MINISTRY OF TRANSPORT AND
CIVIL AVIATION

RAILWAY ACCIDENTS

REPORT ON THE COLLISION

which occurred on

17th February 1959

between

SLADE GREEN and DARTFORD

in the

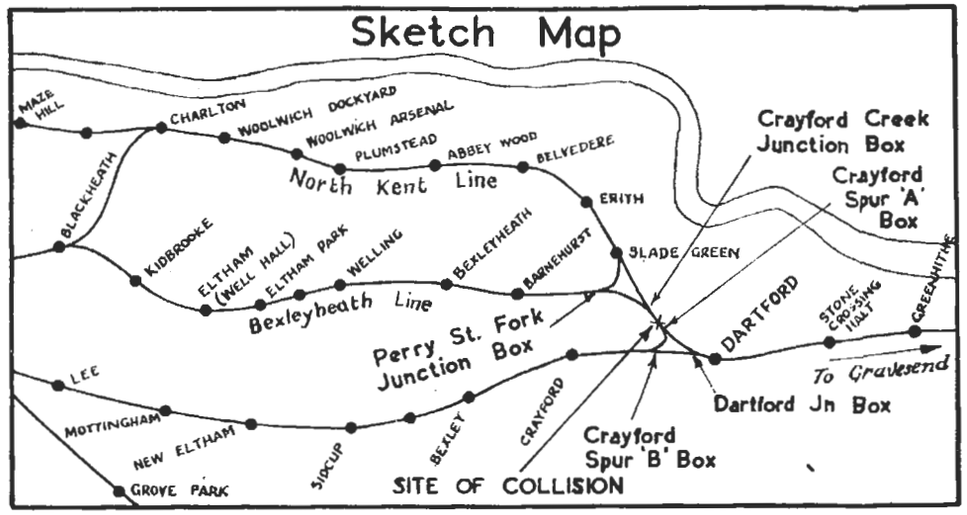
SOUTHERN REGION

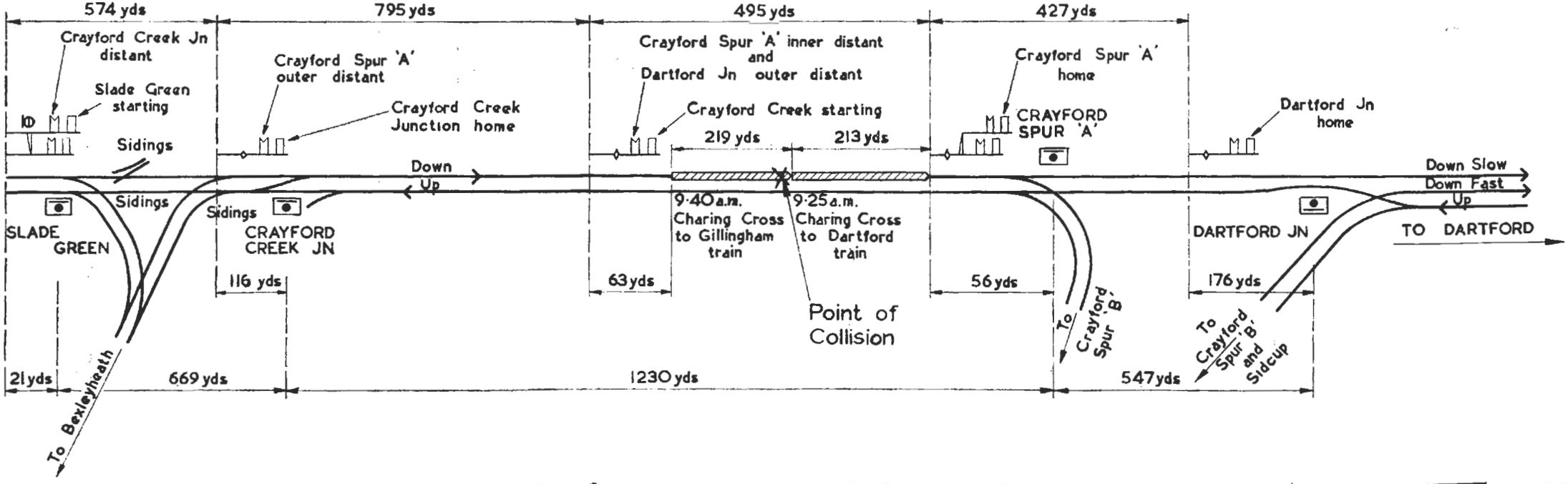
BRITISH RAILWAYS

LONDON: HER MAJESTY'S STATIONERY OFFICE
1959
TWO SHILLINGS NET

COLLISION NEAR CRAYFORD SPUR 'A' SIGNAL BOX, 17th FEBRUARY 1959

LINE DIAGRAM
(Not to Scale)





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

SIR,

19th August, 1959.

I have the honour to report for the information of the Minister of Transport and Civil Aviation in accordance with the Order dated 18th February 1959, the result of my Inquiry into the collision which occurred at approximately 10.54 a.m. on Tuesday, 17th February 1959, on the Down line near Crayford Spur "A" signal box, between Slade Green and Dartford on the North Kent line of the Southern Region, British Railways. I was assisted in the Inquiry by Colonel J. R. H. Robertson.

In fog, the 9.40 a.m. Charing Cross to Gillingham electric train, which had been wrongly admitted into the block section, ran at about 15 m.p.h. into the 9.25 a.m. Charing Cross to Dartford electric train, which was stationary at the home signal. Two sections in one coach of this train were wrecked by telescoping but fortunately they were empty. There were about 50 passengers in the 9.25 a.m. train and 150 in the following one; 17 were taken to West Hill Hospital at Dartford but all except one with a broken ankle were discharged after treatment. The guard and a driver learning the route in the leading train were also injured though not seriously.

The emergency arrangements were prompt and all the injured had left for hospital by 11.32 a.m. The permanent way, signalling, and conductor rails were not damaged but the collision caused a short circuit on the power supply which opened the Down line circuit breakers at once. Power was restored on the Up line about 20 minutes later, and both lines were closed to traffic until the damaged trains had been removed. Normal running was resumed at 3.30 p.m; in the meantime trains were diverted and an emergency omnibus service was introduced between Slade Green and Dartford.

The fog was thick, limiting visibility to 60 to 80 yards.

DESCRIPTION

1. A sketch map of the railway in the area of the accident and a dimensioned diagram to illustrate the position of the trains and the relevant signal boxes and Down line signals, are shown on the facing page.

The route

2. The North Kent line, on which both trains travelled, runs through Woolwich Arsenal (9½ miles from London) and Slade Green (15½ miles from London) to Dartford, and on to Gravesend and Chatham. Between Slade Green and Dartford, which are two miles apart, it is joined by the Bexleyheath line at Crayford Creek Junction, and by the Sidcup line at Dartford Junction where there is a connecting spur, controlled at its junction with the North Kent line from Crayford Spur "A" signal box, and with the Sidcup line from Crayford Spur "B" signal box. The collision took place between Crayford Creek Junction signal box and Crayford Spur "A" box where the double track line is on a high bank over low-lying land, some of it marshy. The line crosses a stream and a road by an arched bridge immediately before Crayford Spur "A" signal box. The alignment is straight and gradient negligible. The track consists of 109 lbs. flat bottom rails on wood sleepers.

The signalling

3. The signals are upper quadrant semaphores. The Down homes at Crayford Spur "A" box are 56 yards from it towards London and they are not provided with a berth track circuit; they comprise the signal for the spur line on the post with the Crayford Spur "B" fixed distant signal below it, and the North Kent signal above the Dartford Junction distant signal on a bracket arm at a higher level to the left. The Down line signals on the approach to Crayford Spur "A" Down home signal are as shown on the diagram.

4. The Sykes Lock-and-Block system of block working is in use with three-wire, two-position instruments. It is designed to prevent a section signal being lowered until a release has been given by the signalman in the box in advance by pressing a plunger; after this release has been given it is not possible, under normal working, to release the Block for a second train to enter the section until the first train has reached a point ahead of the home signal at the box in advance and until the lever of that signal has been pulled and replaced. The distant signal arms at that box must also be at caution. The locking of the plunger can be released by the operation of a key at the forward signal box in special circumstances which are detailed in the Rules. An extract from the standard Regulations for the Southern Region which describes this signalling and the method of working is given more fully at Appendix A.

5. A feature of relevance to the circumstances of this accident is the working of the two-position Block Indicator: this has the appearance of a miniature semaphore arm in a case on top of the instrument which controls the section signal. The semaphore arm is normally lowered; it rises to the horizontal position when the plunger at the signal box ahead is pressed to release the lock on the section signal lever. The electrical circuit through the plunger to the indicator is so designed that the indicator arm will rise when the plunger is operated to cause the "Train on" tablet to show in the box ahead even if the electrical circuit is made so briefly that the heavier electrical lock on the section signal lever in the box in rear does not have time to operate.. This can happen if the plunger is not pressed firmly. The circuit is then disconnected and the lock cannot be freed until the system has been made normal by a release in the signal box ahead.

6. The boxes are of the usual construction with elevated working floors and mechanical lever frames. Crayford Spur "A" box has 15 levers of which 3 are spares, and Crayford Creek Junction box has 31 levers of which 6 are spares. At this box the block bells and plungers to Slade Green and Perry Street Fork Junction (on the Bexleyheath line) and the Down line section signal instrument are above the frame at the London end, whilst the bell and plunger to Crayford Spur "A" and the Up line section signal instruments to Slade Green and Perry Street Fork Junction are at the other end.

7. The Standard Regulations for Train Signalling by Block Telegraph require that all signals be acknowledged by exact repetition, and that no signal must be considered as understood until it has been correctly repeated to the signal box from which it was received.

The trains

8. The 9.25 a.m. electric passenger train comprised a 2-coach unit of British Railways design with the "driver/trailer" leading, followed by two 4-coach units of Southern Region design. Each of these latter was formed with a "motor/second brake" at either end with two "trailer/seconds" in the middle. All were of steel construction and comparatively new, the oldest being the ninth coach which had been built in 1947. The tare weight was 340 tons and the length over buffers was 215 yards. The standard type of air pressure brake with electro-pneumatic operation was fitted to all coaches, and all wheels were braked; the calculated brake efficiency at 50 lbs. per square inch pressure was 77%.

9. The 9.40 a.m. train was also formed of ten all-steel coaches consisting of five 2-coach sets, all of British Railways design and built in 1958. The tare weight was 360 tons and length was 219 yards. The calculated braking pressure was 78%. On both trains the coaches were close coupled within units, and couplings of the automatic buck-eye type were in use between units.

Effects of the collision

10. The end couplings of the two trains became engaged when they collided and the rear of the leading train was then pushed forward about 24 feet. The energy of the collision seems to have been absorbed for the most part by the telescoping of the eighth and ninth coaches of the leading train; the ninth one, a compartment type trailer weighing 28 tons, overrode the eighth, an open-type trailer weighing 27 tons, by approximately 9 feet, crushing the end two sections and damaging the next two. The forward movement of the train as a whole then carried the eighth coach onwards to reduce the overriding by approximately 3 feet. The sole bars of the last coach were twisted upwards near the ends and some of the diagonal bracing of the underframe was broken by the force of the impact, and the end of the coach was buckled and the partitions displaced. Most of the other coaches of the leading train also were damaged.

11. The damage to the leading coach of the second train was very much less than that to the rear of the first one. The underframe was not distorted and the body shell was only slightly affected, though the partition of the motorman's compartment became loose and the doors were jammed. The superior strength of this coach, of British Railways type, as compared with the rear coach of the leading train, of Southern Region design, was marked, and it was confirmed by Mr J. S. Cartlidge, the Assistant Outdoor Carriage and Wagon Engineer, that this was due to improvements in design; a brief description of the differences between the two types is included at Appendix B. One other noticeable feature of the damage was the distortion of the buffer back plates and the crushing of the buffer packings on most of the coaches of both trains. This, in conjunction with minor shock damage throughout the trains, suggested that the buffers had not been of much service in dissipating the energy of the collision, which occurred at moderate speed only.

Report

12. The 9.25 a.m. train left Charing Cross at 9.46 a.m., 21 minutes late; it lost time throughout the journey, leaving Slade Green 40 minutes late at 10.47 a.m. Motorman C. J. Bevan said that the Crayford Creek Junction distant, home, and starting signals were at clear but that he saw the outer and inner distant signals for Crayford Spur "A", which are on the same posts as the home and starting signals for Crayford Creek Junction, in the caution position. He stopped his train a few yards short of the Crayford Spur "A" home signal which was at danger, and he said that he touched his whistle. He considered that the fog was patchy, very thick in some places, but he could see the signal box clearly after he had stopped, and the signalman moving about inside it. After a few minutes he was preparing to leave the train to go to the signal box when the collision took place. His immediate concern then was to attend to Motorman H. E. Hill who was with him in the compartment learning the route; he had been thrown against the partition and had hurt his back. It was therefore a minute or two before Bevan was free to go to the box; as he went he was told by two motormen who had been travelling as passengers that there had been casualties, and he therefore asked the signalman to send for the Emergency Services. He noted that the signal box time was 10.58 a.m. He did not speak to the signalman at any time about the cause of the accident.

13. As soon as Bevan had returned to the train he placed a short circuiting bar across the conductor and running rails. He then assisted in looking after the passengers until the emergency services arrived. He was quite sure that the brake had been off, with the handle in the full release position, when the collision took place; he said that he turned the handle to the brake on position before leaving the train though a broken pipe had already caused the brake to become applied.

14. So far as can be judged the train had probably arrived at the signal at about 10.50 a.m. after travelling slowly over the distance of about 1 mile from Slade Green, and the collision took place at 10.54 a.m. I asked Bevan why he had not gone to the box sooner in view of the fog conditions and he reaffirmed that he could see the box, which was less than 60 yards away, quite clearly, and the signalman. He had been sure that the signalman could in turn see his train. He was not unduly concerned at the delay at this signal as it was quite usual for trains to be held there for some time owing to the congestion ahead at Dartford where two routes to Kent converge.

15. Motorman Hill did not remember whether Bevan had sounded the whistle or not, and he did not speak to him about it while the train was waiting at the signal. His impression of the visibility was that the signal box could be seen dimly but not the signalman. He thought that the train had been standing for about three minutes only before the collision took place. Guard W. A. Blackman, who was travelling in the rear coach of the 9.25 a.m. train was not fit enough to give evidence; his statement made in hospital did not in any way contradict the evidence of the motorman. It included a comment that it was a common occurrence to stop at the Crayford Spur "A" Down home signal.

16. The 9.40 a.m. train left Charing Cross 31 minutes late at 10.11 a.m; it lost 4 minutes on the journey to Woolwich Arsenal, the last booked stop before Dartford, but it was a further 7 minutes behind time when the collision took place. Motorman E. F. Baker confirmed that the fog was thick in patches. He said that he had had clear signals for the run through Slade Green and that the Crayford Creek Junction home and starting signals had been off, with the Crayford Spur "A" distants beneath them at caution. He expected therefore to be stopped at Crayford Spur "A" home signal and was travelling at about 15 to 20 m.p.h. when he suddenly saw the rear of the train in front loom out of the fog at perhaps 1½ to 2 coach lengths away. He was sure that he applied the brake fully but doubted whether it had taken effect before the collision. He did not notice the tail lamp at the time but saw afterwards that one was in position on the 9.25 a.m. train. Though shaken by the collision and unable to open the jammed doors Motorman Baker, who is of spare build, got out through the window of his driving compartment and went forward to place detonators on the Up line before going to the signal box. He then returned to his train and satisfied himself that it had been protected in rear.

17. Passenger Guard C. W. Ottley of the 9.40 a.m. train had nothing to add to Motorman Baker's evidence except that he felt the emergency brake application before the collision took place. He went back to Crayford Creek Junction signal box to protect the train and to tell the signalman of the accident but did not have any further conversation with him.

18. The visibility immediately after the accident was established by Mr. W. J. Crowe, Works Study Assistant in the Southern Region, who was travelling in the 9.40 a.m. train. He paced the distance to a post between the bridge and signal box, which was at the limit of visibility, and found it to be about 80 yards. Mr. Crowe also estimated the speed at collision to be about 15 m.p.h.

19. Evidence from the signalmen established that the 9.40 a.m. train had been wrongly admitted into the block section between Crayford Creek Junction and Crayford Spur "A" signal boxes after an improper use of the release key. Signalman A. J. Miller, who was on duty at Crayford Creek Junction signal box, is a senior man, 64 years of age with 32 years' experience as a signalman, the last 15 of which had been spent in this box. He said that he sent for fog signalmen at 6.48 a.m. and that men for the Down lines came to their posts at the distant signals but that there was no fogman for the Up line. He then gave an account of the various Up and Down train movements past his box near to the time of the accident; these have been shown in tabular form at Appendix C which summarises all relevant train movements in the area shortly before the accident, as recorded in the signal boxes concerned.

20. Miller's evidence regarding Down trains was as follows.

> "I was offered the 9.25 a.m. Charing Cross to Dartford from Slade Green at 10.45 a.m., 'Train Entering Section' received at 10.47½ a.m. 'Train out of Section' was sent at 10.48½ a.m. I offered it forward to Crayford Spur 'A' at 10.45 a.m., it was accepted at 10.45 a.m., and 'Train Entering Section' given at 10.48 a.m. I record (in the Block Register) having received the 'Train out of Section' signal for the 9.25 a.m. Charing Cross to Dartford at 10.50 a.m. I was offered the 9.40 a.m. Charing Cross to Gillingham, from Slade Green at 10.50 a.m. I accepted it at 10.50 a.m., and received 'Train entering Section' signal at 10.52½ a.m. and sent 'Train out of Section' signal at 10.53 a.m. I offered this train to Crayford Spur 'A' at 10.50 a.m. I do not recall the position of the semaphore arm at this time, but as I have got it booked as being accepted by Crayford Spur 'A' at 10.50 a.m., I imagine the Signalman gave me 3 pause 1 (Line Clear for passenger train) on the bell, but I did not get a 'Free'. As I had had a bit of trouble with this instrument last week I presumed that the instrument had failed temporarily again so I spoke to the Signalman at Crayford Spur 'A' on the telephone and told him that I did not get a 'Free' but I did not mention any train. I do not recall what his reply was and so I hung up. I then gave the 'Cancelling' signal to him which was not acknowledged, and then I got a 'Free' on my Down Line instrument, so I pulled off my Down Home and Starting signals and the Distant signal. I have the 'Train Entering Section' signal at 10.53 a.m. At about 10.55 a.m. I received a telephone call from the signalman at Crayford Spur 'A' who said he had a motorman in his box who said there had been a collision and added, 'I do not know how the 9.40 a.m. Charing Cross got down here'. At 10.58 a.m. I received the 'Obstruction Danger' signal from Crayford Spur 'A'."

21. Miller then gave further evidence about the movement of Up trains (shown in Appendix C) and in explanation of the mistakes which happened continued as follows.

"After the empty train from Crayford (the 9.33 a.m. Up Crayford empties) had gone into the sidings on the Up side I gave 'Train out of Section' signal to Crayford Spur 'A' for this train (at 10.50 a.m.) and it is possible that the acknowledgment of this signal was delayed a bit whilst I was making other movements. I assumed this 2 pause 1 bell signal (Train out of Section acknowledgment) to be the 'Train out of Section' signal on the Down line for the 9.25 a.m. Charing Cross to Dartford. I then gave the 'Call Attention' signal to Crayford Spur 'A' and before the signalman there had time to acknowledge it I went to the other end of the frame and accepted a train from Slade Green for which I had already received the 'Call Attention' signal (the 9.40 a.m. Down train). I cannot remember whether or not I then gave 3 pause 1 (Is Line Clear) to Crayford Spur 'A' but I do not see how I could have done, and so I telephoned. When I spoke to the signalman at Crayford Spur 'A' I told him that I had not got a 'plunge' for a train that I had not offered and what this amounts to is, I was asking for a 'Free' the second time for the 9.25 a.m. Charing Cross to Dartford, and as I have mentioned before, I do not remember seeing the position of the semaphore arm before I gave the 'Call Attention' signal to Crayford Spur 'A'."

22. This explanation by Signalman Miller is a little confused; he must have been under the impression, however, when he telephoned to Crayford Spur 'A' box, that he had previously received "Train out of Section" for the 9.25 a.m. train and had sent "Is Line Clear" for the 9.40 a.m. train. It would appear that he realised afterwards that these two messages had not been sent and that the signalman at Crayford Spur 'A' box had taken the telephone call about the release failure to refer to the 9.25 a.m. train, whereas he (Miller) had in mind the 9.40 a.m. train.

23. With reference to the trouble with the Sykes instrument for his Down line starting signal lever, Miller said that there had been intermittent failures in the past which occurred perhaps twice over a period of a week. There had been a complete failure of the instrument to clear on the previous Friday at about 10.0 p.m. but none since then. He did not report the intermittent failures as he thought that they were due to the manner of operating the plunger by the signalman at Crayford Spur "A" box. When it had happened he had repeated the train message and a second plunge from the signalman at Spur "A" had released his instrument. In view of the statement of intermittent failures I asked for the record of failures during the past year at this signal box and at Crayford Spur "A". The number reported was 13, of which only two were directly concerned with the Down line plunging instrument at Crayford Spur "A" box.

24. Signalman M. Blandford, who was on duty in Crayford Spur "A" box, is 31 years of age with 4 years' experience as a signalman, of which two have been spent in this signal box. He gave evidence as follows.

"I was on duty at Crayford Spur 'A' signal box from 7.15 a.m. and was booked off duty at 4.30 p.m. I have been there since October 1956. I do not book trains at that point, except those going round Crayford Spur line. The 9.10 a.m. Cannon Street to Dartford was signalled in the normal way and I received 'Train out of Section' signal from Dartford Junction for this train. We were working Double Block between my box and Dartford Junction. I was offered from Crayford Creek Junction and accepted the 9.25 a.m. Charing Cross to Dartford but I do not remember receiving the 'Train Entering Section' signal for this train and this to me is borne out by the fact that the switch hook was not over the plunger when I had a telephone call later from the signalman at Crayford Creek Junction about the Down line. At the time I could not see my Down home signals (on account of the fog) and I did not see at any time the 9.25 a.m. from Charing Cross to Dartford which I have subsequently learned was standing there. I booked the visibility about 11.0 a.m. as approximately sixty yards.

I received a telephone call from the signalman at Crayford Creek Junction asking me if I had taken the Down train. I looked across at my instrument and saw the tablet at 'Train On' and the switch hook off the plunger. I said, 'Yes, I have taken it' and he said, 'I have not got your plunge' so I said, 'All right I will give you another one'. That finished the telephone conversation. I inserted the release key, released my instrument and plunged, not having received a 3 pause 1 signal a second time. I received the 'Train Entering Section' signal immediately and placed the switch hook over the plunger. Very soon after I heard a noise like a detonator exploding. I went out on to the verandah of the box and saw a motorman coming up and he said, 'Something has run into the back of me'.

I assumed the first train to be the 9.25 a.m. from Charing Cross but I did not know what the second one was. I sent 'Obstruction Danger' signal to Crayford Creek Junction and booked this at 10.58 a.m. I did not send 'Obstruction Danger' signal to Crayford Spur 'B' box as I thought that this might be of use for Up line traffic but I realise now that I should have done so as I did not know at the time whether or not the Up line was obstructed.

I subsequently had a telephone conversation with both boxes and got on to the Dartford Inspector and the Control Office at Orpington to inform them what had happened and to summon all three emergency Services.

On the Up line the 9.33 a.m. Charing Cross to Crayford, empty from Crayford via the Spur line to Slade Green, passed at 10.47 a.m. but there was no Up train about at the time I had the telephone conversation."

25. Blandford maintained that the fog had been so thick during his turn of duty which began at 7.15 a.m. that he was not able to see the home signals before the accident occurred. The signal box door which faces towards these signals was closed and he did not hear a whistle from the 9.25 a.m. train. He did not normally experience any difficulty in hearing train whistles.

26. Blandford was certain that he had not been given the Train Entering Section message for the 9.25 a.m. train and said that he would naturally have put the hook over the plunger if he had received the message. This action was a normal reflex and to the best of his knowledge he had never failed to use the switch hook. He remembered clearly an incident about a week earlier (on 12th February) when his plunger had become jammed and could not be depressed; this had been quickly repaired after reporting. He also remembered an occasion sometime earlier when his pressing of the plunger had failed to release the instrument at Crayford Creek Junction; he had had to use the release key and plunge again.

27. When I asked Blandford why he should have thought that on this occasion there had been a simple failure to plunge properly when Signalman Miller telephoned him, he said that the jamming of the plunger on the 12th February, though different in its effects, had put the thought of failure into his mind. He thought at the time that the telephone conversation with Signalman Miller had been sufficient to establish that the train for which the release was being asked was the 9.25 a.m. He knew from his list of trains that this would be the next Down train to pass his box and he did not think of going outside his box to look towards the signal to see if it was standing there, mainly because he had not received the Train Entering Section message.

28. Signalmen R. Holmes and J. Carnan, who also work in Crayford Spur "A" signal box, confirmed that there were occasional failures to release the starting signal lever instrument at Crayford Creek Junction when the Down plunger was pressed. They thought that these failures occurred not more than two or three times a year. They might happen on the Up line as well as on the Down. Carnan made the point that when such a failure occurred the signalman at the box in rear would see the indicator arm rise to the horizontal position and would telephone at once to say that he had not obtained the release for his instrument.

29. Signalman A. C. Bristow, who was on duty in Dartford Junction signal box, said that he had asked for fog-signalmen at 7.15 a.m. that morning but none had been available for the outer and inner distant signals for the Down North Kent line and that he had therefore been working "Double Block" with Crayford Spur "A" box. He was offered the 9.25 a.m. train by Crayford Spur "A" box at 10.46 a.m. but could not accept it as he had not received the Train out of Section message from Dartford for the previous train, the 9.10 a.m. Cannon Street to Dartford. This message was received at 10.55 a.m. and he thereupon gave Line Clear for the 9.25 a.m. train. Immediately afterwards the signalman at Crayford Spur "A" telephoned him about the accident and sent him the cancelling signal and the Obstruction Danger signal for the Up line; this was at 10.58 a.m. Signalman Bristow confirmed that it was necessary at times to hold Down trains at Crayford Spur "A" signal box because of the train movements in Dartford which was the terminating point for a number of trains.

30. Station Master B. H. Highwood said that he arrived at Crayford Spur "A" box at 11.15 a.m. He was told by Blandford that he had used the release key and had given a second plunge to Crayford Creek Junction. Mr. Highwood had only been at Dartford for two months at the time of the accident; he said that he had watched Blandford at work on a few occasions and had had no criticisms to make on his way of working. Blandford had not spoken of any difficulties in working the box.

31. Station Master W. A. Smith said that the explanation which he received from Miller at Crayford Creek Junction box was to the effect that Miller had asked for a Line Clear for the 9.40 a.m. train and that his section signal instrument had not been released; he had then spoken on the telephone to Crayford Spur "A" box and had been given a release. He had then pulled the signal levers. This explanation is not as frank as the one which the signalman later gave to me but it may represent his first recollections before he had had time to think carefully over his actions. Mr. Smith said that he had not received any official requests from Miller or the other two men who worked in the box for a booking lad to assist them, though from time to time they had mentioned that the box was very busy. During his visits he had been entirely satisfied with the way in which the signalmen worked.

32. The evidence of Signal Inspector F. W. Mann who described in detail the various tests made after the accident, showed that there was no fault in the equipment.

Conclusions

33. Signalman Miller and Signalman Blandford are both responsible for this accident. I am satisfied that Miller omitted to give the Train Entering Section message to Crayford Spur "A" box for the 9.25 a.m. Down train, which he recorded as sent at 10.48 a.m., and that he was not given the Train Out of Section message for this train which he recorded as having received at 10.50 a.m. He then failed to carry out the proper procedure for obtaining a second release for his starting signal instrument when he thought that the plunge from Crayford Spur "A" box had failed to release it. Signalman Blandford failed to carry out the elementary duty of making sure that he and Miller were talking about the same train when he was asked on the telephone to release the lock on his instrument and give the second plunge.

34. Miller recorded in his Train Register six block messages as having been passed at 10.50 a.m. It is obvious that these entries were not made as each message was passed, and they can only be accepted as evidence of what Miller remembered. It may well be that the entries of messages passed earlier were also made in groups. Between the times of 10.46 a.m. and 10.49 a.m. he was occupied at the Slade Green end of the frame in moving the 9.33 a.m. Up Crayford empties into the sidings and receiving the 9.25 a.m. Down train from Slade Green, and I can only assume that he thought he had sent the Train Entering Section message for this train to Crayford Spur "A" box when he subsequently entered it as sent at 10.48 a.m. Blandford, in Crayford Spur "A" box, had little to do at this time and I can think of no reason why he should have failed to receive the message if it had been sent and to have turned the switch hook. This would have served as a reminder to him, as is its purpose, that the 9.25 a.m. train was in the block section.

35. The six messages recorded by Signalman Miller as passed at 10.50 a.m. are tabulated below, with my comments against each one.

(a) He sent Train Out of Section to Crayford Spur "A" signal box for the 9.33 a.m. Up Crayford empties. This message was sent.

(b) He gave Line Clear to Slade Green box for the 9.40 a.m. Down Charing Cross to Gillingham train. This message was sent.

(c) He received the Train Out of Section message from Crayford Spur "A" box for the 9.25 a.m. Down Charing Cross to Dartford train. This message was not sent; he may have mistaken the acknowledgment by repetition of his message at (a) for this one.

(d) He gave Line Clear to Crayford Spur "A" box for the 9.39 a.m. Up Gillingham to London Bridge train. This message was sent.

(e) He asked for Line Clear from Slade Green box for the 9.39 a.m. Up Gillingham to London Bridge train but was not given it. This message was sent.

(f) He asked for and received Line Clear from Crayford Spur "A" box for the 9.40 a.m. Charing Cross to Gillingham train. These messages were not sent; he agreed in his evidence that he could not in fact have asked for Line Clear for this train.

36. I am satisfied that Blandford did not send the Train Out of Section message for the 9.25 a.m. Down train (item (c)), which had not even entered the block section so far as he knew. The entry by Miller of Line Clear received for the 9.40 a.m. Down train (item (f)) relates to the time when he was given the second plunge from Crayford Spur "A" signal box which Blandford thought to be for the 9.25 a.m. Down train.

37. I am of the opinion that Signalman Miller made the very serious mistakes in block procedure described in paragraph 33 above because he was working too quickly and without method at this period of pressure; with his long experience he may have been over-confident in his abilities. It is to be noted that Miller's omission to send Train Entering Section for the 9.25 a.m. Down train and his mistake in entering the Train Out of Section message for it which he did not receive, would still not have led to the accident if he had not jumped to the unwarranted conclusion that the plunger at Crayford Creek Spur "A" box had failed to release his Down starting signal instrument, and had then asked Blandford in imprecise terms to give him a second release for the signal.

38. Signalman Blandford's acceptance of the position as put to him on the telephone by Miller seems to have been completely uncritical. When there is a failure of the plunger to release the starting signal instrument the reaction of the signalman who is asking for Line Clear is naturally a prompt one; on this occasion the suggestion of failure was made about five minutes after Blandford had given Line Clear, and this delay ought of itself to have made him suspicious. Apparently, however, it did not and he accepted the situation as put to him by a very senior signalman without taking any steps to establish the true facts. He did not even open the door to try to view the home signal through the fog to see if there was a train there. If he had done so he should have seen it since both motormen could see the signal box.

39. Both signalmen suggested, though not very firmly, that previous instrument failures had pre-disposed them to think that a failure had occurred on this occasion. I do not accept this excuse. Apart from the inherent dangers of such an attitude of mind, the number of occasions on which difficulty with the instruments had been experienced had been few in relation to the number of times that they had been used. I am informed that the instrument failures here are no more frequent than on other sections of the Southern Region where Sykes Lock-and-Block is used.

40. Motorman Bevan cannot be blamed for not going to the signal box at once when his train had stopped. The additional safety provided by the Lock-and-Block system is recognised in the Rules so that the requirement for a train man to go immediately to the box when a train is halted at a stop signal in fog is waived when Lock-and-Block signalling is in operation. The Rules, however, require the whistle to be sounded and it is clear that Motorman Bevan did not do this properly; for this he is at fault. The signalman would have heard the full blast and would not then have made the mistakes which allowed the accident to happen.

REMARKS

41. The many safety features of the Lock-and-Block system of signalling are ample to ensure the integrity of the Absolute Block principle except when serious neglect of the Regulations and mismanagement of the equipment, such as happened on this occasion, takes place. The two-position indicator does not, however, show clearly the state of the Block section ahead; when raised it can mean that—

(a) Line Clear has been refused and the switch hook has been placed over the plunger at the forward box, or

(b) Line Clear has been given but the section signal instrument has not been freed (this rarely happens but it can be caused by not pressing the plunger firmly), or

(c) Line Clear has been given and the train has been despatched but Train Entering Section has not been sent (the situation which arose in this accident), or

(d) Train Entering Section has been sent but not acknowledged, so that the switch hook has not been applied.

(e) Train Entering Section has been sent and acknowledged with the switch hook over the plunger at the forward box.

42. This uncertainty can be overcome by an improved indicator which has separate positions for Normal, Line Clear, and for Train on Line or Line Blocked; it is placed at Line Clear when the plunger is operated, and moved to the Train on Line position when the switch hook is placed over the plunger. It therefore helps the signalman in the box in rear much more than the two-position instrument, and it is natural to expect that he will pay attention to it, especially in a busy box when he is making a number of train movements successively without pause. I am sure that Miller would habitually have paid closer attention to three-position instruments if they had been installed at Crayford Creek Junction, and he might not then have forgotten to send the Train Entering Section message and have jumped to the wrong conclusion which gave rise to this accident.

43. I understand that it is not the policy to carry out piecemeal improvements nowadays to the Sykes type of Lock-and-Block instrument but to replace it by the standard three-position block instrument, with full electrical controls. There is, however, no prospect of carrying out this improvement here for some years to come except by delaying the programme to provide the standard three-position Block in place of the two-position one, which is recognised as out of date, on a number of lines elsewhere in the Southern Region; it would be unwise to interfere with this programme. The Railway are, however, examining as a temporary measure, which will be an exception to the general policy, the addition of three-position indicators to the Sykes Lock-and-Block between Crayford Creek Junction and Slade Green and Perry Street Fork Junction in the Up direction, and Crayford Spur "A" and Dartford Junction in the Down direction. I hope that it will be possible for this to be done.

44. A berth track circuit at Crayford Spur "A" Down home signal, which would have locked the plunger when occupied, would have prevented the accident. The signal is, however, so close to the box that the sound of the whistle of a train standing at it must carry clearly to the signalman; I do not therefore press for a track circuit to be provided in advance of the modernisation of the Block, of which it will be a part. I suggest, however, that motormen might have their attention drawn to the need for sounding the whistle properly when stopped at a signal, especially in fog.

45. It is of interest to note the greater strength of the latest design of rolling stock as compared with former types. The strength of the carriages was, however, unduly tested in this low speed collision by the lack of resistance in the buffers. Buffers have, no doubt, in the past been designed primarily to absorb the normal shocks of running and train marshalling, but modern developments in the hydraulic type of buffer which has a shock-absorbing capacity many times that of the spring buffer when speeds rise to walking pace and above, present a possible way of further enhancing, by the use of this equipment, the safety of coaching stock which has been so improved in other respects by modern design. These buffers are now being tried out with freight stock and I suggest that their use with coaching stock should also be considered.

I have the honour to be,

Sir,

Your obedient Servant,

W. P. REED,

Colonel.

The Secretary,

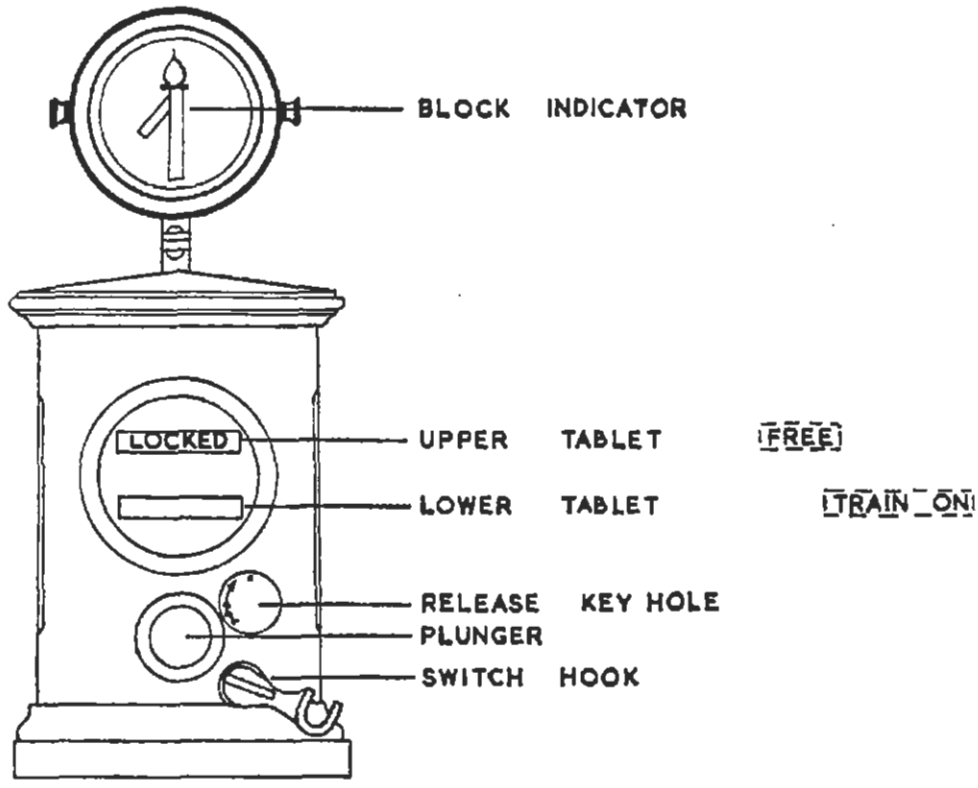
Ministry of Transport and Civil Aviation.

SYKES' THREE-WIRE, TWO-POSITION, LOCK AND BLOCK INSTRUMENT.

The Sykes' Lock and Block Two-Position Instruments although similar in appearance are arranged to work in two different ways, i.e.,

(i) As used on the Central and Eastern Sections (normal position of Block Indicator being lowered).

(ii) As used on the Western Section (normal position of Block Indicator being raised).



Mode of Signalling - Central and Eastern Sections. - "A", "B", and "C" represent three consecutive Block Signal Boxes and the process of signalling a Train is as follows: -

(a) Prior to the despatch of a Train from "A" the Signalman there, provided he has received the Train Out of Section Signal for the previous Train and the Block Indicator is in its normal position, must call the attention of "B" and having obtained it must give the proper Is Line Clear Signal. If the Line be clear at "B" the Signalman there must acknowledge the Signal and press in the plunger firmly which will cause his own lower Tablet to change from Blank to Train On, unlock the leading signal at "A", change the upper Tablet there from locked to free and raise the Block Indicator at "A". The Signalman at "A" may then, if the Line be clear, lower his Signals for the Train to leave "A".

(b) On the Train leaving "A" the Signalman there must send the Train Entering Section Signal to "B" and the Signalman at "B" must thereupon place his Switch Hook over the Plunger and acknowledge the Signal.

(c) "B" must then, provided he has received the Train Out of Section Signal for the previous Train and the Block Indicator is in its normal position, call the attention of "C" and having obtained it must give the proper Is Line Clear Signal. On receiving permission from "C" for the Train to approach, "B" may lower his Signals which will change his upper Tablet from free to locked.

(d) When the Train passes over the Treadle (where provided) fixed beyond the Home, Starting or Advanced Starting Signal at "B", it will change the upper Tablet there to free and enable the Signalman to replace the relevant Signal. The action of replacing the Signal Lever will restore the upper Tablet to locked and the lower Tablet to blank; "B" must then remove the Switch Hook from the Plunger (which will lower the Block Indicator at "A") and give the Train Out of Section Signal to "A" which "A" must acknowledge.

(e) If the Line is not clear, or if from any cause the Signalman is not in a position to give permission for a Train to approach when the Signalman in the rear forwards the Is Line Clear Signal, that Signal must not be acknowledged but the Switch Hook must be turned over the Plunger which will lock the Plunger and raise the Block Indicator at the Box in the rear. When the Line is again clear and the Signalman is in a position to give permission for a Train to approach the Switch Hook must be removed from the Plunger which will lower the Block Indicator at the Box in rear.

LOCK AND BLOCK SYSTEM OF TRAIN SIGNALLING.

1. *Electric Lock and Block System.* - The object of this System of Train Signalling is to prevent more than one Train being in the Section between two Block Signal Boxes on the same Line at the same time. This is accomplished by a Signalman not being able to lower the Signal controlling the entrance to the Block Section ahead until that Signal has been electrically released by the Signalman at the Signal Box in advance, who cannot so release the Signal until the preceding Train has passed his own Signal controlling the entrance to the Section ahead or other Signal at such Box and that Signal has been replaced at Danger, nor where a Treadle is provided, until the Train has reached it. As this system of working is attained by the interior portions of the Block Instrument being connected with the Signal Levers, Signalmen must work these Levers with great care.

. . . . . .

4. *Failures and Defects.* - (a) In order to provide against the contingency of a failure of part of the Apparatus, the Bell Code is arranged to secure the working of the Block System in addition to, and independently of, the Lock and Block Instruments.

(b) If, when the Is Line Clear Signal is given, the Tablet of the Block Instrument for the Section in advance should drop to Free, without an acknowledgment being received on the Bell, the Bell Signal must be repeated until properly answered, unless it is found that the Bell has failed, and in the meantime the Signal controlling the entrance of Trains into the Section ahead must be maintained at Danger.

(c) In the event of "B" failing to free "A" through an imperfect Plunge or a failure of the Apparatus, "A" should call the attention of "B" on the speaking instrument and inform him of the fact. It must then be clearly ascertained that no Train is in the Section between the two Signal Boxes, after which "B" must change the Tablet of the Block Instrument from the Train Accepted (or Train On) position to the normal position by one complete turn of the Release Key in the direction of the Arrow. After withdrawing the Release Key he must again Plunge.

(d) If, however, it is clearly ascertained that the "Plunge" altogether fails to release the Signal in the rear, the Train must be hand Signalled by Flag or Lamp, after the Driver has been stopped, advised of the circumstances and instructed to proceed cautiously, provided that the Is Line Clear Signal has been sent and properly acknowledged.

(e) All cases of failure, from whatever cause, must be immediately reported to the Telegraph Lineman of the district, so that the failure may be rectified in the shortest possible time, and a full report of the matter, stating the nature of the failure, must be promptly sent by the Station Master to the Divisional Superintendent.

5. *Treadles.* - (a) At many places Treadles are provided beyond the Home, Starting, or Advanced Starting, Signal to prevent the Signalman fully replacing a Signal Lever or releasing the Section in the rear until the Train has passed over the Treadle. If, from any cause, a Train in passing over a Treadle does not release the back-lock on the Signal Lever, the Signalman must wait until the Train Out of Section Signal has been received from the Signal Box in advance before releasing the back-lock by means of the Release Key, unless he can be sure by actual observation that the whole of the Train has passed.

(b) Each time the Release Key is used, owing to failure of a passing Train to release the back-locked Signal, an entry of the fact must be made in the Train Register or other book provided for the purpose.

(c) Signalmen are specially cautioned not to put the Lever partially back before the Train reaches the Treadle, except in case of emergency, as this will in many cases prevent the Treadle releasing the back-lock. The Tablet of the Block Instrument should also be watched before attempting to move the Lever.

6. *Switch Hooks.* - The Switch Hooks must always be placed (or maintained) over the Plunger to protect the Line, when at any time the Line is obstructed, or when special protection is needed. The turning of the Switch Hook, besides locking the Plunger, puts up the Block Indicator at the Signal Box in the rear, ... When a Signal Box is being closed, the Switch Hooks must be placed (or maintained) over the Plunger by the Signalman before going off duty; they must be unhooked again on the Signalman reopening the Signal Box . . .

7. *Release Key.* - (a) A Release Key is provided in every Signal Box for use as shown below.

1. To change the Tablet of the Block Instrument from the Train Accepted (or Train On) position to the normal (blank) position when the Cancelling Signal is given, or when the plunger fails to release.
2. To release Back Lock on Signal Lever in case Treadle fails to release or is not actuated for any reason.
3. To release Front Lock on Home (where Starting Signals are provided) or on Starting Signals (where Advanced Starting Signals are provided) after shunting operations.
4. To release Emergency Point Locks after Plunging, provided Train has been brought to a stand at the Home Signal.

Signalmen are specially cautioned not to use the Release Key or other means of Release unless they have clearly ascertained that no Train is in the Section, and that such Release is absolutely necessary and can with safety be given.

Whenever a Signalman is offered a train and finds that his plunger is locked he must first assure himself, beyond all measure of doubt, by consultation with the Signalman at the box in the rear (even if this means delay to traffic) whether his inability to use the plunger in the normal manner is due

(i) to a train having been accepted or being already in the section or,

(ii) to a shunt movement having been made from a siding to the main line within the area under his control or,

(iii) to some failure of the apparatus.

At the same time he must have a clear understanding with the Signalman at the box in the rear as to the description and whereabouts of the last train signalled to him, before he uses the Release Key or other means of release to free the plunger.

When in such circumstances the use of the Release Key or other means of release for accepting a train become necessary the Signalman must maintain his distant signal at caution for the next approaching train.

Should a Signalman find that a Signal (other than the signal controlling the entrance to the section ahead) is "locked" when it should be "free" he must, before effecting release, satisfy himself that no train is in the section between the signal concerned and the next stop signal ahead.

A note of the circumstances must be made in the train register book or other book provided for the purpose at each box.

When the use of the Release Key or other means of release becomes necessary in connection with the Cancelling signal (vide Regulation 18 of the Standard Regulations for Train Signalling) the Signalman at the advance box must, after acknowledging the Cancelling signal and before using the Key or other means of release, confirm with the Signalman at the rear box the particular train that will not proceed and for which the Cancelling signal has been sent.

Release Keys either for the Treadle or other Electric Locking Apparatus must not, under any circumstances, be allowed to remain in the instruments, or other release Key-holes, and Signalmen disregarding this Order will be severely dealt with.

(b) Any Signalman who improperly interferes with the Lock and Block instruments, or any part of the apparatus, or who makes any improper use of the Release Key or other means of release, will be liable to dismissal.

APPENDIX B

STRENGTH OF COACHES OF S.R. AND B.R. DESIGN.

The Southern Region underframe has 10" × 3½" channel solebars which have side trusses of 3½" × 3½" × ¾" angle with inner longitudes at the end bars of 9" × 3" channel. This arrangement provides the main strength of the underframe in the side members.

The B.R. underframe has 7" × 3½" channel solebars which are untrussed but the body side is combined with the solebars which are in turn connected to the main centre girder of the frame by outrigger brackets. The inner longitudes have top members 6" × 6" T section with bottom members 5" × 4" angle, the top and bottom members being welded together to form a main middle girder. The whole strength of the underframe is, therefore, concentrated down the middle of the underframe.

In addition to the above, the S.R. frame is of rivetted construction whilst the B.R. frame is of a welded construction.

The calculated load strengths of the frames are as follows: -

S.R. Body and Underframe	...	...	106 Tons
B.R. Body and Underframe	...	...	200 Tons

The term "load" in each case indicates the amount of force which can be applied without resulting in any permanent set of any of the constituent members.

Summary of Strength of Coach Body Ends to resist telescoping

S.R. Steel Body	...	...	Shear strength	89½ Tons
B.R. Standard Stock	...	,,	,,	230 Tons

The shear strength of the end has been based on the ultimate shear strength of the materials involved in order to obtain a true comparison. This figure should not be taken as the load an end will withstand in collision as application and position of forces would have to be considered. The figures are, therefore, only given for comparative purposes.

TRAIN TIMINGS AS RECORDED AT SIGNAL BOXES.

UP TRAINS

10.20 a.m. Gravesend to Charing Cross	9.33 a.m. Crayford Empties	9.39 a.m. Gillingham to London Bridge	Block message	Signal Box
				Slade Green (or Perry St. Fork Jn.)
	To Up sidings	10.57	Sent } T.O.S.	
10.46		10.57	Rec: }	
		10.54	Ack: } T.E.S.	
10.42½		10.54½	Sent }	
		10.54	Given } L.C.	UP DN.
10.41		10.54½	Rec: }	
10.41		10.50	I.L.C.	
				Crayford Creek Jn.
10.44½	10.50	10.55½	Sent } T.O.S.	
			Rec: }	
10.42	10.46	10.52	Ack: } T.E.S.	
			Sent }	UP DN.
10.41	10.44½	10.50	Given } L.C.	
			Rec: }	
			I.L.C.	
	From Crayford Spur "B"			Crayford Spur A
			Sent } T.O.S.	
10.45		10.53	Rec: }	
			Ack: } T.E.S.	
10.43		10.52	Sent }	UP DN.
			Given } L.C.	
10.40		10.48	Rec: }	
10.40		10.48	I.L.C.	
				Dartford Jn.

DOWN TRAINS

Block Message	9.10 a.m. Charing Cross to Dartford (via Perry St. Fork)	9.25 a.m. Charing Cross to Dartford	9.40 a.m. Charing Cross to Dartford
I.L.C.		10.43	10.49
L.C. Rec:	10.39	10.43	10.49
L.C. Given	10.41	10.45	10.50
T.E.S. Sent		10.47	10.51
T.E.S. Ack:	10.41	10.47½	10.52½
T.O.S. Rec:		10.49	10.54
T.O.S. Sent	10.42½	10.48½	10.53
I.L.C.	10.41	10.45	10.50
L.C. Rec:	10.41	10.45	10.50 (c)
L.C. Given			
T.E.S. Sent	10.42½	10.48(a)	10.53
T.E.S. Ack:			
T.O.S. Rec:	10.44	10.50(b)	
T.O.S. Sent			
I.L.C.		10.46	
L.C. Rec:			
L.C. Given	10.42	10.55	
T.E.S. Sent			
T.E.S. Ack:	10.43		
T.O.S. Rec:			
T.O.S. Sent	10.45		

Cancelled at 10.58 a.m.

Collision advised 10.55 a.m. Crayford Spur "A" recorded "Obstruction Danger" at 10.58 a.m.

NOTES:- 1. I.L.C. = Is Line Clear
L.C. = Line Clear
T.E.S. = Train entering section
T.O.S. = Train out of section

2. When giving Line Clear the signalman presses the plunger to release the lock on the section signal lever instrument of the box in rear.

3. When acknowledging T.E.S. the signalman turns the switch hook across the plunger.

4. When sending T.O.S. the signalman restores the switch hook to the open position.

5. Crayford Spur "A" signalman does not book times.

6. The "panelled" entries of 10.50 p.m. all concern action taken in Crayford Creek Jn. signal box.

Comments

(a) This block message cannot have been sent from Crayford Creek Jn.

(b) This block message was not sent from Crayford Spur "A".

(c) The starting signal lock at Crayford Creek Jn. was released by a second plunge from Crayford Spur "A", after use of the release key.