MINISTRY OF TRANSPORT

RAILWAY ACCIDENT

REPORT ON THE COLLISION

which occurred on

20th March 1961

near

CANNON STREET STATION

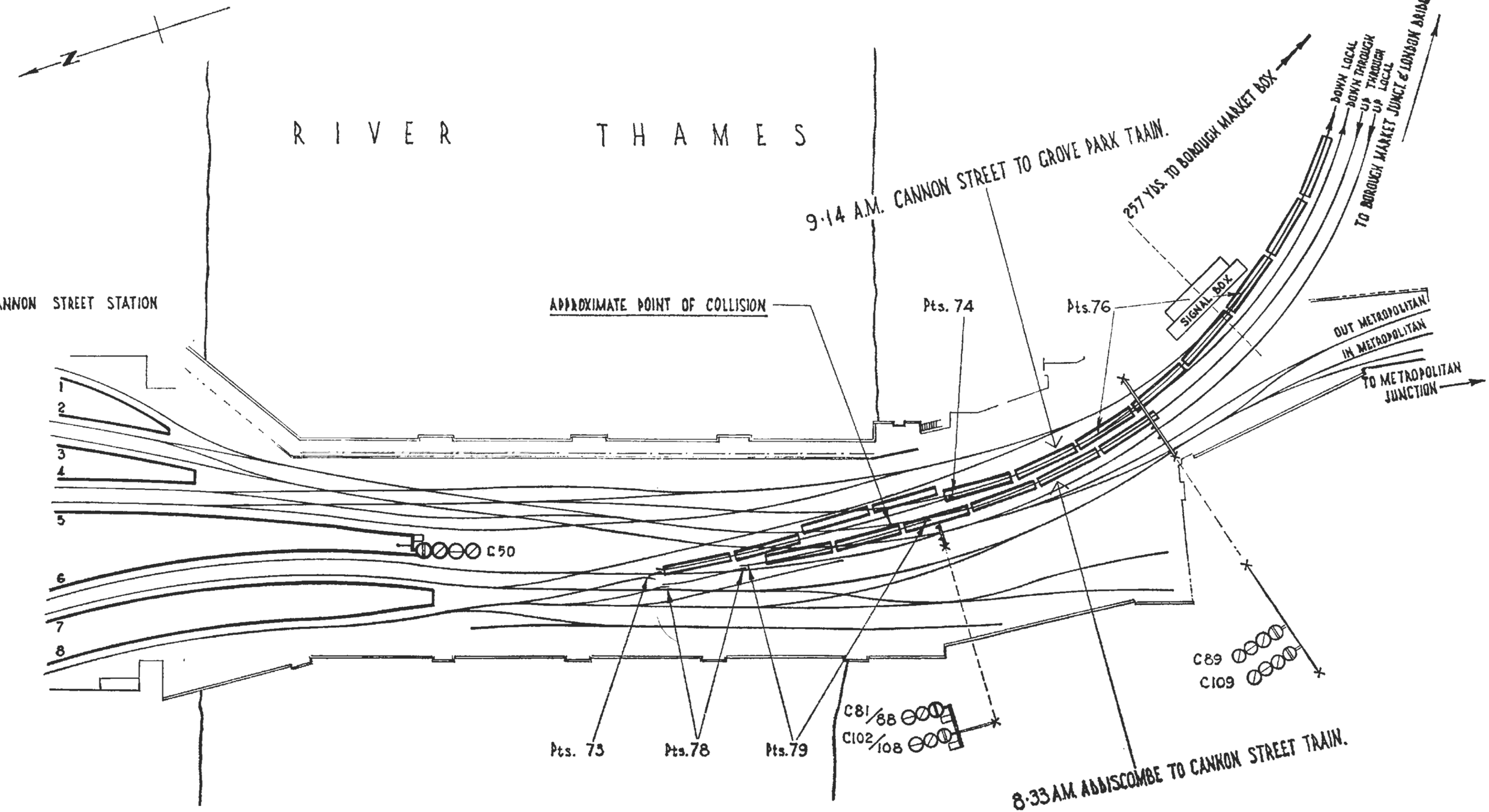
in the

SOUTHERN REGION
BRITISH RAILWAYS

LONDON: HER MAJESTY'S STATIONERY OFFICE
1961

PRICE 1*s.* 3*d.* NET

CANNON STREET - COLLISION ON 20th MARCH 1961



MINISTRY OF TRANSPORT,
ST. CHRISTOPHER HOUSE,
SOUTHWARK STREET,
LONDON, S.E.1.
2nd October, 1961.

SIR,

I have the honour to report, for the information of the Minister of Transport, in accordance with the Order dated 21st March, 1961, the result of my Inquiry into the collision between an electric passenger train and a diesel electric train, that occurred at about 9.18 a.m. on 20th March, 1961 near Cannon Street Station, in the South Eastern Division of the Southern Region, British Railways.

The 8.33 a.m. Up electric passenger train from Addiscombe to Cannon Street, consisting of 6 coaches filled with passengers, passed the Up Through home and starting signals of Cannon Street signal box at danger, and ran at 10 to 15 m.p.h. into the 9.14 a.m. Down empty diesel electric train of 12 coaches from Cannon Street to Grove Park, which was travelling at about the same speed under clear signals from No. 6 platform across the route of the Up train to the Down Local line. The first contact was between the right hand leading edge of the electric train and the side of the eighth coach of the outgoing diesel train ; the electric train scored the side of this coach and then struck the right hand leading end of the ninth coach, crushed the body severely, and overturned it and the following coach. The first two coaches of the electric train were derailed to the left and stopped leaning to that side, but there was little damage to their interiors and no passengers were seriously injured. Eleven out of an estimated load of 650 passengers had minor injuries and were taken to hospital, as was the motorman, who suffered from shock. The other passengers were conducted on foot to Cannon Street station without avoidable delay.

An incoming electric passenger train from Ramsgate on the adjacent Up Local line, also heavily loaded, which was closely following the train from Addiscombe, was stopped by its motorman before coming level with the derailed coaches, from which passengers had begun to detrain ; its passengers were also conducted to the station.

There was a delay of a few minutes before all tracks in the area of the accident were isolated from electric pressure, but there were no casualties on this account.

Three of the four lines between London Bridge and Cannon Street were blocked by the collision and it was necessary to close the fourth line, at first for the safe conduct of the passengers, and then for the removal of the derailed stock. The In and Out lines between Cannon Street and Metropolitan Junction were also closed for a time to facilitate the clearance of the rolling stock. Cannon Street was therefore closed to traffic during the day and evening, and trains were diverted to, and were started from, other South London termini. All lines were cleared and normal services were resumed at 4.47 a.m. on the following morning.

The weather was cloudy and dull but visibility was good.

DESCRIPTION

The sketch opposite shows the relevant parts of the railway, and the two trains involved in the collision, after they had come to rest.

The line and signalling

Cannon Street terminus station is on the north bank of the River Thames and all routes from it go south over the river before diverging eastwards to London Bridge station and South East England, and westward to connect up with the lines to Blackfriars and Charing Cross via Metropolitan Junction. The station extends on to the bridge and the cross connections outside the station between the lines from the eight platforms are for the most part on the bridge. The platforms are numbered from East to West. Immediately south of the river the In and Out lines curve westward towards Metropolitan Junction, and the 4-track route towards London Bridge turns eastwards to Borough Market Junction in a sharp curve of 10 chains radius decreasing to 7 chains at the new Cannon Street signal box, which is about 125 yards beyond the south abutment of the bridge, and 257 yards from Borough Market Junction box. London Bridge station is about the same distance beyond the junction. The gradient towards Borough Market Junction is rising at 1 in 150 from the south abutment of Cannon Street bridge. The triangle of lines between Cannon Street, Borough Market Junction and Metropolitan Junction signal boxes is completed by the double track line between Borough Market Junction and Metropolitan Junction on the route from London Bridge to Charing Cross and Blackfriars. There is a permanent speed restriction of 20 m.p.h. on all lines between these signal boxes.

The four tracks between Cannon Street and London Bridge are, from east to west, the Down Local, Down Through, Up Through, Up Local. The routes concerned in this accident were from No. 6 platform to the Down Local line via the Down Through line over points Nos. 73, 74 and 76 reversed, on which the outgoing diesel electric train ran, and from the Up Through line to No. 4 platform via No. 79 points normal and No. 33, 39 and 40 points reversed for the incoming train. (These three points, which are on the direct route to No. 4 platform, are not shown on the sketch.) These two routes cross at a point almost over the south abutment of the bridge, 175 yards from the end of No. 6 platform, and it was here that the collision occurred.

All the points are electrically operated and the signals are 3 or 4-aspect colour lights. They are controlled from Cannon Street signal box which was rebuilt in its present position after being gutted by fire about four years ago. The box has an all-electric frame of 167 miniature levers, with three identical illuminated diagrams above, one for each of the three signalmen who normally man the frame. There is complete track circuiting into the station and between Cannon Street box and the adjacent boxes, and train passing is effected by block bells and Walkers Train Describers., The six detonator levers which operate the detonator placers on the six lines were at the time of the accident, at the country end of the box ; they were re-positioned later in the middle of the frame. The placers are opposite the box, the ones for the Up Through and Up Local lines being 43 feet on the approach side of the home signals.

The Down starting signal from No. 6 platform, C.50, is 4-aspect, and it is equipped with a theatre type route indicator which can give three indications, one for each outgoing route. The Up Through route into Cannon Street is controlled by two signals. The first is Cannon Street box 4-aspect home signal, C.89, 33 yards from the box towards the station, which leads to the starting signal C.81/88, 76 yards further on. This signal of three aspects leads to the platforms and is equipped with a theatre type route indicator which can indicate any one of the eight platform lines to which it leads. Immediately ahead of this signal lie the crossovers of the outgoing connections from No. 6 and No. 7 platform lines to the Down Through and Down Local lines.

Signal C.89 is on a gantry, together with the 4-aspect home signal for the Up Local line, C.109, to the left of it. Signal C.81/88 is at the end of a cantilever arm extending to the right from the post for the Up Local line 3-aspect starting signal C.102/108. This signal also has a theatre type route indicator. Each of the four signals is above and to the left of the line to which it refers, and each has been aimed so as to give a full view of the focused lamps to a driver as his train approaches the signal closely ; a distant view of the signal lights is not possible because of the sharp curvature.

The electric locking on the Up Through line signals C.81/88 and C.89 keeps them both at Red if a conflicting route ahead of C.81/88 has been set up, and the over-run distance for a train approaching on the Up Through line is therefore the distance between C.89 and the fouling point ahead of C.81/88, a total of about 90 yards. The clear distance ahead of C.81/88 can, however, be lengthened by reversing points Nos. 79 and 78 when an outgoing route from platform 6 has been set up ; signal C.89 can then be cleared to give a single yellow aspect with C.81/88 kept at Red. This is sometimes necessary to allow 12-coach trains on the Up Through line to draw forward to signal C.81/88 so that they are clear of the junctions at Borough Market Junction. In accordance with standard practice the aspect of each signal is restored to red when a passing train occupies a track circuit ahead. At C.89 the restoring track circuit begins 30 yards ahead of the signal.

Electric power arrangement

The lines throughout are electrified at 600/650 volts d.c. on the third rail system. Energy is supplied from a sub-station immediately behind the new signal box which feeds each of the six tracks with a dual supply, one as the sole supply towards the terminus and the other outwards toward the adjacent feeder stations at Blackfriars and South Bermondsey. There are hand operated gap switches in the electrified rail between the connections of each dual feed, which are normally kept closed, and there are a number of other hook switches throughout the system which can also be operated by hand to isolate individual lengths of energised rail. The hook switches that were of importance in this accident were those on each of the four lines on the terminus side of Borough Market Junction and on the two lines from Metropolitan Junction. There are circuit breakers on all the feeder cables for the sub-station which open automatically on excessive load, and are closed remotely by hand from Lewisham Electric Control. Similar circuit breakers exist at the other sub-stations.

The trains

The electric train from Addiscombe comprised a 4-coach unit and a 2-coach unit of a total weight of 206 tons and length 130 yards. It had started that morning as a 10-coach train but a hot axle box had made it necessary to detach a 4-coach unit at Addiscombe. It was fitted with the Westinghouse brake with electro-pneumatic operation on all wheels with a brake power of 85 per cent. on the motor bogies and 75 per cent. on the trailer bogies. The buckeye coupling was in use between the two units, and the 3-link intermediate close coupling between the coaches of each unit. The coaches were of all steel construction except for the floors, which were of wood.

The diesel electric train comprised two 6-coach units of a total weight of 462 tons and length 265 yards. It had the buckeye coupling throughout and the same type of brakes as the electric train. It was also of all steel construction, to a design more robust than that of the electric train.

The damage

The damage to permanent way was not extensive ; parts of two points and crossings and a number of sleepers required replacement, and some of the fittings of the electrified rail were broken. The signalling equipment was virtually unaffected.

The first coach of the electric train was crushed at the offside leading end, the solebars and head stock were bent, and the motor and trailer bogies and brakework badly buckled. The leading

end of the second coach was buckled and the front bogie was derailed and badly damaged. There was a little displacement of the interior of this coach, but on the whole the seating in the other coaches of the train, which had been strengthened as a result of experience in the past, held firm, and this no doubt obviated injuries to passengers.

Both bogies of the 8th coach of the diesel electric train were derailed by the side thrust of the collision and damaged; one solebar was dented, and the body panels were buckled and windows broken. The 9th and 10th coaches were more extensively damaged by the shock of overturning but the bodies were not crushed. The 11th coach was derailed at the forward bogie and there was minor damage to the body.

Report

There were no unusual problems confronting the signalmen at the time of the accident, which happened during the peak of the morning rush period. Signalman F. H. Weedon was working at the middle section of the frame and was responsible for signalling outgoing trains from platforms 6 to 8, and incoming ones on the Up Through line. He gave evidence as follows:—

"A few seconds before 9.16 a.m., the 9.14 a.m. Empty Diesel from Cannon Street, to Grove Park was indicated 'Ready to Start' from No. 6 Platform. Having satisfied myself that there were no movements which should precede this train I reversed No. 73 No. 6 Platform to Down Through points, No. 74 Down Through trailing points, and No. 76 Down Through to Down Local points south. I saw the indication of each of these points go from normal to reverse. I then pulled No. 50, No. 6 platform to Down Local starting signal, and I saw the indication go from red to yellow and the route indicator showing 'L'. I then watched the passage of the train on the diagram as it successively occupied track circuits 'GR', 'GM', 'FY' and 'FU' (on the connections to the Down Through line). At this point I ceased to watch the outgoing movement on the diagram and concentrated on the 8.33 a.m. Addiscombe train which had been described from Borough Market Junction on the Up Through line at 9.17 a.m. Although this train was about 15 minutes late it was the intention to run it to its booked platform on this morning, normally this train runs to No. 5 but on this morning local arrangements had been made for it to run to No. 4. I had been advised that this train which is normally a ten car train had been reduced to six cars and it was, therefore, my intention to hold it at No. 89 Up Through home signal knowing that in that position it would be clear of Borough Market Junction. Had it been a ten car train it is the practice to set a parallel route which in this case would have necessitated reversing Nos. 79 and 78 points to parallel the outgoing train. This was not necessary for the reason I have described. Naturally being a short train it could wait at the home signal so Nos. 79 and 78 points were not touched.

The next thing I became aware of was the speed of the Addiscombe train approaching the home signal in view of the fact that I had not set up the parallel route or operated the home signal. Normally trains on the Up Through line approach No. 89 signal at red very cautiously and almost stop opposite the box, but this one was travelling faster than usual and this drew my attention to it. Looking round I saw it pass No. 89 signal which I could see was at danger. I actually saw the signal itself not the repeater on the frame.

Within a second of the train passing the home signal it had also passed the starting signal. I was very concerned about this and immediately replaced No. 50 signal lever in the frame, the signal aspect was, of course, already showing red, with the intention as soon as the outgoing movement was clear to set the route for the incoming Addiscombe train to No. 4 platform, but, of course, there was no time for this to be done before the impact occurred.

I did not actually see the impact because after seeing the train pass the starting signal I turned away to try and set up the route for it to No. 4 platform but I saw the effects of it immediately afterwards. I immediately alerted my colleagues, and Signalman Holbrook on the Up side immediately sent the 'Obstruction Danger' signal both on the Up Through and Up Local lines to Borough Market Junction, and I immediately followed this with the 'Obstruction Danger' signal to Metropolitan Junction."

Weedon said that he noticed that the home signal for the adjacent Up Local line (C.109) was at Green for the Ramsgate train when he saw the Addiscombe train passing C.89 at Red. He could not say definitely whether when he saw the latter signal at Red the front of the train had reached the controlling track circuit ahead of it or not. So far as the starting signals were concerned, he could not see C.81/88 for the Up Through line because of the curvature, but he saw C.102/108 for the Up Local line at Green. He confirmed that it was his custom, and that of the other signalmen also, during the rush hour to set outgoing routes only after the "Ready to Start" bell had been received from the platform.

I asked Weedon whether, when he saw the electric train passing the home signal, he had not thought of pulling No. 79 points lever in the hope of reversing these points before the train reached them. He said that he would have expected the points to be held by the interlocking. (In the circumstances the points were free until the incoming train passed on to the track circuit on the approach side of them.)

In amplification of one point in Signalman Weedon's evidence Mr. Tyler, the Chief Signal and Telecommunication Engineer, explained that with the type of power frame used in this signal box, the repeaters above each miniature signal lever give an exact indication of each aspect of the relevant signal. He also said that the electrically operated points took about 3 to 4 seconds to move after the lever was moved.

Very soon after the accident Weedon received a call from the station master from which he assumed that the station master would make all the emergency arrangements. He did not recollect having been told to arrange for power to be cut off the electrified line and he thought that it would have been done automatically by the short circuiting which he assumed happened when the trains become derailed. A few minutes later he had a second call from the station master and then spoke on the telephone to the Assistant Electric Track Maintenance Lineman to have the power cut off.

It was clear that Signalman Weedon did not have time to apply the Up Through line detonators before the train had passed the placer machine, and I asked Mr. Tyler to state the purpose of detonators here. He explained that they were for use if an incoming train were reported as "Running away right line" from Borough Market Junction, and if an outgoing train started against a platform starting signal at danger. It was apparent that they could not be of use to warn the driver of an incoming train against passing the home signal at danger unless they were designed to co-act with the signal.

Signalman R. Holbrook was on duty at the country end of the frame where he was responsible for incoming trains from Borough Market Junction on the Local line and for movements on the Metropolitan lines. He gave evidence as follows:—

"I booked on duty at Cannon Street on Monday at 6.0 a.m. and was working the Up side. At 9.16 a.m. I received simultaneously the description and bells from Borough Market Junction in respect of the 8.33 a.m. Addiscombe on the Up Through and the 7.35 a.m. Ramsgate on the Up Local. I thereupon set the road for the Ramsgate to get to No. 8 platform. For this purpose I reversed Nos. 100 (the points immediately ahead of C.102/108), 99 and 98 points, and saw the reverse indications shown, and I also pulled signals Nos. 109 and 108, and saw both repeaters showing a green aspect. I do not deal with Up Through trains, since these are dealt with by the middle man, Signalman Weedon, but I saw both 89 and 81 signal repeaters showing red.

I saw the passage of the Ramsgate train on the diagram (as it occupied the track circuit on the approach side of C.109) and then saw the Addiscombe train run by on the diagram, that is, I saw track circuit 'GH' (the one beyond C.89) show 'occupied'. I cannot say whether I or Signalman Weedon saw it first. We probably saw it together. I immediately gave the 'Obstruction Danger' signal to Borough Market on both the Through and the Local lines at 9.17 a.m., and set the Up Local line signals to danger. I then looked out of the box and looking towards the station saw the coaches of the empty diesel overturning.

I then got on the local omnibus circuit to the Station Foreman and told him of the collision and asked for all possible assistance. When I was doing this, Signalman Weedon answered the automatic telephone, I think it was to the station master, and told him the position.

I then went out and found that the passengers in the Ramsgate train were clamouring to get out. I told them to remain where they were until I was assured, by, I think it was E. T. M. Lineman Jackson, that the current was cut off. I then assisted the passengers in the Ramsgate train to get out by using the ladder from the brake van, and I also put a piece of dry timber on the conductor rail as an additional insulation."

I questioned Holbrook about his procedure in pulling the home and starting signals for the Up Local line, and he said that after setting the route he always pulled the home signal first, C.109, then looked at his working sheet as a double check that the train should proceed as routed, and finally cleared the starting signal C.102/108. The reference to the sheet involved a pause of 3 or 4 seconds between operating the signals. The effect of this procedure was that C.109 first showed yellow and then after a short pause, turned to green when the appropriate lever for C.102/108 was operated and that signal showed green.

Holbrook said that he heard Weedon speaking to the station master on the telephone and he assumed that the station master would take action about cutting off power from the electrified lines.

Signalman N. E. Hewson was working at the London end of the frame. He said that he was concerned with route settings for movements into Nos. 1 to 5 platforms, and for route settings and signalling of movements out from these platforms. He stated:—

"The 7.35 a.m. Ramsgate had been belled and described from Borough Market Junction on the Up Local line and the 8.33 a.m. Addiscombe had also been belled and described. On this morning the 8.33 a.m. Addiscombe was to run to No. 4 platform and although it was running about 15 minutes late, it was still intended to run it into this platform. I accordingly reversed No. 33, No. 39 and No. 40 points. My responsibility for signalling the Addiscombe train had then ceased.

I was watching the diagram and observing the departure of the 9.14 a.m. Cannon Street to Grove Park from No. 6 platform so that when it was clear of track circuit 'EX' (leading

up to Borough Market Junction home signal) on the Down Local 1 could pull off for the 9.19 a.m. Cannon Street to Gravesend which was waiting on No. 2 platform and which had already received the 'Train Ready to Start' indication. While I was looking at the diagram I heard a crash—this must have been at about 9.18 a.m. I looked out of the window and saw that the outgoing diesel had been run into by the 8.33 a.m. Addiscombe to Cannon Street. I saw Signalman Holbrook send the 'Obstruction Danger' signal at 9.18 a.m. to Borough Market Junction and to Metropolitan Junction and at the same time all the signals were put back to danger. Signalman Weedon then telephoned the Station Master's office giving the general alarm. I could not see the indications of any of the incoming running signals as I was at the London end of the frame."

Hewson put a lever collar on the starting signal lever for No. 2 platform, and then left the box to assist passengers.

Driver C. W. Goring of the outgoing diesel electric train started from No. 6 platform when the signal showed a single yellow aspect and the indicator showed "L" for the Down Local line. The front of his train then passed the signal box and he saw the home signal for Borough Market Junction ahead showing a single yellow; he applied power a little but as he did so the brakes became fully applied and the engine stalled. He screwed down the handbrake and went back to see the guard. He then saw that there had been a collision. He had passed a man with a hook switch pole, and he assumed that the power was about to be taken off the line.

Guard T. M. Buttrey, in the last coach of the diesel electric train, said that he was looking forward through his periscope but did not see the electric train run into his train. After the crash he went at once to the electric train to help the passengers, one of whom was screaming. He was told by a lengthman within about 3 or 4 minutes that the power had been taken off.

Motorman F. W. J. Skinner of the 8.33 a.m. Up electric train from Addiscombe said that he remembered the signals on the journey clearly and recounted their aspects. He added that he had had a very poor run after a late start due to the detaching of part of the train at Addiscombe, and that the train had then been stopped at a number of signals before reaching London Bridge. It was stopped again at Borough Market Junction for a train from Charing Cross to London Bridge to cross ahead of it, and he was then given a single yellow aspect at the Junction signal with the "horn" direction indicator for Cannon Street. He continued his evidence as follows:—

"I am not absolutely sure about the next signal, but in my mind I am convinced it was one yellow, the next signal, C.81, had a red light and I was preparing to stop at it but on looking up I saw a green light with No. 8. I thought it was unusual to go so far over (to the left) at Cannon Street, but I knew I was running late and assumed they had made a platform alteration and I opened my controller to get over the gaps (in the conductor rail at the crossings). The next thing I can remember was seeing a diesel train crossing out from the station to the Down Local. I can remember thinking I am going to hit that train, but one often gets this illusion only to find that one swings away at the last minute through other points.

Almost immediately I realised that I was going to hit it and I let go the 'dead man's handle' and moved the brake handle to the full emergency position. I would mention that just before I hit the other train I realised that I must have seen the signal for the Up Local line change from red to green with an '8' by the side of it as I approached it and when I was almost on top of it. After the accident happened I went and helped passengers to alight from my train. I estimate my train was about ten to twelve feet from the diesel and travelling about ten to fifteen miles per hour when I made an emergency brake application."

Skinner said that he knew the route well and had been running into Cannon Street for many years. He had no doubts about the positions of the signals for the Up Through and Up Local lines, and could only account for misreading the starting signals by seeing the one for the Local line go to green as he approached. He had not forgotten that he was on the Through line for he had clearly remembered the "T" indication given at No. 4 platform signal at London Bridge, which is the route indication for the Through line, when he started from it. When I asked him if he had through custom expected to be routed on the Up Local line, he said that there was no set pattern of running and that trains might be brought into Cannon Street on either line. Motorman Skinner did not excuse himself on account of the short view of the signals as trains approach on the sharp curve into Cannon Street. He said that drivers were well aware of the short view and that it was not difficult to pick out the proper signal at the slow speed of approach which applied here.

When asked why he had not used his short circuiting bar after the collision to make sure that the third rail was dead Skinner said that he must have been dazed by the shock and have overlooked it; he had been trained in the method of use of the bar and would not have hesitated to apply it. He stayed to help his passengers until all had been conducted from the train.

Guard J. T. Hopson of the Addiscombe train gave a clear account of the journey. He saw the incoming signals through his periscope; both C.89 and C.81/88 were at red, but he explained that because of the curvature the signals did not come within his view through the periscope at the end of a normal length train until the front of the train had passed on to the restoring track circuit ahead, thus changing the signal aspects to red. At the rear of a 4-car train he was

able to see the signal before it was changed to red. He confirmed having seen C.102/108, the starting signal for the Up Local line at green with the number 8 illuminated on the route indicator.

Guard Hopson could not say whether a clear aspect at the home or starting signal for his own line would have come into his view through the periscope from the rear of a 6-car train before the front of the train had passed on to the restoring track circuit ahead, as this length of train was an unusual one. Mr. R. Shervington, the Traffic Superintendent, confirmed that tests made after the accident showed that in these circumstances the guard could not have seen a proceed aspect at the home signal No. C.89. He added that the signal could be seen from the offside window of the guard's compartment in rear of a 6-car train across the chord of the curve, for a very short time before the front of the train passed it, provided that there was no outgoing train on either of the adjacent Down lines. In the circumstances I did not think it reasonable to press Guard Hopson as to why he had not looked out of the side window for the signal. After the collision Hopson got down on the offside and ran to meet the motorman. On finding him capable of action Hopson went back to protect the train.

Motorman E. E. Appleton and Guard G. E. Levitt were in charge of the 12-car train from Ramsgate, which was stopped at the starting signal on the Up Local line immediately after the accident. Appleton said that after receiving a green at Borough Market Junction he saw C.109 at yellow and C.102/108 at red; as he stopped he noted that there had been an accident, and he also saw two plate-layers waving to him to stop. Appleton told the guard, on the train telephone, that he would speak to the signalman from the telephone at signal C.102/108; he was, however, unable to get an answer at that telephone, so he returned to his cab and told the guard to protect the train, and was informed by him that the rear of the train was clear of the junction at Borough Market. When I asked Appleton why he did not apply his short circuiting bar he said that after a short time the indication light in his cab went out, showing that the power had been cut off. Guard Levitt saw the guard of the Addiscombe train go to the signal box, so he concerned himself at once with the passengers in his crowded train. He restrained them from alighting until other railwaymen were on the scene to conduct them to the station.

It was explained that Motorman Appleton had been unable to get an answer at the signal telephone because, though a light shows on the switchboard in the box when the telephone at the signal is lifted, the telephone remains quiet until the signalman switches in and answers. The telephone was tested and found to be in order, and no doubt Appleton had lifted it at a time when the signalman was speaking to someone else.

Independent and substantiated evidence about the aspect of the home and starting signals on the Up Through line was given by Mr. M. F. T. Fife, who was a passenger on the Addiscombe train. He said that he was standing in the fourth coach near the right hand side, and saw the signals at red. He identified them clearly in his evidence and said that he knew their positions as he was interested in looking at signals where opportunity offered. He was aware that colour light signals were put to red by the train occupying a track circuit beyond them: he thought that the front of the train had not passed far enough beyond the home signal when he saw it at red for it to have been changed by track circuit occupation, and he was quite sure that he saw the starting signal at red before the front of the train reached it. He did not at once try to pull the communication cord as he thought that hand signalling might be in operation. I checked the viewing of these signals from a similar position to that of Mr. Fife and found no difficulty in seeing them as clearly as he did.

Electric Track Maintenance Lineman E. A. Bridges gave evidence about the removal of power from the lines as follows:—

> "On Monday, 20th March, I just arrived at my cabin with my Assistant Lineman, Jackson; the cabin is located behind the signal box, when a Signal Fitter dashed up to say there had been an accident. I immediately went with Jackson to the telephone located on the wall of the Sub-station, and from this position I could see the accident. Jackson immediately said (on the telephone) that he wanted all the breakers involved in the crash, open. This meant circuit breakers Nos. 7-16 (inclusive); with these open it would cut off the current where it was not already cut off by the crash between the Sub-station and Cannon Street Station, but the lines were still being fed from the Sub-stations at Blackfriars and South Bermondsey, except, of course, again where dead circuit had been made by the crash. I immediately sent Jackson to operate the hook switches first of all at Borough Market Junction, and then at Metropolitan Junction. He came back at 9.30 a.m. and told me that these had been opened. This would mean that the last hook switch had been opened a couple of minutes before this."

Bridges can speak only in a whisper and this was no doubt the reason for Jackson giving the message on the telephone on his behalf.

I asked Bridges why he had not told Jackson to request Lewisham Electrical Control to cut off the power feed from Blackfriars and South Bermondsey sub-stations until the hook switches had been opened; he did not give a clear answer but I gathered that he thought such a request was outside his sphere of duty. Assistant Lineman J. Jackson's evidence confirmed that of Bridges. It is evident that he had a proper appreciation of the urgency of his duty from the speed at which he must have run to have made the circuit of the hook switches at Borough Market Junction and Metropolitan Junction and back to Cannon Street so quickly.

Mr. W. G. Woodyer, the station master at Cannon Street, said that he was on the station concourse when the collision happened. He telephoned the signal box and told the signalman to "make sure all the juice is off", and then put in hand the calls for the emergency services. He said that a little later he called the signalman again and was assured that the electric power had been taken off all lines except the In and Out Metropolitan lines. This would probably have been at about 9.25 a.m.

Station Foreman H. P. Nunn supervised the departure of the empty diesel electric train from No. 6 platform : he said that on hearing and seeing the accident he reported first to the station master, and then went to the electrical telephone on No. 6 platform and asked Lewisham Control to have all power taken off the lines in Cannon Street station and yard ; in reply he was told to contact Track Lineman Bridges. He then went to look for Bridges and in a little while he met his assistant Jackson, who told him that the power had been removed. No one could say to whom Nunn had spoken in the Lewisham Control Room.

Control Operator W. S. Gayton, in charge at Lewisham Electrical Control, gave extracts from the log book which showed that the circuit breakers at all sub-stations had functioned correctly when the lines became short circuited as a result of the collision. The circuit breakers for the Up Local line did not open as that line was not affected by the accident. He realised from the extent of the tripping of circuit breakers that there was trouble at Cannon Street, and he did not reclose the breakers at the sub-station there though he reclosed the ones at South Bermondsey.

I questioned Mr. Gayton about telephone calls which had been made to his Control Room asking for power to be cut off, and he was quite sure that he did not receive any definite information about a collision before 9.23 a.m. when Lineman Jackson spoke on the telephone. He understood from him that the hook switches on the routes feeding towards Cannon Street were being opened, and as no request for removing pressure on these lines had been made, Gayton did not consider it necessary to open again the circuit breakers at South Bermondsey. He was informed by Jackson at 9.31 a.m. that the isolating hook switches had been opened.

As I have said, the signal equipment was virtually undamaged by the accident. Mr. P. Guyatt, Divisional Signal Engineer, South Eastern, gave me a record of the tests which he made between 10 a.m. after the accident and 2.30 a.m. the following morning, to ascertain whether signals C.89 and C.81/88 were functioning correctly. The tests took so long because it was necessary to wait for the lines to be clear of debris before the final ones could be made. They included, in addition to the interlocking tests, cable tests to ensure that no fault conditions were present which might have caused the signals to display a false clear aspect, tests of the signal box wiring and signal wiring, tests to ascertain that the controlling relays functioned correctly, tests to ensure the correct sequence of aspects between signals C.81/88, C.89 and the two Borough Market Junction signals on the approach side, tests of the track circuit selection and detection circuits, and tests for current leakage at the 110 volt bus bars. He found no fault in the equipment.

Conclusions and Remarks

I am satisfied that the home and starting signals on the Up Through line were properly at danger as the 8.33 a.m. Up electric passenger train from Addiscombe approached them, and that they remained at danger as the train passed them. The responsibility for the accident must rest on Motorman Skinner of that train. The view of the signals is a short one because of the sharp curvature, but speeds are low and drivers have no real difficulty in identifying them. No doubt Motorman Skinner's attention was momentarily distracted, as he himself suggested, by seeing the adjacent starting signal for the Up Local line change to the clear aspect as his train approached. Motorman Skinner has 14 years' service with the Railway and his record is very good. The circumstances of this accident have been noted by the Committee of the Medical Research Council which is investigating cases of drivers passing signals at danger.

The accident would probably have been prevented if there had been co-acting detonators at the home signal. The explosion should have made the motorman realise his mistake and he should have been able to stop the train in the distance of 90 yards from the signal to the point of collision. It would seem that little would be lost and much gained if the detonator placers on the Up Through and Up Local lines which are only 43 ft. from the home signals, were to be re-positioned at these signals and made co-acting with the red aspect. I am informed that this is being examined.

The British Railways' automatic warning system of train control also might have prevented this accident. The warning on the cab instrument which Driver Skinner would have received as his train approached the home signal, would not have been significant, since he would have expected to receive this warning even if he had seen and misread a yellow aspect at the home signal for the adjacent Up Local line, as applying to his line. Immediately after his train passed the home signal, however, he would again have received the warning for the starting signal ; if by that time the starting signal for the Up Local line had changed, as it may well have done, to green, the aspect at which he saw it a moment later, the warning should have made him realise his mistake. He might then have been able to stop his train though the distance to the fouling point was short.

On the Southern Region priority for the installation of the automatic warning system has been given to the higher speed routes to the West, and the system has not yet been applied to the

electrified lines which are equipped for the most part with colour light signals. I do not think that the circumstances of this accident suggest that any change should be made in the priorities already decided.

The removal of electric pressure from the lines seems to have been somewhat fortuitous. There are three recognised ways of removing pressure in an emergency; they are:

(*a*) by the opening of circuit breakers on either side of the point of emergency;

(*b*) by the opening of hook switches on either side;

(*c*) by the use of the short circuiting bar carried in the driving compartments of all trains.

On this occasion pressure was removed ten minutes after the accident when Lineman Jackson used the hook switches. If, however, the two linemen had been elsewhere, as they might well have been, the misunderstanding between the station master and the signalman about telephoning the Electrical Control to have pressure removed might have resulted in a power feed from the adjacent sub-station towards Cannon Street being kept on for a further unpleasantly long period. Mr. Woodyer, the station master, was quite clear that it was his responsibility to ensure that electric pressure was removed, and he was exercising that responsibility through Signalman Weedon. His instruction was, however, given in very colloquial terms and was missed by Weedon in their first conversation. After the second conversation Weedon thought it enough to ensure that the electrical maintenance linemen were at work isolating the lines, instead of explaining the emergency to the electrical controller.

I think that the electrical controller should have exercised more initiative than he did to find out the nature and extent of the emergency when the lineman was on the telephone to him. The opening of the circuit breakers on all tracks on either side of the scene of the accident was a very quick way of removing power, and the circuit breakers could have been closed again as soon as the lineman had reported, some eight minutes later, that he had opened the hook switches.

The short circuiting bar was not used by either of the drivers of the incoming trains, though both said that they had been instructed in its use. I do not think that either of them thought of using the bar as an immediate method of removing electric pressure and of ensuring that the third rail remained de-energised thereafter.

The procedure to be followed for removing electric pressure in an emergency is laid down in the Southern Region "Instructions applicable to the Electrified Lines." These include the duties of the station master or his representative, the procedure for passing messages to the Electrical Control, and the action which may be taken by train drivers to use short circuiting bars.

The Instructions were in my opinion not sufficiently explicit, but they have recently been revised and are about to be reprinted. The revised Instructions are more detailed and very much clearer and they cover an emergency such as this. In view of the circumstances of this accident, however, I think that the attention of the traffic staff should be drawn to the paragraphs in the Instructions relating to the procedure for sending messages about removing electric pressure, which now includes the repeating back of the message, and that the motive power staff should be reminded of the authority which is given to them to use short circuiting bars both on their own and on adjacent lines, and of their duty to exercise it.

I have the honour to be,

Sir,

Your obedient Servant,

W. P. REED,

Colonel.

The Secretary,

Ministry of Transport.

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