
MINISTRY OF TRANSPORT AND CIVIL AVIATION

# RAILWAY ACCIDENTS

# REPORT ON THE DERAILMENT

**which occurred on**

## 12th August 1958

**at**

# BOROUGH MARKET JUNCTION

**in the**

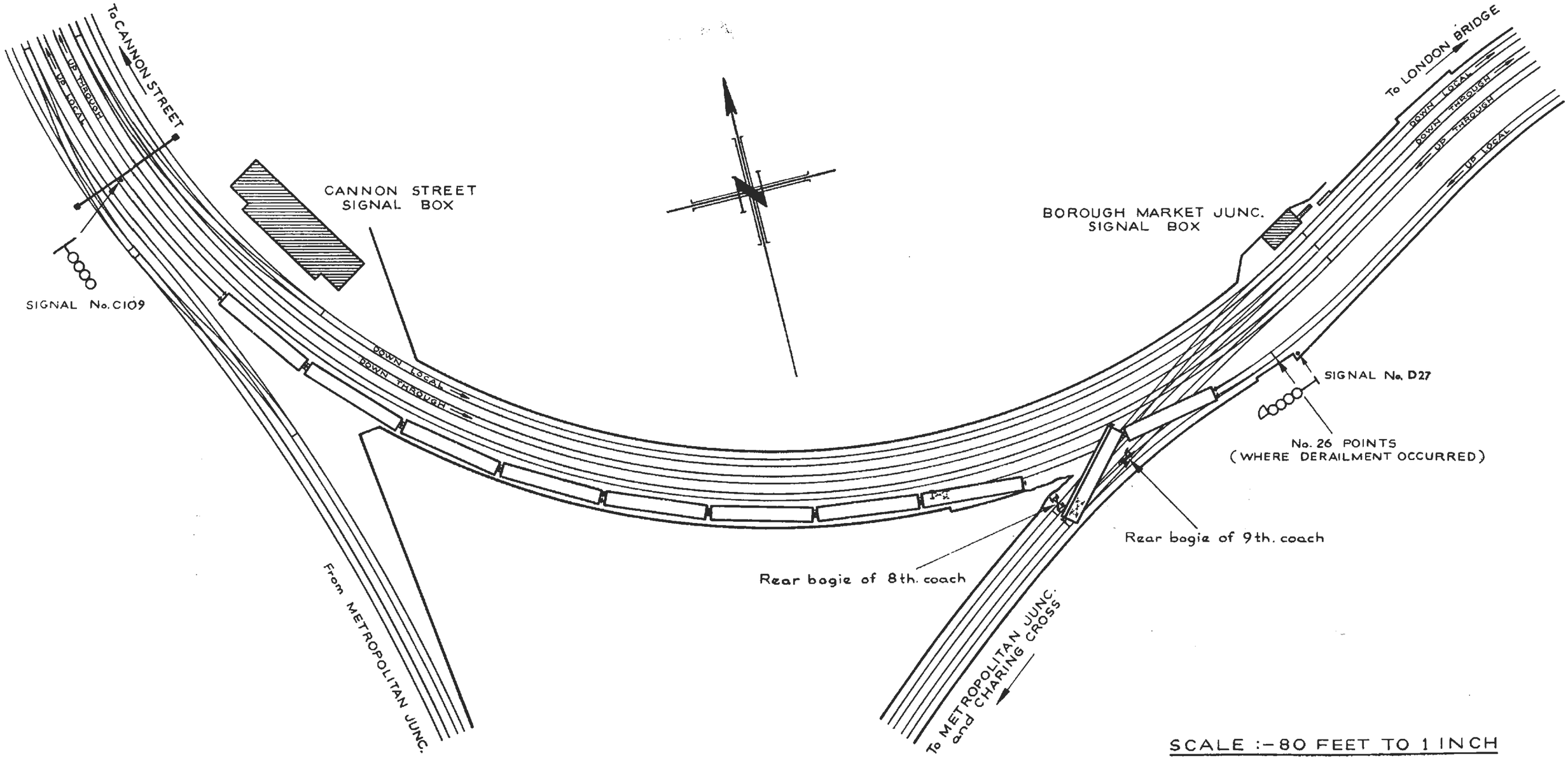
# SOUTHERN REGION
# BRITISH RAILWAYS

LONDON: HER MAJESTY'S STATIONERY OFFICE
1958
PRICE 1*s.* 3*d.* NET

SOUTHERN REGION

# DERAILMENT AT BOROUGH MARKET JUNCTION

## 12th. AUGUST, 1958




SCALE :- 80 FEET TO 1 INCH

J.W.W.

MINISTRY OF TRANSPORT AND CIVIL AVIATION,
Berkeley Square House,
London, W.1.

*4th November* 1958.

SIR,

I have the honour to report, for the information of the Minister of Transport and Civil Aviation, in accordance with the Order dated 12th August 1958, the result of my Inquiry into the derailment which occurred at about 7.30 a.m. on that day, on the viaduct at Borough Market Junction near London Bridge, in the Southern Region, British Railways.

The 6.52 a.m., 10-coach, Up electric train from Sanderstead to Cannon Street became derailed at the eighth coach as it travelled slowly over a set of badly worn switches on the Up local line where the routes to Charing Cross and Cannon Street diverge. The eighth coach was much shaken as a result of the derailment and was forced against the parapet of the viaduct, and the ninth coach was separated from it and slewed across the lines leading to Charing Cross, and tilted, but none of the few passengers in these coaches was seriously injured. Six were taken to hospital suffering from minor injuries but were not detained. The emergency call for help was answered very promptly and the fire services, ambulances, and police reached the site within a few minutes. The circuit breakers in the power supply lines to the conductor rails tripped properly, and the power on adjacent lines was cut off within a minute.

The accident caused serious dislocation to traffic, and Charing Cross and Cannon Street stations were closed while the derailed coaches were being removed and repairs carried out. Trains were diverted to other London termini where possible, and special bus services were arranged with the London Transport Executive to deal with the extra traffic from London Bridge; services were resumed from Cannon Street at 4.35 p.m. and from Charing Cross at 8.25 p.m. It was necessary to support from the street below the steel spans of the viaduct on which the derailment occurred before it was considered safe to begin lifting with the breakdown cranes, and this delayed the work of clearance.

The weather was fine.

## DESCRIPTION

### *The electric train*

The train consisted of two 4-coach sets and a 2-coach set in rear. The leading and trailing bogies of each 4-coach set were motored and there was a motored bogie at the trailing end of the 2-coach set. All the coaches were of steel and were fitted with the Westinghouse air brake and the electro-pneumatic valve. The tare weight was 341 tons and the length over buffers 215 yards.

### *The site*

The sketch opposite illustrates the layout of the tracks and the position of the relevant signals. The 4-track route runs westwards in the Up direction from London Bridge in a left handed curve which changes to right handed at Borough Market Junction signal box, 260 yards from the London Bridge platforms. The route to Cannon Street then diverges to the north in a sharp right handed curve, while the double track route to Charing Cross, via Metropolitan Junction and Waterloo (Eastern), continues westwards, changing curvature to the left immediately beyond the junction points. A connection from Metropolitan Junction to Cannon Street (not shown on sketch) completes the triangle of routes, controlled at each point by Borough Market Junction, Cannon Street, and Metropolitan Junction signal boxes respectively.

The derailment took place on Borough Market Junction facing points No. 26 on the Up local line, almost opposite the signal box, where the turnout towards Cannon Street leads over a curve of 7 chains radius from the inside of the right handed curve of 12½ chains radius towards Charing Cross. There is a permanent speed restriction of 20 m.p.h. through the turnout on both routes.

As is well known the railway lines in this area are on viaducts which are partly of masonry and brick arch construction, and partly of girder construction on steel and masonry piers. The girder bridges under the diverging routes at Borough Market Junction have steelwork parapets which were renewed and strengthened a short time before the accident. Their extra strength may have helped to minimise the result of the derailment for, though buckled, they appear to have guided the eighth coach back towards the line after it became derailed.

The signals are of the 4-aspect colour light type, and all lines are continuously track-circuited. Points and signals in the Borough Market Junction area are operated electrically from a miniature lever frame of 35 levers in the signal box, which is equipped with an illuminated diagram. The levers are mechanically interlocked and there are also electric locks which are released when the appropriate track circuits are unoccupied.

Signal No. D.27 which protects the diverging junction points No. 26 is equipped with an illuminated route indicator and is a few yards in rear of the points. The signal ahead of D.27 on the Up local line to Cannon Street is the Outer Home No. C.109 worked from Cannon Street signal box, and is about 270 yards from D.27. The 7-chain radius curve extends throughout this length and the colour lights of No. C.109 cannot be seen from an approaching train until it is about 120 yards from them as the lights are focussed to present maximum brilliancy towards the track close to the signal.

The aspect of signal No. D.27 when the signalman has operated the lever, is controlled by the aspect of the signal ahead; it clears only to yellow if that one is at red, showing double yellow or green as the aspect ahead shows yellow, or double yellow or green.

*Train frequency*

Borough Market Junction is a very busy junction with heavy traffic on all lines. On the Up local line the number of trains each weekday over No. 26 points is about 210 towards Metropolitan Junction and Charing Cross, and about 65 towards Cannon Street. With this frequency permanent way renewals, except very minor ones, are not possible, and such work is carried out at weekends, when traffic is easier and " track occupations " can be given to the engineering staff.

*Permanent way details and damage*

Points No. 26 consisted of 95 lbs. bull head carbon steel rails on wood crossing timbers. The " E " type curved switches and stock rails were of " joggled " design, in which the toe of the switch is given a substantial thickness amounting to $\frac{3}{8}$ ins. and the stock rail is kinked immediately in front of the toe to that extent so as to provide a smooth alignment on the running edge from stock rail to switch when the switch is closed. This design is frequently used at facing points where traffic is dense and where wheel flanges tend to bear heavily against the switch rails, since it allows much more metal at the thin end of the blade towards the tip. Manganese steel switches are authorised for these points because of the rapid wear which takes place on carbon steel switches, and replacement sets in manganese steel had been on order for some months. There had, however, been delay in the assembly of the curved switches and stock rails at the Southern Region permanent way depot due to the very great amount of work there in connection with the modernisation programme, and the previous manganese switches had been replaced with carbon steel switches and stock rails on 15th March 1958. The frog of the crossing which, as will be apparent from the sketch, is part of a compound assembly and therefore of special design, was of cast-manganese steel.

The points were not damaged by the derailment, and score marks were visible on the left hand switch rail to show where wheel flanges had travelled over it and had dropped outside near the heel, where the first broken chair was found. There were a number of broken or displaced chairs, sleepers and conductor rails in the lead of No. 26 points and on the two turnouts ahead on the Charing Cross lines, but the crossing assembly was fortunately undamaged.

The switch rail was excessively " side-cut ", and the top of it for about the first 2 feet from the end was chipped, leaving a flattened top instead of one sloped to fit against the stock rail. The stock rail was also excessively side-cut and the joggle had completely disappeared on the running edge so that the alignment was regular along the length of this rail on the route leading towards Charing Cross which, as already indicated, carries over three times as much traffic as the other route. As a result, when the points were closed for the Cannon Street route, the toe of the left hand switch projected inside the running edge of the rail and the flattened top provided a sort of ramp for the flanges of oncoming wheels, which would have been bearing against the left hand rail because of the curvature, to ride up it on to the rail table.

The photographs at the end of the report, one of which was taken after the switch and stock rail had been removed from the track and reassembled, show the heavy side wear and the even alignment of the running edge on the worn stock rail with no trace of joggle, though a vestige can be seen at the bottom of the head just clear of the toe of the switch. The ramp effect at the end of the switch, caused by battering can also be seen in the detailed photograph.

*Course of the derailment and damage to coaches*

The position of the coaches after the derailment and the damage to the track showed that the first seven coaches and the leading bogie of the eighth coach passed safely over No. 26 points before the left hand wheels of the trailing bogie of that coach became derailed. This bogie was then diverted to the left along the Charing Cross route, and it was followed by the leading bogie of the ninth coach.

The eighth coach must have been drawn forward with the front bogie proceeding towards Cannon Street and the rear bogie towards Charing Cross until the body made sidelong contact with the " V " of the parapets of the bridges and was guided back towards the Cannon Street route, becoming separated from the trailing bogie which came to rest astride the Down Charing Cross line. The front bogie of this coach was also derailed by the crabwise movement of the body, but was not detached from it.

The automatic coupling between the eighth and ninth coaches parted vertically, presumably when the eighth coach was forced back towards the Cannon Street line, and the ninth coach stopped across the Up and Down Charing Cross lines, leaning over to one side with the trailing bogie detached from the frame. The tenth coach was not derailed.

The interior damage to the bodies of the two derailed coaches was not heavy though a number of windows were shattered, and three doors were broken in the eighth coach. The damage to the coach underframes and bogies was, of course, severe.

## Report

There was no conflict of evidence regarding the circumstances of this derailment and it is clear that it was due to the worn state of the left hand switch and stock rails of No. 26 points. A careful examination, however, was made of the derailed bogies of the two coaches, and of the underframes, to ascertain whether any stiffness in movement or wear of tyres might have predisposed the derailed bogies to leave the track. No fault was found in the bogies or their attachments to the coaches, and the tyre profiles of the derailed wheels were almost unworn. The interlocking of the points was also thoroughly checked and found to be correct; there was no fault in any of the equipment at Borough Market Junction signal box.

Signalman B. W. Bailey, who was in charge of Up direction signalling in the box, stated that he set the points and cleared No. D.27 for the 6.52 a.m. train from Sanderstead to run from the Up local line towards Cannon Street in preference to another electric train which was approaching on the Up through

line; this train was due to pass the junction a minute later than the Sanderstead train. He saw the detection light for points No. 26 reversed appear on the illuminated panel, and also saw the signal aspect indication there. He had no cause to touch the levers while the train was passing and did not do so. As soon as the derailment occurred he and his fellow signalman took immediate steps to block the lines and to call for assistance.

Motorman M. C. Chandler, who was in charge of the 6.52 a.m. electric train, said that on leaving London Bridge the aspect of the starting signal was a single yellow; the next signal, No. D.27 at Borough Market Junction, also showed a single yellow. He had shut off power before reaching this signal and he coasted past it at about 15 m.p.h. as he expected to be stopped at the next signal, C.109 at Cannon Street, and his view of it would be short on account of the curvature. The signal came into view at the usual point, when he was about 120 yards from it, and as it was showing a green aspect he applied power. Subsequent measurements showed that at this moment the eighth coach would have been over points No. 26 with the trailing motored bogie a few yards from them.

A few seconds later the brakes became applied automatically and the train stopped. Chandler then saw from his gauge that the power had been cut off, so he applied the hand brake and walked along the train, to find that it had become derailed. Thereafter he took steps to secure the train and to make sure that it was protected. The distance travelled by the train after the derailment began was about 70 yards, and after the automatic application of the brakes when the eighth and ninth coaches became separated, about 20 yards.

Guard J. Diggerson, who was in the tenth coach, heard the noise of the derailed wheels for a few seconds before the coach came to a sudden stop. He was shaken but carried out the protection of the Down lines towards Metropolitan Junction after first going to the signal box and then warning passengers to remain in the coaches until they could be conducted off the railway premises.

Ganger A. A. Grover, who had been in charge of permanent way maintenance here for the past four years, said that he had last inspected points No. 26 on the Sunday, two days before the accident. He found a sliver about 2 ins. long broken off the top of the switch rail and came to the conclusion that the generally worn state of the switch and stock rail was such that it ought to be changed. He reported this to his permanent way inspector early on Monday morning and was told that arrangements would be made to change it during the next weekend.

Permanent Way Inspector E. K. Drane said that he also had looked at the points on the Sunday before the accident, though not in company with Ganger Grover, and had already decided that the switch must be changed when Grover spoke to him on the next day. He had been keeping a watch on the wear at these points for some little time because he knew that they must soon be renewed, but he was not unduly concerned about their condition when he saw them on the Sunday. He said that they were—

> "just the same as a lot more on the section, you go round and notice these jobs want doing or getting near to the time when they want to be done; that was more or less as I looked at that one."

Mr. Drane added that he always paid particular attention to these points because of the exceptionally heavy wear to which they were subjected: before the last change of switches on 15th March 1958 the previous set of manganese switches had been laid 9 months earlier, and the manganese set before that had only lasted 10 months.

Mr. Drane said that when he saw the points shortly after the derailment the switch was fitting well and had not been distorted by the wheels riding over it. He found a small piece of steel, 2 to 3 ins. long, which had been broken off the top edge of the blade towards the toe, and he also saw marks of the derailment on the running surface of the switch. He checked the cant and found it to be $\frac{1}{4}$ in. to $\frac{3}{8}$ in. which is the proper amount, and he said that the gauge was $\frac{1}{4}$ in. wide of standard; this was correct for the sharp curvature. The gauge measurement was, however, taken between the rail faces and not between the running edges where the gauge must have been at least $\frac{3}{4}$ in. wide due to rail wear. Mr. Drane explained that the rail wear was measured with a separate gauge which he had used at these points.

Mr. Drane said that after the derailment he noted that the side wear on the stock rail had reached the maximum permissible amount, but cross section profiles taken at 6 in. intervals showed clearly the heavy side-cutting on both stock and switch rails, which was in places appreciably more than the approved limiting angle of wear which is 26° from the vertical, and the profiles also showed the ramp characteristic that had developed on the top of the flattened switch rail.

In view of Inspector Drane's insistence on the attention which he gave to this turnout because of the rapid wear which occurred, I asked how often the points had been renewed in recent years, and was given the following information:—

| *Date renewed* | *Type of Material* | *Life in months* |
|---|---|---|
| 13th April, 1947 | Manganese Steel | 22 |
| 6th February 1949 | Manganese Steel | 21 |
| 12th November 1950 | Manganese Steel | 22 |
| 7th September 1952 | Manganese Steel | 17 |
| 28th February 1954 | Carbon Steel | 13 |
| 20th March 1955 | Manganese Steel | 17 |
| 19th August 1956 | Manganese Steel | 10 |
| 23rd June 1957 | Manganese Steel | 9 |
| 16th March 1958 | Carbon Steel | 5 |
| 12th August 1958 (after the accident) | Carbon Steel | |

It was also stated that since the introduction of 10-car electric trains in March 1957, followed by 12-car diesel trains in June 1958, the rate of wear had appreciably increased.

## Conclusion and Remarks

As I have already stated the derailment was due to an excessively worn switch and stock rail. The condition of these points had not been overlooked by Permanent Way Inspector Drane but he made a serious error of judgment in not renewing them some time earlier. It may be that he had allowed his judgment to be influenced by past experience of the rate of wear of permanent way here, and had been reluctant to renew the switch and stock rail earlier as they had been in the track for so short a time; this cannot, however, be regarded as an excuse for failing to deal with the situation on its merits.

There were two interesting features in the wear on the switch and stock rails, which are worthy of comment. The first was the side cutting of the stock rail throughout its length, which as already stated was on a right handed curve of 12½ chains radius, caused by the heavy traffic towards Charing Cross. This wear on the running edge meant that the top of the switch rail had no lateral support when closed against the stock rail for the Cannon Street route. The other feature was the complete disappearance of the joggle on the running edge of the stock rail which, combined with the side cutting, exposed the blunt end of the switch rail and allowed it to be battered by the flange of the leading outer wheel on each bogie on every train travelling towards Cannon Street. The flanges of such wheels would all have been bearing hard against the outer rail of this sharp curve, and the sideways pressure against the unsupported head of the switch where it was thinnest towards the nose, combined with the end batter on the exposed nose by the wheel flanges, undoubtedly caused the head to be chipped and broken away over about the first 2 feet of the switch rail, so that a rough ramp was developed.

The wear must have reached a critical stage when the rear bogie of the eighth coach came to the points, and it may also be that the broken piece from the top of the switch rail which Inspector Drane found, became detached shortly before or as this bogie passed over it; the rough fractured surface left on the switch rail would have provided further grip for the riding wheel flange. The mounting of the flange over the ramped head on to the rail table may, in addition, have been assisted by the application of power which would have enhanced the tendency to climb.

Apart from the excessive wear in general of the switch and stock rail the absence of the joggle on the running edge of the stock rail was, in my opinion, a noticeable danger sign which Inspector Drane did not appreciate. It may be appropriate to draw the attention of Engineering staff to the significance of such wear.

I discussed with the officers of the Chief Civil Engineer's staff the advisability of using the joggle design on a turnout of similar flexure in circumstances such as this where there is a preponderance of traffic over the straighter route, but was advised that switches and stock rails of the alternative undercut or chamfered designs would wear so quickly as to be unacceptable. I was also assured that the supply arrangements for manganese steel replacements for switches such as these are being overhauled so that material will be available when required.

The increase in the rate of wear of the points, as shown by the record of renewals, which was attributed to the introduction of the longer trains, is much greater than the increase in the number of wheels now passing over the switches, and it may well be due to the running characteristics of this stretch of the line. Though on the occasion of this accident it was clear that power was applied to the electric train which had been coasting over the crossing, just before the trailing motored bogie of the eighth coach reached it, there must have been many occasions when the motorman of an 8-car train passing over this crossing lingered over applying power after seeing a clear aspect at the signal ahead, for a second or two while the end of the train cleared the points. The addition of two more coaches, however, means that the trailing motored bogie of the tenth coach of each such electric train, and the rear motored bogies of 12-car diesel trains, will be under power on a great many occasions as they pass over the points. This factor may account for a disproportionate increase in the rate of wear. The significance of such heavy wear from the point of view of safety, however, is not very direct provided that Inspectors are aware that it may develop, and I have no doubt that they will now be fully alert to it.

I have the honour to be,
Sir,
Your obedient Servant,

W. P. REED,
*Colonel.*

The Secretary,
Ministry of Transport and Civil Aviation.

(87194) Wt. 3360—V185 K8 12/58 D.L.