MINISTRY OF TRANSPORT

RAILWAY ACCIDENTS

REPORT ON THE DERAILMENT
which occurred on the
21st July, 1947, near
POLESWORTH
on the
London Midland and Scottish
Railway

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MINISTRY OF TRANSPORT,
Berkeley Square House,
Berkeley Square,
London, W.1.
25th November, 1947.

SIR,

I have the honour to report for the information of the Minister of Transport, in accordance with the Order dated 22nd July 1947, the result of my Inquiry into the derailment which occurred at about 10.38 a.m. on Monday, 21st July 1947, near Polesworth Station in the Trent Valley, on the Western Division four-track main line of the London, Midland, and Scottish Railway. I was assisted by Brigadier C. A. Langley.

The 8.30 a.m. Down express passenger train from Euston to Liverpool, comprising 16 screw-coupled bogie vehicles, hauled by a Pacific type engine, was travelling on the Down Fast line at 65-70 m.p.h. when the engine and 14 coaches became derailed to the outside of a left-handed curve. All four lines were blocked, but an Up express was stopped well clear by the Polesworth signalman who was becoming anxious after the usual section time for the Liverpool express had elapsed. A freight train already in the section on the Down Slow was also stopped clear of the obstruction by the prompt action of a fireman who was travelling in the last coach.

The express engine was overturned to the right just before it came to rest approximately 400 yards beyond the point of derailment ; it received only superficial damage, but the two leading coaches, which were also overturned on their right-hand sides, were wrecked. The ends of the following six coaches were crushed together, though not telescoped, but otherwise they were not very seriously damaged and the last eight came to rest with their bodies almost intact. All the couplings held, and the 16 vehicles retained fairly good line considering the comprehensive nature of the derailment.

The train was crowded with about 800 passengers of whom some 130 were standing, and I regret to report that four passengers were killed outright and one succumbed later in hospital. Nineteen passengers were detained in hospital with serious injuries, and a further 45 persons, including six members of the dining car staff, and a travelling carriage cleaner, sustained minor injuries or shock. The driver and fireman were uninjured, and the former went forward at once to protect the opposing lines.

The Polesworth and Tamworth stationmasters were informed of the accident, which was not in sight of any signal box, within five or six minutes, and immediately called for assistance from the local ambulance organisations and the Staffordshire and Warwickshire Police ; the Control was also notified. In response, doctors, nurses and ambulances were in attendance in strength from 11.10 a.m. onwards and no time was lost in conveying the injured to hospitals in the neighbourhood after they had received first aid attention. In the meantime valuable rescue work had been performed by passengers and the train crew and by the permanent way gang who were working nearby, and special credit is due to a nurse who was travelling in the train. Much was also done by ambulance-trained Railway staff under the supervision of the Tamworth stationmaster, and rescue parties were sent by the Pooley Hall Colliery, the Royal Naval Air Station, Bramcote, and by the N.F.S. Some ladies brought a mobile canteen to the site and generous hospitality to the uninjured passengers was given by many residents at Polesworth.

The track of the Down Fast line required complete renewal for 380 yards and the adjacent Up Fast for 200 yards ; the Up Slow line also required a considerable amount of repair, but the Down Slow was undamaged, though it was obstructed by the derailed vehicles. Four heavy cranes from Rugby, Crewe, Derby, and Wellingborough were at the site by 3.0 p.m. They worked at first from the Down Slow line, and after long hours of unremitting work by the staff of all departments, the two Slow lines were made available to traffic by 7.0 p.m. on 22nd July ; normal working was resumed under speed restriction, with the restoration of the Down Fast line at 2.50 a.m. on 23rd July, after an interval of 40 hours. During the blockage, advantage was taken of the alternative route for through traffic via Rugby, Birmingham, and Stafford.

The weather had been fine and warm for several days.

DESCRIPTION OF SITE AND TRACK.

1. With reference to the attached plan, Fig. 1, the Trent Valley line for the 51½ miles between Rugby and Stafford forms part of the West Coast main route from London (Euston) to the North. It runs via Nuneaton (14½ miles from Rugby) and Atherstone (19 miles) to the site of the derailment, 3 miles beyond Atherstone and 1½ miles short of Polesworth ; the block section concerned is from Baddesley Sidings signal box to Polesworth, 3¼ miles.

From Nuneaton onwards the order of the four tracks from East to West is Up Slow, Up Fast, Down Fast, and Down Slow. Occupation of the Down Fast line at Polesworth is considerable ; during the 24 hours on Friday, 11th July, a typical summer weekday, it carried 39 express passenger trains, 7 parcels trains, 12 express and through freight trains, and 2 light engines, or 60 movements in all.

2. For the first 10 miles from Rugby, where the train had stopped, the line is level or slightly rising. For the next 20 miles past the site of the derailment the general trend is falling with local undulations ; at the immediate approach to the site, the gradient rises at 1 in 888 for ½ mile after falling at 1 in 439 and 1 in 321 for 3 miles. With the timings now in force, the usual speed of express passenger trains there is about 65 m.p.h.

3. The left-handed curve concerned has a radius of 72 chains. It lies in a sandy cutting and its length between tangent points is 675 yards ; it is preceded by a long right-handed curve of 225 chains radius, with no intervening straight. The derailment was initiated as the flange of the right-hand leading bogie wheel of the engine began to mount the outside or high rail 376 yards beyond the commencing tangent point of the curve, and 60 yards beyond the 105¼ mile post from Euston (105m. 500 yards).

4. The permanent way material was 95 lbs. R.B.S., laid new in 1929 in replacement of 21 year old track. Each 60 ft. rail length was supported by 24 sleepers ; those on either side of the joints were of Douglas Fir 8 ft. 6 ins. by 12 ins. by 6 ins., with Baltic Fir sleepers 8 ft. 6 ins. by 10 ins. by 5 ins. elsewhere. There were three coachscrews per chair, with hard wood ferrules in the chair holes, and the rail joints were held by standard four-hole fishplates ; the keys were of hard wood.

As shown by Fig. 1, the 1929 track extended from 104 m. 16 yds., to 105 m. 586 yds., i.e., from 2,244 yards in rear to 86 yards ahead of the point of derailment. Thenceforward for 542 yards the sleepers had been renewed in 1942. The 588 yard length from 105 m. 10 yds., to 105 m. 598 yds., covering the whole of the 72-chain curve up to and beyond the point of derailment, had been accepted for the 1948 renewal programme ; the preceding 1754 yards of 1929 track, which lay on the very easy right-handed curve, had been proposed for renewal in 1949.

5. The curve was last surveyed, re-aligned, and re-canted during the summer of 1937, when concrete monuments were put in. They provide for an entering transition of 177 yards, in which the cant is run up from zero at the tangent point to the designed figure of 4¼ ins. for the circular curve ; this represents a deficiency of ⅜ in. on the theoretical or equilibrium cant for 75 m.p.h., which is the maximum now permitted on the Company's system. For 90 m.p.h., which was the corresponding pre-war maximum, the deficiency would have been 2¼ ins.

6. I examined the track on 24th July before any repairs had been carried out in rear of the point of derailment. The weight of the high rail at the point of derailment was 87.3 lbs. per yard and of the low rail 87.7 lbs. per yard ; this was representative of the curve as a whole. The weights were thus well in excess of the permitted minimum of 79 lbs. per yard, but on the high rail the permissible limit of side cutting had been reached or slightly exceeded on a considerable portion of the curve. Fig. 3 shews the actual profiles one rail length in rear of the point of derailment. The rails had been indented by the chair seats to a maximum of 3/16 in.

7. The actual gauge and cant for over 300 yards in rear of the point of derailment are shown to an exaggerated vertical scale by the diagram Fig. 5, which is based on measurements taken at every sleeper before any repairs had been carried out to the track. From 300 yards in rear to 220 yards, on the transition, there was a length of 20 yards where the gauge was slack to a maximum of ⅜ inch, with nearly correct gauge on either side. For the next 115 yards (220 yards in rear to 105 yards), at the end of the transition and on the circular curve, there was varying slackness to a maximum of 7/16 inch, with a few tight places (max. ⅛ in.). So far, the signs of progressive movement of the chairs on the sleepers were much as might be expected with track nearing the end of its life.

For the last 105 yards, however, the widening of the gauge to a maximum of ¾ inch was of quite different character, and had occurred in five clearly defined waves, 60—70 feet apart. The movement was evidently of very recent origin, and the inclination of the coachscrews and the lateral shift of the chairs showed that the high and low rails alternately had been forced from their correct gauge line. Fig. 5 also shows the position of 11 sleepers on which the chairs had been refastened with fresh screw holes three weeks before the derailment, in order to correct slack gauge to the extent of ½ inch.

8. As viewed in the line, there appeared to be little evidence of decay in the sleepers, but some were badly split and the chairs generally had cut into the timber by ⅛ in. to ¼ in. A few of the coach-screws were loose and a number had evidently lost their hold in the sleepers and were beginning to work up. The original 18 year old ferrules were in use and were broken and worn, though it is the normal practice to change them after 10 years' life.

Brigadier Langley later examined about 50 sleepers which had been taken out of the track. He confirmed their general soundness, including the seatings under the chairs, but he found that in most of them the timber around the screw holes was bruised and soft, particularly in the sleepers taken from the last 90 yards of track before the point of derailment. In the 11 sleepers mentioned above, on which the chairs had been refastened, most, but not all, of the old holes had been plugged and some of the new holes had been bored rather close to the old ones ; a few had become elongated by the lateral pressure as the gauge was forced out.

9. There was plently of clean stone ballast and the formation appeared to be solid and well drained ; it is not liable to subsidence, although there are collieries in the neighbourhood. The "top" was good and the voidmeter readings showed no serious depression of the sleepers under load.

The maintenance of the cross-level, however, on the transition and on the circular curve left a good deal to be desired, particularly as high and low cant alternated in comparatively regular waves. This is shown by the diagram, Fig. 5, which it will be noted that slack gauge of $\frac{3}{8}$ in. and $\frac{5}{16}$ in. was related to a drop in cant, and in the last 105 yards, the fresh movement of the high and low rails from the gauge line, which has been described, corresponded with remarkable regularity to low and high cant respectively.

10. The curve alignment in rear of the badly spread gauge appeared regular to the eye, but versine measurements disclosed a variation in actual radius from 57 to 90 chains; it will be noted that the minimum of 57 chains occurred at a point where the cant was low. The alignment on the transition curve was fairly satisfactory, as also was the record of a test run with a Hallade instrument on 5th May, 1947, 11 weeks before the derailment.

Description of Engine and Train.

11. The engine was No. 6244, "King George VI," of the Company's latest and most powerful design for express passenger service (Class 7P) with left-hand drive. As shown by Fig. 4, it was of the four-cylinder 4-6-2 type with a sheet steel streamlined casing. The coupled wheels are 6 ft. 9 ins. diameter, and the tractive effort at 85 per cent. of the boiler pressure (250 lbs. per sq. in.) is 40,000 lbs. With a maximum axle load of 22 tons 10 cwt. (trailing coupled), the weight in working order with six-wheeled tender is 164 tons 9 cwts. No. 6244 was built at Crewe in 1940, and at the time of the derailment had run 506,432 miles since new; since the last general repair in March 1946, it had run 95,742 miles, and 6,601 miles since the last service repair in April 1947.

12. The total wheelbase of the engine is 37 ft. 0 ins., with a rigid coupled wheelbase of 14 ft. 6 ins. As is usual in engines of long wheelbase, the middle coupled wheels have thin flanges, but the bogie and rear pony wheels have flanges $\frac{1}{8}$ in. thicker than standard to improve steadiness of running at the high speeds for which the engines were designed. The coupled wheels have underhung and the rear carrying wheels overhung laminated springs. The leading bogie has a single inverted laminated spring at each side, the load on which is divided between the leading and trailing axleboxes by a compensating beam. The designed weight distribution is shown by Fig. 4.

13. The weight of the engine at the front end is transferred to the bogie framing by heavy steel castings bolted to the main frames at each side. The under side of each casting is hemispherical, and is seated in a cast iron cup with a plane under surface, which slides, in accordance with the lateral displacement of the bogie, on an oil-lubricated gunmetal alloy pad on the main bogie bolster. Side control is by coil springs, acting with an initial centring force of 4 tons, rising to 5 tons at the maximum displacement to one side of $2\frac{7}{8}$ ins. The central bogie pivot carries no weight.

The rear carrying axle is mounted in a pony truck with a trailing arm of 6 ft. 10 ins. radius. As with the leading bogie, the weight is transferred to the pony frame by two ball and cup assemblies, but some additional damping is given by self-lubricating ferrobestos pads on the plane sliding surfaces. Side control is also by coil springs, initially at 1.44 tons, rising to 2.96 tons at the maximum displacement to one side of $4\frac{1}{4}$ ins.

The control springs of the bogie and of the rear pony truck are so disposed that lateral wear is automatically taken up, and no uncontrolled side play can develop, apart from that due to wear of axle box surfaces and wheel bosses. In the design of the side control arrangements of this class, special care was taken to ensure a satisfactory distribution of the lateral flange forces under all running conditions.

14. As stated, the 16 bogie vehicles were screw coupled throughout, and all were equipped with long stroke shock absorbing buffers, in accordance with the Company's modern practice. All had steel underframes; except for the 7th and 9th, the bodies were framed in hard wood with light sheet steel panelling. The body of the 7th coach was entirely of hard wood and that of the 9th entirely of steel; neither, however, suffered much damage.

The weight of the coaches was 507 tons (average 31.7 tons) so that, with the $164\frac{1}{2}$ tons engine, the total tare weight of the train was $671\frac{1}{2}$ tons; its total length was 356 yards. The continuous brake was in operation on the coupled and tender wheels and on all wheels of the coaches; the combined brake power was approximately 82 per cent.

Effects of Derailment and Damage.

15. With reference to Fig. 2, the first sign of derailment was a single light flange mark, with no perceptible indentation, crossing the surface of the right hand (high) rail in a length of 11 ft. 6 ins. The preceding widening of the gauge, alternatively to the high and low rail side has already been described.

16. For 61 yards beyond the end of this flange mark, the heads of the screws on the outside of the high rail were damaged intermittently, and a good many chairs were marked and broken on both rails; in this distance there were also intermittent single flange marks on the sleepers in the four-foot

for 38 yards, just clear of the low rail chairs. For the next 74 yards, there was similar intermittent damage to chairs and screws, with continuous flange marks on the sleepers just clear of the chairs to the outside of the high rail, but there were no flange marks on the sleepers in the four-foot.

The track damage so far, i.e. for 134 yards beyond the end of the flange mark on the high rail, suggested that one pair of wheels only had become derailed to the right; it appears reasonable to conclude that they were the leading wheels of the engine bogie, as they alone of the engine wheels showed any signs of bruising from violent contact with the coachscrews and chairs. Also a single derailed coupled axle would have been held clear of the sleepers by the horn stays.

17. Thereafter, derailment became complete as a rail joint was released by fracture of the fishbolts, but fortunately the engine and possibly the first four coaches continued to run on the sleepers of the Down Fast line until the speed had been considerably reduced. It was only in the last 50 yards or so that the engine fell over on its right-hand side, as its right-hand wheels left the sleeper ends and ploughed into the ballast. There were no traces of earth or ballast on the left-hand wheels.

Thus for the first 135 yards up to the point where complete derailment began, damage to the track of the Down Fast line by the single pair of derailed wheels was mainly confined to chairs and fastenings. For the next 60 yards the track was completely broken up, probably as the coaches in the middle of the train ran off to the right; thereafter this divergence to the right probably saved the complete destruction of the Down Fast at the expense of severe damage to the flat bottom track of the adjacent Up Fast, though nearly all the sleepers in the former were smashed or heavily damaged, as the engine ran over them, completely derailed to the right, for a further 200 yards.

18. Apart from the fracture of the bogie cast iron cup seating (see paragraph 13 above) on the left-hand side and some distortion of the bogie frame, there was only superficial damage to the engine, which was protected to some extent by the streamlined casing; after re-railing it was hauled for 53 miles to Crewe without dismantling the motion.

19. The overturning and sudden stoppage of the engine as it slid on its side was no doubt responsible for the throwing out to the right and the overturning of the first and second coaches, also for the departure from line of the seventh and eighth. The first and second coaches must have travelled for some distance on their sides, which resulted in the destruction of their body work and severe distortion of their underframes.

The next four coaches kept in line although the third and fourth were partially overturned to the right; I was informed by a passenger in the latter that it went over quite gradually as its right-hand wheels left the sleeper ends and ploughed into the ballast. It appeared, however, that the fifth and sixth had run into the ballast at an earlier stage, probably as the Down Fast track was completely destroyed, and they came to rest upright. None of these four coaches received very serious structural damage, though both ends of the third were crushed, also the rear panel of the sixth by a corner of the seventh, as the latter was thrown out to the right and partially overturned.

As will be seen from the plan, the seventh and eighth coaches came to rest across the tracks with their adjacent ends crushed and the gangways torn apart. The body of the ninth was also crushed at the front end, but it and the remaining five derailed vehicles remained upright and in true line without further structural damage. The last two remained on the rails intact. All the derailed vehicles suffered considerable damage to bogies, brake work, and undergear generally.

As has been stated, all the couplings held fast, and there was no overriding of the underframes. With the crowded train, however, crushing of the end panels and the destruction of several gangways were responsible for some of the casualties.

20. The following is a summary of the relevant distances with reference to the commencement of the flange mark on the high rail :—

Rugby station	22 miles South.
Nuneaton station	7½ ,, ,,
Atherstone station	3 ,, ,,
Commencing tangent point of left-handed curve	376 yards ,,
Overbridge No. 67	215 ,, ,,
End of transition	199 ,, ,,
Commencement of severe and recent widening of gauge ..	105 ,, ,,
Commencement of flange mark on high rail	——
End of flange mark on high rail and commencement of damage to screws and chairs	4 yards North.
Commencement of flange marks on sleepers in four foot ..	9 ,, ,,
Rear of train after derailment	76 ,, ,,
Commencement of track destruction	139 ,, ,,
Front of overturned engine	399 ,, ,,
Polesworth station	1¼ miles ,,

EVIDENCE.

21. The train in question, in charge of Driver S. Owen of Edge Hill (Liverpool) shed, left Rugby on time at 10.13 a.m., and the signal box timings between Rugby and Nuneaton indicated that speed was gained rapidly with the powerful engine, despite the 16 coach load. According to Owen, the train passed Nuneaton " more or less on time " (10.30 a.m.), and this was confirmed by the train register at Nuneaton No. 2 signal box, though the guard's journal recorded 10.29 a.m., 1 minute early ; these times represent average speeds for the 14½ miles from Rugby, start to pass, of 51.2 or 54.4 m.p.h. respectively.

The signalman at Baddesley Sidings said that the train, though running well when it passed him at 10.36 a.m., was not travelling unusually fast ; the " Train Entering Section " signal was also received by the Polesworth signalman at 10.36 a.m. As both the clocks were correct, the average speed for the 20 miles from Rugby to Baddesley Sidings was 52.2 m.p.h., which does not suggest that any particularly high speed was attained after passing Nuneaton, having regard to the very similar average before it. Driver Owen estimated that speed at the time of the derailment was about 60 m.p.h., but it was probably rather higher after three miles of falling gradient, perhaps 65-70 m.p.h.

22. Driver Owen described the journey until the derailment as a good run in splendid weather. Engine No. 6244 was in first class condition, and he mentioned that engines of this class, of which he had had considerable experience, were particularly steady in running. All went well until just after he had passed over bridge No. 67, when the engine began to roll alarmingly from side to side. He applied the brake lightly and after rolling perhaps half a dozen times, the engine seemed to steady down momentarily, but it became completely derailed almost at once and he made a full brake application. He felt the engine " rattling " over the sleepers for some distance until it " settled over " on its right-hand side and came to rest. He held on to the reversing wheel as the engine fell over and, after ascertaining that the fireman was uninjured, got out of the cab and concerned himself with the protection of the opposing lines.

Owen had driven regularly between Liverpool and London during recent months, often with this class of engine, and he had never experienced any unusual movement on the curve in question. Otherwise he would have reported it, as he had done the previous week after experiencing a lurch at another point with an Up train ; the receipt of this report was confirmed by the District Engineer. He could not say which way the engine rolled first, but the fireman, F. W. Parr, said that the first roll flung him across the cab from right to left. He confirmed Owen's description of the subsequent course of the rolling and the derailment, and was half buried in coal when the engine fell over, without however receiving any injury. He also knew the road very well and had never previously experienced bad riding on this particular curve.

Written statements were also received from the enginemen of the previous fast train, namely the 6.50 a.m. express from Euston, which passed the site at about 9.50 a.m. Neither had felt any rough riding on the Down Fast line between Atherstone and Polesworth.

24. Detailed examination of Engine No. 6244 after stripping in Crewe workshops disclosed no defect which might have contributed to the derailment. None of the tyres and flanges was appreciably worn, and there was no material increase by wear of the designed side play of the axles in the main, bogie, or pony frames. All the bearing and side control springs were in good condition and tests showed little variation from the standard relation of deflection to load. The weight distribution after the derailment was fairly even on both sides, but there was some excess on the bogie and on the pony truck, with a corresponding reduction on the coupled axles ; there could, however, be no certainty that this distribution was representative of the condition before the derailment.

25. Mr. F. Everitt, District Engineer, Crewe, who was within a month of his retirement, and Permanent Way Inspector H. L. C. Reynolds, explained the circumstances of the proposal in 1946 for relaying of this section of the Down Fast line in 1948. The Chief Permanent Way Inspector, Mr. S. A. Saunders, was not yet fully acquainted with the Crewe District, having been appointed only 8 weeks before from another area, on the retirement of his predecessor. Mr. Reynolds, however, had been in charge of the Nuneaton permanent way district from January, 1944, and before that, as Sub-Inspector, he had assisted the Chief Permanent Way Inspector at Crewe.

26. It is the Company's practice to put forward proposals for relaying two years ahead. The proposal is initiated by the Permanent Way Inspector concerned, based on the age and condition of rails, sleepers, and fastenings in relation to the speed and density of traffic, and the curvature. The District Engineer, after personal inspection, then submits the proposal to the Chief Engineer, who arranges for Head Office inspection before final acceptance for the relaying programme. Where the outside rails of a curve are badly side cut, and the track condition is otherwise good, there are instructions that they should be turned end for end in advance of relaying so as to present an unworn edge to the flanges. On main lines, the work is generally done by crane on Sundays, and a mile of rails can be turned in a day's work.

27. The relaying proposal form for the 588 yard length of the Down Fast line concerned (see para. 4 above and Fig. 1) was submitted by Permanent Way Inspector Reynolds to the District Engineer early in 1946. Mr. Reynolds had not had occasion to put forward any relaying proposals in 1944 or 1945, but he said that his proposals for the next few years would be heavy. Although he stated at the Company's Inquiry that he had to make every effort to get the last bit of life from the sleepers, he assured me that he was referring to what he felt to be his ordinary duty in the interests of economical maintenance. It was his practice to consider track for renewal strictly on the merit of each case, and he was not influenced in any way by the present stringency in the supply of new material.

28. For the length concerned, the average weight of the rails was shown on the proposal form as 88 lbs. per yard, and the supporting " General Remarks " were " rails light, sleepers showing signs of decay and indented." Although there was no mention of side cut rails on the form, Mr. Reynolds said that this was one of the factors which he had taken into consideration at the time, following a test with the side wear gauge. Speaking of the condition of this length generally in 1946, he said that the whole of the material was getting " fairly well worn out," both the sleepers and the rails, having been in the road since 1929 ; he felt, however, that it would last with a good margin of safety for two more years. There was much less side wear on the preceding 1,754 yard length of 1929 track on the 225 chain right-handed curve, so he had not proposed it for relaying before 1949.

29. Mr. Reynolds said that it was his practice to visit this length about once a month, and his attention was drawn by Ganger A. Scaysbrook on 27th June this year to movement of the chairs on the sleepers, with slight inclination of the coachscrews, and widening of the gauge by nearly ½ in., in the neighbourhood of the 105¼ mile post. As he considered that more than a ¼ in. slackness of gauge should not be permitted in a main line, he instructed Scaysbrook to refasten the sleepers concerned, shifting them a few inches to the right or left ; 11 adjacent sleepers were dealt with, 53—43 yards in rear of the point of derailment (see Figs. 2 and 5). A few other sleepers on the curve were refastened at the same time, where the gauge had become slack by ³⁄₁₆ in. After the work was done Mr. Reynolds again inspected the track on 10th July and was satisfied that the gauge was reasonably uniform on the curve, with no greater slackness than ³⁄₁₆ in.

He spoke well of Scaysbrook's work and he felt satisfied, from his inspection on 10th July, that the track was fit for the passage of trains at 70 m.p.h. He was, in fact, " amazed " at their failure 11 days later but added that the sleepers might not have been so good as they appeared on the surface and that " once a thing starts to go, it goes very rapidly." He did not feel that any attention was required to the cant, and with regard to the side cut rails, he had thought that they would last without turning until relaying in 1948.

30. Scaysbrook had been in charge for three years of the length gang of five men, including Sub-Ganger J. Lees and himself ; he was responsible for 1¾ miles of quadruple track with no point and crossing work. He examined his length in the usual way on the morning of Sunday, 20th July, and found nothing requiring attention on the Down Fast line. He then went on his annual holiday, and on Monday morning, 21st July, the day of the accident, Lees took his place in charge of the length.

31. In his statement, Scaysbrook referred to continual trouble during recent months with maintenance of the gauge of the Down Fast line in the neighbourhood of the 105¼ mile post and beyond ; he had told Permanent Way Inspector Reynolds some time in 1946 that this was the worst part. Though he had never felt that the track was unfit for traffic at the prevailing speeds, he said that it was not so good as he would like to see it ; he had done his best with the time available, and mentioned that the gang had had to give a lot of attention to the alignment and level of the newly laid flat bottomed track of the Up Fast line when the ground thawed after the exceptionally severe frost in February and March. During those two months he had been unable to do any repair work to his length.

Early in April, he had to refasten some sleepers in the Down Fast line near the 105¼ mile post owing to widening of the gauge. He had not thought, however, that the general track condition was bad enough to call on Permanent Way Inspector Reynolds for extra assistance to re-gauge right through from the 105¼ to the 105½ mile post ; in his own words, " everyone was shorthanded, we were all alike, and there was a lot of frost work to be dealt with."

He again checked the gauge of the Down Fast Line in May and found it satisfactory except at the Atherstone end of his length, where he refastened a few sleepers. The next occasion when he had done any refastening was at the end of June, about three weeks before the derailment. He had then " pulled through " and refastened the eleven sleepers where the gauge had become wide to a maximum of ½ in., as described by Mr. Reynolds ; he had noticed that the high rail had moved and that the screws had been pushed over. On refastening he had left the gauge a little slack, perhaps ¹⁄₁₆ in. or ⅛ in., " to meet the gauge on either side." He had remarked to the other men at the time that if the gauge went again, it would be necessary to change some sleepers.

Scaysbrook referred to the solid well drained formation, and said that he had had no difficulty in maintaining the cross level. He had appreciated for some time that the high rails of the curve were badly side cut, but he did not consider that they required turning, so he had not brought the matter to Mr. Reynolds' notice. He reaffirmed that he was satisfied with the general condition of the Down Fast line after he had put the eleven sleepers to gauge at the end of June, and " did not feel that the job was getting on top of him."

32. Sub-Ganger Lees generally confirmed Scaysbrook's evidence and was quite sure that he would have noticed if there had been anything seriously wrong with the gauge when he examined the Down Fast line on the morning of the derailment ; he finished his examination at 9.30 a.m., about 20 minutes before the passage of the 6.50 a.m. express from Euston. The next train was the 8.30 a.m. from Euston. Lees was there as it approached and first saw the engine after all its wheels had become derailed ; he said that it seemed to run along the top of the sleepers for some way, and that the speed had been much reduced when it " toppled over."

33. Mr. Saunders, the Chief Permanent Way Inspector, saw the track for the first time on the evening after the accident. In view of his recent appointment he had no first hand knowledge of its history, and was unable to suggest how it had got into such a condition that the fastenings failed to hold under the passage of the train. He considered that the few split sleepers should have been changed, but he did not think that the ganger would have been justified in recommending a speed restriction ; if he had done so, Mr. Everitt would have made a personal inspection. On the whole, he thought Scaysbrook had maintained his length well ; the ballast was good and clean and the cant seemed satisfactory.

34. Mr. Everitt had personally inspected the track, with Permanent Way Inspector Reynolds, in November, 1946 ; he had noticed the side cutting then, but it was not so pronounced. He had next seen it at the Head Office relaying inspection on 15th July, 1947, six days before the accident, when Mr. H. B. Everard, Permanent Way Assistant to the Chief Engineer, had accepted the length concerned for the 1948 relaying programme in accordance with the 1946 proposal ; this was necessarily a very brief inspection. Mr. Everitt said that he would not undertake the turning of rails unless they had reached their limit of wear by the side cutting gauge. In this case he considered that they were due for turning, and stated that if the condition of the rails and sleepers had been brought to his notice, he would have arranged for relaying at the first opportunity, in advance of the programme.

35. Mr. Everard, who was not present at my Inquiry, subsequently informed me that special consideration had been given to the effect of the enforced stoppage of track maintenance during the prolonged frost. As a result, an instruction was issued to District Engineers on 10th March to give priority to track repairs as soon as conditions permitted, and it was emphasised that this was particularly necessary where track was nearing the end of its life. Special stress was also laid on footplate riding as a means of examining the track, and District Engineers were given a free hand to impose local speed restrictions if they felt it necessary pending repairs or renewal. This instruction was followed by another on 13th March, referring to the possible need for speed restrictions at short notice.

With regard to this derailment, Mr. Everard was of the opinion that the side cutting of the rails was a material factor, not only by facilitating the climbing action of the flange, but also by virtually widening the gauge so that the thrust on the fastenings was accentuated with the additional lateral freedom of the axles. He said that, as a general rule, rails should be turned when the side cutting had progressed downwards to within a ¼ in. of the under side of the rail head. I understand that there are long standing instructions to this effect, but they have not been re-circulated for many years.

CONCLUSION.

36. The condition of Engine No. 6244 was not open to criticism in any material respect, and the speed of the train was not abnormal and was within the authorised general limit of 75 m.p.h. The track, however, on this curve was not in fit condition for traffic of the prevailing speed and weight, and this was the sole cause of the derailment.

37. It was considered in 1946 that the track was approaching the end of its life, and it had been accepted for renewal in 1948, but the extent to which its margin of safety was decreasing in the meantime had been seriously misjudged in spite of warning signs. The point was reached eventually when the holding power of the screw fastenings in 18 year old sleepers was insufficient to withstand the passage of a heavy engine at moderately high speed, and at the same time the fastenings were unfairly stressed by the effect of the side cut rails, which in their turn facilitated the derailment of the leading bogie wheels. Thus the rail wear and the condition of the fastenings were interdependent factors ; each reacted on the other, and the regular wave form of the cant variations also contributed.

38. The gauge on the curve as a whole, as measured after the derailment, was deteriorating, with slackness of ⅜ in. and $\frac{7}{16}$ in. on the transition and at the beginning of the circular curve. This was more than should have been accepted in a main line carrying high speed traffic, but I have little doubt that the passage of the train concerned was responsible for the considerable movement of the chairs which began 105 yards from the point of derailment. In this length, the gauge was widened to either side alternately and, as has already been described with reference to Fig. 5, the alternations corresponded closely to the alternations of cant above and below its designed value. It appeared, however, that the variations of cant which were present had not previously given rise to any serious degree of rolling, and it was not until the fastenings began to give way, that the full effect was felt and Driver Owen experienced the first alarming roll. After that, there was cumulative interaction between the lurching of the engine and the yielding of the fastenings, and it continued to thrust from side to side until the right hand leading bogie flange met with more resistance where the gauge had held, and started to mount the side cut high rail. Once the leading wheels were derailed, severe damage to the track and full derailment were to be expected.

39. Responsibility for the continuing fitness of the track must rest at all times with the District Engineer, but it appeared that Mr. Everitt was out of touch with the position notwithstanding the two special reminders which were issued by the Chief Engineer in March this year, as he had not had the support to which he was entitled from Permanent Way Inspector Reynolds. The latter had not appreciated that the side wear of the high rails had been approaching the danger point for some time, with the result that no action was taken to turn rails and so eliminate its effect ; at the time of the derailment it had exceeded the permissible limit.

There was also misjudgment of the remaining strength of the fastenings, although the increasing trouble in maintaining the gauge during the spring and summer should have provided ample warning. Mr. Reynolds apparently realised the rapidity with which such deterioration can progress once it has begun, and I consider that in all the circumstances, he should have brought the situation to the notice of the District Engineer before it was too late, with a view to more drastic repairs than the refastening of individual sleepers. Ordinary maintenance was clearly insufficient, and by retaining the matter in his own hands, Mr. Reynolds was adding unnecessarily to his responsibilities.

40. Ganger Scaysbrook also appears to have misjudged the position. He seems, however, to have done his best to maintain the gauge with the means and time at his disposal, following the long and severe frost, and the track was also solidly packed with clean and tidy ballast. On the other hand, he had not paid sufficient attention to the cross level, which could not but add to his difficulties with the gauge under fast and heavy traffic.

41. No responsibility can rest with Chief Permanent Way Inspector Saunders, who had only recently come to the District, but I am unable to accept his opinion that the cant was satisfactory.

REMARKS.

42. The effects of the war did not directly contribute to this derailment, but the accumulated arrears of renewals at the present time cannot but have their psychological effect, and I feel that it becomes nearly impossible to resist the acceptance of a less perfect standard of maintenance than prevailed before the war. In these circumstances, close supervision and control assumes even greater importance, and all District Engineers on the Company's system have been so reminded by an instruction which was issued by the Chief Engineer within a few days of the derailment.

District Engineers have been required by this instruction to carry out a special and personal examination of main lines by engine riding fortnightly until further notice, and they have again been given full discretion to impose an appropriate speed restriction at any point where considered justified and unavoidable ; the results of these examinations are to be reported fortnightly to the Chief Engineer, with an immediate interim report should a speed restriction be necessary. Attention has also been drawn to the necessity for turning side worn rails on curves, and at the same time checking and correcting the gauge and renewing worn and broken ferrules.

In addition, a separate letter was sent to the Crewe District Engineer instructing him to initiate an immediate and regular programme of turning side worn rails on successive Sundays, and his attention was specially drawn to the arrears of re-ferruling in the District. After the derailment, work was concentrated on the curve in question, with a special gang ; the high rails were turned, all doubtful sleepers were renewed, as well as all the ferrules.

43. Though the necessity for instructions of this kind is to be regretted, they should ensure the close watch on the condition of the track which is so essential to-day, and should strengthen the hands of District Engineers and their staff in giving full weight to the safety factor in relation to the adverse effect of speed restriction on the operation of traffic. I understand that a number of restrictions have already been imposed where high speed is ordinarily attained, in the majority of cases where it has not been possible to adhere to the programmed relaying date owing to delay in delivery of new material. As was pointed out in the concluding paragraph of the Annual Report of the Chief Inspecting Officer of Railways for 1946, operating efficiency will have to suffer increasingly from speed restrictions unless the supply of track material can be substantially improved in the near future.

44. There are two further points which I think should be mentioned. Although the actual cant gradient on this curve was nowhere greatly in excess of 1/720, which is the maximum generally permitted by the Company where there is no change of curvature (as on a transition), the regular wave form of the variations was particularly objectionable. Their contribution to the eventual failure of weakened fastenings illustrates the need for special care in the maintenance of the cross level when track is becoming worn out.

The side wear of the high rails also added to the stress on the fastenings, and there appeared to be some confusion as to its permissible extent, i.e., whether it should be allowed to reach the full limit of the gauge before turning the rails, as was understood by the District Engineer, or whether this should be done at an earlier stage when the worn surface has extended to within ¼ in. of the under side of the rail head, as Mr. Everard suggested. The Chief Engineer has confirmed that the latter should be the practice on important lines and, to avoid any possible misunderstanding, printed instructions, with explanatory diagrams, are in course of preparation, and will be issued to all concerned, down to Permanent Way Inspectors.

I have the honour to be, Sir,

Your obedient Servant,

G. R. S. WILSON,

Lieut. Colonel.

The Secretary,
Ministry of Transport.

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FIG. 5. GAUGE AND CANT DIAGRAM.

Horizontal Scale: 25 feet to 1 inch.

Vertical Scale: as shown ($1\frac{1}{4}$" to 1 inch).

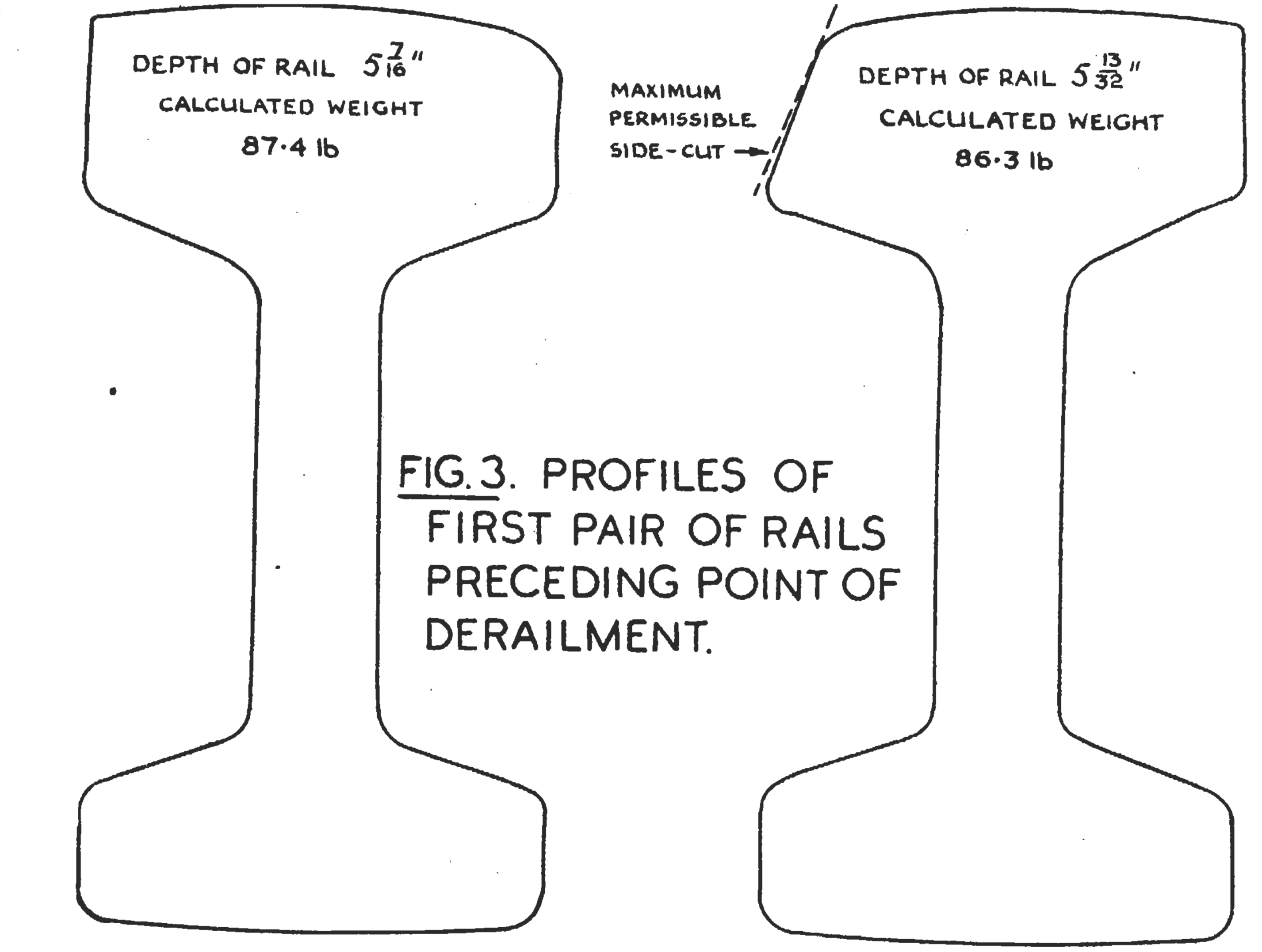

FIG. 3. PROFILES OF FIRST PAIR OF RAILS PRECEDING POINT OF DERAILMENT.

FIG. 1. SITE PLAN.

SCALE: 2 CHAINS TO 1 INCH

YARDS 20 10 0 20 40 60 80 100 120 140 160 180 YARDS

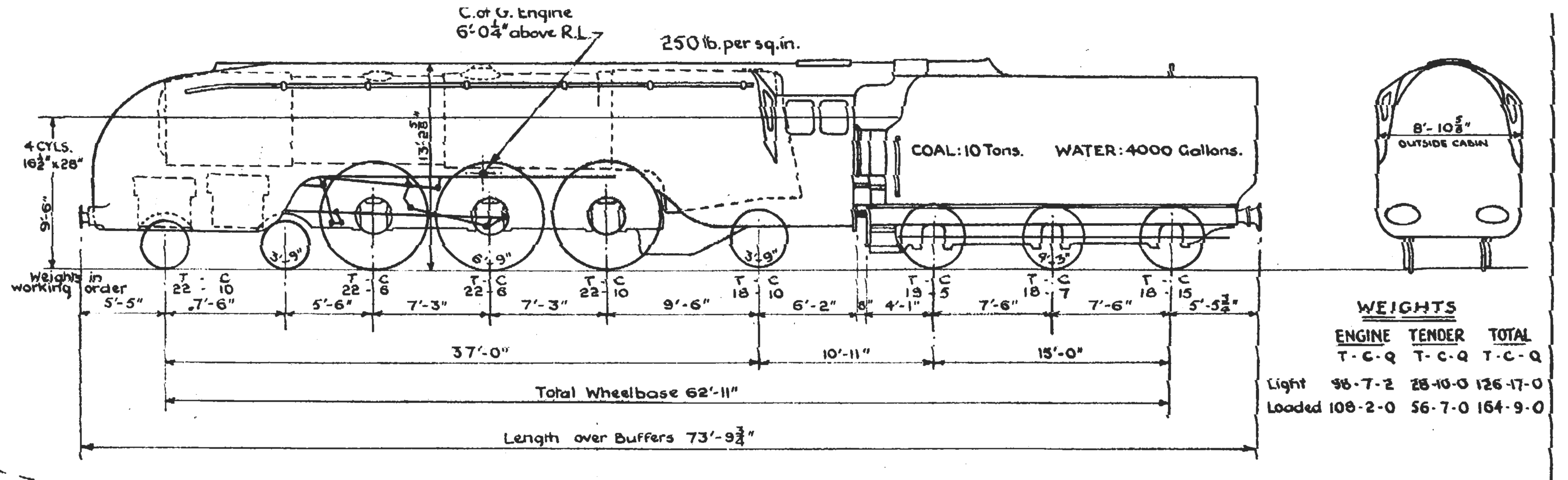

FIG. 4. ENGINE NO. 6244 POWER CLASS 7P.

Scale: ⅛ inch to 1 Foot.

FIG. 2. GENERAL PLAN.

SCALE: 40 FEET TO ONE INCH

FEET 40 30 20 10 0 40 80 120 160 200 FEET

L. M. S. R.

DERAILMENT NEAR POLESWORTH

21st JULY 1947