INTERSTATE COMMERCE COMMISSION

WASHINGTON

REPORT OF THE DIRECTOR

BUREAU OF SAFETY

ACCIDENT ON THE

LOUISVILLE & NASHVILLE RAILROAD

KIRKSTALL, TENN.

FEBRUARY 1, 1940

INVESTIGATION NO. 2413

SUMMARY

Inv-2413

Railroad:	Louisville & Nashville		
Date:	February 1, 1940		
Location:	Kirkstall, Tenn.		
Kind of accident:	Rear-end collision		
Trains involved:	Freight	:	Freight
Train numbers:	Fourth 53	:	Fifth 53
Engine numbers:	1523	:	1512 - 1548
Consist:	35 cars and caboose	:	60 cars and caboose
Speed:	Standing	:	25 - 30 m. p. h.
Operation:	Timetable, train orders, and an automatic block-signal and automatic train-control system		
Track:	Single; 3° curve to the right; level		
Weather:	Clear		
Time:	8:50 p. m.		
Casualties:	1 killed, 4 injured		
Cause:	Failure to provide adequate flag protection for preceding train and failure to provide adequate stopping distance between signals involved for maximum authorized speed.		

Inv-2413

April 30, 1940.

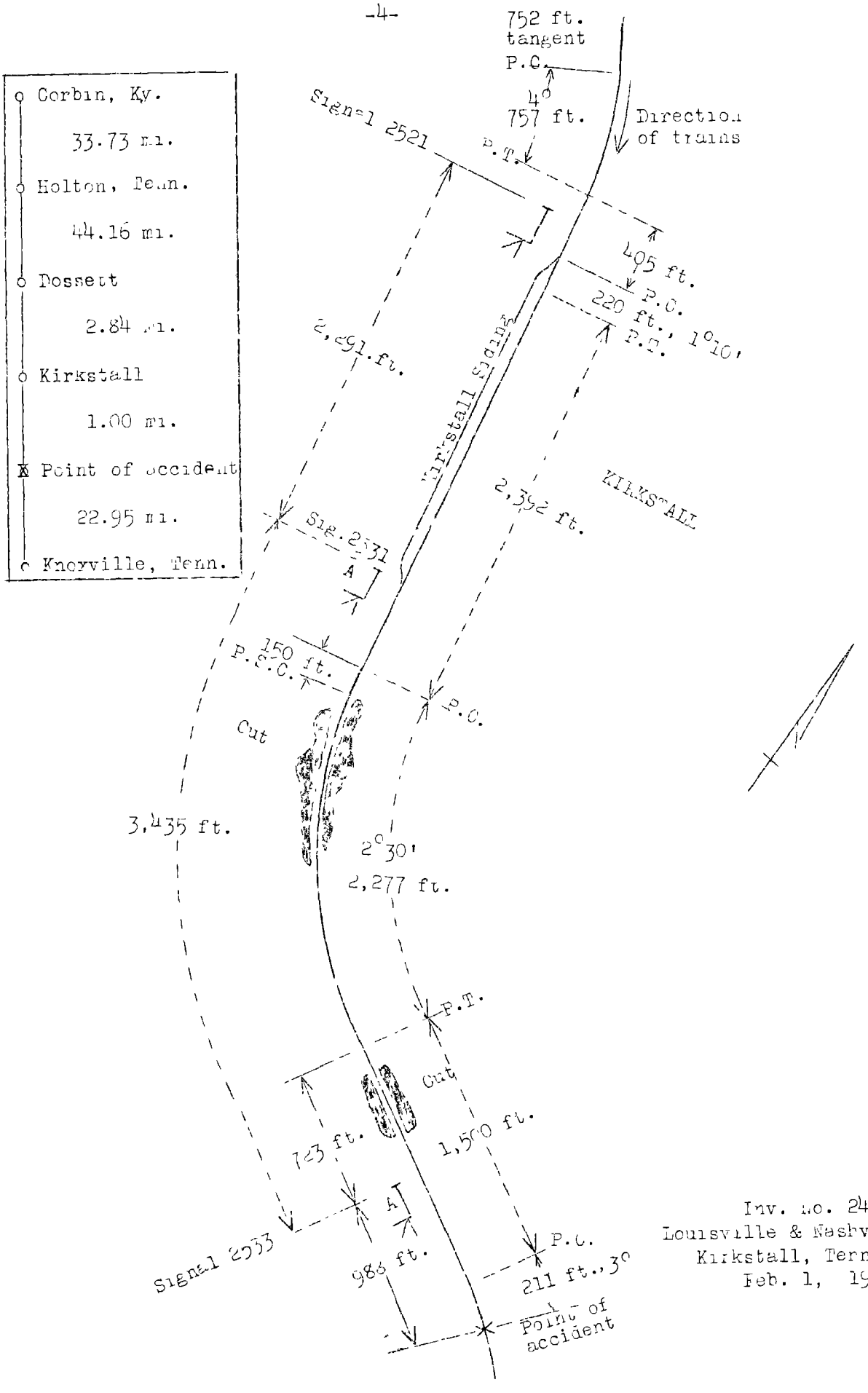
To the Commission:

On February 1, 1940, there was a rear-end collision between two freight trains on the Louisville & Nashville Railroad near Kirkstall, Tenn., which resulted in the death of one employee and the injury of four employees.

Location and Method of Operation

This accident occurred on that part of the Knoxville and Atlanta Division which extends between Corbin, Ky., and Knoxville, Tenn., a distance of 104.68 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 and automatic train-control system. At Kirkstall a siding 2,243 feet in length parallels the main track on the west; the accident occurred at a point 4,436 feet south of the south switch of this siding. Approaching the point of accident from the north there are, in succession, a tangent 752 feet in length, a 4° curve to the right 757 feet in length, a tangent 405 feet in length, a 10°0' curve to the left 220 feet in length, a tangent 2,392 feet in length, a 2°30' curve to the left 2,277 feet in length, a tangent 1,500 feet in length, and a 3° curve to the right extending 211 feet to the point of accident and 1,104 feet beyond. The grade for south-bound trains is slightly undulating a distance of 4,900 feet and then level a distance of 2,315 feet to the point of accident and 436 feet beyond.

The automatic train-control system is of the continuous inductive type; each engine in this territory is equipped with a 2-indication color-light cab-indicator which displays a green light when the train is operating under a proceed indication displayed by a wayside signal or when approaching a B point and a red light after passing the B point when approaching a wayside signal displaying a stop indication. The cab-indicator and the automatic train-control apparatus are actuated at a B point located either at a signal displaying an approach indication or at stopping distance from a signal displaying a stop indication; the location of the B point is predicated upon a predetermined maximum authorized speed. The system is so arranged that when a locomotive passes a B point in a restrictive block the cab-indicator changes from green to red, and if the change of indication is not acknowledged by the engineman within the delay time, which is about 6 seconds when the speed is 35 miles per hour or higher, an automatic split application of the brakes sufficient to stop the train will be made. If the speed of the train is in excess of 20 miles per hour, in order to forestall



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an automatic application, the engineman must operate the acknowledging lever, and, in addition, make a manual service application of the brakes to bring the speed of the train below 20 miles per hour, whereupon the brakes may be manually released. If the speed of the train is below 20 miles per hour and the engineman acknowledges the change of indication by operating the acknowledging lever within the delay time which increases as speed is reduced, an automatic brake application will be forestalled.

The automatic block system is of the absolute-permissive type. Signals 2521, 2531, and 2533 are located 6,714 feet, 4,423 feet, and 988 feet, respectively, north of the point of accident. These signals are of the three-indication, upper-quadrant, semaphore type, approach lighted. The aspects, indications and names of the signals involved and the corresponding rule numbers are as follows:

Signal No.	Aspect	Indication	Name	Rule No.
2521	Green	Proceed	Clear	281
2531	Yellow	Prepare to stop at next signal. Train exceeding medium speed must at once reduce to that speed.	Approach	285
2533	Red	Stop; then proceed in accordance with Rule 509 (B)	Stop and Proceed	291

Medium speed is defined as: One-half maximum authorized speed at point involved, not exceeding thirty miles per hour.

Restricted speed which is prescribed by Rule 509 (B) is defined as: Proceed prepared to stop short of train, obstruction, or anything that may require the speed of a train to be reduced.

Between the south switch of the siding at Kirkstall and the point of accident there are four cuts ranging in depth from 2 to 22 feet. Signal 2533 can be first seen from the left side of an engine of a south-bound train a distance of 1,228 feet.

Rules of the transportation department read in whole or in part as follows:

99. When a train stops under circumstances in which it may be overtaken by another train, the flagman must go back immediately with flagman's signals a sufficient distance to insure full protection. At a point one-fourth of a mile from the rear of his train, he will place one torpedo on the rail, continuing back to a distance of not less than one-half mile from the rear of his train, he will place two torpedoes on the rail one rail length apart. If on descending grade, or the view is obscured by curve, weather conditions, or in any other manner, he must go as much farther as may be necessary to reach a point where he is absolutely sure he can be seen by a train at a sufficient distance in which to stop.

* * *

99(b). Should a train be seen or heard approaching before flagman has reached the required distance, he must at once place one torpedo on the rail, and by night or during foggy or stormy weather, he will, in addition, display a lighted red fusee, continuing in the direction of the approaching train as rapidly as possible.

* * *

* * *

99(j). Enginemen are required, before coming to a stop at unusual points, and at usual stopping points when it is known by the engineman that his train will be delayed, to sound the whistle signal prescribed by Rule 14(c). Failure of the engineman to sound this signal will in no manner relieve conductor and flagman from protecting the train.

* * *

Rule 4(c) of the regulations governing use of automatic train control reads as follows:

> The two-light cab indicator located in the cab in the enginemen's line of vision. The purpose of the cab indicator is to give the engineman a continuous visual signal of the condition of the track ahead. When the indicator is showing a GREEN light maximum allowable speed is permitted. When the indicator is showing a RED light the track ahead is occupied or obstructed and the speed must be controlled in accordance with rules or special instructions.

The maximum authorized speed for freight trains in the vicinity of the point of accident is 45 miles per hour.

The weather was clear at the time of the accident, which occurred at 8:50 p. m.

Description

Fourth 53, a south-bound second-class freight train, with Conductor Collins and Engineman Mauney in charge, consisted of engine 1523, 35 loaded cars and a caboose. This train departed from Holton, 47 miles north of Kirkstall, at 4:13 p. m., according to the train sheet, 6 hours 52 minutes late, passed Dossett, the last open office, 2.84 miles north of Kirkstall, at 8:22 p. m., 9 hours 18 minutes late, stopped at a point approximately 1 mile south of Kirkstall between 8:30 and 8:35 p. m., according to the evidence, to replace a broken journal brass on a car, and about 8:50 p. m. the rear end was struck by Fifth 53.

Fifth 53, a south-bound second-class freight train, with Conductor Caughron and Enginemen DeLaney and Tillery in charge, consisted of engines 1512 and 1548, 60 loaded cars and a caboose, in the order named. This train departed from Holton at 5:14 p. m., according to the train sheet, 7 hours 53 minutes late, passed Dossett at 8:45 p. m., 9 hours 41 minutes late, passed signal 2531 displaying an approach indication, passed signal 2533 displaying a stop-and-proceed indication and, while moving at a speed estimated to have been 25 to 30 miles per hour, collided with the rear end of Fourth 53.

The caboose and the rear two cars of Fourth 53 were demolished. The two engines and the first 13 cars of Fifth 53 were derailed and stopped in a tangled mass of wreckage which was piled 3 cars high and confined within a distance of 195 feet; these cars were demolished. Engine 1512 stopped, headed north, on its left side 150 feet south of the point of collision on top of the wreckage at the west side of the track. The engine truck was torn off; the automatic brake-valve and its related piping were torn loose; Engine 1548 remained upright and stopped at the east side of the track and at an angle of 30 degrees to it.

The employee killed was the engineman of the second engine of Fifth 53, and the employees injured were the engineman of the first engine, both firemen, and one brakeman of Fifth 53.

Summary of evidence

Engineman Mauney, of Fourth 53, stated that the air brakes functioned properly en route. As his train was passing the south switch of the siding at Kirkstall at a speed of 40 or 45

miles per hour the front brakeman, who was on the left seat-box of the engine, called a warning to stop. He made a 10-pound brake-pipe reduction and then placed the brake valve in emergency position; the train stopped in a distance of about 70 car lengths. He understood that the rules required him to signal the flagman to protect the rear of the train before stopping at an unusual point, but in this instance he was preoccupied and failed to do so; however, immediately after the train stopped he signaled for the flagman to protect the rear of his train and saw him leave the caboose. He said that the front brakeman discovered a broken journal brass on the seventh car and, after the brakeman unloaded tools from the engine, a cut was made behind the seventh car and it was pulled up to the tools. The renewal of the brass was about completed when the engineman heard two short blasts of the engine whistle of Fifth 53 and about 2 minutes after the accident occurred. He said that he could not see Fifth 53 as it approached because the view to the rear was obstructed. He stated that his train stopped between 8:30 and 8:35 p. m. and the accident occurred at 8:50 p. m.

Fireman Luttrell, of Fourth 53, corroborated the statement of his engineman and added that the flagman was signaled out 10 or 12 seconds after the train stopped. He observed the flagman's lanterns moving back from the caboose until they disappeared from view around the curve. The fireman said that he remained on the engine during the renewal of the brass on the seventh car. As Fifth 53 approached and before the headlight came into view around the curve he heard the explosion of two torpedoes and soon afterward two short blasts of the engine whistle. He stated that the weather was clear and it was possible to see the position of the signal semaphores.

Front Brakeman Witt, of Fourth 53, stated that his train was passing the south switch of the siding at Kirkstall at a speed of 40 or 50 miles per hour when he observed fire flying under a car and called a warning to the engineman to stop. The train stopped in a distance of 80 or 90 car lengths. After 15 minutes elapsed and before completion of the renewal of the brass the accident occurred. The brakeman heard torpedoes exploded about 1 minute before the accident occurred.

Conductor Collins, of Fourth 53, stated that approaching the point of accident his train was moving at a speed of about 40 miles per hour when the air brakes were applied and the train stopped in a distance of 80 or 85 car lengths. It was 8:35 p. m. when the train stopped and the engineman immediately signaled the flagman to protect the rear of the train. He said that an engine whistle could not be heard at the rear of a train in motion because of the noise made by the car wheels. The flagman started back immediately with flagging equipment and the conductor started toward the front end of the train. The conductor

assisted in renewing the journal brass and the new brass was in place when he heard one torpedo explode and the engineman of Fifth 53 acknowledge his flagman's stop signals. Looking back he observed a lighted fusee which appeared to be on the curve south of Kirkstall. The accident occurred at 8:50 p. m., which was about 1 minute after the torpedo had exploded. He said that as his train was stopped about 15 minutes before the accident occurred, a fusee thrown off at the time the brakes on his train were applied south of Kirkstall would have burned out before Fifth 53 passed Kirkstall, since the fusees were of the 10-minute type. He thought that although the ties were covered with ice his flagman should have gone back a distance of about 100 car lengths in the time available.

Flagman Gass, of Fourth 53, stated that he was in the cupola of the caboose when the brakes were applied on his train at Kirkstall. Shortly after the train stopped the engine whistle sounded the signal for the flagman to protect the rear of his train and he started back to flag. Because of soft ground at the side of the track it was necessary to walk on the ties and ice on the ties hampered his progress. When he reached a point about midway of the curve south of Kirkstall he heard Fifth 53 whistle for Kirkstall and he immediately placed two torpedoes on the rail and lighted a fusee. He continued to walk northward waving stop signals which were acknowledged by the engineman of Fifth 53 just as the headlight came into view at the north end of the curve. The engine of Fifth 53 passed him at a speed of about 50 miles per hour and he turned and ran in the direction it was moving; when the collision occurred the caboose of Fifth 53 was opposite him. He believed that he went as far to the rear of his train to flag Fifth 53 as anyone could have gone under the same conditions.

Engineman DeLaney, of the first engine of Fifth 53, stated that when approaching Kirkstall his train was moving at a speed of 45 or 50 miles per hour. The air gauge indicated 110 pounds main reservoir and 70 pounds brake-pipe pressure. Signal 2521 at the north end of Kirkstall siding displayed a clear indication and when passing that signal he observed that signal 2531, the next signal in advance, displayed an approach indication. His view of signal 2531 was then momentarily obscured by trailing smoke and, thinking the signal might clear soon, he did not take action until the smoke cleared; then soon after his engine passed signal 2521, observing that signal 2531 was still displaying an approach indication, he made an initial brake-pipe reduction of 7 to 10 pounds. The brake-pipe exhaust, which appeared to be of normal length for a 60-car train, had just ceased when the fireman and the brakeman called a red-block and red-flag warning to him and he immediately placed the brake valve in emergency position. He felt a heavy run-in of slack and, as the emergency application of the brakes did not seem to be

effective, he opened the sand valve and reversed the engine. After his engine passed signal 2531 he acknowledged the red light which was displayed on the cab indicator; however, since the brakes were already fully applied there was no action by the automatic train-control system. The speed of his train was reduced to between 25 and 30 miles per hour at the time of the accident. He said the brakes functioned properly en route except that he thought they did not hold so well when approaching the point of accident, because, as the brakes did not apply on the second engine, a loss of braking power equivalent to that of 7 or 8 cars resulted. He said that it is customary for the engineman in charge of the second engine of a doublehead to secure the independent brake-valve in release position because of instructions not to permit overheating driving-wheel tires while braking on descending grades. He understood that immediately after observing a signal displaying an approach indication he was required to reduce to medium speed as quickly as possible. In this instance when he made the first brake application he thought it was sufficient to stop his train before passing signal 2533. He stated that he thought a full-service application of the brakes, if made at signal 2531, would not stop a train of 60 cars moving at the maximum authorized speed before it passed signal 2533. He thought he handled the braking the best way possible.

Fireman Smith, of the first engine of Fifth 53, stated that his train was stopped several times between Corbin and Kirkstall and the air brakes functioned properly. Approaching Kirkstall his train was moving at a speed of 40 or 50 miles per hour. After passing signal 2521, which was displaying a clear indication, the engineman eased off on the throttle and trailing smoke and steam obscured the fireman's view of signal 2531. After turning on the blower at a point about 20 car lengths north of signal 2531, he saw that signal displaying an approach indication and he called it to the engineman who answered, as he had done at all signals. The engineman made a brake-pipe reduction which the fireman thought was from 15 to 20 pounds. Soon after passing signal 2531 and before the brake application had become effective he saw the red aspect of signal 2533, the caboose markers of Fourth 53 and the flagman of that train running toward Fifth 53 and waving a lighted fusee. He called a warning to the engineman who placed the brake-valve in emergency position. Realizing that a collision was imminent he started back over the coal in the tender; he did not remember hearing torpedoes exploded. He estimated that the speed of his train at the time of the collision was about 30 miles per hour.

Front Brakeman Ault, of Fifth 53, stated that when his train was approaching Kirkstall the speed was about 45 miles per hour. He was on the left seat-box of the first engine and the

fireman was seated ahead of him. Trailing smoke and steam obscured his view of signal 2531 until the engine was about 20 car lengths north of the signal. He and the fireman simultaneously called the approach indication to the engineman, who answered. The engineman made a brake-pipe reduction which the brakeman thought was about 20 pounds. When they reached a point about 25 car lengths south of signal 2531 he observed the flagman of Fourth 53 in the cut waving a lighted fusee, and he and the fireman simultaneously called a warning to the engineman who immediately placed the brake-valve in emergency position. At this time the flagman of Fourth 53 was about 25 car lengths south of the south siding-switch at Kirkstall. Soon after the brakes were applied in emergency two torpedoes were exploded by his train. There was a heavy run-in of slack and the brake application did not seem to respond properly. The speed of the train was about 25 miles per hour at the time of the collision. He said the air brakes functioned properly throughout the trip prior to the accident. He thought that the engineman did all that possibly could have been done to stop the train after the approach signal was observed.

Fireman Cloud, of the second engine of Fifth 53, stated that approaching Kirkstall the speed of his train was about 40 or 50 miles per hour. His engineman was using a drifting throttle only. The fireman said that when his engine was rounding the curve north of Kirkstall and when at a point about 5 car lengths north of signal 2521 he observed that signal 2521 was displaying a clear indication and signal 2531 was displaying an approach indication. He could see the red aspect of signal 2533 when about 20 car lengths distant and at the same time he saw the flagman of Fourth 53 running toward Fifth 53 with a lighted fusee. He heard the explosion of torpedoes at a point approximately where the flagman stood. He thought that the speed of the train was reduced as much as could be expected in the distance traversed. He stated that during the trip his engineman had wired the independent brake-valve handle in release position to prevent the driving-wheel tires from becoming overheated and he thought the independent brake-valve was in that position at the time of the accident.

Conductor Caugaron, of Fifth 53, stated that at Corbin an air-brake test of all the cars of the train except the caboose was made; the air brakes functioned properly throughout the trip. Approaching Kirkstall he and the flagman were in the cupola of the caboose. At a point just north of Kirkstall the conductor observed that the gauge in the caboose indicated 70 pounds brake-pipe pressure, and when the caboose was passing the south switch of the house track, located approximately 1,590 feet north of signal 2531, he felt the air brakes become applied on the train and observed that a 20-pound brake-pipe reduction was

made. He said the speed of his train at this time was 45 or 50 miles per hour. The flagman remarked that he thought there was a fusee or a red block ahead; the conductor got up to look ahead and the accident then occurred; at this time the speed of his train had been reduced to about 25 miles per hour. He thought that when the air brakes were applied at Kirkstall they functioned properly. After the accident occurred he walked to the front end of his train and, as he passed, he saw at various places that the brakes were applied; however, he did not inspect each brake. When he reached the south end of the first car that was undamaged he closed that angle cock and raised the uncoupling lever. After the relief engine was coupled to the rear of his train he heard the brakes release. The weather was clear.

Flagman Raper, of Fifth 53, corroborated the statement of his conductor in all essential details.

Car Inspectors Clark and Hixon stated that at Corbin they conducted an air-brake test on Fifth 53 and the brakes applied and released properly on all cars.

Car Foreman Moore stated that subsequent to the accident an air-brake test was made on 46 undamaged cars of Fifth 53 and the air brakes applied and released properly on all cars except one; the pressure head-gasket on this car was blown out, and the piston travel on the remaining 45 cars was between 7 and 9 inches.

Hostler Summer stated that he tested the automatic train-control equipment on engine 1512 at Corbin prior to its departure and it functioned properly.

Signal Maintainer Duckett stated that subsequent to the accident he tested the signals involved and found them to be functioning as intended.

Mechanical Supervisor of Automatic Train Control Bose stated that he arrived at the scene of the accident at 3:10 a. m., February 2. He inspected both engines of Fifth 53 and found the electric and the pneumatic features of the automatic train-control on engine 1512 were cut in service. The acknowledging-valve lever was in the acknowledging position. The automatic train-control equipment was badly damaged as a result of the collision but his inspection did not disclose any defect which might have prevented it from operating as intended before the accident occurred. From his inspection at the scene of the accident and from the statement of the engineman involved he formed the opinion that the engineman had placed the brake-valve in emergency position before the expiration of the 6-second delay time and this forestalled an automatic train-control application of the brakes. The automatic train-control apparatus of engine

1548 was cut out of service; the throttle was in closed position and the independent brake-valve handle was secured in release position.

Signal Supervisor Atchison stated that the approach-lighting circuit for signal 2531 extends to a point 4,396 feet north of this signal.

Traveling Engineer Traylor stated that enginemen of second engines of doubleheaders are instructed to release the engine and the tender brakes when the brakes become applied on descending grades to prevent frequent reapplication of the engine and the tender brakes. These instructions have resulted in enginemen using a wire to secure the independent brake-valve handle in release position on grades when it is necessary to keep the engine and the tender brakes released. The practice of using wire to secure the independent brake-valve in release position in other locations is contrary to instructions and he did not know of any instance wherein an enginemen kept the independent brake-valve handle secured in release position other than while descending a grade. He stated that the braking power of the second engine would be equivalent to that of approximately eight cars. Enginemen are instructed to start braking as soon as a signal displaying an approach indication is visible and to reduce the speed of a train to medium speed as soon as possible and to be prepared to stop at the stop signal.

Operator Crutchfield, on duty at Dossett when the trains involved passed, stated that Fourth 53 and Fifth 53 passed his station at 8:22 p. m. and 8:45 p. m., respectively.

Superintendent Fulkerson stated that traveling engineers have instructed all enginemen to commence braking as soon as a signal displaying an approach indication is seen.

Records of the railroad disclose that in the vicinity of the point of accident on January 31, 1926, the maximum authorized speed for freight trains was 60 miles per hour; on December 15, 1932, it was 35 miles per hour, and at the time of the accident it was 45 miles per hour.

According to data furnished by the carrier, signals 2521, 2531, and 2533 are, at the present time, approximately at the same locations as when the automatic train-control installation was approved by the Commission in 1926.

According to observations made by officials subsequent to the accident, the night aspect of signal 2531 can be first seen from the right side of a south-bound engine a distance of 3,902 feet; however, to do so, it is necessary for the engineman to

look across the inside of a curve and a considerable distance from the track; it can be seen from the left side of a southbound engine a distance of 2,794 feet.

Observations of the Commission's Inspectors

The Commission's inspectors observed the results of air-brake tests conducted at the location of the accident with a train similar to Fifth 53. The first test was made by simulating as closely as possible the performance of Engineman DeLaney on the night of the accident; it was made with 2 engines, similar to those on Fifth 53, and 60 cars. While this train was moving at a speed of 50 miles per hour, as indicated by the speedometer, the engineman made a 10-pound brake-pipe reduction at signal 2531. Signal 2531, which was displaying an approach indication, was passed at a speed of 46 miles per hour and, at a point 400 feet south of this signal, the automatic train-control apparatus started a further reduction of the brake-pipe pressure which continued until the brake-pipe pressure was reduced to 35 pounds. At a point 1,228 feet north of signal 2533 the brake valve was placed in emergency position; the engine passed signal 2533 displaying a stop-and-proceed indication at a speed of 24 miles per hour and stopped at a point 888 feet south of the signal or 100 feet north of the point of accident. During this test the engine and the tender brakes on the second engine were held in release position; fairly heavy drifting throttles were used on both engines and sand was freely used under the first engine; the total braking distance was 6,614 feet. The second test, made with 2 engines and a train similar to that involved in the accident, was conducted to ascertain the braking distance required to comply with the rules and oral instructions governing the observance of a signal displaying an approach indication. When signal 2531 could be seen from a point 5,770 feet north of it and while the train was moving at a speed of 51 miles per hour, a full-service application of the brakes was made and the engine passed signal 2531 at a speed of 40 miles per hour and stopped at a point 1,365 feet north of signal 2533. The total stopping distance was 5,850 feet. During this test the engine and the tender brakes of the first engine were held released but the engine and the tender brakes of the second engine were permitted to apply. A fairly heavy drifting throttle was used on both engines and the rails were sanded. The standard brake-pipe pressure of 70 pounds was used in both tests; brake-cylinder piston-travel on both trains was within the prescribed limits.

Discussion

According to the evidence, Fourth 53 stopped about 8:35 p. m., with its rear end standing 988 feet south of signal 2533, to change a journal brass on the seventh car, and its rear end was struck by Fifth 53 at 8:50 p. m.

The flagman of Fourth 53 had reached a point about 2,900 feet to the rear of his train when the engine of Fifth 53 passed him. The employees on the engines of the following train could see the flagman a distance of only 1,000 feet because of embankments and track curvature; this gave Fifth 53 a distance of about 4,100 feet, after the flagman's signals came into view, in which to stop short of the rear of Fourth 53. Fourth 53 had been stopped at least 15 minutes before the accident occurred. If the flagman could have proceeded to the rear at a rate of 3 miles per hour during the 15-minute period available to him, he would have reached a point 3,960 feet north of the rear end of his train; at this point he would have been at the south end of a section of tangent track 2,392 feet in length, and, after the flagman's signals came into view, the engineman of the following train would have had a distance of about 6,400 feet in which to stop short of the rear of Fourth 53. In tests conducted subsequent to the accident a train similar to Fifth 53, moving at a speed of 51 miles per hour, was stopped as a result of a full-service brake-pipe reduction within a distance of 5,850 feet. The flagging rule provided that in case the view was obscured by track curvature the flagman must go back far enough to reach a point where he was absolutely sure that he could be seen by an approaching train at a distance sufficient in which to stop short of his own train.

The speed of Fifth 53 approaching Kirkstall was estimated at 40 to 50 miles per hour; the maximum authorized speed for this train was 45 miles per hour. The engineman of the first engine first saw the approach indication displayed by signal 2531 when his engine was near signal 2521; smoke then momentarily obscured his view of signal 2531 but as soon as he saw it again he made a brake-pipe reduction of about 7 or 10 pounds, according to his statement, and soon after passing signal 2531 he was warned by the front brakeman and his fireman that signal 2533 was displaying a stop indication and that a flagman was waving stop signals; he then placed the brake-valve in emergency position but his train overran signal 2533 a distance of 988 feet and, while moving at a speed of 25 or 30 miles per hour, collided with the rear end of Fourth 53. The engineman of the first engine said he thought he could stop short of signal 2533 but the brakes did not seem to hold as well as on previous occasions and he attributed this to loss of braking power because the independent brake-valve on the second engine was in release position; he said this would be equivalent to the loss of braking power of about 8 cars. It was customary on descending grades for the engineman of the second engine of a doubleheader to secure the independent brake-valve handle in release position to prevent overheating driving-wheel tires. Subsequent to the accident the independent brake-valve handle of the second engine was found wired in release position. Brake tests of the equipment involved

made subsequent to the accident disclosed no defect that would have contributed to the cause of the accident.

The engineman of the first engine of the following train understood that immediately after observing a signal displaying approach he must reduce to medium speed as soon as possible and be prepared to stop at the signal beyond; this instruction had been given to him orally. An instruction of this kind results in a wide variation in train operation in automatic-block territory. During this investigation officials of this railroad observed that the indication displayed by signal 2531 could be first seen by the enginemen of Fifth 53 a distance of 3,902 feet; in effect the officials' interpretation of the rules in regard to observing and obeying signal indications was that an engineman must observe and obey a signal indication as soon as it is possible to see the signal. In the case involved, in order for the engineman of Fifth 53 to see the indication of signal 2531 from a point 3,902 feet north of that signal, it was necessary for him to look across the inside of a curve to the right which would cause him to look a considerable distance to the right of that portion of the track immediately ahead of his engine. In this instance the weather was clear and to comply with the oral instruction the engineman was required to reduce speed at a point before reaching a signal displaying a proceed indication, in order to have sufficient distance in which to stop short of the third signal in advance, signal 2533. If the weather had been foggy or the visual conditions obscured by smoke or otherwise, then under this rule the engineman would have been permitted to operate at maximum authorized speed until he could see the approach indication of signal 2531 and this distance from the signal would vary in accordance with the range of vision. Since the distance between signals 2531 and 2533 is only 3,435 feet and since a test subsequent to the accident made with a similar train disclosed that it took a distance of 5,850 feet to stop by a full-service brake-pipe reduction and by permitting the brakes of the second engine to apply, it appears that if a full-service brake-pipe reduction had been made by the engineman of the following train near signal 2531, the train could be expected to overrun signal 2533 a distance of at least 2,400 feet. Inspections of signals and automatic train-control equipment involved made subsequent to the accident disclosed no defect that would have contributed to the cause of the accident.

In order to procure a uniform practice on the part of enginemen operating trains in automatic-block territory, it is necessary that signals be so located or so arranged as to provide adequate stopping distances at all times regardless of variations, permanent or temporary, in visual conditions, and so that enginemen can operate their trains from signal to signal by observing and obeying them in consecutive order. In 1925, when

the automatic train-control system was installed in this territory to supplement the automatic-block system, the maximum authorized speed for freight trains in the vicinity of the point of accident was 30 miles per hour; however, a short time before this accident occurred the maximum authorized speed for freight trains was increased to 45 miles per hour, an increase of 50 percent, without a change being made in the automatic block-signal system or in the automatic train-control system to provide for the additional stopping distance necessary. The Commission's order of June 13, 1922, which pertains to installation of automatic train-control systems, specifies that an automatic train-stop, train-control, or speed-control device shall be operative at braking distance from the stop-signal location if signals are not overlapped. In the Commission's report upon the installation herein involved, which was approved with certain exceptions on June 8, 1926, it was stated: "While established braking distances appear to be adequate for trains running at authorized speeds, these braking distances should be given careful consideration wherever there is a chance of such authorized speeds being exceeded."

This investigation disclosed that notwithstanding reference in the Commission's report of June 8, 1926, calling attention to the relatively short braking distances provided in this installation, the carrier subsequently, on two occasions, increased the maximum authorized speed for freight trains, the total increase being from 30 to 45 miles per hour; under this increased speed limit the stopping distances provided by the automatic train-control installation were inadequate to meet the requirements of specifications for automatic train-control systems which had been prescribed by the Commission. Section 204 of the rules, standards, and instructions for signal systems and appliances which were prescribed by the Commission's order of April 13, 1939, under the provisions of section 26 of the Interstate Commerce Act as amended, provides that signals shall be spaced at least stopping distance apart, or, where not so spaced, an equivalent stopping distance shall be provided by two or more signals arranged to display restrictive indications approaching signal where such indications are required; also, section 504 of the rules, standards, and instructions provides that automatic train-stop, train-control and speed-control devices shall be operative at braking distance from the stop signal location if signals are not overlapped. As a result of this investigation, it is clearly apparent that the automatic block system and the automatic train-control system as at present installed in the vicinity of the point of this accident do not comply with the requirements of orders of the Commission and are inadequate to provide proper protection for the operation of freight trains at a maximum speed of 45 miles per hour.

Conclusion

This accident was caused by failure to provide adequate flag protection for the first train and by failure to provide adequate stopping distance between the signals involved for maximum authorized speed.

Recommendation

It is recommended that this carrier immediately take necessary steps to establish maximum authorized speed limits for trains commensurate with stopping distances provided by existing automatic block signal and automatic train-control systems, or rearrange existing systems so as to provide adequate stopping distances for present maximum authorized speeds.

Respectfully submitted,

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Director.