MINISTRY OF TRANSPORT AND
CIVIL AVIATION

RAILWAY ACCIDENTS

REPORT ON THE COLLISION

which occurred on

6th September 1956

at

LUDLOW

in the

WESTERN REGION
BRITISH RAILWAYS

LONDON: HER MAJESTY'S STATIONERY OFFICE
1957
THREE SHILLINGS NET

MINISTRY OF TRANSPORT AND CIVIL AVIATION,
Berkeley Square House,
London, W.1.
18th January, 1957.

SIR,

I have the honour to report for the information of the Minister of Transport and Civil Aviation, in accordance with the Order dated 6th September 1956, the result of my Inquiry into the collision between two Up trains which occurred at about 3.20 a.m. on that day at Ludlow, on the main line between Shrewsbury and Hereford in the Western Region, British Railways.

The 2.0 p.m. fully braked parcels train from Penzance to Crewe travelled past a distant signal at caution and two stop signals at danger without reducing speed, and collided at 40-50 m.p.h. with the rear of the 4.45 p.m. express passenger train from Penzance to Manchester which had been stopped out of course at Ludlow signal box owing to an obstruction on the line at a level crossing ahead. The last two vehicles of the stationary train, which fortunately were not passenger coaches, were demolished and much of the wreckage was forced under the brake second ahead; the end of this vehicle was lifted some feet and separated from the bogie, but the body was not much damaged and only two of the ten passengers in the coach required treatment for shock.

The engine of the parcels train was derailed, but it remained upright and in line, and was encased in the body of the last vehicle of the express train. The three vehicles behind it were wrecked and thrown off the track to the right across the adjacent Down line. The guard and fireman escaped with a shaking but the driver was injured and suffered severely from shock. He was unable to give evidence until 12th November 1956.

The emergency relief arrangements were very prompt. The Police and the Ludlow fire brigade arrived at the site 13 minutes after the accident, and doctors and ambulances two minutes later. Hot refreshments were organised for the passengers while the mails were being transferred to the front part of the express train and minor repairs carried out, before it went forward at 6.25 a.m. Breakdown cranes from Shrewsbury and Cardiff were ordered to the site and work was put in hand without delay to clear the tracks; this was completed and through working was restored on both lines early on the following morning.

The night was dark but the weather was fairly clear, and there was a moderate wind from the South East.

DESCRIPTION

The line

1. With reference to the plan, the general direction of this route is North (Up) and South (Down). The Up line from Woofferton Junction (32 Mile Post) rises to a summit close to the 27¾ mile post, mostly at 1 in 112 and 1 in 220 for the last 2½ miles, as will be seen on the gradient diagram. Immediately beyond the summit the line falls at 1 in 132 through a tunnel 132 yards long and at 1 in 418 past Ludlow station platforms and past Ludlow signal box (27¼ M.P.). On the approach to the summit the line curves to the left for 1½ miles; it then curves right-handed on the falling gradient through the tunnel and past the platforms, and again left-handed past the signal box. There is a permanent speed restriction of 50 m.p.h. in both directions between the tunnel and the signal box, a distance of 514 yards.

2. The station sidings extend from the Up end of the platforms to beyond the signal box on both sides of the through lines. The Up Refuge siding, which is used for placing freight trains when they are to be overtaken by passenger trains, is next to the Up line, with its mid point about opposite the box.

The Signalling

3. The distances of the signals and other relevant features of the line from Ludlow signal box are: —

Woofferton Up starting signal	4m 643 yards	South of Ludlow signal box
Ashford level crossing Up distant signal	3m 1,628 yards	,, ,, ,, ,, ,,
Ludlow Up distant signal (Lever No. 1)	1m 377 yards	,, ,, ,, ,, ,,
Ludlow Up home signal (Lever No. 2)	1,028 yards	,, ,, ,, ,, ,,
Ludlow end of tunnel	514 yards	,, ,, ,, ,, ,,
Ludlow Up intermediate home signal (Lever No. 3) ...	369 yards	,, ,, ,, ,, ,,
Approximate point of collision	20 yards	,, ,, ,, ,, ,,
Ludlow Up inner home signal (Lever No. 4)	opposite Ludlow signal box	
Ludlow Up starting signal (Lever No. 5)	393 yards	North of Ludlow signal box

The three home signals and the starting signal at Ludlow are shown on the plan.

4. Ludlow Up home signal is further than is usual from the box as it was necessary to site it on the Woofferton side of the tunnel so that it could be seen clearly from approaching trains; it was convenient also to use it to protect a public level crossing which is a short distance from the tunnel mouth. A telephone to the signal box is provided at this signal.

5. At the signal box, and at those on either side, Woofferton Junction and Bromfield, the starting signals are controlled by the Block so that they cannot be lowered unless Line Clear has been received, and the distant signals are interlinked with the Block so that Line Clear cannot be given unless the arm of the distant signal is properly at caution. There is also a berth track circuit 180 yards long at the Up home signal at Ludlow which prevents Line Clear being given when it is occupied. Another track circuit, extending from the home to the intermediate signal, locks the home at danger when occupied, and one between the intermediate and the inner home signal locks the intermediate home when occupied. All these track circuits are separately indicated in the signal box. Separate arm repeaters are provided in the box for the distant signal which is electrically worked, and for the home and intermediate signals respectively. There is also one light repeater for all three signal lights.

6. The box has a frame of 62 levers, the locking of which is conventional. The top of the staircase, which is within the structure of the box, leads to the working floor at the South end where No. 1 lever stands in the frame. At night the box interior is adequately lit by gas.

7. This route is equipped with the Great Western Railway type of Automatic Train Control, and the ramps for the Up distant signals at Ashford level crossing and at Ludlow are approximately 440 yards on the approach side in accordance with the usual practice.

The trains

8. The 4.45 p.m. express passenger train, Penzance to Manchester, comprised 12 vehicles weighing 334 tons, drawn by a 4-6-0 type tender engine No. M45644 weighing 133 tons. The driver's position was on the left and the engine was not fitted with the A.T.C. apparatus. The rearmost vehicle of the train was a bogie brake van without interior partitions, of all steel construction except for a wooden floor, and the one ahead of it was a bogie milk van with a wooden body on a steel frame; ahead of this again was a brake second with the brake compartment trailing, of similar construction to the rearmost vehicle. The remainder of the train comprised 6 passenger coaches and 3 bogie vans. The length over buffers was 250 yards.

9. The 2.0 p.m. parcels train from Penzance to Crewe comprised 13 vehicles with a tare weight of 287 tons. The leading vehicle was a 4-wheeled wagon with a steel frame and a wooden body with steel ends, the second and fourth were bogie milk vans and the third was a parcels van, all constructed with wooden bodies on steel underframes. These were followed by two 4-wheeled luggage vans, a bogie brake van, another 4-wheeled van and five bogie vans. All were vacuum braked and the calculated power was 295 tons at 25 in. of vacuum, which the engine concerned was designed to maintain; this is 98% of the estimated loaded weight of about 300 tons.

10. The train was drawn by an ex-G.W.R. mixed traffic engine No. W.9306 with 2-6-0 wheel arrangement and a 6-wheeled tender, weighing in all 105 tons. It was built in 1932 and had run 37,600 miles since the last heavy repair in August 1954. The driver's position was on the right and the G.W.R. type of Automatic Train Control apparatus was fitted, as is usual, on the inside of the cab side sheeting in front of the driver's seat. A description is given in the Appendix. This apparatus, which is scheduled for examination every 28 days, had last been examined on 30th July and this was therefore 9 days overdue.

11. The vacuum brake operates on the coupled and tender wheels of the engine with a force of 65 tons, equivalent to 62% of the weight when fully loaded. The combined brake power of the engine and train was 360 tons, equivalent to 89% of the approximate total weight of 405 tons. The length of the train over buffers was 228 yards.

EFFECTS OF COLLISION

The Express Train

12. The violence of the collision was such that the steel underframe of the rearmost bogie van was driven under that of the milk van in front, and then both underframes were forced under the brake second ahead. The wooden body of the milk van was crushed between the steel bodies at either end, but it must have momentarily offered sufficient resistance for the end brake van body to be sheared from its underframe and to be penetrated by the parcels engine which was enveloped by it for the whole length of the boiler. The body of the brake second remained virtually intact, though the rear end had been lifted some feet.

13. The shock caused the train to become divided in the middle, and a gap of 10 ft. was created between the two portions. The leading three vehicles of the rear part suffered minor damage only, and the front six vehicles and engine remained fit to run, and later were sent forward with the passengers.

The Parcels Train

14. The engine travelled about 60 yards before coming to rest after colliding with the last vehicle of the express train. It suffered comparatively little damage; the smoke box door was pushed in, the front buffers and buffer beam bent, and the pony truck framing twisted. There was some damage to the back of the tender.

15. The first three vehicles of this train were reduced to scrap and the wreckage was thrown to the right alongside the engine: the fourth vehicle was in line and had closed up to the engine but it also was damaged beyond repair. Minor damage was suffered by all of the other vehicles, and two of them were derailed.

CONDITION OF EQUIPMENT

The A.T.C. Apparatus on the Engine of the Parcels Train

16. Since the cab was undamaged and the engine remained upright, there was no difficulty in testing the A.T.C. cab equipment. There was ample current from the battery, and the equipment was found to be clean inside and in good order except that the siren could not be made to sound. It was dismantled later in my presence and a thread of cotton waste was found to have jammed the spinner.

17. The A.T.C. shoe, which is fixed under the pony truck, showed signs of contact with the wreckage but was little damaged, and it was found on inspection to have been in proper working order. The state of the equipment therefore showed that a correct bell signal should have been received when a distant signal in the clear position was approached, but that there would have been no warning siren when a distant was at caution, though the brake would have been applied automatically and to the same extent as it would if the siren had been free.

The signalling

18. The inner home signal post was broken and there was some damage to the rodding, but the electrical circuits were not affected. Careful tests made on the morning following the accident confirmed that there had been no fault of any kind in the signalling equipment at Ludlow. In view of the circumstances of the collision, special attention was given to testing the insulation of the A.T.C. ramp for the Up distant signal to investigate the possibility of false energisation: to the circuits for the distant signal motor: to the interlinking of the distant signal with the block: to the interlocking of the lever for this signal with the Up stop signals, and to the Block control on the Up starting signal. All tests gave correct results.

The Track

19. The Up main line was destroyed for about 70 yards in the vicinity of the signal box, but there was only superficial damage to the Down line.

SUMMARY OF EVIDENCE

20. Train movement through Ludlow had been normal during the night until about 2.0 a.m. when the Up main line became obstructed at a level crossing beyond Bromfield, the box ahead, through a lorry colliding with the gates. Single line working was soon put into force over the Down line, but the incident had caused delay, and it was necessary to regulate the traffic on the Up line in order to give priority to passenger trains.

21. Signalman J. E. Angell who was on duty in Woofferton box said that the exchange of bell codes and telephone messages between his box and Ludlow had been clear and straightforward. The Ludlow signalman had told him of the level crossing obstruction and he knew also that there was a man under training in Ludlow box. All the equipment was working properly.

22. Relief Signalman L. J. Owen at Ludlow had accepted an Up freight train from Woofferton at 2.12 a.m. (the 10.15 p.m. Cardiff to Saltney), but since the 12.5 a.m. Cardiff to Liverpool express and the 4.45 p.m. express from Penzance were following, he decided to back it into the Up Refuge siding and give precedence to the two express trains. This manoeuvre was carried out in the normal way after the train had been stopped at the box for the signalman to instruct the crew. Driver S. J. Wall of the freight train confirmed that he had received the siren on the A.T.C. equipment and had seen the distant signal at caution. He said also that the weather was fine and clear when he was running into Ludlow.

23. Signalman Owen gave Train out of Section for the freight train at 2.29 a.m. and then accepted the 12.5 a.m. Up express from Cardiff, which ran through Ludlow at 2.38 a.m. under clear signals a few minutes after a Down freight train had passed. The Down line thereafter remained unoccupied. Owen knew that this Up train would be held at Bromfield to await a path over the single line section, and he therefore arranged to stop the following one, the 4.45 p.m. express, Penzance to Crewe, which he accepted at 2.43 a.m. He had with him Porter H. J. Tong under training, and he instructed him in the procedure of bringing this train to a stand at the starting signal. He showed him when to lower the home signal after the approach track indication had shown that the train was near the signal, and the intermediate home signal when he saw the train emerging from the tunnel; the inner home signal was lowered in turn as the train slowly approached it. He watched Tong put the home signals to danger successively as the train passed them; the starting signal lever had not been pulled and so the distant was locked at caution.

24. Driver R. W. J. Gwilliam was in charge of the 4.45 p.m. Penzance to Manchester express. He confirmed that he had passed the distant signal at caution

The inner home signal had been lowered as he approached it. He said that the tunnel was fairly clear as he went through it. He stopped the train when he judged that the last coach was opposite the box, and well before he reached the starting signal at danger, so that the guard could report quickly to the signalman to remind him of the position of the train in accordance with Rule 55. He did not move the train again before the collision took place about 25 minutes later, though he released the brake, and he observed from time to time that the starting signal remained at danger.

25. The last coach of the express train came to a stand short of the box and on the track circuit between the inner and intermediate home signals. Owen could not see the tail lamp with the coach in this position and sent Porter Tong out to verify it before giving Train out of Section at 2.57 a.m.

26. Guard J. E. Jones came into the box and passed close to the frame at the No. 1 lever end on his way to the signalman's table where he signed the Block Register at 3.0 a.m.; he did not, however, verify as he should have done, that the signalman had placed collars on levers Nos. 3 and 2 to prevent them being pulled through inadvertence. Though Signalman Owen and Guard Jones overlooked this procedure they were both positive that all the levers were normal in the frame after the arrival of the express train.

27. Porter Tong worked the block instrument under the supervision of the signalman to give Line Clear to Woofferton for the parcels train, which was offered and accepted at 3.10 a.m. This acceptance was in order as there was more than the required distance between the home signal and the train ahead. Owen expected to receive a telephone call from the engine crew at the home signal a few minutes after receiving Train Entering Section at 3.13 a.m.; he would then have told them of the position of the express and have lowered the home signal for the train to draw forward to the intermediate home. Both Owen and Tong were sure that the Up signal levers were still normal in the frame after the parcels train was accepted and that the repeaters were showing that the signals were "on".

28. A few minutes later Owen saw the home signal berth track circuit indicator show occupied and this was followed by the occupation of the track circuit between the home and the intermediate home. He thought for a moment that the driver had overrun the home signal and would set back, but he began to collect detonators and the hand lamp which he kept lit at the top of the stairs. He then saw the train coming past the platforms, and ran down the stairs and along the Down track to meet it, waving his lamp. He had gone about 50 yards beyond the rear of the stationary train when the parcels train passed him; he heard no sound of brakes being applied and there was no whistle to acknowledge his hand signals. He thought that the engine was steaming and that the train was travelling at about 50 m.p.h., which is the usual speed for Up trains which do not stop at the station. The collision took place immediately afterwards, and he returned at once to the signal box and sent the Obstruction Danger signal at 3.20 a.m.

29. The guard of the express train had rejoined it after signing the register; after a few minutes he walked along the corridor to the forward end and descended on the left-hand side in order to tell Driver Gwilliam about the single line working ahead. He again checked that the starting signal ahead was at danger. When the collision occurred he was standing on the cess talking to the driver who was leaning out of his cab; the front of the train was pushed forward, so he said, by about two coach lengths. Guard Jones made sure that the Down line was being protected and then walked along the train to see if any of the passengers had been injured. He found only the two already referred to and, assisted by the guard of the Saltney freight train, helped to move them and the other passengers in that coach to the front part of the train. He then helped in transferring the mails forward from one of the rear vans.

30. While the guard was walking up his train Fireman R. J. Colley had been sent back by Driver Gwilliam along the track to find out the cause of the delay. He was only a few yards from the signal box when he saw the parcels train approaching at normal speed and, as he said, steaming hard. He saw the collision take place and jumped for safety. His first impulse when the vehicles had come to rest was to help the crew of the parcels train engine, but he could not get quickly to the cab of the engine because of the wreckage of derailed vehicles piled alongside, so he ran forward to tell his driver and protect the Down line. He later returned to the parcels train engine to find that the driver and fireman had got down. He climbed on to the engine to make sure that the fire had been damped down, but he did not think of looking at the controls.

31. Driver E. W. Chandler, who is 62 years of age, said that he had taken over the parcels train at Pontypool Road Station at 12.40 a.m. after reporting for duty an hour earlier at the depot nearby. He had rested well the day before and was in good health. He had worked this engine on the previous day and had reported it for poor steaming, but he had considered it to be satisfactory otherwise. He noticed that the intermediate joint between the right-hand steam valve and injector was still leaking, allowing an escape of steam which obscured his view, and that the steaming performance had not been improved. The A.T.C. equipment appeared to work perfectly, and the driver whom he had relieved had no complaints about it. He personally had had every confidence in this equipment which he had regarded as his "guardian angel" when there was a thick autumn fog, as he said he found on this occasion when approaching Ludlow. The vacuum gauge registered 25 in. and he had no difficulty in maintaining this degree of vacuum with the crosshead pump only. He was satisfied that the brake was working well.

32. As has been stated, the engine was driven from the right-hand side. Chandler said that he always liked to stand at the controls, but that as he was a tall man he had to stoop a little in order to see forward through the cab spectacle of this class of engine. He normally held the cab frame with his right hand and did not rest it on the A.T.C. apparatus, nor did he carry waste in his hand, though he had some in his pocket. He had only worked with his present fireman for ten days but thought him to be an experienced man though perhaps a little anxious about his work. He did not rely on the fireman to look out for signals on his behalf even when they were difficult to see from his side on account of curvature of the line, and he would step across the footplate if necessary to look at them. On this occasion the fireman was busy with the fire between Woofferton and Ludlow as he required a good head of steam in order not to lose time on the rising gradient.

33. Chandler went on to say that he had a clear run after leaving Hereford where he had received an A.T.C. caution indication with a distinct siren. He received a clear bell from the A.T.C. apparatus at the distant signal at Ashford crossing, and again at the Ludlow distant signal. He said that as his view of this signal was poor, owing to the left-handed curvature, he stepped across the footplate while the fireman was busy pulling down coal in the tender, and saw it showing green as he passed. He did not see the home signal which is also to the left at the end of the left-handed curve, but he was satisfied that it must have been clear, as he had had the A.T.C. bell; he saw the intermediate home signal at danger through the steam and fog when he was "halfway down the platform", and then the tail lamp of the train ahead. He applied the brake but the engine wheels skidded; he thought the speed had been reduced by one half from between 45-50 m.p.h. before the impact. He did not see the signalman waving his hand lamp from the Down track.

34. Chandler was surprised to be told that the intermediate home signal was as much as 369 yards from the box, and that if he had seen it shortly after the engine came out of the tunnel 145 yards away there would have been at least 400 yards braking distance before reaching the back of the express train.

35. Chandler was thrown forward by the impact and injured his thigh on the reversing handle. After a time he was helped down to the track and to the signal box where he remained until medical assistance came. He insisted at the time that he had received a clear indication at the distant signal.

36. Fireman L. R. Thomas of the parcels train has had eleven years' experience in the grade, and is familiar with the route. He said that he was exceptionally busy trying to maintain steam on the rising gradient after running through Woofferton, and did not see any signals after the Woofferton starter. He was definite that he had heard the A.T.C. bell once after Woofferton and thought it had been for the Ludlow distant signal, but he became uncertain when asked whether the bell he heard might not have been for the distant signal at Ashford crossing. He thought that if this had been the case he would have identified it as such by the shortness of the time interval, as the crossing is reached fairly soon after leaving Woofferton. He had heard the bell and siren clearly earlier during the run. Fireman Thomas said that the driver did not move to his side of the cab so far as he was aware, though he agreed that Chandler could have done so without his knowledge while he was pulling coal down in the tender. He confirmed that there was some steam at the front of the engine and that a certain amount of smoke had been caused when he raked the fire on the approach to Ludlow.

37. Thomas said that he had had no warning of the accident. He had stopped attending to the fire and was about to step across the footplate to the driver's side to prepare the scoop for the water troughs ahead when he heard a "bang like a detonator exploding", accompanied by a severe retardation and shaking which brought coal down from the tender on to the footplate. He was sure that there had been no effective brake application as they approached the point of collision. Thomas was bruised and shocked but he climbed out over the wreckage of vehicles on the driver's side and went to the signal box to ensure that the Down line was protected; he then returned to his engine to help his driver down and to damp the fire.

38. Guard G. Evans said that he was sorting parcels on the approach to Ludlow, but looked out of the window while going past Ludlow platforms. He thought that the train was running at the usual speed of about 50 m.p.h. He did not see the intermediate home signal but saw the inner home signal at danger a moment before the impact. He said the effect of the collision was like a sudden and fierce application of the brake accompanied by a grinding noise as the train jolted to a stand. There was no brake application or slowing down of the train beforehand. Evans went back through the tunnel and past the home signal to protect the rear of his train; he saw it at danger as he returned after putting down detonators.

39. Inspector C. V. Pragnell, who is responsible for the maintenance of A.T.C. engine equipment throughout the Western Region, said that the period between examinations of this apparatus was four weeks. The work was done by specially trained electricians controlled directly from the headquarters of the Motive Power Superintendent at Swindon. He described in detail the tests he had made of the equipment on this engine on the morning after the accident. All gave correct results except his attempt to make the siren sound. When this failed he left the siren unopened until I was present to see the cause of the failure which, as already stated, was a thread of cotton waste which had been drawn in through the perforated casing and was wound round the spindle of the spinner.

CONCLUSION

40. I am unable to reconcile Driver Chandler's statements on certain points with the other evidence, which is consistent and well corroborated on the whole, that the signals were against the parcels train and that it ran past them into the express train without lessening speed. He said that he applied the brake when approaching the intermediate home signal and had reduced speed by one half before the collision, but the weight of evidence is that the engine was steaming and that there was no noticeable brake application beforehand. The result of the collision, moreover, though fortunately without loss of life because the last two coaches of the express were unoccupied, also indicates that the speed was fairly high.

41. On his own evidence Chandler did not see the intermediate signal at danger until his engine was halfway along the platform, but the sighting of this signal from a right-hand drive engine is made easier by the curvature of the line, and the signal can be seen clearly before the engine emerges from the tunnel. He said that the night was foggy and the tunnel full of smoke, though the general opinion was that the night was clear, and Driver Gwilliam who had preceded him by half an hour said that the tunnel had been clear. The alignment of this short tunnel is approximately S.E. to N.W. and the wind was therefore blowing through it in the Up direction; it should have cleared any smoke left by the express train in a very few minutes.

42. If Driver Chandler had taken action as soon as the signal came into view he would have had over 500 yards in which to brake instead of the distance of about 400 yards according to his evidence. With a well braked train such as this the collision might have been avoided if the brake had been applied before emerging from the tunnel; even if he had applied it when he said he did the impact would certainly have been much less than it was. Furthermore, if Driver Chandler had been alert, as he would have been if he had made an emergency brake application, he should not have overlooked the red lamp waved by the signalman running towards him on the Down line.

43. Driver Chandler admitted that he made no effort to see the aspect of the home signal and that he did not ask his fireman to look at it.

44. The distant signal could not have been at clear when Driver Chandler approached and passed it unless there was some fault in the signalling equipment. In the first place it was necessary for it to be at caution before the Ludlow signalman could give Line Clear to Woofferton, as it was interlinked with the Block, and thereafter the lever could not have been pulled unless all the Up line stop signal levers had been pulled. There was ample independent corroboration that the starting signal certainly had not been lowered. There was no fault to be found in the motor operation of the distant signal; it had worked correctly before and continued to work correctly afterwards without attention.

45. There remained then the possibility of a false energisation of the A.T.C. ramp, or a false clear indication in the A.T.C. cab apparatus, though this would not have been in accordance with Driver Chandler's evidence that he saw the signal at clear as well as receiving the "bell". There were no traces of any fault which might have caused either of these results.

46. It is reasonably certain that the thread of waste jammed the spinner when the engine passed over the dead ramp for this distant signal and that the siren failed here for the first time. The spinner is small and light, and finely machined; when the thread was drawn in by the rush of air into the vacuum system as the atmospheric valve was opened by the A.T.C. mechanism, the spinner may well have become jammed almost at once and have made no noise, though there would have been a subdued sound of the rush of air. It may be that the thread had been left adhering to the casing previously and had been sucked into the interior on this occasion, or that it was drawn in from a piece of waste held in Driver Chandler's right hand, which he might quite naturally have been resting on the apparatus, though he said that it was his habit to hold on to the cab frame with it.

47. In view of the other inaccuracies in his evidence I do not accept Driver Chandler's statement that he heard the bell from the A.T.C. apparatus and saw the distant signal light at green, since there is so much circumstantial evidence to the contrary. I am satisfied that the Up line stop signals were properly against the parcels train when it passed them, and I can only suppose that Driver Chandler was not properly alert at the time. He did not receive the warning of the siren whistle, and he must have involuntarily operated the cancelling lever without realising what he was doing. He then failed to take action in time to stop the train as it ran at speed past two signals at danger into the stationary express ahead.

48. The failure of the siren may have contributed to the accident in so far as the noise of the whistle might have brought Driver Chandler to his senses, but there was no excuse for his admitted failure to look out for the home signal.

49. It is the fireman's duty to look out for signals when he is not otherwise occupied, and Fireman Thomas might well have taken a greater interest in certain of the signals which he must have known were difficult to see from a right-hand drive engine. I accept his statement, however, that he was very busy with his firing duties on the approach to Ludlow.

50. The omission of Relief Signalman Owen to use the lever collars, and of Guard Jones to see that he did so, had no bearing on the accident. Reminder appliances of this kind are nevertheless a valuable additional safeguard and Owen should have used them, particularly as he was instructing another man at the time. Owen gave his evidence in a clear and straightforward manner and impressed me as being a very competent signalman.

REMARKS

51. The accident took place at a period of the 24 hours when vitality is at its ebb, and this may have led to Driver Chandler's lack of concentration as the parcels train ran into Ludlow. He may also have been lulled to some extent, through his long knowledge of the working over the line, by the expectation of a clear run through Ludlow as is usual with this train. Whether he realised the situation before the collision took place is by no means certain, but there is no doubt that he was severely shocked, and this may well have affected the accuracy of his memory and have caused him to recollect what he thought must have happened rather than what actually occurred.

52. The fact that the A.T.C. engine apparatus was overdue for examination by 9 days is hardly relevant to the failure of the siren, since the apparatus was clean and in perfect working order except for the presence of the thread of waste. A failure from this cause could have happened at any time after an examination if conditions had been suitable. Nevertheless, the excessive period without examination, which was due in part to the transfer of the engine from one shed to another, was regarded as unsatisfactory by the Motive Power Superintendent and he had taken action in the matter.

53. The entry of the cotton waste into the siren was not unprecedented though such instances are infrequent. The Western Region have already fitted covers to prevent the entry of foreign matter into sirens, as a routine modification, to one third of the 3,000 engines fitted with A.T.C.; this programme has now been accelerated and it should be completed before the end of the year. An additional measure which should be of value would be to provide engine cloths to drivers and firemen instead of cotton waste.

54. The Great Western type of automatic train control has a long established reputation for reliability, and there is no doubt that it has played an important part over the years in maintaining the excellent safety record of that railway which has been continued in the Western Region. The system is designed, however, like the modern B.R. type recently approved, to reinforce the driver's vigilance and not to be a substitute for it. In the conditions in which the apparatus must work occasional failures do occur, but this is appreciated by the running staff; drivers are normally quick to detect each instance, and the general value of the system and its reputation are not impaired. The steps which are being taken to fit covers should improve still further the reliability of this simple and robust form of automatic train control.

I have the honour to be,

Sir,

Your obedient Servant,

W. P. REED,

Colonel.

The Secretary,

Ministry of Transport and Civil Aviation.

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 comprises a contact shoe and switch fixed on the leading bogie, and in the cab an electrically controlled brake valve combined with a siren and bell.

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 and a movement of only ⅛ inch is needed to open it; there is thus 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.

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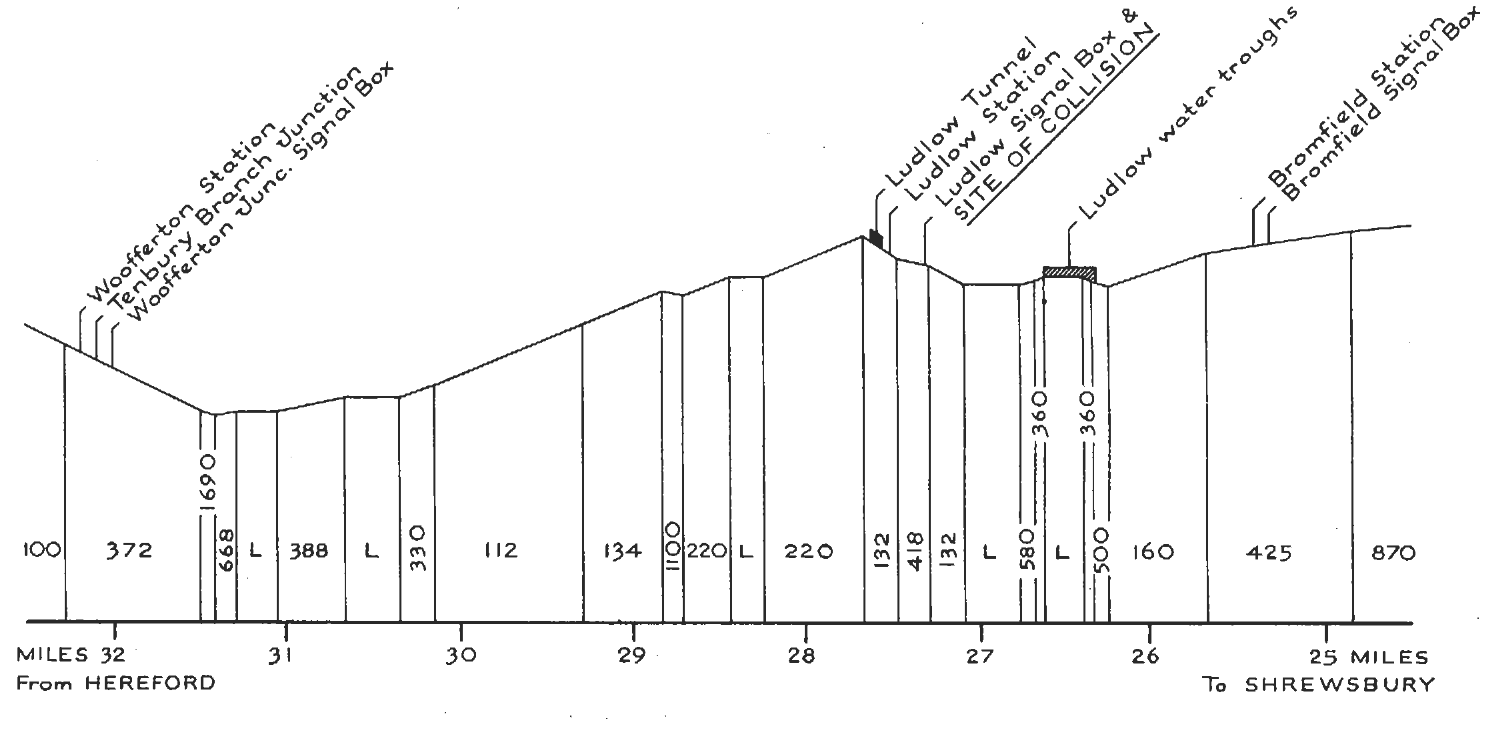
WESTERN REGION

COLLISION AT LUDLOW

6th. SEPTEMBER, 1956

PLAN OF SITE

SCALE: 2 CHAINS TO 1 INCH



GRADIENT DIAGRAM

POSITION OF TRAINS AFTER COLLISION

SCALE: 40 FEET TO 1 INCH