MINISTRY OF TRANSPORT AND
CIVIL AVIATION

RAILWAY ACCIDENTS

REPORT ON THE DERAILMENT

which occurred on

20th November 1955

at

MILTON (near DIDCOT)

in the

WESTERN REGION
BRITISH RAILWAYS

LONDON: HER MAJESTY'S STATIONERY OFFICE
FOUR SHILLINGS NET

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LONDON: HER MAJESTY'S STATIONERY OFFICE
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MINISTRY OF TRANSPORT AND CIVIL AVIATION,
Berkeley Square House,
London, W.1.
26th March, 1956.

SIR,

I have the honour to report for the information of the Minister of Transport and Civil Aviation, in accordance with the Order of 22nd November, 1955, the result of my Inquiry into the derailment which occurred at about 1.13 p.m. on Sunday, 20th November, 1955, at Milton, near Didcot, on the Bristol-Paddington main line in the Western Region, British Railways.

Owing to the occupation of the Up Main line for engineering purposes, all traffic was being diverted to the Up Goods loop at Milton in accordance with the printed Weekly Notices. Eleven trains had been so diverted without incident during the morning, but the 8.30 a.m. excursion train from Treherbert to Paddington, comprising 10 coaches hauled by a Pacific type engine, became derailed at the facing crossover between the Main and the Goods lines. The derailment was caused by the excessive speed of the train through the sharply curved crossover.

The engine and the leading three coaches went down the 18 ft. embankment to the left and the five following vehicles were derailed. The engine was overturned and four of the first five coaches were demolished or heavily damaged. I regret to state that 11 of the 293 passengers in the train lost their lives, and that 157 were injured, of whom 62 were detained in hospital. In addition the engine driver and a travelling ticket collector were seriously injured, and 4 other railway servants, including the guard, sustained minor injury or shock.

The Up Main and the Goods loop were destroyed or heavily damaged over a length of about 70 yards and the Down Main line was obstructed by debris. Prompt steps were taken to stop traffic in both directions.

The Didcot Central Ordnance Depot and a large R.A.F. depot adjoin the site, and their emergency plans were put into operation at once. Although there was no immediate road access to the site, their Fire Brigades were in position by 1.29 p.m. together with many servicemen and policemen from both the depots. Ambulances from the depots were equally prompt in attendance and they were followed by civilian ambulances from at least ten towns in the area. Fire Brigades from Didcot and Reading and other centres were also quickly on the scene, together with many doctors, St. John's Ambulance men and a strong contingent from the Berkshire County Police.

The rescue work was carried out with great speed and efficiency under difficult and dangerous conditions in the unstable wreckage. Outstanding amongst the many railway helpers was the fireman of the overturned engine, A. G. P. Marsh, who after rescuing the injured driver ran to protect the train and then spent the next two hours extricating passengers from the wrecked coaches. He worked continuously without regard for his own safety until he was persuaded to stop and rest.

The first of the injured passengers to be rescued were treated at the Ordnance Depot medical reception station and were then conveyed to hospital. The first loaded ambulances arrived at the Radcliffe Infirmary, Oxford, at 2.35 p.m. and the last of the injured reached Battle Hospital, Reading, at 6.0 p.m. These two hospitals received most of the casualties, but others were admitted to the three smaller hospitals in Abingdon.

The Didcot railway breakdown gang arrived at 1.50 p.m. and the heavy cranes from Old Oak Common and Swindon were on the site by 3.40 p.m. The Down Main was soon cleared of debris, and single line working was introduced over it between Milton and Steventon at 3.15 p.m. The Up Main was brought into use at 7.52 a.m. on Monday, 21st November, some 18½ hours after the accident. The overturned engine was recovered from the foot of the embankment on Sunday, 4th December, and the Up Goods loop was opened again for through running between Steventon and Didcot on 6th December. The Milton crossover was restored for traffic two days later.

The weather was dull with a little haze but the visibility was generally good. The rails were dry.

I. SUMMARY OF EVENTS

1. On the day of the accident the Severn Tunnel was closed for the normal Sunday repair work and consequently all South Wales traffic was diverted via Gloucester, as shown by Fig. 1 of the accompanying plans. A number of other diversions and restrictions were in force as is usual on Sundays, and particulars of them had been printed in the booklet of Weekly Notices for the period Saturday, 19th November to Friday, 25th November. They included diversions to the Goods lines at Lliswerry and Milton and speed restrictions for bridgework near Gloucester and Wantage Road; relevant extracts are given in Appendix 1. After leaving Cardiff, the excursion train was booked to stop at Newport, Gloucester (for water only), and Swindon, after which the next stop would have been at Reading. The booked timings were easy; they are given in Appendix II together with the actual times recorded by the guard.

2. The train left Cardiff seven minutes late, and a further minute was lost at Newport. It was diverted from the Main to the Goods line at Lliswerry on account of track-laying on the Main line, and a 5 m.p.h. restriction was observed at Over Junction outside Gloucester, where the train arrived 10 minutes late. Four minutes were saved by smart station working, but were lost again by signal checks outside Swindon, which was reached at 12.44 p.m. From there the train ran at a good speed along the Main line, but the 15 m.p.h. restriction over the bridge between Wantage Road and Lockinge was strictly observed. Steventon was passed at 1.10 p.m. still 10 minutes late, the 21 miles from Swindon having been covered at an average of 52 m.p.h. in spite of the restriction.

The next diversion was to be at Milton, 1½ miles further ahead, but Driver Wheeler who was in charge of the engine had not noticed the reference in the Weekly Notices when he studied them on the previous day, and therefore he was expecting a clear run on the main line. He missed the Distant signal, and he also failed to see the Home signals until the engine had almost reached the facing points. He made an emergency brake application much too late to be effective, and the train was derailed in the crossover at a speed of about 50 m.p.h. compared with the authorised maximum of 10 m.p.h.

3. The excursion train engine was a British Railways standard locomotive fitted with the well-known Great Western Railway type of Automatic Train Control (A.T.C.). It had left-hand instead of right-hand drive, which was the former Great Western practice, and as the Milton signals were on the right-hand side of a right-handed curve they were more difficult to see from the driver's seat. Driver Wheeler also alleged that the A.T.C. apparatus did not work at the Milton Distant signal and in consequence exhaustive tests were made to check the integrity of the equipment and the view of the signals.

II. Description of Engine and Train

4. The train was hauled by engine No. 70026, of the British Railways Britannia No. 7 standard mixed traffic class (see Fig. 4). It is a Pacific type and weighs 146½ tons in working order with its six-wheeled tender. The length over the buffers is 68 ft. 9 ins., and the engine wheelbase is 35 ft. 9 ins., with a coupled wheelbase of 14 ft. 0 ins. The coupled wheels are 6 ft. 2 ins. in diameter and they are driven by two outside cylinders, 20 ins. by 28 ins. The rated tractive effort at 85% of the boiler pressure of 250 lbs per square inch is 32,150 lbs with an adhesion factor of 4.23.

The engine is driven from the left-hand side with an upholstered seat for the driver. The driving controls are handily grouped with the vacuum brake, sanding, and blower valves on a control column at the driver's right hand, and the reverser, the steam brake valve, and the regulator handle are in front of him. The A.T.C. apparatus is also mounted on the control column alongside and to the right of the vacuum brake valve. No speedometer is fitted. The steam and water controls for the exhaust and live steam injectors are operated from the fireman's side of the engine. Glass windscreens are provided on either side of the cab.

The steam brake operates on the coupled and tender wheels, and it is applied through the graduable steam brake valve, either by direct application of the valve handle or by the application of the vacuum brake handle which also controls the working of the train brakes. The total brake power of the engine and tender is 76.9 tons, equivalent to 52.5% of its weight.

5. The engine was stationed at the Canton Motive Power Depot at Cardiff. It had run 216,152 miles since it was built in 1952 and 78,779 miles since light intermediate repairs at Crewe in November, 1954. The last daily examination was carried out on 19th November, the day before the accident, and the A.T.C. equipment was examined on 7th November.

6. This class of engine has only been in service on the Western Region for the last four years, and has been employed on main line passenger and fast freight services of the kind also undertaken by the Western Region Castle class. Although these Britannia class engines are reputed to be freer running than those of the Castle class they have earned an unenviable reputation among enginemen for being noisy and dirty. The view from the footplate is also restricted by the long boiler, and obstructed by the smoke deflector plate, hand rails, and the vacuum ejector. This and the left-hand drive makes the observation of signals difficult at many places where they have been sited to give the best view from the right-hand side of the footplate, which, as already stated, is the normal driving position on Western Region engines.

7. The ten coaches were of former Great Western Railway design except the sixth, the cafeteria car, which was of London Midland type. They were built with timber body framing and steel panels carried on steel underframes, and they were screw coupled throughout with British standard gangways. The vacuum brake operated on all wheels and the brake power was 258 tons, equivalent to 82% of the total weight of 315½ tons.

The combined brake power of the engine and train was 335 tons equivalent to 72.6% of the total weight of 462 tons, and the length over buffers was 234 yards.

III. Description of the Route, Site and Signalling

The Route

8. It will be seen from Fig. 1 that the line from Gloucester joins the main South Wales to Paddington line at Swindon. From there it runs through open country with easy curves and a slight

falling gradient all the way to Reading, and it is one of the fastest running sections in the Western Region. On the day of the accident, however, a 15 m.p.h. restriction was in force over a bridge between Wantage Road and Lockinge, about four miles west of Milton, where, as already stated, trains were being diverted to the Up Goods loop.

The Site

9. There are two main lines at Milton with Up and Down Goods loops on either side of them. The Up loop begins at Steventon, just over a mile in rear of the intermediate crossover where the derailment occurred, and it runs from there past Milton signal box to Foxhall Junction, Didcot (see Fig. 2). The Up main line through Steventon and Milton is on an easy right-handed curve of 500 chains radius and the gradient is falling at 1 in 754. The formation is in cutting from Steventon to the Milton overbridge and thereafter on an embankment which gradually increases in height to about 18 ft. at the point of derailment.

Signalling

10. The Milton Up signals are of the lower quadrant type and their positions are shown on Fig. 2. The Up Main Distant is on the right-hand side of the line 170 yards in rear of the Milton overbridge; it is 1,183 yards from the Home signal with the A.T.C. ramp 417 yards further out. The two Up Main Home signals at the intermediate entrance to the loop are carried on a post which is also on the right of the main line, but the Up Goods Home is on a separate post to the left of the loop line. The position of these signals relative to each other and to the tracks is shown by Fig. 3. There is a berth track circuit 506 yards long in rear of the Up Main Home, and the controls on the Up Main block instrument require this track to be clear and the Distant signal arm and lever to be normal before a train can be accepted. The mechanical interlocking follows conventional practice.

The Milton signal box is sited on the left-hand side of the Up loop, and the signalman has a clear view of all the tracks to the west as far as the Milton overbridge. The intermediate entrance to the Up loop is, however, 348 yards from the box and hence it is not easy for the signalman to judge the speed of trains as they approach the Home signals. This box is open throughout the week, but it is normally closed on Sundays from 6 a.m. to 2 p.m. It was, however, open during this period on the day of the accident on account of the pre-arranged diversion.

Table of Distances

11. The relevant distances from the Milton Up Main Home Signals are: —

Swindon		22 miles		West
Wantage Road restriction		4 ,,		,,
Steventon	Signal box	1 ,,	730 yards	,,
	Overbridge	1 ,,	313 ,,	,,
	Up Main Advance Starting signal	1 ,,	78 ,,	,,
Milton	Up Distant Signal A.T.C. ramp		1,600 ,,	,,
	Up Distant signal		1,183 ,,	,,
	Overbridge		1,012 ,,	,,
	Beginning of Up Main Home track circuit		506 ,,	,,
	Up Main Home signals		– –	–
	Up Main to Goods facing points		26 yards	East
	Initial point of derailment		73 ,,	,,
	Front of engine after derailment		160 ,,	,,
	Signal box		374 ,,	,,
	Up Goods Starting signals		716 ,,	,,
Foxhall	Junction Signal box	1 ,,	1,090 ,,	,,
Reading		19¼ ,,		,,

IV. Description of the Track and Effects of the Derailment

The Track

12. The Up Main line between the Milton Distant and Home signals was relaid in 1942 with 95 lbs bull headed rails and wooden sleepers on an ample bed of thoroughly consolidated ballast. The 1 in 9 crossover from the main line to the loop was laid in 1941 with similar materials. The main line was in excellent condition; the 1½ inches of cant on the curve was well maintained and did not vary by more than ¼ inch. Gauge was also good, the maximum variation being 1/16 inch wide in one or two places. The sleepers were bearing hard on the ballast, and the maximum recorded void meter reading was equivalent to a gap of ¼ inch under one sleeper. The crossover also appeared to be in good condition and it was resting on solid ballast, but it had been damaged in the course of the derailment as described in the following paragraph.

Damage to the Track

13. The track in rear of the point of derailment was surveyed on the morning after the accident and particulars of the damage are shown by Fig. 6. The first signs were on the leading right-hand curved rail of the main line facing points. Five chairs were fractured and in consequence the gauge at this point had been widened to a maximum of ⅝ inch. Acid from the batteries of one of the derailed coaches had been spilt over the rail from the toe of the switch to the nose of the facing V crossing, and this had obliterated all marks of excessive side pressure, but further indications of this were noted near the V crossing where three chairs had recently cut into the sleepers and the gauge had been widened by 3/16 inch. The gauge between the two V crossings was correct but there were signs of severe side pressure on the left-hand rail beyond the trailing V crossing in the loop line. The gauge was ⅛ inch wide for the next 20 feet, but thereafter the left-hand rail had been pushed outwards until the track was destroyed near the heel of the trailing switch for a length of 70 yards.

There were other marks on the crossover but I am satisfied that these were caused by the derailment of one or more coach bogies and that they were not made by the engine. The left-hand check rail of the facing V crossing showed signs of wheels bearing hard against it followed by a very faint diagonal mark across it. The nose of the crossing was also scored where it had been hit by a wheel. Many of the timbers were lightly marked, and a number of the chairs on the left-hand rail of the Main line just ahead of the V crossing had been broken. This line was distorted for 60 yards and the sleeper ends were split.

Damage to the Signalling

14. The derailed engine ran over the signal wires and rodding alongside the up cess and pushed them down the embankment for 60 yards. All the wires were cut except the one for the Up Main to Goods Home signal; this wire was so taut that the signal was still off directly after the accident, although the lever had been replaced in the frame. The thrust on the rodding was so great that the loop line was pulled two inches towards the main line at the point where the rodding crossed to the Up Main facing points.

V. Course of the Derailment

15. The marks on the track gave clear evidence that the engine had entered the crossover much faster than the authorised speed of 10 m.p.h. The fractured chairs under the leading right-hand rail indicated very severe side pressure, though this had not been sufficient to cause mounting. The engine managed to negotiate this half of the crossover but on reaching the loop line, the flange pressure on the left-hand curved rail as the engine changed direction was sufficient to burst the track and initiate the derailment.

The course of the derailment on this occasion was very similar to those of the derailments at Bourne End in 1945, Goswick in 1947 and Polesworth in 1951, where in each case the engine entered a crossover at excessive speed and was derailed at or just beyond the trailing points. One cannot gauge precisely the speed at which the train entered the Milton crossover, but it was considerably less than the estimated 65 to 70 m.p.h. overturning speed of a Britannia class engine on a 747 feet radius curve with 1½ inches of reverse cant. The probable speed was 50 m.p.h. or a little higher.

16. An analytical investigation into the movement of the engine through the crossover confirmed these conclusions. On the assumption that the engine pivoted about the trailing coupled axle, the areas of theoretical maximum flange pressure on the rail would have occurred some 10 to 14 feet from the tangent points of the crossover curves. These positions are marked on Fig. 6, and it will be seen that they coincide closely with the places where the chairs were damaged and the gauge began to spread.

17. As soon as the engine left the rails it ploughed straight through the ballast and cut a ramp for itself down the side of the embankment, where it was overturned in a soft grassy field, as shown by Fig. 5. The leading coach broke away from the tender and was thrown clear; it was comparatively little damaged. The second coach followed it down the bank and its rear end was then twisted and shattered by the third. This coach also broke away and ran forward until the front end was crushed by the weight of the following coaches, which had stayed on the embankment. It seems likely that the fourth coach veered to the right at the facing V crossing where its leading bogie was derailed, after which it was over-ridden by the fifth coach, and both vehicles were then carried along between the loop and main lines. The body of the fourth coach was swept from its underframe and the fifth coach was split into three pieces, finally coming to rest with the rear end on top of the third. The sixth, a cafeteria car, mounted the debris, but it and the rest of the train were not badly damaged.

VI. Condition of the Engine after the Accident

18. The engine was examined after the accident whilst it was still lying on its side at the bottom of the embankment. The reversing gear was found in the forward position at 15% cut-off, with the locking catch engaged. The regulator lever was two inches off its stop, equivalent to one third opening of the valve. The cylinder cock control lever was also open but both this and the regulator position could have been affected by the engine falling on its left-hand side. The vacuum brake handle was in the "off"

position but the graduable steam brake valve was partly open with the ratchet control engaged in the 9th of 24 notches. Their positions also could have been affected by the derailment. The tender hand brake was "off". All the remaining valves and controls were closed with the exception of the damper gear, which was fully open, and the re-starting injector water feed valve, which was in No. 4 position.

The tyre profiles of the wheels showed that they had worn comparatively little, and the flanges were in good condition except for some score marks which had been caused by the wheels striking rails and other obstructions in the course of the derailment. The wheels and axles were true to gauge, except the leading coupled wheels; they were $\frac{1}{8}$ inch wide at the crank pin quarter, and the left-hand wheel centre had moved approximately 1/16 inch outwards on the axle.

19. A rail, possibly the one connection to the left-hand stock rail in the loop line, had been forced between the left-hand leading bogie wheel and the frame, and it had then passed between the frame and the cylinder, breaking a bolt and four of the supporting ribs, after which it struck the leading hanger bracket with such impetus that it sheared off the six rivets and drove the bracket against the flange of the wheel. The pressure was so great that a deep groove was gouged in the bracket, and the blow was quite sufficient to move the wheel on its axle. On removing the rail, half a fishplate and some broken pieces of cylinder ribs were found embedded between the cylinder casting and the cleading.

20. As previously mentioned, the engine was recovered on Sunday, 4th December, and was taken to Swindon Works where it was given a thorough examination. Most of the fittings on the left-hand side were found to be damaged and the regulator rod was broken. The left-hand smoke deflector plate had been swept away, and the boiler cleading was crushed and twisted. A hole had been driven through the back of the tender by the right-hand buffer of the first coach, but on the whole the damage to the engine and tender was comparatively slight considering the nature of the derailment.

VII. The Automatic Train Control Equipment

21. The engine was equipped with the Great Western Railway type of A.T.C. apparatus which indicates in the cab the aspects displayed by the Distant signal. When the signal is at "caution", a siren is sounded and a partial but restorable brake application is made; when the signal is at "clear" a bell is rung. These signals are transmitted to the engine through a fixed ramp in the centre of the track in the vicinity of the Distant signal; at Milton this ramp is 417 yards in rear of the Up Distant. A full description of the apparatus is given in Appendix III and it is illustrated by Figs. 8 and 9.

22. When B.R. standard engines were first introduced on the Western Region it was noticed that the A.T.C. brake application was much less effective than with Western Region engines. This was due to the small ejector of the B.R. brake remaining in action during the brake application, whereas on the Western Region engines the air pump which maintains the vacuum during running is isolated from the train pipe by means of a vacuum retaining valve, whenever the vacuum is reduced in the train pipe; this may be caused by a normal application, by the operation of the A.T.C. or by the opening of the passenger communication valve.

In order to overcome this difficulty an automatic ejector isolating element was designed and fitted to a B.R. Class 4 engine. A series of trials were made with a 10-coach train and these demonstrated clearly the effectiveness of the new device. For example, with the isolating element fitted to the ejector, a train was stopped by an A.T.C. brake application in 1,030 yards on a rising gradient of 1 in 300 from a speed of 57.2 m.p.h. with the regulator fully open and 30% cut-off. Without the isolating element the same train was only stopped in 3,363 yards on the same gradient from a speed of 61.5 m.p.h. with full regulator and 30% cut-off. Tests at other speeds produced comparable results. This element was fitted to a number of B.R. standard engines working in the Western Region but the excursion train engine had not been so equipped at the time of the accident.

VIII. Rules and Regulations

23. Extracts from the relevant Rules and Regulations are given in Appendix IV. These include instructions to the driver that he must study any special notices concerning the lines over which he has to work, that he must control the running of the train so as to ensure its steady passage through junction points and crossings, and that he must obey all speed restrictions shown in the Appendices and Notices. The guard must keep a good look-out, and should he see any reason to apprehend danger he must make every effort to attract the attention of the driver.

Included in the instructions for working passenger trains over Goods lines is one which prohibits a passenger train from entering a Goods loop unless the loop signal has been lowered, and the driver has received verbal instructions from the signalman or handsignalman to do so (Permissive Block Regulation 5(c)).

In the Working Timetable it is laid down that the maximum permissible speed through a crossover from a Main line to a Goods loop is 10 m.p.h. unless otherwise authorised.

IX. Evidence

Trainmen

24. Driver W. T. Wheeler, who was in charge of the excursion train engine, was 55 years of age with more than 40 years' railway service. He had been posted to the Canton (Cardiff) Motive Power Depot in 1939, and at the time of the accident he was employed in the No. 4 Link, to which he had been promoted in February, 1953. This link is the senior Vacuum Goods Link and in a period of 24 weeks it has six booked trips to London and back with passenger trains as well as four trips with goods trains to Reading, in addition to spare work which includes excursion and other trains to London.

Wheeler had signed the "Knowledge of the Road" book for the Swindon to Paddington main line route when he was promoted in 1953, and he had since confirmed his knowledge of this route every six months, the last date being on the 14th November 1955, only six days before the accident. He had worked 12 passenger and 4 goods trains over the Swindon to Paddington Up line during the six months before the accident, and on two of these occasions, namely on 7th and 17th October, he was in charge of a Britannia class engine hauling the 10 a.m. Cardiff to Paddington "Red Dragon" express. He had driven one of these engines on nine other occasions during the previous six months, though not on the Swindon-Didcot section.

25. Wheeler said that on the morning of the accident he booked for duty at 8.53 a.m. at the Canton Shed, having signed off at 12 noon on the previous day. He had received the printed book of Weekly Notices on Thursday 17th November, and he had studied it during the weekend. He marked one or two of the speed restrictions, including the 15 m.p.h. restriction near Wantage Road, but he did not mark either of the diversions, although he remembered reading about the one at Lliswerry on page 48. He admitted quite frankly that he had missed the Milton diversion on page 34, and he thought that he would be proceeding along the main line as usual; he never imagined that the train would be diverted into the Milton Goods loop.

On taking over the engine in the Canton Shed he tested the vacuum brake, and on opening the large ejector the A.T.C. siren sounded in the normal way. He then exhausted the vacuum and used the steam brake when leaving the shed, and consequently he did not check the working of the A.T.C. apparatus when the engine passed over the two testing ramps at the exit.

On arrival at Cardiff passenger station he had to wait for a few minutes because the excursion train was late, so he took the opportunity of telling his fireman about the various restrictions. He remembered in particular mentioning the Lliswerry diversion and the Wantage Road restriction. Fireman Marsh was not his regular mate, and he had not previously worked with him on a Britannia class engine.

26. The excursion train arrived at 9.52 a.m. and left at 10.1 a.m.—8 minutes late. The timing via Gloucester was easy, and little time was lost in spite of the various restrictions. The A.T.C. siren was working satisfactorily, although the bell was a little irregular and sometimes only gave a faint ring. At Lliswerry the Distant signal was at "caution" and the siren sounded correctly. Wheeler reduced speed to about 15 m.p.h. and entered the Goods loop without incident. The train arrived at Gloucester 10 minutes late, but four minutes were saved in taking water. Wheeler recalled that on approaching Over Junction, where there was a 5 m.p.h. restriction, the Distant signal was at "caution" and on this occasion the fireman re-set the A.T.C. apparatus after the siren had sounded. Wheeler was not disturbed by this, and only said to his mate "That's alright Frank, I can manage now". Wheeler agreed that the fireman should not in any circumstances have touched the A.T.C. equipment, and he said it was only on rare occasions that he allowed this to be done.

On approaching Swindon the train was stopped outside the station by signals, and again the A.T.C. siren sounded correctly.

27. The train arrived at Swindon at 12.44 p.m. and left again at 12.46 p.m. still 10 minutes late. The engine was working perfectly and Wheeler had no difficulties with it except he stated it was very dirty and at speed "the noise was terrific". He said he carefully observed the 15 m.p.h. restriction near Wantage Road making several brake applications as he approached the bridge. He explained that it was his practice and that of other drivers on Britannia class engines to open the large ejector slightly before making brake applications so that he could, where necessary, release the brakes quickly and so avoid a premature stop. He normally closed the large ejector when running between stops, and he thought that he had done so on this occasion.

After passing the restriction he opened the regulator with a cut-off of about 45 per cent, and he agreed that he might have notched up to 15% by the time the train reached Steventon where he thought the speed was between 35 and 40 m.p.h.

As the train was approaching the Milton Distant signal, Wheeler noticed that his fireman was having difficulty with the exhaust injector and this distracted his attention so that he did not see the signal, nor did he hear the siren at the ramp and consequently he did not re-set the A.T.C. apparatus. He also said that he did not see the Milton Home signals as his mind was still distracted by the fireman's difficulties, and he did not realise the train was being diverted through the crossover until he actually saw the points set for the loop. He made a full emergency brake application and shut the regulator just before the engine was derailed at about 40 m.p.h.

28. Wheeler pointed out that the view of the signals from the footplate of Britannia class engines was poor; he often had to lean right outside the windscreen and in doing so his eyes got full of dirt and on one occasion his eye was badly burnt by a cinder. Owing to the right-handed curve, the Milton signals were particularly difficult to see from the left-hand side of the cab and on this occasion he did not see any of them. Usually his regular mate helped him by repeating signal aspects especially in difficult places and he thought that Fireman Marsh would do the same. Marsh had called out the signal aspects at other places on the journey, and but for the trouble with the injector Wheeler would have expected him to have looked out for the Milton signals.

29. Fireman A. G. P. Marsh, a man of 30 with 13½ years' railway service, had been working in the No. 4 Link for the last three months, but he was not Driver Wheeler's regular mate although he had worked with him on one or two previous occasions.

Marsh did not remember any tests of the brakes or of the A.T.C. equipment at the Canton Shed. He recalled that on arriving at Cardiff Station his driver spoke to him about the various restrictions on the route, mentioning the diversion at Lliswerry and the speed restrictions for bridge works near Gloucester and Wantage Road, but he had made no reference to the Milton diversion.

Marsh said that on leaving Cardiff he was busy firing, and owing to this and the noise of the engine he did not hear the A.T.C. bell or siren except when running into Gloucester, when he heard a faint "whirring" noise and lifted the re-setting handle; the driver did not make any comment about this. The journey to Swindon was uneventful and the engine ran well to Wantage Road, where the restriction was observed.

Marsh continued firing as far as Steventon, where he stopped to look at his watch. He was standing close to the driver, who passed the remark that they were still 10 minutes late. This conversation took place just about the time when the engine was passing under the Steventon overbridge, after which Marsh looked at the fire and then noticed that the exhaust steam injector on the right-hand side of the footplate was wasting water. He went over to attend to it, but as he could not settle the trouble he changed over to the live steam injector. He thought he did this when the engine passed under the Milton overbridge. He was quite sure that he did not hear the A.T.C. siren, nor did he touch the re-setting handle when he was standing beside the driver. He was not familiar with the position of the Milton signals which he did not observe as he was busy with the injectors. He thought the speed at Steventon was about 40 m.p.h. and that this was maintained up to the moment of derailment.

30. After the derailment Marsh extricated the driver from a pile of coal which had fallen on him and helped him out of the cab. He then went back to collect flags and detonators, but as he could not find them he climbed up the bank and ran to the signal box, where the signalman gave him some detonators. Marsh then ran back to protect the rear of the train, but he found that the guard had already done so. He therefore returned to the engine and shut off the two injectors and the steam heating valve, but he did not touch the regulator, the brake handle, or the large ejector valve. He collected some bars and a spanner and spent the next two hours rescuing passengers from the wrecked coaches as already described.

31. Temporary Passenger Guard L. W. Wall, who was in charge of the excursion train from Treherbert said that it was reversed at Cardiff where the express engine was coupled on. He walked to the other end of the train and tested the vacuum brake from the van at that end; he noted that the gauge dropped to 10 inches when he applied the brake, and on release the vacuum was re-created.

He had been issued with the Weekly Notices and he had noted the various restrictions and diversions, and in particular the Milton diversion, which he had recorded in his notebook. He did not, however, wait to speak to the driver when the engine was coupled on, since the Inspector gave him all the particulars he needed. Wall explained that he sometimes discussed the running of a train with the driver, but he did not do so on this occasion.

Wall described the journey to Steventon, and confirmed that the various speed restrictions were observed, although he thought the train had kept to the Main line at Lliswerry, where in fact it was diverted through the Goods loop. According to his journal the train arrived at Swindon at 12.44 p.m. and left at 12.46 p.m.—10 minutes late; it ran at normal speed to the Wantage Road restriction, where the speed was reduced to about 25 m.p.h. after which it rose to between 35 and 40 m.p.h. by the time the train passed Steventon at 1.10 p.m. still 10 minutes late.

Wall said that he knew the Milton diversion was about 1½ miles ahead and he was waiting to see whether the driver would reduce speed. He glanced through the window on the off-side of the van, but he did not see any signals; he was, however, rather vague about their position. He said he was still waiting for the driver to take action when the brakes were fully applied and there were three severe jolts before the train stopped. Wall admitted that he was feeling rather worried as the train approached the Milton diversion without reducing speed, but he thought that if he had interfered with the brake at the same time as the driver was making an application, "the vacuum would have parted the train". After the accident he ran back and protected the train, finally arriving at Steventon, where he reported to the Stationmaster.

32. Travelling Ticket Collector W. H. Cheeseman, who was in the third coach, and Engine Driver R. G. Cheeseman, who was travelling as a passenger in the first coach, both confirmed that the Wantage Road restriction was observed, and they thought that the speed at the moment of derailment was between 35 and 40 m.p.h.

33. Driver S. J. Wooster, who was in charge of the last train — a freight train — to be diverted through the Milton crossover before the accident, said that he arrived at Milton at 11.45 a.m. The Distant signal was at "caution", and on passing over the A.T.C. ramp the siren sounded in the cab. His speed was about 25 m.p.h. but he gradually reduced it as he approached the Home signals at danger. He was about 100 yards away when the Main to Loop signal was lowered and he entered the crossover at about 5 m.p.h.

34. Drivers who had been in charge of the excursion train engine No. 70026 on the days immediately before the accident stated that the A.T.C. apparatus was working satisfactorily, with no difficulty in hearing either the bell or the siren.

Signalmen

35. Signalman G. C. Birt was on duty in Milton signal box which had been kept open on this Sunday on account of the engineering occupation of the Up Main line. Inspector Checkley who had made the arrangements told Birt that he did not appoint a hand signalman to work at the entrance to the loop because it was not necessary.

Birt explained that during the two years he had worked in Milton box, passenger trains had been diverted on to the Goods loop on several other occasions but a hand signalman had never been posted and no questions had ever been raised regarding one. He said, however, that when passenger trains travelled over the loop it was his practice to keep the Up Main to Goods signal No. 32 at danger until the train had been brought nearly to a stand. The Home signals were about 375 yards from his box, and he thought that the Up Main track circuit in rear of the Home signal was about 400—500 yards long. He used to judge the position of the trains by watching the track circuit indicator, but he had some difficulty in estimating their speed when they were so far away.

Birt came on duty at 6 a.m. and the occupation of the Up Main began at 6.57 a.m. when he received the blocking back signal from Foxhall Junction. He set and bolted No. 22 points (Up Main to Up Goods) for the loop and he placed collars on the Up Main Home and Distant levers (Nos. 34 and 35). The repeater for the Distant signal was in the "on" position.

Before the arrival of the excursion train three passenger trains had passed through the crossover from the Main to the Goods line without incident, and their speed through the loop was approximately 10 m.p.h.

Birt said that he accepted the excursion train at 1.4 p.m. and immediately obtained permission for it to proceed along the Goods loop to Foxhall Junction under the absolute block working regulations which had been brought into use in accordance with normal practice on such occasions (see Permissive Block Regulation 5(b) in Appendix IV). On receiving "Train Entering Section" at 1.9 p.m. he placed his block instrument to "Train on Line" and recorded the time in the Train Register.

He said that he was still standing near his desk when he observed that the track was occupied, and after waiting for a moment or two, he pulled signal lever No. 32. He gave a demonstration of these movements in the Milton signal box, and the time taken was 8½ seconds.

Birt said he could not tell whether the engine was steaming as the train approached the crossover, but he thought it was travelling a little too fast for entering the loop. He saw the engine lurch as it passed through the crossover and he watched the train go down the bank. He immediately sent "Obstruction Danger" in both directions and telephoned to the signalmen at Foxhall Junction and Steventon. He noted that the time was 1.10 p.m. and he recorded this in his Register after the telephone conversations. While he was talking on the telephone the fireman arrived and Birt gave him some detonators so that he could protect the rear of the train. Birt thought that the last Down train was between the Milton and Steventon bridges at the time of the accident.

36. Signalman A. Bennett, of Steventon box, said that he accepted the excursion train at 1.2 p.m. and he got it accepted from Milton at 1.6 p.m. when he received the "Train Approaching" signal. Four minutes later the train was "on line" and it passed his box at 1.12 p.m. Its speed was roughly 40 m.p.h. compared with 60—65 m.p.h. which was normal for expresses before the Wantage Road restriction was imposed. The engine was steaming as it passed the box and Bennett thought the driver was picking up speed after the restriction. Three other expresses had passed that morning, and all of them were traveling at about the same speed as the excursion train and they had taken the same time from Swindon, namely 24 minutes.

At 1.15 p.m. Bennett received "Obstruction Danger" from Milton and immediately afterwards the signalman told him the train had gone down the bank. Bennett operated the Up line detonator placer and then informed the Stationmaster, District Inspector, and Swindon Control of the accident. Bennett

booked the time of the "Obstruction Danger" signal after his telephone conversation with the Milton signalman, which had not lasted for more than a few seconds. He thought the clock in his box was showing the right time, although it had a tendency to gain.

37. There was a discrepancy between the time given by the two signalmen. Birt's statement that he sent the "Obstruction Danger" signal at 1.10 p.m. cannot be reconciled with its receipt by Bennett at 1.15 p.m. The Steventon clock may have been a little fast, and Birt could scarcely have sent his message only one minute after he had received the "Train Entering Section" signal. The derailment must have occurred at some intermediate time, probably about 1.13 p.m.

Operating and Motive Power Inspectors

38. District Inspector W. F. Checkley said that he arranged for Signalman Birt to take duty at Milton box for the 6 a.m. to 2 p.m. shift. He did not post a handsignalman at the entrance to the Goods loop because he thought that Permissive Block Regulation 5(c) (see Appendix IV) applied to emergency working only and not to diversions which were shown in the Weekly Notices. He said that he had worked on this principle ever since he was posted to the Didcot District nine years ago, and he understood that a similar practice was in force in other districts on the Western Region.

Inspector Checkley stated that he also was on duty on the Sunday morning and he visited Milton box at about 12.10 p.m. Everything was in order, collars had been placed on the Up Main Home and Distant signal levers, and the Distant signal repeater was showing "on". He spent a few minutes in the box, and then went to Moreton Cutting, finally returning to Didcot where he heard of the accident. He bicycled back to Milton and reached the box at about 1.30 p.m. He noted crossover lever No. 22 was reversed and locked by No. 23. The Up Main Home and Distant signals were "on", but the Up Main to Goods signal No. 32 was still "off", and he found it was being held in this position by a taut signal wire which had not broken like the others. This was cut shortly afterwards and the signal returned to normal.

39. Motive Power Inspectors Jenkins and Pettifor described the working of the A.T.C. apparatus on Britannia class engines. Both men said that these engines were very noisy at speed and it was difficult to hear the A.T.C. bell and siren. The sirens were inclined to get dirty and when this occurred they sounded weakly, but this did not affect the efficiency of the brake in any way.

Engineering and Signal Staff

40. Ganger F. Greenaway, who was in charge of the length which included the Milton Up crossover, said that on the day before the accident he made a special inspection of the Up Main and the crossover in view of the diversion of passenger trains over it on the following day. Everything was in good order, the gauge through the crossover and on the Main line was correct and the cant on the Main line was 1½ inches.

41. On the day of the accident Greenaway was engaged with the ballast train, so Ganger E. W. Greenough from the adjoining length walked over Ganger Greenaway's tracks as well as his own. He examined the Up Main and crossover at about 10 a.m. and found them in good condition. On the completion of his inspection he noticed a passenger train take the diversion safely at about 10 to 15 m.p.h.

42. Signal Inspector W. S. Stark checked the position of the signals and tested the interlocking as soon as he arrived at Milton box at about 1.35 p.m. Signal lever Nos. 31, 32, 34 and 35 were normal, with point lever No. 22 and locking bar No. 23 reversed; collars were on lever Nos. 34 and 35, the repeater for the Distant signal No. 35 was showing "on" and the Up Main berth track circuit was showing "occupied"—the rear of the excursion train was still standing on it. He tested the lever locking and found it correct. The Up Main Home signal lever No. 34 was correctly locked by point lever No. 22, the detection of which was in order.

X. Testing of the Automatic Train Control Equipment

43. The ramp for the Milton Up Main Distant signal was examined by Signal Inspector Stark on the afternoon of the accident. It was in good condition and it was electrically "dead"; the electric contacts on the Distant arm and lever were also in good order. On the following morning the Inspector gauged the ramp and found it was 1/16 inch high, which was satisfactory.

44. On the same morning A.T.C. Inspector C. V. Pragnell examined the equipment on the overturned engine. Owing to its position, the cab apparatus was on its side but it was still fixed to the control column, and it was not damaged in any way though it was covered with ashes from the fire which had been thrown out after the accident. The re-setting handle was free and the brake valve was closed. The Inspector removed the lid of the apparatus box and found that the armature was pressed against the electro magnet, which was still electrically alive 18 hours after the accident, as the automatic switch had not cut off the current. The shoe in front of the engine had fortunately escaped damage, and when it was lifted the current to the electro magnet was correctly cut off, though the armature could not fall with the apparatus on its side. Inspector Pragnell unscrewed the siren and found that the disc revolved quite freely.

45. The apparatus box was then closed, the siren was replaced and the A.T.C. apparatus was not touched again until the engine was raised on Sunday, 4th December, when I tested the equipment personally. The vacuum train pipes on the engine were undamaged, and one end was connected to the hose pipe of an engine standing on the loop line at the top of the embankment. The full vacuum was created without difficulty and this caused the automatic battery switch of the A.T.C. apparatus to close in the normal way. There was still sufficient current in the battery to energise the electro magnet which held the armature in position as soon as it was lifted by the re-setting handle. The contact shoe was then lifted and the armature dropped immediately. Air entered the brake valve and the vacuum fell to 18 inches, at which it was maintained by the operation of the ejector on the other engine. When the ejector was closed, however, the vacuum fell to zero in a few seconds, thus demonstrating that the A.T.C. brake was working efficiently. Air entered through the ports in the siren cover but the disc did not revolve freely and in consequence the siren made a "spluttering" sound in place of a steady whine. It was dismantled in my presence and I noticed that the disc was covered with a thick layer of black dust and the oil on the bearing had dried. The siren was cleaned and oiled, after which it operated perfectly. It is reasonable to conclude that much of the dirt in the siren had accumulated from the coal dust and fine ash which had covered the equipment after the accident, and the oil may have dried during the fortnight the engine was lying in the open.

46. The engine was taken back to Swindon, where the A.T.C. equipment was again tested on 12th December. The height of the shoe above rail level was $2\frac{7}{16}$ inches which was within the permissible limit. In the first instance the engine was propelled over a dead ramp with the vacuum maintained by the propelling engine. The siren sounded clearly and air was admitted freely to the train pipe. The engine was then pulled over the ramp with the Distant signal "off" and on this occasion a weak bell signal was recorded. The battery, however, was nearly run down as it had been on the engine since 7th November when the apparatus was last examined.

47. On 9th December I tested a number of A.T.C. sirens which had been removed from Britannia class engines. These sirens had been in service without examination for periods ranging from 5 to 42 days. Several of them were dirty and the discs were covered with black dust, but none of them was coated as thickly as the disc of the siren of the excursion train engine when I examined it on 4th December.

Each siren was inserted in the brake valve of an A.T.C. apparatus, and it was tested by releasing the armature. In each case the vacuum in the train pipe fell from 25 inches to 10 inches, but the sounds of the sirens varied considerably. Only one which had been in service for a week, gave a strong clear note, the others varied from a low whine to a "spluttering" noise similar to the sound made by the siren of the derailed engine. These tests showed that the sirens on the Britannia class engines got dirty quickly, and that they did not always give a clear note, but the efficiency of the brake application was in no way impaired. On the other hand, the sirens from a number of Western Region type engines sounded clearly when they were tested under similar conditions.

48. The disc of a new siren was then jammed with the ports closed, but the sound of the air rushing through the independent port opening could be heard clearly when the armature was released and the vacuum in the train pipe dropped as before to 10 inches. Further static tests were made with a 10-coach train. A Britannia class engine was first attached to a train set which had a leaking train pipe, and then to a similar set with tight pipe joints. The small ejector was in continuous operation for each test and the A.T.C. brake application was made first with the siren spinning normally, then with the siren ports half closed, and finally with the ports fully closed. The average reductions of vacuum in the train pipe were 8 inches, 6.8 inches and 6 inches respectively; the time taken to reduce vacuum averaged 54 seconds with the first train and 45 seconds with the second. These tests indicated that the A.T.C. apparatus gave a fair brake application on a Britannia class engine even with the small ejector continuously open though its effectiveness was somewhat reduced with a closed siren.

49. On 9th December a running test was made between Swindon and Milton with a 10-coach train weighing 314 tons including a dynamometer car, and drawn by Britannia class engine No. 70028 without an isolating element. The record of the test is given by Fig. 7. The 15 m.p.h. restriction at Wantage Road was carefully observed after which the driver notched up quickly to 15% cut-off which was the position of the reverser on the derailed engine. The train accelerated more slowly than normal owing to the short cut-off and the speed was only 49 m.p.h. at the Milton Up Distant signal ramp. The signal was at "caution" and consequently the siren sounded immediately the A.T.C. shoe was lifted by the ramp, and as the apparatus was not re-set the brake was gradually applied. The vacuum in the train pipe fell slowly from 24 inches to 13 inches and the steam brake came into operation on the engine after about half a minute. The speed was correspondingly reduced until the train stopped with the front of the engine a yard past the Milton Up Main Home signal 1,600 yards from the A.T.C. ramp.

This result was a surprisingly good one compared with the other trials (see para. 22), but on this occasion the steam brake as well as the vacuum came into action which was not always the case in the earlier tests, and the engine was working with a very short cut-off. The trial showed, however, that even without an isolating element the A.T.C. apparatus on a Britannia class engine could produce an effective brake. The opening of the large vacuum ejector would of course have neutralised the A.T.C. brake to a large extent, but it would not have affected the siren in any way.

XI. Speed Tests

50. In addition to the running test described above, the speeds of three passenger trains were recorded by Chief Inspector Pullen shortly after the accident. In each case the Wantage Road restriction was still in force, and the speeds at the Milton Distant signal ramp were 50, 51, and 52 m.p.h. respectively. The actual time for the excursion train to run between Swindon and Steventon, as recorded by the guard, was 21 minutes, which was the same as the time taken by the other trains, so it can be concluded that the speed of the excursion train at the Milton Distant ramp was probably 50 m.p.h. or a little higher.

XII. View of the Signals

51. On the 18th December I observed the Milton Up Distant and Home signals from the footplate of a Britannia class engine. The day was fine with a slight haze, just as on the day of the accident. The engine travelled slowly along the Up Main and it was stopped at various places in order to check the view of the signals from different positions on the footplate.

As was to be expected on a right-handed curve, the Distant signal was first seen from the right-hand side of the cab at a range of 680 yards, and from this point onwards it was in full view. From the left-hand side the view ahead was obstructed by the hand rails and smoke deflector plate, and it was necessary to lean right outside the cab in order to identify the signal clearly. It could be seen through the spectacle glass at a distance of 360 yards, when it came into view in the gap between the deflector and the boiler hand rail, but it remained in sight for 100 yards only before it was obscured by the hand rail.

The Up Main Home was first seen from the right-hand side of the cab at a distance of 1,200 yards, after which it was partly obscured by the Milton overbridge, but it came into full view again at a range of 1,000 yards against a sky background. The other two signals were difficult to see against the trees, but when the engine was 600 yards away the Up Main to Goods signal began to show against the sky.

The Up Main Home was first seen from the left-hand side through the windscreen at a range of 770 yards, but it was difficult to identify between the deflector plate and the boiler hand rail. It remained in view for 300 yards, but it gradually became obscured by the hand rail. The Up Main to Goods signal could not be distinguished at first as it was partially hidden by the deflector plate and its hand rail, but when the engine was 515 yards away this signal could be seen through the spectacle glass in the gap between the deflector and the boiler hand rail. This hand rail obscured the view of the Up Main signal arm so that only one signal could be seen at the same time until the engine was 100 yards away, when the Up Main came into sight above the band rail. As before, the only way in which both signals could be seen together was by leaning right outside the cab.

52. I made another inspection on 15th January from the footplate of a Britannia class engine. This engine had been fitted with an automatic ejector isolating element, (see para. 22), which was mounted on top of the vacuum ejector and further obstructed the view from the driver's seat, so much so, that it was extremely difficult to pick out either the Distant or Home signals from the left-hand side without leaning outside the cab. It was a very clear day and a series of photographs were taken. These confirmed generally the results of the first test, except that the view through the left-hand spectacle glass was even more obscured than before.

53. On the 1st February I travelled on the footplate of a Castle class engine from Swindon to Paddington in order to make a comparison with the Britannia class engine. The weather was fine and visibility was excellent. On this occasion the engine did not stop at Milton, where the speed was 63 m.p.h. but I had no difficulty in identifying the Distant signal through the left-hand spectacle glass. It came into full view at a distance of 600 yards, and remained in sight until the engine had almost reached the signal post. Similarly on passing under the Milton overbridge the Home signals came into view at a range of 900 yards and stayed in sight again until the engine was within a few yards of the signal post.

I also observed other signals on right-handed curves in positions similar to the Milton signals, and I had no difficulty in identifying them from the left-hand side of the cab though they had been sited for right-hand drive engines.

XIII. Conclusion

54. There is no doubt that this derailment was due to the excursion train's taking the Milton crossover much too fast. Indications of excessive speed were the fracture of the chairs under the leading right-hand rail of the crossover, the spread of the gauge, and finally the destruction of the Goods loop trailing points. The track was in good order, and its condition did not contribute to the accident in any way. The engine driver stated, and other witnesses confirmed, that the train was travelling at about 40 m.p.h. at the moment of derailment, but the results of the trial with the special train and an analysis of the timings of the excursion and other trains indicate that the speed was approximately 50 m.p.h. instead of the authorised maximum of 10 m.p.h.

55. Driver W. T. Wheeler frankly admitted that he failed to see the Distant and Home signals at Milton and that he did not attempt to reduce speed until almost at the facing points, when his emergency brake application was much too late to be effective. He asserted that the A.T.C. apparatus failed

on this occasion, but I am satisfied from the thorough examination and subsequent tests that it must have functioned correctly. Wheeler agreed that although he did not test it at Cardiff as he should have done, the A.T.C. apparatus had been working satisfactorily up to Milton, and there was nothing in its condition afterwards to suggest its sudden failure. The siren may not have sounded clearly, but I am confident that it did work, and that the apparatus was re-set when the engine passed over the ramp; otherwise the train would have stopped or it would have been travelling slowly at the diversion. Wheeler probably lifted the handle without realising he had done so, and then allowed his attention to be diverted, although re-setting by Fireman Marsh, as he did at Gloucester, cannot be entirely ruled out. It is also possible that Wheeler failed to close the large ejector properly after the Wantage Road check; this action would have neutralised the A.T.C. brake though it would not have affected the siren. In any event, it is the driver's clear duty always to observe the running signals irrespective of the condition of the A.T.C. equipment, which is provided as an aid to, and not as a substitute for, his vigilance. Driver Wheeler must therefore accept full responsibility for this accident. He has over 40 years' railway service and he has been a driver for the last 16½ years. His record was clear.

56. Wheeler had ample time to study the book of Weekly Notices in which the restrictions and diversions were set out clearly, but he overlooked the one at Milton. This may account for his lack of vigilance after passing Steventon, added to which the view of the Milton signals from the left-hand side of a Britannia class engine is far from good; an inattentive driver, who had ignored the A.T.C. warning, could easily miss the Distant signal. Similarly, the view of the Main Home signals is obscured by the smoke deflector plate, the vacuum ejector and the hand rails, and in certain positions the Main to Loop signal stands out more clearly than the other; consequently Wheeler may have mistaken this signal for the Up Main when the former was lowered by Signalman Birt. Some smoke or steam from the passing Down train may have partially obscured the view for a short time but Wheeler did not complain of this.

57. On the other hand, the Distant and both Home signals could have been seen by the driver if he had leaned well outside the cab, and in striking contrast all these signals were visible at long range from the right-hand side. Had Fireman Marsh looked ahead at the critical period he could not have failed to see them and warn his driver. It must be remembered, however, that both men were used to Western Region engines with right-hand drive, and that Wheeler had travelled over this route on the footplate of a Britannia class engine only twice previously, but not with Marsh as his mate; hence he had not arranged for his fireman to give him warning of the aspect of the Milton signals, which is common practice amongst enginemen at places where signals are difficult to see from the driver's side. In these circumstances Fireman Marsh cannot be blamed for failing to see the signals, especially as he was not familiar with the route and he was having trouble with the injectors.

58. Guard L. W. Wall knew about the Milton diversion and had even noted it in his book. It is therefore unfortunate that he did not discuss the running of the train with Driver Wheeler before they left Cardiff. Wall realised that the train was travelling too fast as it approached Milton, but he failed to apply the brake. His fear that he might have parted the train was quite unfounded, but a guard is placed in a difficult position because he is naturally loth to take control out of the driver's hand unless danger is imminent. This was clearly a case for action, and Guard Wall's judgment was at fault.

59. Signalman Birt correctly accepted the excursion train and obtained "Line Clear" for it from Foxhall Junction in accordance with the Absolute Block Regulations. In the absence of a hand signalman he decided rightly to wait until the berth track circuit was occupied before clearing the Main to Goods signal. This track circuit is over 500 yards long, and as the box is nearly 400 yards from the signals it was difficult for him to judge the speed and the position of the approaching train. In demonstrating his actions Birt waited for 8½ seconds after the track circuit was occupied before pulling the signal lever, but he may have acted more quickly on the day of the accident. It therefore seems likely that the excursion train was 300 to 400 yards away when the signal was lowered.

60. A hand signalman should have been appointed in accordance with Western Region Permissive Block Regulation 5 (c) but this was District Inspector Checkley's responsibility. He was under the serious misapprehension that the rule applied to cases of emergency working only, and it is indeed surprising that his failure to carry out the regulation was never noticed during the nine years he was at Didcot. The presence of a hand signalman at the crossover might have attracted the driver's attention in time for him to have taken emergency action, and with both the Home signals at danger the chance of their being misread would have been avoided. Had Wheeler seen them even at a range of only 300 to 400 yards, a full brake application might have reduced the speed sufficiently for the train to have negotiated the crossover safely, or for the effects of any derailment to have been reduced.

XIV. Remarks and Recommendations

61. The tests of the A.T.C. equipment proved its integrity beyond all doubt, but as it only functions at the Distant signal, control of the brake application must be left in the driver's hands, and the chance of human error is always present. Accidents caused by the disregard and subsequent unthinking cancellation of the A.T.C. warning and braking effect have been very rare indeed, and a mistake of

this kind has featured only once before in a formal Inquiry*. Other accidents have occurred, and cases are also known where drivers, having ignored the warning, have passed stop signals at danger but without ill results. *On the other hand, there can be no doubt that this valuable safety device has given timely* warning to drivers on countless unrecorded occasions and it has been of particular value in reinforcing their vigilance at those places and on those occasions when observation of Distant signals has been difficult.

It is obviously impossible to say how many accidents have been avoided by this apparatus, but its value is demonstrated by an analysis of Inquiries which have been held during the last 43 years. This shows that 69 out of 664 accidents might have been prevented, and that 400 out of 1,454 fatalities (or 27½ per cent) might have been saved by Automatic Train Control of the Warning type. There are, however, many types of accident which cannot be prevented by this device and the way to improvement of safety also lies in the extension of colour light signals, track circuits and block controls. All these measures are needed, but their provision must be tempered by a proper appreciation of the economic position. The British Transport Commission's Modernisation Plan strikes an admirable balance by allotting large sums for signalling improvements as well as providing for the progressive extension of A.T.C. of an improved type to all main lines in the country.

62. B.R. standard Britannia class engines were introduced on the Western Region four years ago, but the excursion train engine was not equipped with the new vacuum ejector isolating element. It was thought, therefore, that the A.T.C. brake application might not have been fully effective, but the test which is described in para. 30 showed that under the conditions prevailing at the time of the accident, the train would have been stopped or its speed would have been greatly reduced if the A.T.C. brake had not been cancelled by re-setting the armature or else neutralised by the large ejector. The fitting of isolating elements to B.R. standard engines working on the Western Region is now nearly completed. All Britannia class engines have already been equipped and the work on the others will be completed shortly.

63. A number of sirens which had been in service on Britannia class engines for periods varying from 5 to 42 days were found to be dirty, and in consequence orders were issued for them to be examined and cleaned once a fortnight instead of every 28 days. This is a wise precaution, because the A.T.C. apparatus on this class of engine is close to the fire box door and thus is more liable to collect dust than the apparatus on the Western Region type of engine, where it is mounted on the right-hand side of the cab.

64. The Western Region A.T.C. equipment does not incorporate a visual indicator which is part of the new B.R. standard apparatus. This indicator is a disc which turns from black to black and yellow whenever the re-setting handle is used, and it remains so until the next A.T.C. ramp is reached; thus, in addition to an aural warning, the driver is given a visual reminder that he has passed the Distant signal at "caution". Such an indicator might have warned Wheeler that he had re-set the armature when he passed the Milton Distant signal ramp at "caution" and so enabled him to have taken action in time to prevent a derailment. Although, as stated in para. 61 the Western Region apparatus has been a very effective safeguard for many years, I recommend that consideration be given to fitting it with this modern improvement provided that the reliability of the equipment is not impaired in any way.

65. It should not be necessary to remind enginemen that a fireman must never interfere with the A.T.C. apparatus when the driver is in charge, but as Wheeler did not appreciate fully the significance of such action, it would be desirable to draw the attention of enginemen to the dangers of misunderstanding which may arise from this practice.

66. As is the case with most large modern locomotives, the view from the footplate of the Britannia class engine is restricted by the long boiler; it is further obstructed by the smoke deflector, the vacuum ejector and the hand rails, and the view compares unfavourably with that obtained from the footplate of other Western Region express engines. I recommend, therefore, that early steps be taken to modify the design, where practicable, so as to improve the view.

A start might be made with the Britannia class engines on the Western Region where right-hand instead of left-hand drive has been the general practice until recently. With the nationalisation of the Railways in 1947 this Region has come into line with the others and signals are now being sited for left-hand drive. Similar problems arose after the formation of the four main line companies in 1923, but the temporary difficulties of operating with different types of drive were successfully overcome. The engine drivers on the Western Region are also becoming well accustomed to the new conditions but their difficulties in observing some of the signals will remain for a number of years until the change-over is completed. The gradual introduction in the Western Region of the main line diesel locomotive with an unobstructed view from the cab will improve conditions, but meanwhile everything possible should be done to assist the driver in his responsible task.

**NOTE*: The Inquiry was held into the derailment at Norton Fitzwarren on 4th November 1940, when the driver of a passenger train failed to respond to the A.T.C. warning and ran past a Distant signal at "caution" and two stop signals at "danger". The train was eventually derailed at the catch points of a converging junction.

67. The Milton Up Home signals are excellently sited, especially for right-hand drive, and they can be distinguished easily from one another, so that in normal circumstances little difficulty should be experienced in identifying them even from the left-hand side of the footplate. I can see no reason therefore why their position should be changed until they become due for renewal when no doubt the siting will be reviewed in the light of the conditions existing at the time.

68. The derailment occurred on a Sunday, and it has been asked whether there is any special significance in this. During the last ten years (1946-55) there have been 146 Inquiries into train accidents of which only 17 were on Sundays. This is less than the weekday average but as traffic on Sundays is only about one-third of the volume on other days the accident rate per train mile is higher. In view of the reduced traffic the number of engineering works in progress on the running lines is much greater on this day than on any other day of the week, and nine of the 17 Sunday accidents were connected directly or indirectly with these works, but in nearly every case, including this derailment, the accident would have been avoided if proper attention had been paid to the Weekly Notices or if the safety rules had been fully observed.

69. The Weekly Notices are clearly set out, and a driver should have little difficulty in following the items which affect him. It has been suggested, however, that some reference to diversions from passenger lines should be added to Section A, Temporary Speed Restrictions, on the grounds that these diversions invariably call for a reduction in speed. There is much to be said for this proposal, which is now being examined by the Western Region.

70. The rules for working passenger trains over goods lines vary to some extent between Regions but they have now been revised in order to improve and consolidate them. I recommend, however, that consideration should be given to the addition of a rule forbidding drivers of passenger trains from entering goods loops and other lines not normally used by passenger trains until they have received verbal instructions to do so. This rule, which is based on the one now in force on the Western Region, should not cause much delay to traffic, and it would ensure that passenger train drivers are given special warning before being diverted on to lines over which they normally never travel. As already pointed out, the enforcement of this rule might have prevented this accident or reduced its effects.

71. The fact that the engine was not fitted with a speedometer had no bearing on this accident, which was due to the driver's failure to observe signals, and not to his misjudgment of speed through a crossover. A speedometer is, however, a valuable asset, and all new electric and diesel locomotives and multiple unit trains are being so equipped. It has been the British Transport Commission's policy since 1952 to fit speedometers to all new passenger and mixed traffic steam locomotives, and the fitting of this equipment to steam engines built before this date is, I understand, also under consideration.

72. Many suggestions have been received from members of the public; some of them have already been covered in this Report and most of the others concern additional precautions to be taken when trains are diverted from their normal route. It will be appreciated that in this case ample warnings were given but the driver failed to respond to them as he frankly admitted. Some of the factors which may have affected him have already been discussed, but it must be remembered that additional precautions add to the work of the staff, and the more complicated the instructions become the greater is the risk of mistakes.

The proper observance of signals is a fundamental duty laid upon every engine driver, and although he should be given all reasonable assistance nothing should be done to condone lack of vigilance upon which the safe and efficient working of railways so largely depends.

I have the honour to be,
Sir,
Your obedient Servant,
C. A. LANGLEY,
Brigadier.

The Secretary,
Ministry of Transport and Civil Aviation.

Restrictions and Diversions

On the day of the accident a number of speed restrictions and diversions were in force, and these were shown in the printed booklet of Weekly Notices for the period Saturday 19th November to Friday 25th November. The following is a relevant extract: —

Section A

Temporary Speed Restrictions

Page of the Booklet	Location of Work	Lines Affected	Mileage at or between M.	Ch.	M.	Ch.	Speed Restr. m.p.h.	Remarks
	Severn Tunnel Junction, Swansea, Carmarthen and Fishguard Harbour							
9	**Lliswerry Crossing and Llanwern**	**Up**	**155**	**70**	**154**	**60**	**15**	**Track renewal**
	Swindon and Severn Tunnel Junction, via Gloucester							
9	**Lydney Jct. and Awre Jct.**	**Up**	**129**	**10**	**128**	**20**	**30**	**Pending track improvements**
8	**Gloucester West and Over Jct.**	**Down and Up**	**115**	**5**	**115**	**9**	**30**	**Pending bridgeworks**
8	**Over Jct. and Gloucester West**	**Up**	**114**	**28**	**114**	**20**	**5**	**Bridgeworks**
8	**Tuffley Jct. and Haresfield**	**Up**	**112**	**0**	**108**	**40**	**50**	**Track improvements**
8	**Minety and Purton**	**Up**	**82**	**60**	**82**	**40**	**30**	**Slip**
	Reading and Cogland via Bristol							
4	**Wantage Road and Lockinge**	**Up**	**59**	**34**	**59**	**24**	**15**	**Bridgework**

Section B

TEMPORARY ENGINEERING WORKS

	At or Between	Lines affected	Remarks
	Severn Tunnel Junction, Swansea, Carmarthen and Fishguard Harbour		
	SUNDAY, 20th NOVEMBER		
48	**Between Lliswerry and Bishton**	**Up and Down Mains BLOCKED**	6.30 a.m. to 6.0 p.m. Pre-assembled track renewal with steam crane 154¾ and 155½ m.p. **Up trains to travel over the Up Goods Running Loop.** **Down trains to travel over the Down Goods Running Loop.**
	Reading and Cogland via Bristol		
	SUNDAY, 20th NOVEMBER		
34	**Between Milton and Foxhall Jct.**	**Up Main BLOCKED**	6.45 a.m. to 4.30 p.m. Loading spent ballast 55 and 54 m.p. **Trains to travel via the Up Goods Loop.** Milton Signal box open.

REPORT ON THE DERAILMENT
WHICH OCCURRED ON 20TH NOVEMBER 1955
AT MILTON (NEAR DIDCOT) IN THE WESTERN REGION
BRITISH RAILWAYS

CORRIGENDA

Page 15, lines 24 and 38: —

Delete COGLAND
Insert COGLOAD

MINISTRY OF TRANSPORT AND CIVIL AVIATION
LONDON: HER MAJESTY'S STATIONERY OFFICE, 1956

TIMINGS OF THE EXCURSION TRAIN

Point to Point Distances	Place	Booked Times				Actual Times				Remarks
		Arr.	Dep.	Mins.	Average Speed	Arr.	Dep.	Mins.	Average Speed	
miles		a.m.	a.m.		m.p.h.	a.m.	a.m.		m.p.h.	
	Cardiff	9.43	9.53			9.53	10.00			
11½	Newport	10.12	10.16	19	36	10.20	10.24	20	34½	
44¾	Gloucester	11.25	11.32	69	39	11.35	11.38	71	37¾	Includes time lost at the Lliswerry diversion and the Over Junction restriction.
		p.m.	p.m.			p.m.	p.m.			
36¾	Swindon	12.34	12.36	62	35½	12.44	12.46	66	33½	Includes four minutes lost by signal checks outside Swindon.
20¾	Steventon	Pass	1.0	24	52	Pass	1.10	24	52	Includes time lost at the Wantage Road restriction.

Note: The booked times are taken from the Special Traffic Notice for the period 18th to 24th November, 1955, and the actual times are those recorded in the guard's journal.

The Automatic Train Control Equipment

The engine was equipped with the Great Western Railway type of A.T.C. apparatus which indicates in the cab the aspects displayed by the Distant signal. When the signal is at "caution" a siren is sounded and a partial but restorable brake application is made; when the signal is at "clear" a bell rings.

These signals are transmitted to the engine through a fixed ramp in the centre of the track in the vicinity of the Distant signal. The ramp is about 44 feet long and in the centre it is precisely 3½ inches above rail level. Experience has shown that as the rails always wear faster than the ramp, the tendency is for the surface of the ramp ultimately to get higher than 3½ inches above rail level, which is a safety factor. The ramp is connected electrically through a contact on the signal arm to a switch on the lever in the signal cabin. When the lever is pulled and the signal is cleared, the switch is closed and a current passes from a battery in the signal cabin through the signal arm contact to the ramp. When the signal is at "caution" the switch is open and the ramp is electrically "dead"; it is also "dead" if the battery fails, or the connecting wire breaks, or the signal arm does not respond correctly to the lever.

The engine equipment, which is shown diagrammatically by Fig. 9, comprises a contact shoe and a switch fixed to the cannon type axle box on the leading bogie, and in the cab an electrically controlled brake valve combined with a siren and bell. The cab apparatus is illustrated in perspective by Fig. 8.

The contact shoe is fixed on the centre line of the engine and it projects to within 2½ inches of rail level, in which position it is held by two powerful springs. The allowable tolerances are plus or minus ¼ inch. It is capable of being raised 1 inch vertically in order to operate the switch, although a movement of only ⅛ inch is needed to open it; thus there is ample allowance for shoe wear or for variation in the height of the ramp.

The brake valve is controlled by a heavy armature which is coupled loosely to a hinged lever, the opposite end of which is inserted in a slot in the stem of the valve. In the normal position the armature is held against the poles of an electro magnet which is energised by a 4-volt battery. In this position the end of the lever is floating loosely in the slot and the brake valve is held pressed against its seating by a spring loaded plunger, so preventing the vacuum in the train pipe from being diminished.

As soon as the engine passes over a "dead" ramp the shoe is lifted and the contact switch is opened thus cutting off the current from the battery to the electro magnet. The armature drops immediately by gravity, and the end of the lever rises and opens the brake valve. This allows air to enter the train pipe, thus partially destroying the vacuum and applying the brake. The air is drawn through the siren with such force that the perforated disc spins round rapidly and produces a high pitched whine. Air is also drawn through an independent port so as to ensure that the vacuum is reduced irrespective of the condition of the siren. The brakes continue to be applied and the siren to sound until the armature is re-set by lifting the lever on the outside of the apparatus box.

When the engine passes over a "live" ramp the shoe is lifted and the current from the battery is cut off as before, but current from the ramp now passes from the shoe through a polarised relay to a secondary winding on the electro magnet, thus maintaining the magnetic field and holding up the armature. At the same time the polarised relay tongue closes a circuit through a slow releasing relay which causes the bell to ring for one or two seconds according to the speed of the train.

The electro magnet, the armature, and the polarised relay are housed in a metal box which is locked by a special key so as to prevent unauthorised persons from tampering with the equipment. An automatic switch which is mounted on the side of the box cuts off the electric current from the battery until the vacuum in the reservoir is created, and the electric circuits are arranged so that any failure of the battery causes the armature to drop and the brake to be applied.

EXTRACTS FROM RULES AND REGULATIONS (WESTERN REGION)

British Railways Rule Book 1950

Rule 126 (*ii*)

"The Driver and Fireman *must when commencing duty ascertain from the notices posted for their guidance if there be anything requiring their special attention on the lines over which they have to work . . . . . ."

Rule 127 (*iv*)

"The Driver must observe and obey all signals, whether the cause of the signal being shown is known to him or not . . . . . ."

Rule 127 (*xiv*)

"The Driver must when running through junctions to or from lines diverging from the straight road, regulate the speed to ensure a steady passage for the whole train through the junction points and crossings."

Rule 127 (*xv*)

"The Driver must observe in all cases the speed restrictions shown in the appendices or notices."

Rule 148 (*b*)

"The Guard of a train must keep a good look-out and should he see any reason to apprehend danger, he must make every effort to attract the attention of the Driver or Signalman."

Regulations for Train Signalling on Double and Single Lines

SECTION VII

Regulations for signalling trains and engines by permissive Block system over Goods running loop lines and other permissive lines

1. The Loop lines will be worked in accordance with the Standard Double Line Block Regulations with the following modifications and additions: —

* * * * * *

5. (a) "The Goods loop line must not be used as a running line for passenger trains except when the usual running line is not available, either by reason of accident or failure, or because it is occupied by the Engineer by previous arrangement with the Divisional Superintendent or District Traffic Manager."

(b) "Whenever the goods running loop is used for passenger trains as set out above, absolute block working must be maintained, and passenger trains must only be accepted by the signal box in advance under the regulations applying to the main line. In addition all facing points not equipped with a facing point lock (with facing point lock bar or track circuit locking) must be clipped and padlocked, the keys being kept by the Officer or other person in charge of the operations."

(c) "A passenger train must never enter a goods loop unless the loop arm has been lowered, and the driver has received verbal instructions from the signalman or hand signalman to do so."

Extract from Additional Instructions for Milton Signal Box

Regulation 3

"Is Line Clear?" must be sent for Up Main Line Trains as soon as "Is Line Clear?" is received.

"The Up and Down Goods Running Loops between Steventon and Foxhall Junction will be worked in accordance with the Regulations for signalling trains and engines by Permissive Block System as shown in Section VII of the Book of Regulations for Train Signalling on Double and Single Lines."

*(This Rule is not applicable to Firemen who are not passed Drivers, such men not being allowed time for Notices when booking on duty. Fireman A. G. P. Marsh is not a passed Driver).

Printed in Great Britain under the authority of Her Majesty's Stationery Office
By Porterprint Ltd., Leeds, 9.

Wt. 2037/3925. Ps.104355. 6/56. K.9. Ppt. Ltd. 314.

FIG. 1 LOCATION PLAN

SCALE: 8 MILES TO 1 INCH

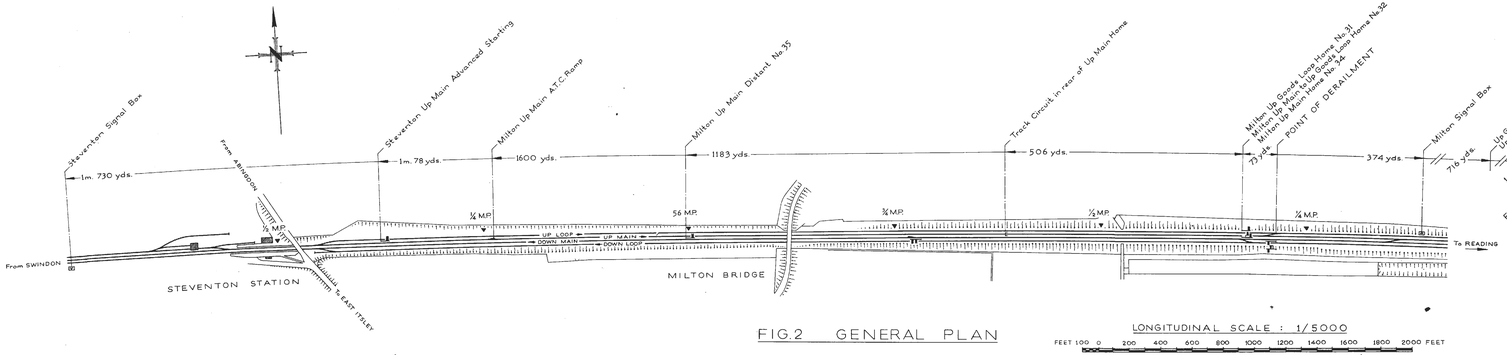


FIG. 2 GENERAL PLAN

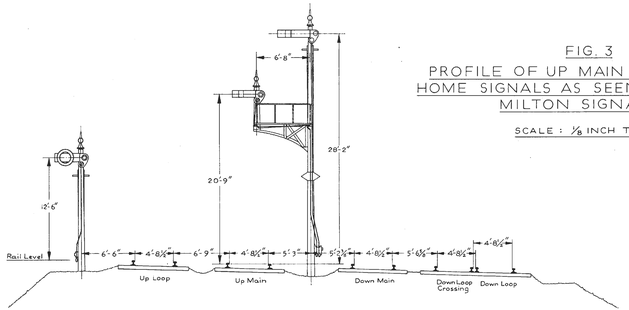
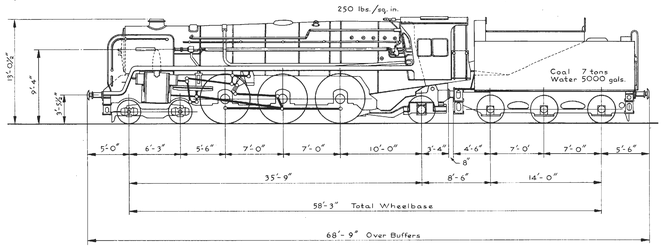


FIG. 3

PROFILE OF UP MAIN AND UP LOOP HOME SIGNALS AS SEEN APPROACHING MILTON SIGNAL BOX

SCALE: ⅛ INCH TO 1 FOOT

FIG. 4 ENGINE No. 70026 — CLASS 7



Weights (Full)

	T.	C.
Engine	94	0
Tender	58	10
Total	146	10

Weights in working order	T. C.	T. C.	T. C.	T. C.	T. C.	T. C.	T. C.
	17 - 2	20 - 5	20 - 5	20 - 5	16 - 3	16 - 10	17 - 10	18 - 10

WESTERN REGION

DERAILMENT AT MILTON

ON

20th. NOVEMBER, 1955

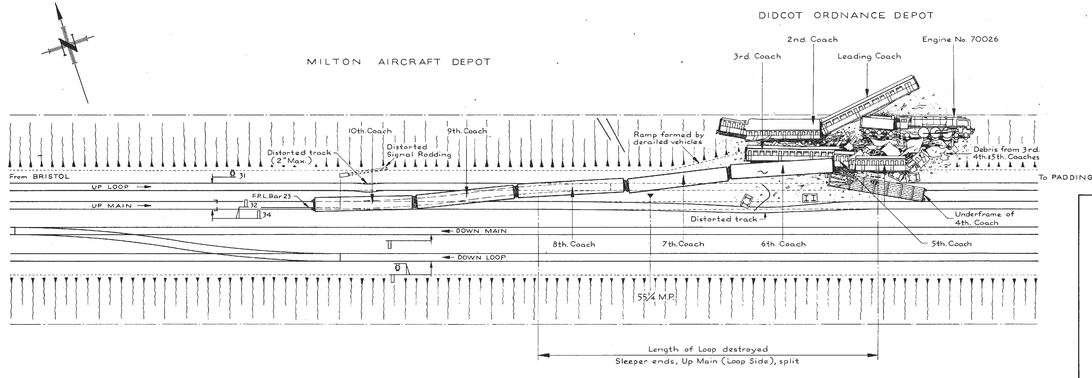


FIG. 5

ENLARGEMENT SHOWING RESULTS OF DERAILMENT

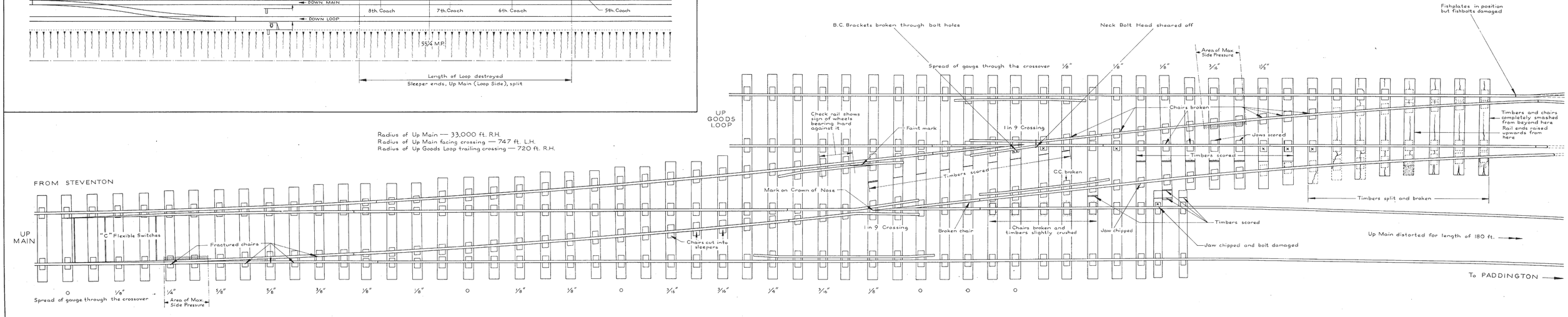
SCALE : 40 FEET TO 1 INCH

FIG. 6

MARKS OF DERAILMENT THROUGH CROSSOVER No 22

SCALE : 4 FEET TO 1 INCH

Damaged Chairbolts shown thus ✕ Chairs completely smashed shown thus ⬚



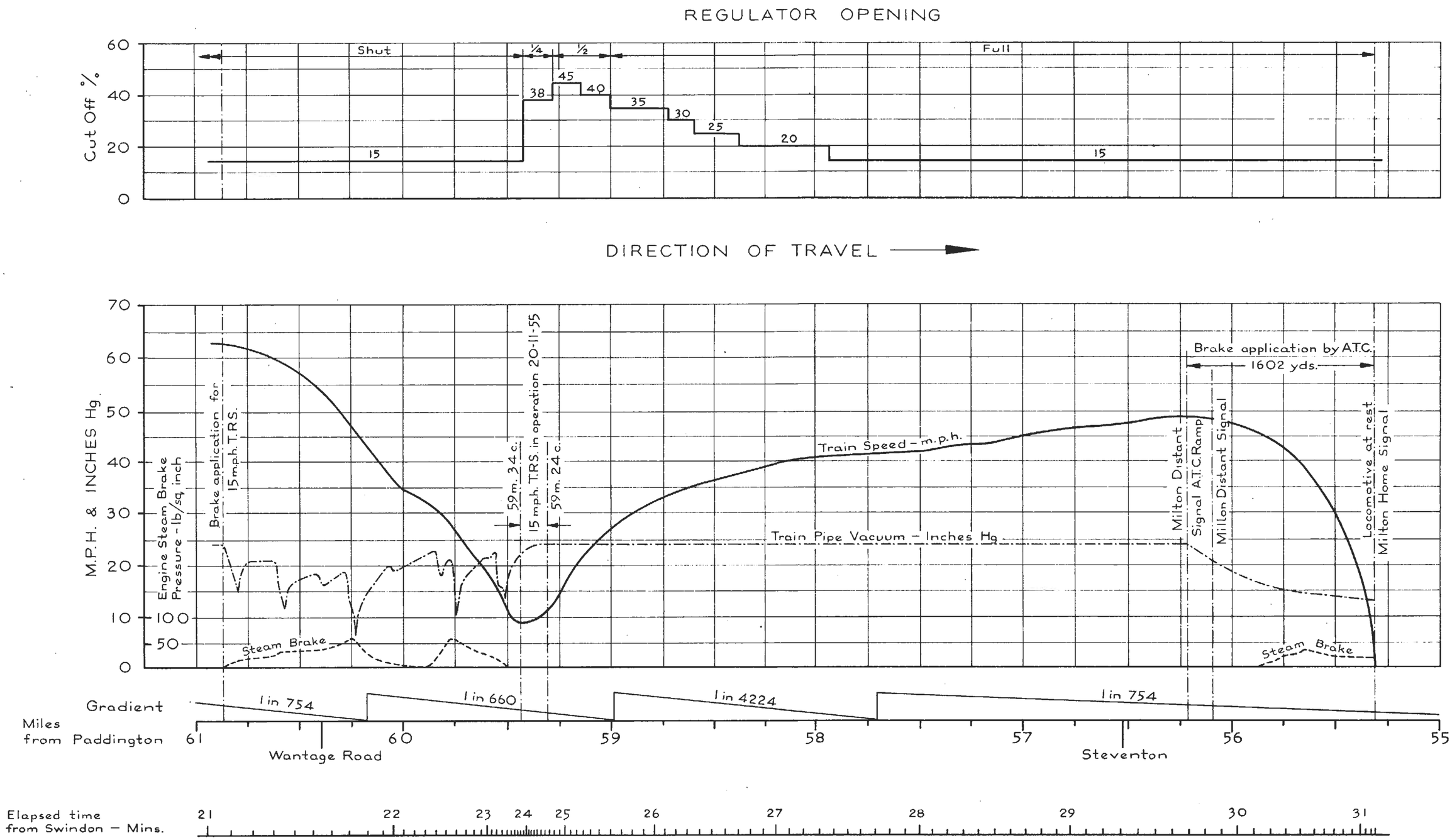
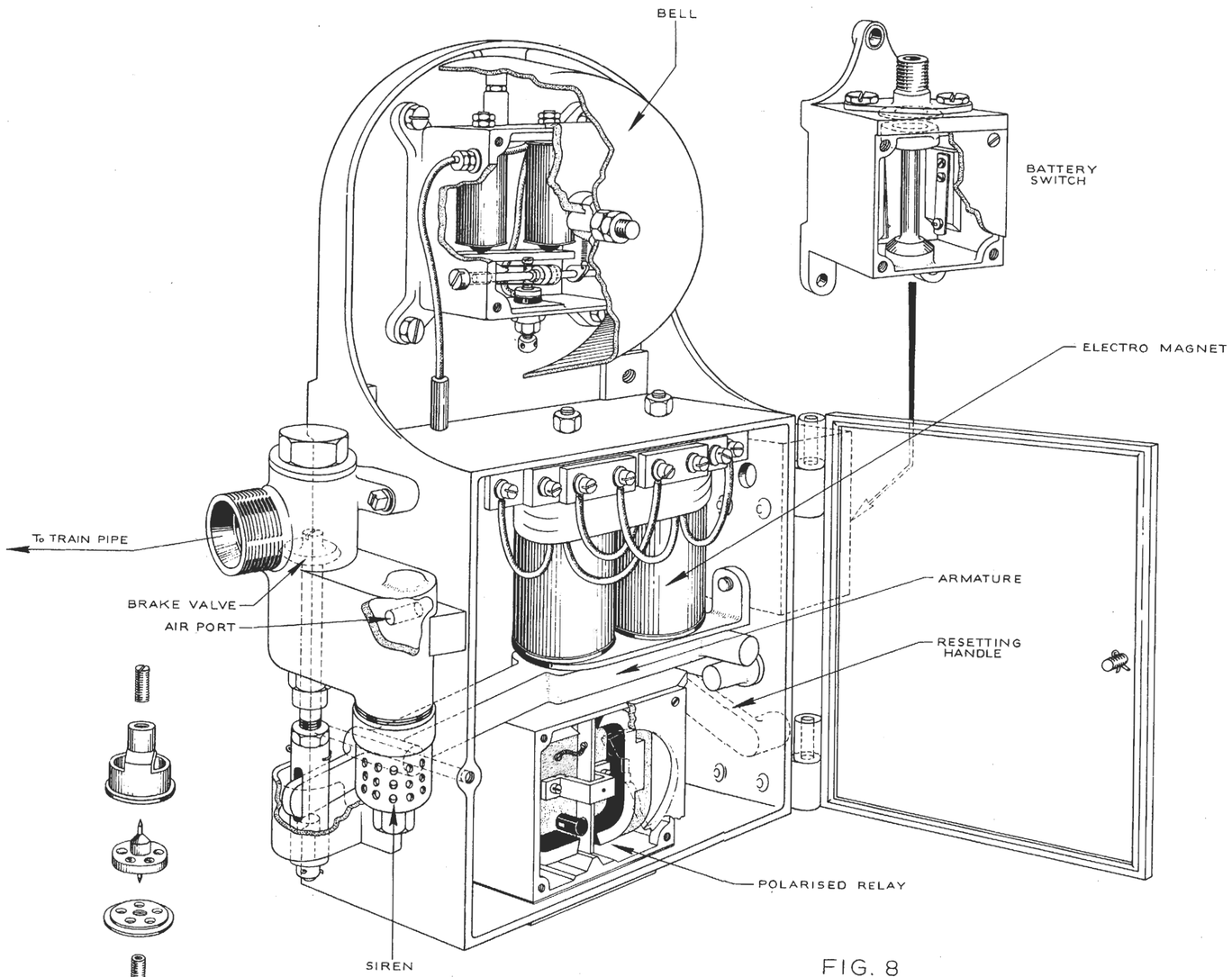


FIG. 7

RECORD OF TRIAL RUN ON 9th. DECEMBER, 1955

ENGINE No. 70028 WITH 10 COACHES INCLUDING DYNAMOMETER CAR (314 TONS TARE)

(ENGINE NOT FITTED WITH EJECTOR ISOLATING ELEMENT)



EXPLODED VIEW OF SIREN COMPONENTS

FIG. 8

PERSPECTIVE DRAWING OF WESTERN REGION AUTOMATIC TRAIN CONTROL CAB APPARATUS

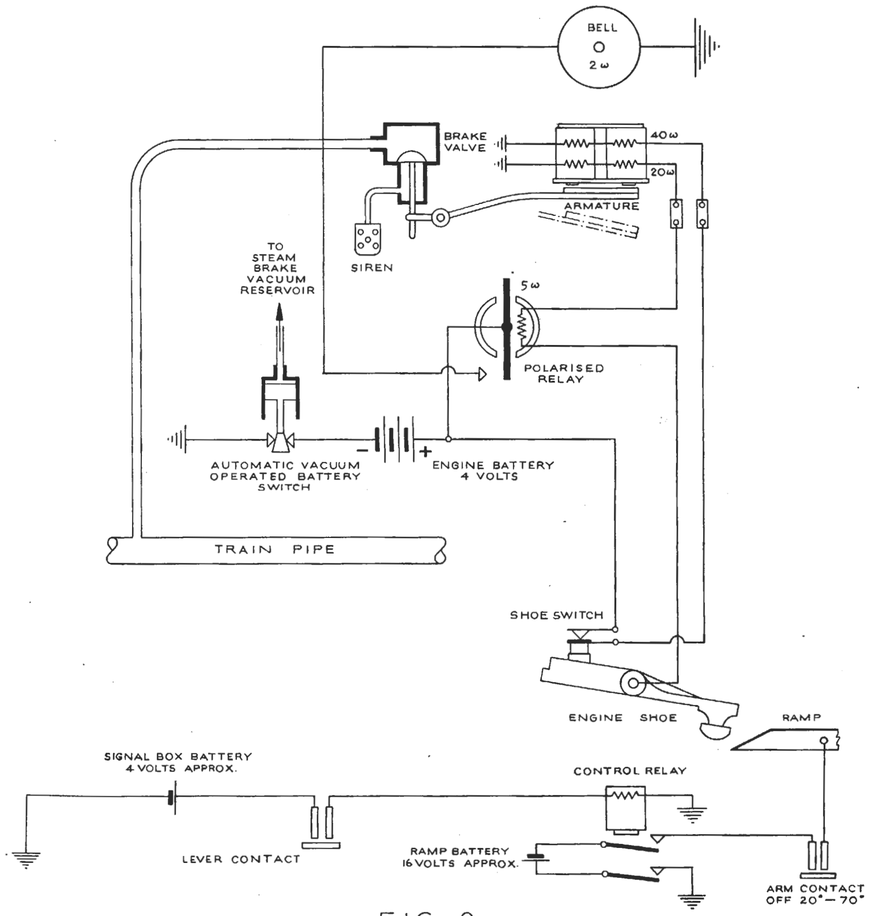


FIG. 9

DIAGRAM OF WESTERN REGION A.T.C. APPARATUS AS FITTED TO B.R. STANDARD LOCOMOTIVES

J.W.W.