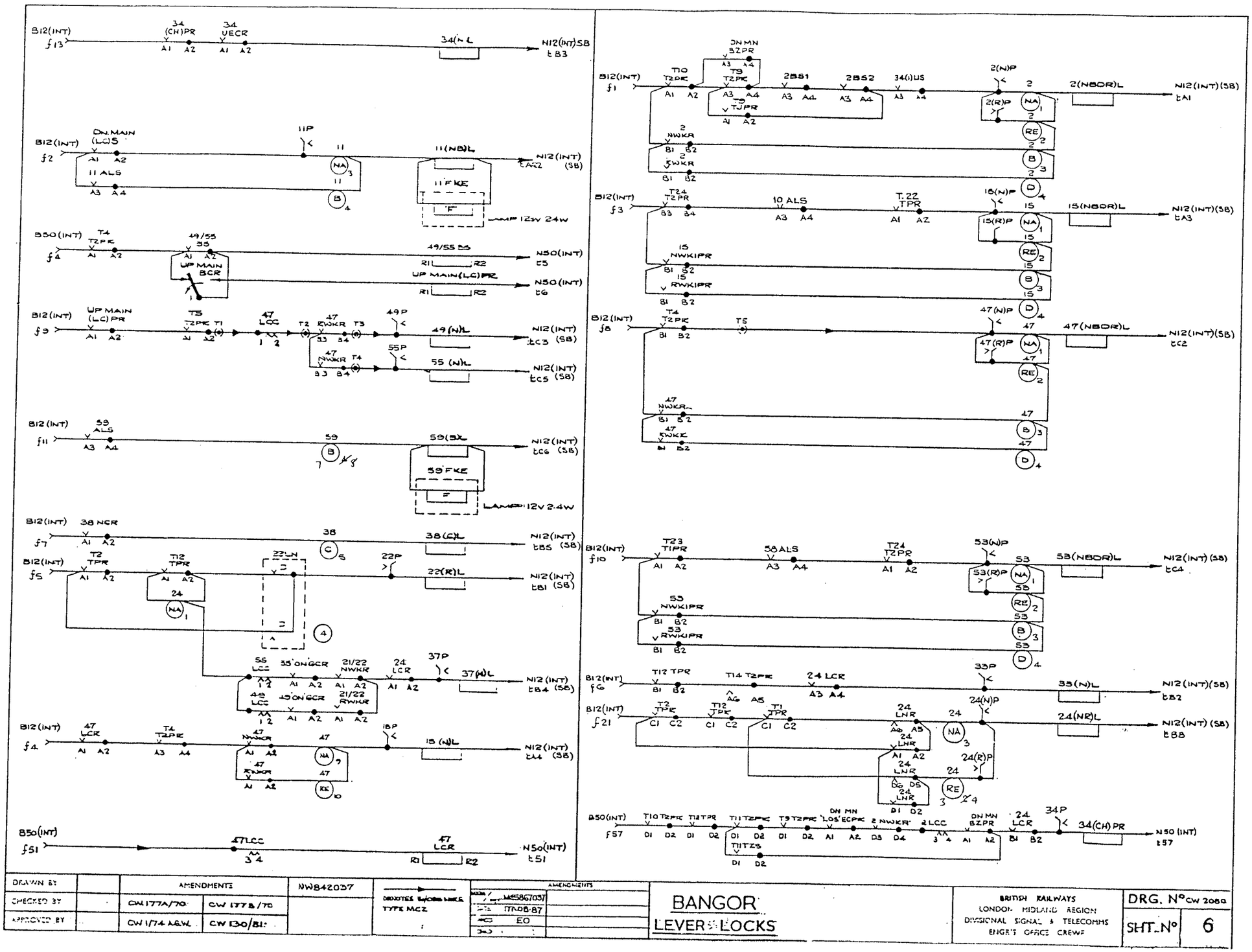



FIGURE 2

continued

## THE (N) LOCK CIRCUIT (FIGURE 3)

If we take a look at the Bangor Signalling Plan extract and in particular Signal 55 there are certain controls we must prove before we can energise 55(Normal) Lock, such as tracks clear, points in the correct position etc.

Where would we need to look in order to find out what these controls are? The answer to that question is the "Control Tables". In the control table it can be seen that in order to energise 55(N) Lock we need to prove the following:-

a) T4 & T5 Track circuits clear,
b) 47 Points detected in the normal position,
c) 47 Lever locked,
d) A line clear release on the Up Main, which is for "One train only".

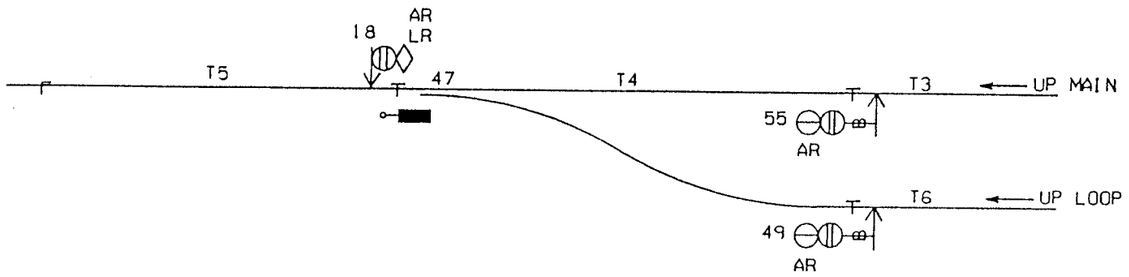
Looking at 55(N) Lock circuit it is possible to see all the controls asked for in the control table, except T4 track circuit clear. This is a good example for inexperienced staff of where you will not always see everything that is listed in the control table directly in the lock circuit. In this example T4 proved clear has been inserted in the UP MAIN (LC)PR circuit because it has also been used to enforce the control asked for in the control table of a line clear for "one train only".

What are the catch-handle contacts doing in the lock circuit? In every lever frame there is always a number of levers which are free to be pulled at any time, and this means that their locks would be carrying current for long periods to keep them energised and this is undesirable. It is undesirable because compared with relays lever locks draw a heavy current. In the days when the only signalling power supply was the primary cell, if the locks remained energised they would soon drain the cells. To prevent this the catch handle economiser contacts are inserted which says the lock will only energise when the lever is used.

continued

# BANGOR SIGNALLING PLAN EXTRACT

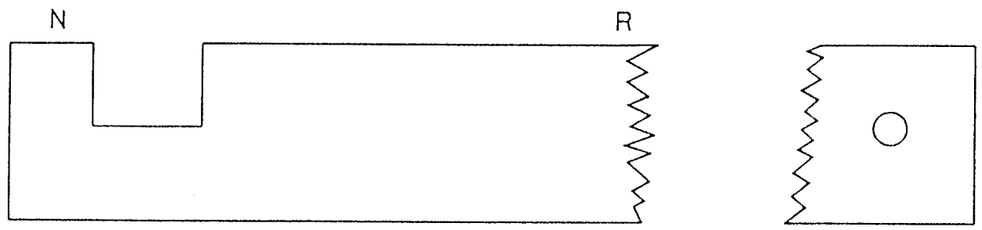
FIGURE 3



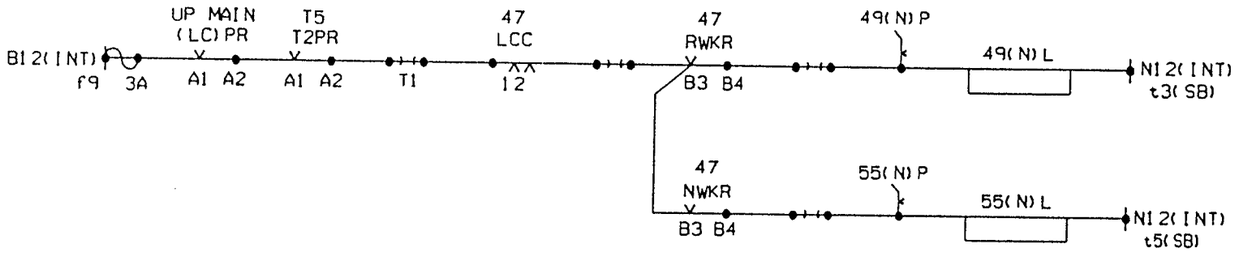

# BANGOR CONTROL TABLES EXTRACT

| LEVER NO | FUNCTION | DETECTION | | | LEVER LOCKED | TRACK CIRCUITS | | BLOCK | | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|
| | | POINTS N | POINTS R | FPL | | CLEAR | OCCUPIED | AT | LINE | |
| 49 | (N) L | | 47 | | 47 | T4. T5 | | L. C | UP MAIN | ONE TRAIN |
| 55 | (N) L | 47 | | | 47 | T4. T5 | | L. C | UP MAIN | ONE TRAIN |

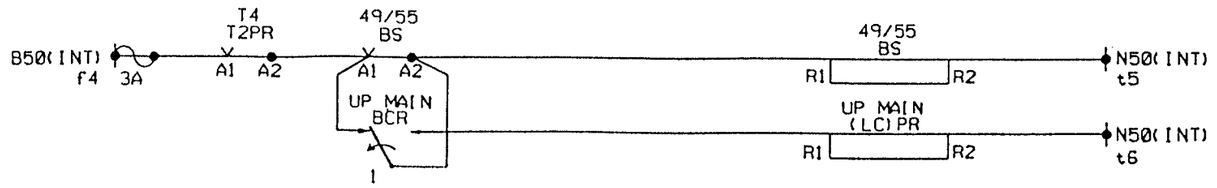
# NORMAL LOCK SLIDE




# BANGOR LEVER LOCK CIRCUIT EXTRACT




# BANGOR BLOCK CONTROLS CIRCUIT EXTRACT




continued

## THE (NB) LOCK CIRCUIT (FIGURE 4)

This is a normal lock circuit with the addition of a (B) Lock which has been used to enforce "Approach Locking". In this module it is not the intention to go into the subject of approach locking in any great detail as it is covered in a later module. Approach locking is used to prevent the signal lever controlling the signal governing a route from being fully restored when a train has approached within a predetermined distance of the signal, if this one has shown a clear aspect. If we take a look at the example taken from Bangor, the reason approach locking has been applied to 11 signal is because Standard Signalling Principle No 19 states that approach locking

**"shall be provided when a signal is protecting a level crossing."**

As before we must look at the control table to see what controls are required in order to energise 11(N) Lock:-

a) T28 Track circuit clear,
b) A line clear release on the Down Main, which is for "one train only".

As in the previous example T28 track circuit clear is not directly in the lock circuit but in the DN MAIN(LC)S circuit. Having completed the module on "The Absolute Block System and Associated Circuits" you should be able to deduce for yourself how 11BS/DN MAIN(LC)S circuit operates.

If for any reason the signalman should then find it necessary to replace 11 signal it is essential that the route ahead of the signal is held locked until the train has either:-

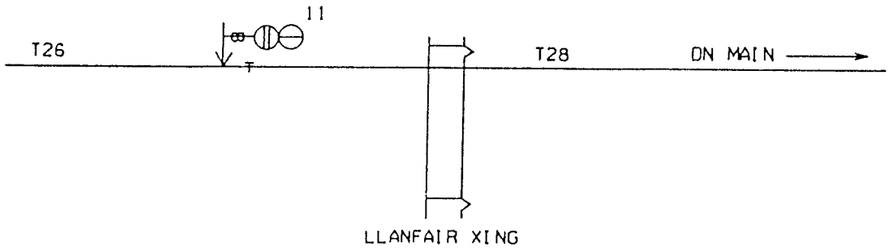
a) been proved to be under control and capable of stopping at the replaced signal or

b) run past the signal and passed through the route.

If we had only provided a (N) Lock on 11 signal there would be nothing to prevent the signalman putting 11 lever back to the normal position and releasing the route ahead of the signal. A (B) Lock is therefore provided on signal levers which permits the lever to be restored to a position roughly about three quarters of its travel from reverse to normal. Before the lever can go back to the normal position we have got to energise the (B) Lock. Looking at 11 (NB) Lock circuit we have to wait until 11 ALS has energised.

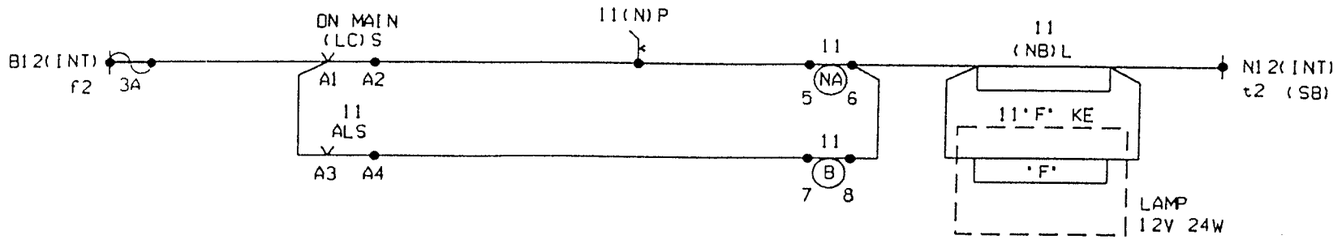
continued

## BANGOR SIGNALLING PLAN EXTRACT




## BANGOR LEVER LOCK CIRCUIT EXTRACT

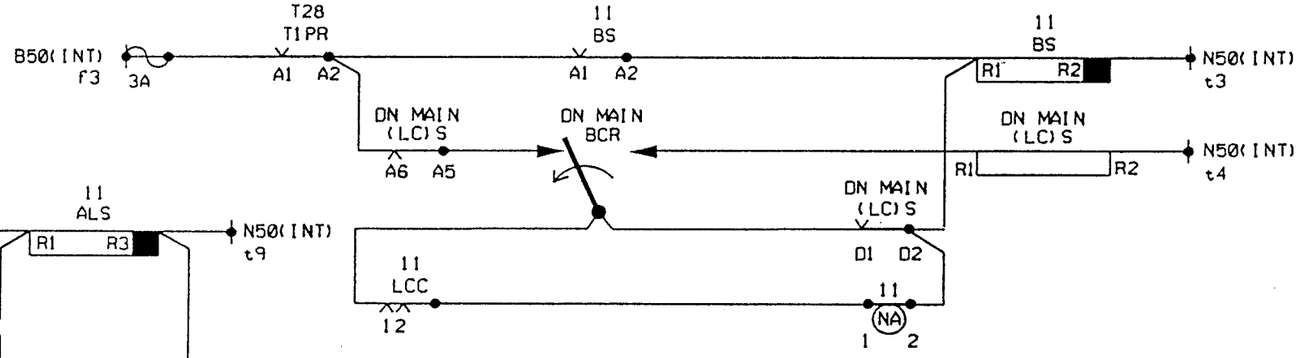
FIGURE 4



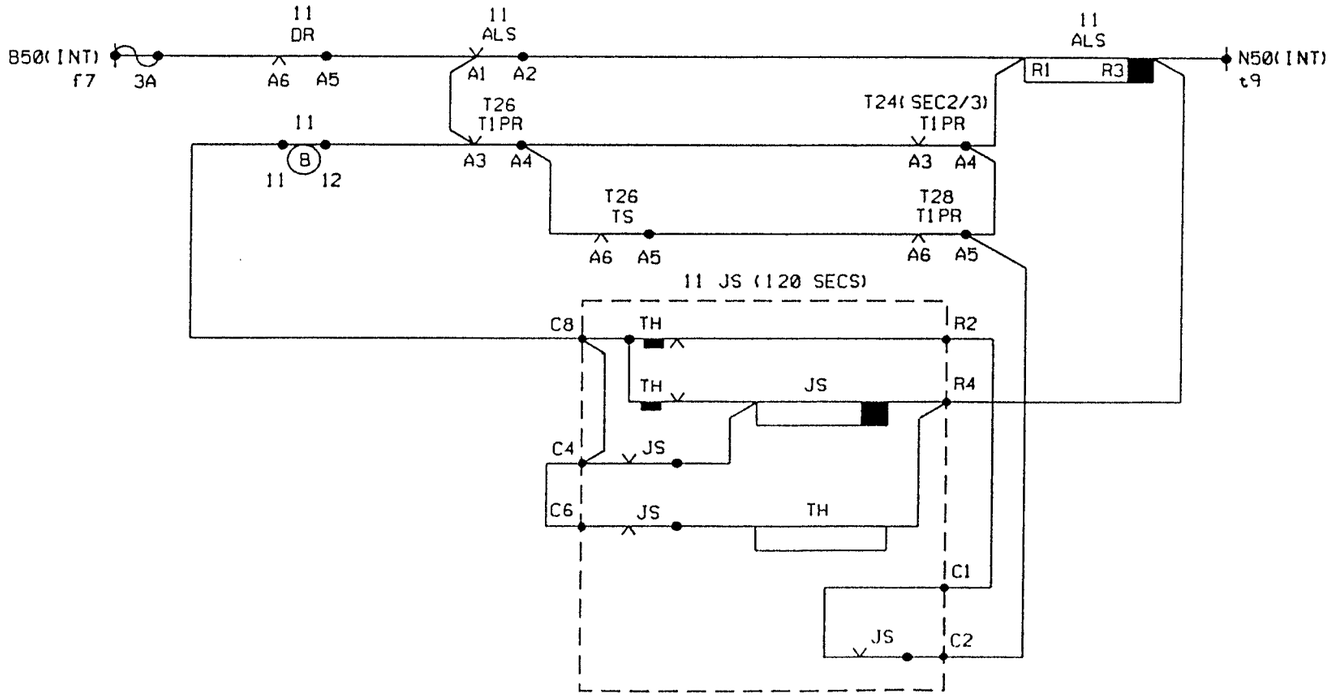

## BANGOR CONTROL TABLES EXTRACT

| LEVER NO | FUNCTION | DETECTION | | | LEVER LOCKED | TRACK CIRCUITS | | BLOCK | | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|
| | | POINTS N | POINTS R | FPL | | CLEAR | OCCUPIED | AT | LINE | |
| 11 | (N)L | | | | | T28 | | L.C | DN MAIN | ONE TRAIN |
| | (B)L | | | | | [T24.T26 (T26 AFTER OR 120 | OR T26.T28)] SECS | | | |

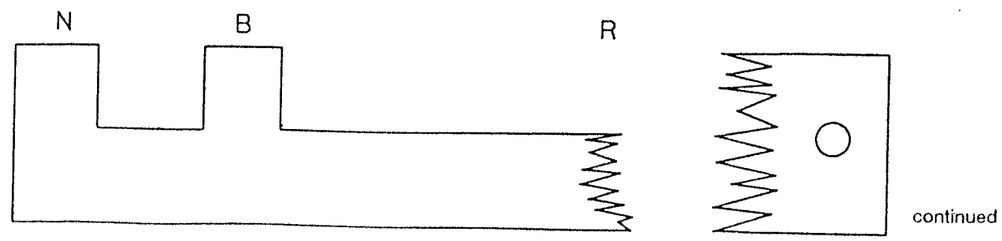
## BANGOR BLOCK CONTROLS CIRCUIT EXTRACT




## BANGOR CIRCUITS EXTRACT




## NB LOCK SLIDE




continued

## THE (R) LOCK (FIGURE 5)

In this example the (R) Lock has been put on 22 facing point lock lever. The first thing we need to establish is what is a facing point lock lever's normal position in the lever frame. It is actually normal in the frame when the lever is reverse. When the lever is reverse it means the lock plunger has entered the lock stretcher bar at the points on the trackside thereby locking the points. Therefore if we want to lock 22 facing point lock lever we must lock it in the reverse position.

When 22 lever is locked it will prevent 21 points being moved out of the position that they are in whether it is normal or reverse. Before allowing 22 lever to be released we must prove T2 track circuit clear. We must also prove T12 track circuit clear but only when 24 points are in the reverse position. The sealed release plunger is in the circuit as it enables the signalman to overcome track circuit controls when there has been a track circuit failure which could unduly delay the running of trains. The signalman can use the release many times until the S & T Technician rectifies the fault as stated in the Signalman's General Instructions, Issue Date June '88:-

**28. Releases for points, facing point locks, signals and block instruments.**

**28.1 Sealed Releases.**

**28.1.2 Before using a sealed release, the signalman must ensure <u>on each occasion</u> that it is safe to do so and the portion of affected line is clear and no movement is about to be made over it."**

continued

# BANGOR SIGNALLING PLAN EXTRACT

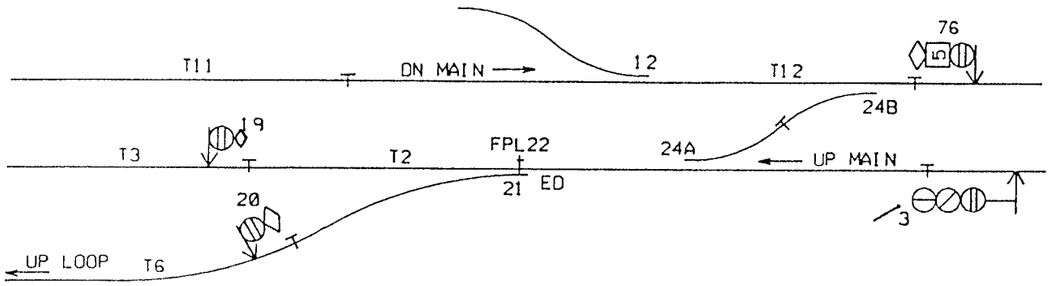
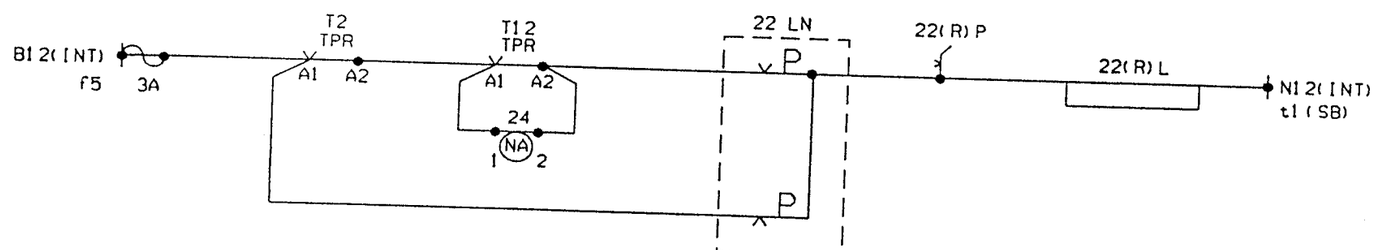



FIGURE 5

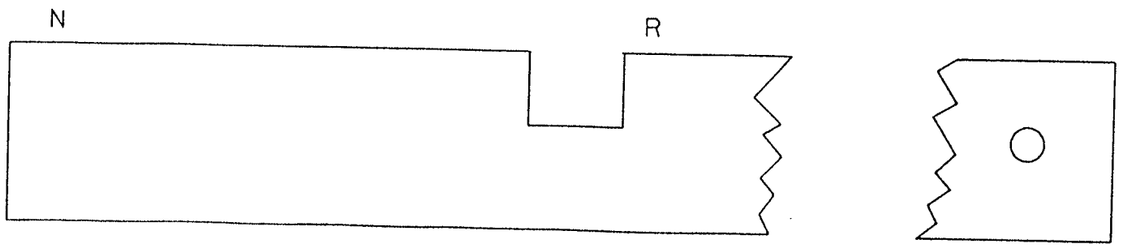
# BANGOR LEVER LOCK CIRCUIT EXTRACT




# BANGOR CONTROL TABLES EXTRACT

| LEVER NO | FUNCTION | DETECTION | | | LEVER | TRACK CIRCUITS | | BLOCK | | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|
| | | POINTS N | POINTS R | FPL | LOCKED | CLEAR | OCCUPIED | AT | LINE | |
| 22 | (R)L | | | | | T2(T12-<br>-W24R) | | | | SEALED RELEASE |

# REVERSE LOCK SLIDE




continued

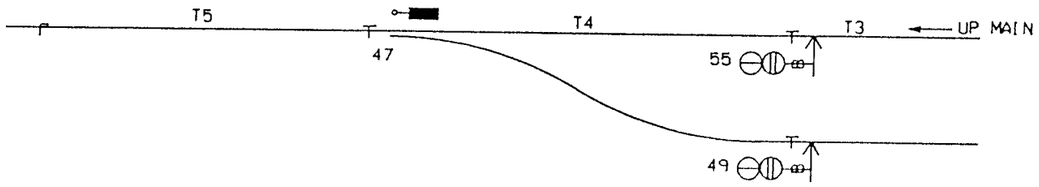
## THE (NBDR) LOCK CIRCUIT (FIGURE 6)

The (NBDR) lock circuit is locked in the full normal and reverse positions to prevent its manipulation whilst a train is occupying the track circuited section in which the points are located. In effect, it takes the place of fouling bars in mechanical signalling. It is considered that mechanically operated points, being rod coupled, would normally correspond to the position of the lever. Electrically operated points, on the other hand, are more prone to disconnection of the link between the points and lever and it has become the practice, therefore, to prove this.

In the example shown if we want to operate 47 points from normal to reverse, the lever would be moved to the reverse indication locking position "D". Before being able to get to this position we must have first picked the normal lock by proving the controls asked for in the control tables. It is impossible to get the lever past the "D" check position until the points have moved on the track to the reverse position. When the points have completed their movement and have been detected in the reverse position, the circuit to the electric lock is completed over reverse points detection relay (**RWKR**) and the "D" lever band. The lever can then be fully reversed. A similar sequence is performed when the points are to be operated from the reverse to the normal position. As a footnote to this section any track circuits which have points within them are referred to as "Dead Locking" track circuits.

continued

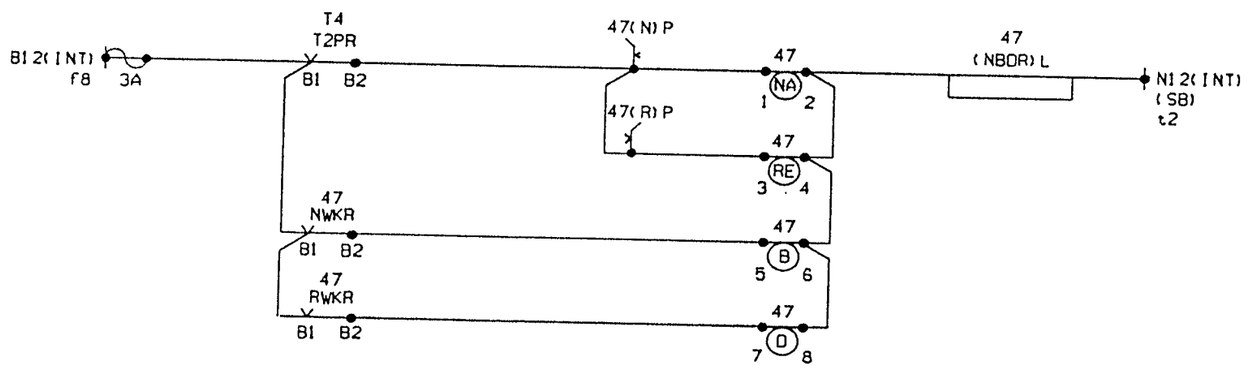
## BANGOR SIGNALLING PLAN EXTRACT




## BANGOR CONTROL TABLES EXTRACT

| LEVER NO | FUNCTION | DETECTION | | | LEVER LOCKED | TRACK CIRCUITS | | BLOCK | | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|
| | | POINTS N | POINTS R | FPL | | CLEAR | OCCUPIED | AT | LINE | |
| 47 | (N) L | | | | | T4 | | | | |
| | (B) L | 47 | | | | | | | | |
| | (D) L | | 47 | | | | | | | |
| | (R) L | | | | | T4 | | | | |

## BANGOR LEVER LOCK CIRCUIT EXTRACT




## NBDR LOCK SLIDE

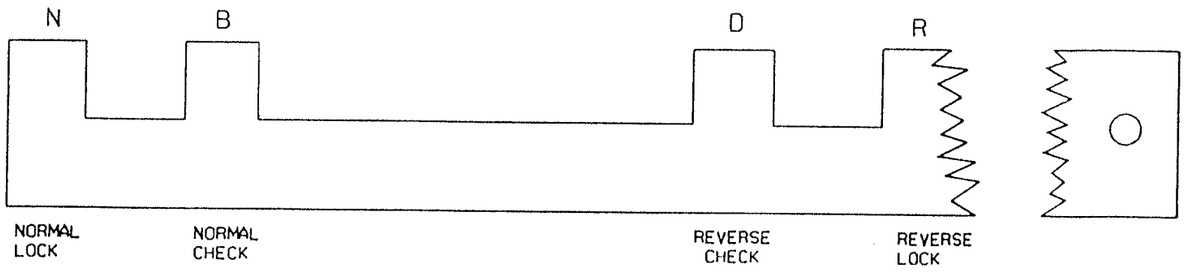



FIGURE 6

continued

## THE (C) LOCK (FIGURE 7)

In the example shown a (C) Lock is being utilised in the operation of a ground-frame release. The operation of the ground-frame release involves some co-operation between the signalman and the person who requires the release. The first thing to establish is the normal state of the relays, equipment etc when everything is normal i.e. lever normal and no release given.

### SIGNALBOX

a) 6 LR De-energised,
b) 6 LCC contacts broken,
c) 6 "C" and "RE" lever bands not made,
d) 6 (C) Lock De-energised.

### CEMENT SIDINGS GROUND FRAME

a) 1 LR De-energised,
b) 1 LCC contacts made,
c) 1 (N) Lock De-Energised,
d) 1 N Plunger not pressed.

The first thing to happen is the person at the ground-frame will contact the signalman to request the release. If in the view of the signalman and train operating requirements allow for this he will give the release.

As there is no normal lock on the lever the signalman is free to pull the lever over to the reverse position. The circuit is completed when the lever reaches the "E" position because the "RE" lever band is made. The circuit starts at the positive on the battery through 6 LR back contact which is made because 6 LR is de-energised, through 6 LCC contacts which are also now made (C lock slide refers). Then via 6 "RE" lever band which is made and the circuit then feeds out to the Cement Sidings Ground Frame. Operationally it is now up to the person at the ground-frame to accept the release and he does this by pressing the plunger provided. This now enables the feed from the battery to pass over the plunger pressed contact and to R1 on 1 LR through the coil to R2 and then returns to the battery in a similar manner.

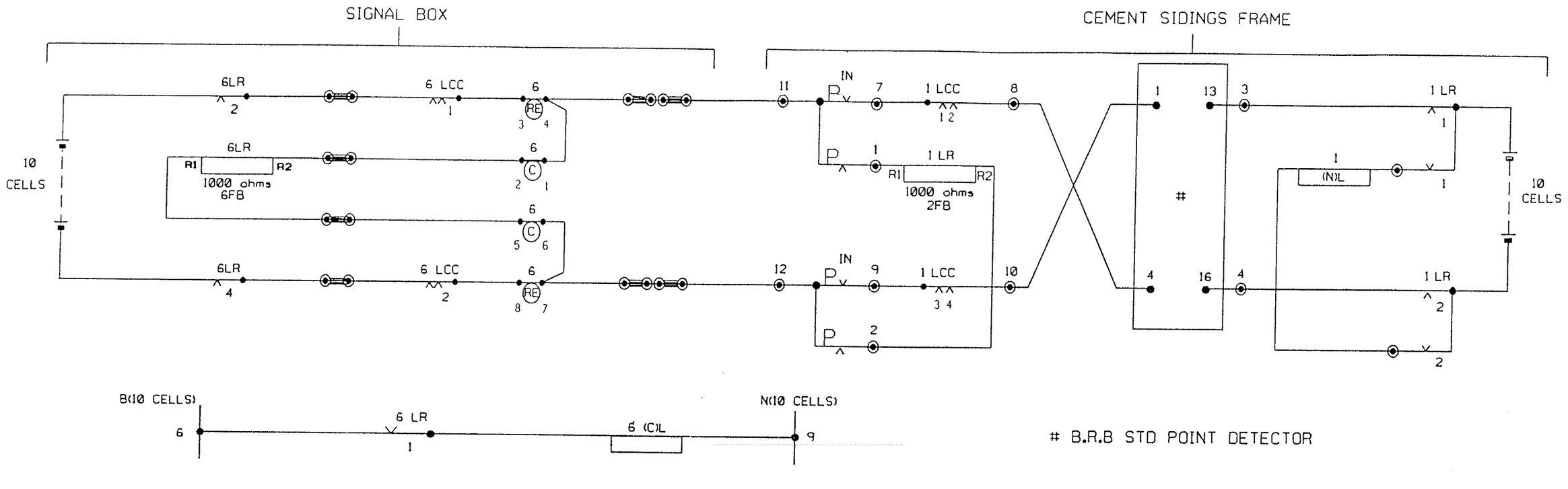
Before the person at the ground-frame can move any points at the ground-frame he has got to energise 1 (N) Lock. Starting at the positive on the battery the feed goes through the front contact of 1 LR (1) which has just been energised, and then back to the batttery. This energises the normal lock allowing the lever to be pulled reverse. A point to remember at this stage is that the operator must keep his hand on the plunger at the same time as pulling the lever, at least until getting out of the normal position. Generally giving a release which will allow movements of points at a ground-frame will cause any signals whose routes read through those points to be locked normal until the release has been given back to the controlling signalbox.

continued

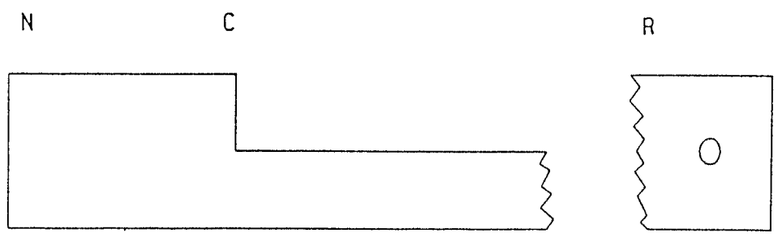
When the operator has finished with the ground-frame release he must give it back to the signalman. The circuit for giving the release starts at the positive on the battery at the ground-frame through the back contact of 1 LR which has de-energised because the operator at the ground-frame has stopped pressing the plunger. It then takes the path through the BRB Standard point detector ensuring the points have been left in the correct position, through 1 LCC contacts which are proving 1 lever at the ground-frame has been left in the normal position. The circuit path then carries on to the plunger not pressed contact and then through the line wire to 6 "C" lever band contact. At this point it is important to remember that the signalman has got as far as the "C" position in his attempt to get the lever to the normal position. As a result of the "C" lock slide it is impossible for the lever to move any further until the "C" lock is energised.

Returning to the path taken by the circuit the feed passes through the "C" lever band to R1 of 6 LR through the coil to R2 and then back through the negative path to the negative side of the ground-frame battery. Energising 6 LR will make the front contact in 6 (C) Lock circuit and energise the lock. This allows the signalman to restore his lever to the normal position. The "C" Lock in this capacity is used to prove that everything has been correctly normalised at Cement Sidings ground-frame before allowing the release lever to return to the normal position and subsequently releasing other locking at the signalbox.

continued




## C LOCK SLIDE



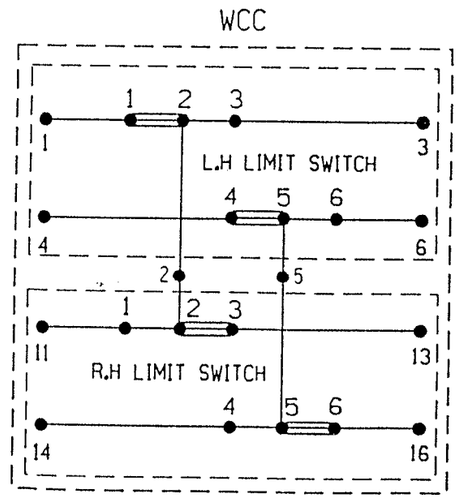




FIGURE 7

end