

# INTERSTATE COMMERCE COMMISSION

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## REPORT OF THE CHIEF OF THE DIVISION OF SAFETY COVERING THE INVESTIGATION OF AN ACCIDENT WHICH OCCURRED ON THE NEW YORK, NEW HAVEN & HARTFORD RAILROAD AT BRADFORD, R I, ON APRIL 17, 1916

MAY 24 1916

*To the Commission*

On April 17, 1916, there was a rear-end collision between two west-bound passenger trains on the New York, New Haven & Hartford Railroad at Bradford, R I, resulting in the death of 5 passengers and injury to 17 passengers, 3 employees and 2 employees of the Pullman Co. An investigation of this accident was made in conjunction with the Public Utilities Commission of the State of Rhode Island, and a public hearing was held at Providence, R I, on April 20, 21, 22, 1916. After investigation as to the nature and cause of this accident, I beg to submit the following report.

The accident occurred on the New London division of the New York, New Haven & Hartford Railroad immediately in front of the station at Bradford, R I. The line at this point is double tracked and its general direction is east and west. The track on the south is track 2 and is used by eastbound trains, while the track on the north is track 1 and is used by westbound trains. The movement of trains is controlled by time table, train orders and a manual controlled block signal system.

Beginning at a point about 1.5 miles east of Bradford station and extending westward there is a 1-degree 1-minute curve to the right 486 feet in length, the track is then tangent for 7,573 feet to Bradford station and for some distance beyond. The track through all this section is practically level, although approaching the distant signal for Bradford from the east there is a slight descending grade of 9.5 feet to the mile. The grade is then ascending for 2,000 feet at a rate of 3.7 feet to the mile, then is descending again at the rate of 4.7 feet to the mile for 2,100 feet, and over the Pawcatuck Bridge is practically level, then ascends for 500 feet at the rate of 10.5 feet to the mile while at Bradford station there is a slightly descending grade. All the grades, therefore, in this vicinity are less than 0.2 of 1 per cent, and the heaviest grade is in favor of a stopping at Bradford.

The distant signal for Bradford tower, governing westbound track 1, is known as signal 24, and is located on the north side of the track about 1,700 feet west of the west end of the curve previously mentioned. The first home signal, No. 23, is on a bracket mast located 4,281 feet west of the distant signal and 1,437 feet farther west on the south side of the track, is Bradford tower. The passenger station is on the north side of the tracks 170 feet west of the tower. The second home signal, No. 21, is 263 feet west of the station and at the same point is a dwarf signal governing the movement of trains into a passing siding leading off from track 1 and extending westward. The country in this vicinity is open and the view of signals is unobstructed. About 315 feet west of home signal 23 is a trestle bridge 150 feet in length over the Pawcatuck River.

The signaling on this division was installed about 20 years ago. Towers are provided for block stations, and are generally at each station, averaging possibly 4 miles apart. When switches are adjacent they are interlocked or bolt locked, and the distant ends of passing tracks are electrically controlled. There may be one or more home and block signals at each station, with one distant signal for all. The block stations are controlled one from another by "Johnson" or "Patenall" cabinets, though a few of another type are in use. A bell code is in use to transmit necessary signals from tower to tower. Weatherproof copper line wires connect the towers being run on the same pole line as the telegraph wires. Each block station therefore is a unit by itself, and has no connection with any other, except through the block instruments and bell code, the system differing, therefore, from an automatic-signal system, where each signal has a direct relation to the next one in advance. Most of the home signals being mechanically operated do not assume the stop position as the train passes, but the arrangement of the controlling circuits is such that before the next train can be forwarded the operator must put the lever back to normal position, where it is automatically locked. Such electric distant signals as have been installed replacing mechanical signals, are so arranged that they assume the caution position as the train passes. The signals are all of the two-position lower quadrant type, and the night indication of the home signal is red and green, and for the distant, yellow and green, for stop and proceed, and caution and proceed respectively. The dwarf signals display a purple light at night for stop, and yellow for proceed. The track circuits are not continuous, but extend from the distant signal to just beyond the advance or block signal, and are divided at each home signal. While in many respects this installation is such that it would not be installed at the present time, it has been well maintained, and is capable of giving satisfactory

service. Block instruments have all been taken to the shops within the past two or three years and been rebuilt.

The operation of the manual block is as follows. A block station desiring to forward a train has to ask for an "unlock" from the station in advance, in order to release his block signal. To get an unlock a "slide" in the cabinet must be put in a certain position and then pulled out to its final position while the operator in advance is pushing in his unlocking "plunger." By this joint action the block signal governing the entrance of trains into the block is released, and may be cleared. If there is a train between the two stations, or if the station in advance does not have his home signal lever back and latched in normal position, this unlock can not be given. After a train enters the block, it is necessary to put the block signal back to stop in order to admit the next train properly, as described above, and when put back it is automatically locked.

The interlocking machine at Bradford has 24 levers, all working, and is of the Johnson type, with vertical locking beneath the floor. Not all of the switches are interlocked at Bradford, but those not directly handled from the tower are controlled by bolt lock, and the outlying switches of the passing sidings are electrically locked, controlled by levers interlocked in the machine. The signals on the westbound track, where the accident occurred, are wire connected, except the distant, which is electrically operated, and one home and dwarf signal just west of the station, which are pipe connected. On this track there are two home signals and an advance signal and the distant signal is controlled by all of them through circuit breakers and mechanical locking between the levers. A separate lever controls this distant signal, and it does not "clear" automatically when the home signals are cleared. In addition to the machine, the tower is equipped with lock and block instruments and necessary bells for transmitting and receiving signals between Bradford and Wood River Junction on the east and Westerly on the west. Electric locks are provided on the home signal levers. In addition to the usual breaks in the track circuit at Bradford, additional sections are made on account of the crossing bell at the street crossing between the tower and the station. The track relays are either in the tower or have repeater relays in the tower, so that all the circuits are controlled through relays in the lower part of the tower.

The circuit controlling the distant signal starts from the battery near home signal 21, west of the tower, through mechanical circuit breakers on the signal itself, circuit breaker on lever 21, stick relay controlled by the track relays, indicator controlled by signal 20, mechanical circuit breaker on home signal 23, to the control relay in the base of distant signal 24, and then to common. The stick relay above mentioned is held up by a local circuit through the two

track relays governing the track between the home signals, and is picked up when the track relays are energized and lever 24 is normal. When this armature has once been dropped it can not be picked up unless lever 24 has been put normal. By this means, after distant signal 24 has been cleared for the passage of a train, it is necessary to put the lever back to normal in order to pick up the stick relay, and, therefore, making one of the breaks in the control circuit through the distant signal lever itself. To put back the distant signal requires all the other home-signal levers and the advance lever to be normal and latched. This control circuit is therefore broken in several places, there being mechanical breaks at no less than three locations, the last of which is on home signal 23, so that if that signal itself is at stop the circuit is opened and the distant signal can not in any way be cleared from the tower.

The electric locks on the home-signal levers serve a double purpose. First, they prevent the lever from being reversed and the signal cleared if a train is standing on the section of track controlling that signal. They also act in the case of home signals 21 and 23, as back locks, that is, the signal lever, particularly 23, can not be latched in its normal position unless this lock is picked up and the circuits are so arranged that this lock can not be picked up by operating the circuit closer in the tower unless the distant signal blade has actually gone back to stop. This circuit is known as the back lock circuit and, in common with the distant control circuit, is broken through a circuit breaker on home signal 23.

Westbound passenger train No. 633 running from Boston, Mass., to New London, Conn., was drawn by locomotive 1106 and was in charge of Conductor French and Engineman Weatherbee. It consisted of the following cars in the order named:

Car	Construction	Year built	Weight	Length
2595, smoker	Wood	1905	<i>Pounds</i> 81,000	<i>Ft. in</i> 67 8
1170, coach	do	1901	75,000	68 0
1725, coach	do	1908	81,320	67 9

This train left Boston at 5:03 p. m., on time. At Forest Hills, about 5 miles west of Boston, it was discovered that the locomotive was not generating steam properly. The train continued on, however, without material loss of time and passed Auburn, the initial station on the New London division, about 5 miles west of Providence, R. I., at 6:21 p. m., 4 minutes late. At Wickford Junction, about 14 miles west of Auburn, the train was delayed 7 minutes, and at Kingston, 8 miles further west, it was delayed 5 minutes on account of low steam. It passed Wood River Junc-

tion, the last block-signal station, located about 8 miles west of Kingston and 4.07 miles east of Bradford, at 7.18 p. m., 16 minutes late, and stopped with the locomotive about 60 feet east of Bradford tower at 7.25 p. m. The engineman and conductor went up into the tower and asked the operator to notify the train dispatcher that they were losing time on account of low steam and to ask for instructions. The dispatcher instructed the train to pull down to the station, discharge their through passengers, to be picked up by train No. 25, then pull in on the siding just west of the station and there wait for train No. 25 to pass. Engineman Weatherbee and Conductor French returned to their train and moved it to the passenger station, stopped, and were discharging their passengers when the train was struck by train No. 25, at about 7.32 p. m.

Westbound passenger train No. 25 known as the gilt-edge express, running from Boston, Mass., to New York, N. Y., was drawn by locomotive 1338, and was in charge of Conductor Read and Engineman Mansfield. It consisted of the following cars in the order named:

Car	Construction	Year built	Weight	Length
5503, baggage	All steel	1914	<i>Pounds</i> 122,260	<i>Ft. in.</i> 74.9
3275, mail	do	1911	122,280	64.5
East Haven Pullman	Steel underframe	1904	110,000	75.8
Weyford, Pullman	do	1905	137,000	79.0
2304 dining car	do	1915	142,300	80.6
7857, coach	All steel	1914	133,200	80.3
6714, smoker	do	1914	132,180	80.3
7933, coach	do	1914	122,440	80.3

This train left Boston at 5.34 p. m. on time, passed Auburn at 6.53 p. m., 4 minutes late, and passed Wood River Junction at 7.27 p. m., 5 minutes late. As the train approached Bradford it is claimed the distant signal was found in the clear position and the home signal was obscured by fog until the train had nearly reached it, when it was discovered to be in the stop position. An emergency application of the brakes was made and the sand applied, but without much effect. The train continued on and, while running at a speed estimated to have been 8 or 10 miles per hour, collided with the rear of train No. 633 standing at Bradford station.

The locomotive of train No. 25 telescoped the rear car of train No. 633 a distance of about 20 feet. Shortly after the collision occurred the wreckage of the rear car of train No. 633 took fire, presumably from the broken pipes of the gas-lighting system with which all three cars of train No. 633 were equipped. There was some testimony given which tended to show that one or more of the gas tanks had exploded, but after removal from the wreckage the tanks bore no evi-

dence of having exploded. The fire was communicated to the remaining cars of train No 633 to the passenger station, and freight house, all of which were completely destroyed.

After train No 25 came to a stop it was found that the train had parted between the third and fourth cars of the train, due to a broken knuckle, and the two portions of the train were separated by about 35 feet.

Engineman Weatherbee, of train No 633, stated that at Forest Hills he noticed that the engine was not steaming properly. He did not know the cause but it did not materially interfere with the operation of his train until it reached Wickford Junction, where 7 minutes were lost, and about 5 minutes more were lost at Kingston, waiting to blow up steam. He stated that approaching Bradford he saw the clear indication of the distant signal for over half a mile and shortly after passing the distant signal he saw both the first and second home signals displaying the clear indication. The weather at that time was slightly hazy, but not sufficient to interfere with the observance of signals. He stated that he stopped his train with the engine about 60 feet east of Bradford tower at 7 25 p m. He and Conductor French went up into the tower and told Towerman McManus to notify the dispatcher that his engine had only 100 pounds of steam and one gauge of water, and that it would seriously delay train No 25 if they attempted to go ahead of them. About that time First-trick Towerman McCluskey entered the tower and McManus asked McCluskey to give the information to the dispatcher, McCluskey then sat down at the instrument and after communicating with the dispatcher got up and changed the signal levers, set up the route for the siding, cleared the dwarf signal, and instructed them to discharge their passengers at the station, then pull in on the siding and let No 25 pass. He stated that he and his conductor then returned to their train and started forward and had just stopped at the station to discharge their passengers when their train was struck by train No 25. Engineman Weatherbee stated that when his train stopped at Bradford station the independent brake was set on the engine, but the brakes were not set on the train. The force of the collision drove his train forward about 100 feet, the engine broke away from the train and went into clear on the siding, being separated from the train about 50 feet. Engineman Weatherbee estimates that about 5 minutes elapsed between the time his train first stopped at the tower and the time he returned to his train. About 1 minute was consumed in pulling down to the station, and the train had been standing at the station about 30 seconds when the collision occurred.

Engineman Weatherbee said that as he left the tower to return to his train he saw the flagman of his train back on the bridge about

seven or eight telegraph poles east of the tower. He further stated that the light on the distant signal at Bradford is the best on the division, and that he saw the lights on both the first and second home signals when his train was about 1 000 feet east of the first home signal. He also stated that he did not notice that the rails were wet or slippery and he had experienced no difficulty in stopping his train.

Fireman Ross, of train No 633, stated that the weather was rather hazy, but not foggy, and that he had no difficulty in observing the signal indications. He stated that approaching Bradford after coming off the curve, he observed the distant signal in the clear position. Just before the train reached the distant signal he saw both the first and second home signals displaying the proceed indication. He stated that when the train first stopped at the tower the second home signal was in the proceed position but about two minutes after the engineman left the engine it changed to red and the dwarf signal changed to proceed. Fireman Ross further stated that he had been firing engine No 1106 regularly three days a week and while the engine did not steam freely the day of the accident was the first time he had experienced any trouble with it.

Conductor French, of train No 633 stated that when his train stopped at Bradford he stepped to the head end of the second car and looking out he saw the second home signal displaying the proceed indication. He then got off on the opposite side of his train and followed engineman Weatherbee up into the tower, at the same time noticing the flagman going back to protect the rear of his train. After receiving instructions he returned to his train and as he did so he looked back toward the east and saw the red and white lights of his flagman about 20 car lengths from the rear of his train and at that time they appeared to be moving eastward, he noticed no fog between him and the flagman, the train then pulled up to the station, stopped and he was opening the vestibule door to discharge the passengers when the collision occurred. Conductor French also stated that the collision extinguished all of the lights in the train. About five minutes after the collision occurred, fire broke out near the middle of the rear coach near the front end of the engine of train No 25. Five extinguishers were brought from both trains, two of which failed to work, but the fire had gained such headway that they were unable to check it.

Flagman Coombs of train No 633, stated that his train was delayed at Wickford Junction on account of low steam. After leaving Kingston he took a position in the rear end of the rear car. When the train stopped at Bradford he secured his lanterns and started back to flag. He did not remember whether his white lantern was on the rear or head end of the car, but estimates that not over 30

seconds elapsed between the time the train stopped and the time he started back. He stated that before he started back he noticed that the second home signal, No 21, just west of the station, was displaying the stop indication. He stated that as he was walking eastward he looked back toward his train and saw the conductor give the engineman a signal to pull up to the station, at that time he had not reached the bridge. When he first saw train No 25 he had crossed the bridge and was at a point somewhere between a switch, located 168 feet east of the bridge, and home signal 23. He stated that he immediately gave a stop signal with his lantern, then lit a fusee, waved across the track, and, seeing that the train was not going to stop, he stepped to one side and threw it at the engine. He then threw his red lantern and also his white lantern at the engine before it passed him. As the train passed he noticed the fire flying from the brakes. After the train had passed he found the burning fusee sticking on a tie of the opposite track, his red lantern he found on the embankment, but the white lantern he could not find. After he threw the white lantern he thought it had gone through a parlor-car window, but after the accident he noticed there was a window broken in the baggage car. He stated that the weather was hazy or foggy, but after train No 25 passed him he looked toward Bradford and saw the markers on the rear of the train. He was unable to state how far distant train No 25 was when he first saw it. Flagman Coombs stated that he did not place any torpedoes on the rail, as he was not back far enough and thought the fusee would be better. He does not believe the point at which he attempted to flag train No 25 was a sufficient distance from the rear of his train to insure full protection, as prescribed by Rule 99. He stated, however, that he got back as far as he could, walking at a normal rate of speed, but that if he had run he would have gotten back farther. He further stated that Bradford was not a regular stop for train No 633, it being, therefore, an unusual one, that he had a time table and a watch that had passed inspection, but in this instance he did not consult them. He stated that in addition to being examined on Rule 99 he had been talked to by the instructing examiner with reference to its proper observation and he fully understands the importance of it.

Engineman Mansfield, of train No 25, stated that on the day of the accident his train left Providence about four minutes late and that none of the lost time was recovered. He stated that the weather was misty and a thick atmosphere prevailed all the evening. At places the mist was heavier than at others, but the conditions were not unusual in that territory. However, he did not experience any difficulty in observing the signals until he reached the home signal at Bradford. He stated that approaching Bradford he saw the distant signal in the clear position just after coming off the curve,



he shouted to his fireman "High ball", the fireman looked out and made some reply. As he passed the distant signal he saw the arm in the vertical position, at that time the train was running at a speed of 48 or 50 miles per hour. He stated that as the train approached the home signal the fog was thicker on account of the river, and when the locomotive was almost to the home signal the fog broke away and he discovered the signal displaying the stop indication. He immediately made an emergency application of the brakes and opened the sand valve. Almost at the same time he saw the signal indication he saw the flagman near the signal, and a second or two later he saw the rear lights of train No. 633. He estimates the speed of the train to have been 8 or 10 miles per hour at the time the collision occurred, and he fully expected that it would come to a stop before striking train No. 633. Engineman Mansfield stated that his engine was working properly and that the brakes were in excellent condition. He made a slow-down at Woodlawn, just after leaving Providence, and at that point the brakes operated in the proper manner. He stated that the atmosphere was full of moisture and that the rail was slippery, but he thinks the sand prevented the engine from sliding. He said that the opportunity for observing the signals approaching Bradford is unusually good, the distant signal may be seen across the curve, and the home signal may be seen from the distant signal. He did not reduce speed approaching the home signal, as the distant signal displayed the proceed indication, and he assumed, of course, the other signals would be at proceed. During his experience on one previous occasion he found a distant signal at Stonington Junction in the clear position with the home signal in the stop position. Engineman Mansfield said that he did not see the fusee nor the lanterns claimed to have been thrown by the flagman, neither did his engine explode any torpedoes.

Fireman King, of train No. 25, stated that after leaving Providence he did not experience any difficulty in observing signal indications. He stated that approaching Bradford he had just finished shaking the fire when the engineman called, "High ball." He immediately went to his seat and, looking out, saw the distant signal displaying the proceed indication. He then returned to the deck of the engine and started to rake the fire with the hook, when he felt the emergency application of the brakes, he immediately stopped to the left side of the engine and, looking ahead, saw a flash of red, which he took to be the home signal, at the same time he saw the lights of the flagman and the rear lights of train No. 633. He does not recall noticing any fog, nor did he see any fusee or lanterns thrown at the engine.

Conductor Read, of train No 25, stated that he was in the corridor of the dining car when he felt the application of the brakes. At first they appeared to hold in a satisfactory manner, but later the wheels began to slide. He estimates that about 30 seconds elapsed between the time the brakes were first applied and the time the train came to a stop. He stated that when he got off he looked toward the rear of his train and saw his flagman going back, he also saw the light on the switch located between the bridge and the home signal, but he saw no fusee. When he reached the forward end of his train he found the knuckle broken on the forward end of the second Pullman car and the two portions of the train separated about half a car length.

Head Brakeman McNamara, of train No 25, stated that as soon as his train stopped he went to the rear, there was some fog, but he could see the lights of the flagman of his train crossing the bridge. He stated that an hour or an hour and a half after the accident occurred he went eastward on track 2 to flag the wreck train coming on that track, at that time his attention was called to the rising and lowering fog, when he reached a point about 1,000 feet east of home signal 23 he looked back, but was unable to see the signal light.

Flagman Camp, of train No 25, stated that approaching Bradford he was riding in the rear end of the last car of his train. The first indication of anything unusual he received was when he felt the application of the brakes. Before the train came to a stop he saw a red fusee burning some distance in the rear, the train stopped about 30 seconds after he felt the first application of the brakes. He immediately got off and started back to flag, he met Flagman Coombs on the bridge a few feet from its eastern end. At that time Flagman Coombs had no lanterns he helped him look for them and found the red lantern lying on the right side of the westbound track, about 5 feet east of the east end of the bridge. He also found the fusee sticking in the end of a tie between tracks 1 and 2, about 10 feet east of the bridge, and at that time it was still burning. He stated that as he passed the home signal on his way eastward it was in the stop position, and when he reached the distant signal it was in the caution position, displaying a yellow light. He also stated that there was nothing in the way of a fog to obscure the signals, and when he reached the distant signal about 10 minutes after the accident he could plainly see the light on the home signal, also the markers on the rear of his train.

Towerman McManus stated that on the day of the accident he assumed duty at Bradford tower at 7 p. m. At that time the distant signal, No 24, and home signals 23 and 21 were in the normal position. After train No 633 entered the block at Wood River Junction he placed the home and distant signals in the proceed

position After the train had passed the home signal he restored the levers controlling distant signal 24 and home signal 23 to their normal position He stated that if distant signal 24 had not been in the caution or normal position he would have been unable to restore the lever controlling home signal 23 to its normal position, and that unless these two signals had been in the normal position he could not have unlocked the block so as to permit train No 25 to enter it from the eastern end at Wood River Junction He stated that after train No 633 stopped, the engineman and conductor came to the tower and asked for instructions, and arrangements were made for them to take the siding there and let train No 25 pass He stated that train No 25 was 75 or 100 feet west of home signal 23 when he discovered that it had run past it Towerman McManus said that the weather was a little hazy, but that he could clearly see signal 20, about 3,000 feet west of his tower

Towerman McCluskey stated that after being relieved by Towerman McManus at 7 p m he went over to the station and had been there 10 or 15 minutes when train No 633 arrived and stopped at the tower He went to the station door, looked out, and saw second home signal 21 in the proceed position, being curious as to the cause of the stop, he returned to the tower, at that time it was about 7:27 p m Upon entering, Towerman McManus asked him to handle the situation Thereupon he went to the telegraph instrument communicated with the dispatcher, and upon receiving a reply he instructed the crew of train No 633 to discharge their through passengers, pull in on the siding, and let train No 25 pass He then got up, restored second home signal 21 and block signal 20 to their normal or stop position, unlocked and threw the switch, and cleared the dwarf signal for train No 633 to pull in on the siding Train No 633 had pulled down to the station when he saw train No 25 approaching He shouted to McManus, "Twenty-five has run the boards" McManus then opened the window and gave a stop signal to the approaching train with his lantern, he estimates that at that time the train was running about 50 miles per hour Towerman McCluskey stated that when he entered the tower the levers controlling distant signal 24 and home signal 23 were in the normal position If they had been in other than the normal position it would have been physically impossible to change the signals and set the route for train No 633 to pull in on the siding He stated further that it would be practically impossible for the distant signal to be in the proceed position with the home signal in the stop position, although on one occasion, about a year ago, such a condition did arise when a steam shovel working in the vicinity broke a telegraph wire,

which fell on one of the signal wires, causing the signal to improperly display proceed. Towerman McCluskey further stated that at the time of the accident the weather was a little hazy, but not foggy, and that he had no trouble in seeing his eastbound block signal, located approximately 2400 feet east of the tower.

Signal Inspector Nicholson, who was riding on train No 25, stated that at the time of the accident he was riding in the third coach from the rear. He noticed the application of the air brakes, but until the collision occurred he thought that it was due to a burst air hose, he was not thrown from his seat by the impact. When the train stopped, he immediately followed the brakemen out and went forward a short distance toward the head end of the train, when he was met by some one whom he afterwards learned to be the operator, who told him of the collision, and said "Go back and look at the signal." He stated that he then started to go back to the home signal, running part of the way. He passed the flagman of train No 633, who was standing just west of the bridge, when he reached the home signal he found it in the stop position, the lamp burning and displaying a red light. While he was at this signal the flagmen of trains Nos 633 and 25 arrived from the west. He then proceeded back to the distant signal, accompanied by the flagman of train No 25. Upon reaching the distant signal he found the blade in the horizontal position, displaying a yellow light.

Mr Nicholson stated that there was a light fog, but he did not consider it sufficient to seriously interfere with the view of signals. On his way back to the distant signal he frequently looked back toward the station and found that he could see the home signal until he reached a point about 600 feet west of the distant signal. He did not at any time see any fusee.

After reaching the distant signal Mr Nicholson returned to the tower. He stated that when he entered he observed that levers 23 and 24, controlling the home and distant signals, were in the normal position, and he told the towerman to seal them so they could not be moved.

Signal Repairman Anderson stated that his territory extends from Mystic to Wood River Junction. He takes care of four interlocking plants and has supervision over two more. In these six plants there are 23 home signals, some of which are wire connected, some pipe connected, and some electrically operated. There are seven electrically operated distant signals and five that are wire connected. He has under his supervision one helper and two lampmen, but no night maintainer. Mr Anderson said that the apparatus in his charge is inspected by him as regularly as is possible and that keeping the apparatus in good condition occupies all his time. Tests of the circuits are made and reported to his foreman. In such tests the

operations of the relays are observed at opening and closing of contacts. Mr. Anderson does not test the locking combination of the machine, but knows it to be correct.

He stated that the last inspection or test at Bradford was made on April 15. On that date the mechanism of signal 24 was observed and found to be working properly. The circuit breakers on signals 23, 21, and lever 24 were examined, cleaned, and properly adjusted. The lock and block instruments were inspected and then contacts cleaned. The operation of the relay at signal 24 was observed 12 or 14 days prior to this date and was found to be working correctly, and at that time the slot coils were tested. The inspection of the 15th was in the ordinary routine of his work and not due to any report of trouble.

Mr. Anderson stated that there had been no trouble with foreign current improperly picking up track relays, but that the line relay at signal 24 had closed improperly in one instance, causing the signal to clear when the home signal was at stop. This was due to a broken Western Union wire falling across the signal wires between home signal 23 and distant signal 24. The trouble was reported at once by a train crew working near the signal and was removed as quickly as he could get there from the tower. This is the only instance reported since the signal was installed about a year ago. Mr. Anderson did not know the voltage of the Western Union wire, but thought it probably about 110. He stated that if this cross had occurred west of the home signal it would have caused no trouble, as the control circuit was open at signal 23, which was in the stop position at the time. He could not say whether the trouble would have remained indefinitely, as the cross might have been removed by the wind.

Mr. Anderson said there had been one false clear indication of a distant signal besides that referred to, and this was at Wood River Junction. As he recalls it it was in the latter part of 1915 and was caused by water leaking into the circuit breaker in the signal.

Mr. Anderson stated that the battery operating signal 24 is in a box located near the signal, and it has not been renewed since it was installed. The battery operating the line relay at signal 24 is near home signal 21, and the control circuit starts at this battery. The circuit is controlled by indicator of the block signal.

He further stated that in his inspection he takes no note of the condition of the signal lamps, but supervises the work of the lampmen by a general inspection. If anything is found in an improper condition it is corrected at the time or the lampmen are notified.

Signal Engineer Morrison stated that he is in direct charge of installation of signals on the New Haven system and in an advisory capacity has charge of their maintenance. He stated that the sys-

tem through Bradford is known as the "Controlled manual lock and block," and operations are governed by a "Johnson" cabinet, which compels a cooperation of the operators in adjacent towers to forward a train. The home and block signals at Bradford are mechanical, and the levers are electrically locked, so that they can not be reversed when a train is standing on the track circuit. The westbound distant signal is semiautomatic, that is, it may be cleared by the operator when home signals 23, 21, and 20 are all clear, but assumes the caution position as soon as a train passes it.

With a train occupying the position that train No. 633 occupied at the time of the accident, Mr. Morrison stated that the westbound distant signal control circuit is opened electrically in three places, and is also broken mechanically at signals 21 and 23 and lever 24. Unless signals 20, 21, and 23 are all reversed, lever 24 will be locked through the mechanical locking. The signals 23 and 24 could not have been clear as the train held signal 23 locked electrically, and that lever by mechanical locking held lever 24 normal. Unless these two levers were in the normal position, and latched, Bradford could not have unlocked Wood River Junction to permit train No. 25 to enter. With train No. 633 standing where it was, it is possible to unlock Wood River Junction, provided the home and distant signals are in normal position. If there was a defect in signal 24 which would have caused it to clear falsely, it must have appeared after Bradford had unlocked Wood River Junction for train No. 25. Mr. Morrison could think of no condition that could occur that would cause the distant signal to be in the proceed position after the unlock had been given for train No. 25, unless it was deliberately changed by tampering. It could not have been done by the levers because the distant signal control circuit was broken at the home signal, which was in the stop position, and held in that position by train No. 633 and the distant signal lever was further locked mechanically by the position of the home lever.

Mr. Morrison said there had been no trouble with foreign current at Bradford, and in no case would foreign current have caused the distant signal to have cleared falsely because the control circuit is mechanically broken at signal 23, when that signal is in the stop position. A crossed wire carrying current from some outside source might cause a false clear failure, if the cross occurred between the distant signal and the first home signal. If the cross were west of the first home signal the circuit controller on that signal, being open, would prevent any false operation. Mr. Morrison has no record of any false unlock being given in this territory by crossed line wires, and stated that the operation is less susceptible to foreign current than the usual block system, on account of the system being controlled from a tower.

Mr Morrison submitted four lists of failures at Bradford and Wood River Junction covering a period of about two years. Two of these show failures of the signals in the stop position. Some of the failures listed are those of switches, and the greater number were mechanical in their nature. There have been two false clear failures at Wood River Junction, as follows:

*February 16, 1914*—Block signal 18 was held in proceed position by a broken chain being caught, under this condition the operator would not have been able to unlock the tower in rear.

*August 11, 1915*—Distant signal 1 and home signal 2 failed, due to water bridging across and forming a circuit, thus allowing control relay to be energized.

At Bradford there have been three false clear failures, as follows:

*April 9, 1914*—A broken wire carrier wheel caused signal 5 to remain in proceed position. The operator could not have unlocked the tower in the rear under this condition.

*October 3, 1915*—The same signal failed, due to a wire carrier being knocked off.

*October 13, 1915*—Western Union line wire broken by a steam shovel fell across signal wires, causing signal 24, the westbound distant signal, to clear falsely.

Mr Morrison stated that there had been no general overhauling of the line wires in the vicinity of Bradford recently.

Referring to a signal failure said to have occurred at Attleboro some time ago, Mr Morrison said that was probably a mechanical signal, electrically slotted. If the operator pulled it too hard the slot might release, allowing the signal to go back to danger. In this way an approaching train might have found the distant signal clear and the home signal at stop, although there would have been a clear block ahead.

Mr Morrison stated that it is about 3 miles from the block signal at Wood River Junction to the distant signal at Bradford and only one train is allowed in this block at a time, except as provided for by the rules governing the use of caution cards. Under caution card or train order, permitting the passing of a block signal in the stop position, one or more trains may be admitted to an occupied block. The issuance of a caution card is considered an emergency measure and their use is prescribed by Rule 429, which is as follows:

If from any cause a signalman be unable to communicate with the next block station in advance, he must stop every train approaching in that direction. Should no cause for detaining the train be known, it may then be permitted to proceed with a caution card, Form T542, provided 10 minutes have elapsed since the passage of the last preceding train.

Under such conditions when two or more trains are in the block dependence for protection is placed on the flagman and the close observance of the engineman.

Mr Morrison said periodical tests of relays are not made, they are, however, all tested when in the shop for repairs and a record kept. The distant control relay at Bradford was tested when installed, about a year ago. In his opinion these relays are not liable to change their operating characteristics within such a period. Line circuits are tested regularly, using bell and battery or voltmeter. The system is being inspected every six months, and Mr Morrison thinks Bradford wiring has been inspected since it was installed. The line wire here between the tower and distant signal is about a year old.

Questioned as to what has been done toward installing a more modern signal system between Providence and New London, Mr Morrison said only estimates had been prepared. He considered the system as safe as that on the western end of the road, but was not capable of handling an equal volume of traffic. Improvements in the existing system are constantly being made. At Westerly a modern electric interlocking plant, with track circuits and all modern features, was installed when improvements were made there. A new electric interlocking has been installed at Stonington, and improvements are under way at East Greenwich. At a number of points distant signals have been moved back, and in many cases where they were mechanical signals they have been replaced by electric signals, as had been done at Bradford.

Mr Morrison said that the tests of an automatic train stop that have been under way for some time, were being continued. Investigations of devices and plans presented are being made, and the number received since the Milford accident has been greatly increased. He has been authorized to employ additional assistance to investigate this question and has a competent engineer assigned to this work who can observe tests being conducted on other railroads. Mr Morrison feels that considerable progress is being made in the art of automatic train control and a great deal of money and energy is being spent in the development of various devices, and that the main trouble with the promoters of the majority of these devices is that they have an idea of crude construction, which must be developed.

Relative to the statement of Engineman Mansfield on one occasion finding the distant signal at Stonington Junction in the clear position with the home signal in the stop position, this has reference to an accident which occurred at that point on July 25, 1912. That accident was investigated by the Commission, and it was found that the distant signal, which was wire connected, had a broken chain in the connection, that temporary repairs were made by the operator prior to the accident, but that he took no steps to ascertain whether or not it operated properly after he repaired it. Investigation developed that by reason of the faulty repairs it was held continually



in the clear position, regardless of the position of the lever in the tower

General Air Brake Inspector Joy stated that after the accident he made an examination of the air-brake equipment on engine 1338 and found it in first-class condition. He stated that under ordinary conditions a train such as train No. 25, running at 50 miles per hour, should be able to stop in 972 feet with an emergency application of the brakes, but if the rail conditions were bad the distance would be materially increased.

Boilermaker Crane, employed at Midway engine house, stated that on the night of April 16 he examined the smoke box of engine 1106 at Midway and found nothing wrong, except the netting was partly plugged up. This was cleaned by him before the engine left.

Assistant Mechanical Superintendent Stewart stated that on April 18 he made an examination of engine 1106 at Midway engine house, and it was found to be in good condition generally. Hydrostatic tests were made, and under 110 pounds pressure no leaks developed. Upon opening the front end of the engine it was found that the netting was plugged solid for about three-quarters of its area. To this cause he attributes the failure of the engine to steam properly. He stated that this condition could have been caused by fine coal and the fine mesh netting used, by improper firing, or by starting out of a terminal with the boiler too full of water.

In order to determine the cause of this accident, careful consideration has been given all the testimony, particularly the statements of the two towermen on duty at Bradford at the time of the accident, the flagman of train No. 633, and the engineman and fireman of train No. 25, and, in addition, on April 19 and 27 representatives of the Commission conducted a thorough investigation and made comprehensive tests of the interlocking plant at Bradford and of the block signals concerned in the accident.

According to the statements of the engineman and fireman of train No. 25, the signal indication received by them at the distant signal was clear, and at the first home signal was stop.

The distant signal was inspected by the signal inspector and the flagman immediately after the accident occurred, and was found to be in the horizontal position, giving proper caution indications under the conditions then existing, and subsequently it continued to operate properly without any adjustments or repairs being made to the signal circuits or apparatus.

An examination of the plant at Bradford disclosed that all parts were working properly, that the locking was correct, and that the electric locks properly performed their function. The distant signal itself was examined and was found to be working freely, and no indications were found of anything that would cause it to stick in the

clear position. The circuit breakers on the home signals were examined, as well as those on lever 24. In order to ascertain whether or not the apparatus was working properly, the distant signal was held in the clear position, and it was then found that home signal lever 23 could not be latched normal, which, through the mechanical locking, prevented the distant signal lever from being latched normal. This would effectually tie up the plant through the mechanical locking, as well as prevent the operator from unlocking Wood River Junction on the east, as that unlocking circuit is broken, except when the home signal is latched normal.

Further tests were made to detect any crosses in the circuits which might cause this signal to clear falsely. Meter readings were taken between the control wire and the common, the former being disconnected from the relay, in such a way as to indicate any current which might be flowing from outside sources. There was found to be a current fluctuating from zero to 0.3 volt, which is entirely insufficient to pick up the 500-ohm relay. A similar test was made between the back-lock circuit and the common, which gave about the same reading. The main battery at this time gave a reading of 12.5 volts. The control relay at signal 24 was found to pick up on 5.8 volts and drop away on 3.85 volts. A test was made in the tower to see if there was any escape of current which would cause the electric lock to pick up falsely and under the conditions in which this would occur the test showed no reading on the circuit. It was noted that when a train passed the circuit on signal 23 lever lock was broken, but was picked up after the train had passed the last signal long enough to release the back lock, and showed then about 11 volts. After the train had passed signal 21 the lock was free and could be released, and the reading was about 8 volts, the lesser reading in this case being due to the additional units in the circuit.

The only possibility for foreign current clearing signal 24 would be from a cross in the line wire connecting both the control wire and the common between signal 23, the last break in the circuit, and the distant signal itself. Test showed no current from outside sources in these circuits, and an inspection also showed the line to be clear. These tests, therefore disclosed nothing to indicate that at the time of the accident these signals were not properly performing their functions.

This accident was caused by the failure of Flagman Coombs properly to protect the rear of his train and by the failure of Engineman Mansfield to observe and be governed by signal indications of distant signal 24 and home signal 23.

General Rule No. 99 reads, in part, as follows:

When a train stops or is delayed, under circumstances in which it may be overtaken by a following train, the flagman must go back immediately with

stop signals a sufficient distance to insure full protection, and will there place two torpedoes on the rail, two rail lengths apart, on the engineman's side. He will remain at this point until recalled.

If a following train is within sight or hearing before the flagman has reached a point insuring full protection, he must at once place two torpedoes on the rail and at night or in foggy or stormy weather, or where the view is obscured, he will, in addition, display a lighted fusee and continue toward the following train, displaying stop signals, until it is met.

Block and interlocking signals will not relieve flagmen from observance of this rule.

This investigation developed the fact that train No 633 arrived at Bradford at 7 25 p m, and that it was struck at 7 32 p m, which allowed Flagman Coombs 7 minutes in which to get back a proper distance to protect the rear of his train. Flagman Coombs had in his possession a time table and a watch, and he should have known that train No 25 was by schedule due to pass Bradford at 7 27 p m, yet, notwithstanding this, Flagman Coombs had reached a point not more than 1,120 feet from the place where the rear of his train first stopped when he was passed by train No 25. The evidence in this case warrants the conclusion that Flagman Coombs did not start to go back as soon as his train came to a stop. According to his own statement, second home signal 21 displayed a red indication before he started to go back, and it is known positively that this signal was not placed in the stop position until Towerman McCluskey came from the station to the tower, after the train stopped, communicated with the dispatcher, received a reply, and then got up and threw the signal lever. It is therefore believed that at least two minutes must have elapsed after the train stopped before Flagman Coombs started back to protect the rear of his train. With a view to ascertaining the time that would be consumed in walking from the point where the rear of train No 633 was standing when it first came to a stop to the point where train No 25 passed Flagman Coombs, a test was made on April 21, and it was found that, including an allowance of 30 seconds for alighting from the train, the distance was covered at a brisk walk in 3 minutes and 22 seconds. This test would indicate that had Flagman Coombs used all of the time at his disposal he would have been able to cover a distance of approximately 2,200 feet, or reach a point about 2,600 feet east of the point of collision before being passed by train No 25.

Rule No 99 states in most positive language that "Block and interlocking signals will not relieve flagmen from the observance of this rule." And it can not be too strongly impressed upon those assuming the responsible position of flagman that they are strictly bound to comply with all safety rules provided by the railroad for their guidance, and in this instance, had the flagman exercised the proper degree of care under the circumstances prevailing, and

hastened back immediately with stop signals, there is every reason to believe that he could and would have warned the engineman of train No 25 in plenty of time to have permitted him to stop his train before colliding with the rear end of train No 633

It is believed further that the evidence in the case is sufficient to support the conclusion that Engineman Mansfield, of train No 25, failed to observe and obey the signal indication of distant signal 24, and did not note the position of home signal 23 until his train was practically under it

As a result of the investigations and tests made, nothing was disclosed to indicate that at the time of the accident the signals were not working properly, and, further, that the possibility for the signal displaying a false clear indication is exceedingly remote. While there is evidence that some fog existed in the vicinity, the preponderance of the testimony is that it was not of sufficient density to obscure the engineman's vision of the signals. If, however, there was sufficient fog to obscure Engineman Mansfield's view of the signals, proper regard for the safety of his train should have prompted him to bring the train under control until he could see the home signals and know that the route was clear.

In order to eliminate the possibility of there being confusion, in reading the wrong signal at Bradford, observations were made from a locomotive cab on the night of April 21. Several runs were made and there seemed to be no possibility of such confusion. The distant signal could be clearly seen while the engine was on the curve, and home signal 23 was not in any way obscured and could be distinctly seen from the distant signal.

As train No 633 stood at Bradford station at the time of the collision, its rear end was approximately 1,400 feet west of home signal 23, and at the speed at which Engineman Mansfield claims to have been running, this distance, under ordinary conditions, would have been sufficient in which to bring the train to a stop with an emergency application of the air brakes, even though the indication of the home signal was not observed until the signal was reached. However, Engineman Mansfield claims that in this instance his inability to stop was due to the bad condition of the rail and the consequent sliding of the wheels.

Flagman Coombs is 30 years of age, and entered the service of this railroad as passenger trainman in April, 1907, and was promoted to baggagemaster in February, 1913, he has a clear record. Engineman Mansfield is 52 years of age, he entered the service of this railroad as fireman in 1882, was promoted to engineman in 1887 and has a clear service record.

At the time of the accident Flagman Coombs had been on duty 6 hours and 23 minutes and Engineman Mansfield 11 hours and 39 minutes in the aggregate in the preceding 24 hours

It will be noted that all of the cars composing train No 633 were of wooden construction, were lighted by gas, and shortly after the accident took fire. It is obvious that had these cars been of modern steel construction they would not have been destroyed by fire, and it might have been possible to save the lives of some of the injured persons who were caught in the wreckage and cremated.

Investigation developed further that all of the cars in each train were equipped with fire extinguishers, and with one exception all had been recharged within one year. This accident again demonstrates the inherent weakness of wooden passenger cars.

General Manager Bardo stated that the New Haven Railroad required a total of about 2,500 passenger cars to protect its service, and of that number about 575 were of all-steel or steel underframe construction, of these, the company owned 375 and the remaining 200 were furnished by the Pullman Co. Mr Bardo also stated that his company had about 200 all-steel cars on order, 100 of which would be delivered this year, and a goodly part of the latter are at present ready for delivery, except for the steel wheels, which the builders are unable to obtain.

Mr Bardo stated that it was the practice to use the steel equipment on all through trains and on some of the more important branch line and local trains, but that as the spring and summer travel increased it was necessary to withdraw this class of equipment from the latter service in order to protect the through trains.

With respect to the car-lighting systems, Mr Bardo stated that many of them cars originally equipped with gas lighting have been changed to electric lighting, and at the present time there are about 1,200 cars on the line that are electrically lighted.

With reference to action taken by the New Haven Railroad with a view to providing greater safety, General Manager Bardo stated that since February 1, 1913, 921 schedules had been lengthened and a total of 1,630 schedules had been rearranged.

In discussing measures to insure the proper obedience to signals, Mr Bardo said that he can not help but feel that if each employee can be thoroughly impressed with the importance of the caution signals there will be a marked reduction in the number of instances where the home signal is overrun or disregarded.

The following is a tabulation of accidents occurring on the New York, New Haven & Hartford Railroad, and investigated since July, 1911, wherein employees have failed to obey fixed-signal indications or failed properly to protect their trains as required by the rules.

Date	Location	Kind of accident	Number of persons --		Cause
			Killed	Injured	
1911 July 11	Bridgeport, Conn	Derailment	14	51	Train crossed over from one track to another at excessive speed, engine man failed to obey signal and rule
1912 July 20	Stonington Junction, Conn	Collision, rear end	2	5	Failure of flagman properly to protect train, failure of towerman to ascertain position of distant signal which he had temporarily repaired
Oct 3	Westport, Conn	Derailment	7	36	Failure of engineman to observe and obey signals and rules governing operation of trains over a crossover
Nov 16	Putnam, Conn	Collision, rear end	1	1	Failure of flagman properly to protect train
1913 June 12	Stamford, Conn	do	6	26	Failure of engineman to apply brakes in time to stop train before reaching home signal, which was in "danger" position
Sept 2	North Haven, Conn	do	21	42	Failure of flagman properly to protect train, failure of both enginemen to control speed of trains before passing danger signal, signal system inadequate
1915 Aug 4	Atlantic, Mass	Collision, rear side		23	Failure of engineman to observe and obey signal indications
1916 Feb 22	Milford, Conn	Collision, rear end	10	266	Failure of engineman to obey signal indications
Apr 17	Bradford, R I	do	5	22	Failure of flagman properly to protect train, failure of engineman to observe and obey signal indications

In these 9 accidents 66 persons were killed and 475 persons injured. The recurrence of such distressing accidents directs attention forcibly to the fact that competent and experienced employees are not infallible, as it is to be noted in each instance that these accidents were due to the same fundamental cause, namely, fallibility of the human element responsible for the safe operation of trains. Attention has been called to this fact in a number of reports dealing with accidents of a similar character. In this connection attention is called to the following statement contained in the Commission's report covering its investigation of the accident which occurred on this railroad at Westport, Conn:

Wisek prevention is the highest duty of railroads. This obligation is not satisfied by merely making rules which prove insufficient in operation. If the "human element" repeatedly fails, then safety requires that the highest degree of mechanical skill be applied to properly supplement the human element at the particular point of danger.

Respectfully submitted

H W BELNAP,  
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