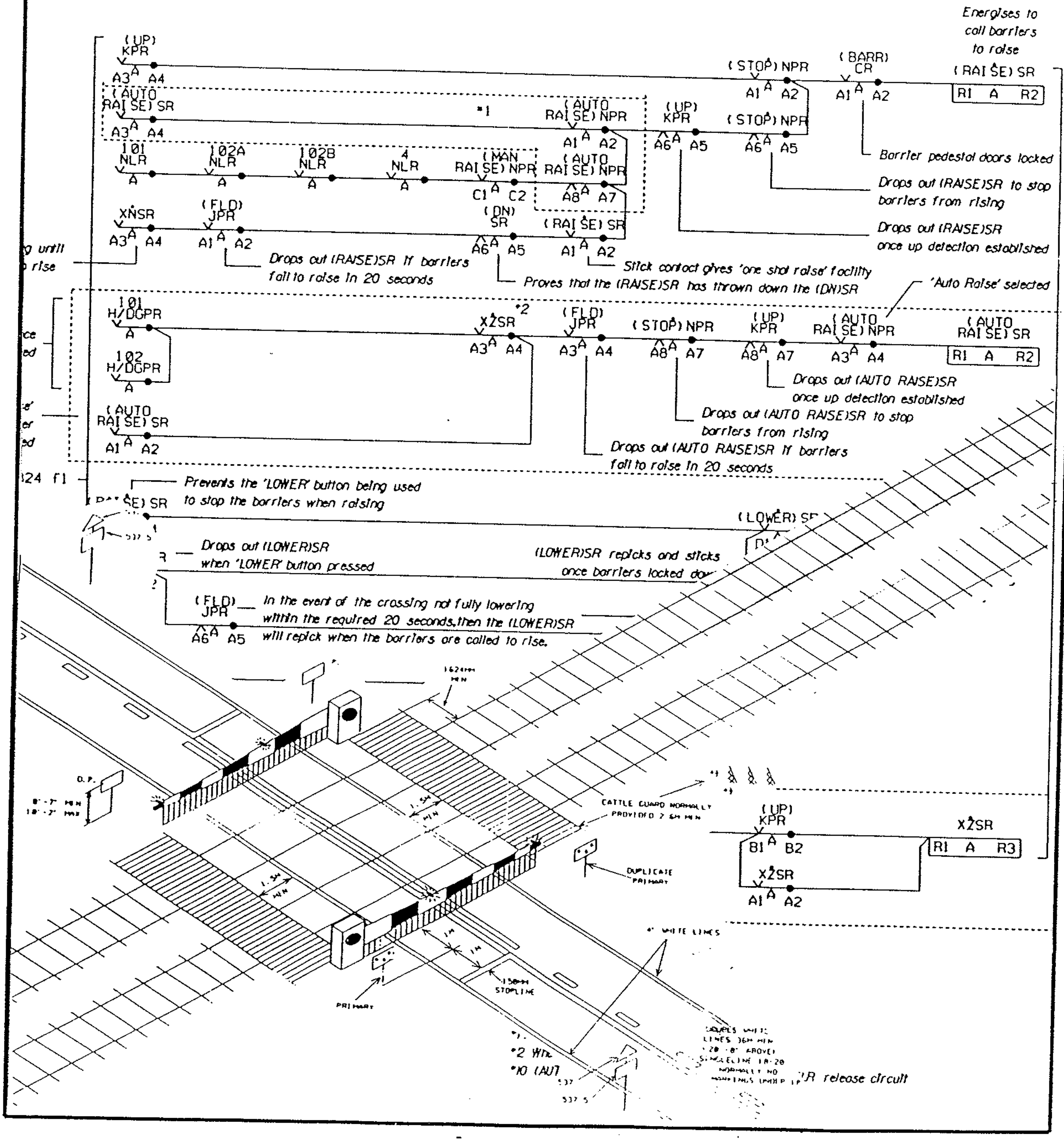
CENTRAL SERVICES
SIGNALLING PROJECTS GROUP

INTRODUCTION TO LEVEL CROSSING CIRCUITRY



INTRODUCTION TO LEVEL CROSSING CIRCUITRY

INTRODUCTION

Although it is most desirable for the intersections between roads and railways to be in the form of bridges, either over or under the railway, economy of construction usually dictated, especially in areas where the terrain was flat, that roads and railways should cross on the level. These intersections became known as grade or level crossings. It is a legal requirement for most railways to be fenced, such level crossings had to be provided with a form of barrier in order to make the fencing continuous. Heavy timber gates provided this protection and were operated by an attendant. The gates were arranged such that the roadway was normally closed, the gates being opened for the passage of each road vehicle. As roads became busier, the Department of Transport allowed amendments to individual Acts concerning the railways to permit the gates to remain open for the roadway and only to be closed for the passage of trains. Usually these level crossings were protected by worked stop and distant railway signals, although in some cases only distant signals were provided. The gates were then so arranged that when they were opened to road traffic, a red target fixed to the gate would be displayed along the railway to act as a stop signal. In some instances only the target was provided, there being no other signals. Even today, examples of such level crossings still exist.

In 1954, Parliament empowered the Railways Board to install lifting barriers in place of gates. These barriers were usually provided with visual and audible road signals, and were fitted with skirts to represent a gate, although on some installations on little used roads, the road signals were omitted. An attendant was still required. The first such example was at Warthill on the now closed direct line between York and Hull. In 1957, an Act was passed which permitted the installation of barriers operated automatically by the passage of trains; this was a major change as it allowed economy of operation by dispensing with the attendant. Furthermore, the principle of continuous fencing was now modified so that the barrier only closed half of the road. This allowed any trapped road vehicle to escape. These crossings were provided with audible and visual road signals, the operation of the crossing being indicated to a supervising signalbox, to where a telephone was provided for the use of the public. The first such automatic half barrier (AHB) was installed in 1961 on the now closed line at Sparth between Uttoxeter and Leek. The Act also allowed for similar crossings (but without barriers) to be installed on lines where rail traffic was infrequent and the rail speeds were low. These are now known as automatic open crossings locally monitored (AOCL). Confirmation that the road signals are operating is conveyed to the driver of the train by means of a white flashing indication, lack of which is an instruction to stop short of the crossing. The first installation is believed to have been at Yafforth on the Wensleydale branch in 1963.

In January 1968 there was a serious accident on an AHB crossing at Hixon in Staffordshire, followed shortly after by an accident at Beckingham Trent Road in Nottinghamshire. This resulted in alterations to the controls of AHBs including the addition of a yellow road signal and an “another train coming” road signal. This made the associated barrier controls very much more complex and considerably increased the cost of such installations.

continued

In an attempt to simplify level crossing protection, a BR/Department of Transport working party was set up which reported in 1978. This recommended that AHB crossings should be modified by the removal of the "Another Train Coming" road signal and that a new type of crossing should be installed to be known as an automatic open crossing remotely monitored (AOCR).

This was essentially an AHB but without barriers, where the protection was by the road users' obedience of audible and visual road signals. Many AOCRs were installed, the first being at Naas on the line between Gloucester and Newport. However, in July 1986 there was a serious accident at Lockington, Humberside at an AOCR crossing. This resulted in almost all of this type of crossing being converted to AHB operation, and it is now unlikely that any other AOCRs will be installed.

AOCLs are now widely installed on lines where simplified signalling infrastructure exists. A further type of crossing has been developed and is known as an automatic half barrier locally monitored by the train driver (ABCL), and is for use where the road conditions make an AOCL unsuitable.

In this training module we are going to take a look at the following types of Level Crossing's employed on British Rail and their associated circuitry:-

a). Miniature Warning Lights (MWL),
b). Automatic Barrier Crossing Locally Monitored (ABCL),
c). Automatic Open Crossing Locally Monitored (AOCL) and,
d). Manned Barrier Crossing (MCB)

Let us first take a look at Miniature Warning Lights (MWL) as from a circuitry point of view. They are probably the easiest to grasp and understanding of it will help you to build a solid foundation before looking at the more complicated ABCL, AOCL and MCB installations.

MINIATURE WARNING LIGHTS (MWL)

These crossings consist of miniature Red and Green lights which can be fitted with gates or user-operated lifting barriers (rural barriers), and at footpaths and bridalway crossings. The lights are operated by the passage of trains, the basic operation is that the Green light normally shows but an approaching train changes the light from Green to Red.

Miniature Warning Lights are not suitable for public vehicle level crossings. They are suitable for use at heavily used footpath and bridleway crossings where line speeds are high and at private vehicular crossings. Telephones may be required.

continued

OPERATING CYCLE OF MINIATURE WARNING LIGHTS

The warning lights shall be operated automatically by the approaching train, the Green light always showing until the Red light appears. For footpath crossings the Red light must show normally for twenty seconds and at bridleway and vehicular crossings for about forty seconds before a train running at the fastest permitted speed can reach the crossing.

If whistle boards are provided they must be 10 + 2 or - 2 seconds running time from the crossing.

The crossing configuration for Miniature Warning Lights could be any one of the following but we are going to look at the application of Miniature Warning Lights on a single line.

a. Single line,
b. Single line, crossing track
c. Double-line, bidirectional
d. Double-line, bidirectional with Crossing Track
e. Double-line, unidirectional with Track Reset
f. Double-line, unidirectional with Treadle Reset
g. Double-line, unidirectional with Crossing Track
h. Double-line, unidirectional with Crossing Track and Treadle Reset

Let us now look at how the circuitry operates when a train travels in the Down Direction from Barmouth to Yarmouth. If it is at all possible it helps to understand how signalling circuitry operates if you can decide what the normal state of the relays are. Below is a list showing the normal state of the relays (energised/de-energised) with no train in the vicinity.

RELAYS ENERGISED

AA TR
AC TR
AA TPR
AC TPR
A TPSR
B TPSR
(MWL)DR
(UP)(MWL)ECR
(DN)(MWL)ECR
A/B SJR
A/B SJPR

continued

RELAYS DE-ENERGISED

A SR
B SR
A/B TCJR
A/B TZJR
A/B TZJPR

TRAIN STRIKES IN "IN THE DOWN DIRECTION" (FIGURE 1A)

When AA track circuit becomes occupied it causes the following relays to de-energise AATR, AATPR and ATPSR (Figure 2). The de-energised ATPSR will energise A/B TCJR (Figure 2), and de-energise (MWL) DR. (Figure 4)

The de-energised (MWL) DR will start the audible warning to sound (Figure 4) and change the (MWL) lights from Green to Red (Figure 5).

TRAIN ARRIVES AT CROSSING

The train strikes "A" treadle energising "A" QRR and A SR (Figure 3) over the following:-

A/B SJPR Energised, A/B TZJPR De-energised
A/B TCJR Energised, B SR De-energised
A TPSR De-energised, A QRR Energised
B QRR De-energised, B TPSR Energised

The next point at which anything happens to effect the circuitry is when the front end of the train strikes "B" treadle energising "B"QRR. The train is now occupying AA and AC track circuits which de-energises ACTR, which in turn de-energises ACTPR and this in turn de-energises BTPSR (Figure 2).

As the train progresses AA track circuit will clear when the rear of the train leaves AA Track Circuit energising AATR, AATPR, and de-energising "A" QRR.

When AA TPR energises it provides a path for A TPSR to energise via the following:-

A SR Energised, B QRR Energised and B TPSR De-energised

As soon as A TPSR energises it sticks up over a front contact of its own coils (Figure 2). With ATPSR energised, (MWL)DR will also energise via;

A TPSR Energised and A SR Energised (Figure 4).

As soon as (MWL)DR energises it has the result of changing the Miniature Warning Lights from Red to Green (Figure 5), and causing the audible warning to cease. (Figure 4).

continued

In effect the rear of the train is now completely clear of the crossing.

Finally, once the train clears AC track circuit ACTR, and ACTPR energise (Figure 2). BTPSR will energise via:

AC TPR Energised
A SR Energised and
A TPSR Energised

As soon as B TPSR energises it sticks up over a front contact of its own coils because if it did not it would de-energise as soon as A SR de-energises which drops when A/B TCJR de-energised which, in fact, happens ten seconds after the train clears AC track circuit.

So the B TPSR stick contact is in the circuit to store the re-setting controls.

The circuitry operates in much the same manner when a train travels in the Up direction from Yarmouth to Barmouth except the opposite directional circuitry operates.

The following additional circuitry has been included to overcome conditions such as **"right-side"** track circuit failures, vandals etc..

TRACK CIRCUIT FAILURE ON AA

AA track circuit fails and so;

AA TR De-energises
AA TPR De-energises
A TPSR De-energises(Figure 2).

When A TPSR de-energises it causes A/B TCJR, to energise (Figure 2) and (MWL)DR to de-energise (Figure 4). This results in the green lights being extinguished and the red miniature warning lights being displayed. Also the audible warning commences.

continued

At this point the state of the relays are :-

AA TR De-energised
AA TPR De-energised
A TPSR De-energised
A SR De- energised
A/B TZJPR De-energised
A/B SJR Energised
A/B SJPR Energised and
A/B TCJR Energised

When the track circuit failure is restored it re-energises AA TR and AA TPR(Figure 2). This then applies a feed to A/B TZJR(Figure 3), which is going to take 120 seconds to "time-off". Shortly after this, A/B TZJPR energises (Figure 3) and this allows the ATPSR to energise and stick up.

When ATPSR energises it allows (MWL)DR to energise via:-

ATPSR and B TPSR energised (Figure 4), and replaces
the Miniature Warning Lights to Green (Figure 5)
and silence the audible warning (Figure 4).

The circuitry has restored itself to normal.

VANDAL OPERATION OF "AA" TREADLE

When the treadle arm is depressed the track circuit becomes occupied which again results in the normal sequence with audible warning and (MWL) lights at Red. Once the treadle arm is released it takes 6-8 seconds to restore to the raised position, energising AATR and AATPR(Figure 2).

continued

AATPR energised with ATPSR de-energised will energise A/B TZJR and A/B TZJPR after 120 seconds. With A/B TZJPR energised ATPSR will energise
via :-

AA TPR Energised
A SR De-energised and,
A/B TZJPR Energised.

With A TPSR energised the (MWL)DR will energise(Figure 4) and silence the audible warning and change the miniature warning crossing lights from Red to Green. The A TPSR energised will also de-energise A/B TZJR and A/B TZJPR(Figure 3).

FAILURE OF THE "RUN-OFF" TRACK CIRCUIT AFTER PASSAGE OF A TRAIN

With a train in the down direction and a normal strike in occupying AA track circuit, followed by the (MWL) changing from Green to Red with audible warning sounding.

The train strikes "B" treadle energising "B" QRR and occupies AC track circuit which de-energises AC TR, ACTPR, and B TPSR (figure 2).

When the train clears AA track circuit it energises AA TR , AA TPR, and ATPSR (figure 2).

Energising ATPSR will allow (MWL) DR to energise, which will silence the audible warning and change the (MWL) from Red to Green (Figure 4 and 5).

When the train arrived at the crossing and struck "A" treadle energising "A" SR the feed was cut off A/B SJR (figure 3).

A/B SJR will de-energise after 120 seconds de-energising A/B SJPR. A/B SJPR de-energising will cause "A" SR to de-energise, this results in the (MWL) DR de-energising, the (MWL) lights changing from Green to Red and the audible warning sounding.

When the technician repairs AC track circuit failure AC TR, ACTPR will energise followed by A/B TZJR 120 seconds later.

continued

Figure 1A.

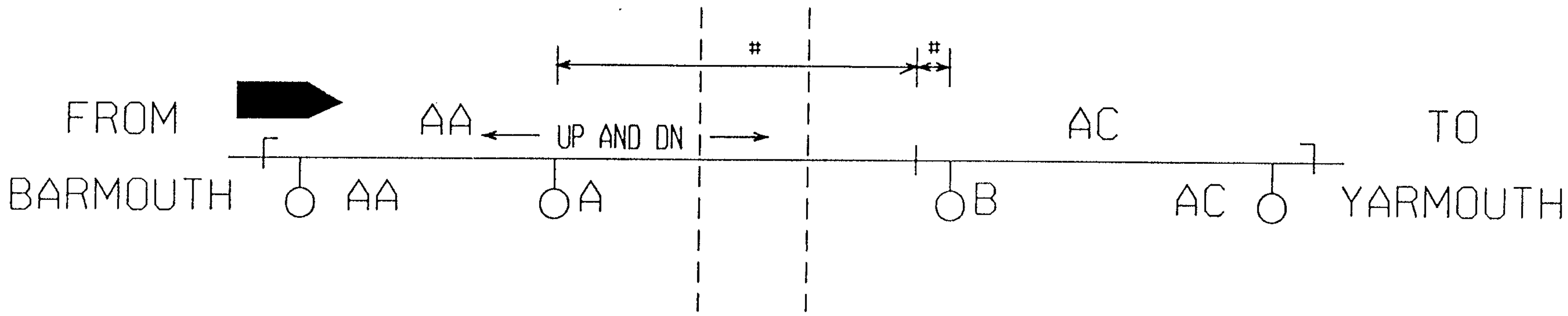


Figure 1B.

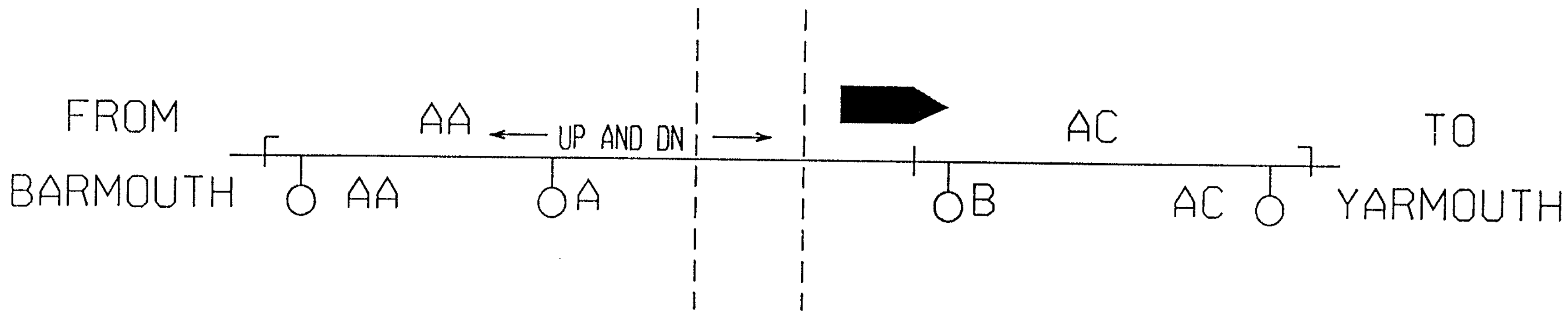


Figure 1C.

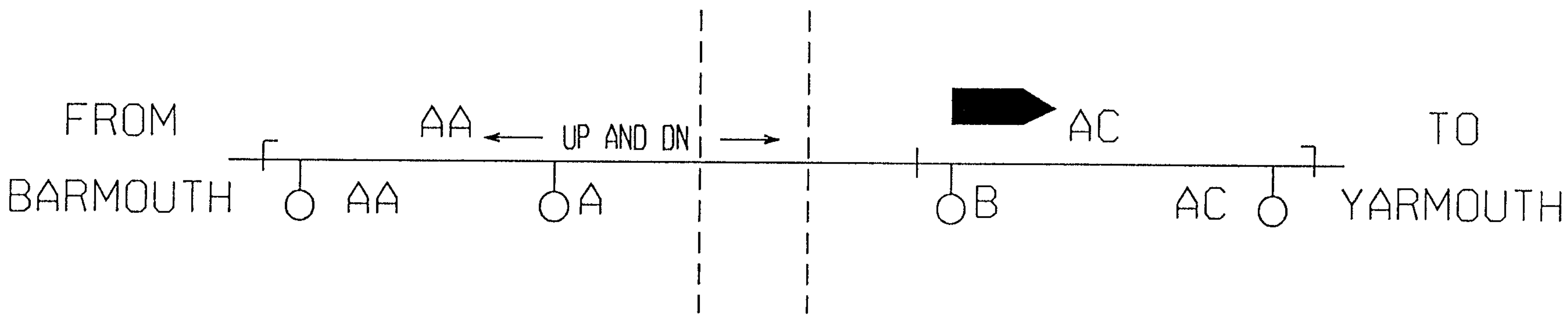
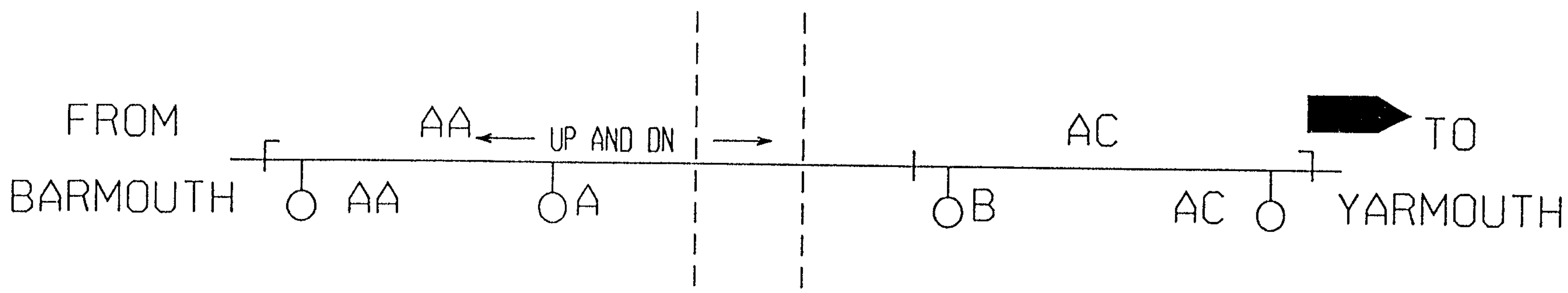


Figure 1D.



A AND B TREADLES TO BE AT LEAST 25 METRES FROM TRACK JOINT.

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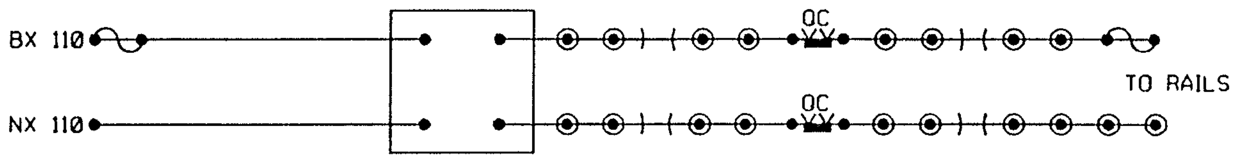
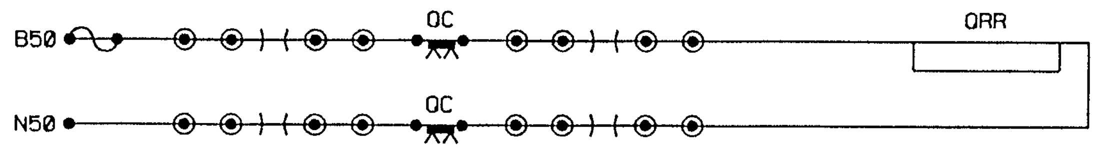
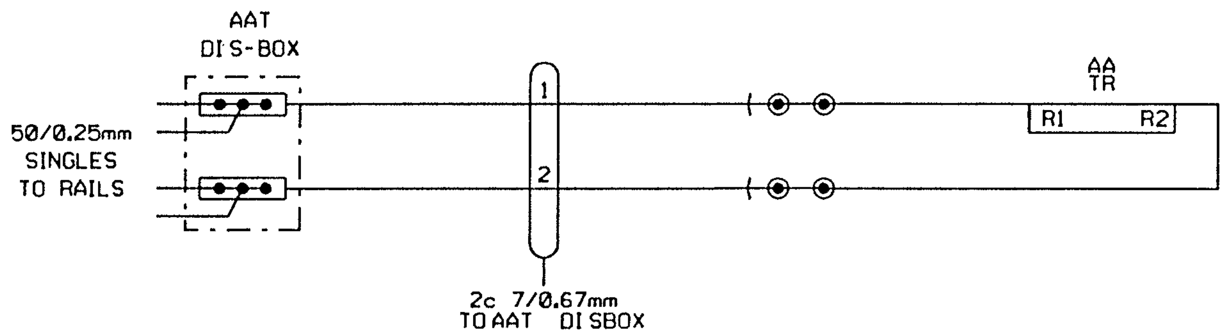
INTRODUCTION TO LEVEL CROSSING CIRCUITRY

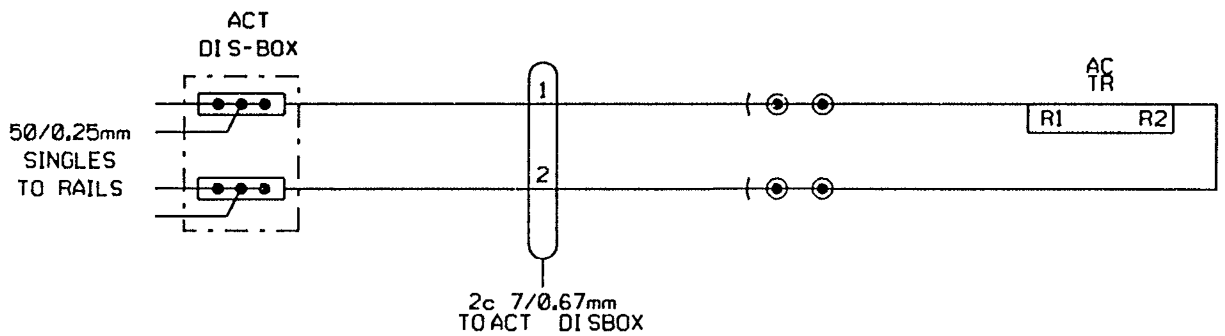
TYPICAL STRIKE IN TRACK CIRCUIT FEED

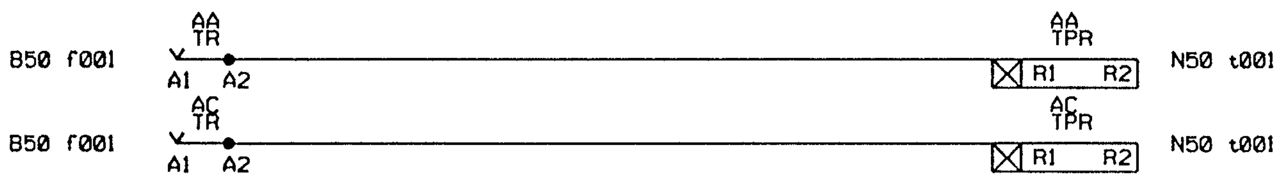


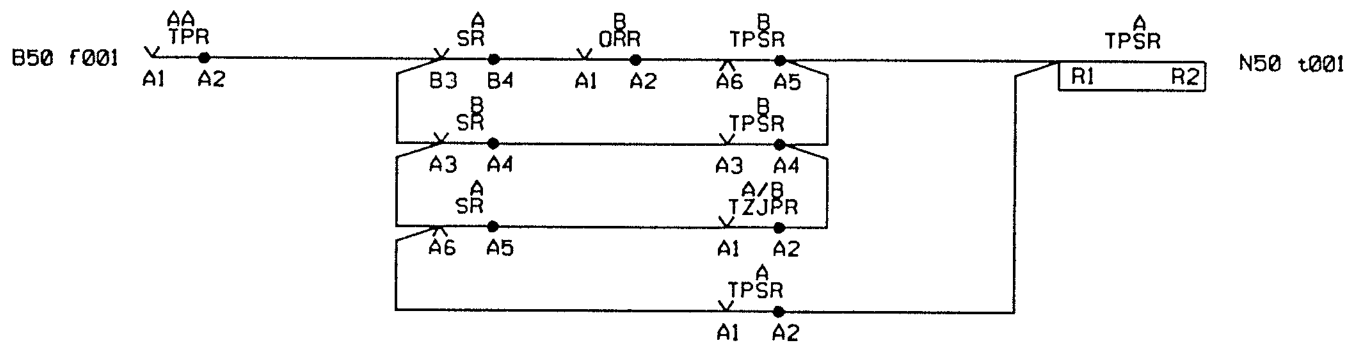
TYPICAL ORR CIRCUIT

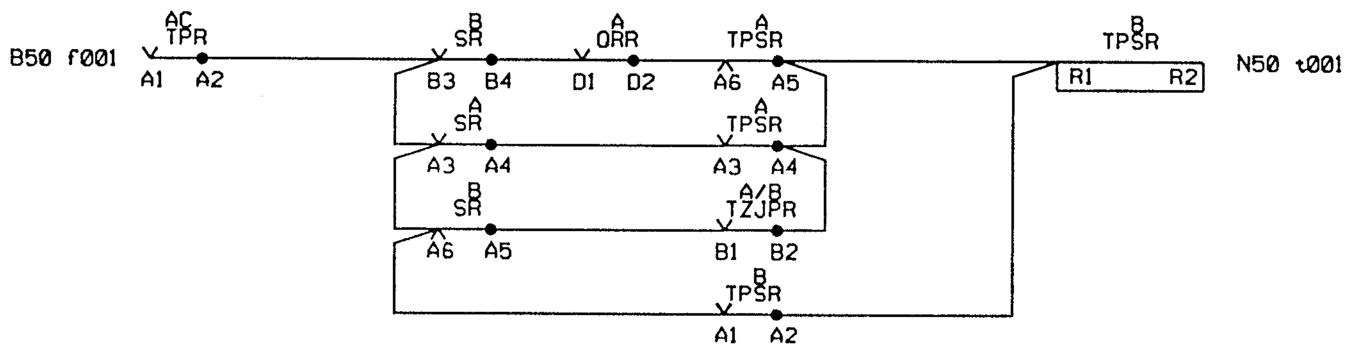


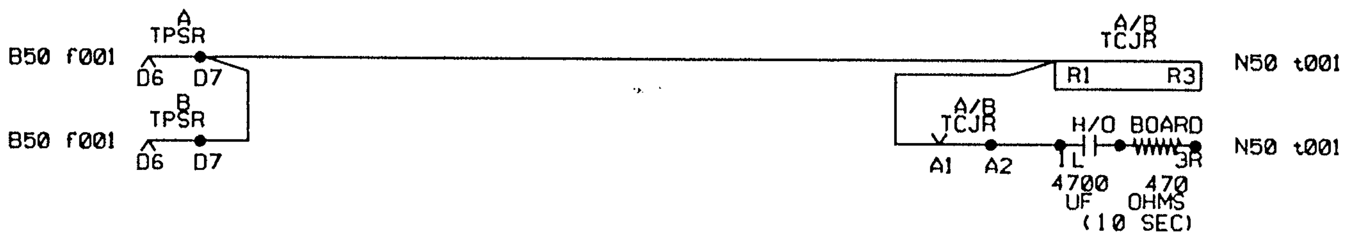












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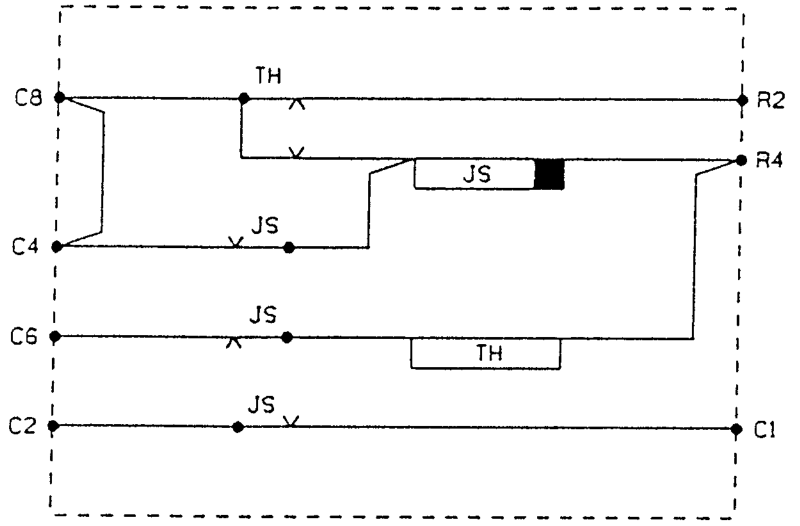
INTRODUCTION TO LEVEL CROSSING CIRCUITRY



INTERNAL WIRING OF TZJR

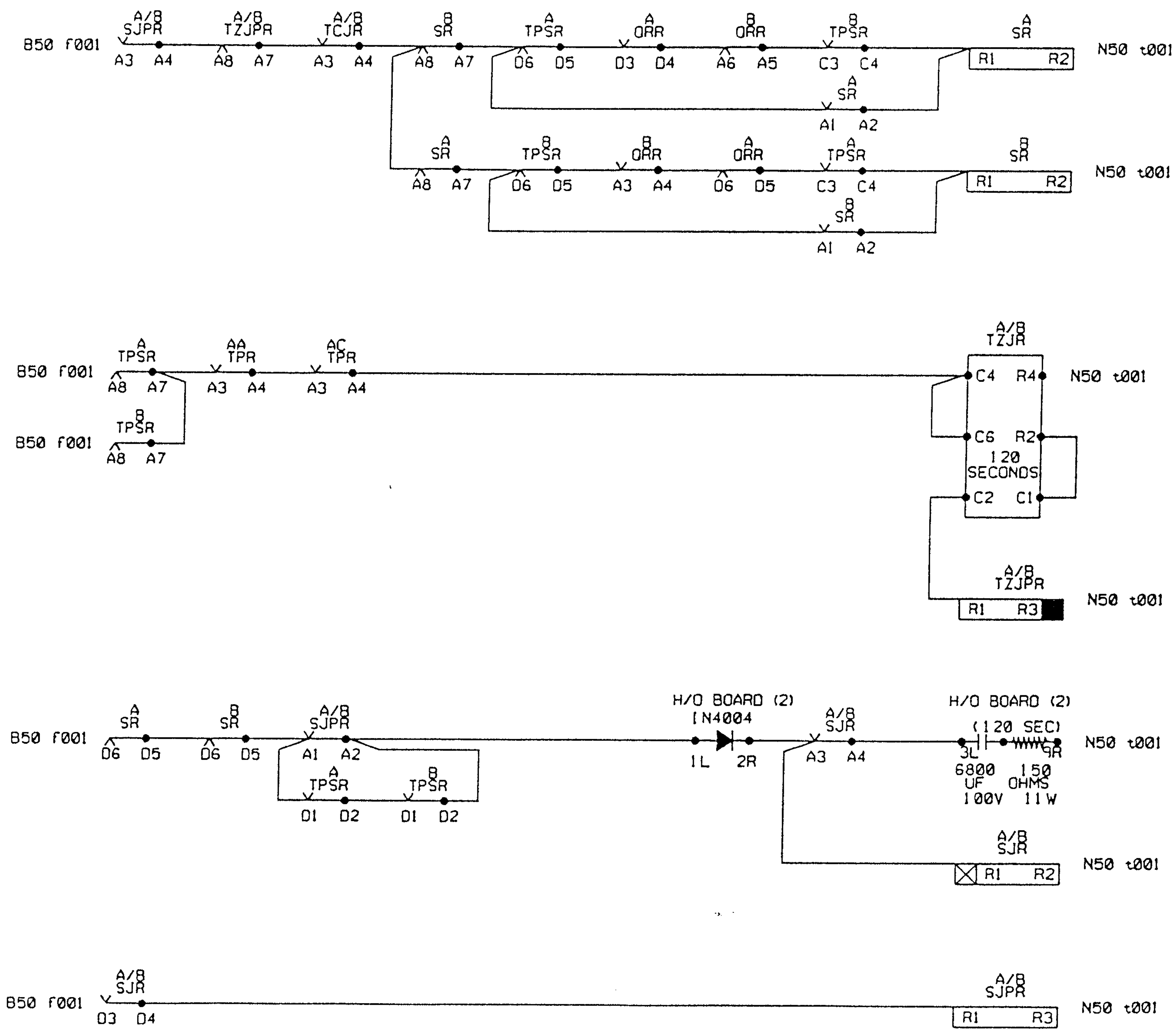
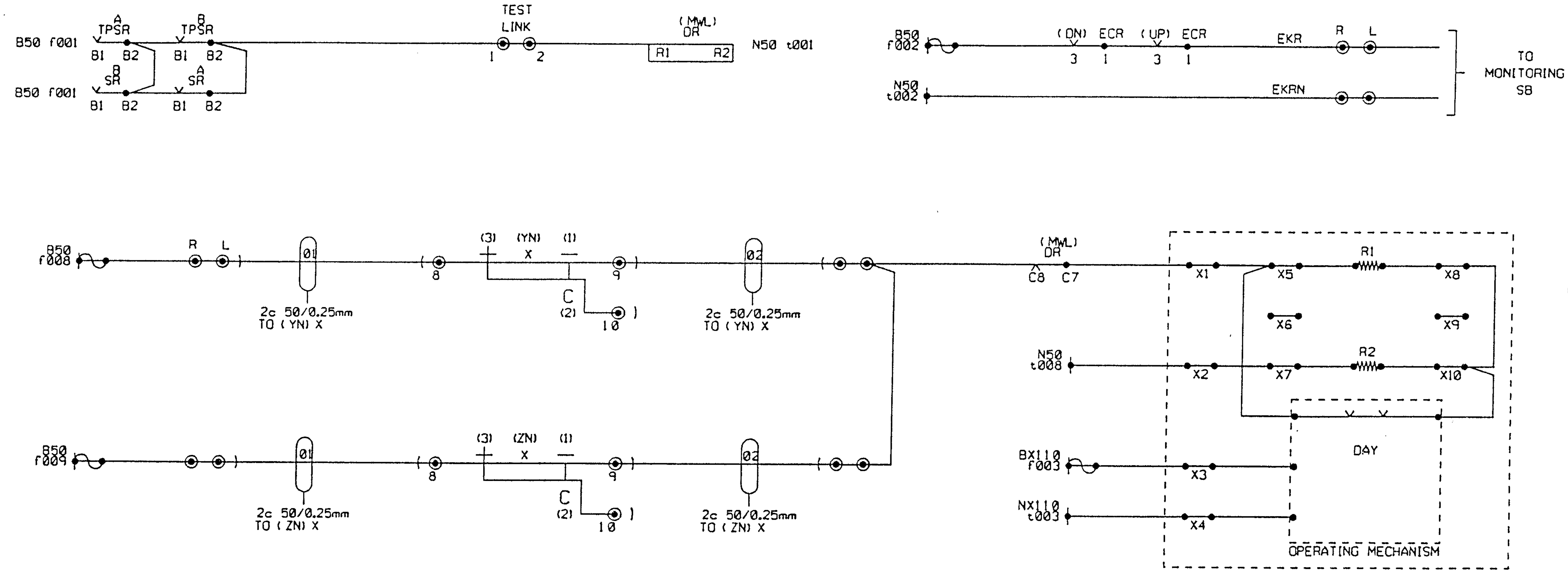


FIGURE 3.

continued



DAY	NIGHT	R1	R2
HIGH	MEDIUM	680R	1K
HIGH	LOW	1k5R	1K
MEDIUM	LOW	820R	1k8R
HIGH / MED	MED / LOW	680R	1k2R

PREFERRED VALUES

NOTES :- 'YODALARMS'.3 TYPE YO3/RF2
(RF SUPPRESSED)
BR CODE 54/70212. (24V VERSION)

RECOMMENDED RESISTOR VALUES (SEE LEFT)
FOR USE WITH YO3/RF2 YODALARMS
2.5W +/- 10%

WIRING TO BE 9/0.30mm MCI. BR SPEC 872

UNIT TO BE ORDERED TOGETHER WITH
PREFFERED VALUE RESISTORS

YODALARMS ONLY TO BE PROVIDED IF
REQUESTED BY ROM

FIGURE 4.

continued

INTRODUCTION TO LEVEL CROSSING CIRCUITRY

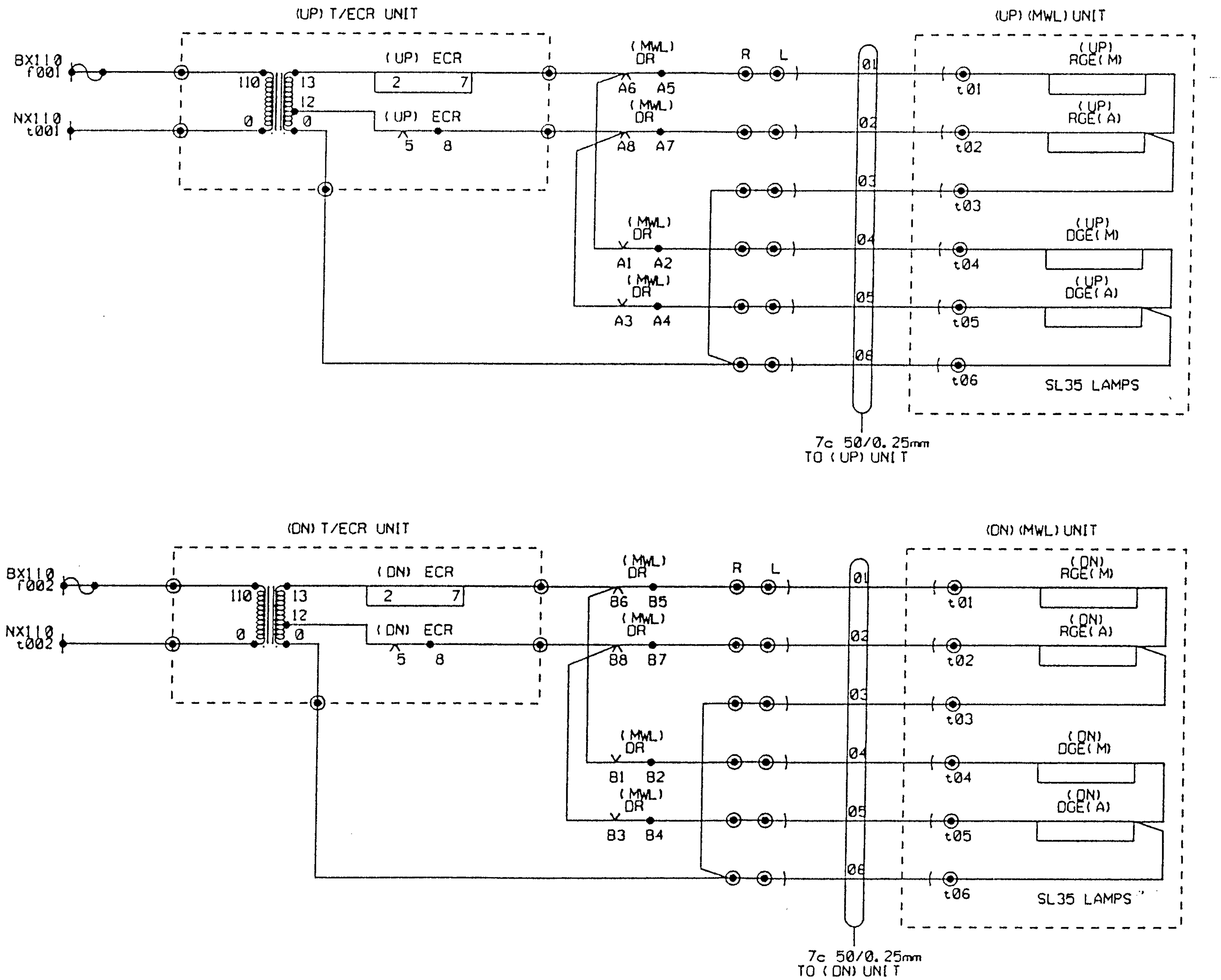


FIGURE 5.

continued

The next crossing to be discussed is the Automatic Half Barrier Crossing Locally Monitored (ABCL).

AUTOMATIC HALF BARRIER CROSSING LOCALLY MONITORED (ABCL)

The Automatic Half Barrier Crossing Locally Monitored Type of crossing is a direct development of the AOCL. As a result of the Stott report on level crossings following the 1986 Lockington accident, certain restrictions were put on the use of AOCL crossings, depending on the traffic moment.

The ABCL does not have such traffic restrictions, but it must satisfy the road conditions which are placed on AHB crossings in that road traffic must not be likely to stand on the crossing and the profile of the crossing must be such that a long vehicle will not ground on the road surface.

The crossing is similar to an AOCL except that an ABCL has half barriers and an AOCL does not. It does not have the another train coming road signal, because in this event the barriers are prevented from re-opening the road.

From the point of view of the train driver, the crossing is identical to an AOCL, having the same signs on the rail approach and being protected by the special red/white flashing rail signals.

ABCL's can only be provided if:-

a). Maximum speed of trains is 55 mph and the driver must be able to stop short of the crossing from a point at which the crossing comes full into view.

b). No more than two running lines and two other lines.

c). The driver shall normally be at the leading end of the train.

d). The carriageway on approaches is wide enough for vehicles to pass safely

e). Although no limit to amount of road traffic there should be no danger of vehicles "blocking back" over crossing.

The construction and location of barriers shall be the same as AHB.

continued

Cattle guards can be provided if trespass or cattle movement is evident.

Telephones for public use are always provided near each duplicate primary traffic light signal.

The crossing configuration for an Automatic Half Barrier Crossing Locally Monitored could be any one of the following but we are going to look at the application of an Automatic Half Barrier Crossing Locally Monitored on a single line:-

a). Single Line Bi-Directional,

b). Double Line Bi-Directional.

OPERATING CYCLE

Amber lights show and audible warning begins. After three seconds amber lights go out and red flashing lights commence. After 4-6 seconds, the barriers start to descend and are fully lowered in 6-8 seconds. Trains shall not arrive in less than 27 seconds after amber light first shows. The barriers shall rise and audible warning cease as soon as the train has cleared the crossing. The flashing lights shall be extinguished before the barriers have risen above 45 to the horizontal.

The train driver will get a flashing white signal located just before the crossing which will allow him to proceed, if he does not get this signal he will stop short of the crossing. At all times that this flashing white signal is not showing a flashing red signal, located on the same post, shall be displayed.

Let us now look at how the circuitry operates when a train travels in the down direction. As said previously it helps to understand how signalling circuitry operates if you are able to decide what the normal state of the relays are. Below is a list showing the normal state of the relays(energised/de-energised) with no train in the vicinity.

RELAYS ENERGISED

AATR	(CON)JPR	(CYC)SR
ACTR	RECPR	
A TPSR	(DWL)YJPR	
B TPSR	(UP)KR	
AA TPR	Y/Z(DOOR)CR	
AC TPR	HJPR	
(CON)SR	(LCU)SR	
(DWL)YJR	(LCU)(DOOR)CR	
HER	(LCU)NCSR	
HJR	(MROT)JR	
(CON)JR	(MROT)JPR	

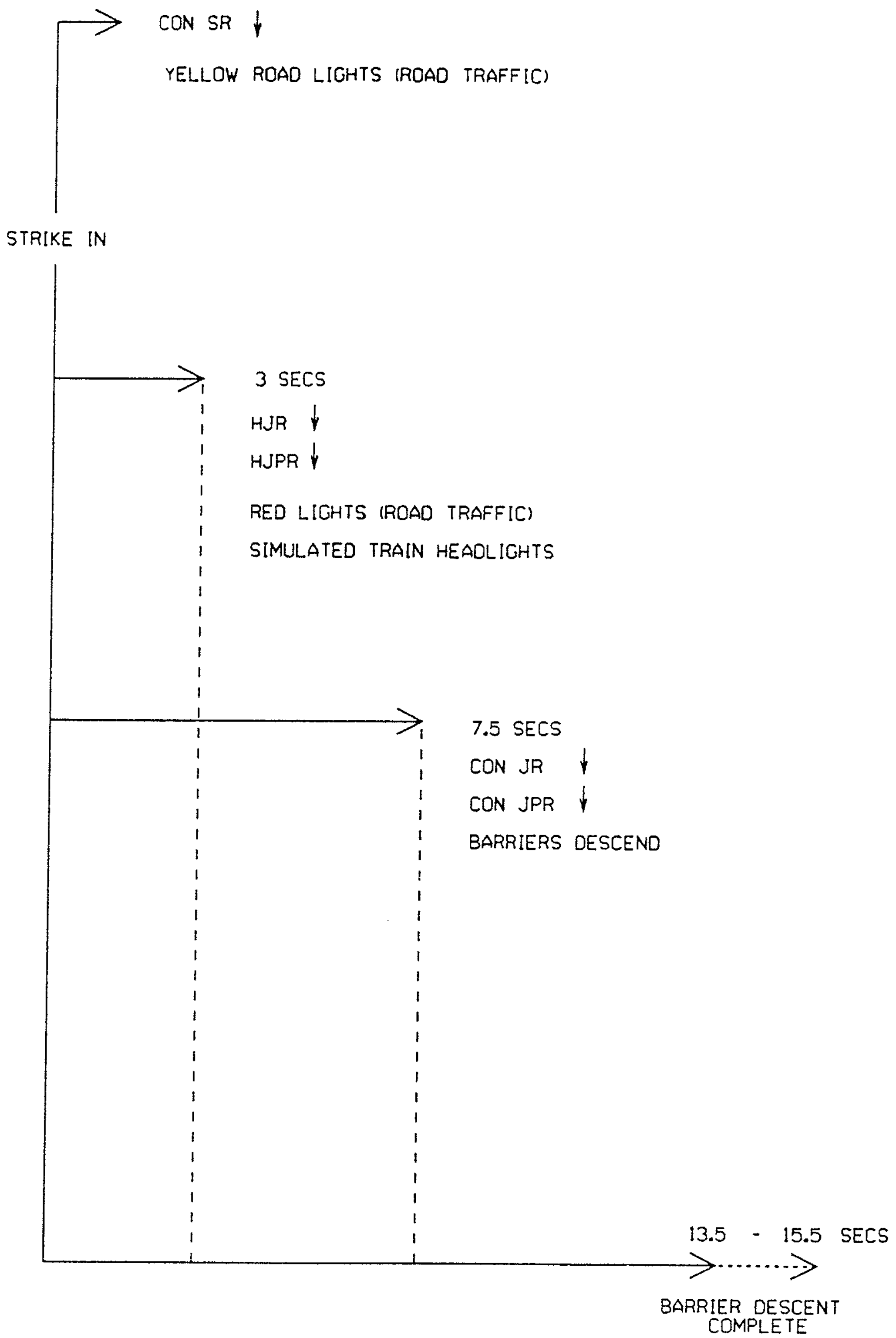
continued

RELAYS DE-ENERGISED

A QRR	(DN)KR
B QRR	(DN)KSR
A SR	Y(VALVE)CR
B SR	Y(UP)KZR
A/B TCJR	Z(VALVE)CR
EJR	Z(UP)KZR
(RE)YJR	(DN)(DWL)R
(RE)YJPR	(UP)(DWL)R
(YN)RECR	(DN)(DWL)ECR
(ZN)RECR	(UP)(DWL)ECR
(YO)RECR	(HEAD)ER
(ZO)RECR	Y ZR
NR	Z ZR

continued

INTRODUCTION TO LEVEL CROSSING CIRCUITRY



As an aid the diagram shown may assist you as it shows the effect the operation of certain relays have on the crossing equipment (lights/barriers).

continued

TRAIN STRIKES IN "IN THE DOWN DIRECTION"

When AA track circuit becomes occupied it causes the following relays to De-energise AATR, AATPR AND A TPSR. The De-Energised A TPSR will Energise A/B TCJR (Figure 8).

With A TPSR De-Energised the (CON)SR will become De-Energised, because its path keeping it energised via the following (Figure 9):-

(LCU)NCSR Energised, HER Energised,
A TPSR Energised, B TPSR Energised and
(DWL)YJPR Energised is broken.

At the same time as the (CON) SR de-energises the feed to the HER is broken. The back contacts of which commence to sound the audible warning (Figure 11) and cause the yellow road signals to light (Figure 10).

The HER de-energising causes the HJR to de-energise 3 seconds later due to its slow release feature.

As soon as the HJR De-Energises it causes the HJPR to do the same (Figure 12) and this in turn extinguishes the yellow road signals (therefore the yellow road lights will show for only 3 seconds) and illuminates the red flashing road traffic signals (YN)RE(L), (YN)RE(R), (ZN)RE(L), (ZN)RE(R), (YO)RE(L), (YO)RE(R), (ZO)RE(L), (ZO)RE(R) (Figure 10). The flashing B24 Busbar is not live until the HJPR De-Energises and this allows a flashing output from the flasher unit. The De-Energised HJPR also Energises the (HEAD)ER (Figure 14) over the following:-

HJPR De-Energised and HER De-Energised.

continued

When the (HEAD)ER Energises it illuminates the two simulated train headlamps, (UP)(HEAD)E and (DN)(HEAD)E at the crossing (Figure 14). When the red flashing road signals become illuminated the four RECR relays, (YN)RECR, (ZN)RECR, (YO)RECR, (ZO)RECR will Energise proving that all the road signals are intact at the crossing (Figure 10).
The RECR relays (Figure 10) for each unit has its feed supplied alternately from the flasher unit supplies FLBB1 and FLBB2. If one of the lamps is defective the appropriate RECR will Energise and De-Energise as each alternate lamp is lit or not as the case may be.

The RECPR circuit (Figure 9) possess a capacitor/resistance network with a stick control of the RECPR to prevent energising and de-energising during a one lamp failure situation. If both the red traffic road lights fail on a particular pedestal then the RECPR will not energise.

When the train "struck in" on AA track circuit not only did this initiate the road lights and associated circuitry but it also initiated the barrier circuitry. So let us examine the circuitry which causes the barriers to descend.

continued

LOWERING THE BOOMS

When the train strikes in the (CON)SR De-Energises which in turn De-Energises the HER this then breaks the feed to the (CON)JR (Figure 9). The (CON)JR does not De-Energise immediately as it has a slow to release feature of 7.5 seconds. The de-energised CON(JR) is followed by the (CON)JPR. When this occurs it causes the Y(VALVE)CR and the Z(VALVE)CR (Figure 13) to Energise via the following :-

> (PO)SR Energised, RECPR Energised,
> (CYC)SR Energised and (CON)JPR De-Energised.

This circuit also energises the (Y)VALVE and (Z)VALVE on the barriers, allowing the barriers to descend.

When the barriers reach 83 degrees as they descend they make a contact which energises the Y(UP)KZR and the Z(UP)KZR (Fig 13). These contacts prove the barriers are descending completing the circuit to the (DN) (DWL)R (Fig 14). This relay changes the (DN) drivers flashing red signal to a flashing white (Fig 14). When the barriers reach 80 degrees in their descent it causes the (UP)KR to de-energise (Fig 12).

The de-energised (UP)KR supplies a 24 volt supply to the (Y) and (Z) barrier boom lights (Fig 12), and de-energises the (MROT)JR (Fig 9).

Finally the barriers reach 4 degrees and so Energise the (DN)KR (Figure 12). Energising the (DN)KR energises the (DN)KSR via the following :-

> (DN)KR Energised, Y(VALVE)CR Energised,
> and Z(VALVE)CR.

The barriers have now fallen across the roadway.

ARRIVAL OF THE TRAIN AT THE CROSSING

The front of the train strikes the "A" treadle and energises AQRR (Fig 7). AQRR energised will complete the circuit to A SR (Fig 8) which energises and sticks, thus establishing the direction of initiation. As the train proceeds and occupies the crossing exit track circuit AC it de-energises AC TR (Fig 7), ACTPR and B TPSR (Fig 8). The de-energised B TPSR will de-energise the (DN) (DWL)R (Fig 14), which will replace the train drivers flashing white light signal to a flashing red light signal.

The de-energised (DN) (DWL)R will de-energise the (CYC)SR at this point (Fig 9).

Provided that the run on track circuit AA was not occupied for 3 minutes the (DWL)YJR and (DWL)YJPR will remain energised.

continued

RAISING OF THE BOOMS

When the train clears the crossing and moves off track circuit AA it has the following effect on the crossing circuitry. A QRR de-energises, AA TR, B QRR and AA TPR energise.

A TPSR now energises over AA TPR, A SR, and BQRR energised, B TPSR de-energised (Figure 8). When A TPSR energises, it completes the circuit to the (CON)SR (Figure 9) via:-

> (LCU)NCSR Energised. HJPR De-energised A TPSR Energised. A SR Energised and (DWL)YJPR Energised.

The feed is also restored to the (DWL)YJR (Figure 9).

Having now energised the (CON)SR it in turn energises the HER and the HJR (Figure 9). When the HER energises it causes the (CON)JR to energise via the following:-

> HER Energised, Y/Z(DOOR)CR Energised (LCU)SR Energised
> and the (CYC)SR De-Energised.

The repeat relay of the (CON)JR, the (CON)JPR also energises (Figure 9) and this results in the YZR and ZZR energising (Figure 13). Feed off the EJR (Figure 9). It also de-energises Y and Z valves and (Valve) CR relays (figure 13).

As soon as the ZR's energise it allows a 24v d.c. supply to drive the barrier motors and so they start to rise (Figure 13).

When the barriers reach 5 degrees from the horizontal the (DN)KR de-energises (Figure 12).

At 42 degrees from the horizontal the HJPR energises over the following (Figure 12):-

> (DN)(DWL)R, (UP)(DWL)R De-Energised,
> EJR and HJR Energised.

As already mentioned when the (CON)JPR energised it broke the feed to the EJR but this relay will not have de-energised yet as it has a slow to release feature of 7.5 seconds. Before the EJR does de-energise the (UP)KR must energise in order to keep the HJPR energised. The (UP)KR energises when the barriers reach 81 degrees from the horizontal. Energising the HJPR causes the audible warning to stop (Figure 11). It also causes the (HEAD)ER to de-energise which extinguishes the simulated train headlights (Figure 14).

The HJPR also extinguishes the red flashing road signals by disconnecting the output from the Flasher unit (Figure 10).

continued

If there is no longer an FLBB1 or FLBB2 supply then the following relays will also de-energise (Figure 10) :-

(YN)RECR
(ZN)RECR
(YO)RECR and (ZO)RECR.

The HJPR energised "holds up" the RECPR (Figure 9).

When the barriers reach 81 degrees the (UP)KR energises and this breaks the 24v supply to the (Y)barrier and (Z)barrier boom lights (Figure 12). The (UP)KR applies a feed to the (MROT)JR which will energise after 10 seconds followed by the (MROT)JPR (Figure 9).

At 84 degrees the 24v supply to the Y(UP)KZR and the Z(UP)KZR is broken and they de-energise, which causes YZR and ZZR to de-energise and stop the Y and Z barrier motors. The barriers are held up by the de-energised valve.

When the Y(UP)KZR and Z(UP)KZR de-energised the (CYC)SR energised (Figure 9).

The level crossing circuitry is restored to its normal state when the train clears the run-off track circuit AC.

There follows some features which you should be aware of when dealing with ABCL types of crossing.

CYCLE RELAY (CYC)SR

The principles of control for ABCL crossings state that it is necessary to prove that the barriers lowered and raised correctly for the previous train. This is achieved via a relay called the (CYC)SR.

When the run off track circuit became occupied B TPSR de-energised (DN)(DWL)R(Figure 14), this relay in turn de-energised (CYC)SR(Figure 9).

To energise the (CYC)SR it must first be proved that the barriers are down, this is accomplished via the (DN)KSR(Figure12). The barriers will rise after the train clears the crossing and be proved raised via the (UP)KR energised.

When the barriers reach 84 degrees from the horizontal Y(UP)KZR and Z(UP)KZR will de-energise and energise the (CYC)SR which will remain energised via the (CON)JPR(Figure 9).

The (CYC)SR being energised will then de-energise the (DN)KSR (Figure 12).

continued

EQUIPMENT FAILURE

Failures can be varied and complex so let us consider the effect of a track circuit failure on AA, where the power supplies are normal. An extract from the "PRINCIPLES OF CONTROL" for ABCL's is included and states:-

> **"If the crossing sequence has been initiated as a result of a track circuit or other equipment failure, or remains operating irregularly after the passage of a train, the crossing shall be reset after 180 seconds. In this event the Driver's Flashing White Light shall be extinguished and the associated Driver's Flashing Red Light illuminated, followed 30 seconds later by the raising of the barriers, the extinguishing of the Red flashing road lights and the silencing of the audible warning devices. A plunger shall be provided on each rail approach to enable the crossing warning sequence to be initiated after the crossing has "timed out". Depression of the plunger shall initiate the crossing light sequence, provided the appropriate track circuit is occupied."**

When AA track circuit failed by becoming occupied, the road traffic signals would operate and the barriers lower as in a normal strike in.

After 180 seconds the (DWL)YJR will de-energise, followed by the (DWL)YJPR(Figure 9) which will de-energise the (DN)(DWL)R. The (DN)(DWL)R will extinguish the Driver's Flashing White Light and illuminate the Driver's Flashing Red Light (Figure 14), it will also energise the (RE)YJPR after 30 seconds, via the following:-

(DWL)YJR,(DWL)YJPR,(DN)(DWL)R
and the (UP)(DWL)R all de-energised(Figure 9).

Energising of (RE)YJPR will cause the (CON)SR to energise via the following:-

(LCU)NCSR,(LCU)SR and
and (RE)YJPR energised

and introduce the normal barrier raising procedure, silence the audible warning, extinguish the Red flashing road signals and simulated train headlights as previously explained.

continued

The next approaching train will observe the flashing red signal and stop at the crossing. The driver will then unlock the cupboard housing the DOWN EMERGENCY PLUNGER. After pressing and releasing the plunger the NR relay will energise momentarily via the (LCU) NCSR energised, (DWL)YJPR de-energised and A TPSR de-energised (Fig 9). This short pulse is sufficient to re-energise (DWL)YJR and (DWL)YJPR for a further 180 seconds via (LCU)NCSR energised (DWL)YJPR de-energised, NR energised, (MROT)JPR energised (Fig 9).

When the (DWL)YJR received its pulse from the NR the (RE)YJR and (RE)YJPR were de-energised, which de-energised the (CON)SR (Fig 9). The de-energised (CON)SR will initiate the audible warning along with the road signal sequence and lower the barriers as previously explained. The railway signal will change from a flashing red to a flashing white.

The driver has 3 1/2 minutes to take his train over the crossing whilst the crossing is closed to road traffic. The crossing will automatically reset after 180 seconds when the (DWL)YJR and (DWL)YJPR are de-energised and they energise the (RE)YJR and (RE)YJPR after 30 seconds allowing the (CON)SR to energise and raise the barriers etc.

If another train arrives at the crossing and the driver presses the plunger just as the barriers start to rise after the first train, the crossing must stay open to road traffic for a minimum of 10 seconds before the road signal sequence restarts and the barriers begin to fall.

Under these conditions when the plunger is pressed the NR energises and remains energised over the (MROT)JPR de-energised, NR energised (Fig 9).

Ten seconds after the barriers reach 81 degrees the (MROT)JR will energise followed by the (MROT)JPR (Fig 9).This will give the pulse to the (DWL)YJR via (LCU)NCSR energised. (DWL)YJPR de-energised, NR energised, and (MROT)JPR energised. When the (MROT)JPR energises it de-energises the NR which is slow to release, thus ensuring the pulse to the (DWL)YJR.

LOCAL CONTROL

When the operating department send an attendant to the crossing he will unlock the door to the LCU and de-energise the (LCU) (DOOR)CR which inhibits the operation of the drivers white light.

When the LCU switch is turned from "AUTO" to "LOWER/HAND" the (LCU) NCSR will be de-energised isolating the (DWL)YJR, (CON)SR, and (LCU)SR (Fig 9). This will start the road signal sequence and lower the barriers. With the barriers down turning the switch from "LOWER/HAND" to the "RAISE" position will energise the (CON)SR and initiate a normal raise sequence.

continued

INTRODUCTION TO LEVEL CROSSING CIRCUITRY

With the barriers raised, turning the switch from "RAISE" to the "AUTO" position shall start the normal lowering sequence. After the barriers are proved down the (LCU)NCSR will energise, and energise the (CON)SR provided the strike in controls are normal. The (CON)SR will energise the (LCU)SR, and these two relays will allow the (CON)JR to energise and continue the barrier raising sequence (Fig 9). Closing the LCU door is proved in the (DWL)R's (Fig 14).

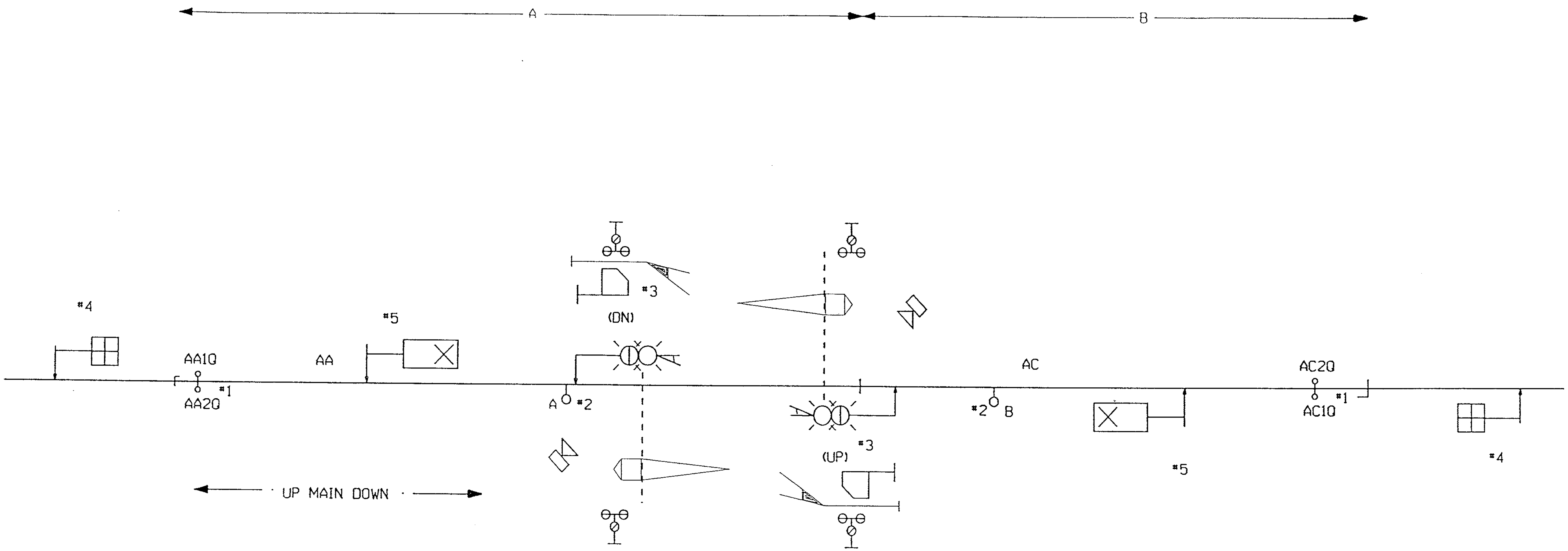
The following circuits appertaining to A.B.C.L's have not been discussed in this module due to limited time:-

Hand Operation,
arrangements when signals located near crossing,
stop board,
stopping and non-stopping,and
shunting movements.

For further information make reference to the standard circuits and relevant principles.

continued

INTRODUCTION TO LEVEL CROSSING CIRCUITRY



#1 TREADLES OPERATE RESPECTIVE TRACK CIRCUIT
#2 A & B TREADLES TO BE A MINIMUM OF 25m
FROM TRACK CIRCUIT JOINTS TO ALLOW DIRECTIONAL 'SR' TO
PICK BEFORE THE EXIT TC DROPS.
(THIS MAY BE REDUCED WHERE LINE SPEED IS LOW
BUT MUST ALLOW 500mS FROM TREADLE TO BLOCK JOINT)
#3 EMERGENCY PLUNGER TO RESET 'TIME OUT' LOCATED
IN HOUSING LOCKED BY DRIVERS No. 1 KEY
#4 ADVANCED WARNING BOARD
#5 CROSSING SPEED BOARD

FIGURE 6

continued

INTRODUCTION TO LEVEL CROSSING CIRCUITRY

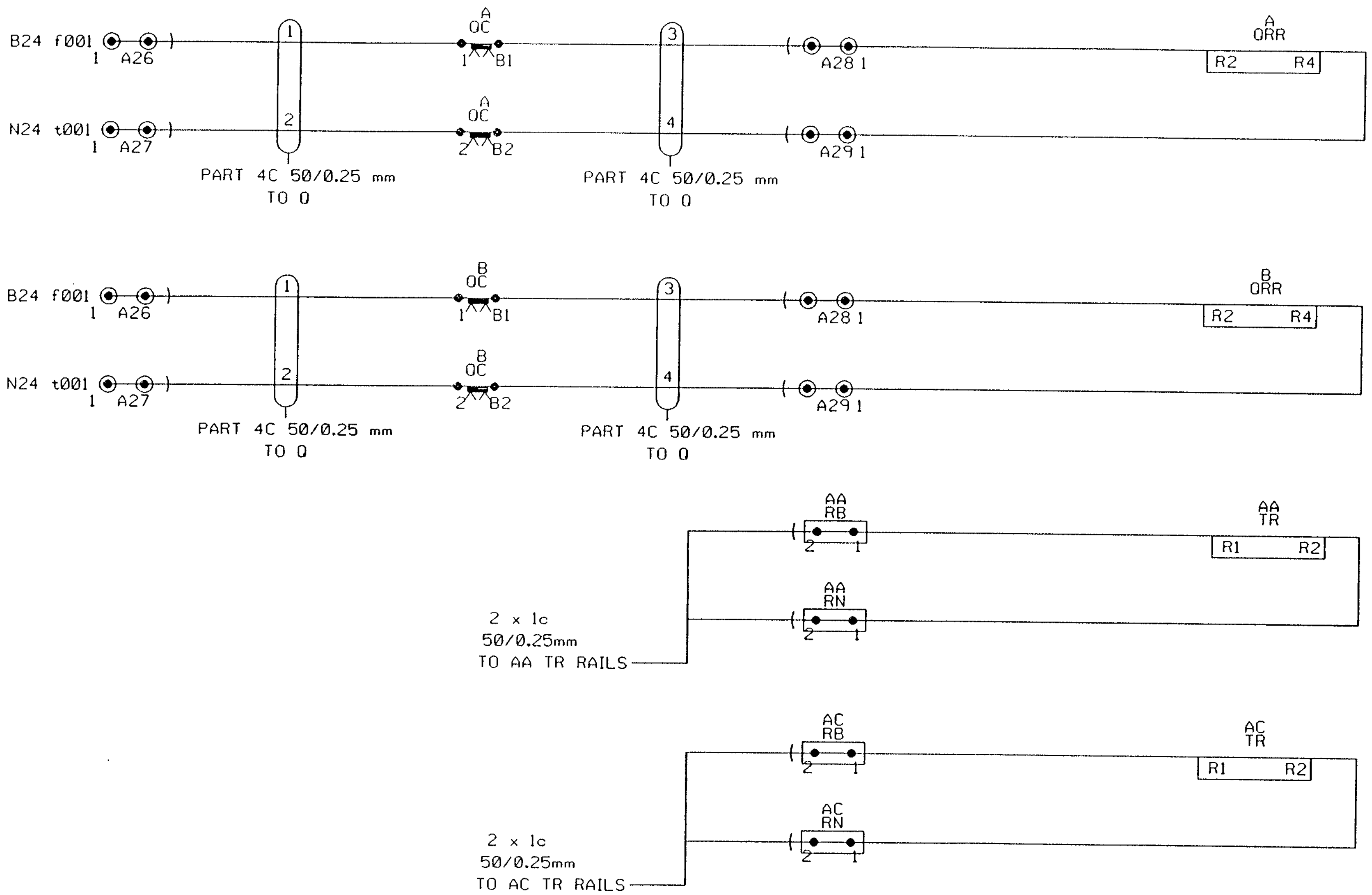


FIGURE 7

continued

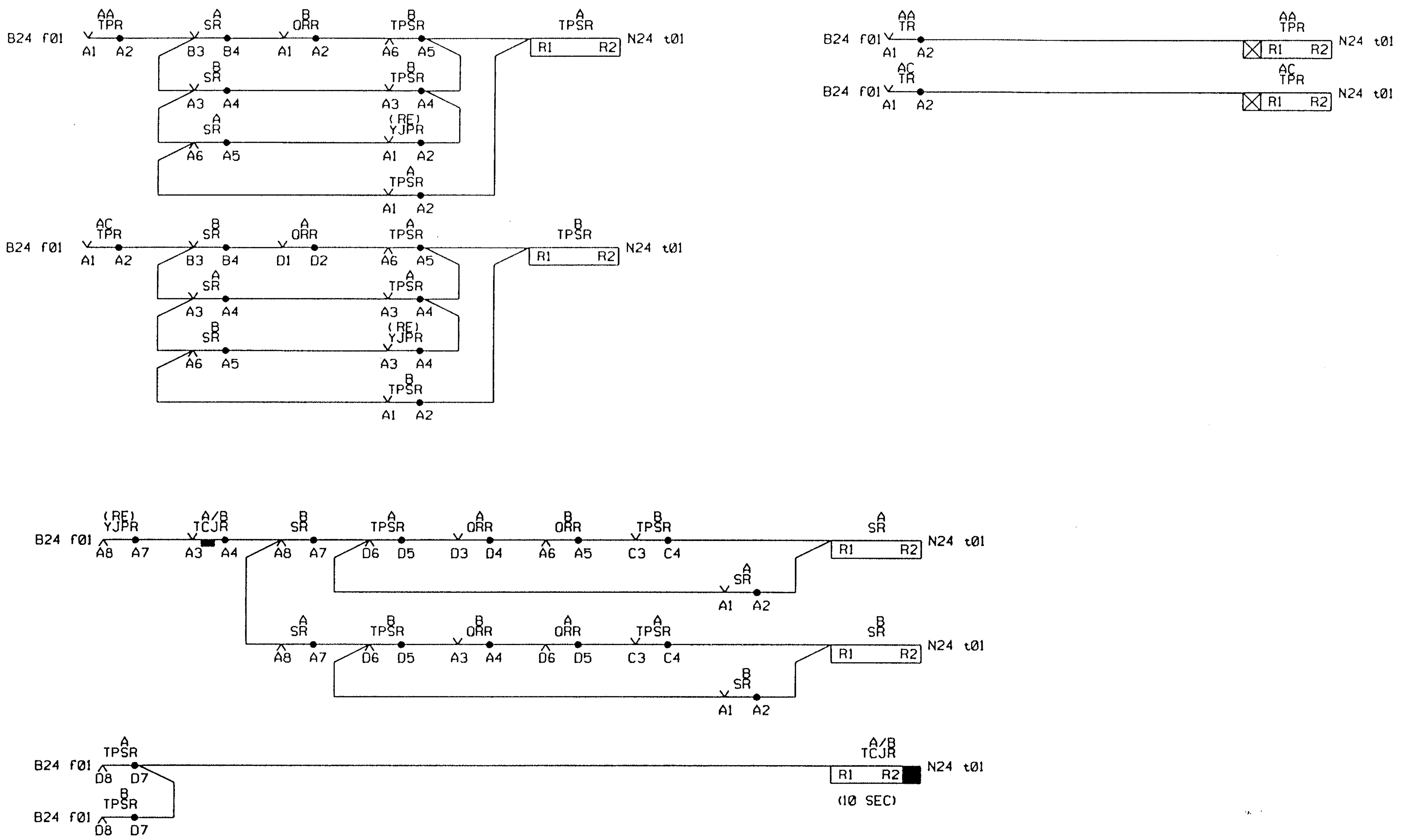


FIGURE 8

continued

INTRODUCTION TO LEVEL CROSSING CIRCUITRY

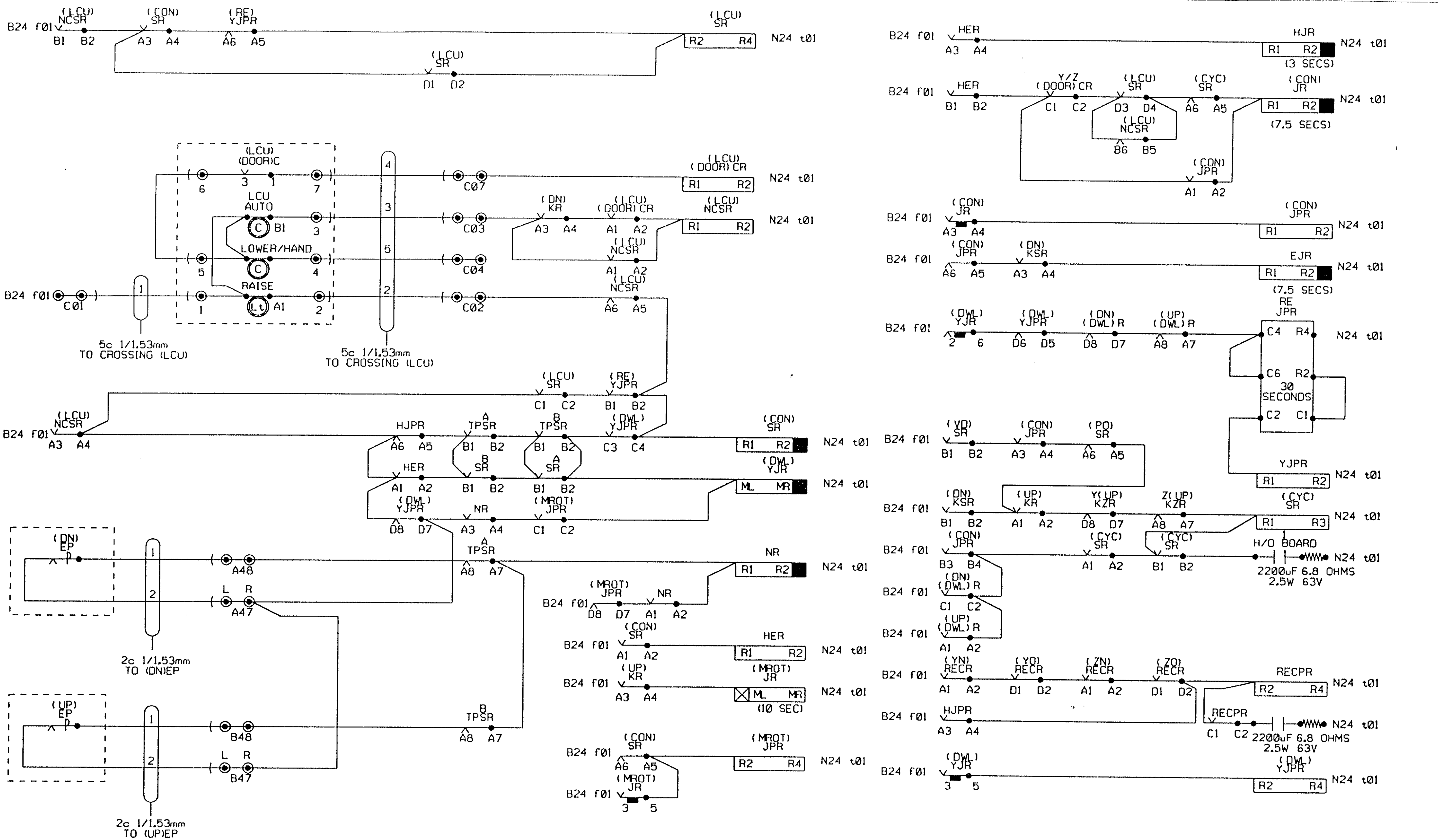


FIGURE 9

continued

INTRODUCTION TO LEVEL CROSSING CIRCUITRY

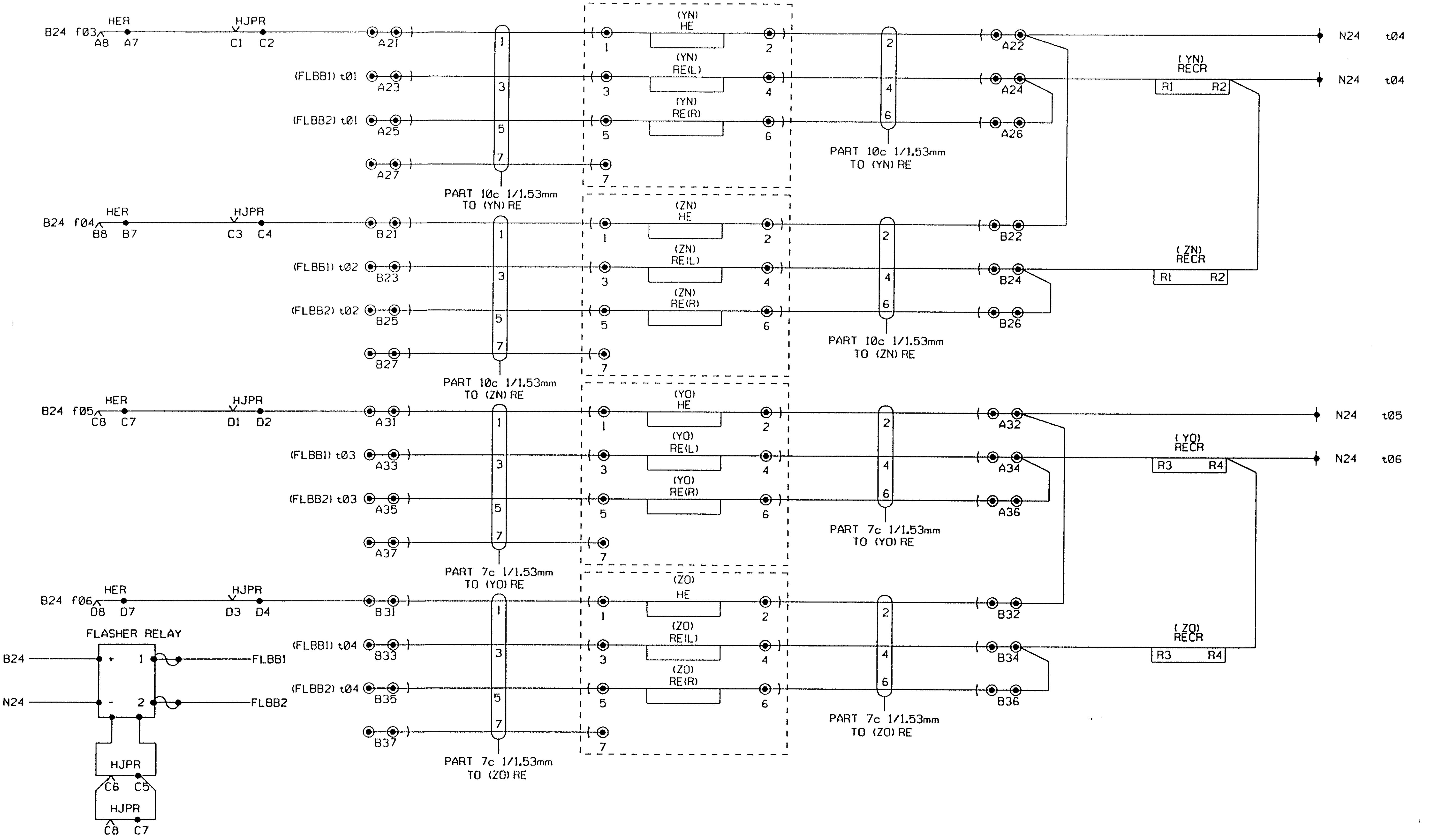
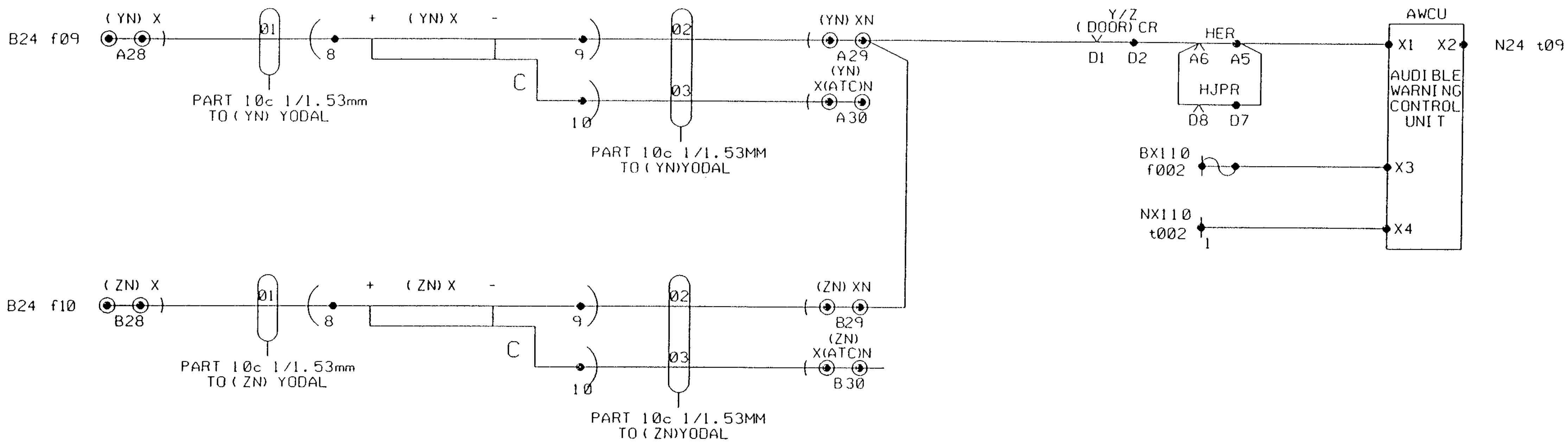


FIGURE 10

continued

INTRODUCTION TO LEVEL CROSSING CIRCUITRY



DAY	NIGHT	R1	R2
HIGH	MEDIUM	680R	STRAP
HIGH	LOW	1k5R	STRAP
MEDIUM	LOW	820R	680R
HIGH/MED	MED/LOW	680R	340R

NOTES:-

'YODALARMS', 3" TYPE Y03/RF2
(RF SUPPRESSED)
BR CODE 54/70215

RESISTORS NOT PROVIDED WITH UNIT

RECOMMENDED RESISTOR VALUES (SEE LEFT)
FOR USE WITH Y03/RF2 YODALARMS
2.5W + OR - 10%

WIRING TO BE 9/0.30mm MC1 BR SPEC 872

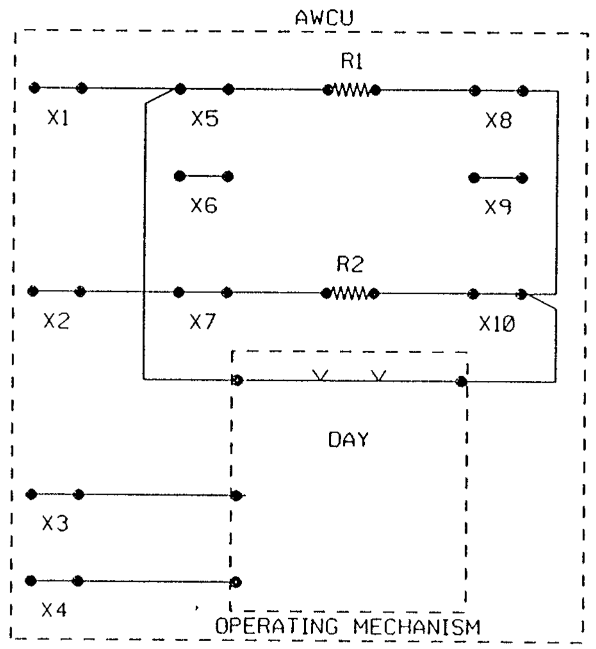


FIGURE 11

continued

INTRODUCTION TO LEVEL CROSSING CIRCUITRY

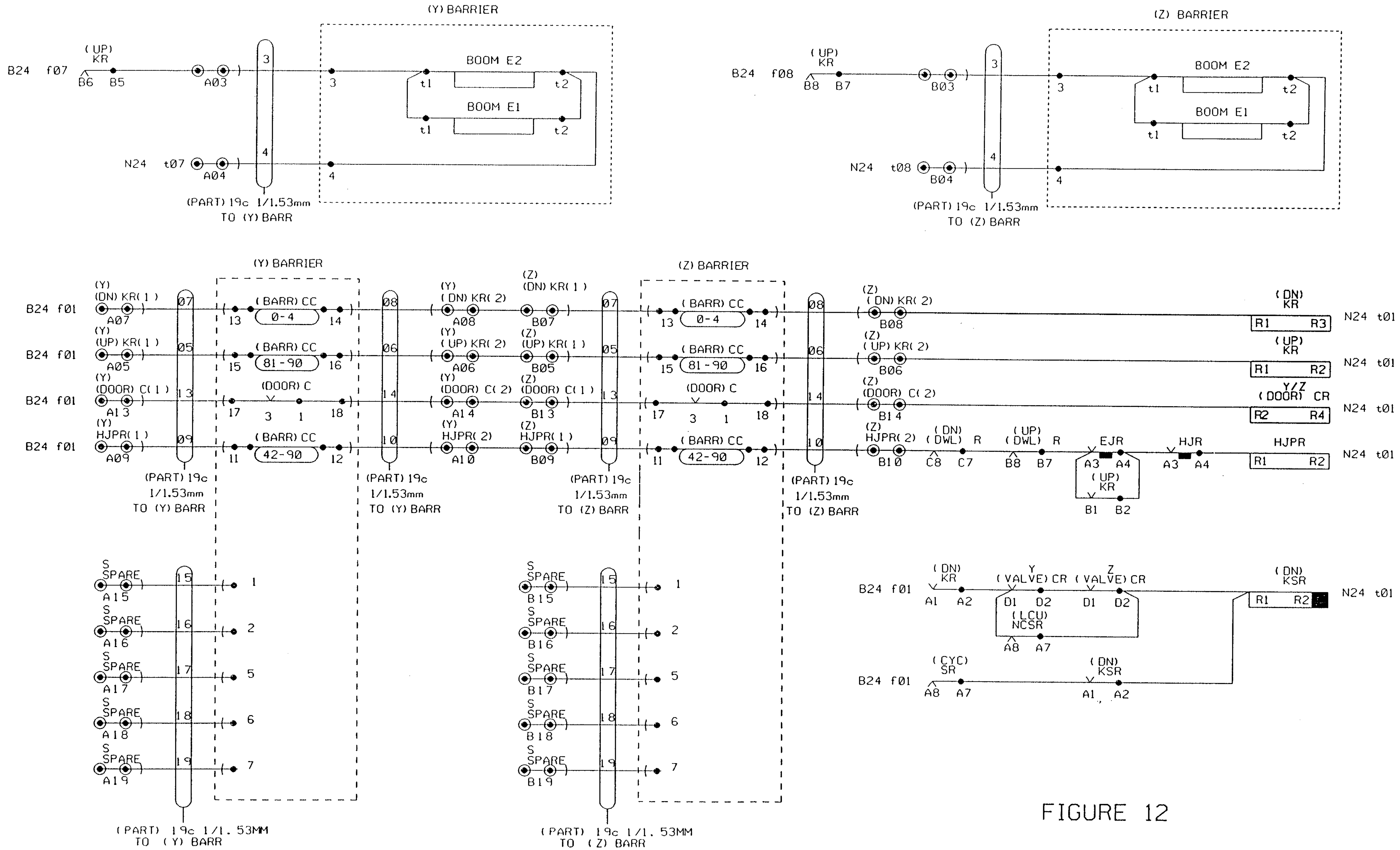


FIGURE 12

continued

INTRODUCTION TO LEVEL CROSSING CIRCUITRY

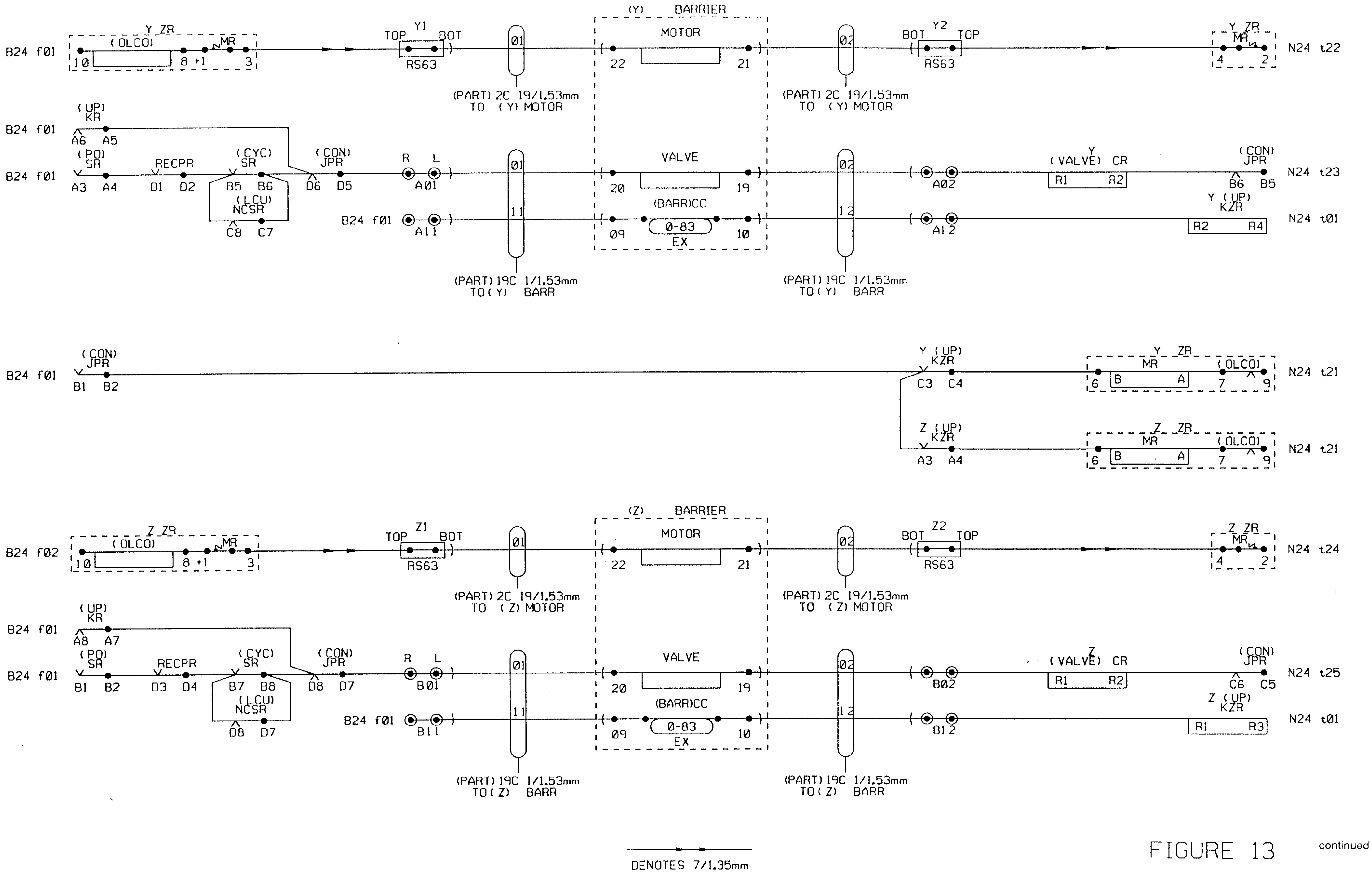


FIGURE 13

continued

INTRODUCTION TO LEVEL CROSSING CIRCUITRY

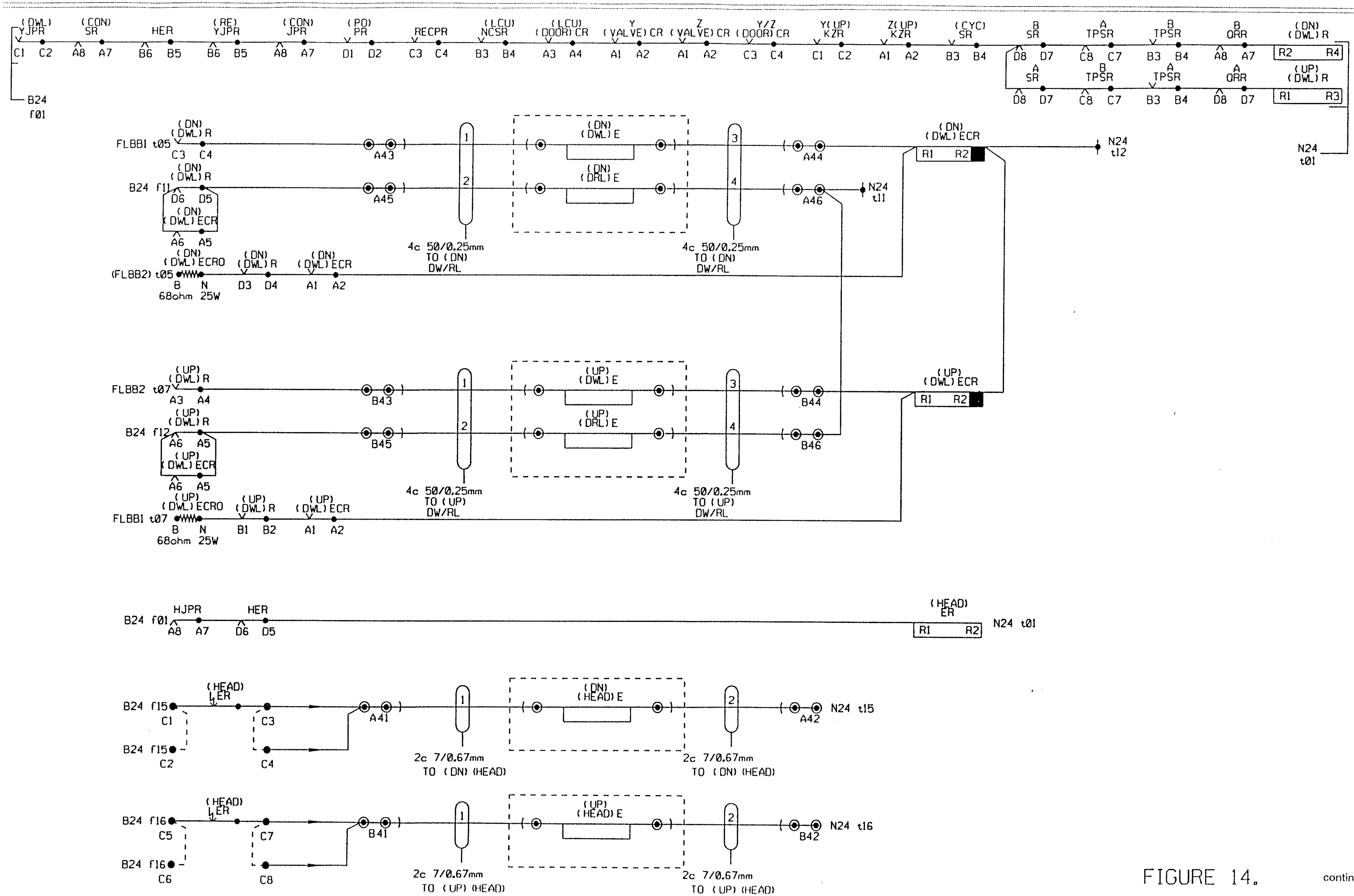


FIGURE 14.

continued

INTRODUCTION TO LEVEL CROSSING CIRCUITRY

The next to be discussed is the Automatic Open Crossing Locally Monitored (AOCL)

The AOCL crossing layout from the road user's view differs from the AHB and ABCL, mainly because there are no barriers and the road signals have a St Andrews cross mounted above the traffic lights. Audible warning devices are provided. The trains pass over the crossing at the crossing speed and the warning sequence is initiated automatically by the approaching train. The equipment at the crossing is monitored by the train driver who can halt his train short of the crossing if the equipment at the crossing is not functioning. On approaching the crossing, the driver will first encounter an advanced warning board, consisting of a black St. George's cross on a reflective white background. This is located at the required braking distance at line speed, to a further board displaying the crossing speed. This distance is subject to a minimum of 100m. The crossing speed board displays the speed at which a train may cross the roadway (different speeds are permitted for passenger and freight trains). This board consists of a black St. Andrew's cross on a reflective white background, mounted above the permissible speed (or speeds) for the crossing, which are shown in white figures on a black background. The crossing speed board must be placed in such a position that the crossing and its associated rail signal can be clearly seen by the driver of an approaching train. It must be at such a distance from the rail signal that it is possible for the driver to stop in the event of the rail signal failing to show a proceed aspect, subject to a maximum distance of 600m.

Finally the rail signal, which is usually placed at 5m from the edge of the crossing, normally displays a red flashing aspect (this being to denote that the red aspect does not constitute an absolute stop signal). When the crossing sequence has been initiated, and the red road signals are being correctly displayed, the rail signal shows a flashing white aspect, indicating to the driver that the crossing may be traversed at the allowable crossing speed.

Once initiation has taken place , the crossing is floodlit from lamps which are usually mounted at the rear of the rail signal.

The following conditions must apply:-

1. The maximum speed of trains is 55 mph and the driver must be able to stop short of the crossing from a point at which the crossing comes fully into view.

2. This type of crossing may not be suitable if the majority of trains require long braking times.

3. There must not be more than two running lines and two other lines.

4. The driver shall normally be at the leading end of the train.

5. The carriageway shall be wide enough for two vehicles to pass.

6. Road and rail traffic is limited to the table in Section 7.2.6 of the Railway Construction and Operating Requirements for level crossings.

continued

The crossing configuration for an Automatic Open Level Crossing Locally Monitored could be any one of the following but we are going to look at the application of Automatic Open Crossing Locally Monitored on a single line:-

a). Single Line,
b). Single Line with crossing track,
c). Double Line Bi-Directional,
d). Double Line Bi-Directional with crossing track.

OPERATING CYCLE

When the operating cycle for the road traffic light signals is initiated, the Amber lights shall show for approximately three seconds, after which they shall cease to show and the Red lights shall begin to flash. The audible warning shall begin when the Amber lights show.

Trains shall not arrive at the crossing in less than 27 seconds after the Amber lights first show, but should arrive as soon as possible thereafter. Where crossings are longer than 15 metres this time should normally be increased by one second for every additional 3 metres of crossing length measured from the Stop line to the point at which all vehicles would be clear of the railway on the far side of the crossing. At least 95% of all trains must arrive within 75 seconds and 50% within 50 seconds.

The Red lights shall cease to show and the audible warning shall cease as soon as possible after a train has cleared the crossing, but, if another train approaches the crossing, the lights shall continue to flash unless at least ten seconds could elapse after the lights have been extinguished before the operating cycle recommences for the other train.

If the lights are to continue to show for another train, as soon as one train arrives at the crossing the illuminated “Another Train Coming” signs shall begin to flash and the warbling rate of the audible warning shall be increased.

Let us now look at how the circuitry operates when a train travels in the down direction. As said previously it helps to understand how signalling circuitry operates if you are able to decide what the normal state of the relays are. Below is a list showing the normal state of the relays (energised/de-energised) with no train in the vicinity.

continued

RELAYS ENERGISED

AA TR
AA TPR
AC TR
AC TPR
A TPSR
B TPSR
(CON)SR
HJR
HJPR
(DWL)YJR
(DWL)YJPR
(PO)PR
NZR
HER
(LCU)NCSR
(LCU)(DOOR)CR
(LCU)SR
(MROT)JR
(MROT)JPR

RELAYS DE-ENERGISED

A SR
B SR
A/B TCJR
(HEAD)ER
(DWL)CR
(DN)(DWL)R
(UP)(DWL)R
(RE)YJPR
NR
(RE)YJR

TRAIN STRIKES IN "IN THE DOWN DIRECTION"

When AA track circuit becomes occupied it causes the following relays to de-energise AATR, AATPR and ATPSR. The de-energised ATPSR will energise A/B TCJR (figure 16).

With A TPSR de-energised the (CON)SR will become de-energised, because its path keeping it energised via the following:-

(LCU)NCSR Energised, HER Energised,
A TPSR Energised, B TPSR Energised and
(DWL)YJPR Energised is broken (Figure 17)

continued

At the same time as the (CON)SR de-energising the feed to (DWL)YJR is broken. This relay will not drop straight away as it has a slow to release feature of 180 seconds.

When the (CON)SR becomes de-energised the HER is also de-energised. The HER back contacts start the audible warning (Figure 19), and causes the Yellow road signals (YN)HE, (ZN)HE, (YO)HE and (ZO)HE to light (Figure 20), via the following:-

HER De-energised and HJPR Energised.

The de-energisation of the HER also cuts off the feed to the HJR. This is a slow to release relay which will drop after 3 seconds. (Figure 17).

As soon as the HJR de-energises it causes the HJPR to do the same and this in turn extinguishes the yellow road signals (therefore the yellow road lights will show for 3 seconds) and illuminates the red flashing road traffic signals (YN)RE(L), (YN)RE(R), (ZN)RE(L), (ZN)RE(R), (YO)RE(L), (YO)RE(R), (ZO)RE(L) AND (ZO)RE(R). (Figure 20)

The flashing B24 Busbar is not live until the HJPR de-energises and this allows a flashing output from the Flasher unit.

The de-energised HER and HJPR also energises the (HEAD)ER (Figure 17) which when energised illuminates the two simulated train headlamps, (UP)(HEAD)E and (DN)(HEAD)E at the crossing (Figure 21).
When the red flashing road signals become illuminated the four RECR relays, (YN)RECR, (ZN)RECR, (YO)RECR and (ZO)RECR will energise proving that all the road signals are intact at the crossing, (Figure 20).

If all the RECR relays energise, the (DWL)CR will be allowed to energise (Figure 18) via the following:-

RELAYS ENERGISED

(LCU)(DOOR)CR
(PO)PR
(YN)RECR
(YO)RECR
(ZN)RECR
(ZO)RECR
(LCU)NCSR
(DWL)YJPR

continued

RELAYS DE-ENERGISED

(CON)SR
(RE)YJPR
HER

The RECR relay (Figure 20) for each unit has its feed supplied alternately from the flasher unit supplies FLBB1 and FLBB2. If one of the lamps is defective the appropriate RECR will energise and de-energise as each alternate lamp is lit or not as the case may be. To ensure the (DWL)CR does not drop when the failure of one lamp occurs a capacitor/resistor network with a stick contact of the (DWL)CR will keep the (DWL)CR energised during the period the RECR de-energises and energises (Figure 18).

Of course if both red traffic road lights fail on a particular pedestal then the (DWL)CR will ultimately de-energise when the capacitor/resistor network discharges.

Also energising the (DWL)CR will energise the (DN)(DWL)R via:-

(DWL)CR Energised, B SR De-energised, NZR Energised
A TPSR De-energised, B QRR De-energised, B TPSR Energised.

This is selective in as much as the energisation of the (DN)(DWL)R will only change the drivers flashing red light to a flashing white light in the DN direction. The drivers flashing red light will continue to be displayed in the Up direction (Figure 21).

ARRIVAL OF THE TRAIN AT THE CROSSING

The front of the train strikes A treadle energising A QRR and A SR (Figure 16). It should be pointed out that the direction of initiation is determined by whichever SR is energised. It then strikes B treadle energising B QRR which de-energises the (DN)(DWL)R replacing the DN(DWL) Signal to a flashing red (Figures 18 and 21). The train occupies AC track circuit, this in turn de-energises B TPSR.

Occupying AC track circuit means AC TR and AC TPR de-energise (Figure 16). As the rear of the train clears the crossing and clears AA track circuit it allows A TPSR to energise via the following :-

AA TPR Energised, A SR Energised, B QRR Energised
and B TPSR De-Energised.

continued

Provided the run on track circuit AA was not occupied for more than 3 minutes the (DWL)YJR remained energised (Figure 17), allowing the (CON)SR to energise via the following :-

(LCU)NCSR Energised, HJPR De-Energised,
A TPSR Energised, ASR Energised
and (DWL)YJPR Energised.

With the (CON)SR energised the (DWL)CR was de-energised (Figure 18).

When the (CON)SR energised the (MROT)JPR (Figure 18) de-energised, this allows the HER (Figure 17) to energise. The HER energised will silence the audible warning (Figure 19), and de-energise the (HEAD)ER (Figure 17) extinguishing the train simulated headlights (Figure 21).

When the HER energised the HJR energised and this in turn energised the HJPR via the following :-

(DN)(DWL)R De-Energised, (UP)(DWL)R De-Energised
and the HJR Energised. (Figure 17)

The energised HJPR extinguishes the flashing Red road signals by disconnecting the output from the Flasher unit (Figure 20). It also energised the (MROT)JR after 10 seconds, followed by the (MROT)JPR (Figure 18).

When the train clears AC track circuit AC TR, and B TPSR will energise. B TPSR energises via the following :-

AC TPR Energised, ASR Energised
and A TPSR Energised (Figure 16).

ASR is de-energised indirectly when B TPSR energises because a back contact of this relay is in the pick path of A/B TCJR. A/B TCJR de-energises and this “breaks” the feed to ASR (FIGURE 16).

EQUIPMENT FAILURE

The "Principles of control" for AOCL crossings give detailed instructions on the operation of crossings during a failure, an extract of which follows:-

If the crossing sequence has been initiated as a result of a track circuit or other equipment failure, or remains operating irregularly after the passage of a train, the crossing shall be reset after 180 seconds. In this case the Drivers Flashing White Light shall be extinguished, followed 30 seconds later by the extinguishing of the red flashing road lights and the silencing of the audible warning devices.

continued

At AOCL on busy roads a plunger may be provided to enable the crossing Light sequence to be initiated after the crossing has 'timed out'. Depression of the plunger shall initiate the crossing sequence.

The drivers white light shall not be illuminated and trains shall only pass over the crossing when the train driver is satisfied that it is safe to do so.

Assume AA track circuit has failed and shows occupied. AA TR & AA TPR will de-energise which will in turn de-energise A TPSR (Figure 16). A TPSR de-energised will de-energise the (CON)SR (Figure 17) and disconnect the feed to the (DWL)YJR.

With the (CON)SR de-energised the normal sequence of events will take place (ie Amber road lights for 3 seconds, red flashing road lights, audible warning, drivers white light and simulated train headlamps).

After 180 seconds the (DWL)YJR and (DWL)YJPR will de-energise followed by the (DWL)CR (Figure 18). The de-energised (DWL)CR will de-energise the (DN)(DWL)R and this will extinguish the driver's flashing White light and illuminate the driver's flashing Red light (Figure 21).

The (RE)YJR and (RE)YJPR will energise 30 seconds after the (DWL)YJR de-energised (Figure 18) and this allows the (CON)SR to energise (Figure 17).

The 30 second delay ensures the road remains closed to traffic for 1/2 a minute after the drivers white light is extinguished before energising the (CON)SR.

The energised (CON)SR will energise the HER, HJR and HJPR. These relays silence the audible warning, extinguish the red flashing road signals and simulated train headlights as previously explained.

The crossing will remain in a failed state. The next approaching train will observe the flashing red signal, and stop at the crossing. The driver will then unlock the cupboard, housing the DOWN EMERGENCY PLUNGER.

After pressing and releasing the plunger the NR relay will energise momentarily via the (LCU) NCSR energised, ATPSR de-energised (Fig 17).

This short pulse is sufficient to re-energise (DWL)YJR & (DWL)YJPR for a further 180 seconds via (LCU)NCSR energised, (MROT)JPR energised and NR energised (Fig 17). When the NR energised it de-energised the NZR (Fig 17) isolating the (DWL)R's (Fig 18) and preventing any drivers white light from operating. When the (DWL)YJR received its pulse from the NR the (RE)YJR and (RE)YJPR were de-energised (Fig 18), which de-energised the (CON)SR (Fig 17). The de-energised (CON)SR will call the normal road signals into operation along with the audible warning as previously described, but the railway signals remain at flashing red.

continued

During this assumed track circuit failure the driver has 3 1/2 minutes to take his train over the crossing whilst the crossing is closed to road traffic. The crossing will automatically reset after 180 secs when the (DWL)YJR and (DWL)YJPR are again de-energised and they energise the (RE)YJR and (RE)YJPR after a futher 30 seconds, allowing the (CON)SR to energise and extinguish the road signals.

Should another train arrive at the crossing and the driver press the plunger just as the (CON)SR had energised after the previous train, the crossing must stay open to road traffic for a minimum of 10 seconds before the road signal sequence restarts.

Under these conditions when the plunger is pressed the NR energises and remains energised over the (MROT)JPR de-energised, NR energised (Fig 17). Ten seconds after the (CON)SR was energised the (MROT)JR will energise followed by the (MROT)JPR (Fig 18).

This will give the pulse to the (DWL)YJR (Fig 17) via (MROT)JPR energised, NR energised. When the (MROT)JPR energises it de-energises the NR which is slow to release, thus ensuring the pulse to the (DWL)YJR.

Local Control

When the operating department send an attendant to the crossing he will unlock the door to the LCU and de-energise (LCU) (DOOR)CR (Fig 17) which prevents any drivers white light from operating.

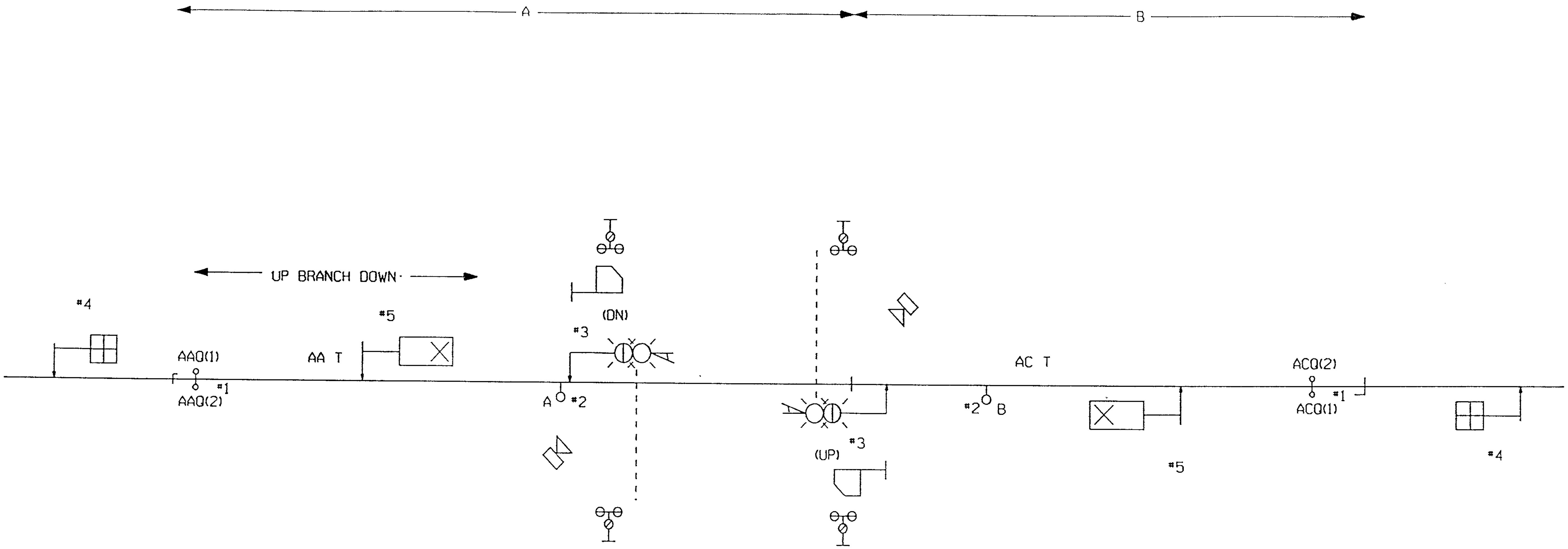
When the LCU switch is turned from "AUTO" to "ON" the (LCU)NCSR will be de-energised isolating the NR, (DWL)YJR, (CON)SR, and (LCU)SR (Fig 17), thus operating the road signals.

When the LCU switch is turned to "OFF" the (CON)SR is energised, extinguishing the road signals.

With the crossing restored after the failure, the LCU switch can be turned to "AUTO" and locking the door energises the (LCU) (DOOR)CR, (LCU)NCSR, and (LCU)SR.

continued

INTRODUCTION TO LEVEL CROSSING CIRCUITRY



\#1 TREADLES OPERATE RESPECTIVE TRACK CIRCUIT
\#2 A & B TREADLES TO BE A MINIMUM OF 25m FROM TRACK CIRCUIT JOINTS TO ALLOW DIRECTIONAL 'SR' TO PICK BEFORE THE EXIT TC DROPS. (THIS MAY BE REDUCED WHERE LINE SPEED IS LOW BUT MUST ALLOW 500mS FROM TREADLE TO BLOCK JOINT)
\#3 EMERGENCY PLUNGER TO RESET 'TIME OUT' LOCATED IN HOUSING LOCKED BY DRIVERS No. 1 KEY
\#4 ADVANCED WARNING BOARD
\#5 CROSSING SPEED BOARD

FIGURE 15

continued

INTRODUCTION TO LEVEL CROSSING CIRCUITRY

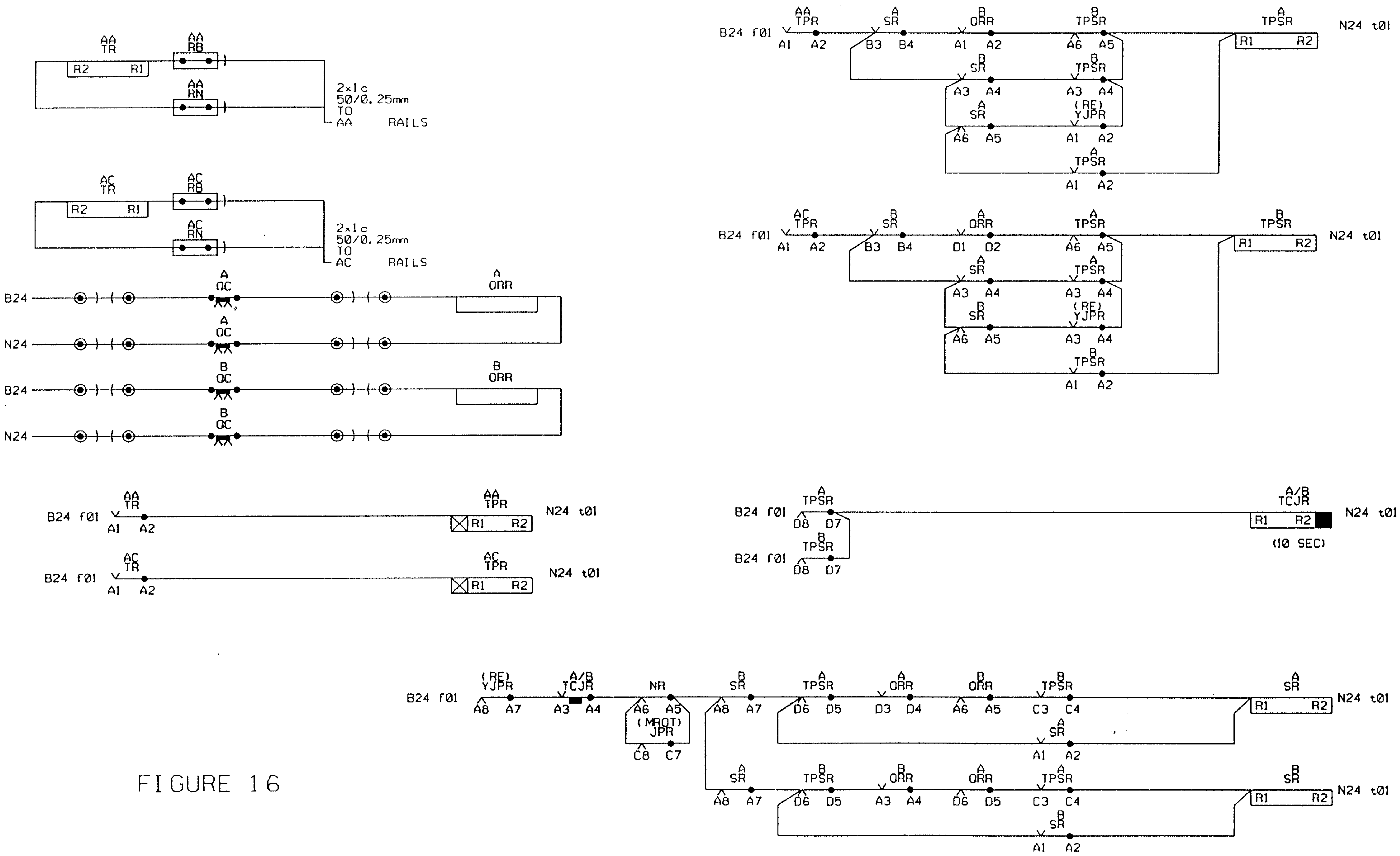


FIGURE 16

continued

INTRODUCTION TO LEVEL CROSSING CIRCUITRY

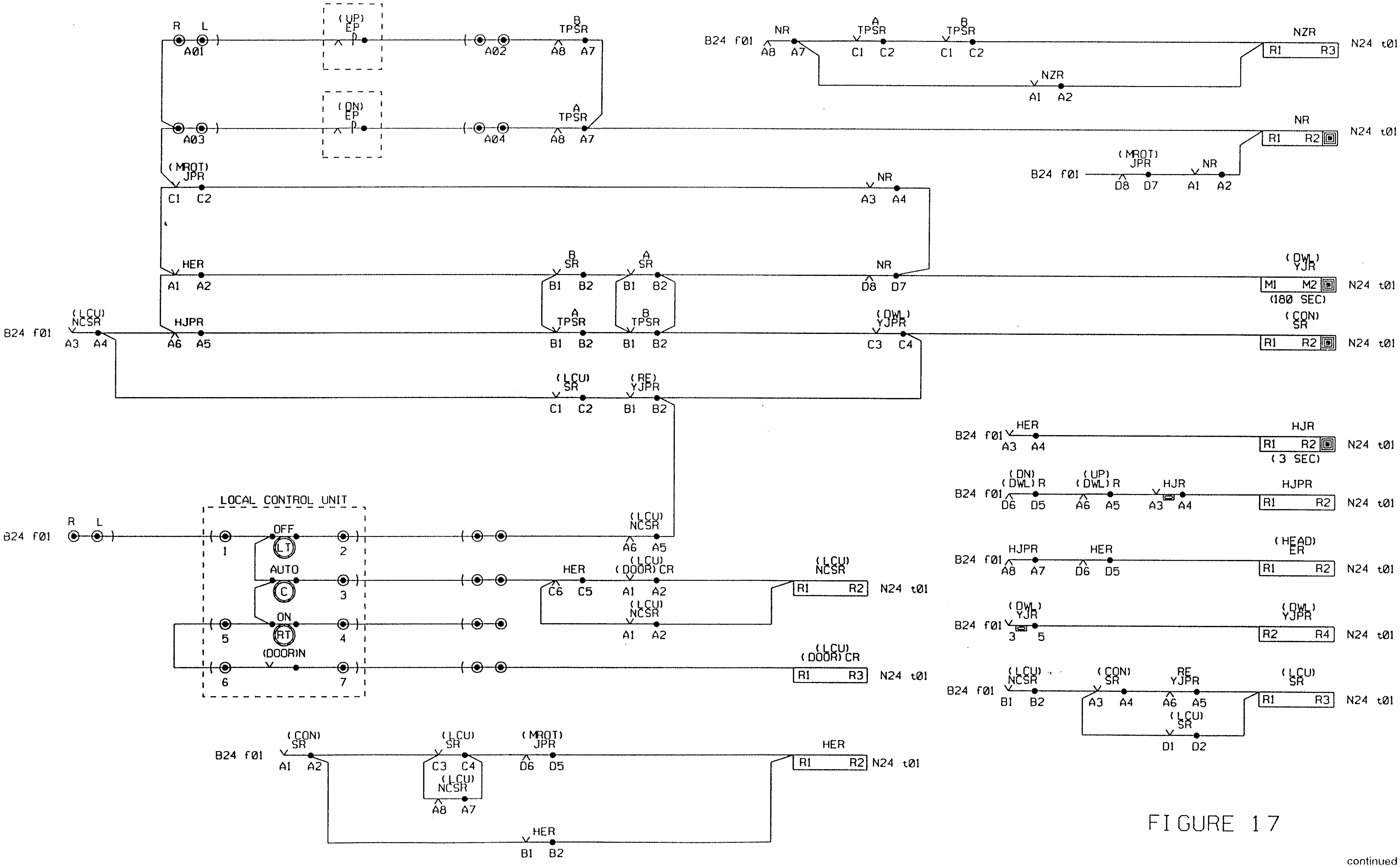


FIGURE 17

continued

INTRODUCTION TO LEVEL CROSSING CIRCUITRY

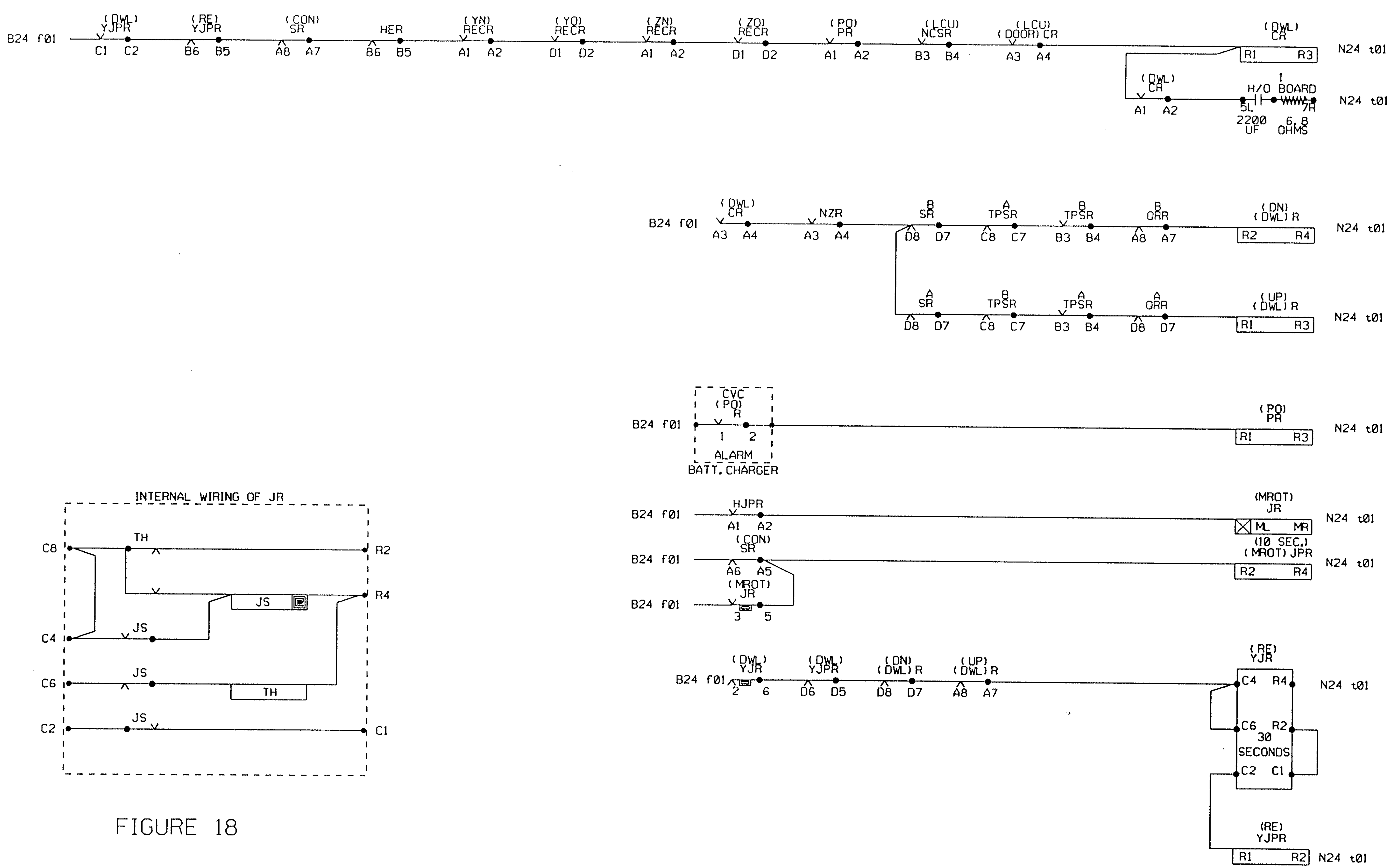
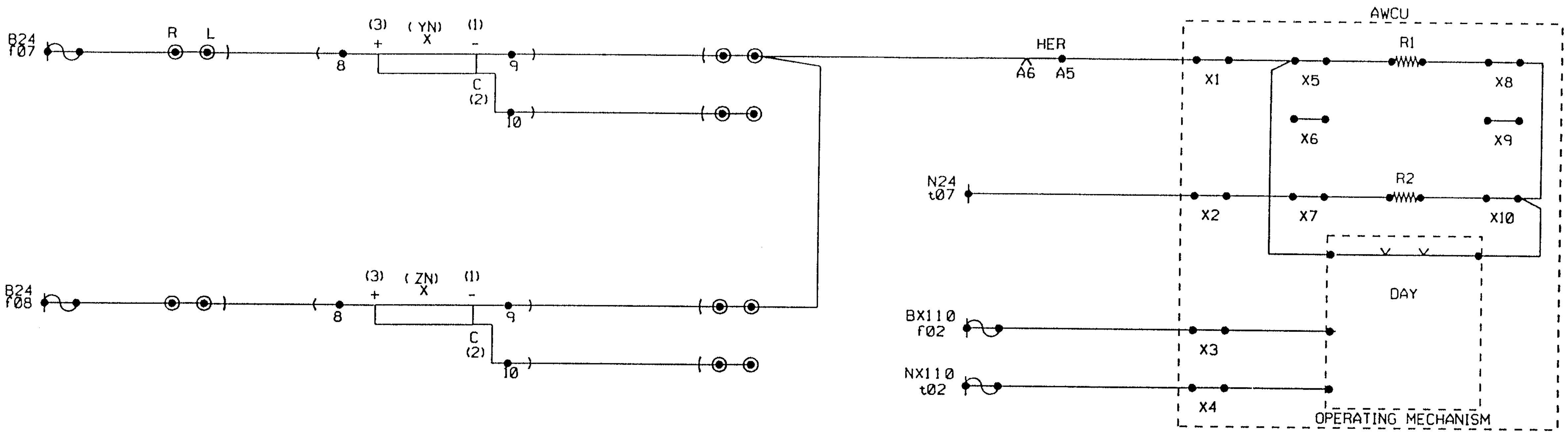


FIGURE 18

continued

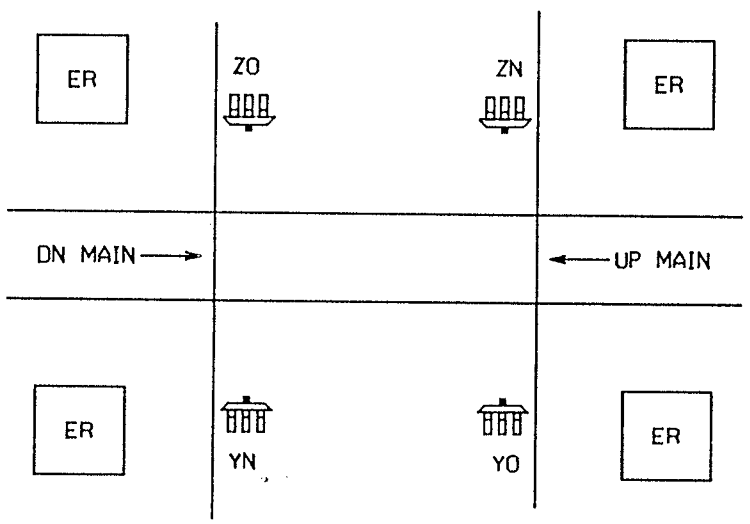


DAY	NIGHT	R1	R2
HIGH	MEDIUM	680R	STRAP
HIGH	LOW	1K5R	STRAP
MEDIUM	LOW	820R	680R
HIGH MED	MED LOW	680R	340R

NOTES:- 'YODALARMS'.3 TYPE YO3/RF2 (RF SUPPRESSED). BR CODE 54/70212.

RESISTORS NOT PROVIDED WITH UNIT

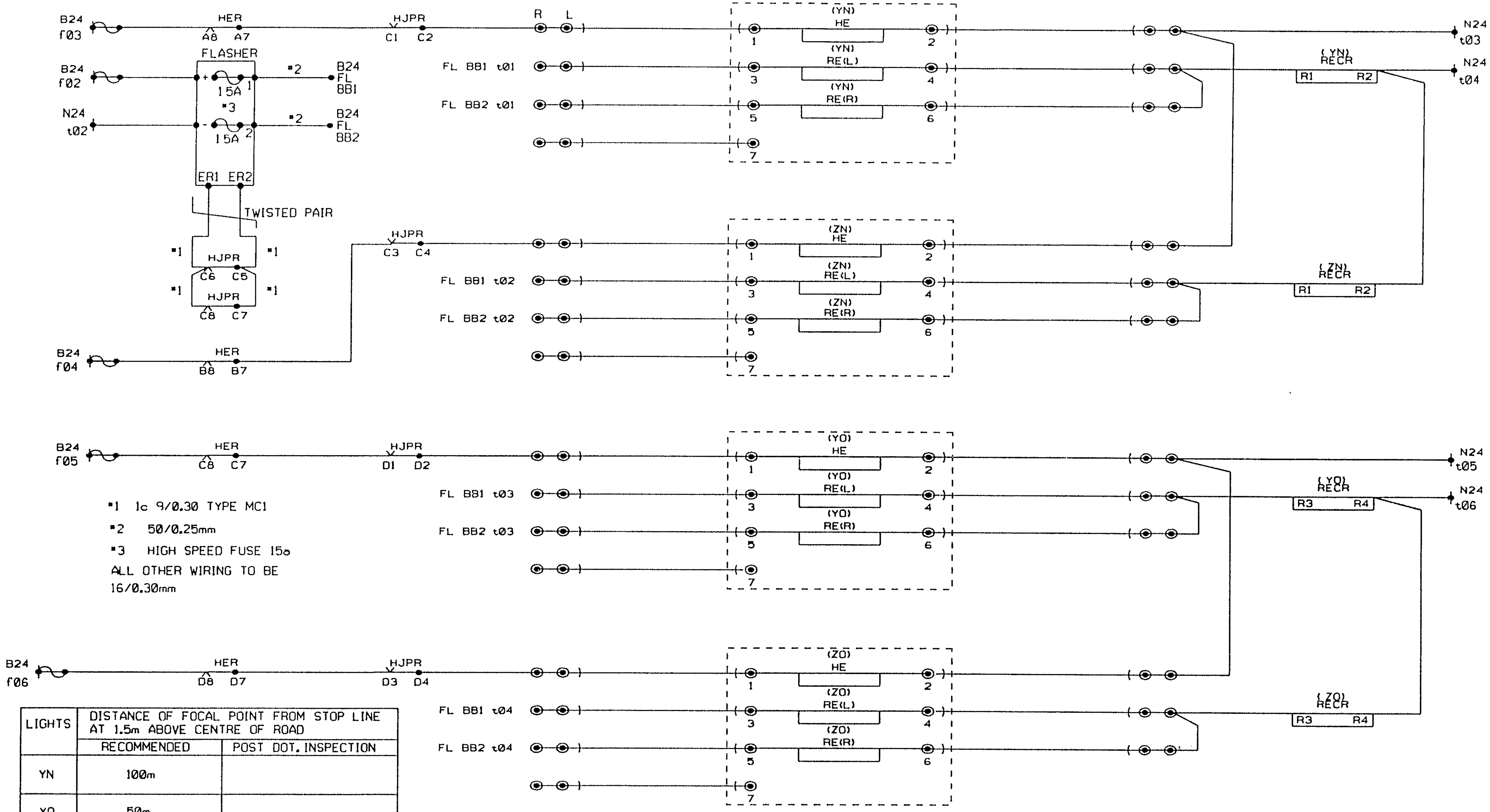
RECOMMENDED RESISTOR VALUES (SEE LEFT) FOR USE WITH YO3/RF2 YODALARMS 2.5W +/- 10%
WIRING TO BE 9/0.30mm MC1. BR SPEC 872



ER - POSSIBLE POSITION OF EQUIPMENT ROOM
(ACTUAL POSITION TO BE SHOWN)

FIGURE 19

continued



LIGHTS	DISTANCE OF FOCAL POINT FROM STOP LINE AT 1.5m ABOVE CENTRE OF ROAD	
	RECOMMENDED	POST DOT. INSPECTION
YN	100m	
YO	50m	
ZN	100m	
ZO	50m	

FIGURE 20

continued

INTRODUCTION TO LEVEL CROSSING CIRCUITRY

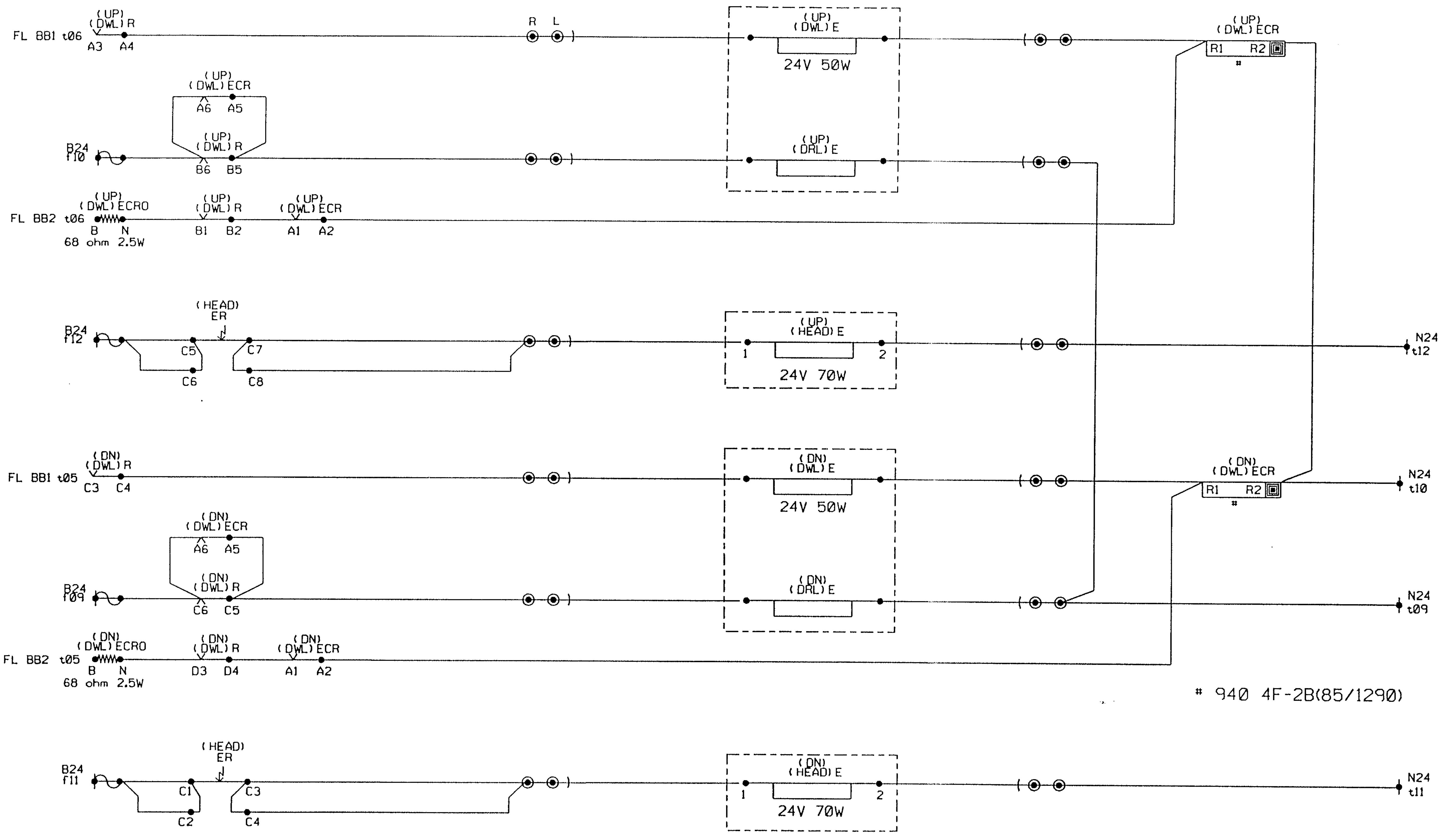


FIGURE 21

continued

Finally the last type of level crossing we are going to look at in this module is the Manned Barrier crossing.

There follows some of the Department of Transports main requirements which apply to a Manned Barrier Crossing. A manned barrier crossing is controlled by a signalman situated within 50 metres of the crossing, and with a clear view of it.

The other remaining types of crossing under the heading of Manually Controlled Barrier Crossings known as Remote Barrier Crossings, CCTV-Monitored Barrier Crossings, Staff Operated Barrier Crossings, and Trainman Operated Barrier Crossings are not covered in this module but for further information make reference to the Department of Transport Requirements.

Manned Barriers are generally suited for any situation but the following conditions shall apply :-

At those crossing where the barriers are normally maintained in the lowered position there shall be a maximum volume of road traffic of about 20 vehicles per hour and a line speed of not more than 160 km/h (100 mph). It therefore follows that if barriers are normally maintained in the raised position. No road traffic restrictions apply.

LEVEL CROSSING EQUIPMENT

BARRIERS

Barriers shall be provided which, when lowered, extend across the full width of the carriage and footways.

Two red electric boom lights (three on barriers longer than 6 metres) shall be fitted to each barrier to shine in both directions along the carriageway. One light shall be within 150mm of the barrier tip. They shall be lit except when the barriers are fully raised.

ROAD TRAFFIC SIGNALS

The description of controls, indications and operating sequences etc given in this module assume that Road Traffic Signals of the steady amber/twin flashing red type will be provided.

AUDIBLE WARNING DEVICES

Audible Warning Devices shall be of the electronic type emitting a warbling tone and these may be reduced in volume during certain hours (usually 2330HRS to 0700HRS).

continued

CONTROL AND INDICATION EQUIPMENT

The movement of the barriers shall be controlled by three push buttons arranged vertically as follows:-

RAISE

STOP

LOWER

Momentary depression of the lower button shall initiate the road traffic light sequence and the lowering of the barriers. Momentary depression of the raise button will cause the barriers to raise and the road traffic lights to extinguish. Depression of the stop button as the barriers are moving will cause the barriers to stop whilst maintaining the road traffic light sequence.

It shall not be possible to clear any protecting railway signals unless a fourth button marked "CROSSING CLEAR" has been operated by the signalman to confirm that the crossing has been observed to be clear and free of all obstructions.

The crossing clear button shall only be effective when the barriers are detected down. The "Barriers Down" indication shall flash until the "Crossing Clear" button has been operated; the indication shall then become steady. The button following relay must be proved to have returned to its normal position before the protecting signal can show a proceed aspect, to ensure the crossing is confirmed to be clear each time the barriers are lowered.

The crossing clear function shall remain effective until the barriers are next instructed to rise.

Where automatic raising and/or lowering are provided, a switch shall be provided for each facility to select either manual or automatic operation. Selection of automatic operation shall inhibit the manual control of that function.

The control unit or panel shall incorporate indications of the position of the barriers which shall be labelled UP and DOWN and an indication that the road traffic signals are working. The indications shall be separate from the buttons.

continued

HAND OPERATED ARRANGEMENTS

The following provisions for hand operation shall be made:-

A pump handle shall be provided in each barrier machine so that access is via a locked door (the operator's door) fitted with a Standard RKB 222 lock. It shall not be possible to close the operator's door unless the pump handle is in the stowed position; moving the pump handle to the operating position closes the valve which arrests the movement of the barriers, a further pumping action of the handle causes the barriers to raise.

The opening of the operator's door of any barrier machine shall:-

i). prevent the clearance of the crossing protecting signals (however, if a protecting signal is already showing a proceed aspect it shall not be replaced to danger).

ii). prevent the raising of the barriers from the signalbox.

A two position switch labelled **NORMAL** and **HAND** shall be located close to the pump handle in one of the machines.

Turning the switch away from the NORMAL position shall lower **all** barriers from the raised position unless the pump handles have previously been placed in the operating position (placing any pump handle in the operation position will maintain that barrier in the raised position).

When the switch is turned to the Hand position the controls to the road traffic signals shall be arranged such that when electrical power is available, the lowering of any barrier below 80 degrees will cause the red traffic lights to show until all the barriers are raised above 80 degrees.

If the barriers are not already in the lowered position, they should be lowered from the signalbox or by use of the Normal/Hand switch, prior to hand operation.

The audible warning devices shall not sound whilst the barriers are being lowered by hand.

SIGNALLING PRINCIPLES

RAILWAY SIGNALLING ARRANGEMENTS

The crossing shall be protected by Stop and Distant signals which may be either in semaphore or colour light form, the distant signals may be in the form of Reflectorised Distant Boards where appropriate.

continued

Track circuiting shall be provided between the signal and the level crossing to hold the barriers down whilst a train is travelling between the signal and the crossing. (A track circuit is required for release of approach locking).

An emergency release shall be provided to enable the barriers to be raised in the event of track circuit failure. This shall take the form of a conventional sealed release plunger situated at the normal operating point of the crossing. The release shall only bridge out track circuit controls.

SIGNALLING INDICATIONS

Track circuits, overlay track circuits or treadles and all other controls (e.g. approach locking) effective on the barriers shall be indicated in the controlling signalbox.

Approach locking shall be provided in accordance with BR Standard Signalling Principle No 19.

Automatic raising or lowering may be provided at manually controlled barrier crossings.

SIGNALLING CONTROLS AND INTERLOCKING

In addition to the standard railway signalling controls the following controls associated with the level crossing shall be provided.

PROTECTING SIGNALS

Where the crossing is normally open to road traffic, all stop signals protecting the level crossing shall be controlled signals. The protecting signals shall be operated for each movement over the crossing.

The protecting signals shall detect the barriers down and the crossing clear plunger pressed and released at time of clearance only.

continued

MANUAL RAISE

It shall not be possible to initiate a manual barrier raise sequence unless all routes over the crossing have been cancelled out and:-

i). the protecting signals are at danger and free of approach locking;

ii). any levers controlling the protecting signals are normal and locked;

iii). any route and track circuit locking is free.

AUTOMATIC RAISING

Automatic raising may be provided where the protecting signals are in colour light form or motor operated semaphore signals.

OPERATING CYCLE

The normal operating sequence, where road traffic light signals are provided and the barriers are normally raised, shall be:-

LOWERING

The amber lights shall show and the audible warning shall begin. Approximately 3 seconds later the amber lights shall be extinguished and the red lights shall begin to flash. Approximately 5 seconds later the barriers shall start to descend. On two-way roads where pairs of barriers are provided, the offside barriers shall not descend until the nearside barriers are fully down. The descent time for each barrier shall normally be 6 to 10 seconds. It may be necessary to arrange for an extra delay to the descent of exit barriers at long crossings in order to enable pedestrians to get clear. When all the barriers are down the audible warning shall stop. The red lights shall continue to flash.

RAISING

All the barriers shall begin to rise simultaneously and the road traffic light signals shall be extinguished before the barriers have risen above 45 degrees to the horizontal. Barriers shall normally rise in 4 to 10 seconds.

Let us now look at how the circuitry operates when a train travels in the down direction from Wootton Broadmead to Kempston Hardwick and the barriers are called to lower manually by the signalman. As previously stated it helps to understand how signalling circuitry operates if you are able to decide what the normal state of the relays (energised/de-energised) is. The list below details the normal state of the relays before the lower button is pressed.

continued

RELAYS ENERGISED

(CON)SR
(UP)KR
(UP)KPR
RER
(RAISE)R
(CON)JR
(CON)JPR
HJR
HJPR
(LOWER)R
(LOWER)SR
(FLD)JR
(FLD)KSR
(FLD)JPR
(HAND)R
(MAN LOWER)NPR
(BARR)CR

RELAYS DE-ENERGISED

XENR
XNSR
(RAISE)SR
(DN)KR(1)
(DN)KR(2)
(CC)SR
(DN)SR
(YN)RECR
(ZN)RECR
(YO)RECR
(ZO)RECR
(CC)NPR

MANUAL LOWERING

The lower button on the control pedestal is pressed by the signalman in the signalbox in response to a train approaching the crossing. This initiates the following series of events. The (MAN LOWER)NPR is De-energised (Figure 23) and this causes the (LOWER)SR to De-energise (Figure 24),which in turn cuts the feed path to the (CON)SR which is slow to drop due to the 6.8 ohm/470 Micro-Farad Resistor/Capacitor network (Figure 26).

When the (CON)SR does De-energise,the (UP)KE is extinguished. (Figure 23).

continued

The audible warning is energised via the (HAND)R energised, (DN)KR(2) and (CON)SR de-energised. (Figure 30)

The yellow steady road signals are fed over the (CON)SR de-energised and RER energised(Figure 29). The HJR (which is slow to release) de-energises 3 seconds after the (CON)SR de-energises. The HJR de-energising causes the HJPR to drop also, and this results in both the (CON)JR (Figure 26) feed being cut (which is also slow to release) and the RER becoming de-energised .(Figure 32)

Once the RER has dropped the yellow road signals are extinguished (3 seconds of amber road light sequence complete) and the red flashing road signals commence to flash. (Figure 29) The flashing B24 Busbar is not live until the RER de-energises and this allows a flashing output from the Flasher Unit (Flasher O/P(1) and Flasher O/P(2)).

When the red flashing road signals become illuminated the four RECR relays, (YN)RECR, (ZN)RECR, (YO)RECR and (ZO)RECR will energise proving that all the road signals are intact at the crossing. (Figure 29)

(Y)REKE and (Z)REKE are illuminated via the recently energised RECR's and the (HAND)R. (Figure 23)

The (CON)JR de-energised 5 seconds after its feed was removed, causing the (CON)JPR to de-energise. The (LOWER)R is de-energised by the (CON)JPR de-energising thus causing the barriers to descend. (Figure 26) The (FLD)JR has its feed removed by the (CON)JPR dropping. The (FLD)JR is a 20 second motorised timer which will now begin to count down.(Figure 27)

(YN) and (ZN) solenoids de-energise since the (LOWER)R is down, which causes the nearside barriers to commence lowering. (Figure 34)

When the nearside barriers have reached 80 degrees from the horizontal the barrier detection causes both the (UP)KR and (UP)KPR to de-energise. (Figure 32) This causes the boom lights on (YN), (ZN), (YO) and (ZO) barriers to illuminate. (Figure 32) Once the nearside barriers have lowered to within 4 degrees from the horizontal the (DN)KR(1) is energised via the (CON)JPR de-energised and the nearside barrier detection. (Figure 31) (DN)KR(1) energised leads the (YO) and (ZO) solenoids to de-energise, allowing the offside barriers to begin to lower. (Figure 34)

The offside barrier valves are maintained closed until the nearside barriers are detected down. When the offside barriers reach 4 degrees from the horizontal the (DN)KR(2) becomes energised via the (DN)KR(1) energised proving both nearside barriers down and the barrier detection. (Figure 32) This has the following effect on the circuitry.

continued

The feed to the (FLD)JR is now re-established via the following :-

XNSR de-energised and (DN)KR(2) energised. (Figure 27)

The (DN)SR(Figure 27) energises via the following:-

RELAYS ENERGISED

(HAND)R-crossing not in hand operation,
(DN)KR(2)-down detection.

RELAYS DE-ENERGISED

XNSR-barriers not called to raise,
HJPR-red road lights called,
(YN)MR-barrier contactors de-energised,
(ZN)MR-barrier contactors de-energised,
(YO)MR-barrier contactors de-energised,
(ZO)MR-barrier contactors de-energised,
(RAISE)R-barriers not called to raise,
(CON)SR-barriers not called to raise,
(CON)JPR-proves valves de-energised,
(RAISE)SR-proves previous raise call not stored,
(CC)NPR-crossing clear button not held in and
CC(SR)-crossing clear not stored from previous operation.

The audible warning is silenced by the energisation of (DN)KR(2) which energises when down detection is established. (Figure 30)

The (MANLOWER)NPR energises as soon as the signalman released the lower button. The (LOWER)SR repicks via (MAN LOWER)NPR and (DN)SR energised. (Figure 24). This causes the (LOWER)R to energise via the (LOWER)SR and (HAND)R energised. (Figure 26)

Once the signalman has observed that the crossing is clear and free of all obstructions he presses the crossing clear button.

This energises the (CC)NPR (Figure 23), which allows the (CC)SR to energise via the following relays energised :-

(DN)KR(2)- barriers fully down,
(DN)SR- barriers locked down,
(CC)NPR- "crossing clear" button operated (Figure 27).

continued

The (DN)KE flashes once the barriers are down and as the (CC)SR changes its state from de-energised to energised the indication becomes a steady light after the crossing clear is achieved (i.e (CC)SR energised) thus informing the signalman that the barriers are down and detected.

As soon as the crossing clear button is released the (CC)NPR will de-energise.

This will now allow 102 GR to energise(Figure 25), via the following:-

RELAYS ENERGISED

102B RLR
(DN)SR
(CC)SR
(BARR)CR-barrier pedestal door locked

RELAYS DE-ENERGISED

(CC)NPR
XENR

and subject to other standard signal controls i.e track circuits clear, signal lamp ahead alight etc the signal will display a proceed aspect.

MANUAL RAISING OF THE BARRIERS

After the train has passed and the signals have been replaced the signalman will press the "MANUAL RAISE" button. This energises the (MAN RAISE)NPR (Figure 23).

This in turn energises the (RAISE)SR (Figure 24) via the following :-

RELAYS ENERGISED

101 NLR
102A NLR
102B NLR
4 NLR
(MAN RAISE)NPR
(BARR)CR

continued

RELAYS DE-ENERGISED

(AUTO RAISE)NPR
(UP)KPR
(STOP)NPR

This then allows the XNSR to energise (Figure 26) via the following :-

RELAYS ENERGISED

(LOWER)SR
(RAISE)SR
(FLD)JPR
(HAND)R - inhibits signal/barrier controls when in "hand" operation.

RELAYS DE-ENERGISED

(CON)SR

As soon as the XNSR energises it breaks the feed to the (DN)SR (Figure 27) and causes it to de-energise, which then results in the (DN)KE indication being extinguished (Figure 23) and the (CC)SR being de-energised.

As soon as the (CC)SR de-energises this provides a path to energise the (CON)SR (Figure 26) via the following :-

RELAYS ENERGISED

(LOWER)SR
(RAISE)SR
(FLD)JPR
(HAND)R
XNSR
(HAND)R

RELAYS DE-ENERGISED

(DN)SR
(CC)SR

continued

RELAYS DE-ENERGISED

(AUTO RAISE)NPR
(UP)KPR
(STOP)NPR

This then allows the XNSR to energise (Figure 27) via the following :-

RELAYS ENERGISED

(LOWER)SR
(RAISE)SR
(FLD)JPR
(HAND)R - inhibits signal/barrier controls when in "hand" operation.

RELAYS DE-ENERGISED

(CON)SR

As soon as the XNSR energises it breaks the feed to the (DN)SR (Figure 27) and causes it to de-energise, which then results in the (DN)KE indication being extinguished (Figure 23) and the (CC)SR being de-energised.

As soon as the (CC)SR de-energises this provides a path to energise the (CON)SR (Figure 26) via the following :-

RELAYS ENERGISED

(LOWER)SR
(RAISE)SR
(FLD)JPR
(HAND)R
XNSR
(HAND)R

RELAYS DE-ENERGISED

(DN)SR
(CC)SR

continued

This then energises the HJR, HJPR, (CON)JR and (CON)JPR (Figure 26). The energised (CON)JPR de-energises the (DN)KR1 (Figure 31) and the (DN)KR2 (Figure 32) and energises the (RAISE)R via:-

(HAND)R, XNSR, (CON)SR,
(CON)JPR and (LOWER)R energised.

When the (RAISE)R energises it puts a feed to (YN), (ZN), (YO) and (ZO)MR's and they energise (Figure 33).

This allows all four barriers ,(YN), (ZN), (YO) and (ZO) to rise simultaneously unlike the order in which they come down.

At 42 degrees the RER energises (Figure 32) via the following :-

(FLD)KSR, (CON)SR, HJPR energised.

When the RER energises the red flashing road signals are extinguished (Figure 29).

As the barriers reach 81 degrees the (UP)KR and (UP)KPR energise (Figure 32). This allows the (UP)KE to light on the pedestal (Figure 23) via the following :-

(HAND)R, (CON)SR, (RAISE)R and (UP)KPR energised.

Also when the (UP)KR energised it extinguished the (YN), (ZN), (YO) and (ZO) barrier boom lights (Figures 31 and 32).

At 83 degrees (YN), (ZN), (YO) and (ZO)MR's de-energise (Figure 33) and the barriers stop having completed their rise.

BARRIERS FAIL TO RISE FULLY

In the event that the barriers fail to rise fully the following series of events will occur in the level crossing circuitry.

The circuitry operates in the same way as previously mentioned when the barriers are raised manually from the "manual raise button" being pressed and the (MAN RAISE)NPR energising to the red flashing road signals being extinguished. It is at this point that the circuitry differs.

continued

If you can remember when the XNSR energised (Figure 26) it broke the feed to the (FLD)JR (Figure 27)and so causes the timer relay to start up as soon as the barriers are called to rise. Up detection of the barriers must be achieved within 20 seconds of the feed onto the (FLD)JR being broken.

In this case this has not happened and the (FLD)JR has de-energised. This in turn has caused the (FLD)JPR to de-energise which de-energises the (FLD)KSR.(Figure 27) When the (FLD)KSR de-energises it causes the "FAILED KE" on the barrier pedestal to flash with the barrier switch in the "IN ORDER" position. The signalman also gets an audible alarm to tell him the barriers have failed when the barrier switch is in the "IN ORDER" position. (Figure 23)

The signalman turns the switch to the "FAILED" position and this makes

a) the Failed KE a steady indication and

b) extinguishes the audible alarm.

Because the barriers failed to achieve up detection within 20 seconds the (FLD)JPR de-energised causing the barrier contactors (YN)MR, (ZN)MR, (YO)MR and (ZO)MR to de-energise (figure 33).

This results in the barriers stopping their ascent

The (RAISE)SR de-energises because of the de-energisation of the (FLD)JPR on the following "pick path" of the (RAISE)SR (Figure 24)

XNSR Energised, (FLD)JPR Energised,
(DN)SR De-Energised, (RAISE)SR Energised,
(UP)KPR De-Energised, (STOP)NPR De-Energised and
(BARR)CR energised.

The de-energised (RAISE)SR and (FLD)JPR also cause the XNSR and the (CON)SR (Figure 26) to de-energise.

When the (CON)SR de-energises it causes the audible warnings to commence (Figure 30) and this results in a normal lowering sequence as mentioned previously in the module.
For any further information regarding level crossing circuitry make reference to the following documents.

RAILWAY CONTROL SYSTEMS M. LEACH,
DEPARTMENT OF TRANSPORT REQUIREMENTS,
LEVEL CROSSING PRINCIPLES,
B.R. RULE BOOK APPENDIX No. 9,
LEVEL CROSSING STANDARD CIRCUITS.

continued

INTRODUCTION TO LEVEL CROSSING CIRCUITRY

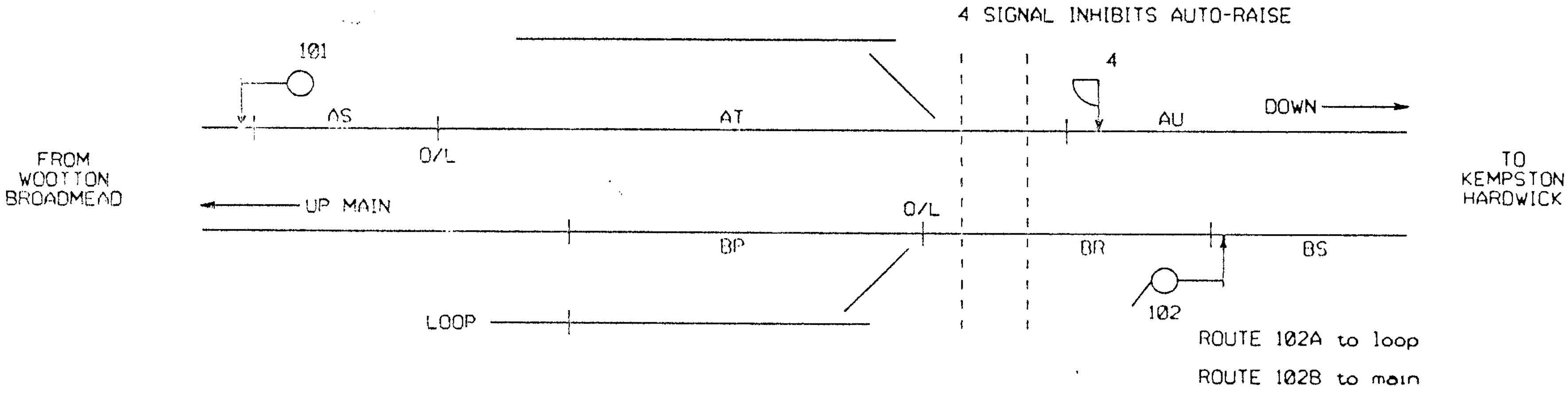


FIGURE 22

continued

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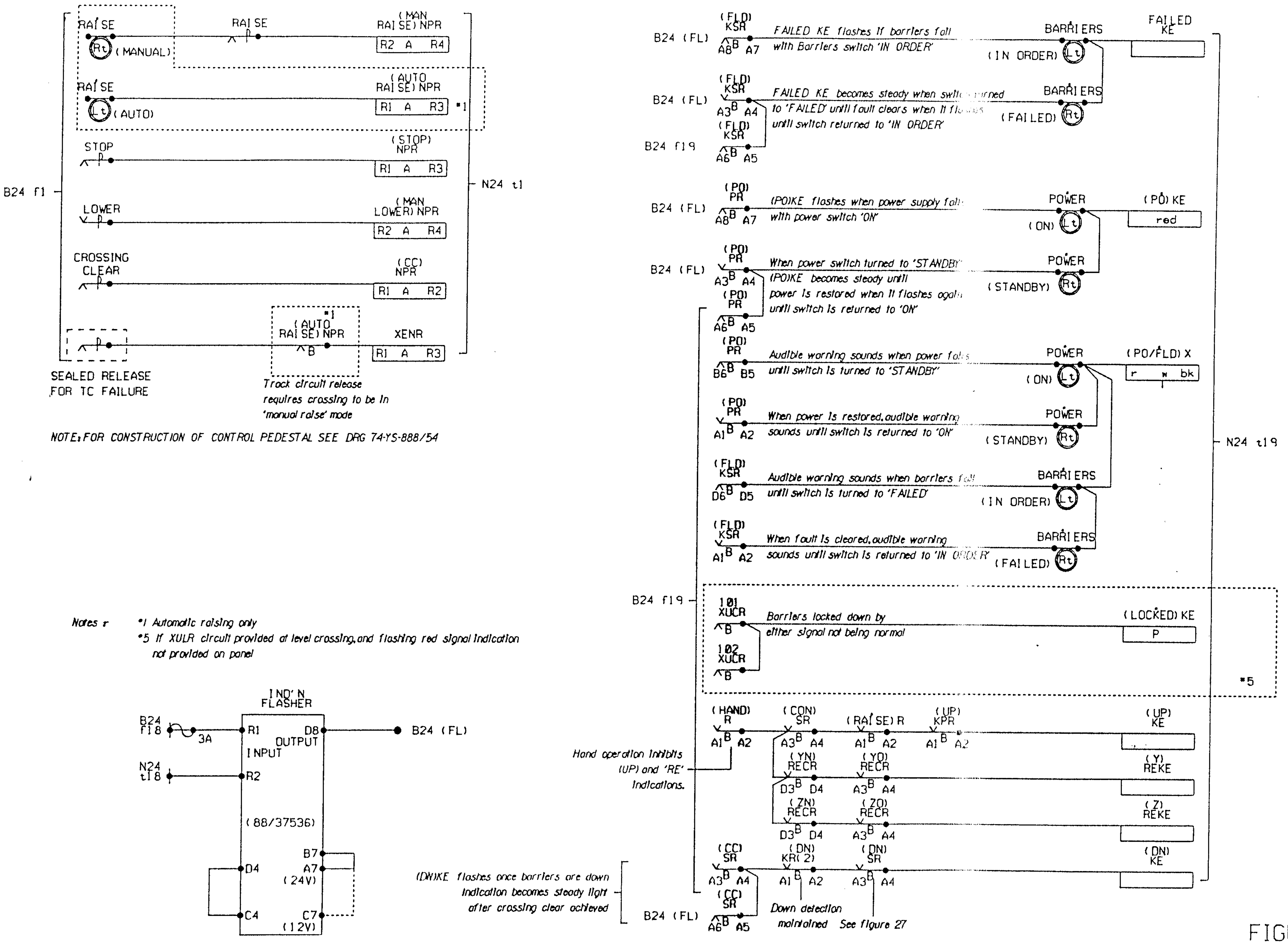
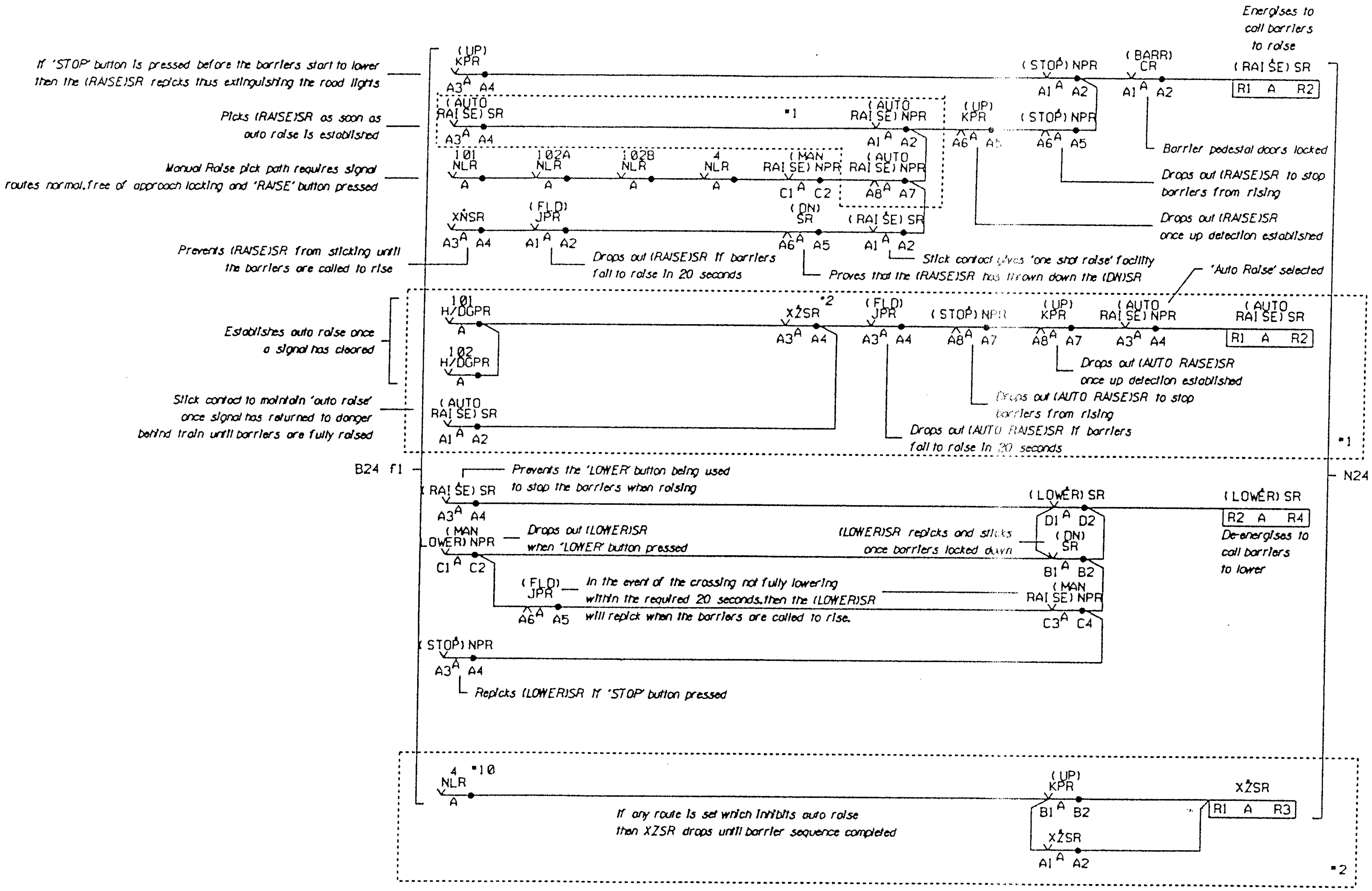


FIGURE 23

Detail of connection between control pedestal and relays ommited for clarity.

continued

INTRODUCTION TO LEVEL CROSSING CIRCUITRY



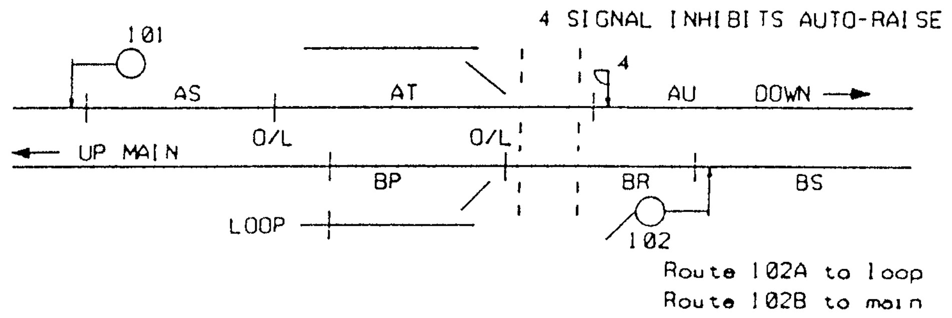
SEE FIG. 22 FOR SIGNALLING LAYOUT

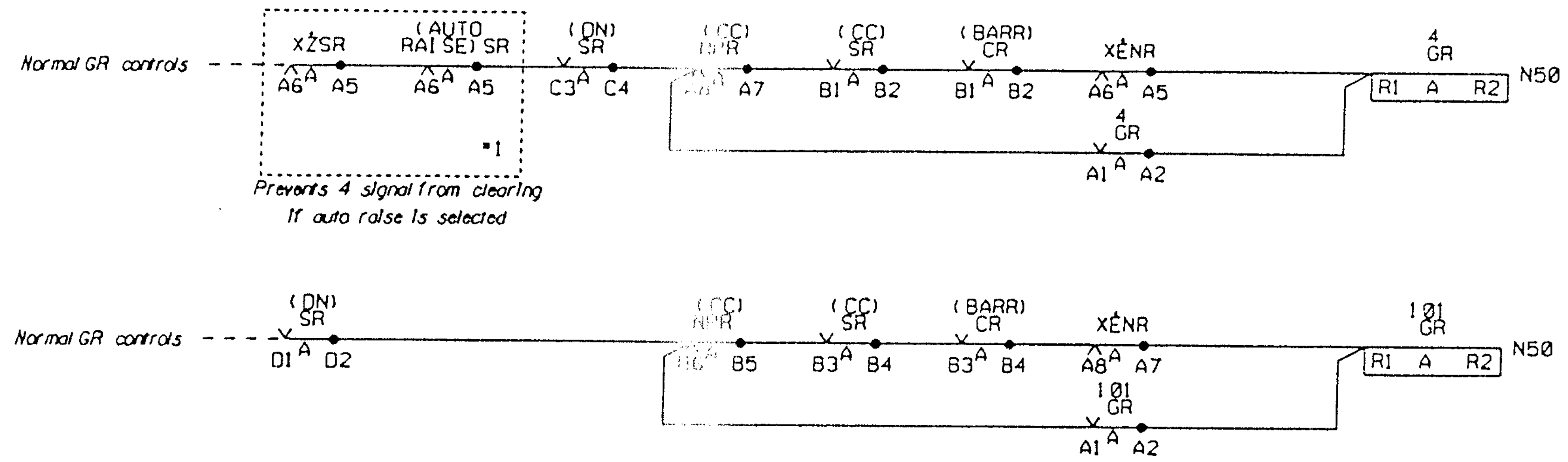
Notes :
*1 Automatic raising only
*2 When automatic raising inhibit required
*10 (AUTO RAISE)NPR to be down proved in 4NLR release circuit

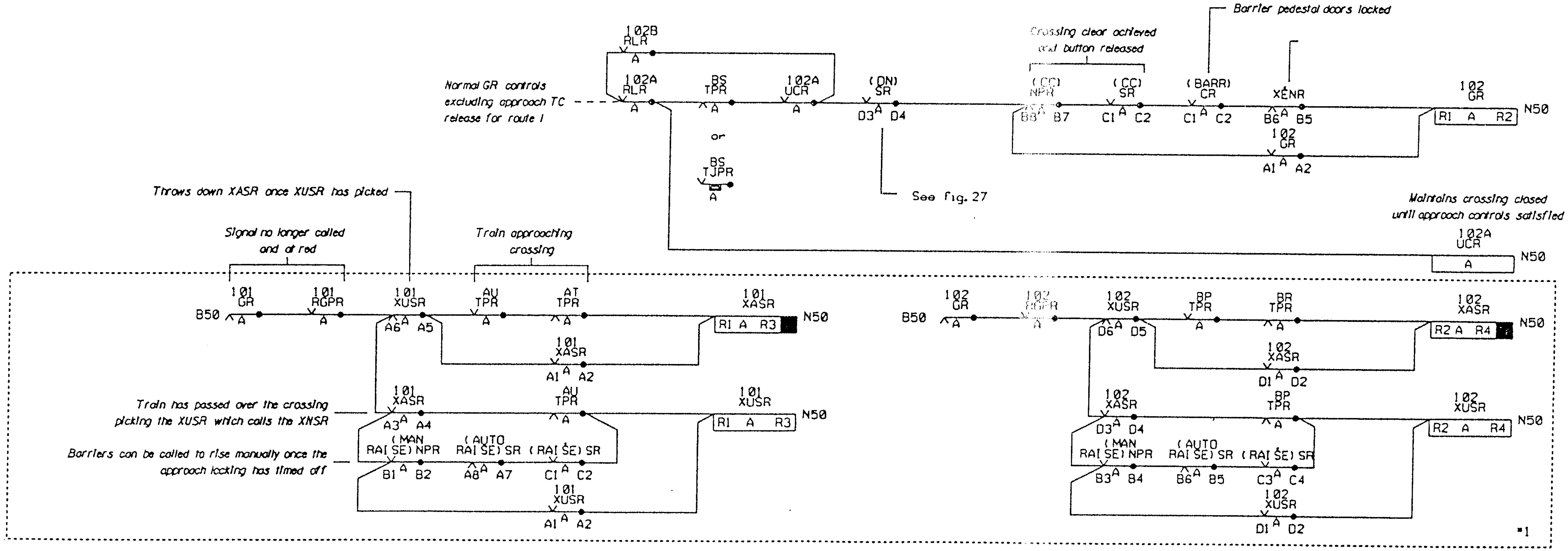
FIGURE 24

continued

INTRODUCTION TO LEVEL CROSSING CIRCUITRY







Notes :
*1 Automatic raising only

FIGURE 25

continued

INTRODUCTION TO LEVEL CROSSING CIRCUITRY

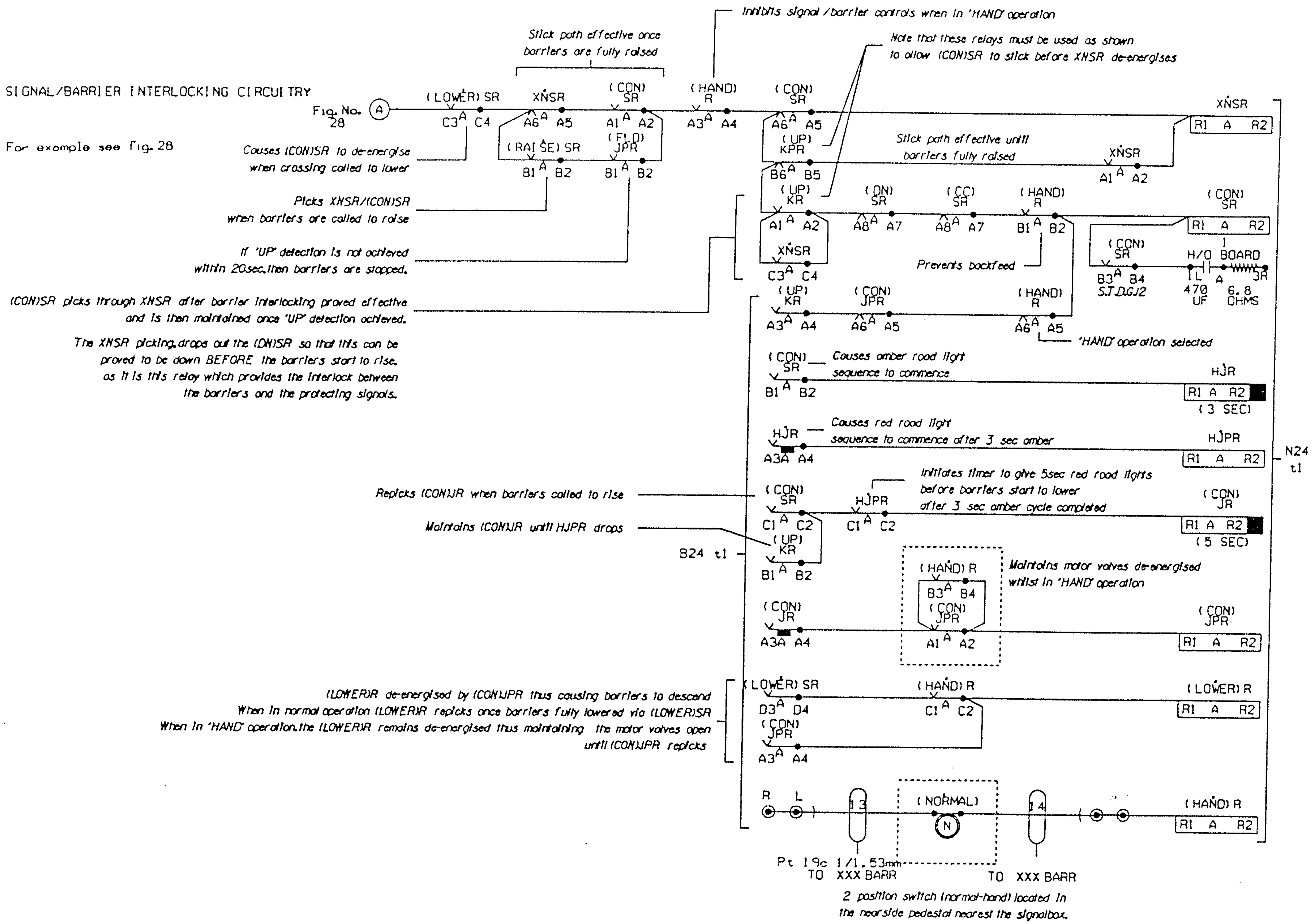
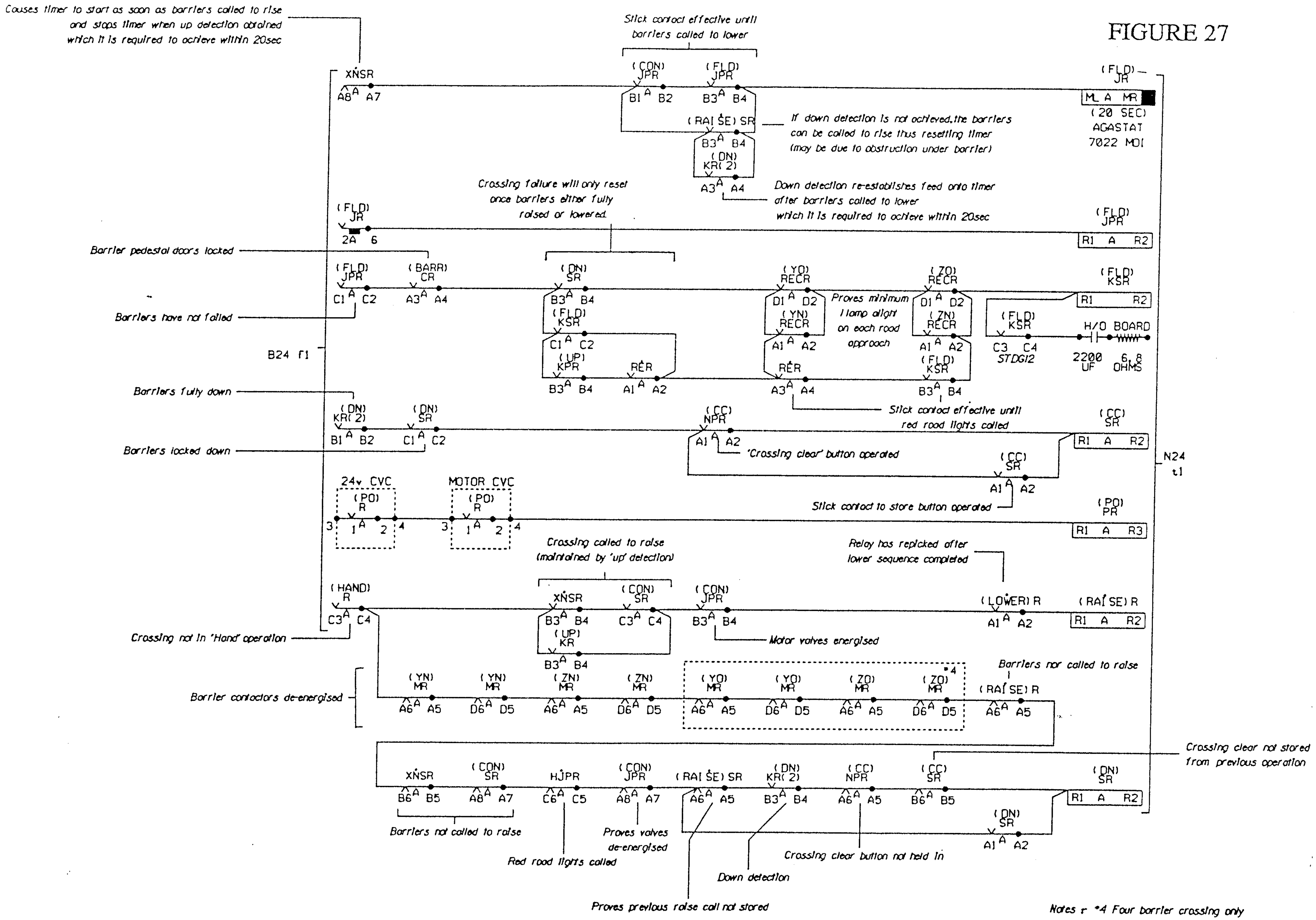


FIGURE 26

continued

INTRODUCTION TO LEVEL CROSSING CIRCUITRY

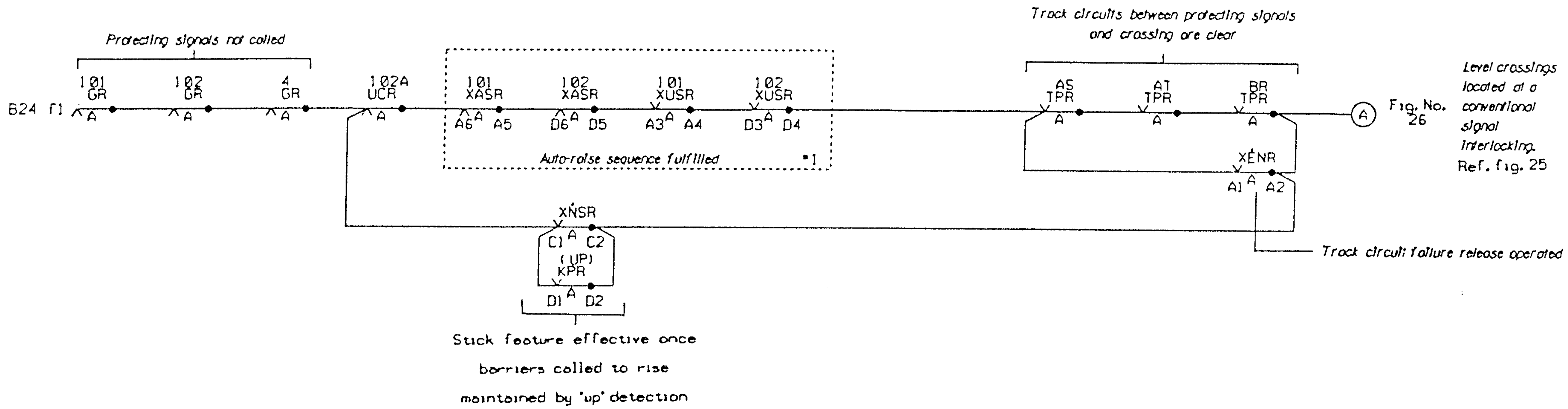
FIGURE 27



Notes :- *4 Four barrier crossing only

continued

INTRODUCTION TO LEVEL CROSSING CIRCUITRY

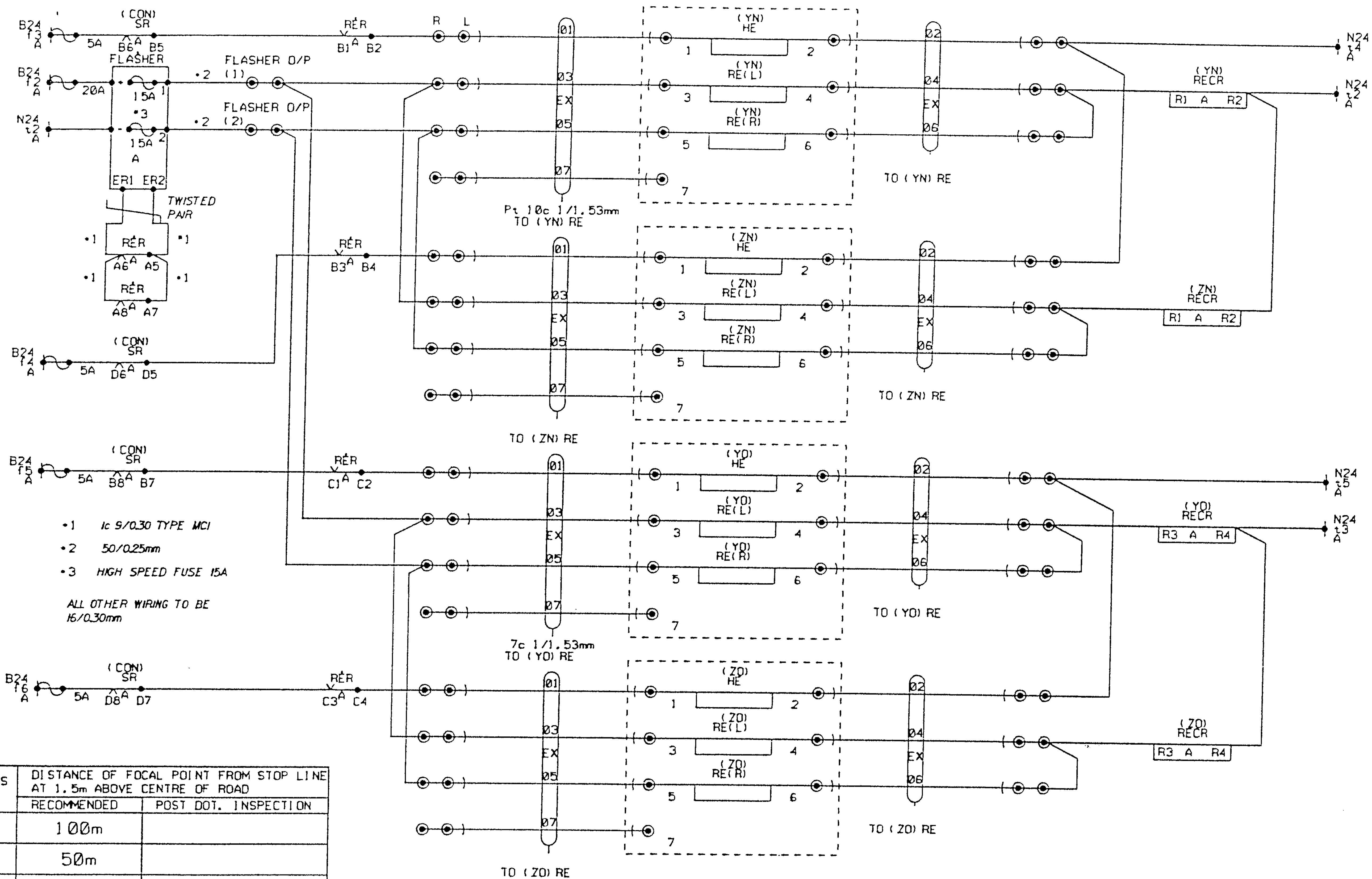


Notes :- *1 Automatic raising only

FIGURE 28

continued

INTRODUCTION TO LEVEL CROSSING CIRCUITRY



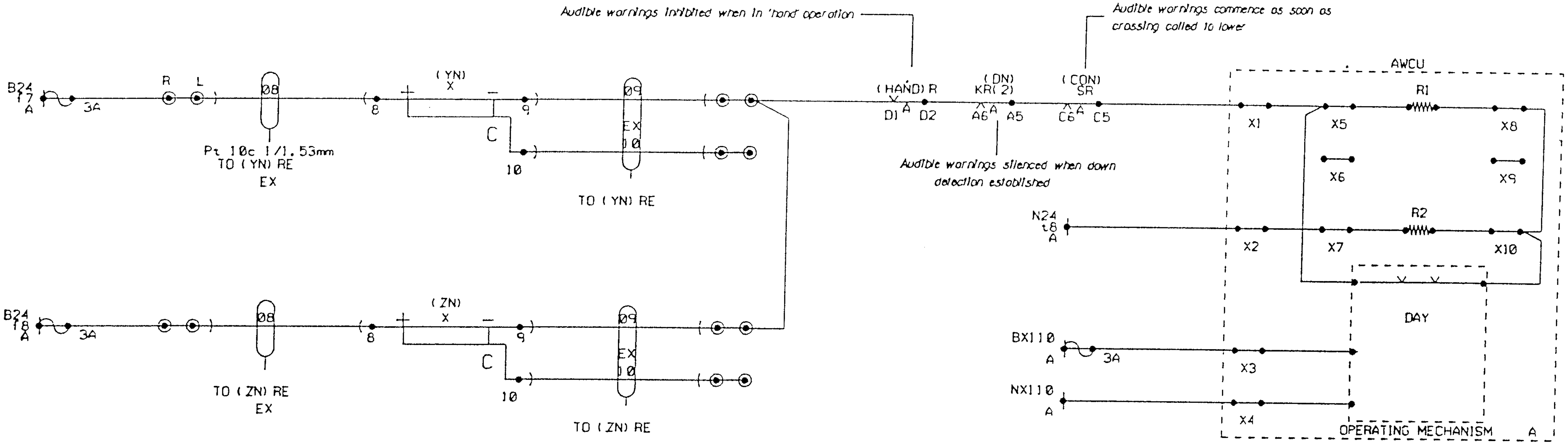
•1 Ic 9/0.30 TYPE MCI
•2 50/0.25mm
•3 HIGH SPEED FUSE 15A

ALL OTHER WIRING TO BE 16/0.30mm

LIGHTS	DISTANCE OF FOCAL POINT FROM STOP LINE AT 1.5m ABOVE CENTRE OF ROAD	
	RECOMMENDED	POST DOT. INSPECTION
YN	100m	
YO	50m	
ZN	100m	
ZO	50m	

FIGURE 29

continued



DAY	NIGHT	R1	R2
HIGH	MEDIUM	680R	STRAP
HIGH	LOW	1k5R	STRAP
MEDIUM	LOW	820R	680R
HIGH / MED	MED / LOW	680R	340R

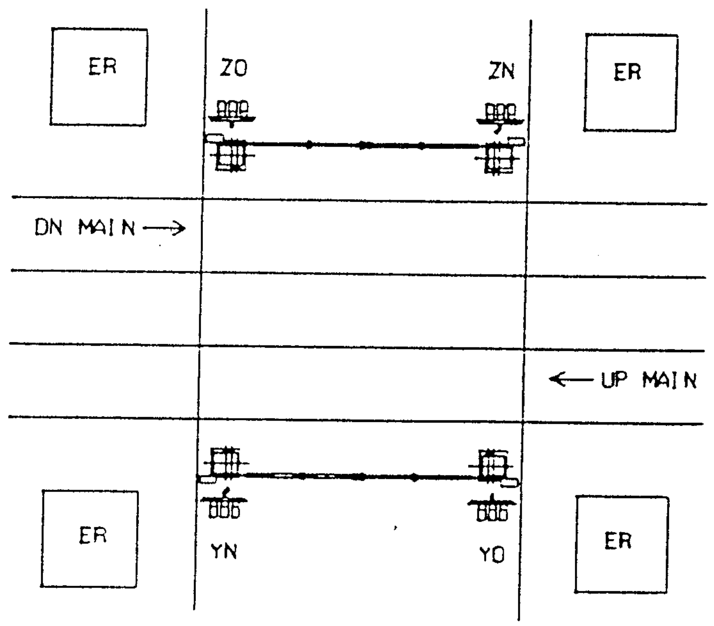
PREFERRED VALUE

NOTES: - 'YODALARMS'.3" TYPE Y03/RF2
(RF SUPPRESSED).
BR CODE 54/70212.

UNIT TO BE ORDERED TOGETHER WITH
PREFERRED VALUE RESISTORS

RECOMMENDED RESISTOR VALUES (SEE LEFT)
FOR USE WITH Y03/RF2 YODALARMS
2.5W +/- 10%

WIRING TO BE 9/0.30mm MCI.BR SPEC 872

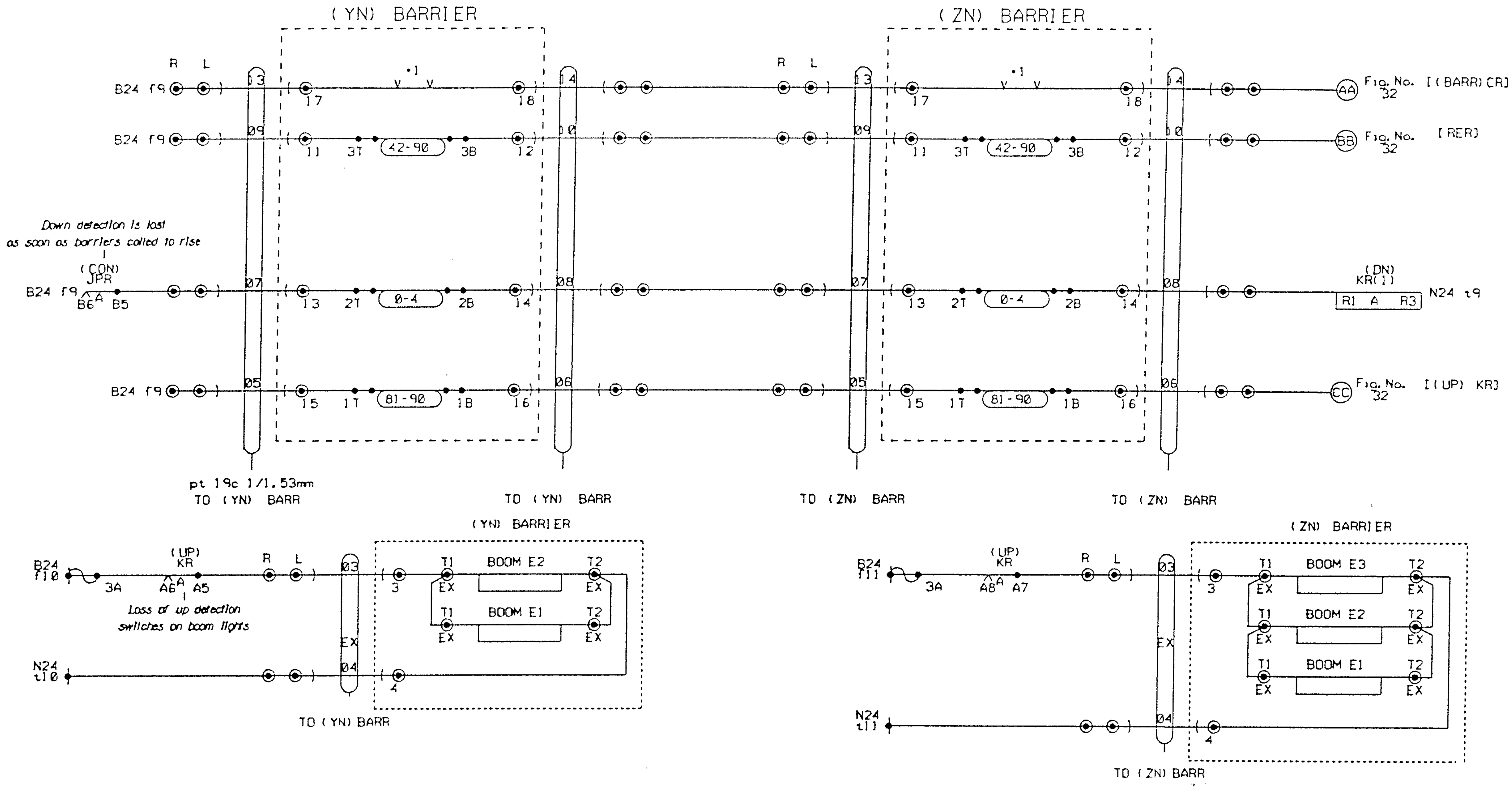


ER - POSSIBLE POSITION OF EQUIPMENT ROOM
(ACTUAL POSITION TO BE SHOWN)

FIGURE 30

continued

INTRODUCTION TO LEVEL CROSSING CIRCUITRY



Third boom light only required for barriers 6.1m length and over.

**1 MACHINE SECURITY DOOR SWITCH (REAR)*

FIGURE 31

continued

INTRODUCTION TO LEVEL CROSSING CIRCUITRY

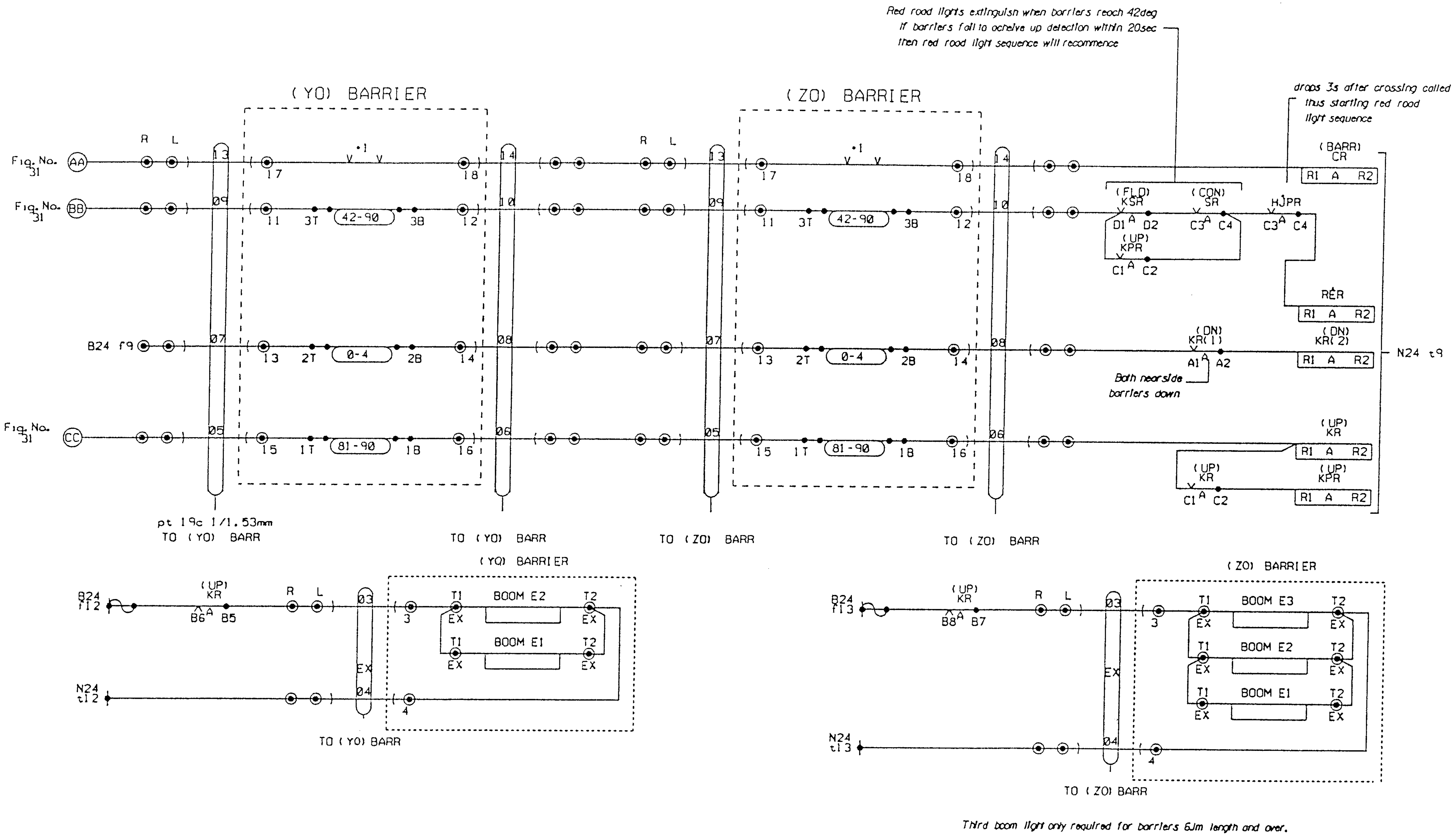
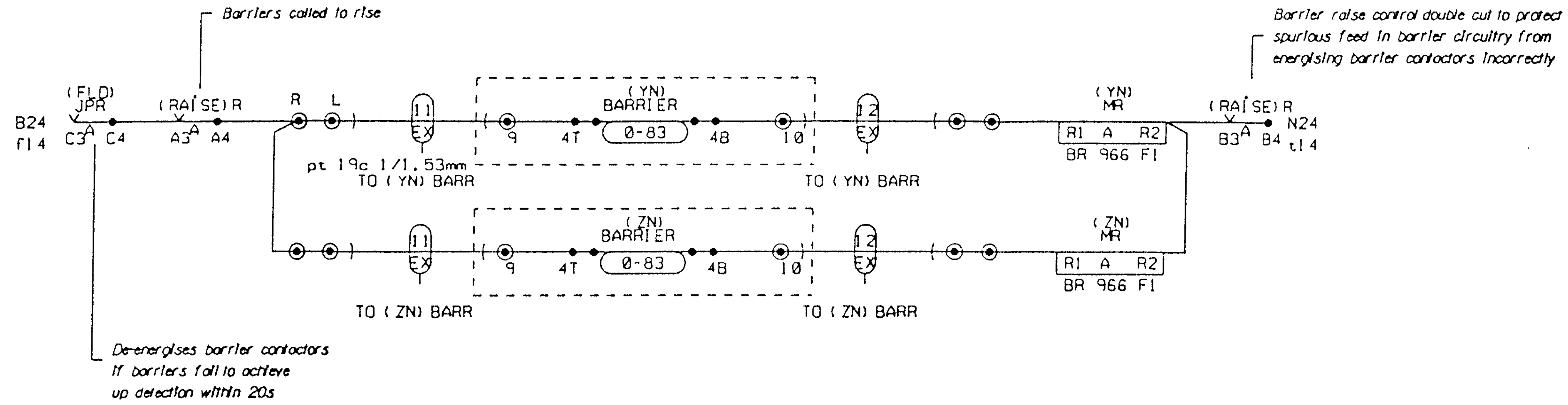


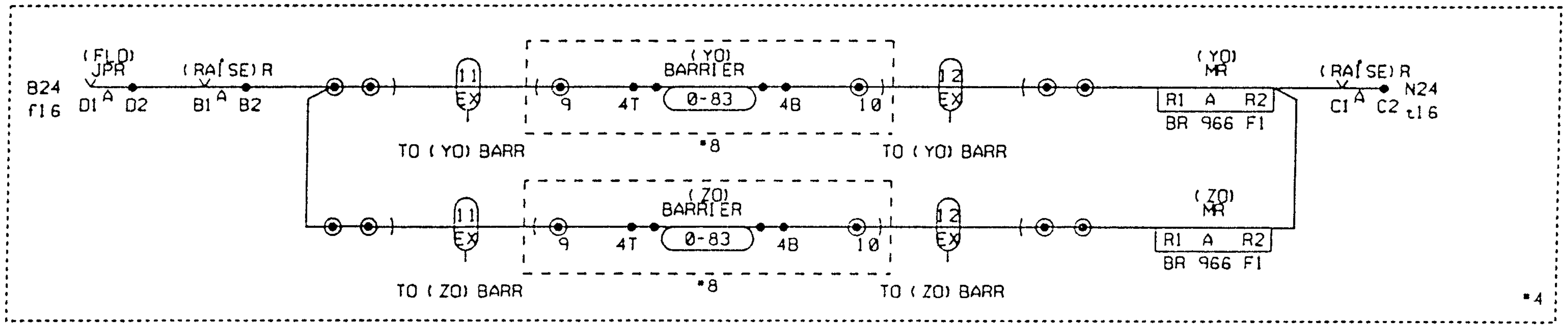
FIGURE 32

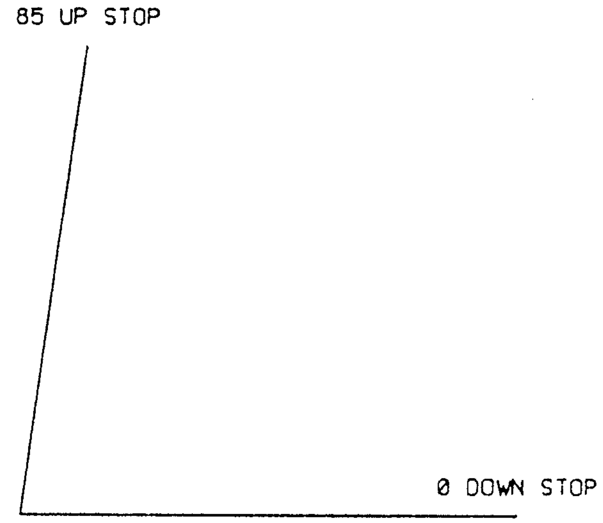
continued

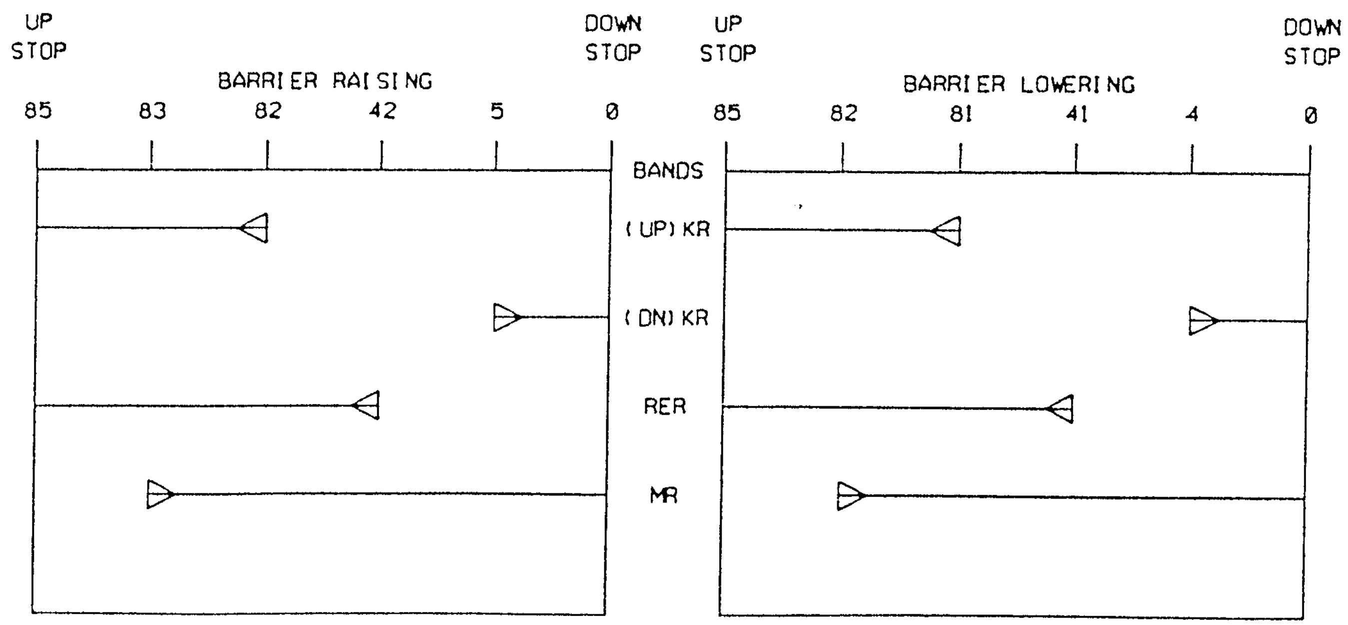
INTRODUCTION TO LEVEL CROSSING CIRCUITRY

FIGURE 33









Notes :

*4 4 Barrier crossings

continued

INTRODUCTION TO LEVEL CROSSING CIRCUITRY

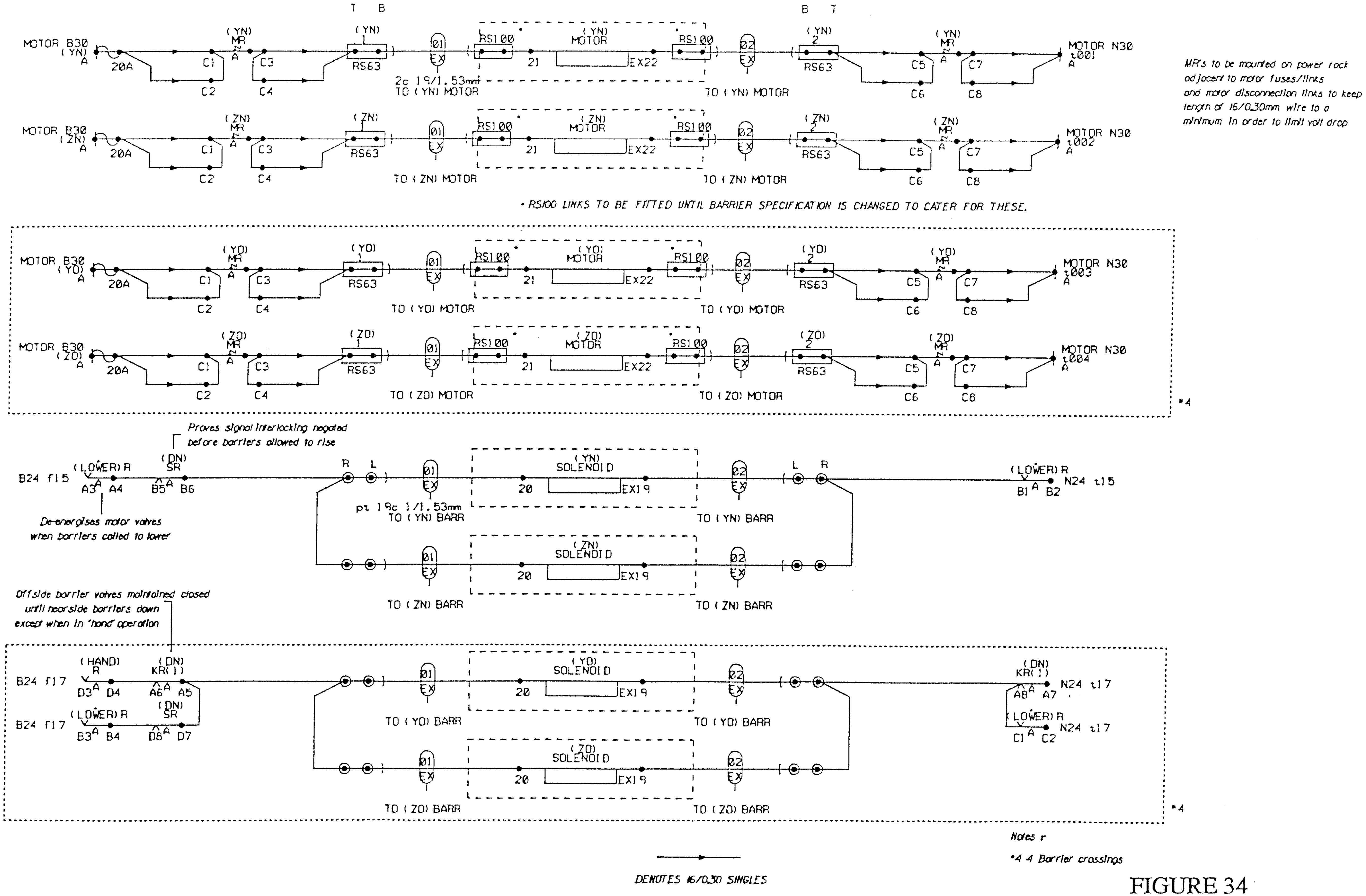


FIGURE 34

end