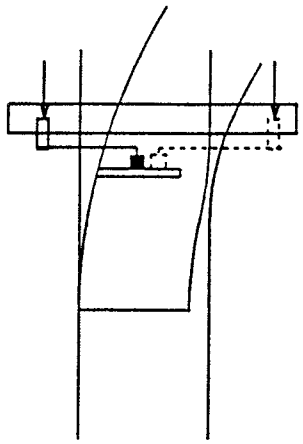
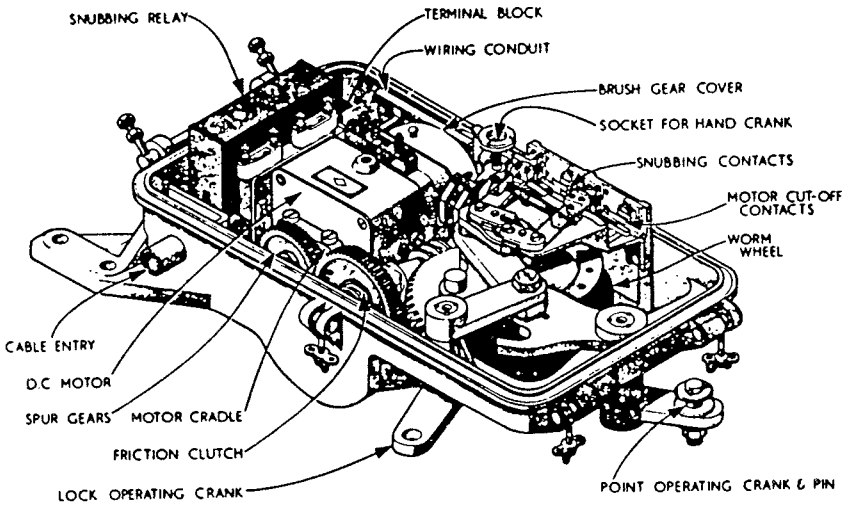
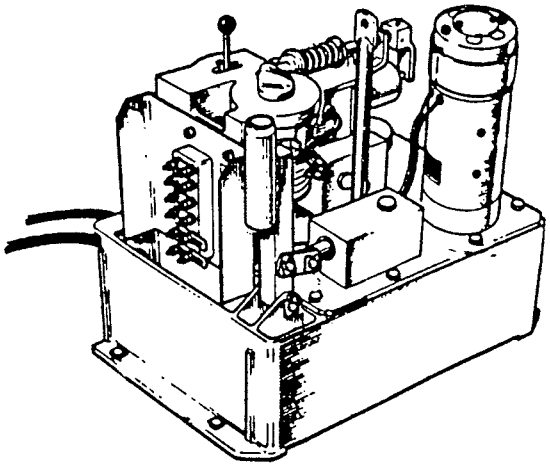
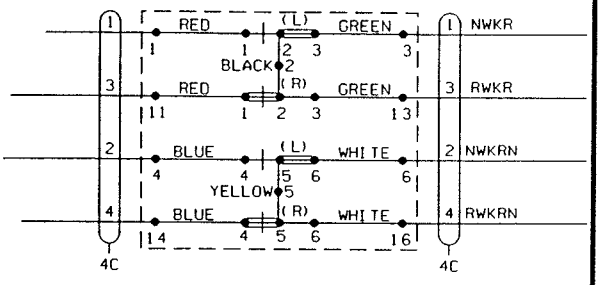
CENTRAL SERVICES
SIGNALLING PROJECTS GROUP

ELECTRICAL DETECTION AND POWER OPERATED POINTS

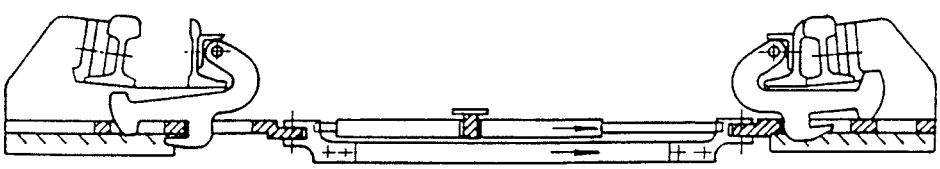








(LHNC)



POINTS REVERSED, COMPLETE MOVEMENT FROM LEFT TO RIGHT HAS CLOSED AND LOCKED THE RIGHT HAND SWITCH RAIL

ELECTRICAL DETECTION AND POWER OPERATED POINTS

POINT DETECTION

Before considering electrical detection circuits first of all we should understand how mechanical detection operates.

Point detection is required to prevent the operation of signals unless the facing point switches and facing point lock if applicable are set in their correct positions. On trailing points only the switches have to be proved when used in the facing direction.

This is achieved by the use of point detectors which consist of a single slide (connected in the signal wire run) and point detector blades (attached to point switches and FPL Escapement if points are facing points) see Figure 1A.

Both the point detector blades and the signal slide have a notch cut out to the correct clearance, with the point detector blades correctly set the signal slide will be able to pass through the detector mechanism (Figure 1B). This method of operation also ensures that if the signal is in the 'OFF' position the points cannot be moved on the ground (mechanical locking will prevent the point lever from being moved while the signal lever is reverse).

To move the points the signal must be replaced and the signal slide must return to its stop position (Figure 1C).

The standard mechanical detector is the Roller Bearing Detector. Provision is made for these to be used singly or in any multiple to a maximum of six signals detecting a set of points. The detector is supplied complete with body, lid, signal slide and adjuster. Detectors are mounted at the side of the points usually on a floating base (Figure 1A). The floating base is fixed to a timber frame in the required position by coach screws, the sliding part of the base being connected to the rail by a special rod. Any movement of the rail will give a corresponding movement to the detector base, thus keeping them at a constant distance from each other.

Figure 2 gives an example of semaphore signals and the points that are being detected either normal or reverse.

ELECTRICAL DETECTION OF MECHANICAL POINTS

If a signal reading over a pair of mechanical facing points is a colour light or power operated in any way, obviously mechanical detection of points cannot be employed and an electrical detector box is fitted to detect the condition of the points.

continued

The standard arrangement of the electrical detection wiring is shown in Figure 3 which illustrates BRS-SW67-15A from the "Standard Free Wired Interlocking Typical Diagrams" which covers the cases you are likely to encounter. These diagrams show an arrangement of wiring dependent on the type of point switch arrangement (LHNC or RHNC) and it is important that you understand the difference between Right Hand Normally Closed (RHNC) and Left Hand Normally Closed (LHNC).

Figure 4 gives you some examples but remember always look at the points in the facing direction approaching the toes of the points.

Referring to Figure 5 this diagram illustrates a typical electrical detection circuit for a mechanical point end at Croesnewydd North Fork signal box.

POWER OPERATED POINTS

POINT MACHINES

General

In basic terms, a point machine is required to move two steel rails through approximately 108mm ($4^1/_4$" approx.). Trains can then be diverted from one line to another. However, points - especially facing points - are a source of danger to the trains. If a "switch" rail should fail to fit tightly up against its associated "stock" rail, an "in-between" condition could arise - leading to a possible derailment. Also, trailing points could be damaged if a train travelled over a set that was not correctly fitting up.

In the earlier days of Railway Signalling, many trailing installations were made "trailable" (ie. the points could be allowed to move, if a train ran through them when set incorrectly). Trailable point machines are necessarily more complicated that the non-trailable variety, and are, therefore, not so reliable and require more maintenance. Current British practice is to regard all main line points as facing and treat them accordingly.

D.O.T. REQUIREMENTS FOR FACING POINTS

1) A third stretcher bar (known as the lock stretcher bar. See figure 6) and locking bolt controlled by facing point lock bar (not installed on B.R. anymore), or track circuit.

2) A stock rail gauge tie (sole plate).

3) Independent detection of the locking bolt and each switch blade.

4) Signals must not clear unless detection is proved.

5) Route holding to hold the points after signal replacement, until a train has passed over them or has been proved to have stopped at the signal.

continued

6) Track locking of points by occupation of the track circuits in which they lie.

7) Time of operation locking - the track circuit over points must be long enough for them to complete their movement before a train reaches them.

8) Approach locking to prevent operation after the protecting signal is restored to danger, until a suitable time has elapsed.

9) Points to be positioned so that movements over them can be seen by the signalman, unless suitably track circuited.

Most of these requirements apply to interlocking of points, the two that govern point machine design are 1 and 3.

BRITISH STANDARD SPECIFICATION 581

This applies to all electrically driven point machines with the exception of those used in hump yards. It lays down operating sequences, voltages, construction and weather protection requirements, methods of manual operation and the performance the machine must give. The specification lays down a number of definitions that apply to point machines.

An extract is given below.

1) Definitions

a. Point Mechanism - That portion of a point operating machine, consisting of clutch, reduction gears, cams and bars, used for the conversion of the rotary movements of the motor in the machine into the straight drive for operating the points, derailer etc. It also includes the pole-changing and/or cut-off contacts and may include operating gear for locking the points.

b. Throw-bar - That part of the point mechanism which provides the thrust for the operation of the points.

c. Lock-bar - That part of the point mechanism which acts in conjunction with the lock slide or slides to effect the locking of the points, and may also serve to connect an additional drive for the purpose of operating an additional set of points, or an external facing-point lock.

d. Lock-slide - That part of the point mechanism which acts in conjunction with the lock-bar to effect the locking of the points, and to which the lock rod is connected.

continued

e. Detector-slide - That part of the point mechanism which controls the detector contacts, and to which the detector rod or rods are connected.

f. Throw-rod - A rod by means of which motion is transmitted from the throw-bar to the points.

g. Lock-rod - A rod by means of which motion is transmitted from the points to the lock slide.

h. Detector-rod - A rod by means of which motion is transmitted from the point tongue end to the detector slide.

i. Detector - A device for proving that the points and/or facing point lock are in the correct position.

j. Time of operation - The time required to open the detection contacts, unlock, move and lock the points, and close the detection contacts.

k. Stalling Thrust - The load applied to the throw bar which, when the clutch of the point machine is deliberately prevented from slipping, would just prevent the driving movement of the machine.

l. Right - hand operation - The operation of a point machine which is fixed to the right of the track as seen when looking at the points in a facing direction.

m. Left - hand operation - The operation of a point machine which is fixed to the left of the track as seen when facing the points.

n. Rated Voltage - The value of the voltage marked on the motor and intended to be applied to its terminals and upon which is based the performance of a machine purporting to comply with this standard.

o. Snubbing Device - A device employed in addition to the clutch to minimise the physical shock of stopping the mechanism at the end of its stroke.

p. Crank - handle - An appliance by which electrically driven point machines may be manually operated at the machine.

continued

2. GENERAL CONSTRUCTION

The machine shall be so constructed that at any position during operation it may be stopped, reversed or obstructed without damage. Means shall also be provided for snubbing the machine where necessary.

The pole-changing and /or cut-off contacts in the machine shall be such as to enable the direction of working of the machine to be changed at any part of its stroke, and they shall not complete their operation until the locking mechanism has completed its function.

The machine shall be so constructed that no movement of the mechanism shall result from vibration of external force applied to the mechanical connections.

The machine shall be suitable for either right hand or left hand operation, and shall be so constructed that it can be readily converted on site from right hand to left hand operation and vice versa.

If the detector forms an integral part of the machine it shall be provided with suitable contacts for proving when the detector-slides and lock-bar (where provided) are in their full normal and reverse positions.

When in the locked position the machine shall be capable of withstanding a total thrust of 20,000 lb. from the switch through the connections, thus ensuring that, in the event of a run through, the damage is confined to the connections between the machine and the points.

All contact springs shall be corrosion-resisting and of sufficient strength and current carrying capacity to function satisfactorily in their respective circuits. The movement of the contact members shall be such as will ensure a wiping contact.

The motor cut-off contacts shall be housed in the mechanism case.

The machine shall be capable of being operated by the use of a crank handle. Unless otherwise specified, the machine shall be provided with a contact which, before the crank handle can engage to operate the mechanism, shall be automatically opened to disconnect the motor circuit. This circuit shall not be capable of being re-connected until the crank handle has been withdrawn from the machine.

If non-interchangeable crank handles are specified, each crank handle and machine shall be suitably inscribed as specified by the purchaser.

The machine shall be capable of operating between the limits of 75 per cent and 125 per cent of the appropriate rated voltage.

continued

Point machine operating sequence to be :-

a) Open the detection contacts
b) Unlock the points
c) Move the points
d) Lock the points
e) Close the detection contacts

B.R. has added to Specification 581 with one of their own (British Railways Specification No. 902)). This fills in the gaps, giving a number of other requirements. Some important points are given below.

3. MOTOR

This is to be suitable for operation from a secondary cell battery floated on a constant potential charger at 130 volts maximum and for operation by a full wave rectified alternating current supply of up to 120 volts mean value.

When immunity to the effects of extraneous alternating currents is required, a permanent magnet machine is to be used. Where such immunity is not required, a 4-wire split field motor is to be used.

So that new machines may be compatible with existing installations where 3 wire control is used, means are to be provided so that the motor circuit can readily be converted on site from 3 to 4-wire control, and vice versa, without recourse to soldering.

4. SNUBBING

Where snubbing is necessary this is to be accomplished by mechanically operated contacts without resorting to centrifugal or friction operated contacts. Diodes may be employed to steer the snubbing currents where immunity to the effect of alternating current is not required. Diodes must NOT be used where alternating current immunity is a requirement.

(NOTE: Many machines do not conform to this part of the specification).

5. DETECTION

Contacts are to be provided capable of indicating that the closed switch tongue is correctly normal or reverse, and that the corresponding open switch is in its correct position. Provision is to be made for double cutting of the detection circuit.

Where a facing point lock is provided the normal and reverse detection contacts shall close only when the lock plunger is correctly positioned.

continued

CRANK HANDLE

It shall be possible only by a manual operation to re-set the crank handle contacts upon withdrawal of the crank handle.

HEATERS

Heating means shall be provided as necessary to prevent condensation on and freezing of, the motor and detection equipment. The circuit for such heating means shall be independent of any other circuit in the machine.

DEVELOPMENT

The idea of the point machine for the actual operation of points is not new. The first experiments were performed at Paris Nord in 1887. Overseas, development of electric point operation was rapid - along with the evolution and installation of the Electro-Pneumatic (E.P.) machine, many of which are still in widespread use today. In Britain, true electric point operation began on the Liverpool Overhead Railway in 1893, but was relatively slow in spreading to other companies' lines. The main use for power operation was, for many years, in marshalling yards. It was not until 1921 that the Great Central Railway installed the first set of facing points on a British main line. After this, development was more rapid leaving B.R. with a legacy of many types of machine. On this course, only the more common ones can be dealt with.

DESCRIPTION

The separate type point machine allows power point operation but retains the point equipment used for mechanically operated points. This type of machine relies on either:-

a) Two crank connections, one for point operation and one for lock operation.

or

b) Cam and escapement mechanisms for point operation and lock operation.

The separate machine does not include detection and this must be provided as a separate unit.

The combined type machine provides for operation of switches and locks but, instead of using cranks or escapements, utilises bars and rods for switch and lock drive movements. The lock is internal, along with detectors for both of the switches and the facing point lock. Many types are in use today, but only two will be covered in detail - the Westinghouse style M63 and the GEC HW machines.

continued

Any combined machine will require to convert rotary motion into a linear point movement, and also to provide a linear facing point lock action. A further requirement is a spring clutch with friction discs to avoid overloading the motor, if the movement of the points should be held by an obstruction, and to absorb initial inertia.

Note that on the combined point machine, machine drive is related to the stock rails - and, therefore, the machine must stay in relationship to these rails. Accepted installation practice to achieve this is to bolt the machine down onto an extended soleplate.

Note also that the F.P.L. (facing point lock) is internal on a combined machine, and hence the third stretcher bar listed in the facing point requirements MUST be extended into the machine by means of a rod.

GEC HW POINT MACHINE - MECHANICAL DETAILS

The facing point lock on the HW machine is of an "in and out" type. The basic layout of the machine is shown in figure 7. Movement is taken from the motor (which will be discussed later) through a gear train to a bevel wheel. The bevel wheel carries a roller engaging with an escapement. Initial machine movement causes the lock to disengage from the lock blades. The roller applies movement to the escapement, which is then used to drive the points themselves. Once the point movement is completed, the roller moves along the escapement and the lock dog is pulled into the reverse notch in the lock blades.

The points should now be in the appropriate positon (left hand switch closed or right hand switch closed). Once movement has completed, detection of the switches and lock must be proved before the signal reading over the points can be allowed to clear.

Switch detection is accomplished by bringing information as to point position into the machine.

It should be possible to attach rods directly to the switch ends, but the HW machine detector blades are designed to operate on a greater movement than that achieved just by the point ends. Thus, the rods are attached to switch extension pieces, which actually amplify the point movement. Both the open and closed switches must be detected - the closed switch for the obvious reason that it must be tightly fitting up against the stock rail; the open switch for the less obvious reason that flangeway must exist to allow wheel clearance. The two rods are attached to the detector blades which then go into the machine. Detection itself is achieved by a rocker assembly, operated by rollers (See Figure 8A). The rollers engage in notches in the upper edges of the detector lock slides, but can only engage when the switches are correctly postioned. The lock must also be proved in the detection. This is done by ensuring that the detection contacts cannot make up unless the lock is engaged. To do this, it is arranged that the lower portion of the rocker rides on a roller running inside a slot on the lock plunger drive. In the lock engaged position, this slot is opened out so that the rocker can move freely. When disengaged the slot forces the rocker to the centre, unmade position.

continued

Thus, only when the notches are correctly aligned, and the lock inserted, can the appropriate detection contacts make up.

WESTINGHOUSE STYLE 63 POINT MACHINE - MECHANICAL DETAILS

The drive for a style 63 machine is taken through the motor, through a toothed belt, to a ball screw (figure 9). This screw drives the ball nut which is attached to a drive slide. This drive slide can only move linearly from left to right, or vice versa, as it is mounted in bearings machined in the bottom of the case. The drive slide carries a roller which is used to drive an escapement crank. The first movement of the machine is to unlock the points by moving the lock dog (also attached to the drive slide) out of the notch cut into the lock blades. The roller then engages with the escapement crank and causes the points to move. Once fully across, the roller and escapement stop the point movement and the remaining stroke on the drive slide inserts the second lock dog into the second notch on the lock blades. Because of its drive slide movement this machine is known as a "straight through" type.

NOTE: To guard against the possibility of the lock extender rod breaking and the machine locking into the same notch for both point positions it is ESSENTIAL that the two locks, and hence the two notches, are of different shape (figure 8B).

As in the HW machine, detection of the points must be accomplished before the signal reading over them can be cleared. This is accomplished by a pair of contacts which are operated by push rods. The push rods have rollers attached to their ends which bear on the detector blades; which are, of course, attached to switch extension pieces via detector rods. Thus, the push rod enters the notch presented when the points have moved and are fitting up on one side, and open the other. The contacts, however, do not make up unless the lock has engaged. The machine ensures this by holding the contact springs up, using a roller, when the lock is out. As locking proceeds, the drive shaft caused a rack and pinion mechanism to turn a cam shaft in the circuit controller until, with push rod engaged and cam (hence lock) in the appropriate position, the roller can drop and detection contacts make.

CLAMP LOCKS

The most modern type of power point machine is the BR clamp lock. This is now being universally installed throughout BR, and is also designed and manufactured within the company.

The clamp lock consists of two rail clamps (see figure 10), one pivoted on each switch rail. Each clamp is driven by its own drive lock slide, the two slides being connected together by an insulated coupling bar. The drive lock slides are moved by hydraulic actuators or rams, which are fixed to a centre thrust bracket mounted on the centre of the sleeper.

In the original design separate rams are provided for each direction of movement; in the latest version a single double-action ram is used.

continued

To move the points, hydraulic fluid is pumped into the relevant ram, which expands. It pulls the drive lock slide, dropping the clamp down into a slot and so unlocking the points. Further operation of the ram pushes the opposite drive lock slide, which pushes the clamp and hence the switch rail. At the end of the movement, the clamp is pushed up behind the stock rail, so positively clamping the switch to the stock rail.

The clamp lock is powered hydraulically, with a two way electric valve to select the appropriate hydraulic ram for the desired direction (see figure 11). Unlike the electro-pneumatic system, the equipment for each clamp-lock powered point is self-contained, a separate hydraulic power-pack being located at the trackside for each point-end.

The power-pack contains an oil reservoir and electric pump, which pumps oil to the thruster selected by the electric control valve. This is also in the power pack. Small bore hoses connect the power pack to the hydraulic thrusters on the track.

A pressure relief valve is incorporated to by-pass the thrusters at the end of movement before the pump is turned off, and also if there is an obstruction in the points.

To work the points by hand, a hand-pump is also included. The power pack must first be turned to manual, which disconnects the electrical feeds, and also allows the directional control valve to be operated by hand.

Detection is achieved using two microswitches, one for open switch and the other for closed switch detection (see figure 12). The "points closed" switch only operates when two cams, one on the point detection blade and the other on the drive lock slide, are correctly positioned. The "point open" switch only operates when the points have moved to a position corresponding to minimum opening.

When viewed from **outside** the track, the left-hand microswitch is always "points closed", and the right-hand for "points open" (see figure 13).

The contacts in each clamp lock microswitch assembly relate only to one switch rail. To detect both switch rails, the detection circuit has to be taken over the contacts of both clamp lock mechanisms in series. A four core cable is run direct between the two mechanisms for this purpose.

Where a point has more than one end, the detection circuit is fed through the switches for each end.

POINT CONTROL AND DETECTION CIRCUITS

Due to the high power consumption of point machines and clamp-locks, it is usually impractical to feed them direct from an interlocking. Instead they are usually controlled indirectly from a location adjacent to the points.

continued

CONTROL CIRCUITS

The NWR and RWR relays repeat the position of the point lock relays in the interlocking, using a two wire polar circuit (see figure 14A).

The voltage of the point mechanism is 120 volts d.c. This is obtained either from a battery and charger, or from a 650/120v rectifier set. The current drawn varies from 5 to 15 amps, with a much higher initial surge as the point starts to move. A B.R. 943 contactor has to be used for switching these currents.

For point machines, we require two contactors (see figure 14B), one for normal and one for reverse. With clamp locks, it is the hydraulic pump which takes the power, so only one contactor is required; the direction control valves are low power, and so can be controlled by ordinary contacts of the NWR and RWR.

When the points have completed their movement, power is removed. This is achieved by the back contacts of the detection relays in the contactor circuit.

If the point blade hits an obstruction, the point machine or clamp lock would eventually burn out if allowed to continue running. Normally, points should throw in less than five seconds, so after 7.5 seconds the WJR will pick and disconnect the contactor relay. The WJR is controlled by a back contact of the relevant detection relay.

DETECTION

"Local" detection relays, the NKR and RKR are provided. These disconnect the contactor(s) when the points have finished their movement and detection is made, or operate the WJR if detection is not made. They also feed the N/RWKR detection circuit back to the relay room, this circuit additionally proving the contactors de-energised.

Note that past practice on some regions has been not to have the local detection relays, the detection being fed straight back to the relay room, where the N/RWKR control the outgoing N/RWR feed.

A four-wire detection circuit is shown in figure 13. In some cases, particularly with point machines, they are combined at the last point-end to give a two-wire polar circuit.

Where a set of points has more than one end, the detection circuit must be taken through every end. It is preferable to return the tail cables to the location between the "A" and "B" ends, instead of running a cable direct. This keeps the wiring standard, and also allows faults to be rapidly traced at the location, without the need for the technician to go back and forth on the track.

continued

The detection circuit shown in figure 13 illustrates the detection wiring required when dealing with a single ended pair of points (RHNC). The "Standard Free Wired Interlocking Typical Circuits" document contains all the permutations of detection circuits showing how the points should be wired and figures 15, 16 and 17 contain the following information applicable to clamp locks.

Figure 15 Single lead cable connections,
Figure 16 Crossover cable connections and,
Figure 17 Internal connections of detector mechanisms.

There is a reference also to "supplementary detectors" in these standard diagrams and these extra detector boxes are fitted to the centre drive position on switch types FV, SGV, SGC, GV and GC. However, some switches with a higher turnout speed than GC require two supplementary detector boxes and the provision of these are also included in the standards.

The supplementary detector box ensures the whole switch blades have moved, not just the toe end of the points on the long point switches that are used where high speed divergences are required.

Some typical examples of Clamp Lock Detection Circuits taken from the SFWI are shown in figures 18, 19, 20 and 21.

Figures 14A and 14B dealt with the method of control and operation of a single ended set of Clamp Locks or point machine indirectly fed. The double ended case for clamp locks fed from separate locations is shown in figure 22.

You will notice an extra pair of NWR/RWR's are required in this case to select the valves of each hydraulic unit fed from their separate sources. In the SFWI there are numerous cases illustrating the many combinations of control and detection of points and the trainee should consult this document before deciding the method of control required, the scope of this manual only touches a few examples.

A typical example of clamp lock operated points extracted from a working situation is depicted in figure 23: Bangor Control and Detection of 47 points.

In a geographical system like Westpac MK IV you will encounter some variations in control and detection (see figure 24).

The example shown is for the control and detection of a single ended clamp lock mechanism fed from a geographical unit (WS-1). The fundamental differences between this method and the SFWI are:- WJR located at interlocking, no local detection relays required to disengage the contactor relay (WMR), down proving of WMR is not provided in detection circuit but an indication of the contactor relay being "stuck up" is given to the signalman who then takes appropriate action.

continued

Finally, when dealing with clamp locks, because they do not have a bolt securing the points in their final position (Normal or Reverse) like a point machine mechanism, provision has to be made to enable the clamp locks to "motor up" if the detection breaks at any time due to the clamp moving. The detection breaking will move the clamp back to the position the interlocking is dictating the points should lie.

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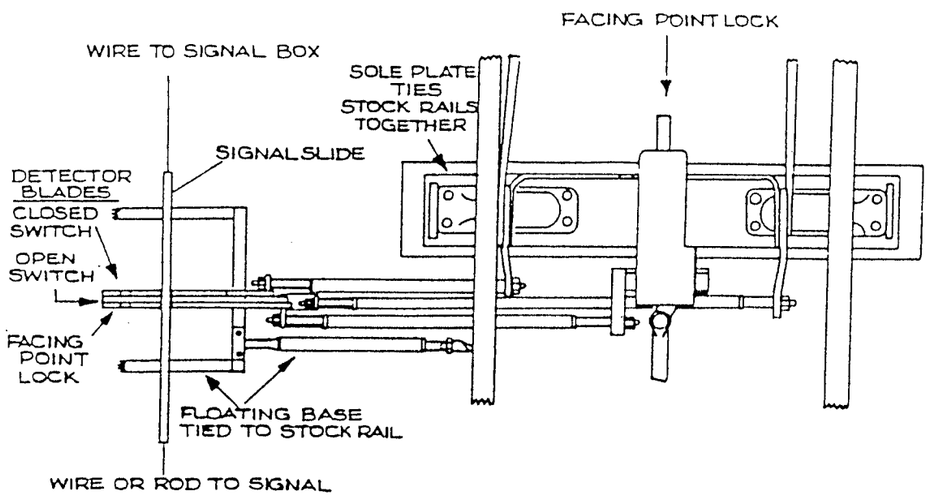

FIGURE 1A

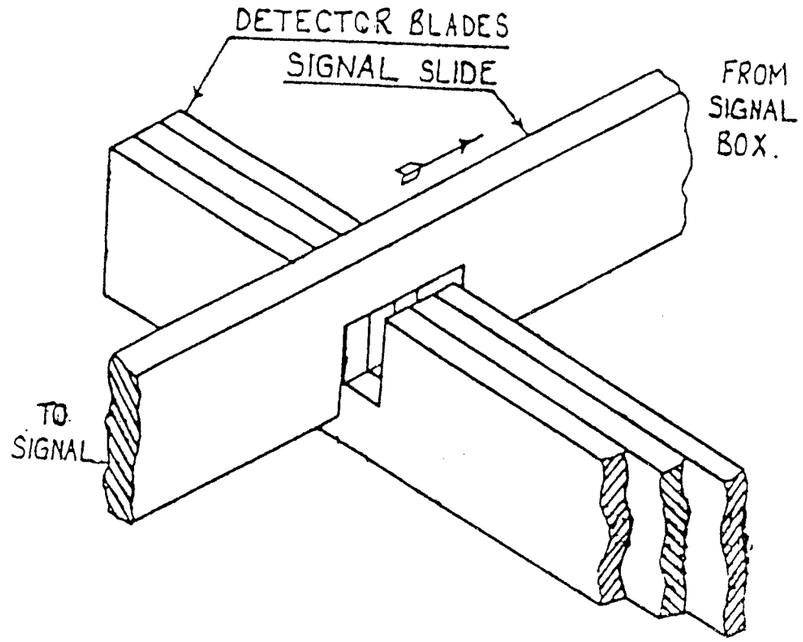

FIGURE 1B

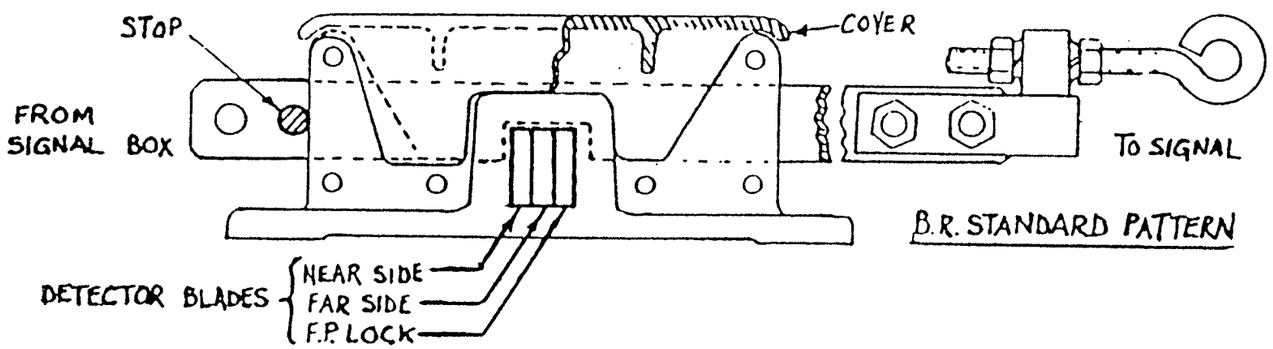

FIGURE 1C

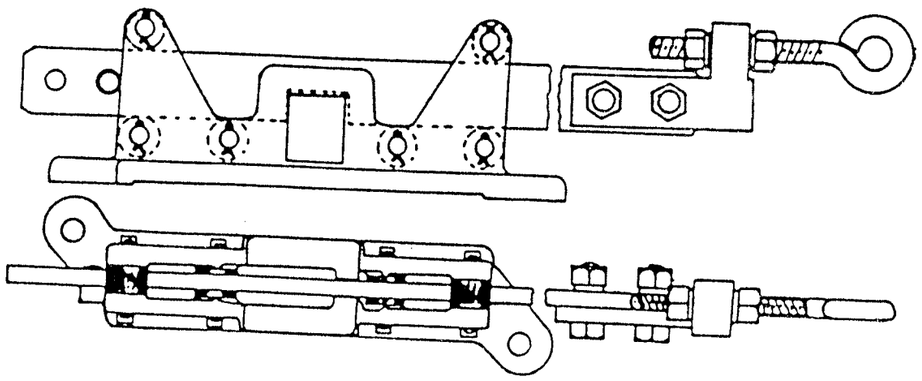

FIGURE 1D

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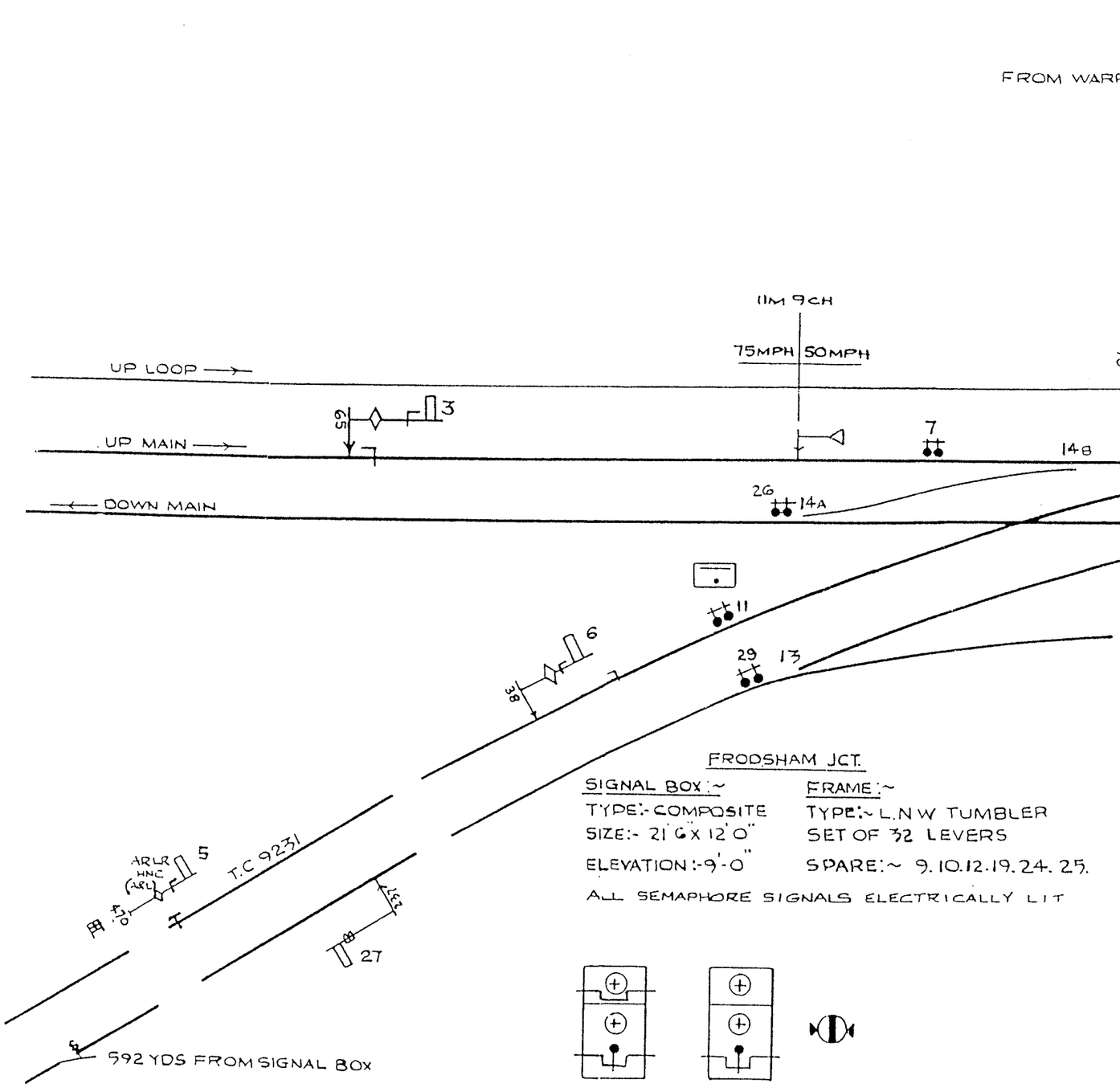
ELECTRICAL DETECTION AND POWER OPERATED POINTS



FRODSHAM JCT.

SIGNAL BOX :~
TYPE:- COMPOSITE
SIZE:- 21'6" X 12'0"
ELEVATION :- 9'-0"

FRAME :~
TYPE:~ L.N.W TUMBLER
SET OF 32 LEVERS
SPARE:~ 9. 10. 12. 19. 24. 25.

ALL SEMAPHORE SIGNALS ELECTRICALLY LIT

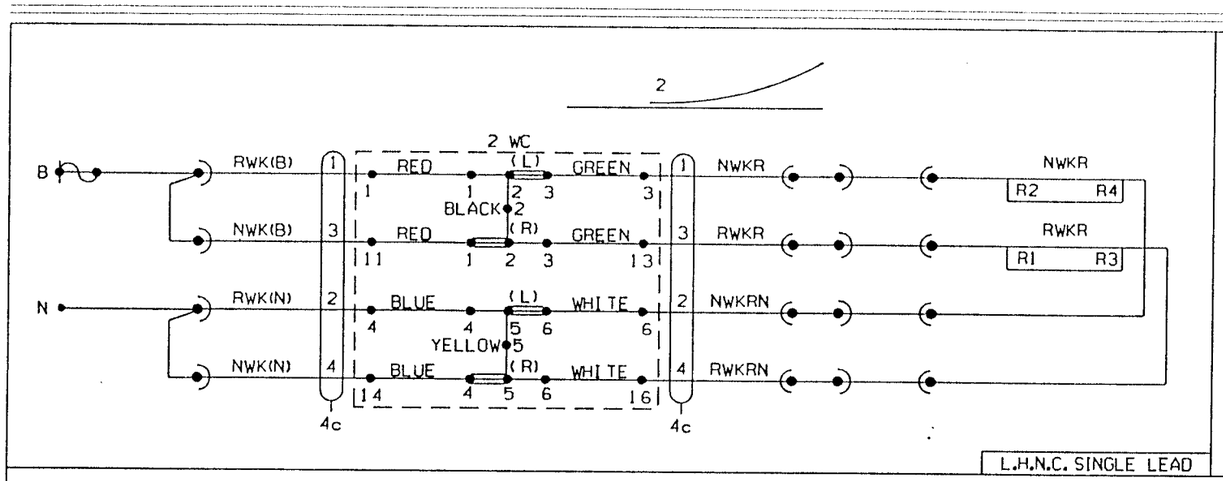
HALTON JCT NORTON STN.

FIGURE 2

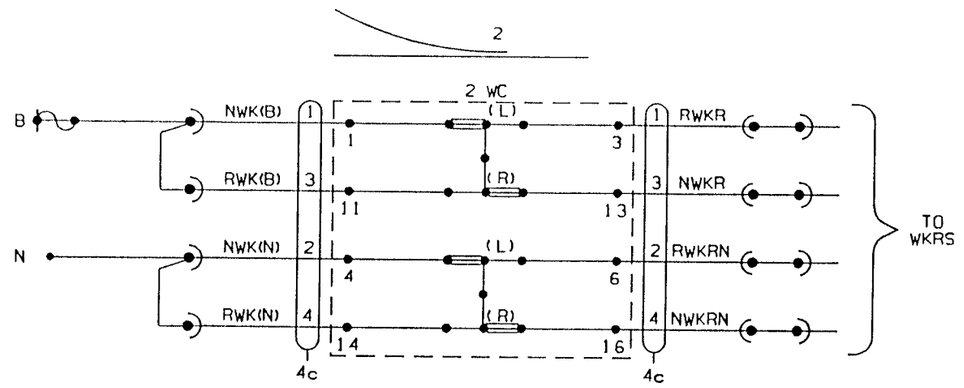
MECHANICAL DETECTION			
F.P.L.	PTS.	DETECTED BY SIGNALS	
		NORMAL	REVERSE
	14B	.	23.
	15	23.	
17	16	28.	31.
21	22A		20.
	22B	23.	23.

continued

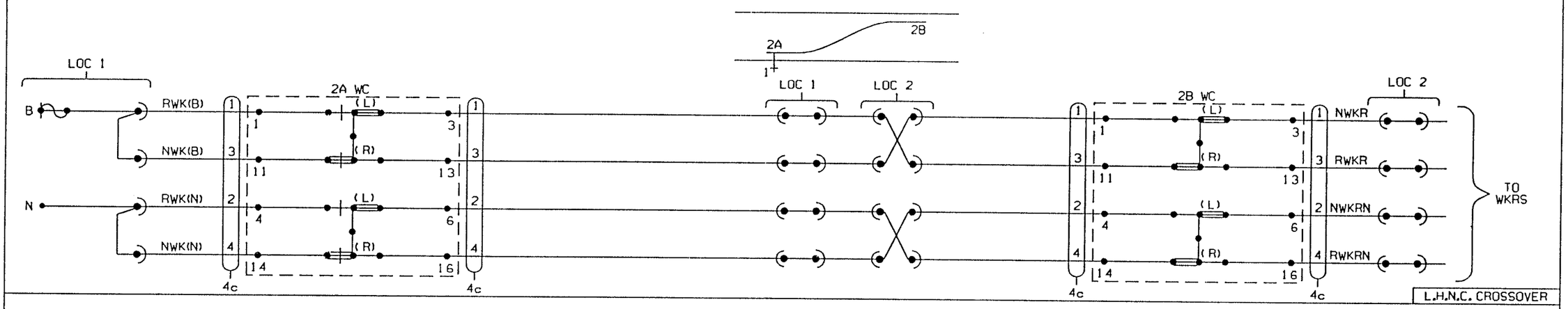
ELECTRICAL DETECTION AND POWER OPERATED POINTS



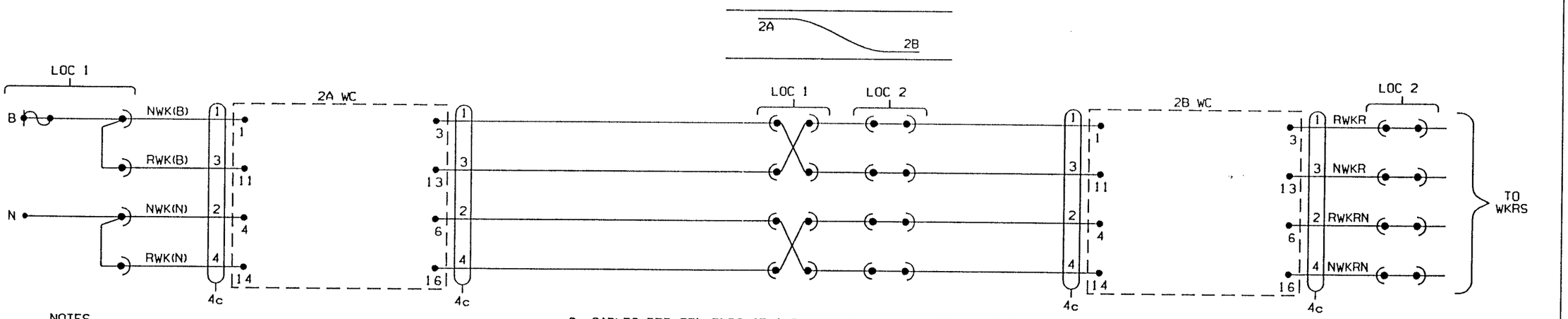
L.H.N.C. SINGLE LEAD



R.H.N.C. SINGLE LEAD



L.H.N.C. CROSSOVER



R.H.N.C. CROSSOVER

NOTES.

1 CABLE CONNECTION TO EACH DETECTOR TO BE STANDARD. ANY LINE CROSSES TO BE CARRIED OUT AT THE LOCATION OR RELAY ROOM.

2 CABLES BETWEEN ENDS OF A CROSSOVER TO BE TAKEN VIA THE LOCATION OR RELAY ROOM AND WHERE APPROPRIATE VIA THE MULTICORE CABLES BETWEEN LOCATIONS. CABLE CONNECTIONS BETWEEN OTHER POINT ENDS TO BE EITHER DIRECT OR VIA THE LOCATION OR RELAY ROOM ACCORDING TO LOCAL CONDITIONS.

3 FOR INDIRECT FED POINTS NWKR BECOMES NKR, RWKR BECOMES RKR & WKRs BECOME KRs.

4 LOCAL CABLES IN ALL LOCATIONS TO BE TERMINATED IN CORE NUMBER ORDER.

continued

FIGURE 3

ELECTRICAL DETECTION AND POWER OPERATED POINTS

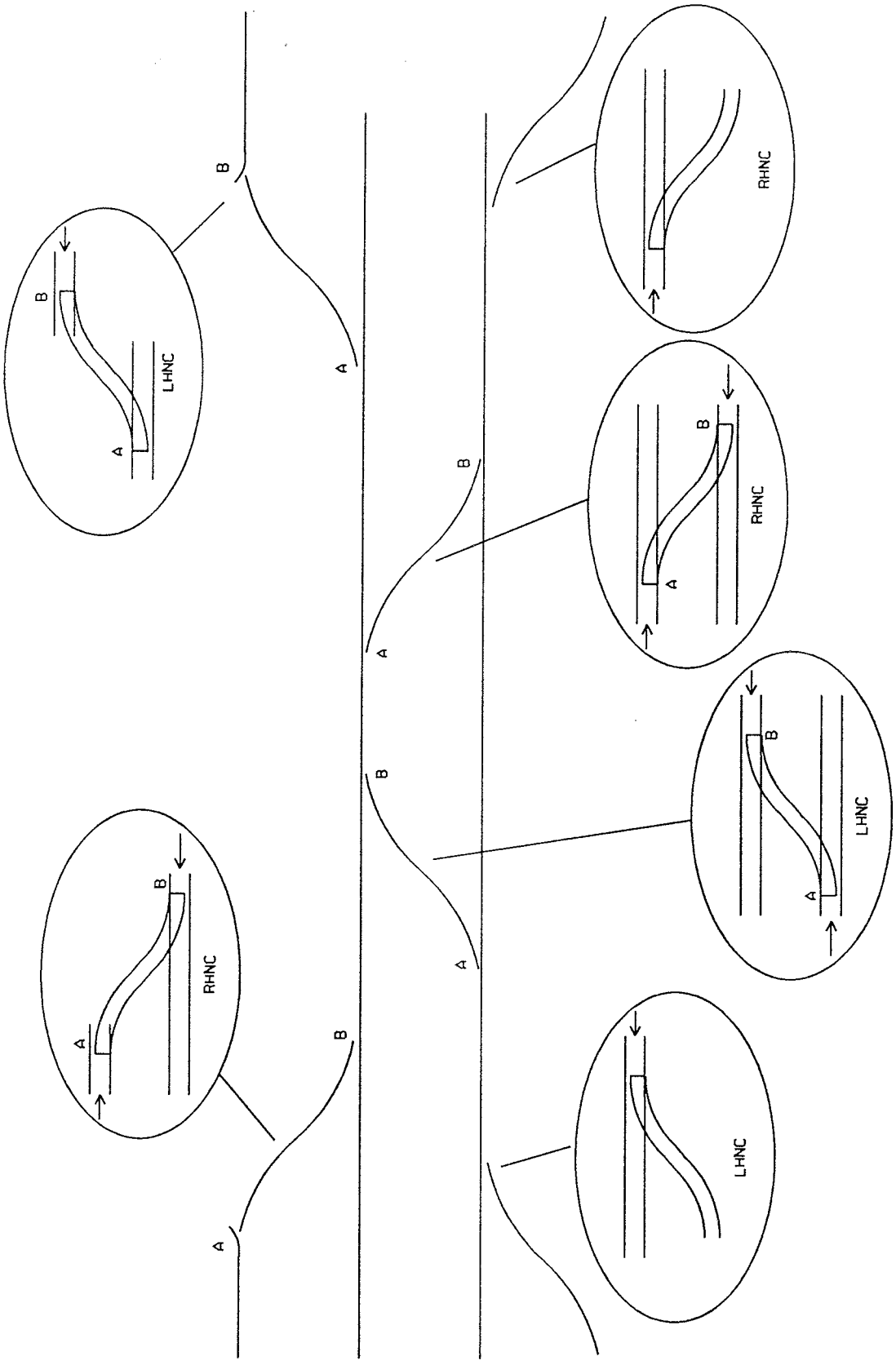
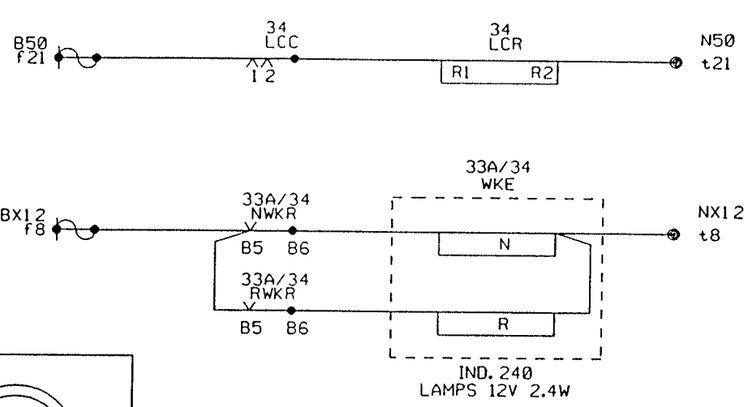
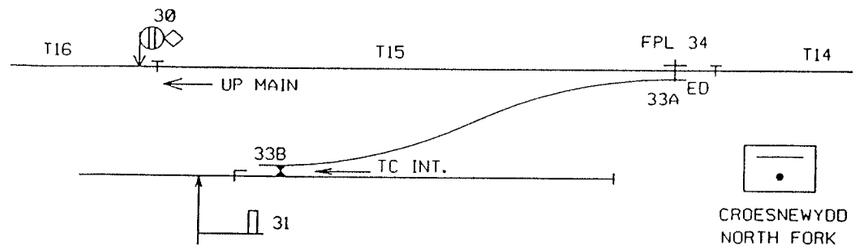


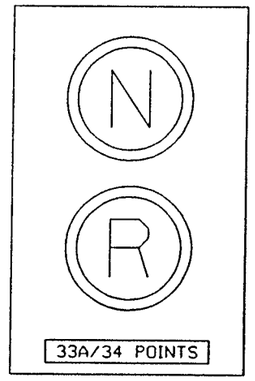
FIGURE 4

continued

ELECTRICAL DETECTION AND POWER OPERATED POINTS







STYLE OF INDICATOR USED FOR INDICATING THE POSITION OF POINTS WHERE POWER IS AVAILABLE AT SIGNAL BOX.

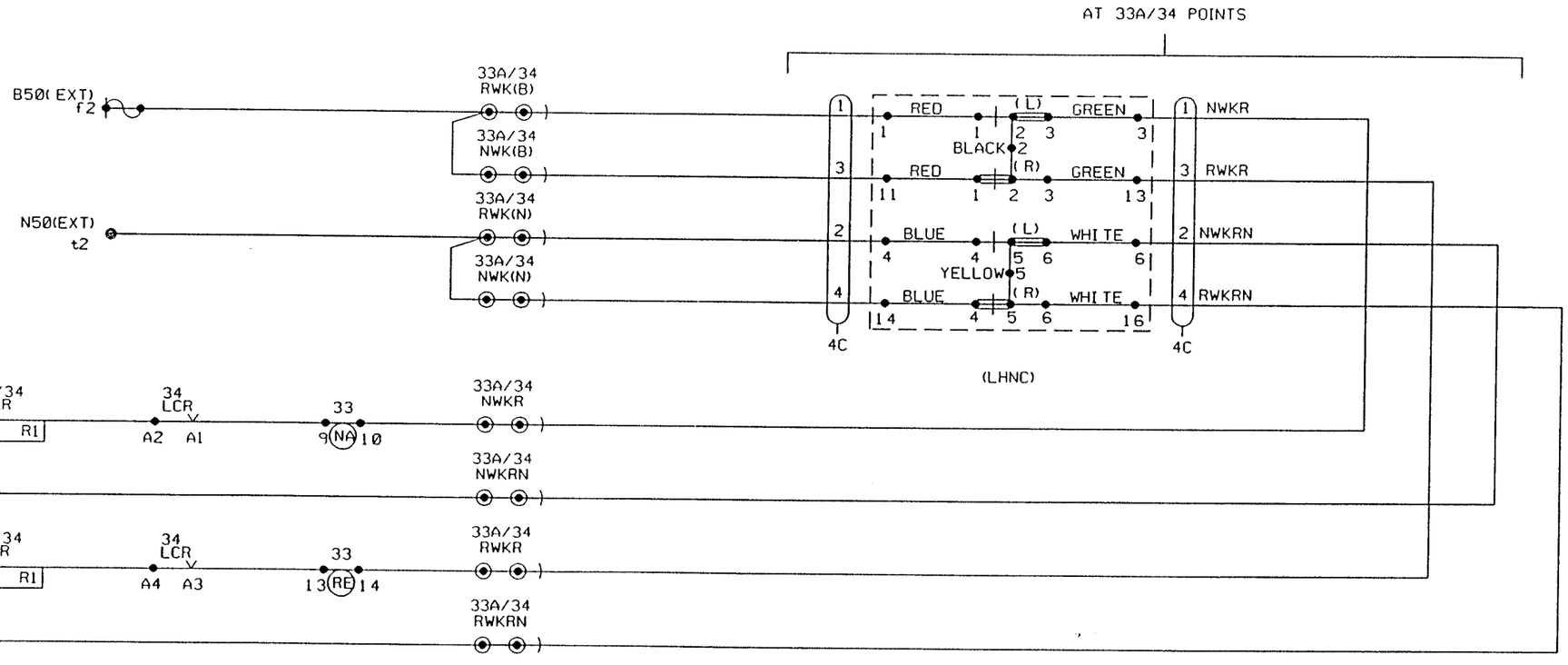


FIGURE 5

ıued

ELECTRICAL DETECTION AND POWER OPERATED POINTS

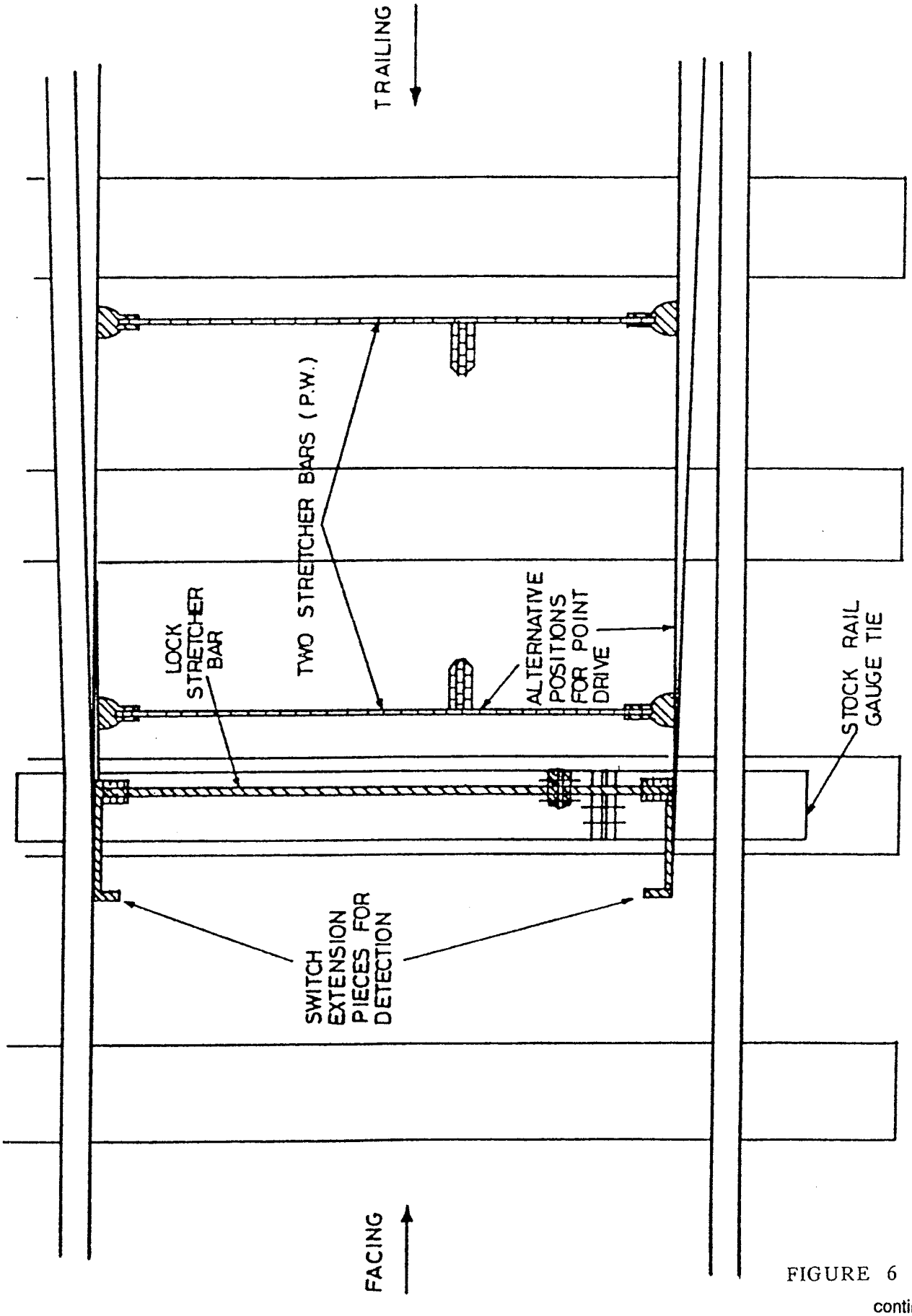
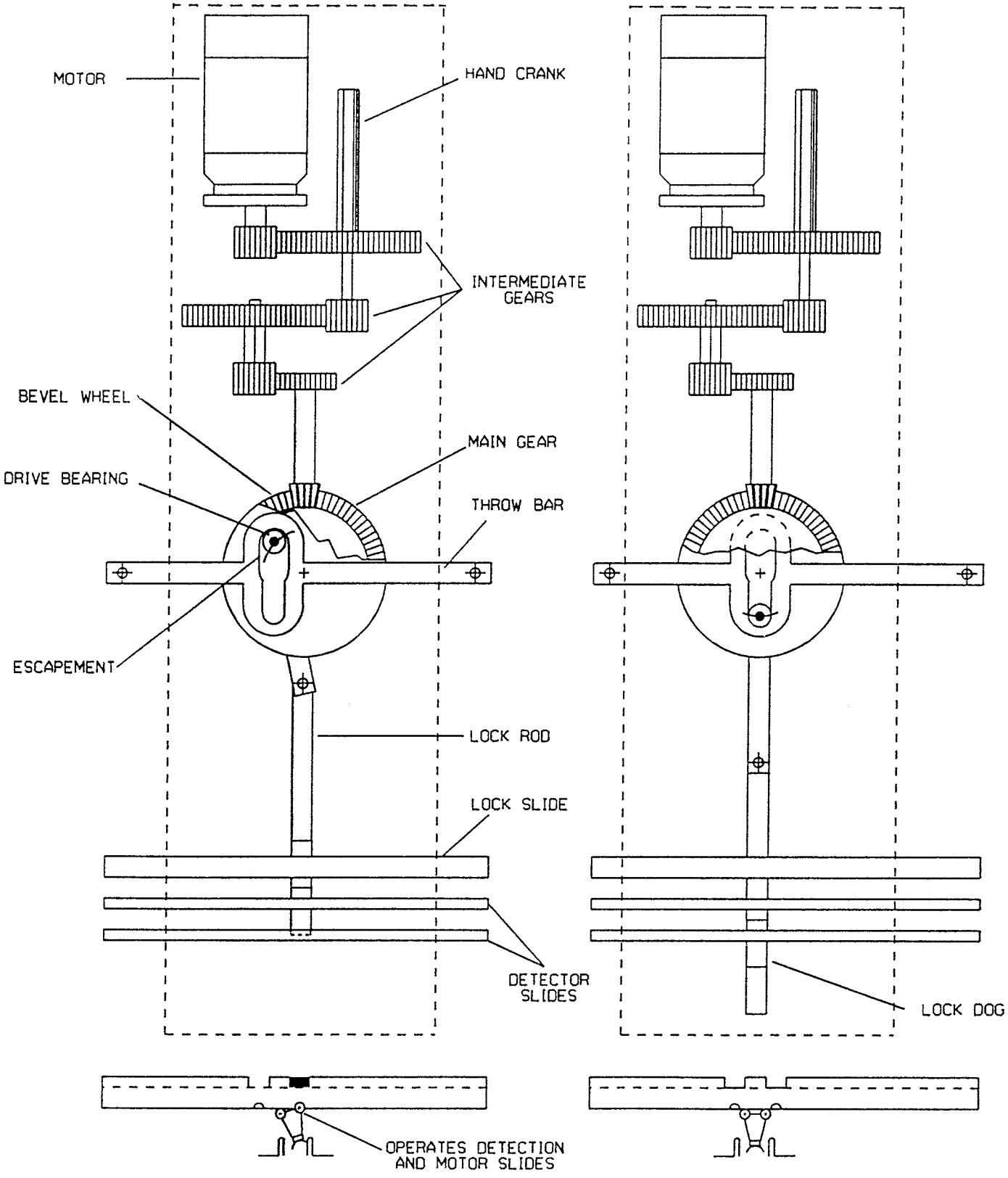


FIGURE 6

continued

ELECTRICAL DETECTION AND POWER OPERATED POINTS



MECHANISM AT END OF STROKE

MECHANISM IN MID-STROKE

FIGURE 7

continued

HW POINT MACHINE SWITCH AND FACING POINT LOCK DETECTOR.

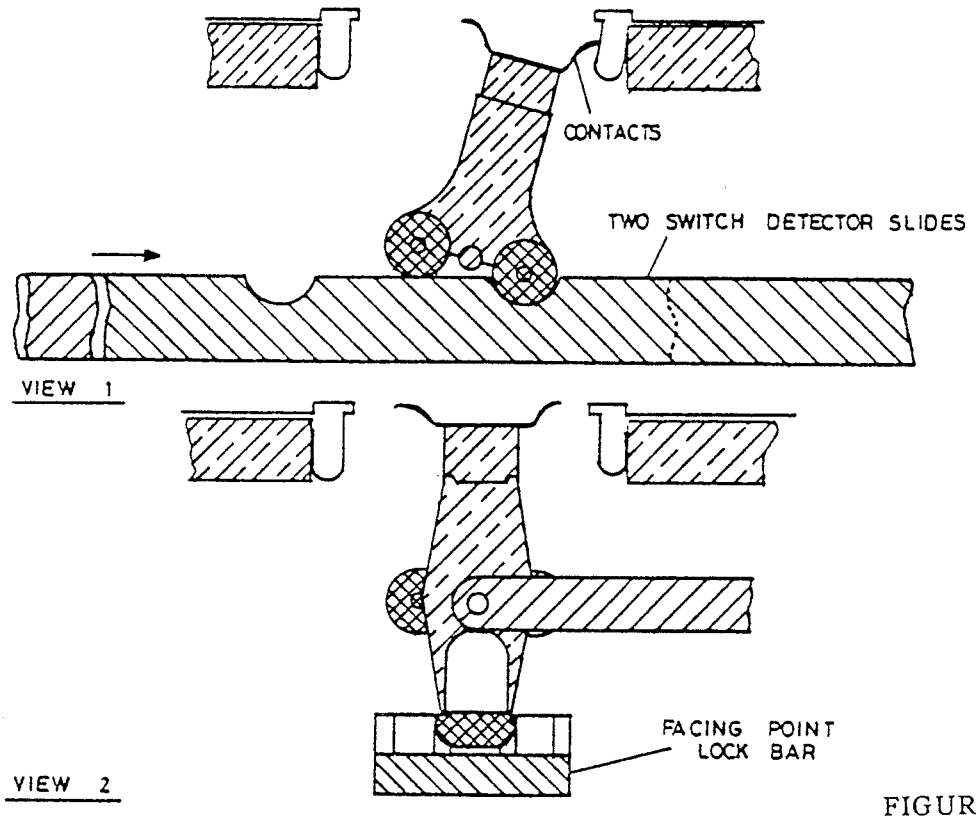
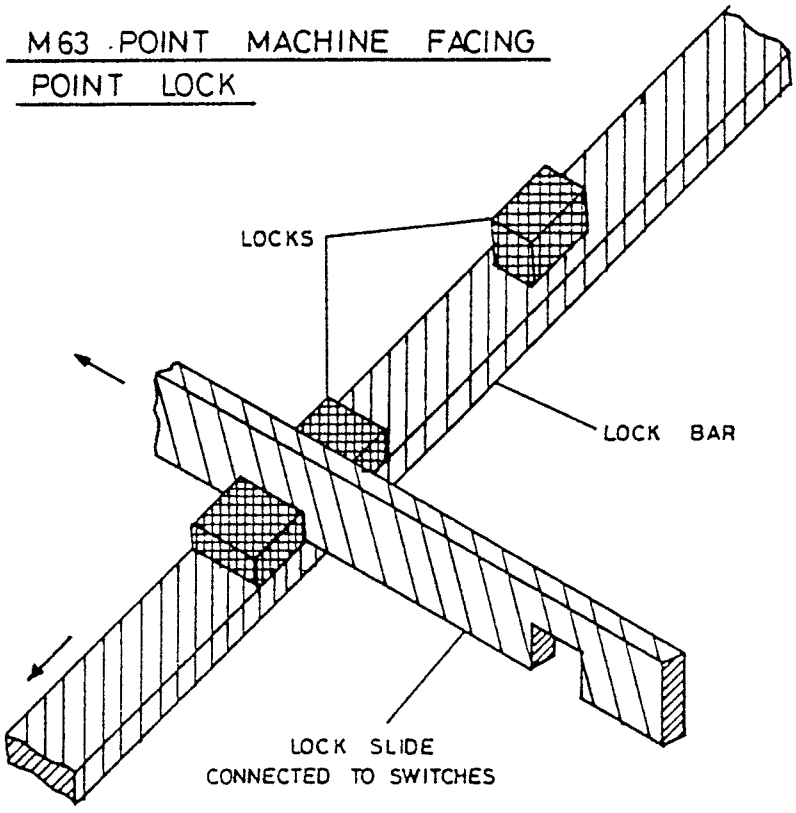


FIGURE 8A

M63 POINT MACHINE FACING POINT LOCK



continued

FIGURE 8B

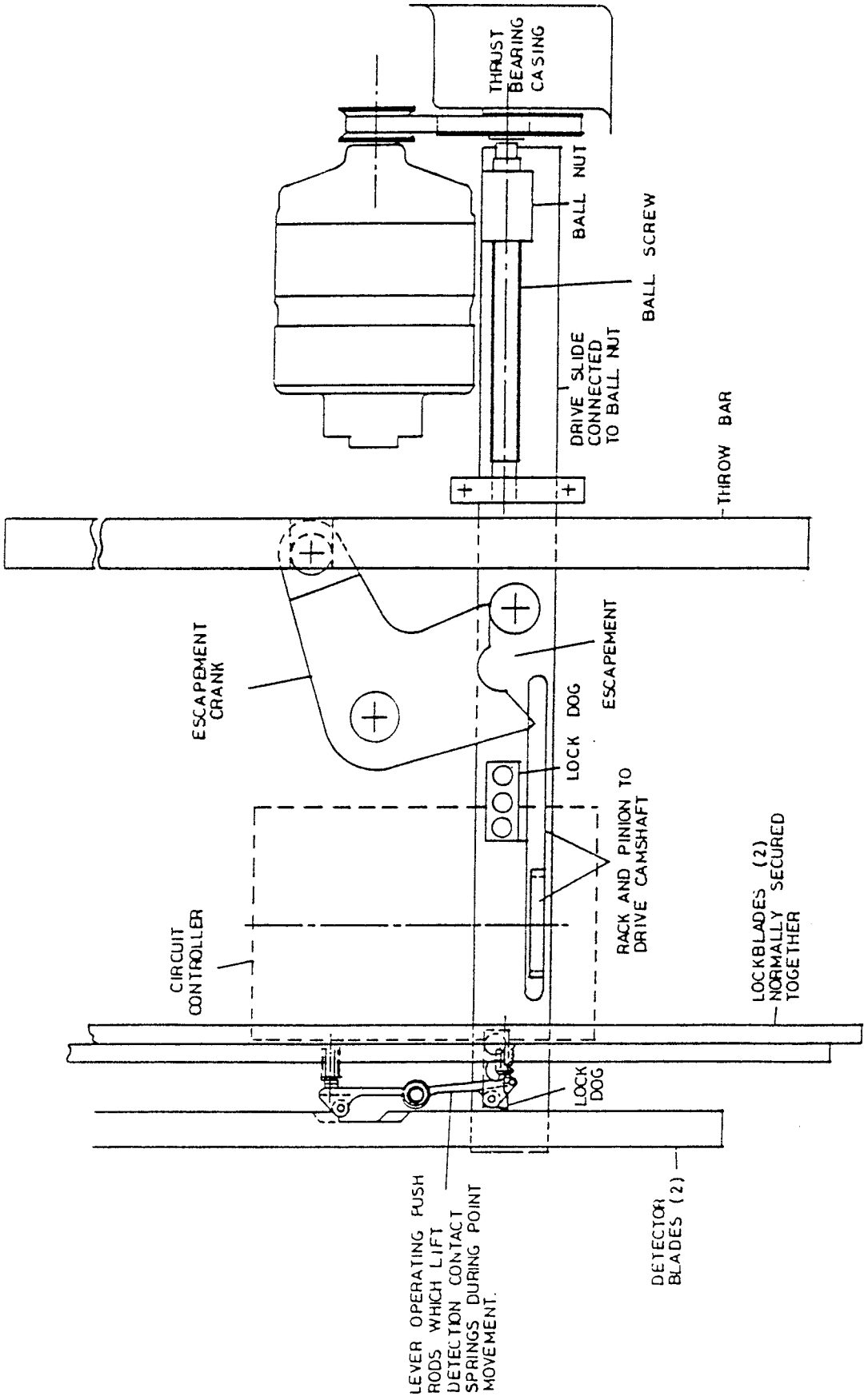
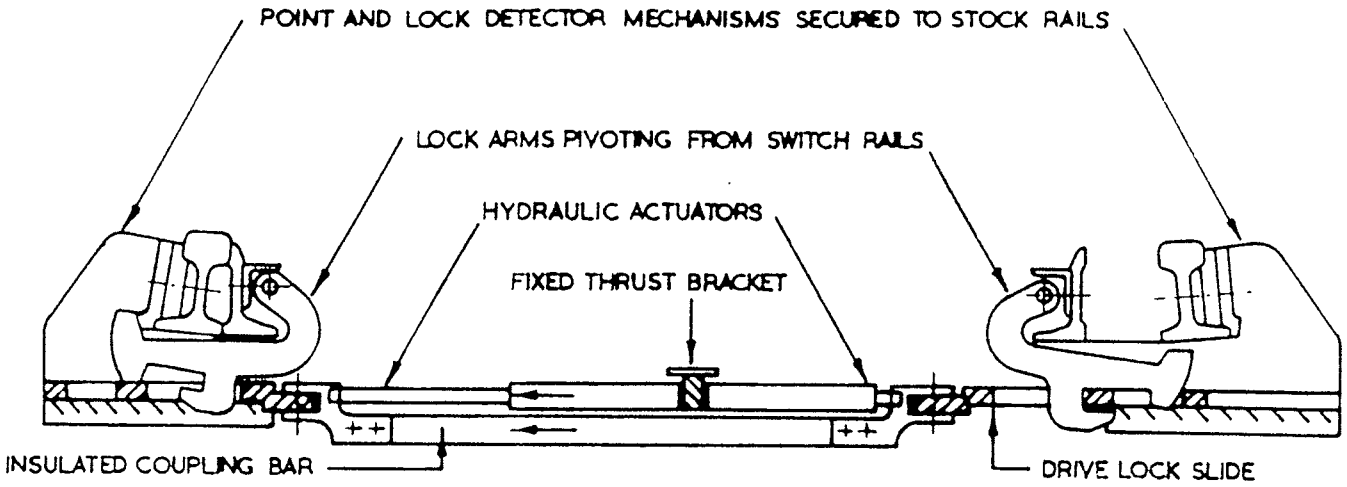


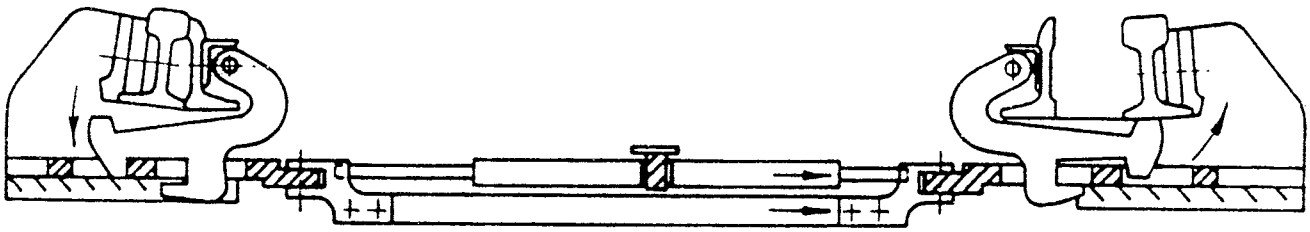
FIGURE 9 WESTINGHOUSE STYLE M63 POINT MACHINE DRIVE AND LOCK MOVEMENT

continued

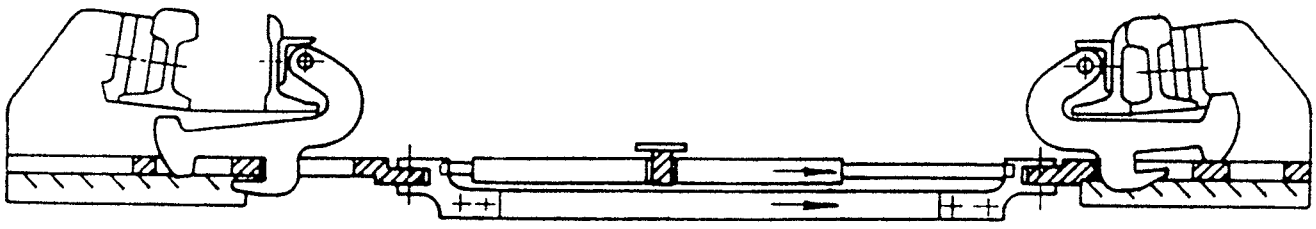
ELECTRICAL DETECTION AND POWER OPERATED POINTS



POINTS NORMAL WITH LEFT-HAND SWITCH RAIL CLOSED AND LOCKED



INITIAL MOVEMENT FROM LEFT TO RIGHT HAS UNLOCKED POINTS AND CONTINUED MOVEMENT WILL THROW POINTS REVERSE



POINTS REVERSED, COMPLETE MOVEMENT FROM LEFT TO RIGHT HAS CLOSED AND LOCKED THE RIGHT HAND SWITCH RAIL

FIGURE 10

continued

ELECTRICAL DETECTION AND POWER OPERATED POINTS

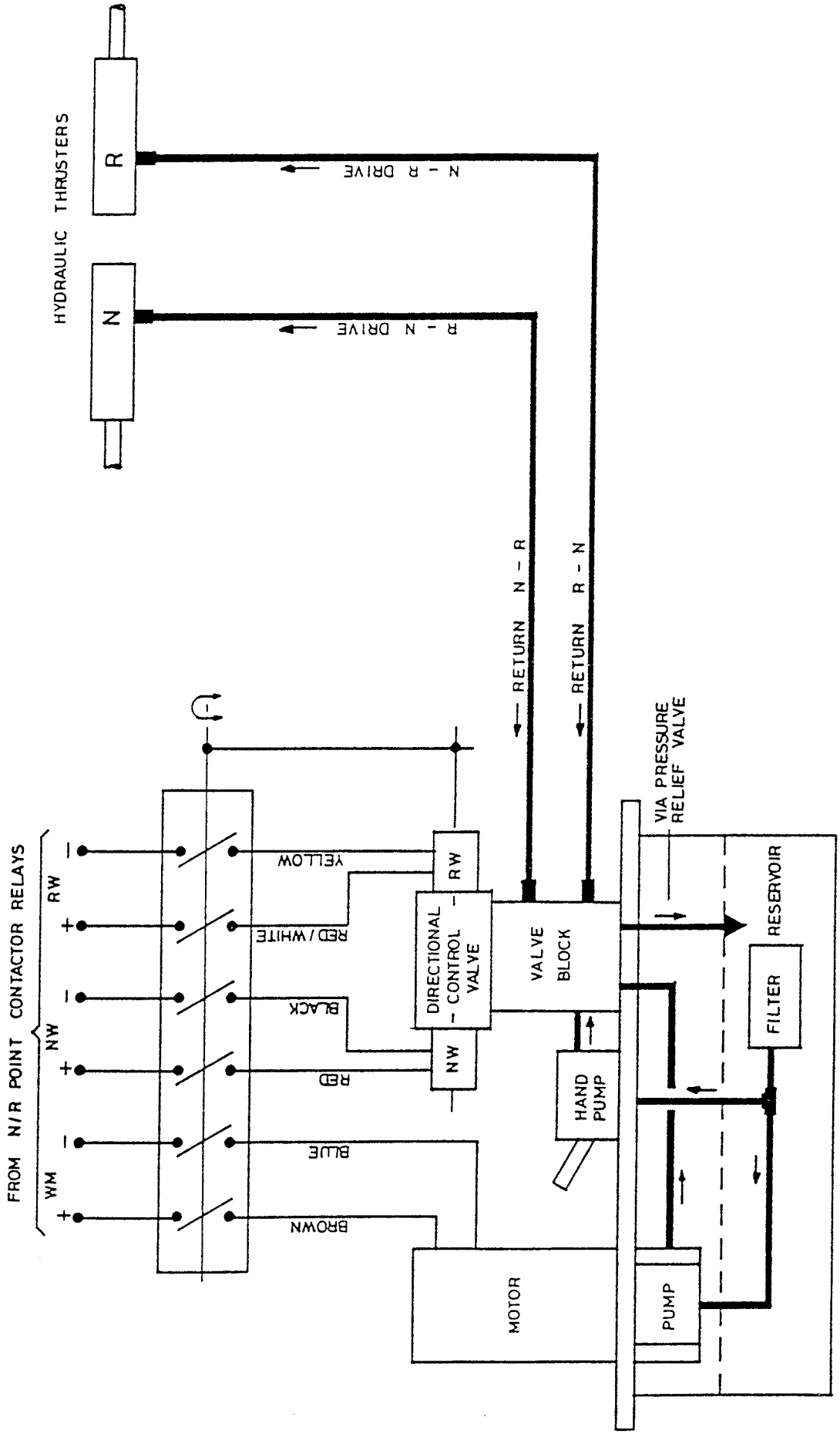
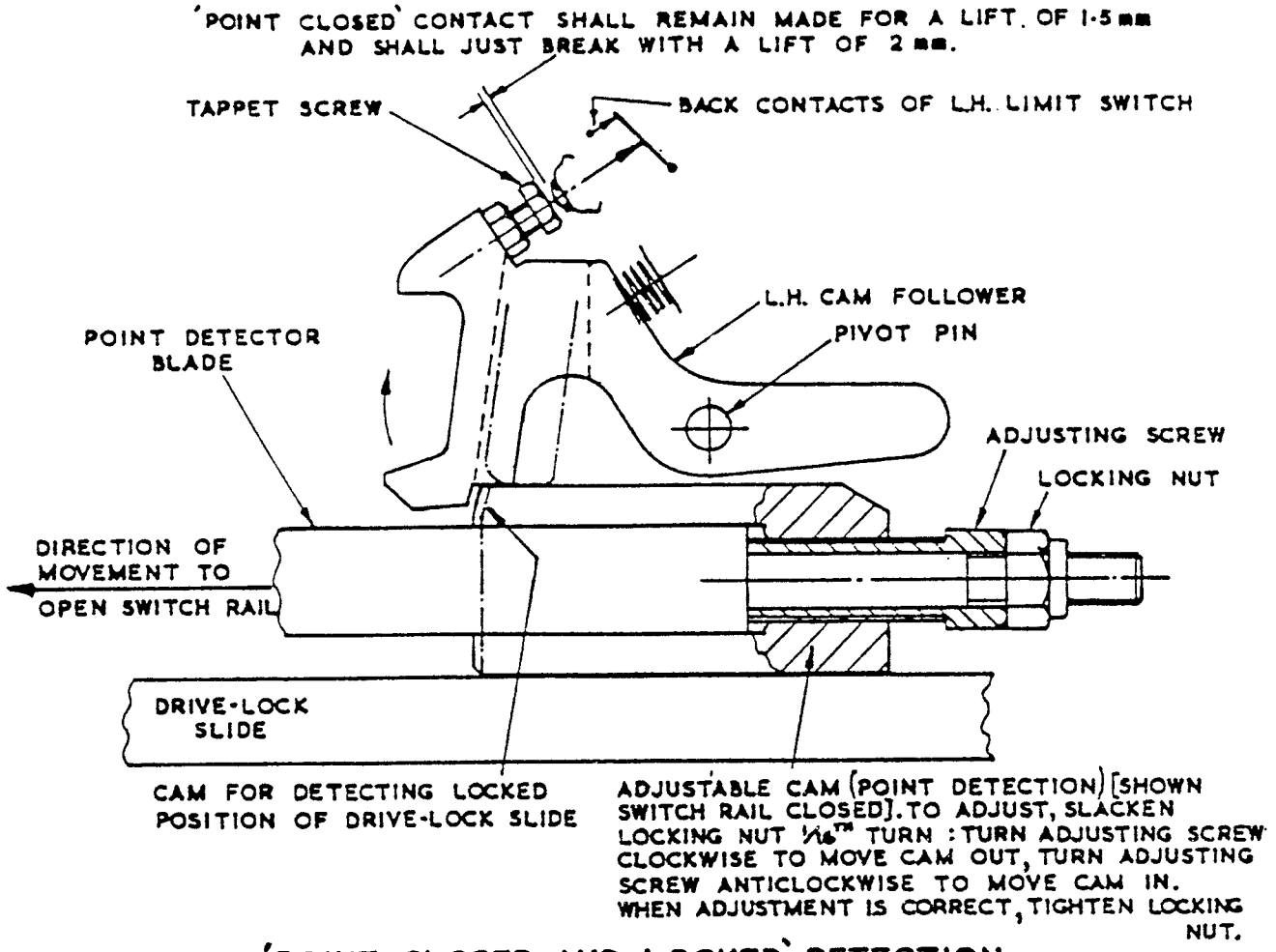
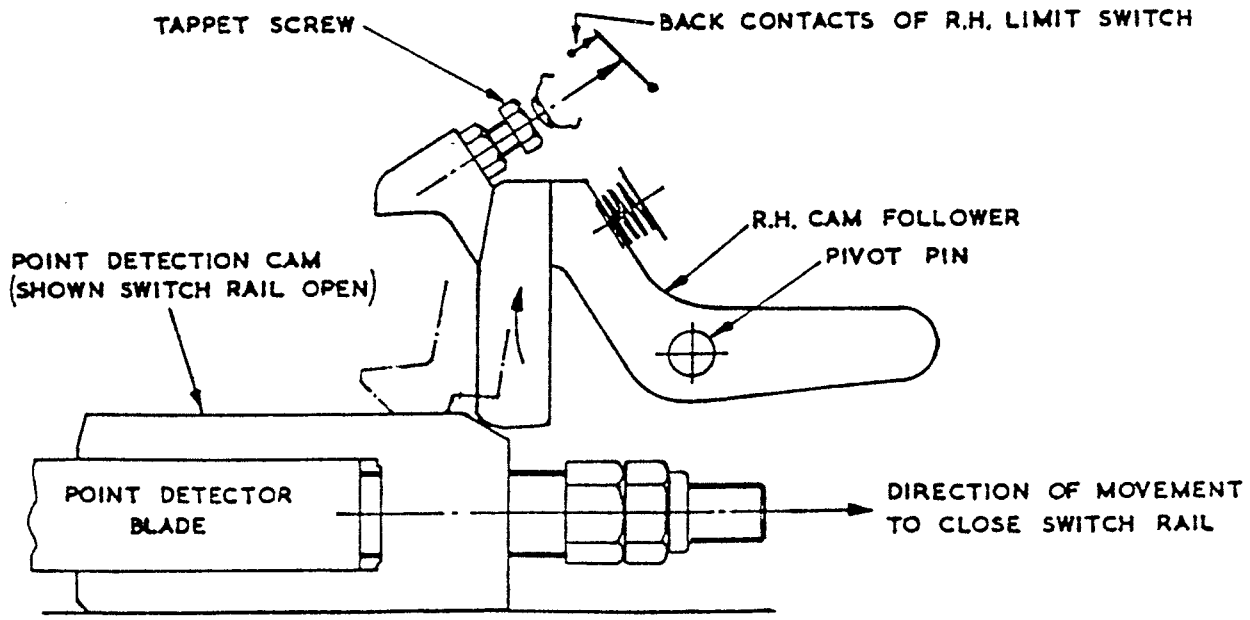


FIG. 11 HYDRAULIC CIRCUIT (CLAMP LOCK.)

continued



'POINT CLOSED AND LOCKED' DETECTION



continued

'POINT OPEN' DETECTION

FIGURE 12

ELECTRICAL DETECTION AND POWER OPERATED POINTS

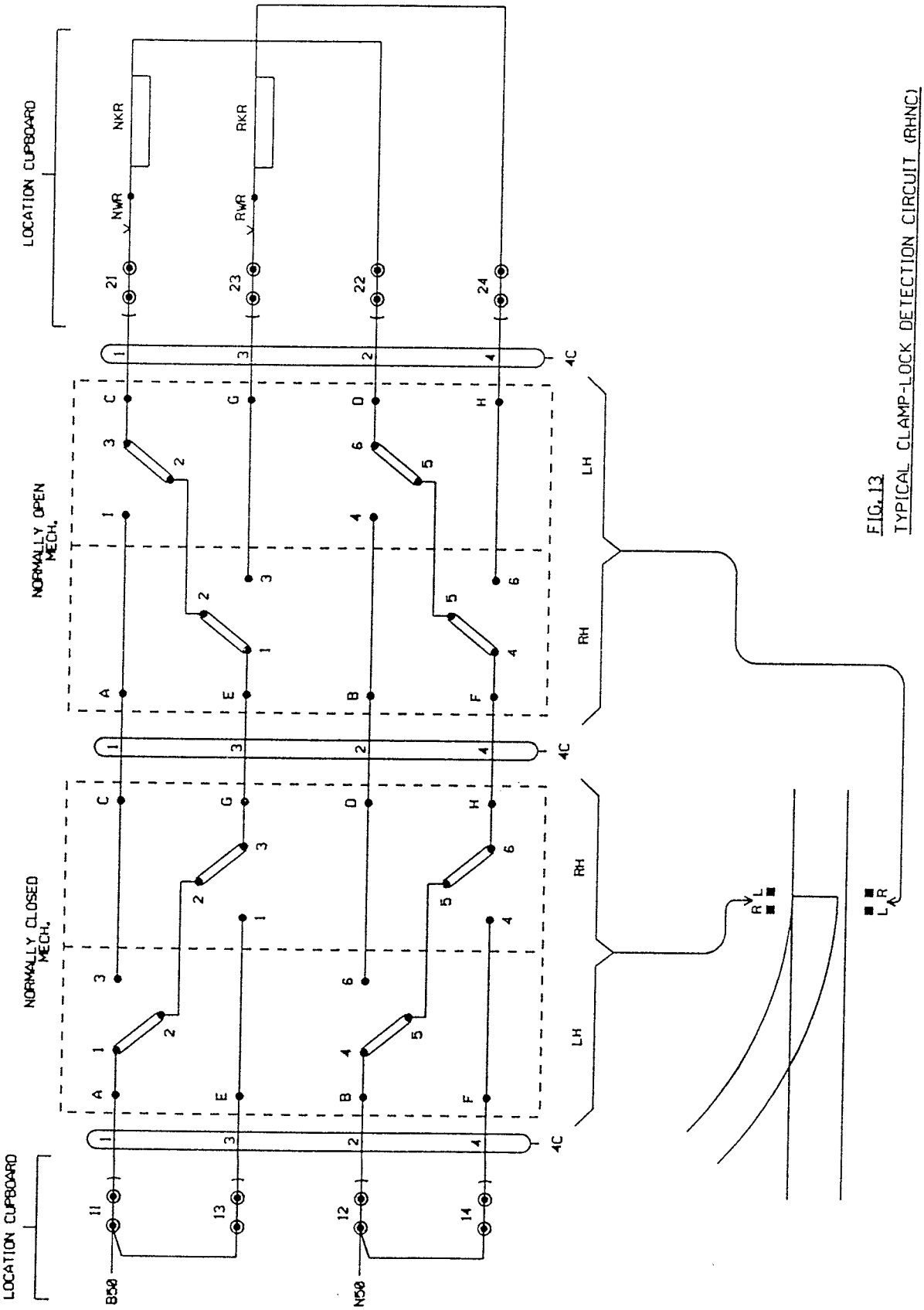
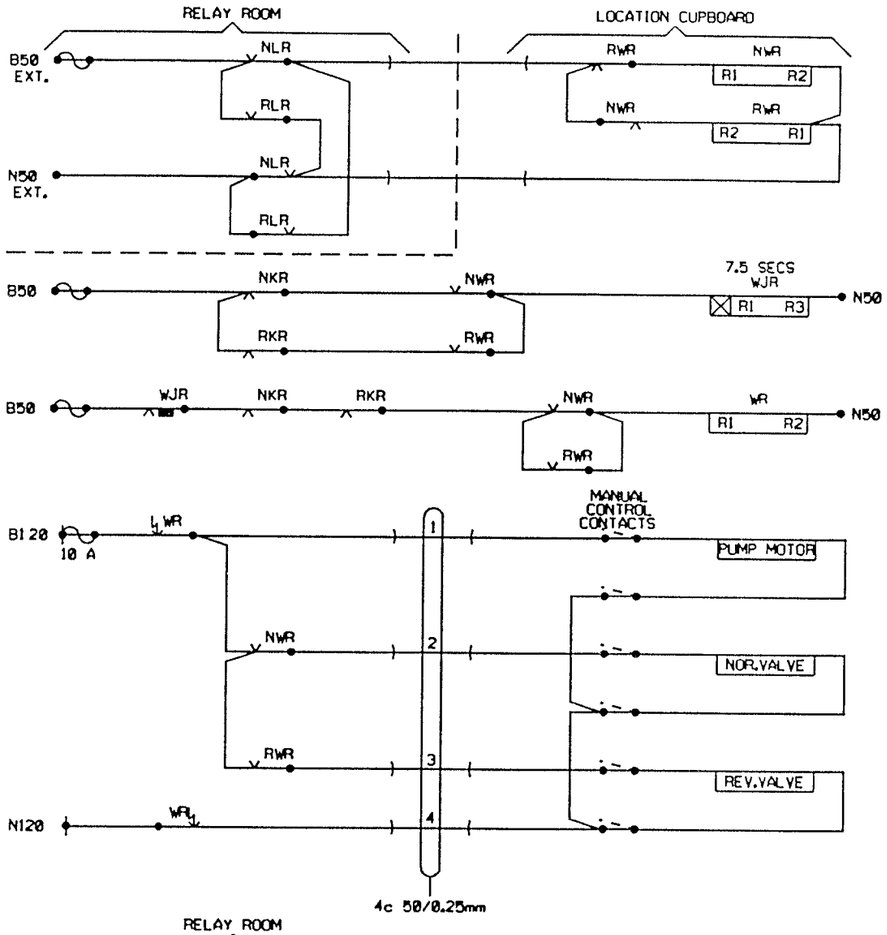


FIG. 13
TYPICAL CLAMP-LOCK DETECTION CIRCUIT (RHNC)

continued



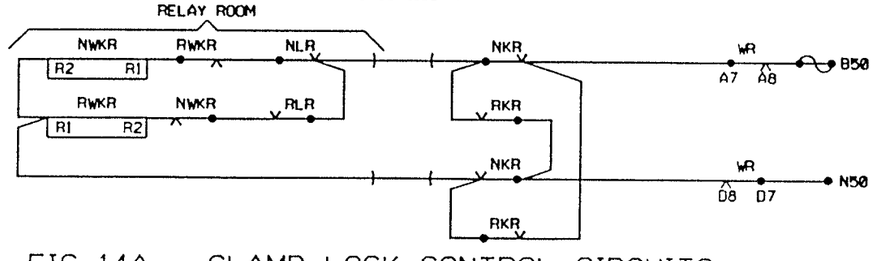
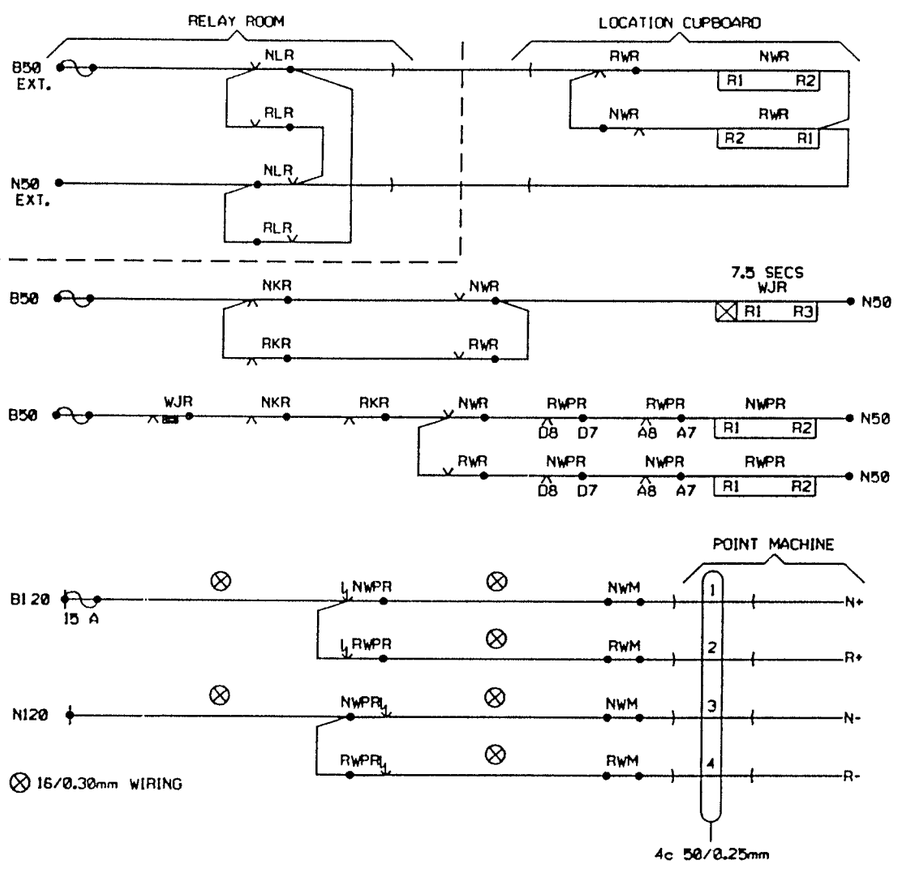


FIG 14A CLAMP LOCK CONTROL CIRCUITS



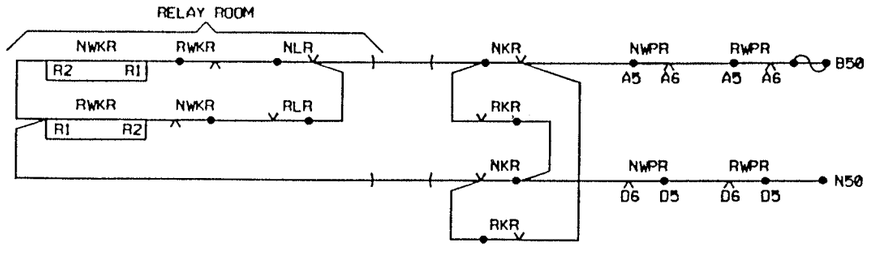
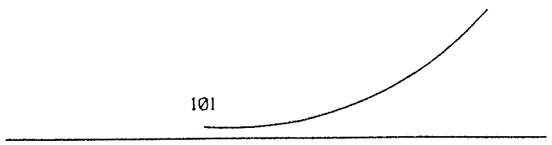


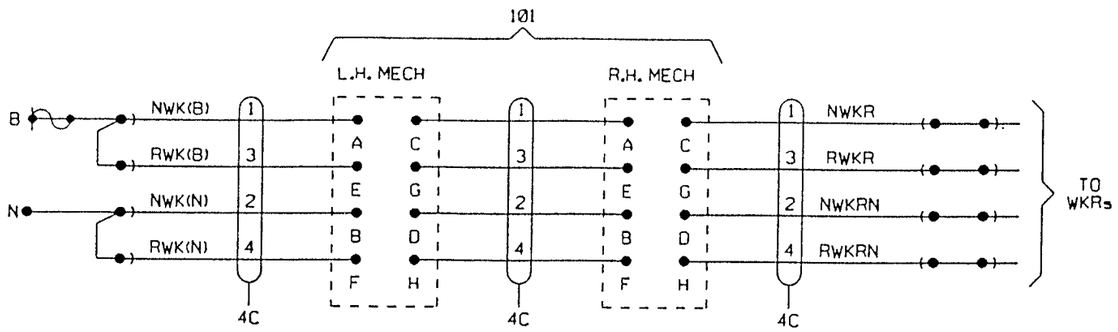
FIG 14B POINT MACHINE CONTROL CIRCUITS

FOR TYPICAL NKR/RKR CIRCUITS REFER TO FIG 013

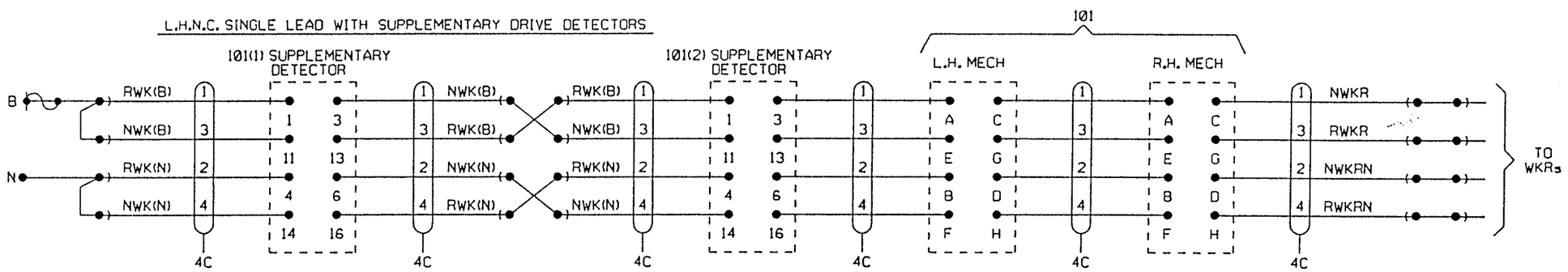
continued



L.H.N.C. SINGLE LEAD

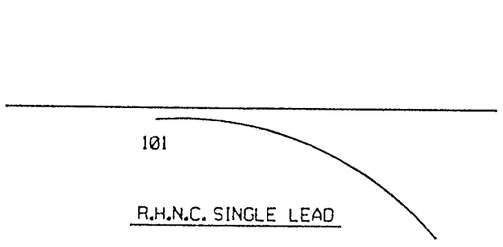


L.H.N.C. SINGLE LEAD WITH SUPPLEMENTARY DRIVE DETECTORS

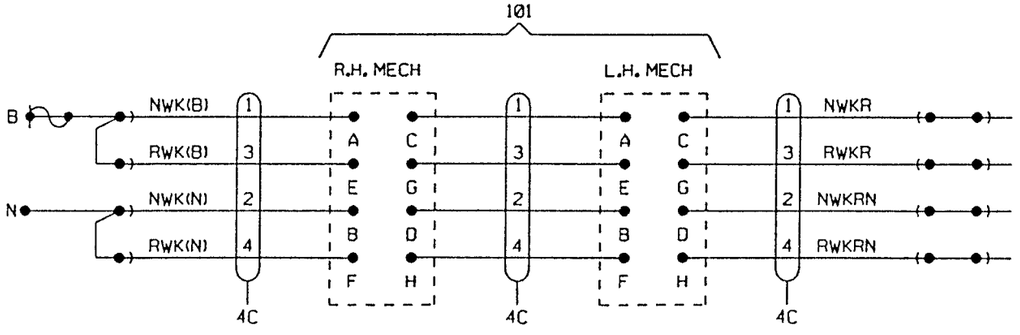


NOTES

1. CABLE CONNECTION TO EACH DETECTOR TO BE STANDARD. ANY LINE CROSSES TO BE CARRIED OUT AT THE LOCATION OR RELAY ROOM.
2. CABLES BETWEEN ENDS OF A CROSSOVER TO BE TAKEN VIA THE LOCATION OR RELAY ROOM AND WHERE APPROPRIATE VIA THE MULTICORE CABLES BETWEEN LOCATIONS. CABLE CONNECTIONS BETWEEN OTHER POINT ENDS TO BE EITHER DIRECT OR VIA THE LOCATION OR RELAY ROOM ACCORDING TO LOCAL CONDITIONS.
3. FOR INDIRECT FED POINTS NWKR BECOMES NKR, RWKR BECOMES RKR & WKRs BECOME KRs.
4. LOCAL CABLES IN ALL LOCATIONS TO BE TERMINATED IN CORE NUMBER ORDER.



R.H.N.C. SINGLE LEAD



R.H.N.C. SINGLE LEAD WITH SUPPLEMENTARY DRIVE DETECTORS

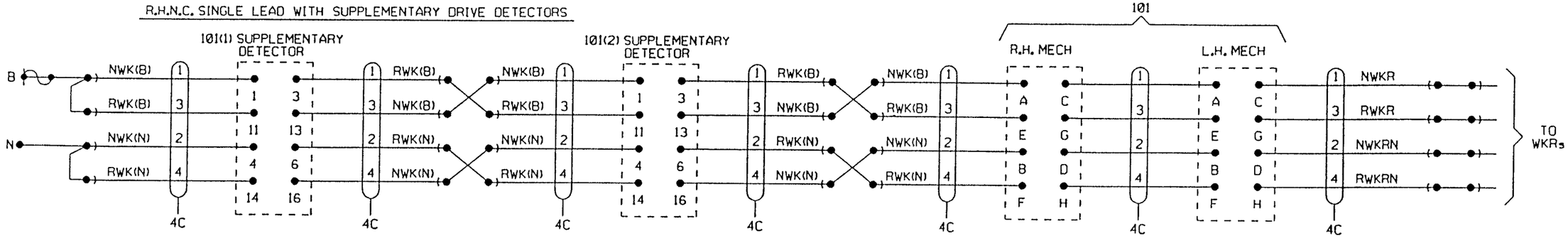
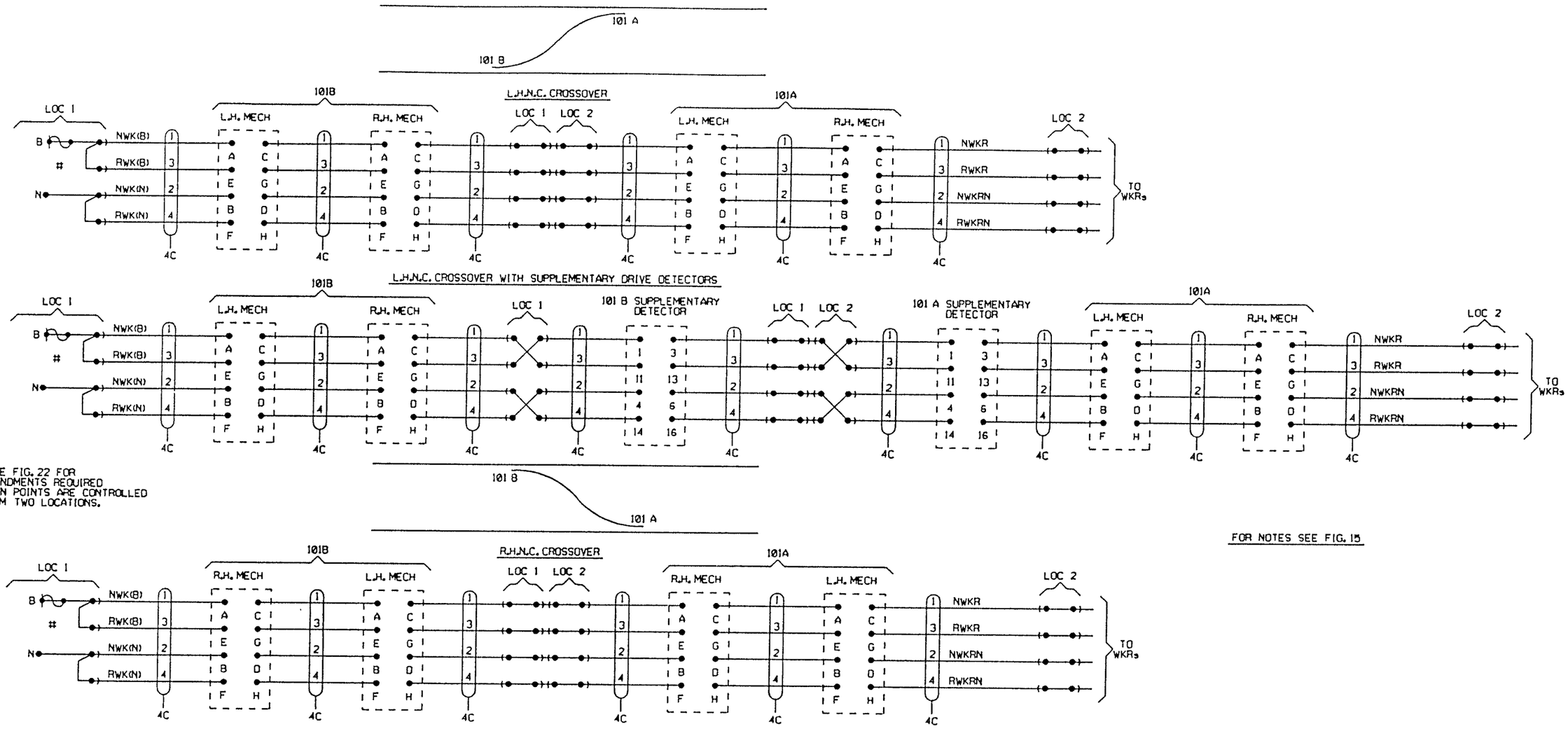


FIGURE 15

continued

ELECTRICAL DETECTION AND POWER OPERATED POINTS



SEE FIG. 22 FOR AMENDMENTS REQUIRED WHEN POINTS ARE CONTROLLED FROM TWO LOCATIONS.

FOR NOTES SEE FIG. 15

TYPICAL INTERLOCKING CIRCUITS
POINT DETECTION
CLAMP LOCKS

continued

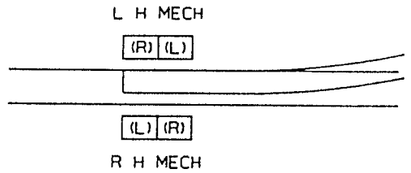
FIGURE 16

ELECTRICAL DETECTION AND POWER OPERATED POINTS

(L) OR (R) INDICATES LEFT OR RIGHT HAND LIMIT SWITCH WITHIN MECHANISM

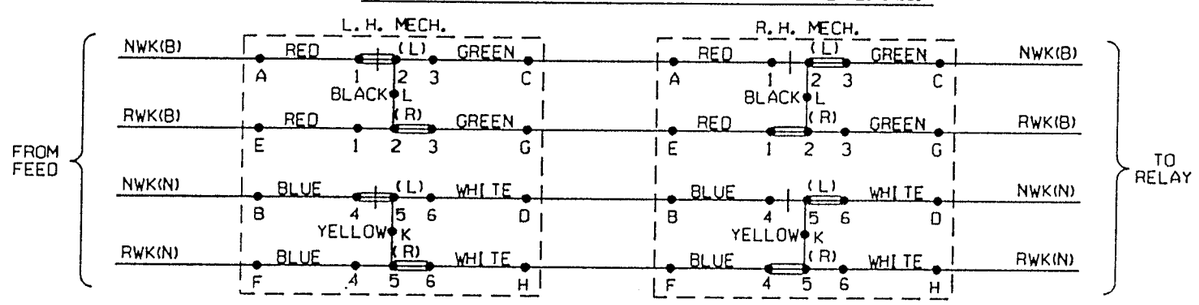
STATE OF TONGUE	(L) LIMIT SWITCH PLUNGER	(L) CONTACTS MADE		(R) LIMIT SWITCH PLUNGER	(R) CONTACTS MADE	
CLOSED AND LOCKED	OUT	1-2	4-5	IN	2-3	5-6
CLOSED BUT UNLOCKED	IN	2-3	5-6	IN	2-3	5-6
OVER 95mm OPEN *1	IN	2-3	5-6	OUT	1-2	4-5

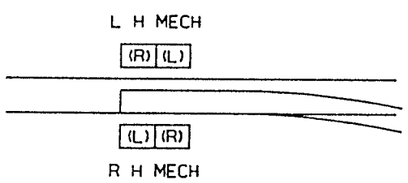
*1 OVER 76mm OPEN FOR SWITCH DIAMOND



- DENOTES CABLE ENTRY POINT

LEFT HAND TONGUE CLOSED WHEN POINTS NORMAL (L.H.N.C.)





NOTE- THAT POSITIVE (OR BX) SHOULD ALWAYS ENTER THE DETECTOR ON THE RED INTERNAL WIRES AND THAT NEGATIVE (OR NX) SHOULD ALWAYS ENTER THE DETECTOR ON THE BLUE INTERNAL WIRES.

RIGHT HAND TONGUE CLOSED WHEN POINTS NORMAL (R.H.N.C.)

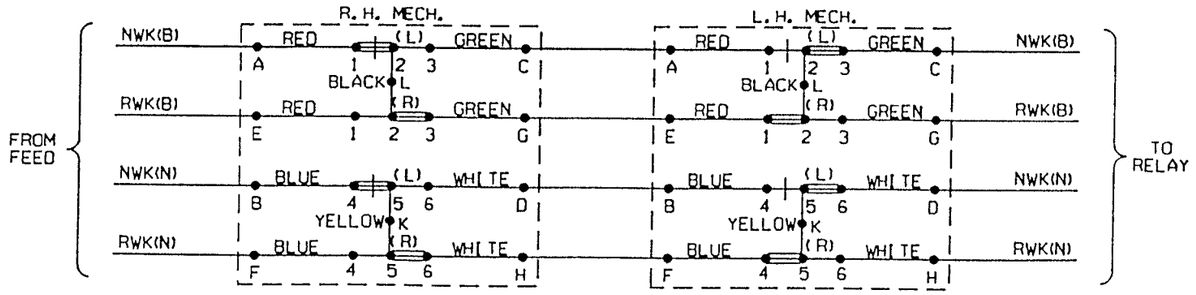
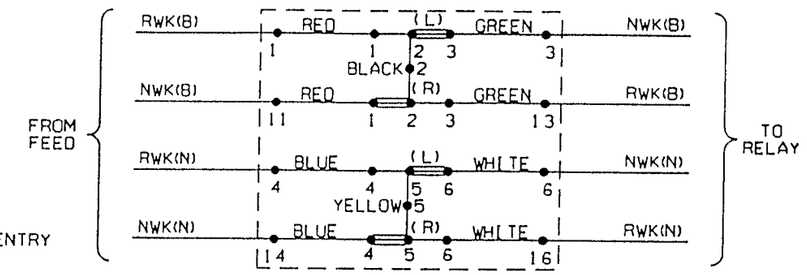


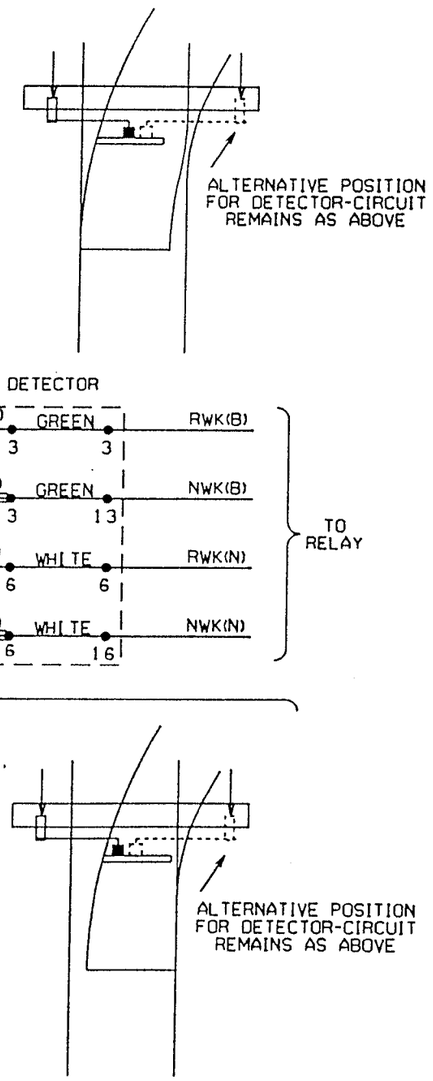
FIGURE 17 INTERNAL CONNECTIONS OF DETECTOR MECHANISMS

SUPPLEMENTARY DETECTOR

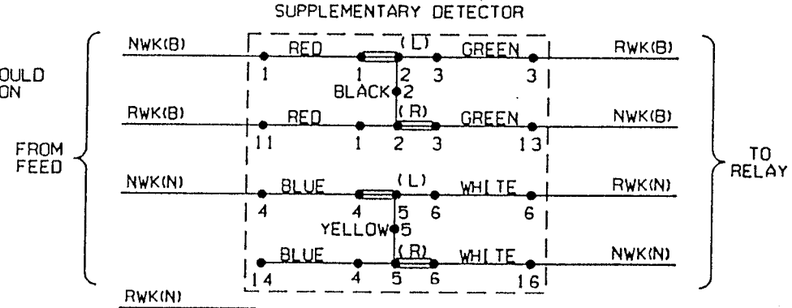


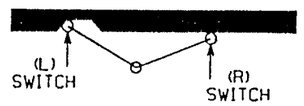
POINTS NORMAL WITH SLIDES OUT R.H. SIDE.

DETECTOR AS VIEWED FROM CABLE ENTRY SIDE



SUPPLEMENTARY DETECTOR



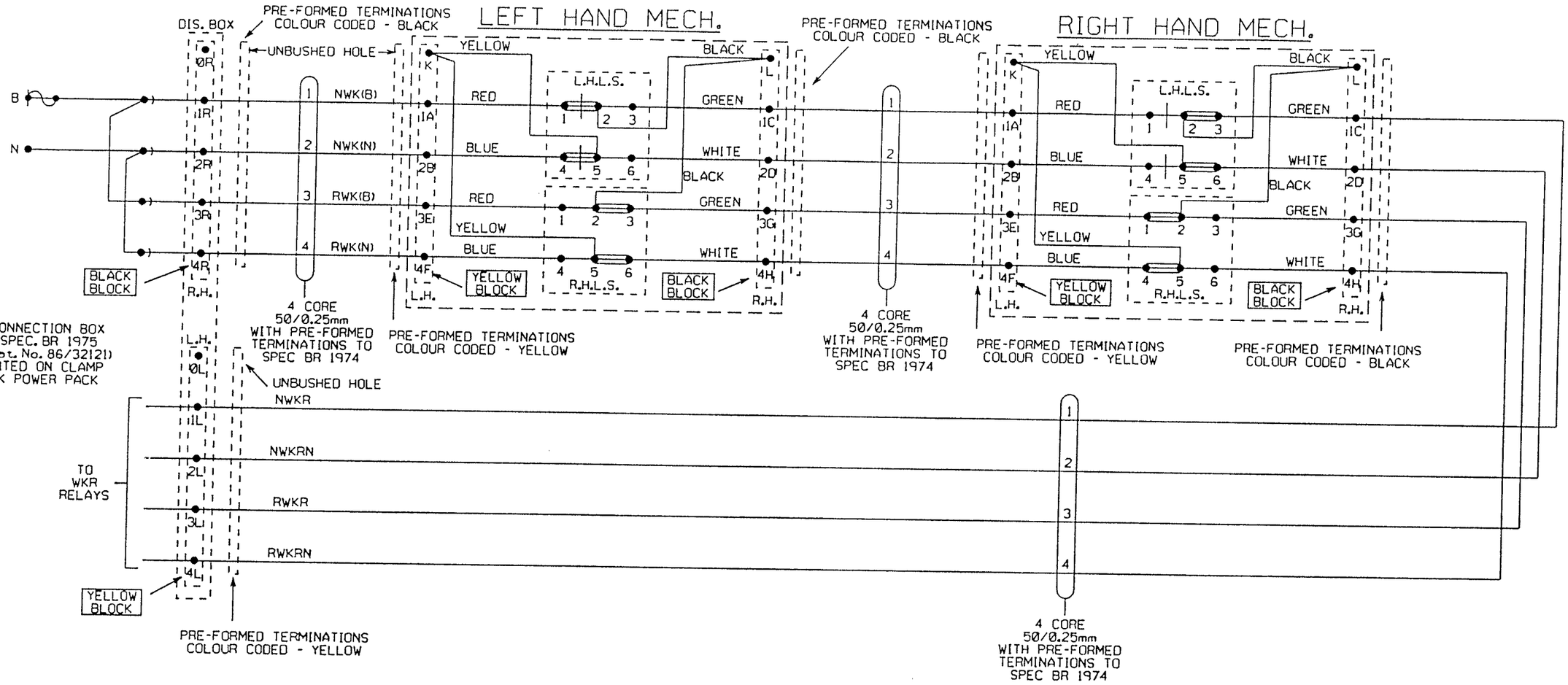


POINTS NORMAL WITH SLIDES OUT L.H. SIDE.

DETECTOR AS VIEWED FROM CABLE ENTRY SIDE

continued

LEFT HAND NORMALLY CLOSED SINGLE LEAD



LEFT HAND CLOSED WHEN POINTS NORMAL (L.H.N.C.)

NOTES :

L.H.L.S. DENOTES LEFT HAND LIMIT SWITCH (L)

R.H.L.S. DENOTES RIGHT HAND LIMIT SWITCH (R)

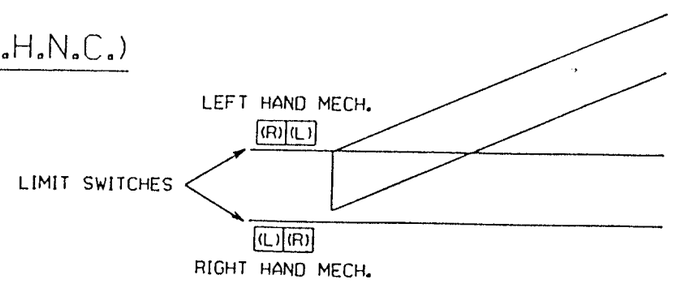
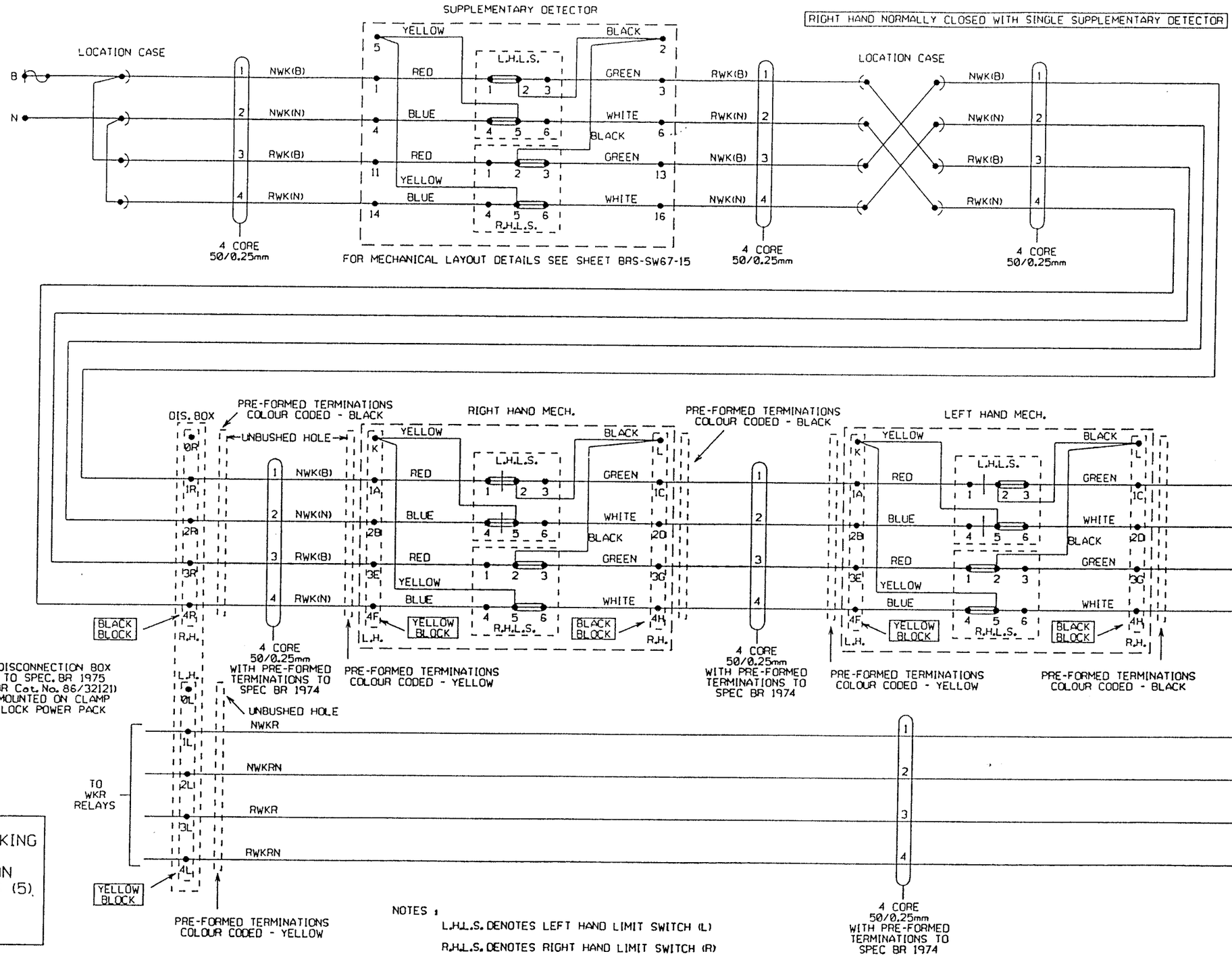


FIGURE 18

continued

ELECTRICAL DETECTION AND POWER OPERATED POINTS



TYPICAL INTERLOCKING CIRCUITS
POINT DETECTION
MK2 CLAMP LOCKS (5).

FIGURE 19

NOTES :

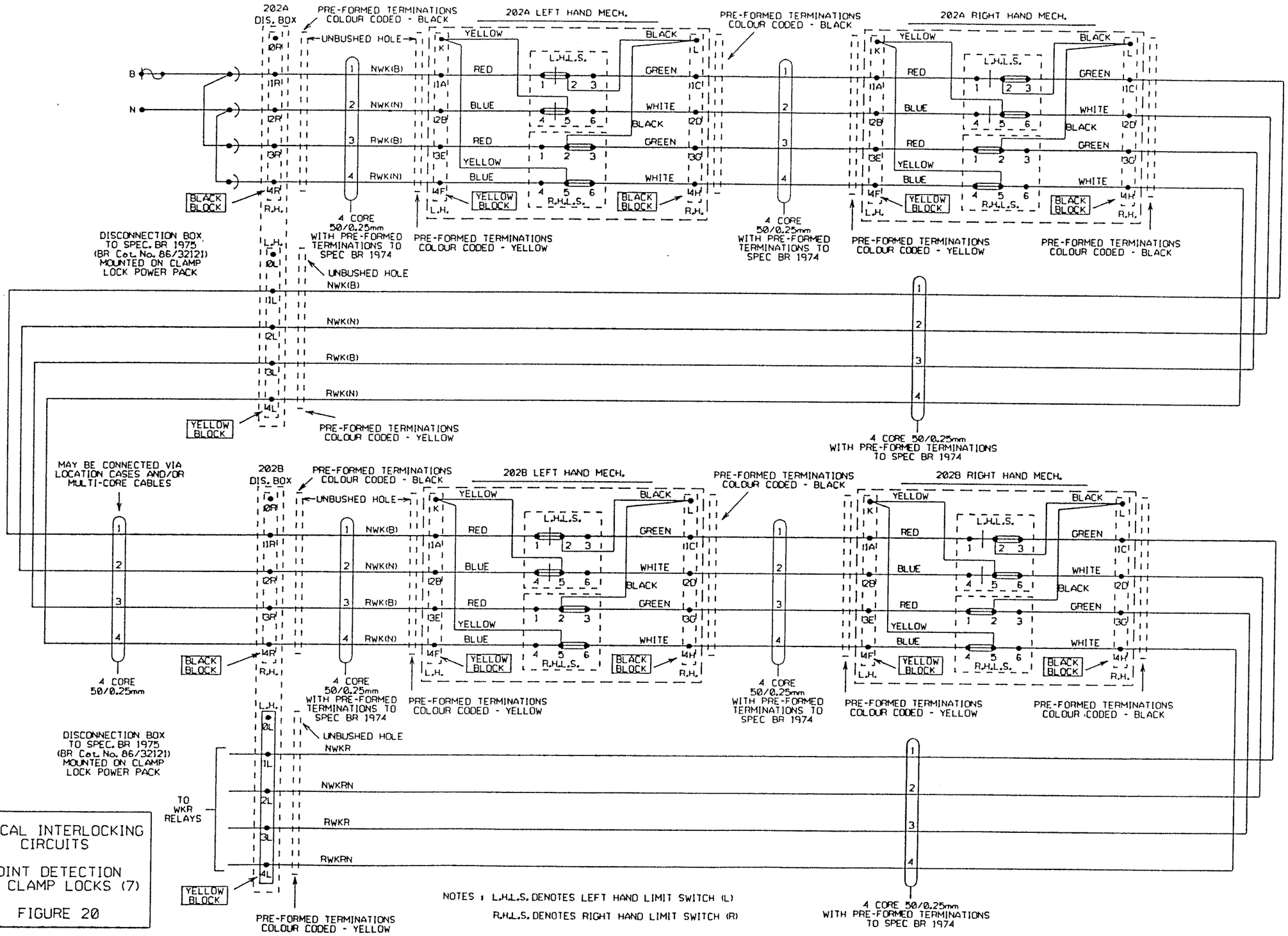
L.H.L.S. DENOTES LEFT HAND LIMIT SWITCH (L)

R.H.L.S. DENOTES RIGHT HAND LIMIT SWITCH (R)

continued

ELECTRICAL DETECTION AND POWER OPERATED POINTS

LEFT HAND NORMALLY CLOSED CROSSOVER



TYPICAL INTERLOCKING CIRCUITS

POINT DETECTION MK2 CLAMP LOCKS (7)

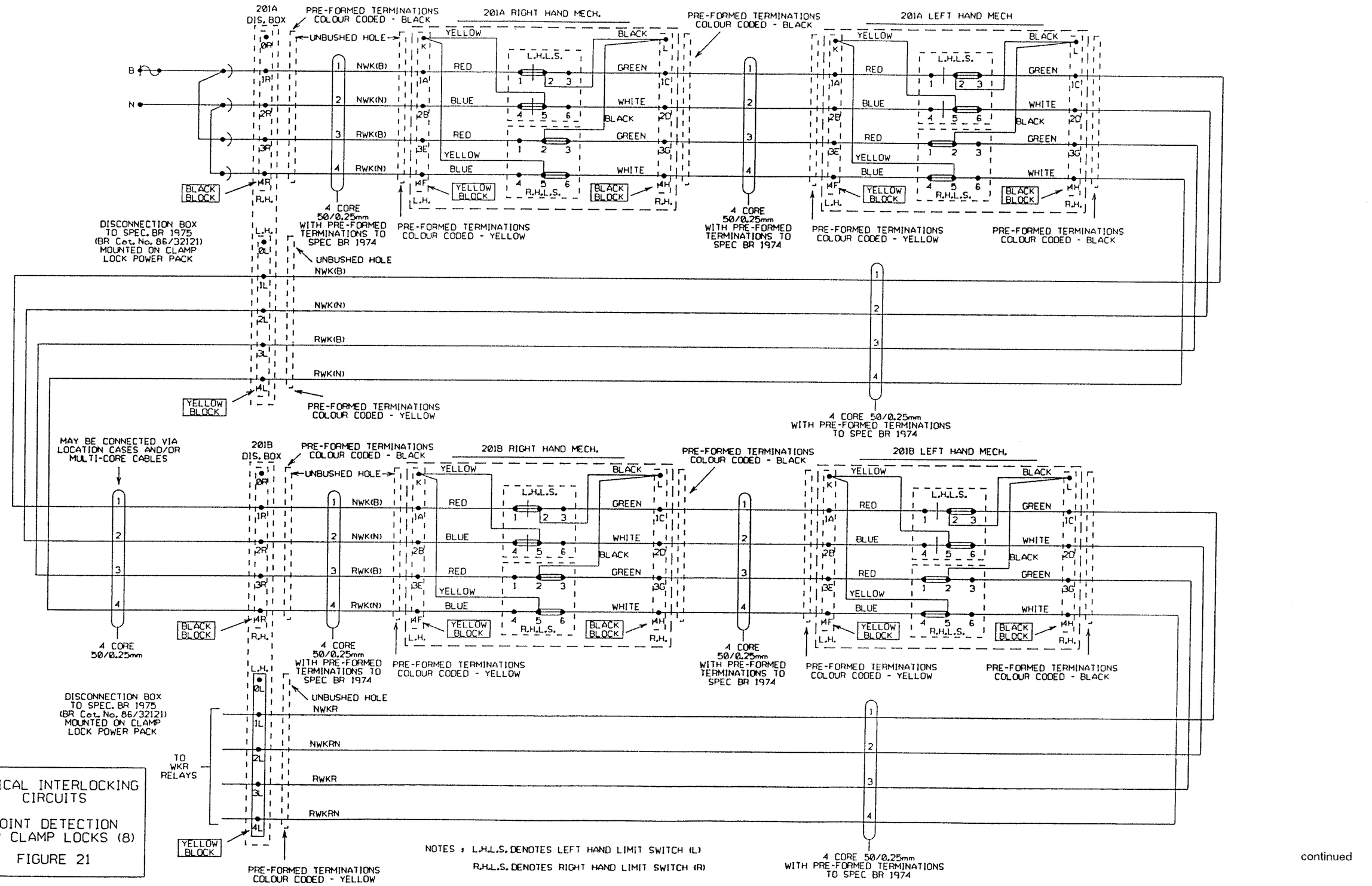
FIGURE 20

NOTES : L.H.L.S. DENOTES LEFT HAND LIMIT SWITCH (L)
R.H.L.S. DENOTES RIGHT HAND LIMIT SWITCH (R)

continued

ELECTRICAL DETECTION AND POWER OPERATED POINTS

RIGHT HAND NORMALLY CLOSED CROSSOVER



TYPICAL INTERLOCKING CIRCUITS

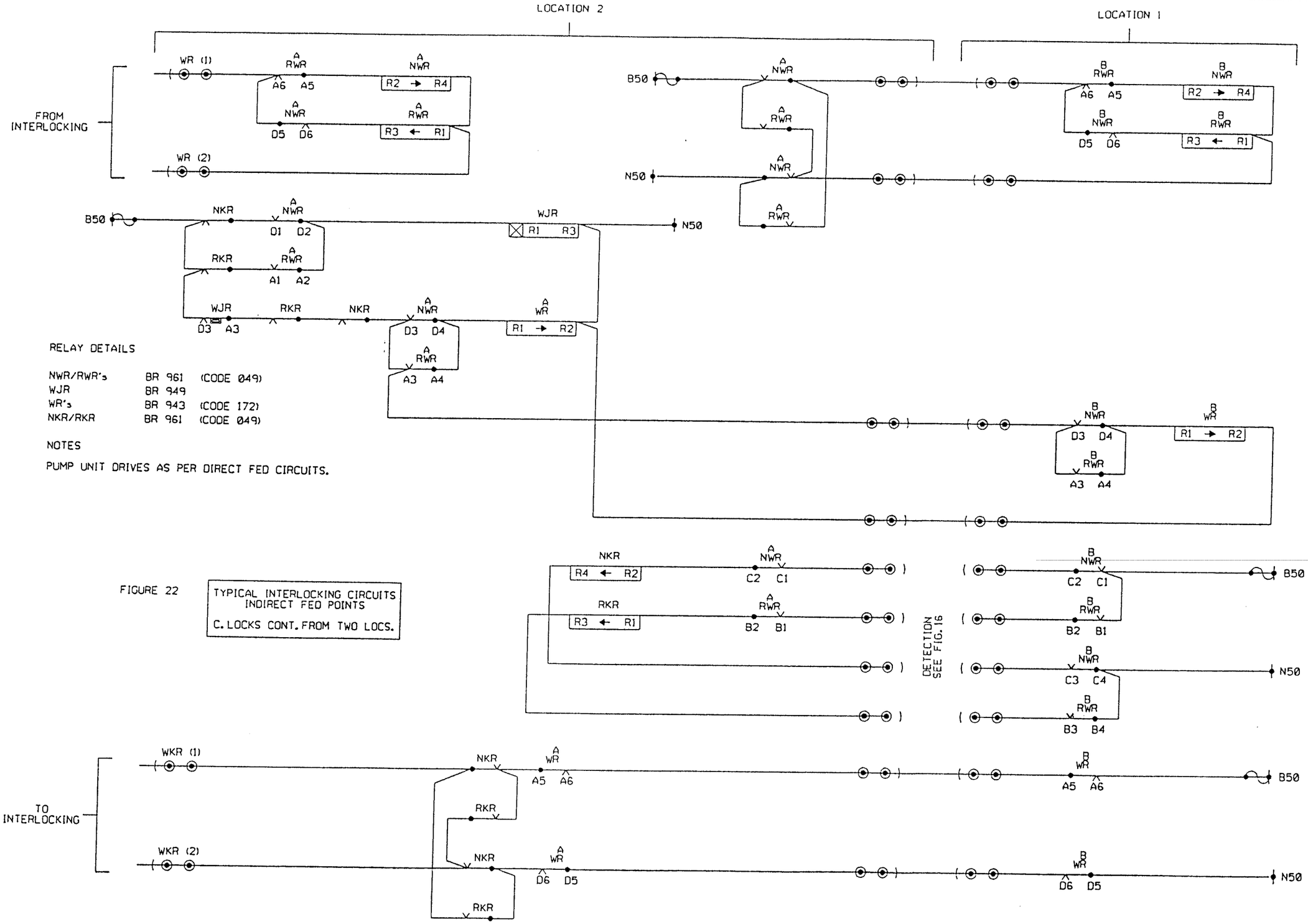
POINT DETECTION MK2 CLAMP LOCKS (8)

FIGURE 21

NOTES ; L.H.L.S. DENOTES LEFT HAND LIMIT SWITCH (L)
R.H.L.S. DENOTES RIGHT HAND LIMIT SWITCH (R)

continued

ELECTRICAL DETECTION AND POWER OPERATED POINTS



RELAY DETAILS

NWR/RWR's	BR 961	(CODE 049)
WJR	BR 949	
WR's	BR 943	(CODE 172)
NKR/RKR	BR 961	(CODE 049)

NOTES

PUMP UNIT DRIVES AS PER DIRECT FED CIRCUITS.

FIGURE 22

TYPICAL INTERLOCKING CIRCUITS
INDIRECT FED POINTS
C. LOCKS CONT. FROM TWO LOCS.

continued

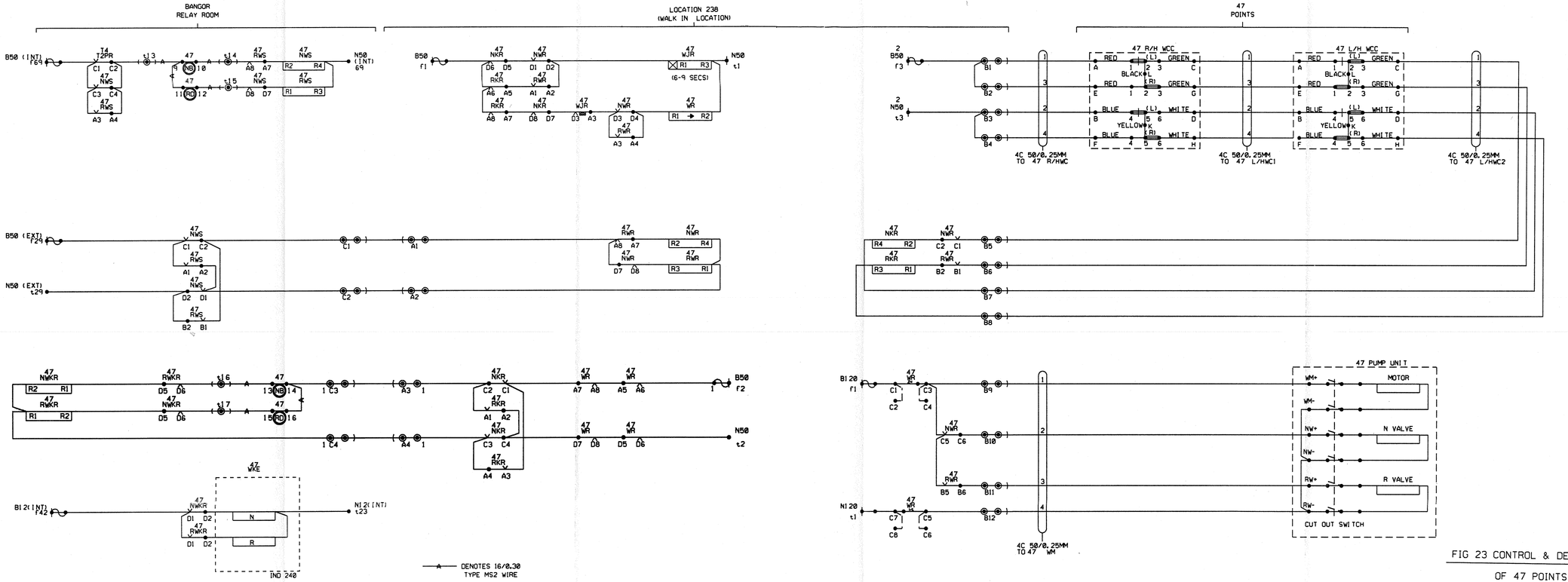
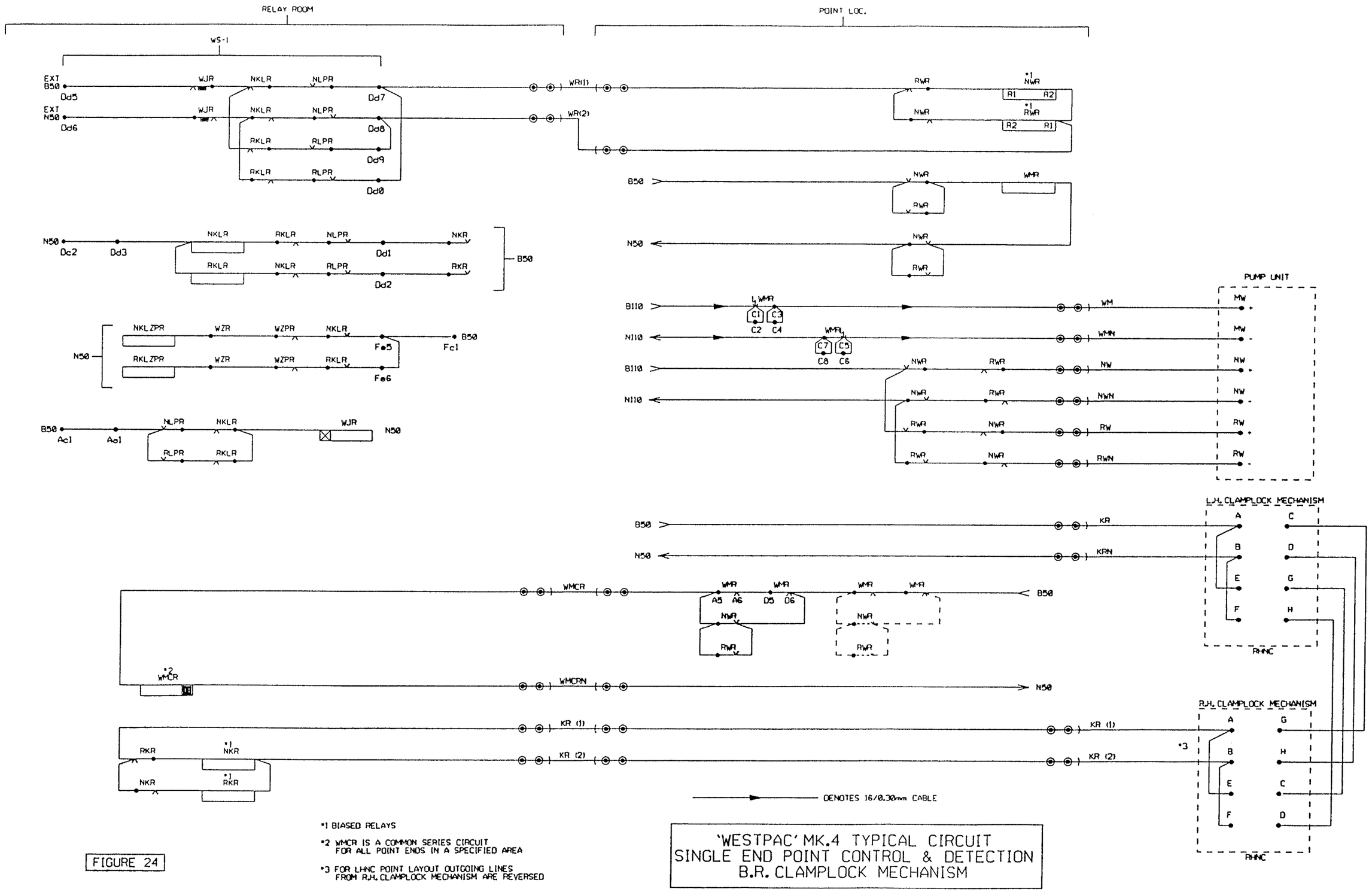


FIG 23 CONTROL & DETECTION OF 47 POINTS

continued

ELECTRICAL DETECTION AND POWER OPERATED POINTS



*1 BIASED RELAYS

*2 WMCR IS A COMMON SERIES CIRCUIT FOR ALL POINT ENDS IN A SPECIFIED AREA

*3 FOR LHNC POINT LAYOUT OUTGOING LINES FROM R.H. CLAMPLOCK MECHANISM ARE REVERSED

FIGURE 24

'WESTPAC' MK.4 TYPICAL CIRCUIT
SINGLE END POINT CONTROL & DETECTION
B.R. CLAMPLOCK MECHANISM

end