DEPARTMENT OF TRANSPORT

RAILWAY ACCIDENT

Report on the Derailment that occurred on 9th June 1981 at Chester

IN THE

LONDON MIDLAND REGION

OF BRITISH RAILWAYS

LONDON: HER MAJESTY'S STATIONERY OFFICE

£2.25 net

RAILWAY INSPECTORATE,
DEPARTMENT OF TRANSPORT,
2 MARSHAM STREET,
LONDON SW1P 3EB.
23rd February 1984.

SIR,

I have the honour to report for the information of the Secretary of State in accordance with the Direction dated 23rd June 1981 the result of my Inquiry into the derailment of a passenger train that occurred at about 15.24 on 9th June 1981 near Chester No. 6 Signal Box in the London Midland Region of British Railways.

Commencing in September 1979, as part of the stage works for the introduction of a new signal box at Chester to be commissioned in May 1984, the signalling controlled by Chester No. 6 Signal Box had been converted from a mechanical system to an electrical system operated from the original levers. On Tuesday 9th June 1981, as the 13.48 five-car diesel multiple-unit local passenger train from Wolverhampton to Chester was moving over the Up Slow Line at about 15 mile/h the trailing bogie of the leading vehicle, followed by the remainder of the train, was diverted to a different line at a set of points. The leading vehicle became derailed and in the process struck a stanchion supporting an overhead signal gantry causing the gantry to collapse on top of it.

No passengers or staff were injured but the Up and the Down Fast Lines and the Up and Down Slow Line were blocked and the power cables carried by the gantry were severed. One line was re-opened at 18.04, rerailing was completed at 02.15 on 10th June and trains ran normally again from 17.15 on 11th June 1981. In the interim, emergency bus services were operated as necessary. At the time of the accident the weather was dry but overcast.

DESCRIPTION

The Site and Signalling

1. The lever frame at Chester No. 6 was a London and North Western Railway tumbler locking frame with the signalbox and frame on a gantry over the Down Fast Line. When the box was built, about 1900, the space beneath the operating floor, in which lay the lever tails and the take-off of the rodding and wires, was extremely limited. This was because of the need to allow the necessary headroom between the passing rolling stock and the underside of the gantry whilst keeping the overall height of the structure as low as possible. The mechanical locking was above the level of the operating floor at the rear of the levers.

2. In the conversion to electrical signalling the track alterations were completed and the new colour-light signals were placed in their final positions but as an interim stage the levers and mechanical locking were retained and the lever tails were connected to combined circuit controllers and electric locks. In the circuit controller the linear movement of the lever tail is converted to rotary motion and used to open and close groups of contacts at various points of the lever movement. The lever lock prevents movement of the lever past any given position. When it is safe for the lever to be moved the solenoid is energised to lift the lock. The circuit diagrams at the back of the report show the circuits involved. Levers 16 and 32 are mechanically interlocked so that Lever 32 can only be reversed when Lever 16 is Normal.

3. Because of the confined space, the circuit controllers were mounted in two staggered rows, alternate levers being connected to the same row. The wiring from the temporary electric lever locks and circuit controllers was led out of each unit to a permanent relay room on the side of the railway where it was connected to the relays and circuits that were to be used in the final arrangement. When the signal box was removed the wiring was disconnected from the circuit controllers and control of the signalling was taken by the new signal box.

4. The circuit controller contacts lie in circuits which may include track circuit relays, point detection relays, timing relays, etc. These circuits are fed from bus bars and when all the conditions are met that are included in an individual circuit for the electrical controls of a signal or set of points, lever locks or relay solenoids are energised.

5. In mechanical signalling the British Railways Rule Book (Section C.4.5.2) requires that "At a junction the signal immediately in rear of and protecting such junction must not be placed to Danger until the last vehicle has cleared the junction points". Because in modern signalling one signal may

control movement over a number of routes, each involving several sets of points, this requirement is enforced by requiring all track circuits between the signal and the farthest set of points to be clear after occupation of the first track circuit beyond the signal before the route can be released and sets of points in the route moved. This does not, however, prevent the signal lever being replaced to Normal and the signal going to Danger in case of emergency. The relays enforcing the route locking are known as route stick relays and the clearance of a signal causes the relevant route stick relay to become de-energised. Contacts of these relays will lie in the circuits through which the lever locks of points in the route are energised, consequently until the track circuits in the route have been occupied and cleared the stick relay cannot be re-energised and consequently the circuit to the lever lock is not completed and the lever cannot be moved.

6. In addition, the occupation of the track circuit in which the point blades lie will prevent the point relays operating and thus prevent movement of the point blades. However, if the point motor has commenced movement, occupation of the track circuit and the shunting of the relay will not affect point operation; this prevents points being stopped in mid travel.

7. Main running signals are three-aspect colour light with junction indicators, shunting signals are of the position-light type, and the point machine driving No. 32 points was an AEI-GS type HW 2000. A signal diagram of the area concerned is included in the report. On the signal box shelf over the levers is an illuminated diagram of the area controlled by the signal box. Some signals controlling movements over more than one route are designated by letters with a lever for each route.

The Course of the Accident and the Damage Caused

8. The signalman at Chester No. 6 had accepted a diesel locomotive from Chester No. 5 Signal Box on the Fork lines to go to Holywell and the 13.48 diesel multiple-unit (DMU) from Wolverhampton to Chester (2D66) from Saltney Junction on the Up Fast Line. It was his intention to route the DMU to the Up and Down Slow Line before signalling the light locomotive. The DMU came to a stand at Signal B, because the train had not been accepted by Chester No. 4 Signal Box, at about the same time as the locomotive came to stand at the signal controlling exit from the Fork line. The signalman had reversed 31 points for the DMU and when the train was accepted he reversed lever 16 which clears Signal B with a junction indicator for the Up and Down Slow Line.

9. The DMU set off and when it had passed beyond the overlap track circuit (TC 121) he replaced lever 16 to Normal, walked along the frame, and reversed No. 32 points lever to set the route for the locomotive. The lever reversed to a position which would have started the points moving and the signalman suddenly realised from the noise of the train passing and its position that something was wrong. He attempted to replace lever 32 but was unable to do so because the DMU was by then occupying track circuit 165. The leading bogie of the DMU went along the correct route but the point blades reversed after the passage of the bogie and the rear bogie of the front car and the rest of the train travelled along the Fork lines.

10. The leading car was derailed and in the process went sideways-on into a stanchion of a signal gantry bringing the horizontal part of the gantry down into contact with the car roof. The DMU was travelling slowly and the driver made an emergency brake application. The gantry also acted as a cable bridge and a number of cables, including 650 Volt signalling cables, were cut in the accident. The underside equipment of the DMU including engine sump, batteries, radiator, exhaust system, and control equipment was badly damaged. Only one main window and two side lights were broken and although the outer body panels were damaged where they had struck the stanchion, the damage to the passenger saloon was slight.

Evidence

As to the Running of the Train

11. *Driver A. Carrigan* of Chester drove 2D66 and explained how he had stopped the train at Chester No. 6 Signal B which was at Danger. It cleared to a single yellow aspect with a route indicator for the Up and Down Slow Line and he drove over the junction at 15 mile/h. As the cab passed the signal box and gantry the train began to vibrate and he applied the brake. He climbed down from the cab, saw what had happened, applied track-circuit operating clips, and went to the signal box to ask for signal protection. He had been looking at the next signal and had not glanced down to look at the points as he approached them.

12. *Signalman C. T. Coss* was on duty in Chester No. 6 Signal Box from 14.00 on the day of the accident. He had worked in the box over a period of about 2½ years. He explained that the two trains were waiting at signals, and described how he set the route for the DMU and then replaced lever 16 when

he saw from the diagram that the DMU had passed over the overlap track circuit. He used the block instrument to send 'Train Entering Section' to Chester No. 4 Signal Box, saw the DMU coming through the tunnel, and as he walked up to lever 32 he could see the locomotive. At the same time he was opening an envelope. However, he was not rushing or distracted but put his hand on the catch handle of lever 32 and was looking towards Chester for the DMU to reappear from beneath the box when for some reason, which he could not explain, he reversed lever 32 without looking at the diagram. He realised at once that he had done something wrong and attempted to replace the lever but it would not move. He then heard the noise of the derailment and took emergency action.

As to the Testing of the Signalling

13. *Mr. P. J. Owen*, the *Crewe Division Signal and Telecommunications Testing Assistant*, was at Chester on the day of the accident and went at once to the signal box where, from the position of the levers, the train, and the points, he concluded that the points had moved beneath the train. Once power had been restored he began testing and found that the 10 Volt and 50 Volt bus bars had earth connections. By removing and replacing the circuit fuses in turn until one removal led to the disappearance of the earth fault he found one 10 Volt circuit with an earth fault. By disconnecting each individual part of that circuit he located the fault on No. 7 lever band of the circuit controller of lever 16. When an attempt was made to dismantle the band, rather than to remove the circuit controller complete, the earth fault disappeared and he was unable to reproduce it. He found by further testing that the remainder of the circuit was in accordance with the wiring diagram and operating correctly. This lever band was in the circuit of the 'Normal' lock of lever 32; the lock that must be energised to permit lever 32 to be moved away from the Normal position.

14. Because there must be two earth faults to cause a wrong-side failure, his staff continued testing for a second earth and when it was indicated they carried out the same procedure to find its position. The second 10 Volt earth was where a wire leading into the circuit controller of lever 5 had been abraded and was in contact with the metal slide. He explained how current from the bus bars was thus able to pass to earth and from earth via the first fault to the lever lock of lever 32 thus shunting out the controls on the movement of the lever and permitting the lock to be energised irregularly so that when the catch handle was pressed the lever could be reversed. The 50 Volt earth was found at the same place due to the same type of fault.

15. He believed that what had happened was that the signalman, having released the mechanical locking by replacing lever 16 prematurely, had started to reverse lever 32 just before the DMU occupied track circuit 165 that directly locked the points. Because this track circuit was clear the relay that would provide power to drive the point motor to the reverse position would be energised. Because more than one relay was involved there would have been a slight time delay before the point blades began to move and this would have permitted the leading bogie to take the correct route before the blades moved and diverted the remainder of the train. A test had shown that there was about 2 seconds delay from the time that lever 32 was moved to the D check-lock position to the first movement of the point blades.

16. Mr. Owen confirmed that the testing of all stage works at Chester No. 6 Signal Box had been properly carried out. The last task of the testing staff before leaving the site each day would have been a complete earth check on all bus bars. At the commissioning of each stage an earth check is also the last task. He knew that the testing staff had carried out such a check on 4th May 1983. Maintenance staff would also carry out earth testing. He described as "numerous" the number of earth tests that had been carried out at Chester No. 6 Signal Box.

17. Having discovered and corrected the earth faults, a complete check and test was carried out on all the circuits connected with No. 32 lever lock, the signal concerned, the points operating relays and the route stick relays. The two earths connected with 32 points were then recreated and he proved that a malfunction was possible. All new wiring connected with repairs to the damage caused by the derailment was also tested.

18. He considered that earth faults found as a result of an accident or discovered by signalmen were few and far between. The most recent one was 3 years ago although it caused only a malfunction which was noticed by a signalman. He thought that during routine testing one might be found every 2 months but they were not recorded as they were always corrected. He recalled one other earth fault on a circuit controller when the cover, which is slid over the contacts to keep out dirt, was forced on, cutting the insulation of a wire. Any wrong-side faults were reported whether found by maintenance or testing staff, and they were collated. Individual earth faults detected during the testing of new works or alterations were cleared but would not necessarily be reported. He could recall one other earth fault on a lever band 2-3 years ago but in that case the insulating ferrule was missing from the bolt.

19. *Area Engineer (Signalling) M. J. Davies* of Chester explained that he was responsible for the signalling maintenance and new works in an area stretching from Beeston Castle to Holyhead including

branches. He described his task after the accident as "getting the line clear and signalling equipment operating again". He had received no complaints or reports of serious defects since the beginning of stage work. He was satisfied that the normal checks, inspections, and examinations had been carried out and he had record cards showing this. He described how, with one of the testing staff, he was attempting to unscrew the bolt that secured the segment to the shaft of the circuit controller when the first earth disappeared. He described the space beneath the operating floor as exceedingly cramped and said that it was defined as a confined space under the Health and Safety at Work, etc. Act 1974.

20. Mr. Davies described the way in which the wiring 'tree' leading from the circuit controller of lever 5 was in contact with the edge of the operating slide causing the second 10 Volt and the 50 Volt earths. He explained how the group of wires leading from the contacts is tied in a neat bundle or 'tree' and how this was difficult to lead out in the confined space. Movement of the slide had led to the insulation being worn from the wires. When the circuit was energised an earth fault would have existed which fed that on the lever band.

21. Mr. Davies explained how the routine earth testing is carried out and that it only tested for the existence of an earth on the circuits that were energised at the time of testing. He described the way in which the circuit controllers were fitted and the responsibility for the wiring that was carried out by skilled installers under his control. He had personally issued a booklet to those concerned giving guidance on wiring in which neatness and the need to keep wiring clear of moving parts was stressed. He had personally given instructions that, during the stage work, at the end of each day's work and also at the start, all bus bars had to be tested for earth potential contacts. If an earth fault was found during these tests trains had to be stopped and the fault isolated. He could not recall this happening during any of the stages and he was sure that he would have been told if it had. His own maintenance staff would also carry out earth tests monthly and the record cards showed that this had been done. In addition, as Mr. Owen had described, the testing staff would conduct earth tests. He explained that the tests were not carried out with levers or trains in particular positions but completely at random.

22. As a result of the defects found, an instruction was issued in the Region that all wiring in proximity to moving parts was to be visually checked to ensure that it was clear and this had been done. In addition his staff were halfway through a test of all lever bands on circuit controllers to prove them free from earths and from contact with the body of the lock. This was being done throughout his area and he pointed out that at Chester No. 6 alone there were 700 bands. He had personally issued an instruction that any bands changed with the circuit controller *in situ* were to be checked to ensure that they were not in contact with the controller body. They had also decided to leave the covers off the circuit controllers until all the stageworks were completed at Chester No. 6 because of the difficulty of leading the wires in with them on. There was a chance that dirt might get in but this could only cause a safe-side failure. He explained that the specification for the wire to be used to connect the circuit controller lever bands and been changed to provide better protection some time before the circuit controller of lever No. 5 had been wired. The new standard was rubber insulated, with braid to give mechanical strength. At the time of the installation of No. 5 lever circuit controller the wire to this higher standard was not available but because the installers were aware of the danger of allowing wiring to rub on moving parts and the installation was not permanent, the use of the lower standard of wire was permitted.

23. Mr. Davies confirmed that the mechanical locking that would prevent lever 32 from being moved if lever 16 was reversed was tested after the accident and was in order. He also said that no other wires had been detected rubbing against circuit controller slides on the other 79 levers.

24. *Technician M. G. Melia* was the technician in whose area lay Chester No. 6 Signal Box. He explained that once a month he carried out a visual examination of the equipment there for earth faults. The earth tests took about 20 minutes and the results were recorded on cards at each location and relay room. He had not found any earth faults at Chester No. 6 since the stage work commenced. He had found an earth fault at another signal box in his area on one occasion. He described what he looked for when examining the circuit controllers beneath the operating floor. Occasionally when there was a fault he would remove the covers, but he was sure that he had never removed those of levers 16 or 5. He said it was not easy to work beneath the operating floor but with practice he had found it not too difficult.

25. *Area Movements Inspector E. H. Stanger* visited the Chester Signal Boxes once or twice a week. He recalled that he had found levers being replaced early in similar circumstances to those of the accident, on one occasion at No. 4 and once at No. 6. On both occasions he had corrected the signalman. He did not, however, think that it was a habit.

26. *Mr. J. W. White* was a Research and Development Engineer for the Chief Signal and Telecommunications Engineer of the London Midland Region. He explained how the shafts on which were mounted the lever bands were drilled in two directions at right angles for the bolts which hold the bands in position. This led to burrs being raised which could be left in position. Any alteration to a band

would lead to the bolt and insulating ferrule being pushed down another hole at right angles to that in which it had been originally placed and carrying the burr into a position where it could connect the bolt to the shaft electrically. He had not been able to reproduce the fault but felt sure this was the cause of the earth fault. Although the shafts are electroplated after drilling and the process should remove loose burrs, he had found a few new shafts with burrs attached and had pushed them off by inserting a ferrule into the hole.

27. The combined circuit controller and lever lock had been manufactured to the same basic drawing since 1936. He calculated that there were 50,000 lever bands in the London Midland Region alone. He had checked records back to 1974 but could find no record of a wrong-side failure being caused in this way. He explained that once the circuit controller was assembled in the workshops it was subjected to a 1,000 Volt insulation test before being sent out to be installed. Now additionally all the holes are reamered out to remove any burrs that might be attached and are then re-plated.

28. *Mr. R. M. Bell* the *Signal Engineer (General)* of the London Midland Region said that he was satisfied that the tests for earth faults had been correctly carried out and that he had come to the conclusion that the faults had not been detected because they had not both been present until shortly before the accident. The movement of the slide would have gradually sawn through the insulation of the wire and the shock of the movements of the circuit controller would have gradually increased the pressure on the burr until it became conducting. He felt that the random nature of earth testing would have detected the faults within about another one or two months if the accident had not occurred. He confirmed that, throughout the Region, checks were being made of all wiring which might be chafing and that the process of reamering and high voltage testing for the shafts was being implemented. They had also passed details of the faults to other Regions who might have similar equipment.

Conclusion

29. Signalman Coss agreed that he made two errors but was unable to explain why he had done so. He replaced lever 16 early thus releasing the mechanical locking on lever 32 and he attempted to reverse lever 32 without satisfying himself, by looking at the illuminated diagram, that the DMU had passed beyond the points operated by that lever.

30. The coincidence of the two earth faults in energised circuits removed the electrical safeguards which would normally have prevented the reversal of lever 32 and thus Coss was able to operate the points just before the DMU occupied the track circuit which would have directly locked the points. I am satisfied that the investigations have correctly identified the two electrical faults in the controls. I believe that Coss made his errors because he was not concentrating properly.

Remarks

31. The alterations to the signalling carried out at Chester No. 6 were not permanent and all the normal precautions were employed to ensure that they were done correctly as well as the issue of certain additional warnings. The decision to use wire of the old standard with a lower mechanical resistance to abrasion was reasonable when the measures that were taken are considered. The confined space beneath the signal box may have had some influence on the making of the error but it was the only wiring defect of its kind found.

32. The frequency of earth fault testing should be adequate because two earth faults are required before a wrong-side failure can occur. In modern signal boxes with route relay interlocking, earth fault detection in each remote relay room and in the signal box is automatic and the results can be relayed to give an indication in the controlling signal box. Thus any earth fault that does occur is detected and warning given at once. The accident occurred because of the most unlikely combination of the signalman's two errors and the two earth faults. The chance of such a coincidence occurring must be minute and I consider that the action taken by the Region to detect other errors and prevent a recurrence is quite sufficient. Accordingly I have no recommendations to make.

I have the honour to be,

Sir,

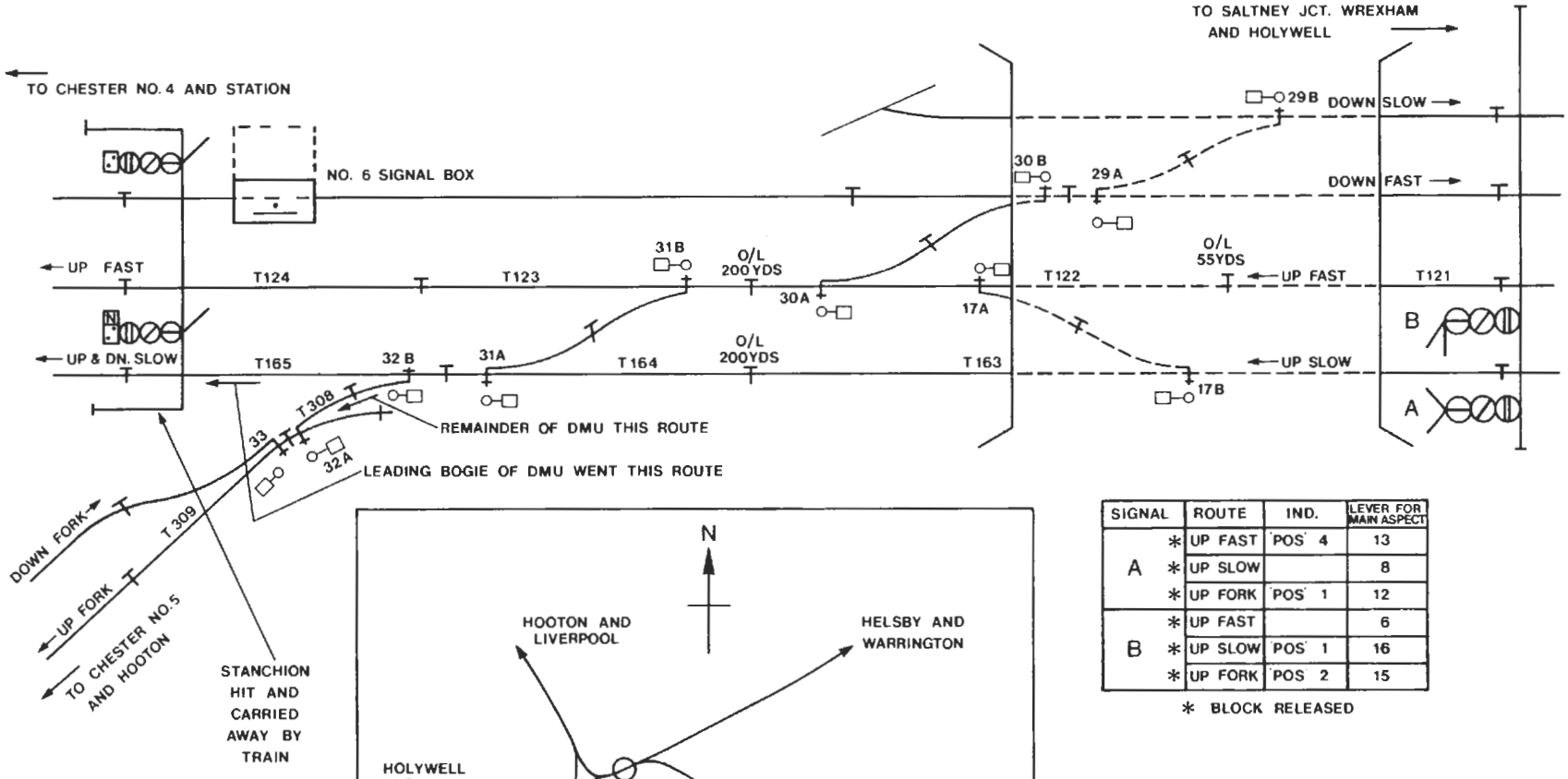
Your obedient Servant,

A. G. B. King

Major

The Permanent Secretary
Department of Transport

DERAILMENT AT CHESTER 9th JUNE 1981



SIGNAL		ROUTE	IND.	LEVER FOR MAIN ASPECT
A	*	UP FAST	'POS' 4	13
	*	UP SLOW		8
	*	UP FORK	'POS' 1	12
B	*	UP FAST		6
	*	UP SLOW	'POS' 1	16
	*	UP FORK	'POS' 2	15

* BLOCK RELEASED

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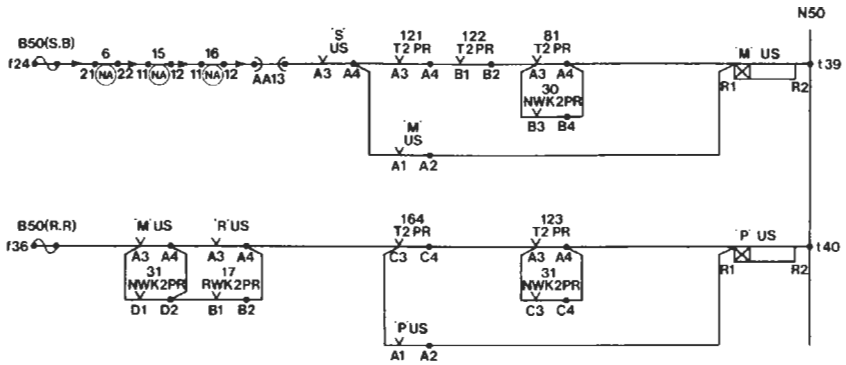
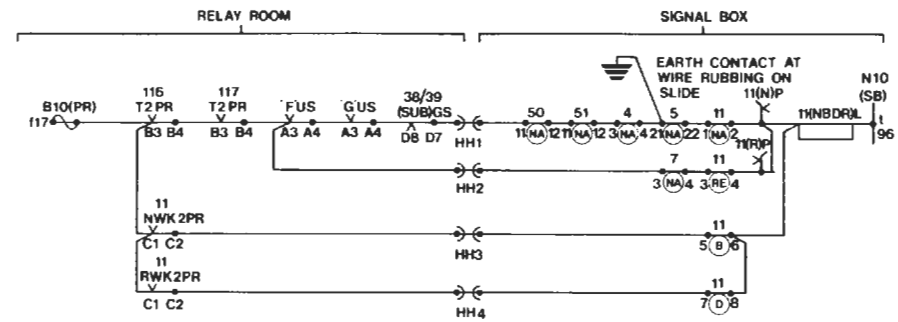
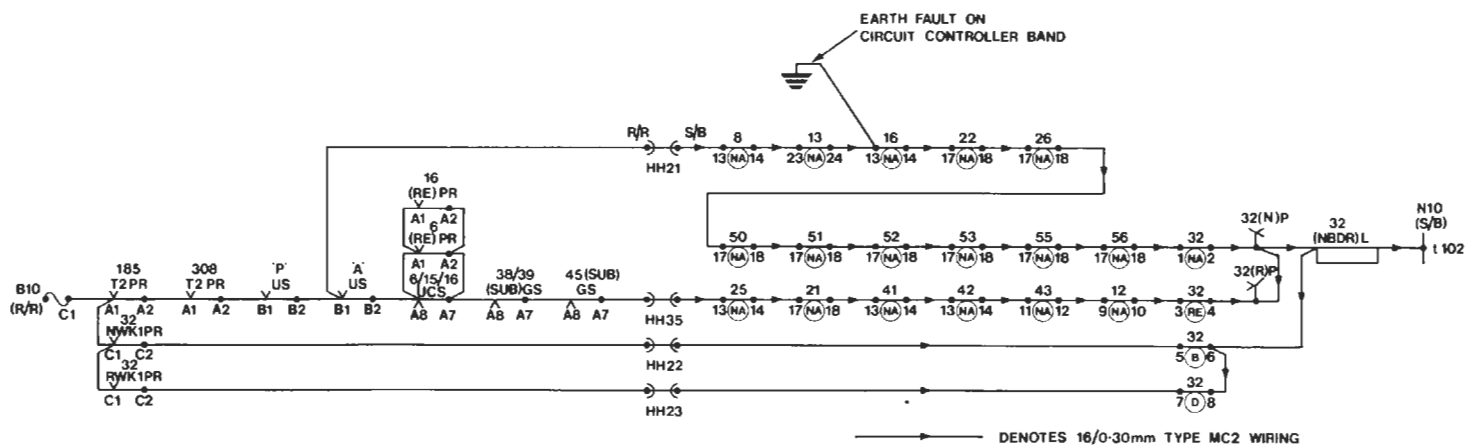


EXTRACT OF RELEVANT ROUTE STICKS SHEETS 66 CHESTER Nº6 WIRING



EXTRACT FROM SHEET 6 CHESTER Nº6 WIRING



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