

RAILROAD ACCIDENT INVESTIGATION

Report No 3846

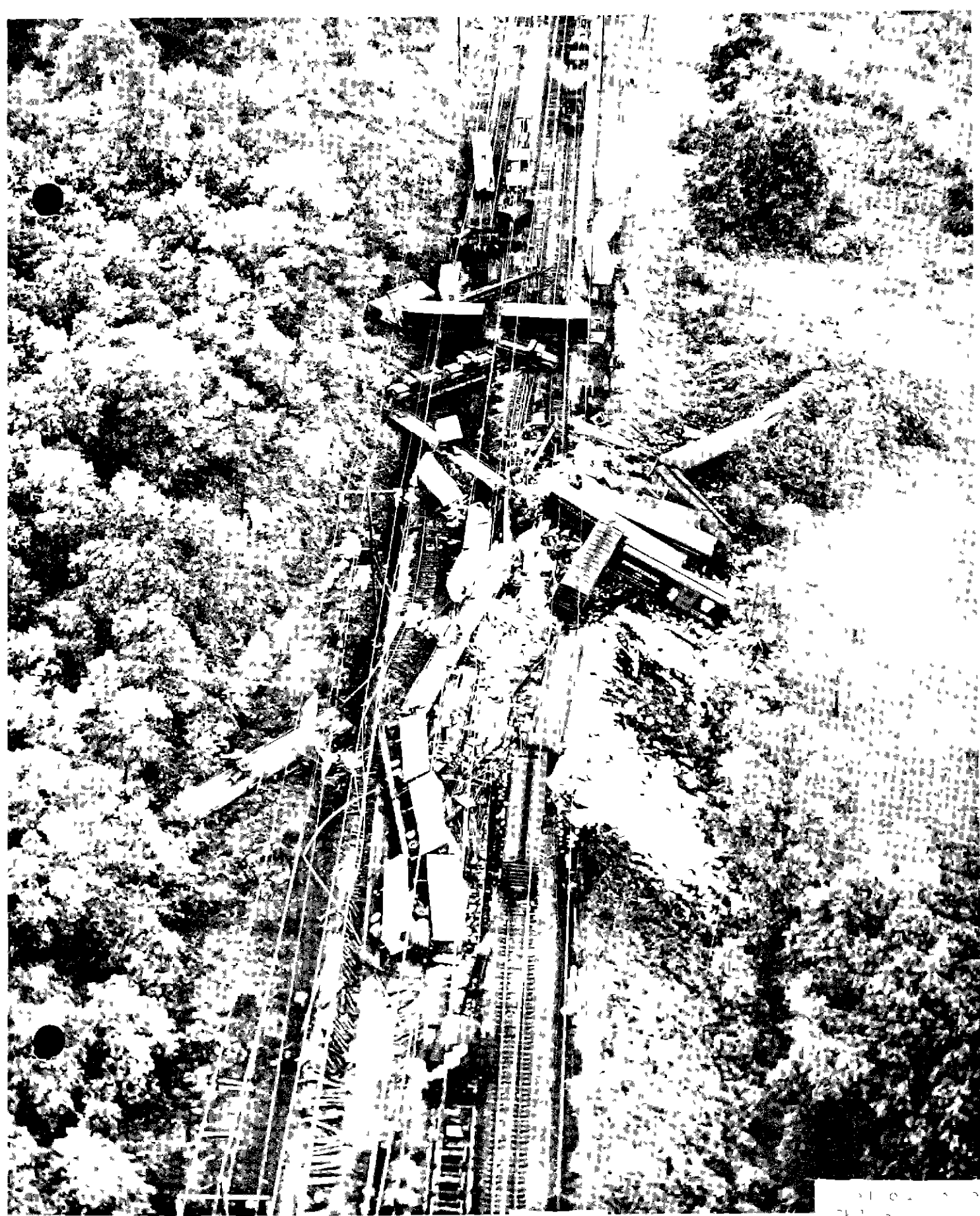
THE PENNSYLVANIA RAILROAD COMPANY

FRAZER, PA

MAY 13, 1959

INTERSTATE COMMERCE COMMISSION

Washington



...the ...
...the ...

SUMMARY

§§§

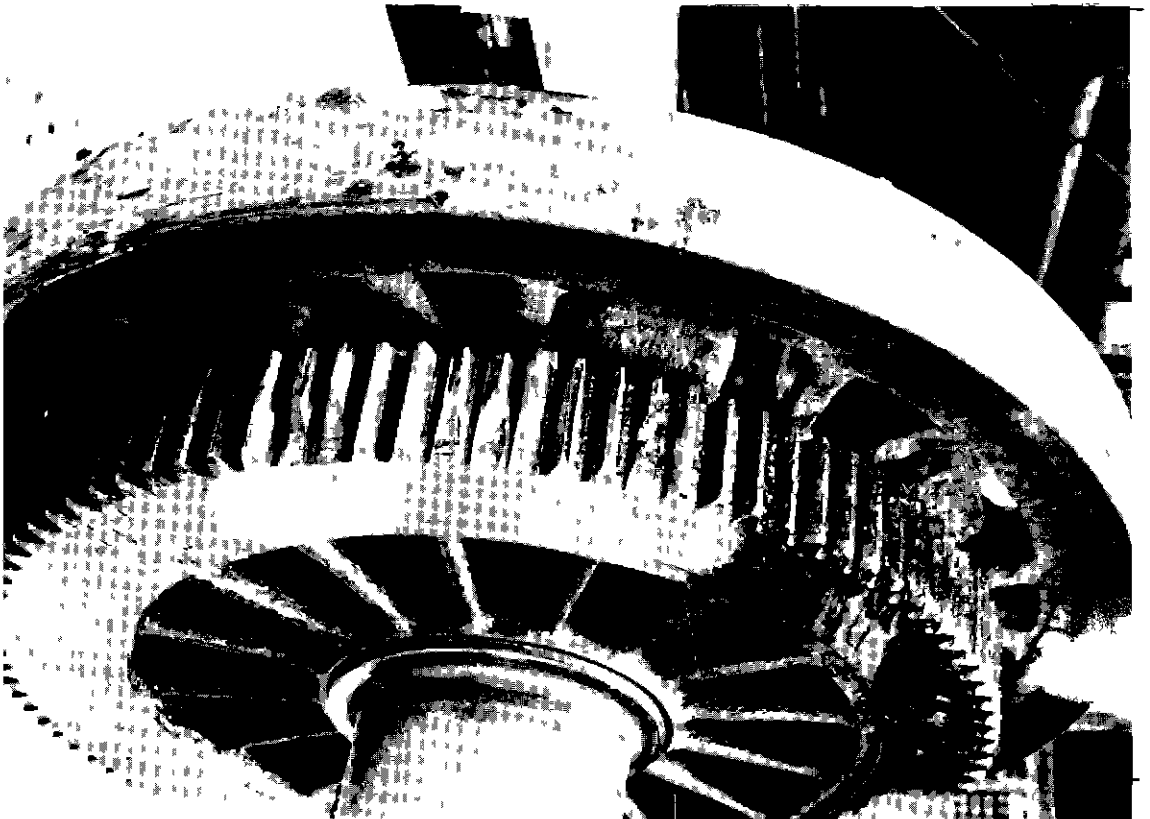
DATE	May 13, 1959	
RAILROAD	Pennsylvania	
LOCATION	Frazer, Pa	
KIND OF ACCIDENT	Deraiment and collision	
TRAINS INVOLVED	Freight	Passenger
TRAIN NUMBERS	Extra 4732 East	635
LOCOMOTIVE NUMBERS	Electric units 4732 and 4774, Helper electric unit 4735	Electric unit 4871
CONSISTS	43 cars, caboose	16 cars
SPEEDS	38 - 42 m p h	65 m p h
OPERATION	Signal indications	
TRACKS	Four, tangent, 0.55 percent ascending grade eastward	
WEATHER	Foggy	
TIME	10 48 p m	
CASUALTIES	24 injured	
CAUSE	A false flange on a slid-flat driving wheel, resulting from a seized traction-motor armature bearing on an electric locomotive unit, and derailed cars obstructing another track immediately in front of an approaching train	

PLATE 1



No 3 Traction motor pinion, electric unit 4774

PLATE 2



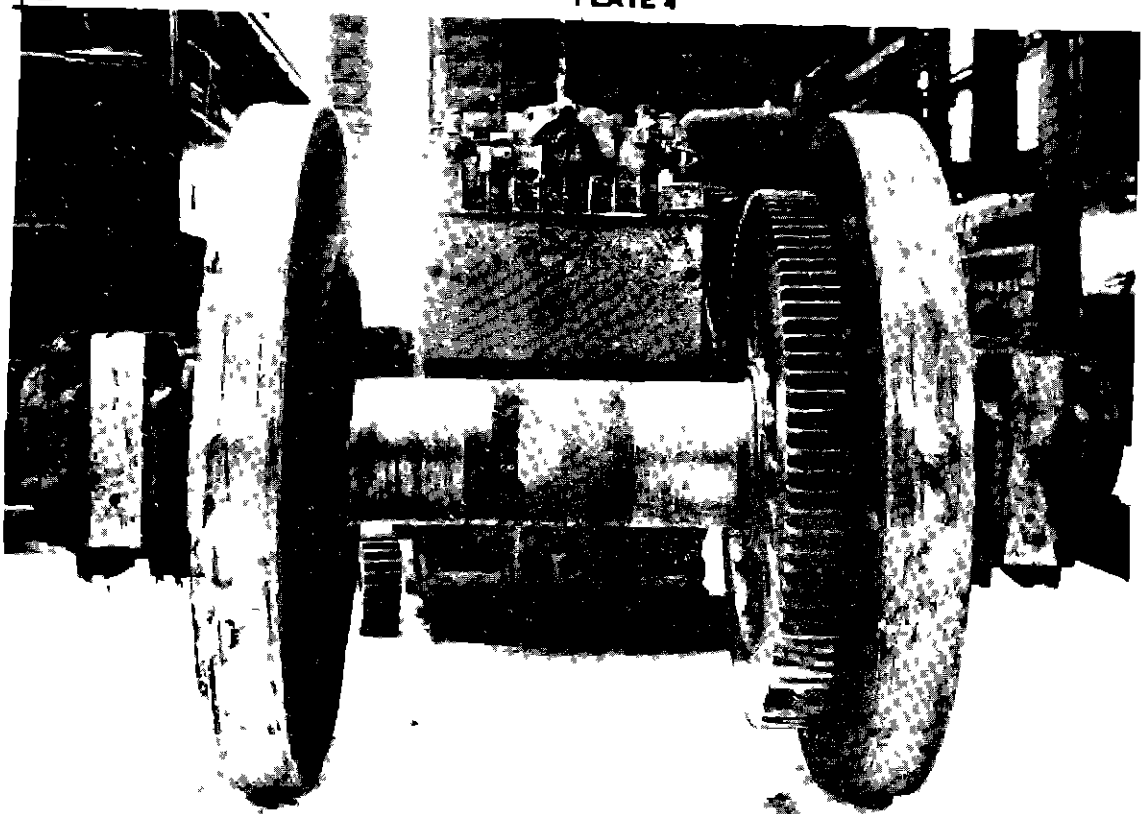
No 2 Driving wheel ring gear, electric unit 4774

PLATE 3



Pinion end of No. 3 traction motor, electric unit 4774

PLATE 4



No. 2 Driving wheels electric unit 4774

INTERSTATE COMMERCE COMMISSION

REPORT NO 3846

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

THE PENNSYLVANIA RAILROAD COMPANY

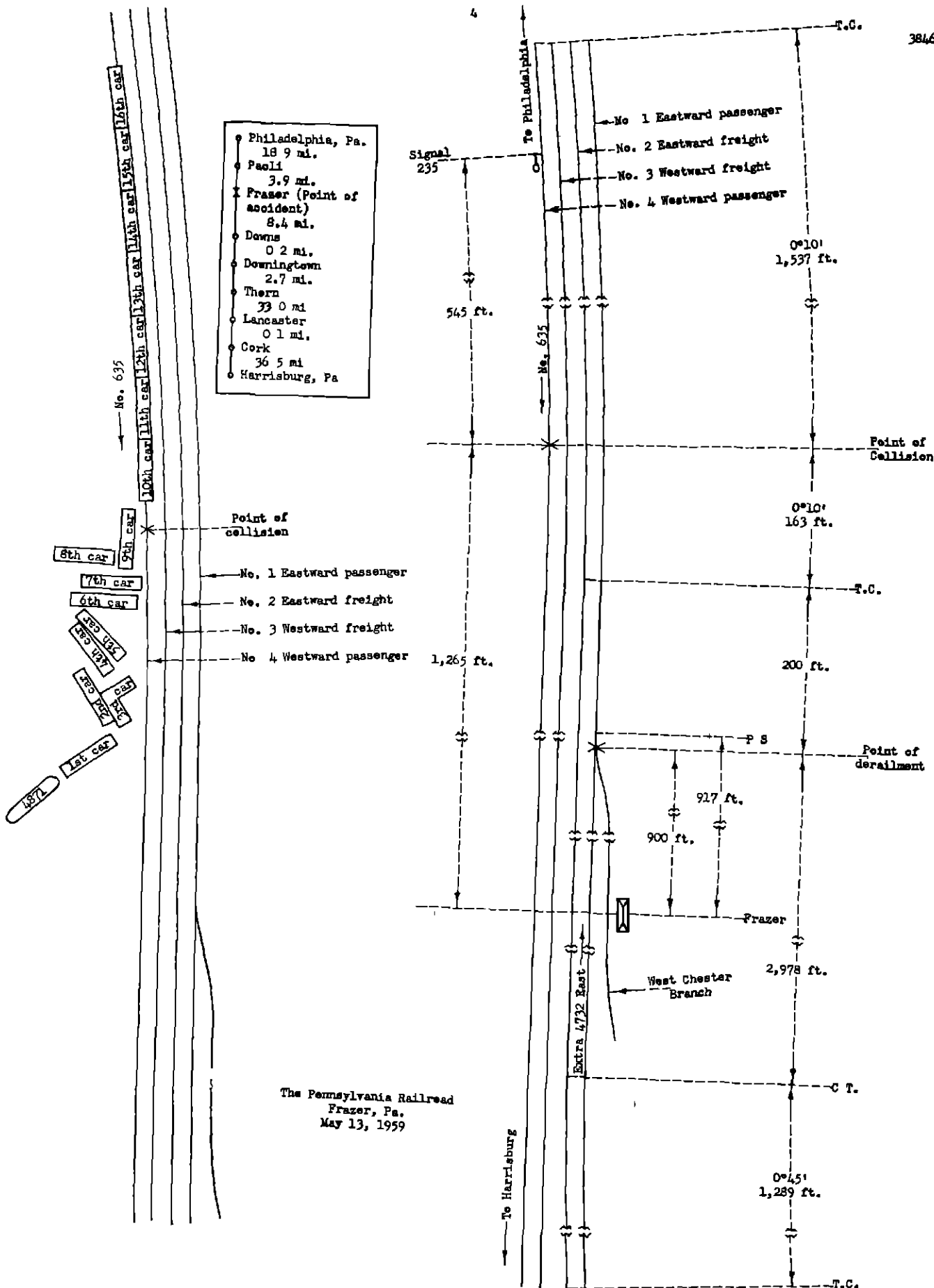
September 14, 1959

Accident at Frazer, Pa , on May 13, 1959, caused by a false flange on a slid-flat driving wheel, resulting from a seized traction-motor armature bearing on an electric locomotive unit, and derailed cars obstructing another track immediately in front of an approaching train

REPORT OF THE COMMISSION¹*FREAS, Commissioner*

On May 13, 1959, at Frazer, Pa , there was a derailment of a freight train and a collision between derailed cars of that train and a passenger train on the Pennsylvania Railroad, which resulted in the injury of 3 train-service employees, 3 Pullman Company employees, 1 Railway Express Company employee, and 17 passengers

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



- Philadelphia, Pa. 18.9 mi.
- Paoli 3.9 mi.
- Frazer (Point of accident) 8.4 mi.
- Downs 0.2 mi.
- Downingtown 2.7 mi.
- Thern 33.0 mi.
- Lancaster 0.1 mi.
- Cork 36.5 mi.
- Harrisburg, Pa.

The Pennsylvania Railroad
 Frazer, Pa.
 May 13, 1959

Location of Accident and Method of Operation

This accident occurred on that part of the Philadelphia Region extending between Philadelphia and Harrisburg, Pa., 103.7 miles. In the vicinity of the point of accident, trains are operated with the current of traffic on a four-track line by automatic block-signal and cab-signal indications. A catenary system is provided for the electric propulsion of trains. From the south to north the main tracks are designated as No. 1 eastward passenger, No. 2 eastward freight, No. 3 westward freight, and No. 4 westward passenger. At Frazer, 22.8 miles west of Philadelphia, a switch connects track No. 1 with the West Chester Branch on the south. This switch is trailing-point for eastbound movements on track No. 1 and is located 917 feet east of the station.

The derailment occurred at Frazer on track No. 1 at a point about 900 feet east of the station, and the collision occurred on track No. 4 at a point about 1,265 feet east of the station. From the west on tracks No. 1 and No. 2 there are, in succession, a 0°45' curve to the right 1,289 feet in length, a tangent 2,978 feet to the point of derailment and 200 feet eastward. From the east on all four main tracks there is a 0°10' curve to the right 1,537 feet to the point of collision and 163 feet westward. The grade in this vicinity is 0.55 percent ascending eastward.

The structure of track No. 1 in the vicinity of the point of derailment consists of 131-pound rail, 39 feet in length, laid new in 1944 on an average of 24 treated ties to the rail length. It is fully tieplated with double-shoulder tie plates and is double-spiked. It is provided with 6-hole, 36-inch joint bars, and an average of 7 rail anchors per rail. It is ballasted with crushed stone to a depth of 18 inches below the bottoms of the ties.

Automatic signal 235, governing westbound movements on track No. 4, is located approximately 545 feet east of the point of collision.

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

76 * * *

Members of crew, as frequently as opportunity permits, must observe engines and cars in their train, moving and standing, to detect any conditions that might interfere with the safe movement of trains.

* * *

77 So far as practicable and other duties permit, employes will observe passing trains for defects and should there be any indication of conditions endangering the train they must take necessary measures for its protection.

* * *

The maximum authorized speeds were 60 miles per hour for the eastbound train and 70 miles per hour for the westbound train.

Description of Accident

Extra 4732 East, an eastbound freight train, consisting of electric units 4732 and 4774, coupled in multiple-unit control, 43 cars and a caboose departed from Harrisburg at 7:10 p. m. After a helper electric locomotive was coupled to the rear end at Cork, 36.5 miles east of Harrisburg, this train departed from that point at 9:56 p. m., and passed Thorn, the last open office, 69.6 miles east of

Harrisburg, at 10 34 p m While it was passing Frazer on track No 1 at an estimated speed of 38 to 42 miles per hour, a false flange resulting from sliding of the No 2 driving wheels of the second electric unit engaged the inside surface of the head of the south stock rail at the West Chester Branch switch When this occurred, the south stock rail was canted outward and the No 2 and No 3 driving wheels and the trailing truck of the second electric unit, and the 1st to 18th cars, inclusive, were derailed The locomotive stopped about 1,179 feet east of the point of derailment The derailed equipment stopped in various positions on or near the track structure, obstructing all four main tracks

No 635, a westbound first-class passenger train, consisted of electric locomotive 4871, 11 express cars, 1 coach, 3 sleeping cars, and 1 business car, in the order named The cars were of all-steel construction The 6th, 8th, and 12th to 15th cars, inclusive, were equipped with tightlock couplers This train departed from Philadelphia at 10 15 p m, on time, departed from Paoli, 18 9 miles west of Philadelphia, at 10 43 p m, on time, and while moving at a speed of about 65 miles per hour on track No 4, it struck derailed equipment of Extra 4732 East The locomotive and the 1st to 10th cars, inclusive, were derailed Separations occurred at each end of the first nine cars and between the 15th and 16th cars The locomotive stopped on its right side about 250 feet west of the point of collision and about 114 feet north of track No 4 The other derailed equipment stopped in positions as shown in the sketch

The second electric unit and three of the cars of Extra 4732 East were somewhat damaged, 9 cars were considerably damaged, and 6 cars were heavily damaged The locomotive and 3 cars of No 635 were heavily damaged, 8 cars were considerably damaged, and 7 cars were somewhat damaged

The fireman, the conductor, and the brakeman of No 635 were injured

The weather was foggy at the time of the accident, which occurred about 10 48 p m

Examination of Track

Examination of the structure of track No 1 after the accident occurred disclosed that at a facing-point turnout of a crossover connecting tracks No 1 and No 2 at Downs, 8 6 miles west of Frazer, the north stock rail and the frog at the west end of the turnout bore abrasion marks where the false flange on the left No 2 driving wheel of unit 4774 had scraped the rail and the frog Similar marks were found on stock rails and frogs on trailing-point turnouts on track No 1 at points, respectively, 7 5 and 4 5 miles west of Frazer At Frazer, a heavy mark was found on the outside of the head of the north rail of the West Chester Branch track where the rail is mitered into the frog casting on track No 1 A heavy mark was also found on the gage side of the south stock rail of the West Chester Branch switch, beginning at a point 35 inches east of the heel of the switch and extending to the point of the switch, and the south stock rail was canted outward throughout this distance, indicating that wheels had derailed at this location Track No 1 was destroyed throughout a distance of 920 feet east of the switch

Description of Locomotive Unit Involved

Electric unit 4774, class P5A, 2-C-2 wheel arrangement, was built by the General Electric Company at Erie, Pa, in December 1932 It is equipped with a control compartment and a full set of operating controls at each end Six traction motors, with a total of 3,750 horsepower, are provided to drive three pairs of driving wheels The traction motor circuits are arranged in groups of three to

form two main-motor circuits. The No 3 traction motor is in the No 1 main-motor circuit. Traction motors No 3 and No 4 drive the No 2 driving wheels. The total weight of the unit, the weight on drivers, the weight on trucks, and the tractive effort are, respectively, 392,000, 220,000, 172,000, and 55,000 pounds. The specified diameter of the driving wheels with new tires is 72 inches. The tires of the No 1 and No 3 driving wheels are of the flange type and those of the No 2 driving wheels are of the plain type.

Single-phase, 25-cycle alternating current at 11,000 volts is collected from the catenary system by either or both of two pantographs (in normal operation, only the trailing or train end pantograph is used) and is conducted through the primary side of the main transformer to ground. The secondary side of the transformer is tapped to provide traction-motor circuit voltages ranging from 296 to 960 volts. Current is conducted to the traction motors from the secondary side of the transformer through preventive coils and electro-pneumatically operated contactors.

The unit is provided with overload relays, wheel slip relays, and a pantograph relay. The type of wheel slip relay used functions when there is an appreciable difference in the rotational velocities of the driving wheels. When this occurs, the circuits of an indicator lamp and a buzzer, located in both control compartments, become energized.

Description of Parts Involved

Power from the traction motors is transmitted to the driving wheels through a quill-type drive. The quill drive consists of a hollow steel shaft having a spider attached to each end. The spider has eight driving arms with rubber cup drives that extend outward between the spokes of the driving wheel. Hardened steel wear plates are welded to each side of the spokes where contact is made with the rubber cup drives. The hollow quill shaft surrounds the driving wheel axle. Pinions on the ends of the traction-motor armature shafts mesh with a ring gear mounted on a cast steel center and shrunk on the quill shaft. Each pair of driving wheels is driven by two traction motors.

The No 3 traction motor was equipped with armature shaft roller bearings having an inside and outside diameter of 5.9055 and 12.5984 inches, respectively, and a width of 2.5591 inches. The pinion end bearing contained 14 rollers, each of which was 1.775 inches in diameter and 1.89 inches in length, the commutator end bearing contained 14 rollers, each having a diameter and length of 1.65 inches. Bearing lubricant was applied only when the traction motors were disassembled.

Examination of Parts Involved

Inspection of the No 3 traction motor after it was removed from electric unit 4774 disclosed that the armature shaft had seized as a result of the failure of the pinion end bearing. Both the pinion end and the commutator end armature shaft bearings had failed, and the armature and field coils were damaged as a result of the armature striking the stator. The pinion was extensively worn, indicating that it had been rotating under an abnormal load for a considerable distance before the armature shaft seized, and the ring gear had a total of seven broken teeth at four locations. The commutator and brushes were intact, indicating that much of the damage occurred after electric power was removed from the motor.

Examination of the armature shaft bearings disclosed that the pinion end bearing was damaged to the extent that the cause of its failure could not be determined. It was evident from the appearance of the bearing, however, that it had lubricant prior to the failure and that the lubricant had been burned by the intense heat which destroyed the bearing. The commutator end bearing was considerably damaged and it was evident that this damage was caused by armature shaft misalignment, resulting from the pinion end bearing failure.

The No. 4 traction motor pinion was loosened to the extent that it could be removed from the armature shaft by hand. There was no other evidence of damage to the No. 4 traction motor.

As a result of the No. 3 traction-motor armature shaft seizure, the tires of the No. 2 driving wheels were extensively damaged by sliding contact with the rails. There was a flat spot on the right tire 11 3/4 inches long, 3 3/4 inches wide, and 5/8 inch deep. At the same relative location on the left tire, there was a flat spot 11 inches long, 3 1/2 inches wide, and 5/8 inch deep. In addition, each tire had a flat spot 4 inches long, 3 inches wide, and 1/16 inch deep, and several smaller flat spots of various dimensions.

The wheel slip relay circuit was tested after the accident occurred and it was found to function as intended.

Photographs of the damaged traction motor pinion, ring gear, and pinion-end bearing of the No. 3 traction motor, and the slid flat spots on the No. 2 pair of driving wheels of electric unit 4774 appear in PLATES 1 to 4, inclusive.

Inspection and Repair Reports

Electric locomotive unit 4774 received a monthly inspection at Enola on April 25, 1959.

The last dielectric test was made at Enola on January 23, 1959.

All wheels were removed and all tires were turned in November 1958.

The No. 3 traction motor was applied January 10, 1958, and had accumulated 75,000 miles since that date.

The unit had accumulated 127,600 miles since the last class repairs were made at Wilmington, Del., on February 8, 1957.

All daily inspection and repair reports pertaining to this unit for a period of 30 days immediately prior to the date of the accident were examined, and the following pertinent items were disclosed:

Enola, Pa., April 19, 1959, by engineer "Slip relay lights. Engine not slipping." Marked off, "Examined. No defect." "Engine received at Orangeville with flat spots on wheels. Same reported to Foreman in Charge." Marked off, "Not condemned."

Morrisville, Pa., May 2, 1959, by engineer "Ground #2 circuit, Partial relay operation circuit cut out." Marked off, "Circuit cut out."

Wilmington, Del , May 12, 1959, by engineer "This engine is very rough, received engine with small flat spots " Marked off, "No defect" "No 1 circuit ammeter No 1 end keeps jumping up and down and you can hear switches going in and out on every notch on quadrant " Marked off, "No defect found "

Reports were approved by foreman

During this period there were no reports of defects on electric unit 4732, which was coupled in multiple-unit control with electric unit 4774 since May 12 1959

Discussion

After the crew of Extra 4732 East went on duty at Enola, Pa , 4 1 miles west of Harrisburg, the enginemen made an inspection of electric units 4732 and 4774 They said that this inspection did not disclose any defects The crew then proceeded with the locomotive and a caboose to the yard at Harrisburg During this movement, the enginemen were in the control compartment at the front end of unit 4774 They said that while en route to Harrisburg the wheel slip indicator in the control compartment became lighted and remained illuminated while the controller was in any position other than off, and that they observed smoke being emitted from underneath unit 4774 The engineer stopped the locomotive with caboose on a yard track at Harrisburg for an inspection of unit 4774 He said that when the movement stopped smoke was no longer being emitted from beneath the unit An electrician, who made a visual inspection of unit 4774 at this time, said that he detected a faint odor of burned insulation at the traction motors but did not observe any smoke The electrician informed the engineer that the odor was not unusual and was similar to that emitted from traction motors on locomotives that had just completed road trips, and that it did not indicate to him any defective condition While the electrician was inspecting the locomotive, the engineer communicated by telephone with the train dispatcher After informing the train dispatcher that he was experiencing trouble with the locomotive, the engineer moved it to another yard track in Harrisburg where the locomotive and the caboose were coupled to the cars of the train The enginemen then moved to the control compartment at the front end of unit 4732

Shortly after Extra 4732 East departed from Harrisburg, the pantograph relay indicator in the control compartment became lighted and the fireman cut out the No 1 traction motor circuit of unit 4774 Although the wheel slip indicator was continually lighted, except when the controller was in off position, from the time the train departed from Harrisburg until the accident occurred, the engineer said that no further difficulty was experienced with the locomotive until the train arrived at Cork, where it stopped in accordance with the indication of an interlocking signal As the train was stopping at Cork, the fireman and the front brakeman alighted from the locomotive and observed that all wheels of the second unit were rotating The engineer then communicated with the train dispatcher by means of a wayside telephone, and in answer to an inquiry he informed the train dispatcher that he thought the locomotive was in condition to proceed When the engineer attempted to start the train, the pantograph relay indicator in the control compartment again became lighted and the fireman cut out the No 2 traction motor circuit of unit 4732 The locomotive of a following train was then used to push Extra 4732 East about one mile eastward to Lancaster After Extra 4732 East stopped at Lancaster, the engineer alighted from the locomotive and observed the forward and reverse movement of the driving wheel spiders of unit 4774 while the fireman operated the controls with the brakes of the locomotive applied The engineer then instructed the fireman to cut in the No 2 traction motor circuit of unit 4732 and no further trouble was experienced with that unit Before Extra 4732 East departed from Lancaster, the locomotive of the following train was detached from the rear end and another unit was coupled to the rear end as a helper locomotive

As Extra 4732 East was approaching the point where the accident occurred, the enginemen were in the control compartment at the front of the locomotive and the conductor and the front brakeman were in the control compartment at the rear end of the first unit. The fireman said that the buzzer associated with the wheel slip indicator in the control compartment had been cut out as he and the engineer were aware that the wheel slip indicator was continually lighted. He also said that he had observed infrequent faint sparking beneath unit 4774 while the train was moving between Lancaster and Thorn, and that he thought the sparking was caused by brake shoes being in contact with wheels of that unit. The operator at Thorn said that he observed the train as it passed that location, and that he did not see anything indicating that a wheel of the locomotive was sliding. The front brakeman and the conductor first observed intermittent faint sparking under the second unit when the train was approaching Downingtown, 8.8 miles west of the point of derailment, and the conductor immediately proceeded to the control compartment at the front of the locomotive to inform the engineer of this condition. The engineer said that the conductor informed him of the sparking under unit 4774 when the train was about 5 miles west of the point of derailment. The enginemen and the conductor then made observations of the second unit and saw light intermittent sparking beneath that unit. They said that they did not consider the sparking unusual, and that the derailment occurred while they were observing the second unit. Immediately after the brakes of the train became applied in emergency as a result of the derailment and before the front portion of the train stopped, No. 635 passed the locomotive of Extra 4732 East and struck the derailed cars obstructing track No. 4.

As No. 635 was approaching Frazer, the speed was 65 miles per hour as indicated by the speed indicator. The enginemen were in the control compartment at the front of the locomotive and the other members of the train crew were at various locations in the cars of the train. The headlight was lighted brightly. The brakes of the train had been tested and had functioned properly when used en route. The engineer said that when the locomotive was about 120 feet east of signal 235 he observed the indication of that signal change from "Proceed" to "Stop-and-proceed," and that the cab signal indication changed from "Proceed" to "Restricting." The change in signal indications was evidently caused by derailed equipment shunting or breaking the track circuits on track No. 4 within the block of signal 235. When the engineer saw the signal indications change he immediately initiated an emergency application of the brakes, but the speed was not materially reduced before the collision occurred.

Cause

This accident was caused by a false flange on a slid-flat driving wheel, resulting from a seized traction-motor armature bearing on an electric locomotive unit, and derailed cars obstructing another track immediately in front of an approaching train.

Dated at Washington, D. C., this fourteenth day of September, 1959

By the Commission, Commissioner Freas.

(SEAL)

HAROLD D. McCOY,
Secretary