INTERSTATE COMMERCE COMMISSION

WASHINGTON

INVESTIGATION NO. 2864

THE CHICAGO & NORTH WESTERN RAILWAY COMPANY

REPORT IN RE ACCIDENT

AT DIXON, ILL., ON

DECEMBER 26, 1942

SUMMARY

Railroad:	Chicago & North Western	
Date:	December 26, 1942	
Location:	Dixon, Ill.	
Kind of accident:	Rear-end collision	
Trains involved:	Passenger	: Express-mail
Train numbers:	87	: First 5
Engine numbers:	4009	: 2909
Consist:	16 cars	: 9 cars
Estimated speed:	15 m. p. h.	: 40 m. p. h.
Operation:	Timetable, train orders and automatic train-control system	
Track:	Three; 2°59' curve; 0.467 percent descending grade westward	
Weather:	Raining	
Time:	11:50 p. m.	
Casualties:	2 killed; 35 injured	
Findings:	Cause of accident, failure of automatic train-control system to function as intended; operating rules not being enforced and obeyed	
Recommendations:	Wayside signals be installed in connection with automatic train-control system; cab signals conforming to specifications and requirements prescribed by Commission's order of April 13, 1939, be installed on locomotives of this carrier in connection with automatic train-control system; operating rules be enforced and obeyed	

INTERSTATE COMMERCE COMMISSION

INVESTIGATION NO. 2664

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

THE CHICAGO & NORTH WESTERN RAILWAY COMPANY

March 12, 1943.

Accident at Dixon, Ill., on December 26, 1942, found to be caused by failure of the automatic train-control system to function as intended; operating rules not being enforced and obeyed.

REPORT OF THE COMMISSION[1]

PATTERSON, Commissioner:

On December 26, 1942, there was a rear-end collision between a passenger train and an express-mail train on the Chicago & North Western Railway at Dixon, Ill., which resulted in the death of 2 train-service employees, and the injury of 30 passengers, 2 railway-mail clerks, 1 Pullman employee and 2 dining-car employees. This accident was investigated in conjunction with representatives of the Illinois Commerce Commission.

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

Subdivision 2
Chicago, Ill.
35.5 mi.
Geneva
57.4 mi.
Nachusa
5.0 mi.
Dixon, Ill. (P.of A.)
40.2 mi.
Clinton, Iowa
To Geneva
P.T.
Beginning of restricted zone
3,450 ft.
3.7 mi.
Block 963
P.C.
7,695 ft.
2°
1,929.6 ft.
Restricted Zone
13,835 ft.
P.T.
Block 973
479.2 ft.
Track 1
Track 2
P.C.
Track 2
Direction of trains
2°59'
1,378 ft.
2°59'
644 ft.
Point of accident
105 ft.
Dixon
Inv. No. 2064
Chicago & North Western Railway
Dixon, Ill.
December 2, 1942

Location of Accident and Method of Operation

This accident occurred on that part of the Galena Division designated as Subdivision 2 and extending between Geneva, Ill., and Clinton, Iowa, 102.6 miles. In the vicinity of the point of accident this is a three-track line. The main tracks from south to north are track 2, either-direction track, track 3, westward track, and track 4, eastward track. Track 2 follows a route some distance to the south of tracks 3 and 4. Trains moving with the current of traffic on tracks 3 and 4 are operated by timetable, train orders and an automatic train-control system. The accident occurred on track 3 at a point 105 feet east of the station at Dixon. Approaching from the east there are, in succession, a tangent 3.7 miles in length, a 2° curve to the right 1,929.6 feet, a tangent 479.2 feet and a 2°59' curve to the left 1,378 feet to the point of accident and 644 feet beyond. In the vicinity of the point of accident the grade for west-bound trains is generally descending, and at the point of accident it is 0.467 percent descending.

The automatic train-control system is of the continuous-inductive type, and each engine is equipped with an arrangement of audible and visual indicators. There are no wayside signals except at interlockings. The track is divided into blocks, in the same manner as where wayside automatic signals are used. The system is so arranged that when a block is occupied there is a restricted zone extending from a point at least stopping distance in approach of the entrance to the occupied block to the point of obstruction. When an engine enters this restricted zone the visual indicator changes from green to red-over-yellow, the speed-control mechanism starts to function, then an audible speed-indicator and an acknowledging indicator sound, and, regardless of the speed at which the train is operating, an automatic brake application will occur unless the engineer operates an acknowledging lever. If the speed is above the maximum low-speed limit of 23 miles per hour, the engineer, in addition to acknowledging properly, must reduce the speed to the low-speed limit within a predetermined distance. The speed-control mechanism functions in such manner that if the speed is not reduced by the engineer in accordance with a gradually reducing or tapered speed-control limit, the brakes become applied automatically and cannot be released until the speed at that particular point has been reduced below the limit fixed by the mechanism. Failure to acknowledge results in an automatic brake application, which cannot be released until the speed of the train has been reduced to approximately 7 miles per hour. When the train is being operated under the low-speed restriction of 23 miles per hour, the acknowledging indicator sounds and recurrent acknowledgment is required at intervals of approximately 4,200 feet to prevent an automatic-brake application. If the low-speed limit is exceeded in a restricted zone, an automatic-brake application is initiated and the brakes cannot be released until the speed has been reduced to 23 miles per hour. When the

restriction is removed the visual indicator changes from red-over-yellow to green, and a single stroke on a gong located in the cab is sounded. Then the train may be operated at maximum authorized speed.

The speed-control mechanism comprises a centrifugal governor for measuring speed, cams for measuring distance and electrical contacts jointly operated by both. The governor and cams are driven from a vertical shaft, which extends through the cistern of the engine tender. The vertical shaft is connected to a horizontal telescoping drive shaft through a bevel-gear unit and the horizontal shaft terminates in an axle transmission mounted on one of the tender axles. At each end of the horizontal drive member, a flexible disc-type universal joint is provided. The functioning of the speed-control mechanism which actuates the audible speed and acknowledging indicators and establishes the various speed restrictions depends upon the operation of the governor and its associated gears, cams and electrical contacts.

A train-control automatic-brake application is effected by means of a brake-valve actuator, which is superimposed upon the brake-valve housing. The actuator has a cut-out cock, the handle of which normally is locked in the cut-in position and sealed. The key for the lock of the cut-out cock cannot be removed unless the automatic train control is cut in. This key is required to be in the possession of the conductor during the trip, and a duplicate key is provided in a sealed box located in the engine cab. The actuator can be cut out after the lock is unlocked or the seal is broken.

The entrance to block 975, the block involved in the accident, is located 2,490 feet east of the point where the accident occurred. With block 975 occupied, there is an approach section extending eastward a distance of 11,345 feet to a point 3,450 feet east of the entrance to block 963, in which a train-control restriction is imposed. As a result, a restricted zone extending 13,835 feet east of the point of accident is provided.

Operating rules read in part as follows:

35. The following signals will be used by flagmen:

* * *

Night signals - A red light,
A white light,
Torpedoes and
Fusees.

85. When a train of one schedule is on the time of another schedule of the same class in the same direction, it will proceed on its own schedule.

* * *

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, placing two torpedoes, and when necessary, in addition, displaying lighted fusees. When recalled and safety to the train will permit, he may return.

When the conditions require, he will leave the torpedoes and a lighted fusee.

* * *

When a train is moving under circumstances in which it may be overtaken by another train, the flagman must take such action as may be necessary to insure full protection. By night, * * * lighted fusees must be thrown off at proper intervals.

* * *

Aspects and indications of the visual indicator are as follows:

Aspect	Indication
Green	Proceed
Red-over-yellow	Proceed at not exceeding Maximum Low Speed

Maximum low speed for the trains involved is 23 miles per hour. Under the rules a train moving under a slow-speed restriction must be operated prepared to stop short of a train or obstruction. In the vicinity of the point of accident, the maximum authorized speed for the trains involved is 80 miles per hour, and on the curve involved, 50 miles per hour.

Description of Accident

No. 87, a west-bound first-class passenger train, consisted of engine 4009, two express cars, one baggage car, five coaches, one dining car, one lounge car, five Pullman tourist cars and one Pullman sleeping car, in the order named. The first and second cars were of steel-underframe construction and the remainder were of all-steel construction. This train departed from Chicago, 97.9 miles east of Dixon, at 9:30 p. m., according

to the dispatcher's record of movement of trains, 10 minutes late, passed Nachusa, 5.0 miles east of Dixon and the last open office, at 11:42 p. m., 29 minutes late, and stopped at the station at Dixon at 11:46 p. m. About 4 minutes later, after this train had moved about 1,000 feet westward, it was struck by First 5 at a point 2,490 feet west of the entrance to block 973.

First 5, a west-bound first-class express-mail train, consisted of engine 2909, five baggage cars, one mail car, two baggage cars and one box car, in the order named. All cars were of steel construction. After a terminal air-brake test was made, this train departed from Chicago at 10 p. m., according to the dispatcher's record of movement of trains, on time, passed Nachusa at 11:43 p. m., 7 minutes late, entered the restricted zone, proceeded through block 963 and into block 973 and while moving at a speed of about 40 miles per hour it collided with No. 87.

The force of the impact crushed the rear portion of the rear car of No. 87 a distance of about 6 feet, and the front portion was crushed a distance of about 23 feet. The six cars next ahead of the rear car were considerably damaged. Engine 2909 was derailed to the right and stopped upright 105 feet west of the point of accident and in line with track 3. The front end of the engine and the cab were badly damaged. The cistern of the tender was torn loose from the tender frame and stopped, bottom up, at right angles to the engine and across track 4. The first to fourth cars, inclusive, of First 5, were derailed and stopped, considerably damaged, in various positions across tracks 3 and 4 and adjacent to them.

Parts of the automatic train-control equipment consisting of the train-control receivers, wiring on the engine, wiring between the engine and tender and the governor drive shafts were damaged in the collision. The mechanism case containing the amplifier, relays and speed-control mechanism was undamaged.

It was raining at the time of the accident, which occurred about 11:50 p. m.

The train-service employees killed were the flagman of No. 87 and the engineer of First 5.

Discussion

The rules governing operation on the line involved provide that 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. When recalled, he may return if it is safe to do so. He must place torpedoes and leave a lighted fusee if conditions require. In automatic train-control territory, a train moving under a restrictive indication must be operated in accordance with predetermined speed restrictions enforced by the device, and must be prepared to stop short of a train or obstruction.

No. 87 stopped at the station at Dixon about 11:46 p. m. About 4 minutes later, after this train had started and moved westward about 1,000 feet, the rear end was struck by First 5. Under the rules, flag protection was required for No. 87, and First 5 was required to be operated prepared to stop short of a train or obstruction, if it received a restrictive indication.

During the time No. 87 was stopped at Dixon and while it was moving just prior to the accident, no member of the crew was in position to observe what action was taken by the flagman. No remnant of a recently burned fusee was found in the vicinity. What action was taken by the flagman to provide protection for his train is not known, as he was killed in the accident. If adequate flag protection had been provided for No. 87 this accident would have been averted.

As First 5 was approaching Dixon the speed was about 70 miles per hour. The enginemen were maintaining a lookout ahead. There was no condition of the engine which obscured the view or distracted their attention. The brakes functioned properly at all points where used en route and nothing unusual had occurred to indicate to the enginemen that the automatic train-control apparatus was not functioning properly. Because of buildings adjacent to the track and track curvature, their view of the track ahead was considerably restricted. When the engine reached a point about 3,100 feet east of the station the engineer made a service brake-pipe reduction and the speed was reduced to about 50 miles per hour. The fireman was on the left side of the engine and did not observe what aspect was displayed by the visual indicator. He did not see any burning fusee or a flagman, and no torpedo was exploded. No warning signal was sounded by the audible indicators. The fireman first saw lighted red markers of the preceding train at a distance of about 300 feet. He called a warning to the engineer, who immediately moved the brake valve to emergency position, but the distance was insufficient to stop First 5 short of the rear end of No. 87. The speed of First 5 was about 40 miles per hour when the collision occurred. The only employee in position to observe what aspect was displayed by the visual indicator was the engineer, who was killed in the accident.

After the accident an examination of engine 2909 disclosed that all seals on the automatic train-control apparatus were intact. The actuator cut-out cock was in its proper position and the key was in the possession of the conductor.

The visual indicator of engine 2909 should have displayed red-over-yellow throughout a distance of 18,385 feet in approach of the point of accident, and the speed-control mechanism should have operated throughout this distance. If the speed-control mechanism had operated properly, both audible indicators would have sounded, the speed of First 5 would have been controlled by either the engineer or an automatic-brake application, and the speed at the point of accident could not have been greater than 23 miles per hour. However, the speed was about 40 miles per hour at the time of the accident.

After the accident extensive tests of both the wayside apparatus and the locomotive equipment were made in an effort to discover any condition which could have caused the failure of the automatic train-control system to perform its intended functions under restrictive conditions. In these tests all apparatus and each circuit of the wayside equipment functioned as intended, and no condition was found that might have caused improper operation. Tests of the undamaged parts of the locomotive equipment disclosed one condition that could have caused or contributed to the cause of the failure of the train-control system to function properly. The front wheels of the engine truck of engine 2909 were found to be sufficiently magnetized to produce substantial voltages in the receiver circuit. These wheels and the axle, the turbo-generator and the mechanism case containing the train-control equipment were removed from engine 2909 and installed in another engine. To determine if the magnetized wheels could have caused the improper operation of the automatic train-control equipment on engine 2909, tests were made in which a speed of 63 miles per hour was attained. The voltages induced in the receiver coils by the rotating magnetic fields of the wheels resulted in a current in each winding of the primary relay which was at least equal to that required for the relay to pick up, but these currents, although of sufficient magnitude, apparently either were not of the right frequency or did not have the proper phase relation to cause the primary relay to operate, and a green aspect was not displayed.

The tests disclosed also that the pick-up value for the electrical equipment on engine 2909 was low. This condition would cause the equipment to be more susceptible to improper operation from such causes as foreign current in the rails, induced voltage in the receiver circuit from magnetized wheels,

power transmission lines and other magnetic fields. The low pick-up value may have been a contributing factor in causing the improper operation of the automatic train-control system. The pick-up value must be materially increased.

After the accident examination of the train-control equipment disclosed that the vertical and horizontal drive shafts and universal joints in the governor drive were broken. The locomotive equipment is so arranged that if the transmission or either of the vertical or horizontal drive shafts is broken, the governor does not operate when the train enters a restricted zone and neither the audible speed-indicator nor the acknowledging indicator will sound and the speed restriction will not be enforced. The fireman stated that the speed-control mechanism and audible indicator were functioning properly 35 minutes before the accident when the train was proceeding through a restricted zone at DeKalb, about 40 miles east of Dixon. It was not definitely established whether the drive shafts were broken prior to the accident or as a result of the collision. However, if they had become broken prior to the accident, the engineer would not know this condition unless he observed the visual indicator after the engine entered a restricted zone. The engineer was killed in the accident and the fireman did not observe the visual indicator. With the visual indicator displaying green, neither of the enginemen had any knowledge of the condition of the speed-control mechanism, because the audible indicators did not sound.

In the Commission's reports approving the installation of this device on another division of this carrier, the attention of the carrier was called to the design of the governor drive and it was stated that, "If it should be found that the intended protection is not afforded by the present construction and maintenance, other means must be provided for insuring the integrity of the device in this respect." According to records of the carrier, during the past 12 years there have been 72 failures of this part of the device prior to the date of this accident. None of these resulted in an accident; however, in view of the facts and circumstances disclosed by this investigation, the automatic train-control equipment should be rearranged so that the audible indicator will sound whenever the visual indicator changes from green to red-over-yellow, regardless of whether the speed-control mechanism is operating; also, means should be provided to furnish definite information to the engineer at the time when for any reason a failure of the speed-control mechanism occurs.

In the territory involved there are no wayside signals except at interlockings. If automatic block signals in connection

with the automatic train-control system had been in use and the cause of the failure of the automatic train-control system was confined to the locomotive equipment, the wayside signals would have displayed aspects indicating that the preceding train was a short distance ahead, and this accident would have been averted.

Findings

It is found that (a) the cause of this accident was the failure of the automatic train-control system to function as intended, and (b) the operating rules were not enforced or obeyed.

Recommendations

It is recommended that (a) wayside signals be installed in connection with the automatic train-control system on this line; (b) cab signals conforming to specifications and requirements prescribed by the Commission's order of April 15, 1939, be installed on locomotives of this carrier in connection with the automatic train-control system; and (c) operating rules be enforced and obeyed.

Dated at Washington, D. C., this twelfth day of March, 1943.

By the Commission, Commissioner Patterson.

W. P. BARTEL,

(SEAL)

Secretary.