BOSTON AND MAINE WRECKS

IN RE INVESTIGATION OF AN ACCIDENT WHICH OCCURRED ON THE BOSTON & MAINE RAILROAD AT WOODSVILLE, N.H., ON APRIL 25, 1921.

May 5, 1921.

On April 25, 1921, there was a derailment of a freight train on the Boston & Maine Railroad at Woodsville, N.H., which resulted in the death of 1 employee and the injury of 3 employees. After investigation of this accident the Chief of the Bureau of Safety reports as follows:

Location

This accident occurred on that part of the White Mountains Division extending between Woodsville and Berlin, N.H., a distance of 60.45 miles. This is a single-track line, over which trains are operated by time-table and train orders, no block-signal system being in use. The accident occurred in the yard at Woodsville, about 60 feet north of the yard office. The yard track from which the train involved in this accident was proceeding is tangent; leaving the yard track in a northerly direction there is a curve to the left of 7 degree, 84 feet in length, a curve to the left of 1 degree which is 30.38 feet in length, and a tangent of 13.3 feet, following which the track passes through a double slip-switch on a curve to the left of 15 degrees 02' which is 50.1 feet in length. There is then a tangent of 13.3 feet on which the accident occurred, followed by a curve of 1 degree 12' to the left, 117 feet in length, and about 1,500 feet of tangent. The yard track is practically level to a point about 400 feet south of the point of accident; the grade is then slightly descending for about 300 feet, followed by a long ascending grade which increases gradually until it reaches a maximum of 3.24 per cent at a point about 2,500 feet north of the point of accident.

The track at the northern end of the yard track, and extending through the slips, is laid with 85 pound rails, 33 feet in length; north of the slips, the track is laid with 75-point rails. There is an average of 18 hard pine ties to the rail.-length, ballasted with old cinder ballast. Except under the slips the ties are single-spiked and no tie-plates or rail braces are used; under the slips, tie plates are used and rail braces are also in use opposite the moveable points. The general maintenance of the track in this vicinity as to gauge, surface and alignment is fair. The accident occurred at about 11:28 a.m., at which time the weather was clear.

Description

The train involved in this accident was northbound freight train extra 2359, en route from Woodsville to Berlin, N.H. It consisted of 15 cars and a caboose, hauled by engines 2359 and 2403, was in charge off Conductor Nichols and Enginemen Paine and Lyons, and was being assisted out of the yard by engine 2913 coupled to the rear end. Extra 2359 was departing from the yard and had traveled a distance estimated o have been about 15 car-lengths when the leading engine was derailed at the north frog of the double slip switch.

Engine 2359 came to rest in a practically upright position, at a point about 175 feet north of where the first marks of derailment appeared. The tender came to rest in an upright position at right angles to the engine, with its left forward corner against the rear of the left side of the engine cab. Engine 2403 and the first two cars in the train were also derailed, the engine being slightly damaged. The employee killed was the engineman of engine 2359.

Summary of evidence

The first knowledge Fireman Bisbee, of engine 2359, had of anything wrong was when Engineman Paine made an emergency application of the air brakes; previous to this he had not felt any jar. He thought the pony truck was first to be derailed, but was not positive on this point. Head Brakeman Stanton, who was riding on the left side of engine 2359 felt the engine jump as it left the rails; it was then just north of the slips, and he said the engineman immediately applied the air brakes in emergency.

s attention was first attracted by seeing the leading engine bouncing around but on looking out himself he was unable to see anything wrong. At this time his o... ...as just enteri... ...slips, and he said that it traveled about its own length before the brakes were applied. He ... unus motion of his engine when passing through the slips.

The statements of these employees, as well as those of all the other members of the crew, with the exception of the conductor, indicated that the train had moved from 12 to 15 car-lengths at the time of the accident, while their estimates as to its speed varied from 7 to 13 miles an hour. Conductor Nichols was not with his train, being engaged in obtaining orders at the tower north of the point of accident, and he knew nothing about the facts surrounding its derailment.

General Yardmaster Carr, he was in the yard office first noticed engine 2359 when it was about 35 feet north of the north frog of the slips; and at that time it seemed to be going up and down; he could not tell whether the driving wheels were derailed at this time. He estimated the speed to have been 12 or 15 miles an hour. The statements of the above-mentioned employees indicated that none of them had formed any opinion as to the cause of the accident.

When Enginehouse Foreman Clough examined engine 2359 after the derailment he found nothing which could have contributed to the accident in any way. The engine was last inspected on the morning of April 25, before starting on the trip on which this accident occurred, and the report for that day showed no defects. He also said there were indications that the engine had been running to the right, the right pony truck flange being worn, while slight wear was also evident on the right forward

had been running to the right, the right pony truck flange being worn. While slight wear was also evident on the right forward driving wheel; in neither case had the condemning limit been reached.

Examination of engine 2359 showed that at some previous time the main frame had been binding on the pony truck frame, but this condition had been remedied recently, and there was nothing to indicate that it existed at the time of the accident, Examination of work reports showed nothing had been reported during the preceding week which could have had any relation to the occurrence of this accident. This engine is of the 2-8-0 type, with a rigid wheel base of 17 feet, and according to the specifications on file in the office of the superintendent of motive power of this railroad, was not designed for operation on curves greater than 10 degrees.

Examination of the track showed that the first mark of derailment was a flange mark on the left side of the top of the head of the guard rail on the inside of the left rail opposite the north frog of the slips. This mark began at a point about 22 inches south of the point of the frog and extended diagonally across the head of the guard rail a distance of about 50 inches to the point where it dropped off on the right side. The next mark on this side of the track was a flange mark on the fifth tie north of where the mark last appeared on the guard rail; beginning at this point, flange marks appeared on 5 ties in succession. The next 7 ties were unmarked, then 1 tie was marked, 8 unmarked, 1 marked, 1 unmarked, 1 marked, and the next 2 ties unmarked, following which all of the tier, were marked up to a point about 120 feet north of the first mark; the track was then torn up by the derailed equipment for a distance of about 3 rail-lengths. All of these marks on the inside of the left rail were within 6 or 8 inches of the base of the rail. On the right side of the track there was a deep flange mark on the point of the north frog, this mark being slightly toward the right side of the point; there was also a slight mark nearer the heel of the frog, but it was not definitely determined whether this was made at the time of the accident. North of this point the only marks on the right side of the track south of where it was entirely torn up were at rail joints; the wooden filler block on the outside of the rail at the first joint north of the frog was badly cut on its southern end and the end of the angle bar bent outward, while at the second joint the top of the nut on the second bolt was slightly marked. At the third joint, the inside angle bar was badly scraped, while the inside of the ball of the succeeding rail was also badly scraped and the elongation of the spike holes showed that the rail had been forced outward. This rail was also cracked through from the ball to the base It was not definitely determined whether the marks on this rail and on the third joint were due to the accident or to the re-railing of the equipment after the accident.

No elevation can be given to the curve of 15 degrees through the slips. Measurements made of the gauge and surface beginning about 100 feet south of where the first marks of the derailment appear, showed that there were some variations in gauge, while the right rail was generally slightly lower than the left rail. Observance of the northern end of the slips while trains were passing showed that the ties settled to some extent; some of the spikes had worked upward and there was a somewhat limited up-and-down movement of the rails under passing trains. The drainage is only fair.

According to Section Foreman Camp, no work in the way of tamping, surfacing. or tie renewals had been done at the slips since November, 1920. He had last taken the gauge and level about 2 weeks previously and had inspected the slips 2 days previous to the accident. After the accident he found the frog and guard rail at which the accident occurred to be in good condition, while the gauge and surface were uneven.

Division Engineer Watson and Track Supervisor Brown thought the condition of the track was about what could be expected at this time of the year. Mr. Watson did not think this slip suitable for an engine of the type of engine 2359. While he considered a speed of 10 miles an hour high enough for the operation of trains at this point, the statements of both of these officials indicated that when an engine is operated on a curve of greater degree than that for which it is designed, the question of speed does not make much difference so far as the liability of derailment is concerned, Mr. Brown saying that when the limit of safety in curvature for a particular engine is passed, no speed is safe.

There are no speed restrictions in force at this point, and observation indicates that northbound trains increase their speed rapidly in order to get a run for the heavy grade leaving the yard. In the case of the accident here under investigation, the statements of the various witnesses as to the speed varied from 7 to 15 miles an hour; it is thought the estimate of from 12 to 15 miles an hour made by General Yardmaster Carr is more nearly correct.

The accident here under investigation is the 14th derailment to occur at these slips in a period of 4 years 3 months. Of the previous 13 derailments, 4 involved engines and all of them were of the same type as engine 2359, 1 of these was due to a broken spring hanger, while the other 3 were due to the sharp curve and type of engine.

Conclusions.

This accident was due to the operation around a curve of 15 degrees 02' of an engine which was not designed to be operated around curves of more than 10 degrees.

While the evidence indicates that engine 2359 had been operated in this territory for several months, during which time it had frequently passed through these slips, the fact remains that the operation of an engine where there are curves of a greater degree than that for which it is designed is a source of constant danger and is liable to result in an accident at any time. That this is a constant menace is evident from the number of accidents which have occurred at this point in the past involving engines of the same type. Not only is a dangerous condition always present in the operation of engines of this type at this point, but if anything it is increased by the lack of speed regulations, and the failure to maintain the track in this vicinity in the best possible condition.

All of the employees involved were experienced men and at the time of the accident none of them had been on duty in violation of any of the provisions of the hours of service law.

REPORT OF THE DIRECTOR OF THE BUREAU OF SAFETY IN RE INVESTIGATION OF AN ACCIDENT WHICH OCCURRED ON THE BOSTON & MAINE RAILROAD AT ST. JOHNSBURY, VT., ON SEPTEMBER 23, 1923.

November 3, 1923.

To the Commission:

On September 23, 1923, there was a derailment of a freight train on the Boston and Maine Railroad at St. Johnsbury, Vt., resulting in the death of one employee and the injury of one employee.

Location and method of operation.

This accident occurred on that part of the Passumpsic Division extending between White River Junction, Vt., and Sherbrooke, Que., a distance of 144.26 miles; in the vicinity of the point of accident this is a single-track line over which trains are operated by time-table, train orders, and an automatic block-signal system. The accident occurred at a facing-point switch 2,200 feet south of the station at St. Johnsbury, within yard limits; approaching this point from the south the track is tangent for a considerable distance, followed by a 1-degree curve to the right for a distance of 300 feet to the points of tae switch involved; the turnout at this switch has a curvature of 9 degree. The grade is slightly undulating, being 0.76 per cent ascending for northbound trains at the point of accident. The track in this vicinity is laid with 75 and 85-pound rails, 33 feet in length, with about 19 ties to the rail-length, partly single-spiked and partly double-spiked, and ballasted with gravel and cinders about 2 feet in depth; the track is well maintained. Under the rules, trains using switches to and from main tracks or sidings, must not exceed a speed of 12 miles an hour. The weather was cloudy at the time of the accident which occurred at about 9.55 a.m.

Description.

Northbound third-class freight train No. 9751 consisted of 33 cars and a caboose, hauled by engine 2381, and was in charge of Conductor McEwen and Engineman Keating. This train passed Barnet, 9.62 miles from St. Johnsbury and the last open office, at 9.20 a.m., 2 hours and 59 minutes late and was heading in at the switch at St. Johnsbury when it was derailed while travelling at a speed estimated by the crew to have been between 10 and 15 miles an hour.

Engine 2381 came to rest on its right side, across the track, with its head end 250 feet north of the initial point of derailment. The first three cars and the forward truck of the fourth car were also derailed one car being destroyed. The employee killed was the engineman.

Summary of evidence.

After train No. 9751 whistled for signals approaching St. Johnsbury, Towerman Coakley lined the route, and shortly after it had headed in at the switch he noticed the engine commence to jump up and down, about at the switch frog, at which [redacted] 12 and 15 miles an hour, with the engine working steam. Fireman Scott said [redacted] gineman shut off steam, that no application of the air brakes was made, and that [redacted] me of the derailment; he thought steam was being worked again at the time of the [redacted], but was not positive about it. Head Brakeman Hartshorn thought steam was being worked, estimated the speed at [redacted] and said he felt a jar when entering the switch, and shortly afterwards the engine commenced to jump around. Neither of these employees knew whether or not the engineman made an application of the air brakes at the time of the derailment. Members of the train crew stated the first knowledge they had of anything wrong was when the accident occurred, at which time they estimated the speed not to have been 'in excess of 15 miles an hour. They stated the air brakes worked properly en route, that an previous trips no trouble had been experienced with thin engine in entering this turnout, and that it is customary to work steam at this point. Towerman Coakley, who was on the ground near the point of derailment at the time it occurred, practically corroborated the statements of the other employees as to the engine working steam, and also as to the speed at the time of the derailment.

Inspection disclosed the first marks of derailment to be on the guard rail, 7 inches south of a point directly opposite the point of the frog, and 83 feet north of the switch points; at this point there was a distinct flange mark, commencing on the head of the rail and extending diagonally across the top of the guard rail for a distance of 4.2 feet, then dropping off on the ties and continuing for a distance of 115 feet, beyond which point the track was badly torn up for a considerable distance. The first marks on the west side of the track were flange marks, which appeared on the top and center of the wedge of the frog, commencing at a point 4.6 feet north of the point of frog and continuing along the center to the north end of the wedge; the next mark was a scarring on a spike head, 13.8 feet north of the point of frog, and then the ties on the west side of the rail were marked to where the track was torn up. Measurements of the guage, taken at the point of accident and for some distance south thereof, showed it to be practically standard, while the variation in level was slight and there was no elevation of any consequence.

Engine 2381 is of the 2-8-0 type, class K-7, having a weight on the driving wheels of 148,000 pounds, and a total weight, engine and tender, of 285,000 pounds. This engine had received class 3 repairs in March, 1923, and since then had travelled only 10,000 miles at the time of the accident; the left pony-truck wheel was somewhat worn, but the radius bar, swing center, links and cradle pins were in good condition, and should have provided for proper radial movement without tendency to derail.

Conclusions.

Conclusions.

The cause of this accident was not definitely ascertained.

Careful examination of the engine showed it to have been in good condition, with no defect which could have contributed to the occurrence of the accident. Examination of the track also failed to disclose the presence of anything wrong. While there was practically no elevation on the left rail of the turnout, it being a flat turnout, the guage and alinement were well maintained, and the flangeway at the guard rail was adequate. There was also no conclusive evidence that the accident was due to the train entering the switch at an excessive rate of speed, for while the head end of the engine stopped 250 feet beyond the first mark of derailment, it appeared that only one pair of wheels was derailed for 115 feet of this distance; this would not have had much effect in retarding the speed of the train, and in view of the fact that steam was being worked, and that there is nothing definite to indicate that the engineman applied the air brakes when that pair of wheels first became derailed, it would not seem that the distance travelled after derailment was excessive for a low rate of speed, or that the damage sustained was unusual.

The employees involved were experienced men; at the time of the accident they had been on duty about 5 hours, previous to which they had had from 12 to 13 hours off duty.

Respectfully submitted,

W. P. BORLAND,

Director.

IN RE INVESTIGATION ON AN ACCIDENT WHICH OCCURRED ON THE BOSTON & MAINE AT DUMMERSTON, VT., SEPTEMBER 10, 1918.

February 25, 1919.

On September 10, 1918, there was a read-end collision between a passenger train and a freight train on the Boston & Maine Railroad, at Dummerston, Vt., about 5-1/3 miles north of Brattleboro, Vt., which resulted in the death of 3 passenger and the injury of 25 passengers and 1 employee. The investigation of this accident was conducted jointed by the Bureau of Safety and the Public Service Commission of Vermont; as a result of this investigation the Chief of the Bureau of Safety reports as follows:

The Second District of the Connecticut & Passumpsic Division of the Boston & Maine Railroad a bands between White River Junction Vt., and Springfield, Mass., a distance of 123.18 miles. Between Windsor, Vt., and East Northfield, Mass., the line on which this accident occurred, the track is used jointly by the Boston & Maine and Central Vermont Railroads. It is a signal track line, over which trains are over *** by time table, train orders and an automatic black signal system. The general direction is north and south, the tracks in the vicinity of the accident following the west bank of the Connecticut River.

The signals on *** line are of the two-position, two-one, lower quadrant, normal clear type. Signals are arranged in pairs, the opposing signals being *** about one-half mile apart, with on average distance between *** of signals of a little less than 2 miles, this being the block length for trains waving in the same direction. Preliminary track circuits are used in order to give proper hand-on protection and a signal cannot clear for a following have until the first train has passed the second opposing signal and its preliminary section. Before the distant signal *** can clear, the train must pare still another signal, so that trains running under clear signals are spaced not less than approximately 4 miles apart. On the Boston & Mains Railroad signals are placed about 200 feet into the block, so that the signal goes to stop position before the engine passes it, the "setting point" being indicated by a "block post." Switch indicators are not used, but switch boxed are used to shunt the track circuit at each switch. Rule No 513 requires that a train before passing from aiding to main line must wait a sufficient time after the switch has been tendon to allow a following train to come to a stop before reaching the switch.

Southbound signal 668 is 9,200 feet north of the point of accident and it is 9,250 feet farther to signal ***, which is located about one-half mile mount of *** Station. Signal 652 is about 120 feet south of were the rear and of train No. 12 stood at the time of collision and is *** feet south of the *** switch at Dummerston. From signal *** to signals 629 is a distance of about 11,650 feet and that distance, added to the length of the preliminary section, a total of 13,700 feet, is the distance a train must travel before signal 652 car start to clear.

The signal and trade circuit conditions at Furrier tan siding are such that then the south switch is opened, signal 668, the first automatic signal north of Dummerston station, assumes the stop position. The opening or *** of the south switch had no effect on signal 652. The track circuit is a tended onto the siding as far as the fouling point, about 165 feet north of the switch.

Approach Dummerston from the *** of short cures and tangents, the track *** it's the station being on a tangent. e is a 5 degree curve to the right, 1,500 feet long, followed by a tangent at the d. This 5 degrees curve passes thought a side cut about 70 feet in depth, the or 60 degrees on the right or engineman's side of a southbound train and restri[illegible] his vision t[illegible] 0 feet from the rear of a train standing on the main track after pulling out from I passin[illegible]ding through the south switch.

Beginning at block signal No. 668, and proceeding south the grade is slightly descending for a distance of about *** feet, and then there is slight ascending grade extending to Dummerston passenger station, there the grade is practically level; south of the station there is descending grade of .46% to .25% extending to level track south of the south passing track switch where the collision occurred.

Approximately 3/4 of a mile north Dummerston there *** board restricting speed of southbound trains between the slow board and the south switch to 20 mile per hour. In time-table No. 42 there is also a speed restriction of 20 miles an hour at the south switch.

The trains involved in this accident were southbound first-class passenger train No. 82 and southbound *** train extra 6. Under the current time-table train No. 82 is scheduled to be passe at Brattleboro by train No. 98, the "White Mountain Express." However, on account of construction work in Brattleboro yard, the passing point of these trains was changed from Brattleboro to Dummerston by joint special order No. 1, issured by, the Boston & Maine and Central Vermont Railroads August 8, 1918, to become effective August 11, 1918, no supplement to time-table No. 52 being issured. A copy of this joint special order was delivered to the crews of Nos. 82, 98 and extra 6, and at the time of the accident all members of the crews, excepting the fireman of extra 6, were fully cognizant of the fact that the passing point of Nos. 82 and 98 bad been changed from, Brattleboro to Dummerston.

Train No. 82 consisted of locomotive 3635, 2 baggage care, 1 combination mail and baggage car, 1 smoking car and 2 day coaches, in the order named, all the coaches being of wooden construction; it was en route Newport, Vt., to Springfield. Mass., in charge of Conductor Biggins and Engineman Forgette. This left Newport, Vt.. at 6s25 a.m., passed Putney at 1:34 p.m., 5 minutes late, entered the north end of the siding at Dummerston and arrived at the passenger station at 1:41 p.m., 6 minutes late. After receiving and discharging passengers, the train order signal being clear, the train proceeded to south end of the siding to wait for train No. 98 to pass.

Train No. 99 passed Dummerston at 1:51 p.m., 9 minutes late. When train No. 98 passed the clearing point of signal 652, approximately 2.59 miles south, and the indication of that signal changed from stop to caution, the brakeman of train No. 82 immediately opened the south switch of Dummerston passing siding and train No. 82 proceeded out upon the main line where it stopped with the rear end of the last coach 89 feet south of the switch points, to wait for the brakeman who closed the switch. About the time the signal changed from stop to caution, the flagman of train No. 82 placed a torpedo on the main track at a point about 965 feet north of on the main line. Immediately after train No. 82 had cleared the rear of train No. 82 where it stopped the siding, the brake closed the switch, and just after the switch was closed, train No. 82 was struck from the rear by extra 6, at about 1:56 or 1:58 p.m.

Local freight train extra 6 consisted of locomotive No. 6, 1 loaded box care 1 empty box car and a coach used as a caboose, in the order named, and was an route from Bellows Falls, Vt., to Brattleboro, Vt., in charge of Conductor Sawin and Engineman Webb. It left Bellows Falls at 12:50 p.m., arrived and took siding at Putney, at 1:20 p.m., to permit trains Nos. 82 and 98 to pass; extra 6 then made a switching movements and left Putney at 1:50 p.m. As extra 6 approached signal 686, the indication of that signal changed from caution to clear. When extra No. 6 passed signal 668, which was also in the clear position, it was traveling at a speed considerably in excess of 20 miles an hour and this rate of speed continued to a point near Dummerston station, where the train slowed down slightly. After passing the station the train picked up speed again, and no reduction was made until the explosion of the torpedo placed by the flagman of train No. 82; the brakes were applied in emergency just before the collision occurred.

The force of the collusion caused coach 665, the second coach from the rear in train No. 82, to telescope coach 702, used as a smoking car, for about two-thirds of its length and the two coaches came to rest with coach 665 slightly above coach 702. Nearly all of the killed and injured were taken from the smoking car. Coach 683, the last coach in train No. 82, was also badly damaged.

Conductor Biggins, of train No. 82, Stated that they pulled into the north end of Dummerston siding, arriving there about 5 minutes late. After stopping at the station the train pulled down to the south end of the siding and waited for No. 98 to pass. After leaving Dummerston station the conductor went into the baggage car and he was there when the collision occurred. After No. 98 passed he looked at his watch and it was about 1:50 p.m.; 3 or 4 minutes later the top arm of signal 652 dropped, the head brakeman then opened the switch and their train immediately proceeded out upon the main line. Then they got out on the main line he looked at his watch and it was 1:56. His train had cleared the switch and had just come to a stop when the collision occurred. He did not hear Extra No. 6 approaching and the first he knew of the accident was the shock of collision. He said they had made this move a number of times and it had been their practice to move out of the siding at soon as the top arm of Signal 652 cleared. He had given hie flagmen no particular instructions, but the flagman's practice had been to place a torpedo on the main track about 500 feet north of the switch, a short distance back of the rear of their train anile standing on the siding, and this he did no the day of the accident. He said he knew the requirements of Rule No. 513; he knew that the throwing of the south switch would set signal 668 at shop and he understood that it would also get signal 652 if train No. 98 had not cleared the block.

Engineman Forgette, of train No. 82, stated that he was substituting for another engineman and that was his first trip on this run. He said they pulled into the north siding at Dummerston, set the switch, then pulled up to the station. He said they were at the station 13 or 14 minutes before they started to pull down to the south end, at 1:40 p.m. When they arrived at the mouth switch they stopped about an length north of the fouling point, to wait for No. 98 to pass. About two minutes after No. 98 passed the hand brakeman walked down to the switch, unlocked it and stood watching signal 652 and when the top arm started to drop the brakeman threw the switch and they started right out. He did not think there was an inteval of more than 2 minutes from the time they started to pull out onto the main line until the collission occurred. In pulling out upon the main line he applied the brakes once to slow up, then released them, and made another application when they were at out; he had not released the brakes when the collision occurred. They had just cleared the switch when the fireman yelled to him and he jumped down from his seat. He did not hear the whistle of Extra, 6 nor the explosion of a torpedo. He did not remember that he had been in Dummerston siding before under similar circumstances, but stated that it was his custom to come out of a siding an moon an the switch was thrown. He said he knew the requirements of Rule 513, but had not considered that the rule applied to their movement at Dummerston; he thought 4 or 5 minutes would have been a sufficient length of time for them to have waited after throwing the switch. He said he did not know that throwing the south switch net signal 668, but thought it set the signal ahead of him and that this was the reason the brakeman did not open the switch earlier.

Fireman Guertin of train No. 82 stated that when they had moved down to the south switch at Dummerston and stopped into clear, the engineman was watching the block, the signal cleared, the brakeman threw the switch and it was about 2 minutes from the time the switch was opened until they were ant on the main line. He was watching for a proceed signal from the rear when he saw Extra 6 coming around the curve and jumped just as his engine was coming to a atop. He heard no torpedo explode.

Brakeman Graves, of train No. 82, stated that after No. 98 passed, at 1:50 p.m., he went back, with flag and torpedoes, and at a point about 500 feet from the switch, two car lengths or more north of the rear of his train an it stood on the siding, he placed a torpedo on the rail. At that time there was no sign of the approach of extra 6 and he than started toward the rear of his train. His train had started to move forward before he reached it and he had to run to catch it. He boarded the train, crossed the rear platform and was Just starting to got off at the switch when he heard the explosion of the torpedo. Looking back, he saw Extra 6 approaching around the curve at a speed he estimated at over 30 miles an hour. He yelled to the head brakeman and they both jumped. While he had not been instructed to do so by the conductor, it had been his practice to protect the movement of his train in pulling out of the siding by placing a torpedo on the main track; each time they had made this move he had put down a torpedo at approximately the same point. On the day of the accident, however, he had extra 6 in mind and thinking they would be through with their station work at Putney, he went up the track farther than usual, going back as far as he could to put down the torpedo and allow himself time to get back to the train and close the switch before the train started. He said he intended to put down two torpedoes, but saw the rear of his train moving and did not think he had time to do so.

Head Brakeman Riley, of train No. 82, stated that when his train stopped at the switch at Dummerston he walked back from the engine and stayed opposite the baggage car until No. 98 passed. When the top arm of signal 652 dropped. after the passage of No. 98, he threw the switch for the main line, but did not give the engineman any signal to proceed; he though they were about 2 minutes in pulling out upon the main line. The rear end of his train had just cleared the switch, he had thrown the handled Over and was just about to drop it into place when he hears the brakeman shout and looking back, saw extra approaching at a speed of 30 or 35 miles an hour; he did not think their speed we reduced much, although steam was apparently shut off. He heard no torpedoes or whistle signal. He said he had been instructed by his engineman and conductor to always wait

shut off. He heard no torpedoes or whistle signal. He said he had been instructed by his engineman and conductor to always wait until the top arm of signal 652 dropped before throwing the switch.

Baggageman Hackett, of train No. 82, stated that No. 98 had been by about by about 6 minutes and they were waiting for it to clear the block. The block cleared and after throwing the switch they pulled out on the main line and were almost immediately struck by extra 6. He heard no torpedo nor warning whistle.

Conductor Sawin, of extra 6, stated that he understood No. 98 was to pass No. 82, at Dummerston and assumed that his engineman had the same understanding. He did not look at his watch while at Putney, but asked the operator there regarding these two trains and was informed that both were on time. They departed from Putney at about 1:50 p.m., approximately 7 minutes after No. 98 left. Leaving Putney, as he was entering the caboose, he looked at the signal and noted that it had cleared. He said there was no appreciable reduction of speed at their train approached signal 668 and he did not see that signal as they passed it. Their speed approaching Dummerston station was between 30 and 35 miles as hour; he heard the engineman sound the station whistle and pass the station the engineman slowed down so the conductor could throw off a way-bill there. He estimated they passed the station at about 25 miles an hour and after throwing off the way-bill he went inside the caboose and was making out time reports when the accident occurred. He said they passed, Dummerston at 1:57 p.m.; he did not looks at his watch, but later asked his rear brakeman, who told him. No one called the position of the signals and as the caboose of their train had no cupola, the signals could be observed only by looking out of the window or from the platform and none of the trainman did this. He heard no torpedoes but felt the brakes being applied, followed not more than 20 seconds, afterwards by the shock of collission. The conductor said he did not think they ware traveling, at any excessive rate of speed and he made to effort to check it, as he considered Engineman Webb qualified to regulate the speed. He did not recall the restriction of the speed board located north of Dummerston nor the time-table restriction of speed at the south switch. He said the brakes were all working, as he helped test them and they bed no trouble with them on this trip.

Engineman Webb, of extra 6 stated that after coupling on the train at Putney he applied the brakes. then released then and heard the triple release on the caboose. The next time he had occasion to use the brakes was coming around the curve at Murder Hollow between Putney and Dummerston, then they operated properly, Coming out of Putney and approaching signal 686 he observed that the red arm was down and the yellow arm was up, but the yellow blade started to drop before he passed it. *** fireman called the indication of this signal to him as clear and he acknowledged it. Signal 668 was in the caution position when he first law it, but as they approached the block post the yellow arm started down and had cleared just before lie reached there; after passing the block post and when his engine was about 50 feet distant both arms went up together. *** the signal south of Putney deport to Murder Hollow they did not exceed a speed of 20 miles an hour, but after receiving a clear Indication at signal 669 their speed increased to about 30 or 35 miles an hour and he maintained this speed until he came to the speed board, where he slowed down; he sounded the station whistle signal and after passing the station he increase speed. His train was traveling at a speed of from 25 to 30 miles an hour when, rounding the cure south of the station, at a point about 6 or 7 car lengths from the switch, he ran over a orpede. He immediately closed the throttle but it flew back open and he again closed it; at the same time glancing out the cab window, he saw the rear end of No. 82 and immediately applied the brakes in emergency, but could not stop his train in time to avoid the collission. He stated that his engine brake was in good condition and the train brakes were working satisfactorily. Engineman Webb stated that he was aware the passing point of Nos. 82 and 98 had been changed from Brattleboro to Dummerston; also he was familiar with the speed restriction for freight trains and with the location of the slow beard. He said he had no. 82 in mind, but when he saw signal 668 clear he assumed it was clear he it was No. 82 just leaving the clearing point for block 668. Engineman Webb said he could not deny that he exceeded the speed limit, as he came at a speed faster than that called for.

Fireman Coughlin of extra 6 stated that at Putney the only conversation he had with Engineman Webb was to remark to him that they were waiting for No. 98. He said he usually calls all signals, but as they were leaving Putney he was working on his fire and did not notice the petition of at 686 ver distinctly; he thought it indicated clear and called this indication to hie engineman, who acknowledged it. He got a glimpse of signal 668 as they were approaching it and thought that it also indicated clear and called the indication to the engineman, who waved his hand in acknowledgment. He said he could not state positively about the signal indications. Their speed between Putney and Dummerston was between 30 and 35 miles an hour, but approaching Dummerston station the engineman sounded the whistle, slowed down, and they passed the station at a speed of about 15 or 20 miles an hour, after which speed was again increased to about 35 miles all hour. He got down to put on some coal, heard the whistle, then the engineman called to him to ***. The engineman made an emergency application of the brakes at the same time sounded the whistle and the collision occurred about a half minute after. The fireman did not think the engineman saw the extra more than 30 seconds before the collision and did not think the speed of the train was checked by the brake application. He said the brakes were all right, but the throttle of their engine was not much good and did not hold.

Flagman O'Connor of extra 6 stated that the air brakes were tested at Putney by the conductor, assisted by tale head and middle brakeman and just previous to the collision they took hold in good shape. He estimated their speed from Putney to Dummerston at from 30 to 35 miles an hour. He heard no torpedoes; their speed was about 30 miles an hour when the engineman sounded the whistle and the brakes were applied in emergency.

Read Brakeman Riley of extra 6 stated that he was riding in the caboose and their speed from Putney to Dummerston was 30 or 35 miles an hour. Just after they passed around the curve he heard a torpedo explode, then the brakes were applied in emergency and the collision Followed within half a minute.

Middle Brakeman Jones of extra No. 6 estimated their speed at 30 miles an hour, except passing the station, when the engineman Slowed down. When at a point about 8 telegraph poles from the point of accident he beard a torpedo explode, and estimated their speed when they struck at 25 or 30 miles an hour.

Bridge Foreman St. Croix stated that on the day of the accident he was working on Bridge 60, which is about 200 feet south of signal 668 and was on the east side of the track as extra 6 approached. He said that as the extra came around the curve, which is about 500 or 600 feet from signal 663, the signal was in the stop position and when the train was about at the fouling point the top arm of the signal dropped and then went right up again, while the lower arm stayed up. When the extra passed him it was traveling at a much higher rate of speed than the other trains.

Bridge Carpenters Pennock, Brennan and Hackett corroborated their foreman's testimony and said that extra 6 did not slacken speed as it passed.

Section Foreman Glavin, in charge of Section 19, between Brattleboro and Dummerston, stated that on the day of the accident he was working with three men about half a mile south of the south switch of Dummerston passing siding, right beside signal 647, the northbound signal. He saw the brakeman of train No. 82 set the switch and the train immediately moved out, a little more than 2 minutes from the time No. 98 passed, and came to a stop on the main line with the engine about half way between signal 647 and the south switch. He could near extra *** approaching the other side of Dummerston station and wounded why it did not reduce speed, which he estimated at 30 miles an hour, and the collision followed. He did not remember hearing a whistle sounded, but just an instant before the collision occurred he heard the explosion of a torpedo.

In the investigation of this accident an inspection of all signals involved was made and the relays tested. The switches in the block in which the accident occurred were tested for shunt and found to cut out the track circuit properly. When opened, the mechanisms were found in very good condition and the shunt boxes were clean. The signals worked freely and the clutch coils of signal 668 showed no signs of residual magnetism. The tests made, together with the testimony, justify the conclusion that the signal apparatus was in good working order and did not fail to perform its proper functions at the time of the accident. It is apparent from the evidence in this case that extra 6 passed signal 668 before the south switch of Dummerston siding was opened.

The investigation disclosed a conflict in the testimony regarding the signal indication displayed by signal 668 for Extra 6. The statement of the engineman of that engineman of that train is to the effect that the signal cleared just before his train reached it, and the fireman stated that although he was not certain of the indication displayed he called the signal clear. The members of the bridge gang who were working near were positive in their statements that the top arm of signal 668 cleared as extra 6 approached, and that the signal indicated caution when the train passed the block post. It extra 6 had passed signal 668 after the south switch at Dummerston was opened, that signal would have indicated stop, while if it passed that signal before train No. 98 passed the clearing point for signal 652, signal 668 would indicate caution. In view of the positive and unquestioned evidence that the south switch was opened as soon as the top arm of signal 652 cleared as well as the evidence furnished by members of the bridge gang that signal 668 was in the caution position for extra 6, that train must have passed signal 652, and signal 668 was therefore in the caution position. This conclusion appears to be thoroughly established, Engineman Webb's statement to the contrary notwithstanding.

From tests conducted after the accident, it was found that a train similar to extra 6 on the day of the accident, proceeding at 32.7 miles an hour, could have been brought to a stop within a distance of 600 feet and within 16 seconds after exploding a torpedo placed 965 feet from the rear end of train No. 82 as it stood on the main line. It was also found that, with an engine the same type as was used on extra No. 6 on the day of the accident, looking out of the cab window from the engineman's side, a clear and unobstructed view of the rear of a train as No. 82 steed at the time of accident could be obtained at a point 546 feet north of the point of collision, form which point signal 652 could also be seen distinctly.

The primary cause of this accident was failure of the crew of train No. 82 to wait a sufficient length of time after opening the switch before moving their train from siding to main line, in violation of Rule 513, for which Conductor Briggins and Engineman Forgette are responsible. A contributing cause was the failure of the crew of extra 6 or properly head and comply with signal indications, speed restrictions and torpedo signal, for which Conductor Sawin and Engineman Webb of that train are responsible.

Rule No. 513, of Rules for Government of the Operating Department of this read, reads as follows:

> "Trains about to enter a track protected by block signals, after the switch has been opened which will cause the automatic signal to indicate Stop, will not enter the main truck until sufficient time has elapsed to allow a train, that may have passed or be approaching the signal, to come to a stop before reaching the switch."

In conformity with this rule, it was the duty of the crew of train No. 82 before proceeding out upon the main line to leave the switch open for a sufficient length of time for the extra to have proceeded from signal 668 to the south switch.

The testimony given at the investigation indicates that subsequently to August 11th, up to the day of the accident it has been the practice of the crew of No. 82 to throw the switch and pull out upon the main line the moment the home blade or top arm of signal 652 began to lower, which was clearly in direct conflict with Rule 513. Instead of waiting for the top blade of signal 652 to clear after the passage of No. 98 before the south switch was open, had the south switch been opened as soon as train No. 98 passed, signal 668 would not have cleared and the accident would undoubtedly have been averted; further, after the switch was opened, had train No. 82 waited a sufficient time, as required by rule, the accident would not have occurred. The testimony in this case indicates that it was the practice of the crew in charge of train 82 to disregard this rule, and discloses the necessity for more specific instruction and thorough examination of employee in regard to rules and their duties.

The indication of signal 668, as extra No. 6 passed it, being caution, it was the duty of Engineman Webb to "proceed, prepared to stop at next home signal," according to Rule 501. Signal 652 was only about 120 feet south of the rear of train No. 82 as it stood at the time of the collision, and it is apparent from all the facts and circumstances that had Engineman Webb complied with this rule, he would no doubt have been able to stop his train in time to avoid the collision. An examination of the throttle lever and quadrant subsequent to the accident of disclosed that they were in good condition. It is apparent from the evidence that Engineman Webb not only disregarded the caution indication of signal 668, but failed to regard the speed limit as indicated by the speed board located north of Dummerston failed to comply with special time-table speed restrictions, and failed to act promptly in reducing the speed of his train after exploding the torpedo placed by the flagmen of train No. 82. Conductor Sawin is responsible in that he failed to take any action to cause a reduction in train speed which he knew was in excess of the maximum speed permitted or authorized by rule.

At the investigation it was found that the brakes on extra No. 6 were in good condition and had the rules been complied with by those in charge of this train the collision would have been averted.

Fireman Coughlin is also at fault, on the basis of his own testimony for calling both signals 686 and 668 clear when as he stated he was not certain of the indications of those signals. While it may have been no bearing in this case, such practice is to say the least misleading.

While a contributing cause of this accident was the disregard of the caution indication of signal 668 by engineman Webb, that rule of the Boston & Maine Railroad governing the obervance of the caution indication, reading "Proceed, prepared

to stop at next home signal," leads directly to a minimizing of the value of the caution indication. This rule permits the engineman to use his Judgment as to when he shall begin to reduce speed in anticipation of a possible stop at the next signal. The danger in this interpretation of the caution indication has been pointed out in previous reports of accidents investigated by this Bureau. The interests of safety demand such modification of this rule as will cause the caution indication to be recognized as being as positive in its indication and requiring as definite action on the part of the engine as does the stop indication.

Conductor Sawin entered the service in 1981, was promoted to conductor in 1885 and had been on this run about one month. He had received 20 demerit marks for responsibility on the occasion of a previous collision and reprimanded once for a careless switching movement.

Engineman Webb entered the service as fireman in February 1905, was promoted to engineman in February 1912. This was not his regular run, but he had been on it about two weeks. He had been discharged once for running his train, which was an extra, on the time of a regular train and on four occasions had received demerit markes for running past signals.

Conductor Briggins entered the service in August, 1888, and had been a passenger Conductor since May, 1910. He had been on this run since February. His record showed that he was reprimanded once for failure to obtain a clearance card and on two occasions had failed to properly read train orders, being once penalized for this oversight, and once reprimanded for failure to register a signal.

Engineman Forgette entered the service as fireman in November, 1903, was promoted to engineman in July, 1911, and had a fair record. On the day of the accident he was making his second trip on this particular run.

At the time of the accident the crew of extra No. 6 had been on duty about 6 hours, with a period off duty of about 16 hours. Engineman Forgette and Fireman Guertin, of train No. 82, had been on duty almost 4 hours, the remainder of the crew about 3 hours, all having had over 20 hours rest.

RWL.

IN RE INVESTIGATION ON AN ACCIDENT WHICH OCCURRED ON THE BOSTON & MAINE AT DUMMERSTON, VT., SEPTEMBER 10, 1918.

February 25, 1919.

On September 10, 1918, there was a read-end collision between a passenger train and a freight train on the Boston & Maine Railroad, at Dummerston, Vt., about 5-1/3 miles north of Brattleboro, Vt., which resulted in the death of 3 passenger and the injury of 25 passengers and 1 employee. The investigation of this accident was conducted jointed by the Bureau of Safety and the Public Service Commission of Vermont; as a result of this investigation the Chief of the Bureau of Safety reports as follows:

The Second District of the Connecticut & Passumpsic Division of the Boston & Maine Railroad a bands between White River Junction Vt., and Springfield, Mass., a distance of 123.18 miles. Between Windsor, Vt., and East Northfield, Mass., the line on which this accident occurred, the track is used jointly by the Boston & Maine and Central Vermont Railroads. It is a signal track line, over which trains are over *** by time table, train orders and an automatic black signal system. The general direction is north and south, the tracks in the vicinity of the accident following the west bank of the Connecticut River.

The signals on *** line are of the two-position, two-one, lower quadrant, normal clear type. Signals are arranged in pairs, the opposing signals being *** about one-half mile apart, with on average distance between *** of signals of a little less than 2 miles, this being the block length for trains waving in the same direction. Preliminary track circuits are used in order to give proper hand-on protection and a signal cannot clear for a following have until the first train has passed the second opposing signal and its preliminary section. Before the distant signal *** can clear, the train must pare still another signal, so that trains running under clear signals are spaced not less than approximately 4 miles apart. On the Boston & Mains Railroad signals are placed about 200 feet into the block, so that the signal goes to stop position before the engine passes it, the "setting point" being indicated by a "block post." Switch indicators are not used, but switch boxed are used to shunt the track circuit at each switch. Rule No 513 requires that a train before passing from aiding to main line must wait a sufficient time after the switch has been tendon to allow a following train to come to a stop before reaching the switch.

Southbound signal 668 is 9,200 feet north of the point of accident and it is 9,250 feet farther to signal ***, which is located about one-half mile mount of *** Station. Signal 652 is about 120 feet south of were the rear and of train No. 12 stood at the time of collision and is *** feet south of the *** switch at Dummerston. From signal *** to signals 629 is a distance of about 11,650 feet and that distance, added to the length of the preliminary section, a total of 13,700 feet, is the distance a train must travel before signal 652 car start to clear.

The signal and trade circuit conditions at Furrier tan siding are such that then the south switch is opened, signal 668, the first automatic signal north of Dummerston station, assumes the stop position. The opening or *** of the south switch had no effect on signal 652. The track circuit is a tended onto the siding as far as the fouling point, about 165 feet north of the switch.

Approach Dummerston from the *** of short cures and tangents, the track *** it's the station being on a tangent. e is a 5 degree curve to the right, 1,500 feet long, followed by a tangent at the d. This 5 degrees curve passes thought a side cut about 70 feet in depth, the or 60 degrees on the right or engineman's side of a southbound train and restri iis vision t 1 ic 0 feet from the rear of a train standing on the main track after pulling out from I passin; 3ing through the south switch.

Beginning at block signal No. 668, and proceeding south the grade is slightly descending for a distance of about *** feet, and then there is slight ascending grade extending to Dummerston passenger station, there the grade is practically level; south of the station there is descending grade of .46% to .25% extending to level track south of the south passing track switch where the collision occurred.

Approximately 3/4 of a mile north Dummerston there *** board restricting speed of southbound trains between the slow board and the south switch to 20 mile per hour. In time-table No. 42 there is also a speed restriction of 20 miles an hour at the south switch.

The trains involved in this accident were southbound first-class passenger train No. 82 and southbound *** train extra 6. Under the current time-table train No. 82 is scheduled to be passe at Brattleboro by train No. 98, the "White Mountain Express." However, on account of construction work in Brattleboro yard, the passing point of these trains was changed from Brattleboro to Dummerston by joint special order No. 1, issured by, the Boston & Maine and Central Vermont Railroads August 8, 1918, to become effective August 11, 1918, no supplement to time-table No. 52 being issured. A copy of this joint special order was delivered to the crews of Nos. 82, 98 and extra 6, and at the time of the accident all members of the crews, excepting the fireman of extra 6, were fully cognizant of the fact that the passing point of Nos. 82 and 98 bad been changed from, Brattleboro to Dummerston.

Train No. 82 consisted of locomotive 3635, 2 baggage care, 1 combination mail and baggage car, 1 smoking car and 2 day coaches, in the order named, all the coaches being of wooden construction; it was on route Newport, Vt., to Springfield. Mass., in charge of Conductor Biggins and Engineman Forgette. This left Newport, Vt.. at 6s25 a.m., passed Putney at 1:34 p.m., 5 minutes late, entered the north end of the siding at Dummerston and arrived at the passenger station at 1:41 p.m., 6 minutes late. After receiving and discharging passengers, the train order signal being clear, the train proceeded to south end of the siding to wait for train No. 98 to pass.

Train No. 99 passed Dummerston at 1:51 p.m., 9 minutes late. When train No. 98 passed the clearing point of signal 652, approximately 2.59 miles south, and the indication of that signal changed from stop to caution, the brakeman of train No. 82 immediately opened the south switch of Dummerston passing siding and train No. 82 proceeded out upon the main line where it stopped with the rear end of the last coach 89 feet south of the switch points, to wait for the brakeman who closed the switch. About the time the signal changed from stop to caution, the flagman of train No. 82 placed a torpedo on the main track at a point about 965 feet north of on the main line. Immediately after train No. 82 had cleared the rear of train No. 82 where it stopped the siding, the brake closed the switch, and just after the switch was closed, train No. 82 was struck from the rear by extra 6, at about 1:56 or 1:58 p.m.

Local freight train extra 6 consisted of locomotive No. 6, 1 loaded box care 1 empty box car and a coach used as a caboose, in the order named, and was an route from Bellows Falls, Vt., to Brattleboro, Vt., in charge of Conductor Sawin and Engineman Webb. It left Bellows Falls at 12:50 p.m., arrived and took siding at Putney, at 1:20 p.m., to permit trains Nos. 82 and 98 to pass; extra 6 then made a switching movements and left Putney at 1:50 p.m. As extra 6 approached signal 686, the indication of that signal changed from caution to clear. When extra No. 6 passed signal 668, which was also in the clear position, it was traveling at a speed considerably in excess of 20 miles an hour and this rate of speed continued to a point near Dummerston station, where the train slowed down slightly. After passing the station the train picked up speed again, and no reduction was made until the explosion of the torpedo placed by the flagman of train No. 82; the brakes were applied in emergency just before the collision occurred.

The force of the collusion caused coach 665, the second coach from the rear in train No. 82, to telescope coach 702, used as a smoking car, for about two-thirds of its length and the two coaches came to rest with coach 665 slightly above coach 702. Nearly all of the killed and injured were taken from the smoking car. Coach 683, the last coach in train No. 82, was also badly damaged.

Conductor Biggins, of train No. 82, Stated that they pulled into the north end of Dummerston siding, arriving there about 5 minutes late. After stopping at the station the train pulled down to the south end of the siding and waited for No. 98 to pass. After leaving Dummerston station the conductor went into the baggage car and he was there when the collision occurred. After No. 98 passed he looked at his watch and it was about 1:50 p.m.; 3 or 4 minutes later the top arm of signal 652 dropped, the head brakeman then opened the switch and their train immediately proceeded out upon the main line. Then they got out on the main line he looked at his watch and it was 1:56. His train had cleared the switch and had just come to a stop when the collision occurred. He did not hear Extra No. 6 approaching and the first he knew of the accident was the shock of collision. He said they had made this move a number of times and it had been their practice to move out of the siding at soon as the top arm of Signal 652 cleared. He had given hie flagmen no particular instructions, but the flagman's practice had been to place a torpedo on the main track about 500 feet north of the switch, a short distance back of the rear of their train anile standing on the siding, and this he did no the day of the accident. He said he knew the requirements of Rule No. 513; he knew that the throwing of the south switch would set signal 668 at shop and he understood that it would also get signal 652 if train No. 98 had not cleared the block.

Engineman Forgette, of train No. 82, stated that he was substituting for another engineman and that was his first trip on this run. He said they pulled into the north siding at Dummerston, set the switch, then pulled up to the station. He said they were at the station 13 or 14 minutes before they started to pull down to the south end, at 1:40 p.m. When they arrived at the mouth switch they stopped about an length north of the fouling point, to wait for No. 98 to pass. About two minutes after No. 98 passed the hand brakeman walked down to the switch, unlocked it and stood watching signal 652 and when the top arm started to drop the brakeman threw the switch and they started right out. He did not think there was an inteval of more than 2 minutes from the time they started to pull out onto the main line until the collission occurred. In pulling out upon the main line he applied the brakes once to slow up, then released them, and made another application when they were at out; he had not released the brakes when the collision occurred. They had just cleared the switch when the fireman yelled to him and he jumped down from his seat. He did not hear the whistle of Extra, 6 nor the explosion of a torpedo. He did not remember that he had been in Dummerston siding before under similar circumstances, but stated that it was his custom to come out of a siding an moon an the switch was thrown. He said he knew the requirements of Rule 513, but had not considered that the rule applied to their movement at Dummerston; he thought 4 or 5 minutes would have been a sufficient length of time for them to have waited after throwing the switch. He said he did not know that throwing the south switch net signal 668, but thought it set the signal ahead of him and that this was the reason the brakeman did not open the switch earlier.

Fireman Guertin of train No. 82 stated that when they had moved down to the south switch at Dummerston and stopped into clear, the engineman was watching the block, the signal cleared, the brakeman threw the switch and it was about 2 minutes from the time the switch was opened until they were ant on the main line. He was watching for a proceed signal from the rear when he saw Extra 6 coming around the curve and jumped just as his engine was coming to a atop. He heard no torpedo explode.

Brakeman Graves, of train No. 82, stated that after No. 98 passed, at 1:50 p.m., he went back, with flag and torpedoes, and at a point about 500 feet from the switch, two car lengths or more north of the rear of his train an it stood on the siding, he placed a torpedo on the rail. At that time there was no sign of the approach of extra 6 and he than started toward the rear of his train. His train had started to move forward before he reached it and he had to run to catch it. He boarded the train, crossed the rear platform and was Just starting to got off at the switch when he heard the explosion of the torpedo. Looking back, he saw Extra 6 approaching around the curve at a speed he estimated at over 30 miles an hour. He yelled to the head brakeman and they both jumped. While he had not been instructed to do so by the conductor, it had been his practice to protect the movement of his train in pulling out of the siding by placing a torpedo on the main track; each time they had made this move he had put down a torpedo at approximately the same point. On the day of the accident, however, he had extra 6 in mind and thinking they would be through with their station work at Putney, he went up the track farther than usual, going back as far as he could to put down the torpedo and allow himself time to get back to the train and close the switch before the train started. He said he intended to put down two torpedoes, but saw the rear of his train moving and did not think he had time to do so.

Head Brakeman Riley, of train No. 82, stated that when his train stopped at the switch at Dummerston he walked back from the engine and stayed opposite the baggage car until No. 98 passed. When the top arm of signal 652 dropped. after the passage of No. 98, he threw the switch for the main line, but did not give the engineman any signal to proceed; he though they were about 2 minutes in pulling out upon the main line. The rear end of his train had just cleared the switch, he had thrown the handled Over and was just about to drop it into place when he hears the brakeman shout and looking back, saw extra approaching at a speed of 30 or 35 miles an hour; he did not think their speed we reduced much, although steam was apparently shut off. He heard no torpedoes or whistle signal. He said he had been instructed by his engineman and conductor to always wait

IN RE INVESTIGATION OF AN ACCIDENT WHICH OCCURRED ON THE BOSTON & MAINE RAILROAD AT WOODSVILLE, N.H., ON APRIL 25, 1921.

May 5, 1921.

On April 25, 1921, there was a derailment of a freight train on the Boston & Maine Railroad at Woodsville, N.H., which resulted in the death of 1 employee and the injury of 3 employees. After investigation of this accident the Chief of the Bureau of Safety reports as follows:

Location

This accident occurred on that part of the White Mountains Division extending between Woodsville and Berlin, N.H., a distance of 60.45 miles. This is a single-track line, over which trains are operated by time-table and train orders, no block-signal system being in use. The accident occurred in the yard at Woodsville, about 60 feet north of the yard office. The yard track from which the train involved in this accident was proceeding is tangent; leaving the yard track in a northerly direction there is a curve to the left of 7 degree, 84 feet in length, a curve to the left of 1 degree which is 30.38 feet in length, and a tangent of 13.3 feet, following which the track passes through a double slip-switch on a curve to the left of 15 degrees 02' which is 50.1 feet in length. There is then a tangent of 13.3 feet on which the accident occurred, followed by a curve of 1 degree 12' to the left, 117 feet in length, and about 1,500 feet of tangent. The yard track is practically level to a point about 400 feet south of the point of accident; the grade is then slightly descending for about 300 feet, followed by a long ascending grade which increases gradually until it reaches a maximum of 3.24 per cent at a point about 2,500 feet north of the point of accident.

The track at the northern end of the yard track, and extending through the slips, is laid with 85 pound rails, 33 feet in length; north of the slips, the track is laid with 75-point rails. There is an average of 18 hard pine ties to the rail.-length, ballasted with old cinder ballast. Except under the slips the ties are single-spiked and no tie-plates or rail braces are used; under the slips, tie plates are used and rail braces are also in use opposite the moveable points. The general maintenance of the track in this vicinity as to gauge, surface and alignment is fair. The accident occurred at about 11:28 a.m., at which time the weather was clear.

Description

The train involved in this accident was northbound freight train extra 2359, en route from Woodsville to Berlin, N.H. It consisted of 15 cars and a caboose, hauled by engines 2359 and 2403, was in charge off Conductor Nichols and Enginemen Paine and Lyons, and was being assisted out of the yard by engine 2913 coupled to the rear end. Extra 2359 was departing from the yard and had traveled a distance estimated o have been about 15 car-lengths when the leading engine was derailed at the north frog of the double slip switch.

Engine 2359 came to rest in a practically upright position, at a point about 175 feet north of where the first marks of derailment appeared. The tender came to rest in an upright position at right angles to the engine, with its left forward corner against the rear of the left side of the engine cab. Engine 2403 and the first two cars in the train were also derailed, the engine being slightly damaged. The employee killed was the engineman of engine 2359.

Summary of evidence

The first knowledge Fireman Bisbee, of engine 2359, had of anything wrong was when Engineman Paine made an emergency application of the air brakes; previous to this he had not felt any jar. He thought the pony truck was first to be derailed, but was not positive on this point. Head Brakeman Stanton, who was riding on the left side of engine 2359 felt the engine jump as it left the rails; it was then just north of the slips, and he said the engineman immediately applied the air brakes in emergency.

Engineman Lyons, of engine 2403, said his attention was first attracted by seeing the leading engine bouncing around and Engineman Paine looking out of the window, but on looking out himself he was unable to see anything wrong. At this time his own engine was just entering the slips, and he said that it traveled about its own length before the brakes were applied. He had noticed no unusual motion of his engine when passing through the slips.

The statements of these employees, as well as those of all the other members of the crew, with the exception of the conductor, indicated that the train had moved from 12 to 15 car-lengths at the time of the accident, while their estimates as to its speed varied from 7 to 13 miles an hour. Conductor Nichols was not with his train, being engaged in obtaining orders at the tower north of the point of accident, and he knew nothing about the facts surrounding its derailment.

General Yardmaster Carr, he was in the yard office first noticed engine 2359 when it was about 35 feet north of the north frog of the slips; and at that time it seemed to be going up and down; he could not tell whether the driving wheels were derailed at this time. He estimated the speed to have been 12 or 15 miles an hour. The statements of the above-mentioned employees indicated that none of them had formed any opinion as to the cause of the accident.

When Enginehouse Foreman Clough examined engine 2359 after the derailment he found nothing which could have
e was last inspected on the morning of April 25, before starting on the trip on
at day showed no defects. He also said there were indications that the engine
flange being worn, while slight wear was also evident on the right forward

driving wheel; the flange being worn. While slight wear was also evident on the right forward [illegible] emning limit been reached.

[illegible]nation of engine 2359 showed that at some previous time the main frame had been binding on the pony truck frame, but this condition had been remedied recently, and there was nothing to indicate that it existed at the time of the accident, Examination of work reports showed nothing had been reported during the preceding week which could have had any relation to the occurrence of this accident. This engine is of the 2-8-0 type, with a rigid wheel base of 17 feet, and according to the specifications on file in the office of the superintendent of motive power of this railroad, was not designed for operation on curves greater than 10 degrees.

Examination of the track showed that the first mark of derailment was a flange mark on the left side of the top of the head of the guard rail on the inside of the left rail opposite the north frog of the slips. This mark began at a point about 22 inches south of the point of the frog and extended diagonally across the head of the guard rail a distance of about 50 inches to the point where it dropped off on the right side. The next mark on this side of the track was a flange mark on the fifth tie north of where the mark last appeared on the guard rail; beginning at this point, flange marks appeared on 5 ties in succession. The next 7 ties were unmarked, then 1 tie was marked, 8 unmarked, 1 marked, 1 unmarked, 1 marked, and the next 2 ties unmarked, following which all of the tier, were marked up to a point about 120 feet north of the first mark; the track was then torn up by the derailed equipment for a distance of about 3 rail-lengths. All of these marks on the inside of the left rail were within 6 or 8 inches of the base of the rail. On the right side of the track there was a deep flange mark on the point of the north frog, this mark being slightly toward the right side of the point; there was also a slight mark nearer the heel of the frog, but it was not definitely determined whether this was made at the time of the accident. North of this point the only marks on the right side of the track south of where it was entirely torn up were at rail joints; the wooden filler block on the outside of the rail at the first joint north of the frog was badly cut on its southern end and the end of the angle bar bent outward, while at the second joint the top of the nut on the second bolt was slightly marked. At the third joint, the inside angle bar was badly scraped, while the inside of the ball of the succeeding rail was also badly scraped and the elongation of the spike holes showed that the rail had been forced outward. This rail was also cracked through from the ball to the base It was not definitely determined whether the marks on this rail and on the third joint were due to the accident or to the re-railing of the equipment after the accident.

No elevation can be given to the curve of 15 degrees through the slips. Measurements made of the gauge and surface beginning about 100 feet south of where the first marks of the derailment appear, showed that there were some variations in gauge, while the right rail was generally slightly lower than the left rail. Observance of the northern end of the slips while trains were passing showed that the ties settled to some extent; some of the spikes had worked upward and there was a somewhat limited up-and-down movement of the rails under passing trains. The drainage is only fair.

According to Section Foreman Camp, no work in the way of tamping, surfacing. or tie renewals had been done at the slips since November, 1920. He had last taken the gauge and level about 2 weeks previously and had inspected the slips 2 days previous to the accident. After the accident he found the frog and guard rail at which the accident occurred to be in good condition, while the gauge and surface were uneven.

Division Engineer Watson and Track Supervisor Brown thought the condition of the track was about what could be expected at this time of the year. Mr. Watson did not think this slip suitable for an engine of the type of engine 2359. While he considered a speed of 10 miles an hour high enough for the operation of trains at this point, the statements of both of these officials indicated that when an engine is operated on a curve of greater degree than that for which it is designed, the question of speed does not make much difference so far as the liability of derailment is concerned, Mr. Brown saying that when the limit of safety in curvature for a particular engine is passed, no speed is safe.

There are no speed restrictions in force at this point, and observation indicates that northbound trains increase their speed rapidly in order to get a run for the heavy grade leaving the yard. In the case of the accident here under investigation, the statements of the various witnesses as to the speed varied from 7 to 15 miles an hour; it is thought the estimate of from 12 to 15 miles an hour made by General Yardmaster Carr is more nearly correct.

The accident here under investigation is the 14th derailment to occur at these slips in a period of 4 years 3 months. Of the previous 13 derailments, 4 involved engines and all of them were of the same type as engine 2359, 1 of these was due to a broken spring hanger, while the other 3 were due to the sharp curve and type of engine.

Conclusions.

This accident was due to the operation around a curve of 15 degrees 02' of an engine which was not designed to be operated around curves of more than 10 degrees.

While the evidence indicates that engine 2359 had been operated in this territory for several months, during which time it had frequently passed through these slips, the fact remains that the operation of an engine where there are curves of a greater degree than that for which it is designed is a source of constant danger and is liable to result in an accident at any time. That this is a constant menace is evident from the number of accidents which have occurred at this point in the past involving engines of the same type. Not only is a dangerous condition always present in the operation of engines of this type at this point, but if anything it is increased by the lack of speed regulations, and the failure to maintain the track in this vicinity in the best possible condition.

All of the employees involved were experienced men and at the time of the accident none of them had been on duty in violation of any of the provisions of the hours of service law.

REPORT OF THE DIRECTOR OF THE BUREAU OF SAFETY IN RE INVESTIGATION OF AN ACCIDENT WHICH OCCURRED ON THE BOSTON & MAINE RAILROAD AT ST. JOHNSBURY, VT., ON SEPTEMBER 23, 1923.

November 3, 1923.

To the Commission:

On September 23, 1923, there was a derailment of a freight train on the Boston and Maine Railroad at St. Johnsbury, Vt., resulting in the death of one employee and the injury of one employee.

Location and method of operation.

This accident occurred on that part of the Passumpsic Division extending between White River Junction, Vt., and Sherbrooke, Que., a distance of 144.26 miles; in the vicinity of the point of accident this is a single-track line over which trains are operated by time-table, train orders, and an automatic block-signal system. The accident occurred at a facing-point switch 2,200 feet south of the station at St. Johnsbury, within yard limits; approaching this point from the south the track is tangent for a considerable distance, followed by a 1-degree curve to the right for a distance of 300 feet to the points of tae switch involved; the turnout at this switch has a curvature of 9 degree. The grade is slightly undulating, being 0.76 per cent ascending for northbound trains at the point of accident. The track in this vicinity is laid with 75 and 85-pound rails, 33 feet in length, with about 19 ties to the rail-length, partly single-spiked and partly double-spiked, and ballasted with gravel and cinders about 2 feet in depth; the track is well maintained. Under the rules, trains using switches to and from main tracks or sidings, must not exceed a speed of 12 miles an hour. The weather was cloudy at the time of the accident which occurred at about 9.55 a.m.

Description.

Northbound third-class freight train No. 9751 consisted of 33 cars and a caboose, hauled by engine 2381, and was in charge of Conductor McEwen and Engineman Keating. This train passed Barnet, 9.62 miles from St. Johnsbury and the last open office, at 9.20 a.m., 2 hours and 59 minutes late and was heading in at the switch at St. Johnsbury when it was derailed while travelling at a speed estimated by the crew to have been between 10 and 15 miles an hour.

Engine 2381 came to rest on its right side, across the track, with its head end 250 feet north of the initial point of derailment. The first three cars and the forward truck of the fourth car were also derailed one car being destroyed. The employee killed was the engineman.

Summary of evidence.

After train No. 9751 whistled for signals approaching St. Johnsbury, Towerman Coakley lined the route, and shortly after it had headed in at the switch he noticed the engine commence to jump up and down, about at the switch frog, at which [redacted] 12 and 15 miles an hour, with the engine working steam. Fireman Scott said [redacted] gineman shut off steam, that no application of the air brakes was made, and [redacted] ime of the derailment; he thought steam was being worked again at the time of the document, but was not positive about it. Head Brakeman Hartshorn thought steam was being worked, estimated the speed at [redacted] and said he felt a jar when entering the switch, and shortly afterwards the engine commenced to jump around. Neither of these employees knew whether or not the engineman made an application of the air brakes at the time of the derailment. Members of the train crew stated the first knowledge they had of anything wrong was when the accident occurred, at which time they estimated the speed not to have been 'in excess of 15 miles an hour. They stated the air brakes worked properly en route, that an previous trips no trouble had been experienced with thin engine in entering this turnout, and that it is customary to work steam at this point. Towerman Coakley, who was on the ground near the point of derailment at the time it occurred, practically corroborated the statements of the other employees as to the engine working steam, and also as to the speed at the time of the derailment.

Inspection disclosed the first marks of derailment to be on the guard rail, 7 inches south of a point directly opposite the point of the frog, and 83 feet north of the switch points; at this point there was a distinct flange mark, commencing on the head of the rail and extending diagonally across the top of the guard rail for a distance of 4.2 feet, then dropping off on the ties and continuing for a distance of 115 feet, beyond which point the track was badly torn up for a considerable distance. The first marks on the west side of the track were flange marks, which appeared on the top and center of the wedge of the frog, commencing at a point 4.6 feet north of the point of frog and continuing along the center to the north end of the wedge; the next mark was a scarring on a spike head, 13.8 feet north of the point of frog, and then the ties on the west side of the rail were marked to where the track was torn up. Measurements of the guage, taken at the point of accident and for some distance south thereof, showed it to be practically standard, while the variation in level was slight and there was no elevation of any consequence.

Engine 2381 is of the 2-8-0 type, class K-7, having a weight on the driving wheels of 148,000 pounds, and a total weight, engine and tender, of 285,000 pounds. This engine had received class 3 repairs in March, 1923, and since then had travelled only 10,000 miles at the time of the accident; the left pony-truck wheel was somewhat worn, but the radius bar, swing center, links and cradle pins were in good condition, and should have provided for proper radial movement without tendency to derail.

Conclusions.

Conclusions.

The cause of this accident was not definitely ascertained.

Careful examination of the engine showed it to have been in good condition, with no defect which could have contributed to the occurrence of the accident. Examination of the track also failed to disclose the presence of anything wrong. While there was practically no elevation on the left rail of the turnout, it being a flat turnout, the guage and alinement were well maintained, and the flangeway at the guard rail was adequate. There was also no conclusive evidence that the accident was due to the train entering the switch at an excessive rate of speed, for while the head end of the engine stopped 250 feet beyond the first mark of derailment, it appeared that only one pair of wheels was derailed for 115 feet of this distance; this would not have had much effect in retarding the speed of the train, and in view of the fact that steam was being worked, and that there is nothing definite to indicate that the engineman applied the air brakes when that pair of wheels first became derailed, it would not seem that the distance travelled after derailment was excessive for a low rate of speed, or that the damage sustained was unusual.

The employees involved were experienced men; at the time of the accident they had been on duty about 5 hours, previous to which they had had from 12 to 13 hours off duty.

Respectfully submitted,

W. P. BORLAND,

Director.

INTERSTATE COMMERCE COMMISSION

REPORT OF THE DIRECTOR OF THE BUREAU OF SAFETY IN RE INVESTIGATION OF AN ACCIDENT WHICH OCCURRED ON THE BOSTON & MAINE RAILROAD AT BALLOCH, N. H., ON FEBRUARY 13, 1928

JUNE 22, 1928.

To the Commission:

On February 13, 1928, there was a derailment of a freight train on the Boston & Maine Railroad at Balloch, N. H., resulting in the death of three employees and one trespasser, and the injury of one employee.

LOCATION AND METHOD OF OPERATION

This accident occurred on that part of the Connecticut River Division extending between Springfield, Mass., and Windsor, Vt., a distance of 109.11 miles. In the vicinity of the point of accident this is a single-track line over which trains are operated by timetable, train orders, and an automatic block-signal system. Balloch is 3.47 miles south of Windsor. The initial mark of derailment appeared at a public road crossing at grade located about 5,870 feet south of Balloch station, while the final derailment occurred opposite the station. Approaching the point of accident from the south the track is tangent and the grade is practically level. The track is laid with 85-pound rails, 33 feet in length, with an average of 19 ties to the rail length, and is ballasted with gravel and cinders. The track is well maintained. There is a passing track just south of the station, on the west side of the main track.

The weather was clear at the time of the accident, which occurred at about 12.50 p.m.

DESCRIPTION

Northbound freight train extra 2607 consisted of 33 cars and a caboose, hauled by engine 2607, and was in charge of Conductor Lamoureaux and Engineman St. Marie. This train left Claremont Junction, 4.46 miles south of Balloch, at 12.38 p. m., and while traveling at a speed estimated to have been about 35 miles per hour was derailed on account of the breaking of the lower arch bar on the left side of the rear truck of the twelfth car behind the engine, Westmoreland Coal Co. car 1543.

The first portion of the train, including the forward truck of the twelfth car, was not derailed, but the rear truck of the twelfth car was derailed and forced the west rail out of line near the north switch of the passing track, at a point about 300 feet south of the station. The coupling broke between the twelfth and thirteenth cars, and all of the cars in the rear of the twelfth car, with the exception of the forward track of the last or thirty-third car and the caboose, were derailed and scattered about at various angles to the track. The seventeenth to the twenty-first cars, inclusive, were thrown to the west against the station building, which [redacted] tove located in the station caused the wreckage to ignite, the flames entirely [redacted] ainst it. Those killed and injured were section men, together with one highway [redacted] he accident, having just finished their noon meal.

SUMMARY OF EVIDENCE

None of the members of the crew was aware of anything wrong prior to the accident. Engineman St. Marie, said that on looking back he saw a number of cars being derailed and that, he, therefore placed the brake valve in full release and opened the throttle in order to keep the forward portion of the train clear of the wreckage, this part of the train finally being brought to a stop with the rear end of the twelfth car about 1,930 feet north of the station. Fireman Jenks and Head Brakeman Dominy felt the air brakes apply from the rear, and on looking back they saw the cars being derailed. Conductor Lamoureaux and Flagman Sullivan were riding in the caboose; the conductor thought the train came to a stop as a result of a burst air hose until he was informed otherwise by the flagman, who had been riding in the monitor of the caboose and saw the cars being derailed. Flagman Sullivan immediately went back to flag. After the accident members of the crew saw the broken arch bar that caused the accident, and they said the fracture appeared to be an old one, only a small portion of the break being new.

Westmoreland coal car 1543, a hopper car, had a stenciled capacity of 100,000 pounds; it was built in October, 1904. It was inspected on its arrival at East Deerfield yard, located about 71 miles south of Balloch, during the night of February 12, no exception being taken to its condition. The train also was inspected by members of the crew at various points en route, but no defective condition was discovered so far as car 1543 was concerned. Apparently the arch bar failed in the vicinity of a crossing located about 5,870 feet south of Balloch station, the planking on the crossing at that point being marked on the outside of the west rail for the entire length of the crossing, the depression in the planking being about 3 inches in width and about one-fourth inch deep. No further obstruction was encountered by the broken arch bar until the south switch of the passing track was reached, located about 2,800 feet north of the crossing, at which point the west rail of the passing track was struck and forced eastward, throwing it out of line. The arch bar evidently then rode high enough from this point northward to avoid further damage to the track until the frog of the north switch of the passing track was reached, near the station, and after passing over the frog the arch bar apparently dropped inside the switch point, throwing the main track out of line and precipitating the derailment.

An investigation into the reason for the failure of the arch bar was conducted by Mr. James E. Howard, engineer-physicist, whose report immediately follows:

REPORT OF THE ENGINEER

-PHYSICIST

The accident to train extra 2607, Boston & Maine Railroad, at Balloch, N. H., on February 13, 1928, was caused by the fracture of a lower arch bar in the rear truck of Westmoreland coal car 1543, the twelfth car from the engine. This arch bar was located on the west, or left, side of the truck, according to the direction the train was running.

The fracture of the arch bar and tie strap of the truck frame made an opening through which the spring plank, its nest of helical springs, and the truck bolster dropped upon the track, leading to the derailment of the rear part of the train, 21 cars. The derailment took place when the point of a passing track switch was reached, a distance of 317 feet south of Balloch station. A part of the train left the roadbed, collided with and destroyed the station, where the fatalities connected with the accident occurred.

Figure 1 is a partial view of the type of arch-bar frame which fractured. It consisted of an upper and a lower arch bar, a tie strap, two column castings, and through bolts.

Figure 2 shows side views of the two lower arch bars of the rear truck, the shape of the west arch bar after fracture, and the location of incipient cracks in the east arch bar.

Figure 3 is a detailed view of each arch bar, from their under sides, comprising sections which include the bolt holes of the column castings. The fracture of the west arch bar originated at its inner lower corner, directly below the rear edge of the spring plank. It extended thence in an oblique direction to the bolt hole of the column casting, completing the rupture of the bar by the fracture of the section between the bolt hole and the outer edge of the bar. The presence of the column casting bolt hole offered a path for the extension of the line of rupture, but was not primarily a vital factor in originating the fracture.

FIG. 1

FIG. 1. - Partial view of arch-bar frame in forward truck of derailed car

FIG. 2

Direction train traveled

FIG. 2. - Lower arch bars from rear truck of derailed car. Arch bar from west frame fractured. Incipient cracks in arch bar from opposite side of truck. Bars made of wrought iron

The points of origins of the incipient cracks in the east arch bar will be noted. They also were located directly under the rear edge of the spring plank. They extended from the under edges of the bar obliquely toward the bolt hole of the column casting. These cracks were in process of extension when the accident occurred. A derailment from the rupture of the east arch bar of this truck was in prospect.

The condition of the forward truck of this coal car became a matter for consideration. It was dismantled, but found to be in good condition. In fact, it was found to be of more recent fabrication than the rear truck, although the age of either truck was not known. The car was built in October, 1904. If a part of the original construction of the car, the fractured truck was 24 Years old.

The seats of the spring plank and column castings of the fractured truck were much worn. At each edge of the spring plank seat of the east arch bar the metal was worn to a depth of a sixteenth of an inch. Under the middle of the width of the plank there was no loss of metal by abrasion. The arch bar itself was bent concave, in downward direction, clearing the plank at the middle of its width. The seats of the column castings were worn to a depth of an eighth of an inch. Similar conditions were displayed by the fractured bar.

FIG. 3

FIG. 3. - View of fracture of west arch bar and incipient cracks in east arch bar

An explanation is called for concerning the loci of the incipient points of rupture of these two arch bars; fractures which originated in the solid bars in close proximity to the column-casting bolt holes where the sectional areas of the arch bars were much reduced. The gross sectional area of the arch bars, 5 inches wide by 1 1/4 inches thick, was 6.25 square inches each. Across the bolt holes the area was 3.95 square inches, a reduction of over 36 per cent. Notwithstanding this reduction, only 2 inches away, fractures originated in the solid bars, in one of which the fracture was complete, precipitating the accident.

In each bar the inception of rupture bore a definite relation to the edge of the spring plank in the plane of concentrated repeated stresses. Facts of this kind should not be overlooked in the design of rolling stock or wherever shocks, vibratory effects, or repeated stresses are to be met. It is admittedly a difficult matter to realize that such a difference in conditions should prevail within the short distance of two inches as illustrated in the rupture of these arch bars. With such examples presented the deduction follows that caution should be exercised in attributing causes of failure to inferior physical properties of the materials used when the trouble perchance lies in the design of the structure.

FIG. 4

FIG. 4. - Fracture of west arch bar under bending test. Bent 180 degrees at location 15 inches from fracture which caused the derailment

The metal of the west arch bar, in the extension of the line of fracture, displayed some toughness; the metal about the bolt hole was elongated. A bending test was made of the full section of this bar, the fracture of which is illustrated by Figure 4. A moderately tough fibrous fracture was exhibited. The bar bent nearly 180 degrees before rupture. The difference in the characteristics of the service fracture and the bending test will be noted. In service there was no display of toughness in the metal, at the origin of fracture; in the bending test there was toughness.

The dominating idea in the usual examination of fractured material attaches to the query whether the fractured metal met the original specifications governing its acceptance, but a matter which rarely has a relation to the actual cause of fracture. In the present case, however, it is believed that a better grade of wrought iron would have postponed if not averted fracture.

Figure 5 illustrates the appearance of the east arch bar after fracture by bending test. The incipient cracks shown on Figure 3 are here shown as the edges of the dark-colored areas on the fractured ends of the bar. In this cut the bar is viewed from the underside. Fractures began at each of the lower corners, and extended progressively upward and obliquely toward the bolt hole.

FIG. 5

FIG. 5. Fractured surface of east arch bar under bending test. Dark-colored parts of fracture represent incipient cracks which were formed in the bar during its period in service

The metal of the bar beyond the incipient cracks retained its toughness, a feature to he borne in mind, which distinguishes wrought or puddled iron from the behavior of carbon steels of any grade. This peculiarity of retention of toughness, notwithstanding the presence of an incipient crack, gives special value to wrought iron in many situations. Other features of value will be mentioned.

Figures 6 and 7 illustrate the appearance of tensile test pieces after fracture. Those shown by Figure 6 represent test pieces in the natural state of the metal; that is, the test pieces were, taken from the ends of the arch bars and tested without treatment of any kind. One specimen from each bar was tested in longitudinal direction, and one from each in crosswise direction. It is well known that the strength of wrought iron is greater in lengthwise than in crosswise direction, the results of the tests being normal in that respect.

FIG. 6

FIG. 6. - Fractured tensile specimens from east and west arch bars, natural state of the metal a, east arch bar, longitudinal specimen; b, west arch bar, longitudinal specimen; c, east arch bar, crosswise specimen; d, west arch bar, crosswise specimen.

FIG. 7

FIG. 7. - Fractured tensile specimens from east and west arch bars after treatment a, east arch bar, longitudinal specimen, cold swaged; b, west arch bar, longitudinal specimen, cold swaged; c, east arch bar, longitudinal specimen. Heated to 1,400 degrees F. and quenched in water; d, west arch bar, longitudinal specimen. Heated to 1,400 F. and quenched in water.

Figure 7 illustrates the appearance of test pieces from each arch bar after special treatment of the metal. A longitudinal specimen from each bar was cold swaged. The metal was extended under the hammer 20 per cent, after which the tensile specimens were prepared. A longitudinal specimen from each bar was quenched in water from a temperature of 1,400 degrees' F.

These special tests were made for the purpose of showing how wrought irons may be treated and still retain good workable properties. Wrought irons are immune from certain dangers which are menacing to other metals.

The following table shows the results of the tests made with the specimens taken from the arch bars, the photographs of which appeared on Figures 6 and 7.

Tensile tests of specimens from east and west arch bars

Table 1

These results are reported filter the usual fashion of tensile tests. The yield point is somewhat above the elastic limit of the metal. The tensile strength represents the maximum stress reached. The elongation is a distorted factor of little real value. It includes the local contraction of the specimen, and does not therefore, show the ability of the metal to stretch under its own strength. The true elongation of the metal in a tensile test is the amount it has stretched when local contraction begins and increase of tensile stress has ceased. The contraction of area as reported is a true value.

These tests show the metal of which the arch bars were made to have been of inferior grade, unsuitable for the important place which they occupied. Responsibility for the accident presumptively attaches to the use of a poor grade of wrought iron in these arch bars.

As a metal wrought iron commends itself for such places as arch bars. A superior grade of metal would eventually succumb to repeated alternate stresses and fracture without display of toughness if exposed to sufficiently high stresses. There is no grade of iron or steel which will not do this under adverse conditions. The reason why wrought iron is a good metal for certain places is on account of its retention of toughness at the root of an incipient crack. A fibrous metal has this property. A granular or crystalline metal becomes brittle when an incipient crack is once started.

The gain in tensile strength of the swaged specimens will be noted. Swaging and cold rolling have the same effect in kind on the tensile strength of the iron. General elongation was practically destroyed, but contraction of area not apparently disturbed.

Quenching from a high temperature had a profound effect on the tensile strength of the iron. Each of the four features, of the tests showed substantial gains. Unlike carbides of iron, no hardening or embrittlement of the metal attended sudden quenching.

Good contraction of area has long been regarded as a valuable feature in metals against sudden and unexpected rupture. It is recalled that the late Professor Jenney, of the Technical High School, Vienna, Austria, attached special importance, to this feature, regarding it as an index of superiority of high degree. In view of the fact that ability to display permanent elongation may be destroyed without having shown an appreciable set, the retention of good contraction of area becomes a safeguard against brittleness of fracture, and therefore a feature of practical value. If service conditions or special treatment fail to impair "contraction of area" as a factor, its practical importance is certainly well founded.

The higher physical properties of steels have enabled them to nearly drive puddled iron out of the market. So little use is being made of wrought iron that its peculiar properties may eventually be lost sight of. This opportunity therefore will be availed of to introduce, some tests which have been made on wrought irons.

Forty-six years ago it was the privilege of the writer to make some tests on single and double refined wrought irons. They were bars 2 inches in diameter, 80 inches long. The original tests, made in 1882, showed in round numbers, elastic limits of 25,000 pounds per square inch, tensile strengths a little, above 50,000 pounds per square inch, elongation above 20 per cent, and contraction of area in the vicinity of 40 per cent.

Elongations were measured on 10-inch lengths and results given on sections independent of local contraction of area.

The lengths of these bars were such that retests of the metal were, practical to make. Features which were attracting notice in those, earlier days were illustrated in some of the tests. The late Professor Thurston had called attention to the exaltation of the elastic limit by reason of overstraining loads. That is, a new and higher elastic limit was acquired following a period of rest than the limit of the overstraining stress. Stress-strain curves are, modified according to the manner in which the loads are applied. Arresting the test after the tensile strength was reached and slightly passed and then renewing the same after an interval of rest, resulted in increased tensile resistance. All of these phenomena indicated that the particles of iron, set in motion by an external force, gained in rigidity if allowed an interval of rest.

The gain in strength once acquired remains, but is lost by exposing the iron to a moderately high annealing temperature. Current tests have indicated that restoration of primitive strength is attained with hardly measurable change in dimensions of the specimen annealed.

Returning now to a discussion of the retests of the bar of double-refined wrought iron, originally tested in the year 1882. After remaining in a state of repose for an interval of 22 years the bar showed an elastic limit of 66,000 pounds per square inch; tensile strength, 70,000 pounds per square inch; contraction of area, 28 pet cent; referred to the sectional area as it existed when the retest was made. On the original sectional area of the bar-that is, before reduction in diameter in the first test-the tensile strength was 61,200 pounds per square inch.

Forty-six years total elapsed when the iron was again retested. The tensile strength still remained at its acquired maximum value. It had a value of 72,000 pounds per square inch, with a contraction of area of 25.6 per cent. Thus it appears that the forces of cohesion enhanced by early overstraining and rest retained their increased resistance for nearly one-half a century with no indication of release, the metal in the meantime, having been exposed to atmospheric temperature only.

Figure 8 shows the appearance of tensile specimens after fracture, which were taken from this bar of wrought iron, originally tested in 1882. Figure 8 a represents the test piece in the natural state of the iron; figures 8 b and 8 c after the metal had been annealed at 900 degrees and 1,400 degrees F., respectively.

The results of these three specimens appear on the following table:

Tensile tests of specimens of double-refined wrought iron, 46 years after original test

Table 2

It will be seen that annealing at 900 degrees F. lowered the tensile strength which it had acquired by overstraining, in amount nearly 12,000 pounds per square inch, and exposure to the higher annealing temperature of 1,400 degrees F. lowered it another 12,000 pounds per square inch, the latter value bring below the primitive test. Finishing temperature have an influence on primitive strength, hence this result does not require special comment. It is a matter of interest, however, in the study of the physics of this metal, to note that the relief in rigidity of 12,000 and 24,000 pounds per square inch for the two annealing temperatures, respectively, was accomplished with hardly any measurable change in the linear dimensions of the iron.

FIG. 8

FIG. 8. - Specimens from bar of double refined wrought iron. Original test made in 1882 a, tested in natural state after 46 years' rest; b, annealed at 900 degrees F.; c, annealed at 1,400 degrees F.

FIG. 9

FIG. 9. - From bar of double-refined wrought iron tested in 1882. Strain gauge measurements made after different treatments.

Figure 9 represents a section 12 inches long, 1.85 inches, diameter, from the bar of double-refined iron, from which this and the several test pieces were taken. Strain gauge measurements were made on this section, three gauged lengths 10 inches long each, spaced cumferentially 120 degrees apart, and designated by the letters a, b, and c.

The bar was first subjected to progressive annealing temperatures from 200 degrees F. to 1,400 degrees F, with increments of 200 degrees each. There were apparently some minor changes at times in plus or minus directions on the gauged lengths, but on the whole it could not be said that any material change occurred. It was heated in an electric furnace and furnace cooled.

After the several annealings were completed the bar was suddenly heated in an open fire to approximately 1,700 degrees F. and cooled in lime. This treatment caused an average shortening of 0.0027 inch, equivalent to a compressive stress of 7,300 pounds per square inch, based on a modulus of elasticity of 27,000,000 pounds per square inch.

The bar was next heated along elements b and c, about 8 inches each, with an oxy-acetylene torch, and cooled in the air. Element b was first heated. When cold it was found shortened 0.0122 inch, equivalent to 32,900 pounds per square inch compressive stress. Element c was shortened 0.0057 inch. Element a was increased in length 0.0023 inch. That is, the two elements heated and overcompressed at the time, when cold, were shorter than originally, while the element not heated was longer finally.

In the next operation element a was heated with a torch in the same manner as before. When cold this element was shortened, the two unheated ones were each lengthened.

The bar was next heated in a gas furnace to 1,700 degrees F. and furnace cooled. Each element was found shortened. It was again furnace heated to 1,700 degrees F. and quenched in water. Each element was again shortened. It was next heated to 1,100 degrees F. in an electric furnace and quenched in water. It contracted in length a moderate amount. Finally it was heated rapidly in an electric furnace to 1,250 degrees F. and quenched in water. Very pronounced contraction in length then resulted. The mean

total contraction of these several treatments was 0.0328 inch, equivalent to a stress of 88,560 pounds per square inch.

In review when one or two elements were heated they were found to have been shortened when cold. The unheated elements were lengthened. When the entire bar was heated there was a contraction in length on each gauged length.

The examination was completed by boring out the metal of the core of the bar, leaving the walls 0.13 inch thick, whereupon the shell expanded on each gauged length. The surface metal at the end of the series of tests was therefore in a state of internal compression, equivalent to a stress of 28,350 pounds per square inch, or not far from the elastic limit of the metal.

In tabulated form these results appear as follows:

Treatment of double-refined wrought-iron bar

Table 3

Other examples might, be added, showing the behavior of wrought irons under what would seem unfavorable conditions. Tests made in 1901 on best puddled iron showed a decided advance in the value of the elastic limit after a few days rest following an overstraining load. With an original plastic limit of 32,700 pounds per square inch the test piece, was loaded to 35,000 pounds, per square inch, causing a permanent set of 0.24 inch in 10-inch lengths. After a rest of eight days, without load, it sustained it stress of 40,000 pounds per square inch without additional set. It displayed an increased set at 41,000 pounds per square inch. This grade of iron showed gains in rigidity ranging from 4,000 to 7,000 pounds per square inch, according to the overloads applied and intervals of rest.

In addition to the zone of increased rigidity immediately above the primitive elastic limit, the influence of overstraining seemed to reach even to the tensile strength of the metal, increasing that value in some degree.

Norway iron, nearly pure iron, was included in a series of tests made in 1901. Original tensile, strength 41,800 pounds per square inch, contraction of area 71.7 per cent. Overstrained with 25,000 pounds per square inch, showed the usual exaltation in elastic limit, and after a rest of 7 days an apparent gain in tensile strength. Overstraining at 35,000 pounds per square inch with 7 days' rest showed a gain in tensile strength of 6,600 pounds per square inch, an increase too great to admit of any doubt of its existence and its cause.

On the other hand, some earlier annealing tests made 36 years ago on cold-rolled iron shafting showed a progressive decrease in tensile strength resulting from annealing temperatures ranging from 400 degrees F. to 1,768 degrees F. There was a corresponding lowering of the elastic limit and accompanying increase in both elongation and contraction of area.

Examples of the behavior of wrought iron might be multiplied, all to the effect of illustrating its valuable properties. It can be heated and quenched at any temperature without causing brittleness. Its elastic limit and tensile strength is even raised by such treatment. It can be overstrained and in a few days display increased rigidity requiring the application of a much higher stress before it takes an increased permanent set. Overstraining a few thousand pounds above its primitive elastic limit, and it acquires an exalted elastic limit with increased resistance reaching even to its ultimate strength. If strained up to its tensile strength, in a few months or years it will display a much higher strength. As experiments herein quoted have shown, the gain in tensile strength remains a fixed quantity, approaching a half century in time, hence it may be classified as a permanent gain.

Different kinds of treatment show little or no effect upon its contraction of area. If good contraction of area is retained, it is quite clear that warning will be given impending fracture when exposed to rupturing stresses.

The effect of repeated alternate stresses on wrought irons are the same as corresponding stresses upon steels. The ability to elongate is destroyed and rupture ensues without appreciable display of ductility, in the sense of taking a permanent set. While the results of comprehensive experiments are not at hand, the belief is entertained that there is no metal which will resist rupture caused by repeated alternate stresses without displaying brittleness of fracture.

High manganese steel, noted for its exceptional toughness, will fracture under repeated stresses without display of appreciable ductility. This metal, however, has the exceptional ability of showing toughness in resisting the extension of incipient cracks. Wrought irons and high manganese steel each show similar behavior in this respect

wrought irons and high manganese steel each show similar behavior in this respect.

So far as known no internal fissure has been found in wrought iron. The most drastic treatment, heating and quenching from high temperatures in oil, water, or brine, none have caused the introduction of interior or exterior cracks. Wrought iron is not as strong as common grades of carbon steels which are used in engineering structures. It is stronger, however, than the loads which engineering structures are supposed to be exposed to. These remarks seem to be assuming a panegyric on wrought iron, nevertheless they state only facts. They are due as a testimony to a good all-round metal. One of its striking features in the physics of the metal is its stability in dimensions, while changes in strength are going on when exposed to different annealing temperatures.

In conclusion, the cause of the present accident attaches to the fracture of the arch bar on the west or left side of the rear truck of Westmoreland coal car 1543. The type of fracture indicated exposure to repeated stresses, which in tension concentrated at the under side of the bar directly below the rear edge of the spring plank. No criticism attaches to the use of wrought iron as the metal of the arch bar; criticism, however, does attach to the use of an inferior grade of wrought iron in this important place.

SUMMARY

The cause of the present accident was due to the fracture of an arch bar in the rear truck of Westmoreland coal car 1543. Tests of the physical properties of the metal showed an inferior grade of wrought iron had been used in its fabrication. A better grade of wrought iron doubtless would have postponed the accident or perhaps averted it.

Prior to the accident fractures were in progress in each of the lower arch bars of the rear truck of this coal car. Their origins were at the lower corners of the bars. Each lower corner of the east bar had an incipient crack. The fracture of the west bar started at the lower inner corner.

They were progressive fractures of unknown date of inception, and difficult, of detection in the truck frame under service conditions. It is recognized that this type of truck frame is being superseded by others of unit or different construction. Nevertheless a large number of arch bar frames are still in current service. The manner of failure of this bar shows where attention should center in the inspection of trucks of this type.

The engineer-physicist has dealt extensively with the physical properties of wrought or puddled irons. They possess properties of peculiar value for many situations.

Respectfully submitted.

W. P. BORLAND, Director.

INTERSTATE COMMERCE COMMISSION

REPORT OF THE DIRECTOR OF THE BUREAU OF SAFETY IN RE INVESTIGATION OF AN ACCIDENT WHICH OCCURRED ON THE BOSTON & MAINE RAILROAD AT NAHOR, N.H., ON

OCTOBER 16, 1929.

January 25, 1930

To the Commission:

On October 16, 1229, there was a heed-end collision between two freight trains on the Boston & Maine Railroad at Nahor, N. H., resulting in the death of three employees and the injury of six employees. This accident was investigated in conjunction with representatives of the New Hampshire Public Service Commission.

Location and method of operation

This accident occurred on that pert of the Southern Division extending between Peterboro and Contoocook, N. H., a distance of 32.77 miles; in the vicinity of the point of accident this is a single-track line over which trains are operated by timetable and train orders, no block-signal system being in use. The accident occurred at a point approximately 500 feet west of the station at Nahor; approaching this point from the west the track is tangent for more than 1 mile, followed by a compound curve to the left about 1,400 feet in length with a maximum curvature of 5 degree, the accident occurring on this curve at a point about 825 feet from its western end, where the curvature is 3 degree 40'. Approaching from the east there are several short curves and tangents, followed by the curve on which the accident occurred. The grade for westbound trains is 1.30 per cent ascending at the point of accident.

Owing to a building on the north side of the track at the east and of the station platform, and some large boulders and a growth of trees on the inside of the curve, neither crew could see the opposing train until they were within a vary short distance of each other.

The weather was clear at the time of the accident, which occurred at about 11.49 a.m.

Description

The westbound local freight train involved in this accident was being operated as the second section of first-class train No. 8122. It consisted of three cars and a caboose, hauled by engine 1427, and was in charge of Conductor Vantine and Engineman Chapman. This freight train arrived at Elmwood, 3.87 miles east of Nahor, as extra 1427, but in order to expedite traffic, and as was customary in many cases, instructions were issued for it to run from Elmwood to Peterboro, 7.23 miles, both of which points are register stations, as the second section of train No. 8122, a gasoline motor car train. Train second No. 8122 left Elmwood at 11.38 a.m., and collided with extra 1446 at Nahor while traveling at a speed estimated to have been between 20 and 25 miles per hour.

Eastbound freight train extra 1446 consisted of one freight car and a caboose, hauled by engine 1446, and was in charge of Conductor Raby and Engineman Crosby. This train left Peterboro at 11.38 a.m., no check having been made of the train register, set out a car of coal which was being pushed ahead of the engine, this being done at a siding a short distance east of the station, and then proceeded, colliding with train second No. 8122 while traveling at a speed estimated to have been about 25

station, and then proceeded, colliding with train second No. 8122 while traveling at a speed estimated to have been about 25 miles per hour.

Both engines were looked together and badly damaged, the engine trucks being pushed back under, the frames, the engine cabs practically demolished, and the boiler head appurtenances broken; both tender cisterns were jammed against their respective engines. None of the equipment in either train was derailed, with the exception of the caboose of train second No. 8122. The employees killed were the engineman end fireman of train second No. 8122 and the engineman of extra 1446, while the employees injured were the conductor, brakeman and flagman of each train.

Summary of evidence

Conductor Vantine, of train second No. 8122, stated that before departing from Elmwood, the agent came out and informed him that the dispatcher wanted them to hurry, as there was a train waiting for then at Peterboro. Conductor Vantine transmitted this information to the engineman and shortly afterwards the train departed, and the first intimation he had of anything wrong was when he felt the sir brakes apply, followed by the collision. Conductor Vantine stated that it had been practice, off and on, for quite a few years to run freight trains as the second section of scheduled passenger trains, end that the practice had been increased on this branch in the past year, the last time his train having been operated as the second section of train No. 8122 between Elmwood and Peterboro, under similar orders, being on October 11, 1929. Statements of Flagman McClure developed nothing additional of importance.

Conductor Raby, of' extra 1446, stated that after the work of switching was completed at Peterboro, he registered the arrival of his train, went into the freight office, and received from Operator Sullivan a copy of train order No. 89, Form 19, reading "Eng 1446 run extra Peterboro to Elmwood", together with a clearance *** but that he received no verbal instructions from the operator, nor did the operator make any mention to him of the fact that train No. 8122 was being run in two sections. About the time he received the order from the operator, he had some conversation with Agent Wheeler, who was in the office, as was Traveling Car Agent Gearon, this conversation being of a joking nature so far as the conductor was concerned, and having no bearing on the train order received or the fact that train No. 8122 was being run in two sections. Conductor Raby then left the office and was unaware of' the second section of train No. 8122; he proceeded to the fireman's side of the engine and gave the fireman the engineman' s copy of the train order, but did not compare the order with the fireman, nor was any mention made by the fireman or engineman as to whether all overdue trains had arrived or left. The flagman was then called in, after which the conductor went to the register book, located outside of the passenger station, and registered out, but did not check the register. The first knowledge the conductor bad of anything wrong was when Brakeman Berry shouted a warning of danger, the collision occurring immediately afterwards. Conductor Raby stated that during the course of switching at Peterboro, before he went to the freight office for his orders, he had observed train No. 8122 standing in the yard at its usual place, with its markers displayed, but no signals displayed for a following section, and he assumed that there was no opposing train due. Conductor Raby acknowledged that in his hurry, he neglected to perform the duty of checking the register, either at the time he registered in or at the time he registered out, to ascertain if all trains due had arrived.

Fireman Hardy, of extra 1446, stated that the conductor handed up to him a copy of train order No. 89; the fireman read the order to the engineman, who read it back, and the fireman thought that he also remarked to the engineman that they would probably go to Elmwood for Conductor Vantine's train. The first the fireman knew of anything wrong was on seeing the opposing train across the inside of the curve, about eight or nine car-lengths away, and he shouted a warning of danger and jumped just before the collision occurred. Fireman Hardy said that Engineman Crosby had shut off steam prior to the accident and he thought that the engineman applied, the air brakes.

The statements of Brakeman Berry were to the effect that he, the conductor, and flagman, rode in the caboose after the car of coal was set out, but the brakeman did not recall any conversation as to train orders or about train No. 8122 being operated in two sections; he said the conductor usually showed any orders received, but that on this occasion the conductor did not show him the order and he did not know whether the conductor showed the order to the flagman.

Conductor Eaton, of train first No. 8122, stated that he received orders at Elmwood to display signals for the following section and accordingly green flags were displayed from Elmwood to Peterboro. His train departed from Elmwood at 10.28 a.m., according to the train sheet, and he said that after arrival at Peterboro, at 10.43 a. m. according to the train sheet, the signals were taken down, this being done on reaching the turntable in the yard. Conductor Eaton also stated That at the time he registered in at Peterboro, some one spoke to him, diverting his attention from the register book, and that on this account he made an error in registering, writing on two lines, one above the other, instead of writing only on one line, however, he noticed the error before leaving the book, immediately erased and corrected it, while the agent was present, and called the correction to the attention of the agent. Statements of Engineman Moody corroborated in substance those of Conductor Eaton; the engineman said that extra 1446 had not arrived at Peterboro at the time the green flags were taken down.

Operator Sullivan, at Peterboro, stated that before Dispatcher Ainsworth made train order No. 89 complete, the dispatcher told the operator to be sure that Conductor Baby, of extra 1446, understood that train second No. 8122 was not in, [redacted] edgment of these instructions. At the time the operator delivered the train order [redacted] mary place to deliver orders except in the case of a passenger train, at about

[illegible] train second No. 8122, but the conductor made no reply. Operator Sullivan stated that at the time this took place, Agent Wheeler and Traveling Car Agent Gearon were present in the freight office, and t[illegible]nducto[illegible]d was to remark something about why the operator had told him to place a oar on a track that was occupied by another car with the hopper doors down. After delivering the order to the conductor, the operator left the office and went to dinner, being informed of the accident at his home, at about 11.53 a.m., by Agent Wheeler.

Agent Wheeler stated that at the time the train order was delivered to Conductor Raby, Operator Sullivan remarked to look out for train second No. 8128, but that the conductor made no reply. Agent Wheeler also confirmed the statements of Conductor Eaton, of train first No. 8122, as to the correction made at the time that conductor registered in, on his arrival at Peterboro. Statements of Traveling Car Agent Gearon were to the effect that a remark was made while he was in the freight office about train second No. 8122, but he did not know who made the remark or whether Conductor Raby was present when it was made.

Conclusions

This accident was caused by the failure of Conductor Raby, of extra 1446, to check the train register before departing from Peterboro.

Rule 109, of the book of operating rules of this railroad, reads in part as follows:

> "***Conductors must, unless otherwise instructed, register their trains and make the proper examination of registers personally, and ascertain if all trains due have been registered."

The investigation developed that it was not unusual on this branch, in order to expedite traffic, to operate freight trains as the second section of scheduled passenger trains. On the day of the accident, however, train first No. 8122, the gasoline motor car, arrived at Peterboro, registered, proceeded to the turntable, and had taken down the green flags before extra 1446 arrived. After extra 1446 arrived and while performing switching, Conductor Raby noticed the gasoline motor car standing in the yard at its usual place, but no green flags, indicating a following section, were displayed at this time, and the conductor assumed that there was no opposing train due. When Conductor Raby went to the freight office, after work was completed, and received the train order from Operator Sullivan, it appears that the operator made mention of the fact that train No. 8122 was being run in two sections, but that the conductor did not hear the remark, the operator failing to impress this fact on the conductor' s mind, as he had been instructed to do by the dispatcher. The conductor, apparently, was more concerned as to why the operator had told him to place a car on a track that was occupied by another car with the hopper doors down. Conductor Raby then left the office and shortly afterwards his train departed; he had registered its arrival and departure, but no check had been made in order to ascertain if all trains due had been registered.

Operator Sullivan erred in not firmly impressing on the conductor's mind the verbal instructions of the dispatcher, issued as a matter of extra precaution; apparently he made a somewhat feeble attempt to carry out the instructions he had received, but it does not appear that he was thoroughly alive to the situation or particularly energetic in attending to his own duties properly. A little more cooperation on his part might have prevented the occurrence of this accident.

All of the employees involved were experienced men; at the time of the accident the crews of train second No. 8122 and extra 1446 had been on duty less than S hours, and 4 hours, respectively, prior to which they had been off duty 11 hours or more.

Respectfully submitted,

W. P. BORLAND,

Director.

INTERSTATE COMMERCE COMMISSION

WASHINGTON

INVESTIGATION NO. 3213

BOSTON AND MAINE RAILROAD REPORT IN RE ACCIDENT NEAR NEWBURY, VT., ON OCTOBER 30, 1948

Inv-3213

SUMMARY

Railroad:	Boston and Maine		
Date:	October 30, 1948		
Location:	Newbury, Vt.		
Kind of accident:	Head-end collision		
Trains involved:	Passenger	:	Passenger
Train number:	78	:	79
Engine numbers:	3661	:	3646
Consists:	8 cars	:	7 cars
Estimated speeds:	20 m. p. h.	:	20 m. p. h.
Operation:	Timetable, train orders and automatic block-signal system		
Track:	Single; 3 degrees curve; 0.23 percent descending grade southward		
Weather:	Foggy		
Time:	2:30 a.m.		
Casualties:	4 killed; 165 injured		
Cause:	Failure of one of the trains involved to obey a meet order and the Indication of an automatic block signal		

INTERSTATE COMMERCE COMMISSION

INVESTIGATION NO. 3213

IN THE MATTER OF MAKING ACCIDENT INVESTIGATION REPORTS UNDER THE ACCIDENT REPORTS ACT OF MAY 6, 1910.

BOSTON AND MAINE RAILROAD

January 13, 1949

Accident near Newbury, Vt., on October 30, 1948, caused by failure of one of the trains involved to obey a meet order and the indication of an automatic block signal.

REPORT OF THE COMMISSION 1

PATTERSON Commissioner:

On October 30, 1948, there was a head-end collision between two passenger trains on the Boston and Maine Railroad near Newbury, Vt., which resulted in the death of 4 employees, and the injury of 148 passengers, 6 railway-mail clerks, 8 train-service employees on duty and 3 train-service employees off duty. This accident was investigated in conjunction with a re representative of the Vermont Public Service Commission.

Diagram

Inv. No. 3213 Boston and Maine Railroad Newbury, Vt. October 30, 1948

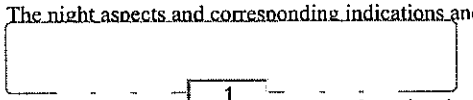
Location of Accident and Method of Operation

This accident occurred on that part of the White River Jct. and Berlin and Groveton Branch of the New Hampshire Division

This accident occurred on that part of the White River Jct. and Berlin and Groveton Branch of the New Hampshire Division extending between Wells River and White River Junction, Vt., 40.36 miles. This is a single-truck line, over which trains are operated by timetable, train orders and an automatic block-signal system. At Newbury, 5.16 miles south of Wells River, a siding 2,420 feet in length parallels the main track on the east. The north and the south switches of this siding are, respectively, 2,508 feet and 88 feet north of they station. Both switch-stands are located on the west side of the main track and are equipped with reflector type lamps. The accident occurred on the main track 3,813 feet south of the south siding-switch at Newbury. From the north there are, in succession, a 1 degree 58' curve to the left 1,320 feet in length, a tangent 4,370 feet and a 3 degrees curve to the right 895 feet to the point of accident and 714 feet southward. From the south there are, in succession, a 3 degrees 06' curve to the right 1,353 feet in length, a tangent 806 feet, a 2 degrees 33' curve to the left 990 feet, a tangent 2,435 feet and then the curve on which the accident occurred. The grade is 0.23 percent descending southward.

The automatic block-signal system is arranged on the overlap principle. These signals are of the 2-arm semaphore type and they display three aspects. Each arm operates in two positions in the lower quadrant, and is approach lighted.

The night aspects and corresponding indications and names are as follows:



Green Proceed signal

Green-over-yellow Prepared to stop at next signal. Approach signal

Train exceeding medium speed

must at once reduce to that speed

Red-over-yellow Stop then proceed in accordance Stop and proceed signal

with rules S-509 * * *

Signals P362 and P352, governing south-hound movements, are located, respectively, 1.72 miles and 3,304 fret north of the point of accident. Signal P352 is located 509 feet south of the south siding-switch at Newbury. Signals P325, P335 and P347, governing north-bound movements, are located, respectively, 2 miles and 5,121 feet south, and 637 feet north of the point of accident.

These signal are so controlled that when a south-bound train passes signal P362 it will cause signal P347, located 1.60 miles to the south, to indicate stop-then-proceed, and signal P335, located 2.64 miles to the south, to indicate prepare-to-stop-at-next-signal. When a north-bound train passes a point 2,225 feet south of signal P335 it will cause signal P352, located 2.02 miles to the north, to indicate stop-then-proceed, and signal P362, located 3.11 miles to the north, to indicate prepare-to-stop-at-next-signal.

This carrier's operating rules read in part as follows:

DEFINITIONS.

FIXED SIGNAL.--A signal of fixed location indicating a condition affecting the movement of a train or engine.

NOTE.--The definition of a "Fixed Signal" covers such signals as * * * block, * * * or other means for displaying indications that govern the movement of a train or engine.

SPEEDS: Medium --A speed not exceeding 30 miles per hour.

* * *

Restricted--A speed that will permit stopping short of another train, obstruction, or switch not properly lined but not exceeding 15 miles per hour.

* * *

14. ENGINE WHISTLE SIGNALS.

NOTE. --The signals prescribed are illustrated by "o" for short sounds; "-----" for longer sounds, * * *

SOUND. INDICATION.

* * * * * * *

S(n) ----- ----- o Approaching meeting or waiting points.

(See Rule S-90.)

* * * * * *

16. COMMUNICATING SIGNALS.

NOTE.--The signals prescribed are illustrated by "o" for short sounds; "-----" for longer sounds.

SOUND INDICATION.

* * * * * *

(b) o o When running, stop at once

INTERSTATE COMMERCE COMMISSION

WASHINGTON

REPORT NO. 3600

BOSTON AND MAINE RAILROAD IN RE ACCIDENT AT NASHUA, N. H., ON NOVEMBER 12, 1954

Report No. 3600

SUMMARY

Date:	November 12, 1954
Railroad:	Boston and Maine
Location:	Nashua, N. H.
Kind of accident:	Derailment
Train involved:	Passenger
Train number:	302
Engine number:	Diesel-electric units 3818 and 3820
Consist:	8 cars
Speed:	70 m.p.h.
Operation:	Timetable, train orders, and automatic block-signal system
Tracks:	Double; 6 degrees 35' curve; level
Weather:	Clear
Time:	5:52 a.m.
Casualties:	1 killed; 53 injured
Cause:	Excessive speed on curve

INTERSTATE COMMERCE COMMISSION

REPORT NO. 3600

IN THE MATT OF MAKING ACCIDENT INVESTIGATION REPORTS UNDER THE ACCIDENT REPORTS ACT OF MAY 6, 1910.

BOSTON AND MAINE RAILROAD

December 27, 1954

Accident at Nashua, N. H., on November 12, 1954, caused by excessive speed on a curve.

REPORT OF THE COMMISSION 1

CLARKE, Commissioner:

On November 12, 1954, there was a derailment of a passenger train on the Boston and Maine Railroad at Nashua, N.H., which resulted in the death of 1 passenger, and the injury of 35 passengers, 5 railway mail clerks, 2 Pullman Company employees, 2 buffet-sleeping car employees, 1 railway express messenger, 4 train-service employees, and 4 employees not on duty. This accident was investigated in conjunction with representatives of the New Hampshire Public Utilities Commission.

Diagram

Report No. 3600 Boston and Maine Railroad Nashua, N.H., November 12, 1954

Location of Accident and Method of Operation

This accident occurred on that part of the New Hampshire Division extending between Concord, N. H., and South Lowell, Mass., 50.0 miles. In the vicinity of the point of accident this is a double-track line, over which trains moving with the current of traffic are operated by timetable, train orders, and an automatic block-signal system. The main tracks from west to east are designated as southward main track and northward main track. At Nashua Union Station, 34.36 miles south of Concord, auxiliary tracks parallel the southward main track on the west, and a siding and an auxiliary track, front west to east in the order named, parallel the northward main track on the east. A three-track through-truss bridge, 117 feet in length, spans the Nashua River at a point 1,279 feet north of the station. The accident occurred on the southward main track at a point 281 feet south of the south end of the bridge. From the north on the southward main track there are, in succession, a tangent 2,050 feet, a 1 degree

the south end of the bridge. From the north on the southward main track there are, in succession, a tangent 2,050 feet, a 1 degree curve to the left 345 feet, a tangent 429 feet, 3 degrees 08' curve to the right 309 feet a tangent 117 feet over the bridge, and a compound curve to the right, having a maximum curvature of 6 degrees 35', 281 feet to the point of accident and 423 feet southward. The grade in the vicinity of the point of accident is practically level.

The track structure of the southward main track consists of 112-pound rail, 39 feet in length, laid new in 1944 on an average with double-shoulder canted tieplates, spiked with two rail-holding and two plate-holding spikes per tieplate, and is provided with 4-hole 24-inch joint bars and an average of 8 rail anchors per rail. It is ballasted with trap rock to a depth of 6 to 8 inches below the bottoms of the ties. In the immediate vicinity of the point of derailment the gage varied between 4 feet 8-9/16 inches and 4 feet 8-3/4 inches. The superelevation at the point of derailment was 2-1/8 inches. At the northernmost point where marks of derailment were found the curvature was 6 degrees 20'.

A diamond-shape speed restriction sign 26 inches long and 20 inches high, which bears the numerals "30" in 8-inch a black figures on a yellow background, is located 3,040 feet north of the point of accident. Reflector buttons are provided in the numerals. This sign is approximately 7 feet above ground level and is mounted on a post about 25 feet west of the center-line of the southward main track.

This carrier's operating rules read in part as follows:

110. * * *

Speed restrictions shown in time-table, bulletin orders, by wayside signs, or by other means, must be strictly observed.

The maximum authorized speed for the train involved was 70 miles per hour, but it was restricted to 30 miles per hour on the curve on which the accident occurred.

Description of Accident

No. 302 a south-bound first-class passenger train, consisted of Diesel-electric units 3818 and 3820, coupled in multiple-unit control, one baggage-mail car, one baggage car; one milk-tank car, one baggage car, two coaches, one sleeping car, and one buffet-sleeping car, in the order named. All cars were of conventional all-steel construction except the fifth car, which was of lightweight steel construction. This train passed Tie Plant, 1.74 miles north of the point of accident, at 5:50 a.m., 6 minutes late, according to the dispatcher's record of the movement of trains, and while it was moving at a speed of 70 miles per hour the locomotive and all cars of the train were derailed at a point 998 feet north of Nashua Union Station.

unite and between all units of the train except the fifth and sixth cars. The first t west of the southward main track and approximately 825 feet south of the ped on the southward main track, which curves to the left at this point. The secon [illegible] ft side across the adjacent tracks. The front end of this unit was on the southward r [illegible] out 40 feet to the rear of the first unit, and the rear end was about 45 feet east of the southward main track. This u [illegible] rst fou rs were off their trucks. The first to the seventh cars, inclusive; overturned. The first car stopped upside down on the auxiliary track east of the siding. The second and fourth cars stopped on their east sides in diagonal positions across the northward main track and the siding. The third car stopped on its west side, to the east of the southward main track, in the angle formed by the second and fourth cars. The fifth, sixth, and seventh cars stopped on their east sides on the northward main track. The rear car stopped approximately in line with the southward main track with the rear end 85 feet south of the point of derailment. It leaned toward the east at an angle of approximately 15 degrees. The first Diesel-electric unit and the rear car were somewhat damaged. The second Diesel-electric unit and the other derailed cars were badly damaged. A baggage car on the siding and two freight cars on an adjacent auxiliary track east of the siding were struck and damaged by derailed equipment of No 302.

Diesel-electric unit 3818 was the first unit of the locomotive. It in of the 0-6-6-0 type and is provided with a control compartment at the front end. The unit is 71 feet 1-1/4 inches in length over the pulling faces of the couplers. The trucks are of the swing-motion type. The wheelbase of each truck is 14 feet 1 inch, and the centers of the trucks are spaced 43 feet apart. The specified diameter of the wheels is 36 inches. The total weight of the unit is 322,436 pounds. The brake equipment is of the 24-RL type, with DS-24-H automatic brake valve and S-40-F independent brake valve. A safety control feature actuated by a foot pedal is provided. The regulatory devices are adjusted to maintain main-rerservoir pressure of 130 pounds and brake-pipe pressure of 110 pounds. The center of gravity of the unit is 60-1/2 inches above the level of the tops of the rails. Diesel-electric unit 3820, the rear unit of the locomotive, is similar in design and construction. The theoretical equlibrium, safe, and overturning speeds for these units moving on a 6 degrees 20' curve having 2-1/8 inches superelevation are, respectively, 22, 45, and 75 miles per hour.

The first two cars of the train were equipped with PC type control valves, and the other cars were equipped with UC type control valves. One of the two tanks on the milk car was loaded. The centers of gravity of the cars varied between a minimum of 55 inches and a maximum of 60 inches above the level of the tops of the rails. The theoretical equlibrium speed for this equipment was 22 miles per hour at the point where track curvature was 6 degrees 20' and the superelevation was 2-1/8 inches. Safe speeds for the equipment varied between 43 and 47 miles per hour, and overturning speeds were estimated at from 75 to 80 mile per hour.

The engineer, the fireman, the conductor, the flagman, the front brakeman, and the train baggageman were injured.

The weather was clear at the time of the accident, which occurred about 5:52 a.m.

Discussion

As No. 302 was approaching the point where the accident occurred the speed was about 70 miles per hour, as indicated by the tape of the speed-recording device. The engineer and the fireman were maintaining a lookout-ahead from the control compartment at the front of the locomotive. The conductor, the front brakeman, and the baggageman were in the baggage car, the fourth car of the train, and the flagman was in the rear car. The engineer said that he placed the brake valve in first service position when the locomotive was in the vicinity of a concrete base at the former location of a water column 5,183 feet north of the station, the usual point at which he began to reduce train speed to comply with the speed restriction on the curve south of the bridge and to make the stop at Nashua Union Station. He said that soon after he placed the brake valve in first service position the gauge indicated that a brake-pipe reduction of about 9 pounds had been effected, but there was no reduction in the speed of the train. He then made a service brake-pipe reduction of about 10 pounds, and when this failed to reduce the speed he again placed the brake valve in service position. He estimated that there was an interval of about 4 or 5 seconds between the first and second reductions, and the third reduction was made about 3 seconds after the brake-valve exhaust caused by the second reduction had ceased. He did not think that the exhaust from the brake valve was normal. He said that about this time he began to sound the whistle signal for Bridge Street crossing, located 839 feet south of the bridge, but then became concerned because the brakes were ineffective, and he did not complete the signal. He said that he moved the brake valve to emergency position

the brakes were ineffective, and he did not complete the signal. He said that he moved the brake valve to emergency position when the locomotive was entering the bride and that about the same time the fireman called a warning. He thought that the emergency brake application was effective in reducing the speed of the train considerably before the locomotive became derailed. The fireman said that he and th engineer called all signal indications en route and that the grade-crossing whistle signal was sounded for a crossing in the vicinity of Tie Plant. He thought the engineer made the initial brake-pipe reduction before the locomotive passed the speed-restriction sign. Then the speed was not reduced he became concerned and called a warning as the train wag closely approaching the bridge. He said that the locomotive lurched violently toward the east as it entered the curve south of the bridge and then lurched violently in the opposite direction. He thought it became derailed before the speed was materially reduced by the emergency application of the brakes. The baggageman said that he felt a slight brake application which caused some retardation before the baggage car became derailed and overturned. The other members of the train crew said that the train had been riding smoothly and they did not feel any brake application before the accident occurred.

An assistant maintenance foreman said that No. 302 passed him as he was walking adjacent to the track in the vicinity of the crossing-whistle sign for Bridge Street crossing, approximately 500 feet north of the bridge. He said that the locomotive whistle was not sounded in the vicinity of the sign and that he did not observe any indication of braking action on the wheels of the train as it passed. The crossing watchman at Bridge Street said that he did not hear the whistle sounded as the train approached and that the train approached at unusually high speed. He observed sparks flying from the wheels of the Diesel-electric units immediately before the derailment occurred, but he did not know whether the brakes were applied on the cars.

Examination of the track after the accident disclosed that the first mark on the track structure, was a flange mark inside the east rail 281 feet south of the south end of the bridge. The east rail on the curve was canted outward beginning at a point about 320 feet south of the bridge. The rail at this point was bent, and the general derailment occurred approximately 75 feet southward. Apparently the train entered the curve at approximately overturning speed, and the sequence in which the equipment became derailed could not be determined. The southward main track was destroyed throughout a distance of approximately 490 feet, and the northward main track and adjacent auxiliary tracks in the immediate vicinity were damaged. The marks on the track structure north of the point of general derailment apparently were made by following car equipment.

Examination of the equipment of No. 302 after the accident occurred disclosed that all angle cocks in the train, with the exception of the angel cock from the front end of the third car, which was broken off and could not be located, were in proper position for control of the brakes from the engineer's brake valve. No slid-flat spots or other indications of heavy braking were found on the wheels. Before any of the derailed equipment was moved the brake pipes of the locomotive units and the cars were tested for obstructions. Where the brake pipes were broken, each of the separated portions was tasted. Compressed air at a pressure of approximately 80 pounds per square inch was used in these tests, and no obstruction to the normal flow of air was found in any of the brake pipes, air hose, or fittings. All air hose and fittings, with the exception of the angle cock from the front end of the third car, were tested for internal defects or obstructions at the shops in Billerica, Mass., on November 26, 1954. No defective condition was found.

The brake control apparatus of Diesel-electric unit 3818 was tested after this unit was moved to the shops at Pillerica. In these tests the piping was so arranged that the main reservoir of the unit could be fully charged and breaks were plugged to permit the making of tests that would indicate the pressure developed, during brake-pipe reductions, in the two brake cylinders which remained intact after the accident. With the air-brake system properly charged, movement of the engineer's brake valve to first service position effected an initial brake-pipe reduction of approximately 8 pounds, after which brake-pipe pressure continued to reduce at the normal restricted rate. Brake-cylinder pressure began to build up after equalizing-reservoir and brake-pipe pressures had been reduced approximately 7 pounds. Brake-cylinder pressure of 54 pounds was obtained with a service brake-pipe reduction of 20 pounds. During those tests the brake valve functioned properly in all positions.

The investigation disclosed that on the day of the accident train No. 302 was assembled at White River Jct., Vt., 103.76 miles north of the point of accident. A terminal test of the air brakes was made after the locomotive was coupled to the train. The car inspectors who inspected the train took no exception to the condition of any of the equipment. During this inspection the engineer made a brake-pipe leakage test and he took no exception to the rate of leakage in the train. The train departed from this point at 3:25 a.m., 5 minutes Late. A running test of the brakes was made immediately after departure from this terminal, and stops were made at Lebanon, Franklin, Concord, Bow, and Manchester, N. H., located, respectively, 94.14, 52.83, 34.16, 32.14, and 16.52 miles north of the point of accident. In each instance the brakes functioned properly to control the speed of the trains This train departed from Manchester approximately 15 minutes before the accident occurred. The temperature at Canaan, N. H., 85.71 miles north of the point of accident, as reported to the train dispatcher at 12:01 a.m., was 32 degrees and it was 42 degrees at that point at 6 a.m. The minimum temperatures at other reporting points in this territory at the same hours were, respectively, 36 degrees and 37 degrees.

Examination of the tape of the speed-recording device disclosed that between Manchester and South Manchester, a distance of 1.74 miles, the speed of the train was first increased to 54 miles per hour and then reduced to about 28 miles per hour in compliance with a speed restriction at the latter point. The speed was then increased within a distance of approximately 4 miles to a maximum of 73 miles per hour, after which there was deceleration to about 70 miles per hour. Throughout a distance of approximately 10 miles immediately north of the point of accident an indicated speed of about 70 miles per hour was maintained and there was no appreciable reduction in the speed of the train before it entered the curve on which the accident occurred.

No conditions were found in any of the inspections or tests which would have caused the brakes of any of the equipment of this train to become inoperative. The brakes of the train were last used at South Manchester and they functioned properly to control the speed of the train. Under these circumstances, it appears that the speed of the train would have been properly controlled at the point of accident if braking action had been initiated a reasonable distance before reaching the point at which the speed restriction applied.

Cause

This accident was caused by excessive speed on a curve.

Dated at Washington, D. C., this twenty-seventh day of December, 1954.

By the Commission, Commissioner Clarke.

(SEAL) GEORGE W. LAIRD,

Secretary.

FOOT NOTE:

1. Under authority of section 17 (2) of the Interstate Commerce Act the above-entitled proceeding was referred by the Commission to Commissioner Clarke for consideration and disposition.

Inv-3272

INTERSTATE COMMERCE COMMISSION

WASHINGTON

INVESTIGATION NO. 3272

BOSTON AND MAINE RAILROAD REPORT IN RE ACCIDENT AT CANAAN, N, H., ON

AUGUST 19, 1949

SUMMARY

Date:	August 19, 1949	
Railroad:	Boston and Maine	
Location:	Canaan, N. H	
Kind of accident:	Head-end collission	
Trains involved:	Passenger	: Passenger
Train numbers:	332	: 307
Engine numbers:	Diesel-electric unit 3807	: Diesel-electric units 4225-A and
Consists:	6 cars	7 cars
Estimated speeds:	Standing	40 m. p. h.
Operation:	Timetable, train orders and automatic block-signal system	
Track:	Single; tangent; 0.28 percent descending grade northward	
Weather:	Clear	
Time:	2:34 p.m.	
Casualties:	235 injured	
Cause:	Switch being opened immediately in front of approaching train	

Recommendation: That the Boston and Maine Railroad install electric switch-looking at main-track and hand-operated switches in automatic block-signal territory

INVESTIGATION NO. 3272

IN THE MATTER OF MAKING ACCIDENT INVESTIGATION REPORTS UNDER THE ACCIDENT REPORTS ACT OF MAY 6, 1910.

BOSTON AND MAINE RAILROAD

October 6, 1949

Accident at Canann, N. H., on August 19, 1949, caused by a switch being opened immediately in front of an approaching train.

REPORT OF THE COMMISSION I

PATTERSON, Commissioner:

On August 19, 1949, there was a head-end collision between two passenger trains on the Boston and Maine Railroad at Canaan, N. H., which resulted in the injury of 221 passengers, 6 persons carried under contract, and 8 train-service employees. This accident was investigated in conjunction with representatives of the New Hampshire Public Service Commission.

Diagram

Inv. No. 3272 Boston and Maine Railroad Canaan, N.H. August 19, 1949

mpshire Division extending between White River Jct., Vt., and Concord, N

H., 6[illegible] ch trains are operated by timetable, train orders and an automatic block-signal s[illegible]naan, [illegible]06 miles south of White River Jct., a siding 4,340 feet in length parallels the main track on the west. The s[illegible] witch [illegible],992 feet south of the station. A siding 1,170 feet in length, designated as the passenger siding, lies between the main track and the other siding. The north and south switches of the passenger siding are, respectively, 684 feet north and 486 feet south of the station, which is located east of the main track. The accident occurred on the passenger siding at a point 251 feet north of the south switch. Entry to the passenger siding from the south is made through a No. 10 turnout having a maximum curvature of 7 degree 05. From the south on the main track there are, in succession, a tangent 1,040 feet in length, a 2 degree 30' curve to the left 2,060 feet, and a tangent 683 feet to the south switch of the passenger siding and 1,617 feet northward. The grade for north-bound trains varies between 0.18 percent and 0.28 percent descending throughout a distance of 3,534 feet immediately south of the point of accident, and is 0.28 percent descending at that point.

The automatic block-signal system is arranged on the overlap principle. Signal 1239, governing northbound movements, is located 5,005 feet south of the south passenger siding-switch. This signal is of the two-arm, semaphore type, and displays three aspects in the lower quadrant. It is approach lighted. The involved aspect and the corresponding name and indication of this signal is as follows:

Aspect Indication Name

Diagonal over Proceed Clear

diagonal

The switch stand at the south passenger siding-switch is of the horizontal-throw, low-stand type, and is located 4 feet 2-1/2 inches west of the west rail. It is provided with a rectangular red target measuring 8 inches by 12 inches. The center of the target is 1 foot 8 inches above the level of the tops of the ties. When the switch is lined normally the target is parallel to the track. When the switch is lined for entry to the siding the target is displayed at right angles to the track.

This carrier's operating rules read in part as follows:

104. * * *

* * *

A train or engine must not foul a track until switches connected with the movement are properly lined, * * * and when waiting to cross from one track to another and during the approach or passage of a train * * * on tracks involved, all switches connected with the movement must be secured in the normal position. * * *

104c. * * *

Employes must not unlock or stand within twenty feet of main track switches while a train is approaching or passing.

210. * * *

* * * Conductors must show train orders when practicable to trainmen. * * * trainmen must insist on seeing, and or required to read, train orders * * * at first opportunity * * *.

Timetable special instructions read in part as follows:

88. TRACKS TO BE USED IN MEETING OR PASSING TRAINS AT DESIGNATED POINTS.

***

At Canaan, scheduled passenger trains taking siding to meet or pass another train will use "Passenger Siding."

* * *

South-bound, trains are superior to trains of the same class in the opposite direction.

In the vicinity of the point of accident the maximum authorized speed for passenger trains is 60 miles per hour.

Description of Accident

No. 332, a south-bound first-class passenger train, consisted of Diesel-electric unit 3807, one mail-baggage car, one passenger-baggage car, two coaches, one chair car, and one coach, in the order named. All cars were of all-steel construction. At White River Jct. the crew received copies of train, order No. 23, reading as follows:

No. 332 meet No. 307 at Canaan.

This train departed from White River Jct. at 1:55 p.m., on time. At Lebanan, 13.44 miles north of Canaan, the crew received copies of train order No. 24,. reading as follows:

N 332 take siding at Canaan to meet No. 307.

No. 332 departed from Lebanon at 2:09 p.m., 2 minutes late, departed Thom Enfield, the last open office, 6.8 miles north of Canaan, at 2:22 p.m., 3 minutes late, entered the passenger siding at Canaan at the north switch, and stopped opposite the station at 2:32 p.m., with the front end 251 feet north of the south switch. About 2 minutes later it was struck by No. 307.

No. 307, a north-bound first-class passenger train, consisted of Diesel-electric units 4225-A and 4225-B, coupled in multiple-unit control, two milk car, one mail-baggage car, one passenger-baggage car, one coach, chair car, and one coach, in the order named. The second car was of steel-underframe construction, and the other cars were of all-steel construction. At Franklin,