In re Investigation of an accident which occurred on the Great Northern Railway near Tye, Wash., February 19, 1917.

April 10, 1917.

On February 19, 1917, there was a derailment of a freight train on the Great Northern Railway near Tye, Wash., which resulted in the death of one employee, and the injury of two employees. After investigation of this accident the Chief of the Division of Safety reports as follows:

This accident occurred on the first district of the Cascade Division of the Great Northern Railway, a single track line extending from Leavenworth, Wash., at the foot of the eastern slope of the Cascade Mountains, to Everett Junction, on the west slope of the mountains, a distance of 109.6 miles. Train movements between Leavenworth and Skykomish, a distance of 57 miles, are governed by the electric train staff; and between Skykomish and Everett Junction they are governed by time-table and train orders, the latter being transmitted by telephone and telegraph.

At a point 32.3 miles west of Leavenworth is located Cascade Tunnel station, approaching which point from the east, ascending the side of a mountain, there is a grade of 2.1 per cent. The eastern portal of Cascade tunnel is about 800 feet west of this station. The tunnel is approximately 2.6 miles in length, and the grade through it is 1.7 per cent. descending westward. About 1,100 feet west of the west portal of the tunnel is Tye station, for about one-half of which distance the track is laid on a 6-degree curve to the right. Descending westward from the tunnel the grade is 2.2 per cent. The track between Tye and the point of derailment, a distance of 1.8 miles, is laid in a southwesterly direction on the west slope of the mountain.

Beginning 900 feet west of Tye, and extending to a point immediately east of the point of derailment, the track is covered by a snowshed, as a protection against snowslides. Approaching the point of accident from the east, there are 2,157 feet of tangent track, followed by a 2-degree curve to the left, 485 feet in length; there is then a 1-degree 30-minute curve to the left, 1400 feet in length, followed by a 6-degree curve to the left, 314 feet in length, at the west end of which latter curve the derailment occurred. At the time of the accident the weather was cloudy.

At Tye there is a safety spur track, extending 1,800 feet up along the side of the mountain, to be used to stop runaway trains. The switch is normally set for the spur track, and if a train, descending the mountain, is under control, the engineman is required to sound four blasts of the whistle when approaching Tye, as a signal for the operator to throw the switch for the main line.

Westbound freight train No. 401 consisted of 23 empty cars, 31 loaded cars and a caboose, hauled by locomotive 1913, a Mallet, or 2-6-6-2 type, locomotive, and was in charge of Conductor Pierce and Engineman Dean. This train was called to leave Leavenworth at 11.30 a. m., but was delayed 42 minutes in the yards on account of work being done on the air brakes, it leaving Leavenworth at 12.12 p. m., with helper locomotive 1764 between the 36th and 37th cars, and helper locomotive 1911 between the 41st and 42d cars. Upon its arrival at Cascade Tunnel, at 5.05 p. m., the brakes were applied, and locomotive 1913 was cut off in order to take water. The helper locomotives were cut out of the train, locomotive 1764 being placed behind the caboose to assist in starting the train from that point. After locomotive 1913 had taken water it was again coupled to the train, and two brakemen went over the train and turned up the retainers, as required by a special time-table rule, which provides that all retainers must be used from Cascade Tunnel to Skykomish. After a permissive staff had been received, the train left Cascade Tunnel station at 6.14 p. m., having been delayed there 1 hour and 9 minutes. When about the entire train had entered the tunnel, the engineman shut off steam, and the train had attained a speed of about 35 miles an hour when the engineman made an application of the air brakes, it being then discovered that the air was not working through the train line. The fireman immediately took his lantern, started back over the train, and found that the angle cocks between the tender and first car were closed. After opening the angle cocks, he returned to the engine, placed the brake valve in the release position and told the engineman to leave it thus until the train line was charged. However, the engineman, in quick succession, made three emergency applications of the brakes, each before there was sufficient air in the train line to give full effect to such an application. The speed was estimated to have been more than 60 miles an hour when the train passed Tye, and it was derailed about 1.8 miles beyond Tye, just after the engine emerged from the snowshed previously described, while traveling at a speed estimated to have been about 90 miles an hour.

The locomotive came to rest on its left side, clear of the track, about 400 feet beyond the point of derailment, while the tender sistern lay about 30 feet farther west. The

first six cars were thrown down the mountain side a distance of 150 feet, the second, third and fourth cars being demolished. The next five cars were derailed but did not go down the mountain side. The following 24 cars were piled up in a space 120 feet in length and extending 125 feet up the side of the mountain. The 36th, 37th and 38th cars were derailed and slightly damaged, while the remaining 16 cars and the caboose were not derailed or damaged.

Engineman Dean was killed in the accident.

Fireman Nelson stated that his train came to a stop at Cascade Tunnel with the locomotive just clear of the station. The locomotive was uncoupled, water was taken, and the locomotive was recoupled to the train. He stated that he did some work about the engine and did not know whether or not the air brakes had been tested. He then went into the station and remained there about five minutes, the engineman also entering before he went out. He said that when the engineman came out of the station, accompanied by the conductor and two brakemen, the engineman exclaimed, "We are ready to go," but when he attempted to start the train he found it impossible to do so. Fireman Nelson stated that the engineman took the slack in the train four times, each time reversing his engine, and after he reversed the last time he worked steam, with the engine in backward motion, and "bunched the slack" well, after which he succeeded in starting the train forward. He said that during these movements the helper engine on the rear only kept up the slack. He stated that when the train entered the tunnel it began to gain speed, and that the engine was at least a train length in the tunnel before the steam was shut off, the speed then being about 35 miles an hour. He said that the engineman then put the brake-valve handle through the intermediate notches and into the emergency position, but there apparently was no air. Fireman Nelson stated that he immediately got off his seatbox, told the head brakeman that he was going back to inspect the train, and when he reached the first car he found that the air hose was coupled between it and the tender, but that both angle cocks were closed. He stated that he opened them, returned to the engine, found that the engineman still had the brake-valve handle in the emergency position, and that he placed it in the release position and told the engineman to leave it there until the train line was charged. Fireman Nelson stated that he then went over to his side of the engine, because of having the injector working, but he had no more than sat down when the engineman made an emergency application. He then went over to the engineman's side of the locomotive and told him to place the brake valve in the release position and leave it so until the train line pressure was fully restored, but again had no sooner returned to his side of the locomotive than the engineman made an emergency application. He said that he again went over and repeated his previous instructions, then watched

the gauge for one or two seconds, saw that the pressure equalized and then started to go down. He then returned to his side of the engine and shut off the injector, at which time the engineman again made an emergency application of the brakes. Fireman Nelson stated that he shut off the firing valve, got on the tender, and pulled the cord, closing the oil valve. By that time the locomotive was out of the tunnel, and he said that he heard one blast of the whistle, after which he jumped from the locomotive. He thought the speed was more than 60 miles an hour when the train passed Tye. Fireman Nelson stated that this was his first trip with Engineman Dean, who was a new man in this section, and he had impressed him as being careful.

Conductor Pierce stated that he was familiar with the section on which the accident occurred, and that his train stopped on the westbound passing track at Cascade Tunnel between 5.00 and 5.05 p. m. Helper locomotives 1911 and 1764 were cut out of the train, and locomotive 1764 was placed behind the caboose and shoved the train together. He said that when locomotive 1913 had taken water and returned to the train the rear brakeman gave a release signal from the rear of the train, the brakes being released by the engineman on locomotive 1913. The rear brakeman then started forward, the head brakeman starting toward the rear, and when the two met they began to turn up retainers, proceeding in opposite directions, this being at about 5.25 p. m., at which time he was at the head end of the train. He further stated that the train left at about 6.15 p. m.; that locomotive 1764 helped his train to start; that it was necessary to take the slack three times; that he was at the station, watched the train pass, and while he did not notice the brakes, he did notice that there were none sticking; and that he caught the caboose. He also stated that while it is his custom to ride on the engine through the tunnel, then drop off, see that the brakes are working properly, and catch the caboose, in this instance he had a premonition that the train would be running very fast through Tye, thus making it impossible to catch the caboose and necessitating the holding of the train at the next station, and he therefore caught the caboose at Cascade Tunnel, the speed of the train then being 13 or 14 miles an hour. Conductor Pierce stated that he looked at the air gauge and saw that it registered only between 20 and 25 pounds, whereupon he opened the valve, set the hand brakes at both ends of the caboose and on three cars, but was unable to proceed farther because of the smoke in the tunnel. Conductor Pierce stated that the method of testing the brakes at Cascade Tunnel is for the engineman on the head engine to release the brakes, the trainmen then inspecting them to see that all have re-

leased, and turning up retainers. He said that after locomotive 1913 had coupled onto the train after taking water, the angle cocks between the tender and first car apparently were open, as the air pumps worked two or three minutes, and he believed that, between that time and when the train left, someone must have passed over or under and knocked the angle cocks shut. He said the speed was about 90 miles an hour when the derailment occurred.

Middle Brakeman Mathewson stated that after the helper engines had been cut out and locomotive 1764 had been coupled to the rear end, that locomotive pushed the cars, which had originally been in the rear of it, up against the train proper; and that he made the coupling and turned the angle cocks open at that place. A signal was sounded from locomotive 1764 for locomotive 1913 to release the brakes, and he went forward to see if all the brakes had released, continuing until he met the head brakeman, who had performed a similar duty, beginning at the head end. He stated that he then turned up retainers to the rear end and the head brakeman turned up retainers to the head end. Before the train started, Brakeman Mathewson went forward to the engine, remarked to the head brakeman that it would be difficult to move the train, and after two unsuccessful attempts had been made to start he went back to see what was wrong, but on the third attempt the train was started and moved along nicely. When about the 25th car passed him he heard a brake sticking slightly, knocked down the retainer, but secured no release; he also failed to secure releases on a few other cars that he tried, the air pressure being weak. He stated that he caught the caboose as it passed him, looked at the gauge and exclaimed, "We haven't got it;" that he opened the conductor's air brake valve, this being at a point about 25 car lengths before the train tipped over the hill, but without effect; and that the rear brakeman then opened an angle cock, at which time the conductor boarded the caboose.

Rear Brakeman McLean stated that before his train left Cascade Tunnel he noticed the brakes sticking a little on two cars near the caboose, and he released them. He said he knew that the air was working through the train and that the brakes were set, else the train would have started backward. He was the first one to board the caboose after the train started, and when near the station he looked at the gauge and saw that it registered between 80 and 85 pounds.

Head Brakeman O'Connor said he was certain that he opened the angle cocks between the tender and the first car when his locomotive was coupled onto the train after taking water, at Cascade Tunnel. He stated that the proper way to test the brakes, after the locomotive returns to the train, is to apply them from the locomotive, but that in this instance

no such test was made. He thought the speed was eight or nine miles an hour when the engineman shut off steam, in the tunnel.

Engineman Matthews, of helper locomotive 1764, stated that after the head engine was cut off, and the helper locomotives cut out of the train, his locomotive coupled to the rear 13 cars, pushed them up against the rest of the train, and he made a 15-pound application of the brakes on those cars. He said the brakes were then cut in, between these cars and the main part of the train, causing the indicator on his air gauge to drop to zero. The rear brakeman then cut off his engine and he backed it away two or three car lengths, to make certain that the train was properly coupled together. After locomotive 1915 was recoupled to the head end of the train he sounded a whistle signal for the engineman to release the brakes, saying that this is always done, and the head engineman then releases, knowing that the slack will not run out. Engineman Matthews further stated that he knew that in order to be certain that the air was working through the train line, it would be necessary to apply the brakes from the engine, and that in some cases this has been done, while in other cases it has not been done. He admitted that without doing so, the engineman would not have positive assurance that the air was working through the entire train line, although the pumps would work after the engine had been recoupled to the train after taking water, and some information would be furnished by the gauge indication. He stated that when train No. 401 left Cascade Tunnel his engine pushed it for about 20 car lengths.

Fireman Maddox and DeLong, of the two helper locomotives, stated that when a freight train stops at Cascade Tunnel the brakes are applied, and the engine is cut off to take water; that when the engine is recoupled to the train the air is not again applied; but that when the air is again pumped up it gives the trainmen assurance that the air is through the train line. Fireman DeLong stated that the brakes are released upon receipt of a signal from the rear of the train, and the trainmen then proceed to turn up retainers.

Operator Collins, at Tye, stated that at 6.14 or 6.15 p. m. the operator at Cascade Tunnel notified him that there was a train in the tunnel. He said that he went out to the switch leading to the high line, or safety spur track, which was set for the high line but was not locked, and when the train was about 150 yards distant the engineman sounded four blasts of the whistle, in accordance with which signal he threw the switch for the main track, failing to notice that the train was approaching more rapidly than usual. He then started toward the station and a fireman, who was standing on the platform, told him to set the switch for the high

line again, but the engine passed before he could reach the switch. Operator Collins stated that this switch is always set for the high line as soon as a train has passed.

Fireman Tucker, of another westbound train, who was standing on the station platform at Tye when train No. 401 passed, said that he saw the operator throw the switch for the main line, the approaching train having sounded what seemed like four blasts of the whistle, but that Mallet locomotives, when riding hard, have a tendency to lend a treble effect to a blast of the whistle. He said that when the train emerged from the tunnel it was pounding as if there was something wrong, and when it drew nearer he saw that it was running too fast, and he told the operator to run for the switch, but it was too late.

Car Foreman Laden, at Leavenworth, stated that in making the yard test of air brakes at that place, the yard line is used, and if an engine leaves the train the air brakes remain set, and when the engine returns no further application is made from the engine before the brakes are released. He said that if the brakes were set and allowed to remain so for an hour and a half, without recharging, it would be possible for the air to leak off to such an extent that the train could be moved. Car Foreman Laden further stated that 100 per cent. of the brakes must be in operative condition before a train leaves that place.

This accident was caused by the failure of the crew of train No. 401 to make the prescribed air brake test after the engine had been coupled to the train and it was ready to leave Cascade Tunnel; and by the failure of Brakeman O'Connor to turn the angle cocks open between the tender and the first car when connecting the air brake train line, resulting in the absence of compressed air from the train line and the consequent failure of the brakes to operate when needed to control the train on the grade.

While Head Brakeman O'Connor stated that he was sure he had opened the angle cocks between the tender and the first car, after his locomotive had returned from taking water, at Cascade Tunnel, and while Conductor Pierce stated that he thought the angle cocks were accidentally knocked shut some time after the brakes had been released, it is believed that these statements do not represent facts, because it is not probable that both angle cocks would have been accidentally closed by some one passing between the tender and the first car. It is also believed that, had the crew of locomotive 1913 been fully awake to their responsibilities, when their locomotive was coupled to the train after taking water, they would have noticed that the two air pumps with which the locomotive was equipped did not work as long as they would have done if the angle cocks had been open and the air been working through the train line.

The method employed by the crew in testing the brakes in this and practically all instances, according to the statements of employees involved, is not in conformity with the instructions contained in a special time-table rule, which provides as follows:

> "Additional to other required tests of the air brake, no train will leave Cascade Tunnel until the air brakes have been carefully tested. Engineer will set the brakes and leave them set until trainmen examine each car, then release them, and trainmen will again examine each car and see that brakes release before giving the signal to start the train. Conductors must inform engineer how many cars loaded and empty in the train, and how many cars of air are working."

Investigation disclosed that in this instance the brakes were applied immediately upon the arrival of the train at Cascade Tunnel, that they were not again applied, or the train line recharged, before leaving there. The train was at Cascade Tunnel 1 hour and 9 minutes, and it is believed that in that time the brakes leaked off sufficiently to admit of the brakeman thinking that they had been released, and that the brakes that were found sticking, when it was attempted to start the train, were some that had not entirely leaked off.

According to the statement of the car foreman at Leavenworth, it is not the practice to comply with the requirements of rule 475, of the operating rules of this railway, which reads as follows:

> "Before leaving terminal stations engineers must apply the air brake and maintain applications long enough to enable inspectors or trainmen to see that they are in good working condition throughout trains."

Rule 476 reads as follows:

> "When cars are picked up or cut out of trains a similar test for like reasons must be made before proceeding."

Had the crew of train No. 401 complied fully with the requirements of the special time-table rule quoted, and of rule 476, it would have been discovered that the air was not working through the train line, as there would have been no application of the brakes throughout the train when applied from the engine, on account of the angle cocks being closed.

To prevent the occurrence of accidents of this character the rules prescribing the test and inspection of air brakes at Cascade Tunnel should be rigidly enforced, in order

that train crews may know positively the condition of the brakes on their trains when leaving there.

Engineman Dean also used poor judgment, in allowing the speed of the train, in the tunnel, to reach between 25 and 30 miles an hour before trying the brakes.

As disclosed during the investigation, it is the practice for the operator at Tye, upon receipt of a four-blast whistle signal from the engine of an approaching westbound train, to set the high-line switch for the main track. However, the circumstances of this accident reveal the inherent weakness of such a method. The fireman of train No. 401 stated that he heard only one blast of the whistle as his train emerged from the tunnel, but the operator and another fireman, who were at the station at Tye, heard what sounded like four blasts of the whistle, the latter fireman stating that engines of the Mallet type, when riding hard, sometimes give a treble effect to a blast of the whistle. This is evidently what occurred in this case, the operator thereby being misled to throw the switch for the main track. In view of this fact, it would appear that the only safe method would be to require that trains be brought to a stop at Tye before the switch is thrown for the main track, thus eliminating the possibility of a misunderstanding.

Conductor Pierce entered the service of this railway as brakeman January 6, 1910, and was promoted to freight conductor August 7, 1910. Engineman Dean entered the service as engine wiper November 5, 1906, was promoted to fireman December 12, 1906, and was promoted to engineman March 22, 1910.

At the time of the accident the crew of train No. 401 had been on duty about 6 hours and 30 minutes.