MINISTRY OF TRANSPORT & CIVIL AVIATION

RAILWAY ACCIDENTS

REPORT ON THE ACCIDENT

which occurred on

18th September 1953 at

GUILDFORD

in the

SOUTHERN REGION

BRITISH RAILWAYS

LONDON : HER MAJESTY'S STATIONERY OFFICE

1954

TWO SHILLINGS NET

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

18th January, 1954.

SIR,

I have the honour to report for the information of the Minister of Transport and Civil Aviation, in accordance with the Order dated 18th September, 1953 the result of my Inquiry into the buffer-stop collision which occurred at 4.0 p.m. on that day at Guildford station in the Southern Region, British Railways.

The 3.12 p.m. 8-coach electric passenger train from Waterloo to Guildford via Cobham, running under clear signals, entered No. 1 Bay platform at a speed of about 25 m.p.h. but it failed to stop before reaching the sand drag at the end of the bay, where the first coach was dislodged from its bogies and was shot forward over the platform. It demolished the end wall of the station building and then passed through the Station Master's personal office, his Clerk's office and the Enquiry Lobby, finally coming to rest when the buffers hit the wall of the Fish Store alongside the Parcels Office. The front of the second coach was lifted off its leading bogie and was driven against the coach ahead, but the rest of the train remained on the rails.

Two passengers and five members of the railway staff were injured, including the Station Master and the relief Assistant Station Master. I regret to report that the Assistant Station Master succumbed to his injuries on the following day.

Assistance was summoned quickly by the station staff who, in the absence of their supervisors, acted with commendable initiative. Fire appliances arrived within four minutes, followed by the first ambulance at 4.10 p.m. This left for the hospital 15 minutes later, and the last of the injured were cleared by 5.20 p.m.

The train was formed of two units each comprising four close-coupled coaches; its overall length was 513 feet and its weight was 270 tons. The stock stood up well to the shock of the collision. The two bogies of the leading coach were twisted and bent, and the body and framework were badly strained and shaken. The rear end of this coach and the front end of the next one were driven against each other but were not telescoped, although they were damaged to some extent at the ends. There was comparatively little other damage to the coachwork and only nine window and door lights were broken. Much of the electrical and brake equipment underneath the leading end of the motor coach was smashed, as was to be expected since this end of the vehicle took the full force of the collision, but there was remarkably little structural damage. The off side corner of the driving compartment was slightly buckled but the window light in front of the motorman was unbroken.

No. 1 Bay line was closed to traffic until the leading coach could be removed from the station building. This was finally completed by midnight on the 20th September, when normal working was resumed after an interruption of 56 hours. Except for a few trains which were dealt with at Nos. 2 and 3 Platforms, traffic on the Cobham line was terminated at London Road station during this period, and a bus service was operated between London Road and the main Guildford station.

The weather was fine and clear, and the rails were dry.

DESCRIPTION

The Site

1. The track layout and the relevant signalling at Guildford station are shown in the accompanying diagram (Fig. 1) and the location of the Cobham line in Fig. 4. This route is undulating with a long descent for the last two miles to Guildford. London Road station is on a 1 in 300 gradient, after which the line falls at 1 in 100 as far as the approaches to the main station where it flattens out as indicated on the drawing. A 30 m.p.h. restriction is in force on the sharp left-hand curve of 12 chains radius between London Road station and Guildford Park Bridge.

2. Cobham line passenger trains, starting or terminating at Guildford normally use No. 1 Bay platform line. It is provided with a sand drag 24 feet 6 inches long and its length of 525 feet from the top of the platform ramp to the sand drag is just sufficient to hold an 8-coach electric train with a few feet to spare. There is a short length of platform between the end of the sand drag and the Station Master's office, which was the first room in the block of station offices facing No. 2 platform (*see* Fig. 2).

There is a permanent speed restriction of 15 m.p.h. for trains running into the Bay platform.

3. The Down Cobham line signals at Guildford are semaphores. The Distant is a fixed arm underneath the London Road Down Advance Starter, and the directing Down Homes are carried on a bracket nearly 700 yards from the Bay platform. The right hand arm gives access to No. 2 platform and the left to No. 1 Bay; there is a calling on arm underneath the latter.

4. The relevant distances from the commencement of the sand drag are:—

London Road station

Guildford end	1 mile 600 yards

Guildford

Down Cobham line fixed Distant signal	1,862 yards
Down Cobham line No. 1 Platform Home	860 ,,
Guildford Park Bridge	482 ,,
No. 1 Bay platform London end..	175 ,,
,, ,, ,, centre of waiting room	35 ,,

Rolling stock

5. The coaches were of the latest non-corridor 3rd-class suburban stock of all-steel construction with welded bodies. The first units of this type were introduced in 1951 and were put into service on the Cobham line. With the construction of more vehicles their use has been extended till at the present time all trains on this route are made up of the new cars.

The two 4-car units involved in this accident were marshalled with a motor third brake at each end, thus the 8-car train had two motor third brakes in the middle in addition to one at each end; the other coaches were 3rd class trailers.

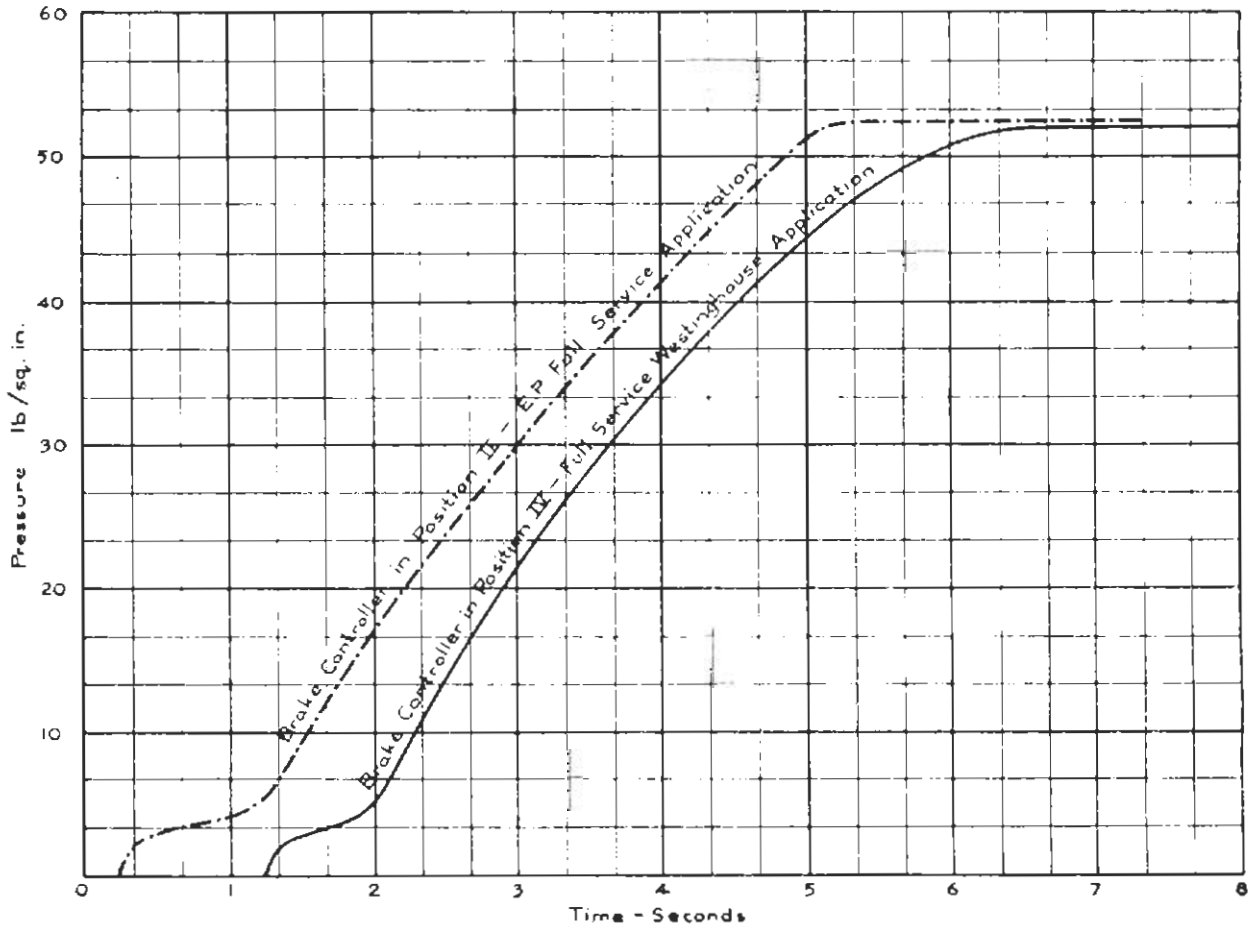
The brake equipment and power controls

6. The new trains are equipped with the self-lapping electro-pneumatic (E.P.) brake working in conjunction with the normal Westinghouse automatic system with all its safety features, which remain in operation whether or not the E.P. brake is in use. The combined brakes apply cast-iron blocks on all wheels and the total brake power in this case was 207 tons, or 76.5% of the total weight of 270 tons.

7. The brake equipment comprises the standard Westinghouse rigging, cylinder and auxiliary reservoir on each vehicle with the usual brake and main reservoir pipes, which are supplied with air from compressors on the motor coaches. The brake is operated by a combined E.P. and Westinghouse controller in the cab and a special E.P. unit, which incorporates the triple valve on each coach. The electrical energy for the E.P. brake control is normally taken from the 70 volt battery in the leading motor coach. This battery is kept fully charged by the motor generator and hence the electric brake will function even when the H.T. supply is temporarily cut off.

8. The feature of the E.P. brake is the simultaneous operation of each brake cylinder by means of magnet valves in the E.P. units which open to admit air direct from the main reservoir pipe, thus ensuring an even and instantaneous application of the brakes throughout the train. It is also somewhat quicker acting than the Westinghouse, taking 5¼ seconds to apply full pressure compared with the best figure of 6¼ seconds obtained on the leading coach with the normal brake, as indicated in the graph.

ELECTRO-PNEUMATIC & AUTOMATIC BRAKE APPLICATION



9. The motorman drives from the left-hand side of the cab with the brake handle on his left, the power controller on his right and the instrument panel in front of him, as illustrated in Fig. 3.

There are five notched positions for the driver's brake handle, namely:—

(1) Release and Running (E.P. and Westinghouse)	1st sector
(2) Full application (E.P.)	
(3) Lap (Westinghouse)	2nd sector
(4) Service application (Westinghouse)	
(5) Emergency (E.P. and Westinghouse)	

The E.P. brake is applied by moving the handle through the first sector. The cylinder pressure is dependent on the position of the handle between Nos. 1 and 2 notches and can be varied from a very light application to a maximum of 50 lbs per sq. inch in the No. 2 position. The holding magnets remain energised when the brake handle is in the Westinghouse positions, which means that any E.P. application is retained when the handle is moved to the lap or service positions on the Westinghouse sector. This part of the brake operates in the same way as the standard Westinghouse, the handle being pulled back from No. 4 to lap to prevent further build-up, and it is returned to the No. 1 position to release the brakes.

The panel holds a standard Westinghouse type duplex pressure gauge with two needles showing the main reservoir and brake pipe pressures, a brake cylinder pressure gauge, a speedometer and an ammeter. On the right are three indicator lights. The top one (blue) is illuminated when the electrical supply is available to operate the E.P. brake, the next one (red) lights up when the line voltage auxiliary supply is switched on, and the bottom one (white) indicates when the motor generator is delivering a 70 volt supply. Brake cylinder and train pipe pressure gauges are also fitted in each guard's van.

10. The power controller is unlocked by inserting the master key and turning it through 90°, and the E.P. and Westinghouse brakes together with the air compressor and control circuits can then be made ready for use by moving the master switch handle from "off" to "on". The master controller main handle has to be depressed in the normal way so as to close the "dead man's" valve, and it is then operated by pulling it in an anti-clockwise direction towards the motorman. The reverser handle is on the left-hand side of the controller and can only be moved when the master controller main handle is in the "off" position, though it will be free to move whether the "dead man's" valve is closed or open.

Report

The running of the train

11. Motorman J. W. Sherman came on duty at Waterloo at 2.55 p.m. on the day of the accident to work the 3.12 p.m. train to Guildford as his first trip. He met the incoming service on its arrival and entered the cab at the country end. He unlocked the master controller and turned on the master switch, noting that the indicator lights were illuminated. The guard tested the Westinghouse brake from the other end by making about a 30 lbs reduction in the brake pipe pressure, after which Sherman tested the brakes in his cab. He first moved the handle to the full E.P. position and this gave a reading of 50 lbs per sq. inch on the cylinder gauge. He then tested the Westinghouse system by making a 40 lbs reduction, but he could not recall the cylinder pressure he obtained.

The train left on time and ran non-stop to Wimbledon, then non-stop to Surbiton, after which it called at all stations to Guildford. Sherman said he had no difficulty in controlling it as far as London Road and he used the E.P. brake on all occasions. Speeds up to 60 m.p.h. were reached and the train responded rapidly to the brake. For example, after checking the speed on the long falling gradient from Horsley he approached Clandon station at about 40 m.p.h., but he had no difficulty in stopping at the 8-car mark. He entered London Road at about 20 m.p.h. owing to a previous restriction and he did not make the final application until he was half way along the platform.

On leaving this station he passed slowly round the sharp curve to the Guildford Home signals, which were at Danger. The train had nearly stopped before the No. 1 Bay signal was cleared, after which he opened his controller to full power and kept it in this position until he reached Guildford Park Bridge, where he shut off power and coasted into the station. He said he made a partial brake application after passing through the bridge and a final one when half way down the platform. He stated that the gauge registered 50 lbs per sq. inch pressure but the brake did not seem to respond, so he tried to reverse his motors. He grabbed the reverser handle with his left hand and tried to pull it towards him, but it was locked.

Sherman explained that he did not try to make an emergency application as he feared he might push the lever into the lap position and so "lose the brake". He also did not try to stop by releasing the controller main handle and allowing the dead man's device to operate, because he thought that by doing this he would not be able to reverse the motors. Sherman demonstrated his actions on a model and he added that in an emergency there was a natural tendency to pull with the right hand as well as with the left. He did not realise that a slight movement of the controller handle would lock the reverser handle. He finally admitted that he must have applied the brake too late, and then in the stress of the moment he tried to reverse, as he thought this was the more effective way of stopping the train.

12. Passenger Guard F. W. Wales joined the Guildford train at Waterloo. He tested the Westinghouse brake from the brakevan at the London end by releasing all the air in the brake pipe, and he noticed that the pressure in the cylinders rose to 50 lbs per sq. inch. He then closed the valve and the needle on the train pipe gauge returned to 75 lbs per sq. inch.

Wales stated that the train left Waterloo on time and ran without incident as far as London Road. On leaving this station it travelled slowly around the curve towards Guildford, coming nearly to a stand at the Home signal. The train then accelerated and the guard who had been watching the signals through the periscope in his van went into the rear motorman's cab to change the head code ready for the return journey. Whilst he was doing this the train ran into the station and he felt a jerk as if it had hit the buffers rather hard. Wales said he did not notice any retardation on entering the platform but he agreed he was not paying any particular attention to this.

13. Bricklayer L. Pink, who was travelling in the next compartment to the motorman said that he also did not feel any brake application.

14. Statements by the porters on duty confirmed that the train was running normally and on time as far as London Road, and that it stopped correctly at the various stations on the route.

15. Porter E. J. Newman of Guildford, who was standing some 25 yards on the London side of the sand drag when the train arrived, said it entered the platform at about the usual speed but by the time it reached the waiting room he was certain it was not going to stop as it appeared to be accelerating instead of slowing down. His evidence was generally confirmed by Chargehand F. W. Gifford, who was standing close to him.

Examinations and tests

16. Carriage and Wagon Examiner H. F. Kurn was outside the store cabin near the signal box on the other side of the station when he heard the noise of the collision and saw a cloud of dust rising from the Bay platform. He immediately made his way there and as many members of the staff were already attending to the injured he began to examine the brake equipment. All the brakes were "off" although they were warm. There were no skid marks on the rails so far as he could see, nor were there any flats on the tyres. He entered the motorman's cab and noticed that all the gauges were "dead". The motorman's brake valve handle was in the first notch of the E.P. brake.

17. Inspection Shop Foreman R. E. Todman made a detailed examination of the brakes of the rear six coaches on the day after the accident. The E.P. and Westinghouse brake connections between the coaches were in their correct positions and were properly connected. He tested the E.P. brake first and obtained the full 50 lbs per sq. inch pressure in all the cylinders. When testing the Westinghouse brake he made a 15 lbs reduction in the brake pipe and obtained the full pressure in the cylinders; an emergency application also gave the same results. The brake blocks were in good condition and the slack adjusters were correct. The piston strokes varied from 4½ to 4¾ inches and the blocks came up fully on to the wheels. All gauges were checked and found to be functioning correctly.

18. Technical Assistant A. Hawes said that he arrived on the scene shortly after the accident and made a rapid examination of the E.P. and control fuses in the leading motorman's cab. Both the E.P. power supply and the main control fuses had been blown, and there were two faulty circuits, one in the E.P. brake and one in the master controller. All the other major power fuses and the compressor fuses throughout the train were intact, except that two of the shoe fuses on the two middle motor coaches were missing (it was established that they had been taken out in connection with the removal of the disabled train).

On the following morning further tests were made and the fault in the E.P. circuit was traced to a piece of cast iron lying across the brake controller terminals. These were housed in a cast iron box, the cover of which was broken during the course of the accident. There was a distinct burn mark on the No. 10 wire terminal which indicated that a current was passing through the No. 10 circuit at the moment of impact. This circuit is energised when the E.P. brake is first applied and again when the handle is moved into the full application position and kept there. It would have been de-energised if the motorman had moved the handle past the No. 2 position in order to apply the Westinghouse brake.

The conclusion which Mr. Hawes reached was that the short circuit which blew the fuse occurred at the moment of impact when the cover was broken, thus the brakes must have been applied at this time, though they may not have reached full power.

The fault on the main control circuit was traced to an earth on No. 7 wire through the 7A connection, which was crushed as a result of the accident. This circuit is only energised when the master controller is in the fully open position and hence the train must have been running under full power when the fuse was blown.

The motors of the leading coach showed no signs of flash-over which might have occurred had they been reversed, and although the reverser for these motors was destroyed all the others were set in the forward position. The condition of the overload relay could not be ascertained owing to the damage, but the relays on the remaining three coaches were in the 'set' condition. The battery on the front coach, apart from superficial damage, was in good order and in a satisfactory state of charge.

19. The E.P. brake controller, which was undamaged, was removed from the cab of the leading coach and fitted to coach No. 14029, which had been the last vehicle on the train. The speed of brake application was then tested with a stop watch and the following results were obtained:—

Instant of application to	5 lbs	pressure	per sq.	inch	0·1 seconds
45	,,	,,	,,	,,	4·6 seconds average
50	,,	,,	,,	,,	6·0 seconds average

The master controller was also checked and found to be working correctly. The "dead man's" valve and operating gear were in good order and functioned normally. The reverser lever could be moved regardless of the position of the "dead man's" handle provided the controller handle was kept in the "off" position, but it was locked the moment any power was applied.

20. The overload relays were tested on 4-car unit No. 5015 which had formed the rear of the train. A full service E.P. brake application was made at various speeds with the power controller fully opened. From 10 m.p.h. the relays did not trip before the train stopped, but from 15 and 20 m.p.h. the relays opened when the speed had been reduced to 8 and 10 m.p.h. respectively. The tripping current in each case was of the order of 1,200 amps per equipment. On another run the master controller was reversed from a speed of 10 m.p.h. and opened fully; the overloads tripped instantly and no braking effect was noticed.

21. Further trials were made with an 8-car train to study the working of the E.P. brake. It operated very smoothly and efficiently and no difficulties were experienced in its use. The handle could be moved easily through the E.P. sector and there was a distinct notch at the full brake No. 2 position. Even if the handle was pushed over this notch into the lap position it could easily be pulled back again or else pushed forward to make an ordinary Westinghouse application. The E.P. brake maintained a steady cylinder pressure which could be varied at will from a few pounds to 50 lbs per sq. inch. At one station a speed of 40 m.p.h. was maintained until the motor cab was passing the platform ramp when a full application was made and the train stopped at the 8-car mark. Emergency applications were also made on the assumption that the E.P. brake had failed, and the train was stopped in 69 feet from a speed of 22 m.p.h. and in 110 feet from 25 m.p.h.

22. Other tests were carried out between London Road and Guildford on 4-car trains actually in service. On each occasion the Guildford Home signal was passed at 5 m.p.h., after which the master controller was opened fully until the train reached Guildford Park Bridge, by which time speeds had increased to 35–38 m.p.h. Power was then shut off and a partial E.P. application was made. With a pressure of 25 lbs per sq. inch in the brake cylinders the speed was reduced from 38 to 19 m.p.h. by the time the train reached the London end of No. 1 Bay platform 290 yards further ahead; with 12 lbs pressure the speed dropped from 35 to 26 m.p.h. in the same distance.

Training

23. With the introduction of the 1951 stock, classes were opened for training motormen in the use of the new equipment. Motorman Sherman, who had had several years' experience in working the standard Westinghouse brake, was one of a group of six men to receive two days' instruction from Driving Inspector H. Gould in February 1952. The trainees were issued with pamphlets giving revised instructions for working the equipment and its details were explained to them fully. The working of the E.P. brake was demonstrated by means of diagrams and then the men were taken out for trial runs. Four trips were made altogether, and each man took charge for about five stations. The action to be taken in case of emergency was explained to them, though emergency stops were not actually made. The men were shown the effect of moving the brake handle into the various positions and Inspector Gould warned them that they would not get any brake if they overshot the No. 2 position and went straight into the lap. He pointed out, on the other hand, that any pressure applied when the handle was in the E.P. position would be maintained when it was moved on to the lap or other Westinghouse positions. In addition to using the E.P. brake each member of the class stopped the train with the Westinghouse brake so as to see how easily it could be applied. The men were not questioned individually about the working of the new system, but they were asked whether or not they understood it, and none of them appeared to have any difficulty.

24. Motorman Sherman generally confirmed Inspector Gould's account of the training and agreed that he had received the pamphlet of instructions, which he thought he understood. Sherman, however, was not at all clear about the working of the combined brake and he said that he feared "he would lose his brake if he moved the handle into the lap position". He had not made any emergency applications either during his training or when he drove the trains in service. He had also neglected to test the Westinghouse brake whilst running, in accordance with instructions, and excused himself by saying that he thought it was a very fierce brake. He said there were long gaps, often up to as much as four months, between the times he worked E.P. fitted trains but the records showed that since July 1952 he had been in charge of the new type of stock on 67 days, the longest gaps being 6½ weeks in 1952 and 5½ weeks in 1953, which times included his annual leaves. Sherman agreed that he had not experienced any difficulty in operating the trains fitted with the E.P. brake which he thought was a very good one.

Conclusion

25. I am satisfied that the electrical equipment was in good condition and the brakes, both E.P. and Westinghouse, were in proper working order when the train entered Guildford station. The evidence of the crew and of the station staff en route proves that the train was running normally up to the Home signal at Guildford, and the tests and examinations after the accident showed that there was nothing wrong with the brakes. The short circuit on the No. 10 wire of the E.P. brake controller proved that this brake was

"on" at the moment of collision, and the fault on the No. 7 wire of the master controller made it equally clear that power was also fully applied when the train struck the sand drag. I have no doubt that these conditions were due to the mismanagement of the controls by Motorman Sherman, who must accept responsibility for the accident.

26. According to his evidence he opened the controller fully as soon as the Guildford Home signal cleared and he did not close it again until he reached Guildford Park Bridge, by which time the train would have been travelling at about 37 m.p.h. I accept his statement that he made a partial brake application at this point but he must have released the brake before making a final application, otherwise the train would have stopped long before reaching the sand drag.

The speed on entering the Bay platform was probably about 25 m.p.h., which was greater than the permissible maximum, but even so the motorman should have been able to stop in time if the E.P. brake had been properly applied, as was demonstrated on the test runs. I fear that on this occasion his judgment was seriously at fault, first by entering the station too fast and then by delaying the final brake application until too late. The pressure always takes a second or two to build up in the cylinders and this delay at a critical moment no doubt led Sherman to think that the brake had failed. But instead of making an emergency application he lost his head and tried to reverse the motors.

He must in the first place have pulled the master controller handle slightly in the stress of the moment and so locked the reverser handle in the forward position; thus when he seized it with his left hand he could not move it, in contrast to the controller handle, which was free. As he explained and demonstrated to me, he had a natural tendency to pull with the right as well as with the left hand, and it is quite evident that instead of reversing the motors he applied full power by pulling the controller handle towards him. The effect of this would have been to counteract to some extent the retardation produced by the brake and I doubt very much whether the speed was less than 20 m.p.h. at the moment of impact. This would have thrown the motorman forward and with his right hand still on the controller handle he would have pushed it back into the closed position in which it was found. With the blowing of the fuses the E.P. brake would be released and the handle would gradually work back towards the No. 1 position.

27. Motorman Sherman is 50 years old with 35 years' railway experience, having entered the service in 1918. In 1944 he qualified as a steam locomotive driver after two years as a passed fireman and he was appointed motorman in 1946. Although he has been driving electric trains for over seven years and had received instructions in the new type of equipment he does not seem to have understood fully the working of the combined E.P. and Westinghouse brake. His fear that he would 'lose the brake' with the handle in the lap position was quite unfounded and he had an unreasonable mistrust of the Westinghouse part of the equipment, which he admitted he had not tested under service conditions. Thus, when the emergency arose he reverted to an old time locomotive practice and tried to reverse his motors. This practice, although it may at times assist the deceleration of steam trains, generally does little more than trip the overload relays of electric trains and allow them to coast freely.

28. Guard F. W. Wales should have been watching the running of the train on entering Guildford station instead of changing the head code ready for the return journey. I doubt, however, whether he would have had time to take action before the train hit the sand drag. He could scarcely have known from his position in the last coach that the train would not stop; even if he had realised that the speed was too fast and had applied the brake in his van it would have had no effect because by this time the motorman had already made the final application and had nullified it by the application of full power.

Remarks

29. This accident was due to the failure of an experienced motorman to take the right action in an emergency, brought about by his own serious misjudgment. The tests showed that the equipment on the new type of electric stock was efficient and easy to use, but Sherman, who did not appear to assimilate technical matters easily, seems to have formed some entirely erroneous impressions about the working of the combined E.P. and Westinghouse brake. The training he received should have been adequate and he himself said he was quite satisfied, but a closer questioning by the Inspector might have revealed some of the doubts in Sherman's mind. I consider that special attention should be paid to this aspect of training, so as to ensure that motormen understand fully the working of equipment and the action to be taken, not only under normal conditions but also in emergency.

30. As already stated, the train entered the sand drag at about 20 m.p.h. At this speed no practicable buffer stop, including the hydraulic type, could have absorbed the energy of the impact and indeed a buffer stop might have caused greater damage to the rolling stock. The sand drag is a cheap and simple way of stopping a train which over-runs at slow speed and I have no comments to make about its use at Guildford, except that its retarding effect might be improved by increasing the amount of sand at the end of it.

I have the honour to be,

Sir,

Your obedient Servant,

C. A. LANGLEY,

Brigadier.

The Secretary,

Ministry of Transport and Civil Aviation.

11913 Wt.4325/— K8 3/54 E.D.P.Ltd.

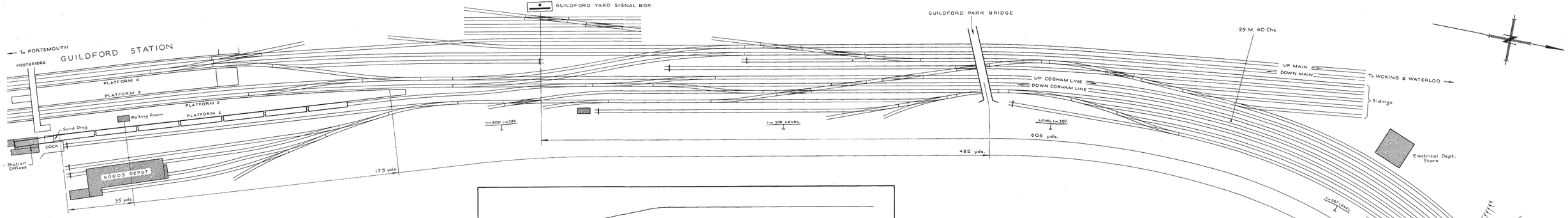


FIG. 1 GENERAL PLAN

SCALE : 66 FEET TO 1 INCH

FEET 100 50 0 100 200 300 FEET

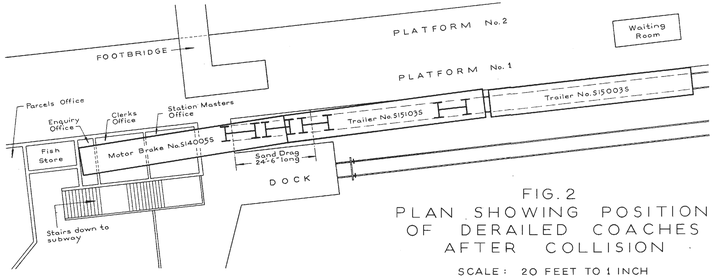


FIG. 2
PLAN SHOWING POSITION OF DERAILED COACHES AFTER COLLISION

SCALE : 20 FEET TO 1 INCH

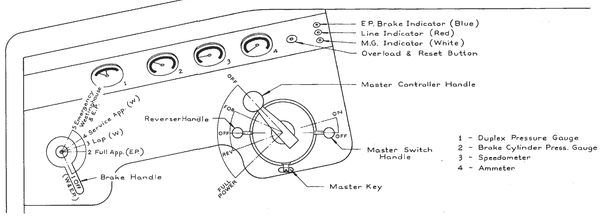


FIG. 3 PLAN SHOWING DRIVERS CONTROLS

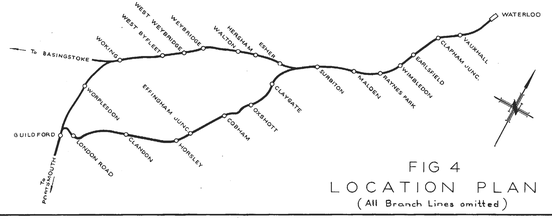
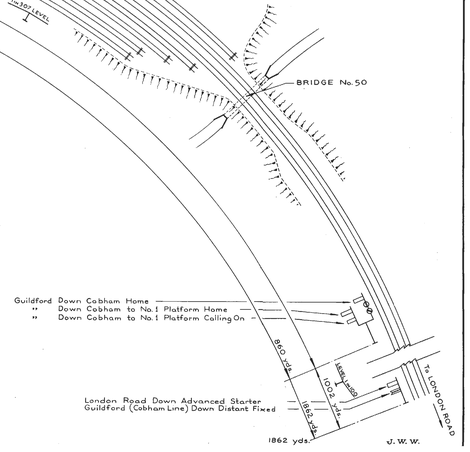


FIG 4
LOCATION PLAN
(All Branch Lines omitted)

SOUTHERN REGION

BUFFER STOP COLLISION — GUILDFORD STATION

18th. SEPTEMBER, 1953.