INTERSTATE COMMERCE COMMISSION

REPORT OF ACCIDENT ON THE WABASH RAILROAD NEAR WEST LEBANON, IND MARCH 7, 1912

BY THE CHIEF INSPECTOR OF
SAFETY APPLIANCES

ACCOMPANIED BY

REPORT OF THE ENGINEER PHYSICIST
OF THE BUREAU OF STANDARDS

PRINTED BY ORDER OF THE COMMISSION
AUGUST 19 1912

WASHINGTON
1912

INTERSTATE COMMERCE COMMISSION

REPORT OF THE CHIEF INSPECTOR OF SAFETY APPLIANCES COVERING HIS INVESTIGATION OF AN ACCIDENT WHICH OCCURRED ON THE WABASH RAILROAD NEAR WEST LEBANON, IND., MARCH 7, 1912, ACCOMPANIED BY REPORT OF THE ENGINEER-PHYSICIST OF THE BUREAU OF STANDARDS COVERING HIS INVESTIGATION OF THE BROKEN RAIL CAUSING THIS ACCIDENT

AUGUST 19, 1912.

To the Commission:

On March 7, 1912, there was a derailment of a passenger train on the Wabash Railroad near West Lebanon, Ind. This derailment caused the death of 2 passengers and the injury of 76 passengers and 11 employees. After investigation as to the nature and causes of this accident and of the circumstances connected therewith I beg to submit the following report:

Train No. 1, known as the Continental Limited, runs from Buffalo, N. Y., to St. Louis, Mo. At the time of the derailment it consisted of engine No. 619, one express car, one mail car, one combination baggage and express car, one coach, two Pullman sleepers, and one dining car.

With Conductor Grant and Engineman Duke in charge this train left Peru, Ind., a division terminal, at 2.19 p. m., 1 hour and 15 minutes late, and left West Lebanon, Ind., the last station which it passed prior to the accident, at 4.38 p. m., 1 hour and 29 minutes late. The derailment occurred at 4.41 p. m., at a point about 2 miles west of West Lebanon. The entire train with the exception of the engine and tender left the rails, and the derailed cars were thrown down an embankment 16 to 20 feet high on the north side of the track. Their positions after the derailment are shown in the illustrations accompanying this report. At the time of the accident the weather was cloudy, a light snow was falling, and it was thawing slightly.

This derailment occurred on a slightly descending grade near the west end of a 2° curve leading to the south. The rail on the north side of the track was torn up for a distance of about 400 feet, but the rail on the south side remained in position. The track is laid with

80-pound rails 33 feet in length, on hardwood ties about 18 to the rail Tie plates are used on the curve

Engineman Duke stated that his train was running about 35 miles per hour when he noticed the rear driver of his engine drop as if it were passing over a broken rail He immediately applied the air brakes The cars broke loose from the tender and rolled down the embankment The engine and tender were brought to a stop about 700 feet beyond the broken rail

Fireman Cox stated that he first noticed a jar as if the engine had struck a broken rail, and he was then thrown across the cab to the engineman's side

Conductor Grant stated that the first indication he had that anything was wrong was when he felt a jar on the car in which he was riding, and immediately afterwards the train left the track He stated that the speed limit on straight track is 50 miles per hour and at the place where the accident occurred the speed limit is 40 miles per hour He did not know at what speed they were running when the accident occurred

This investigation developed the fact that early in February 1912 tie plates had been placed under the rails on each of the ties on this curve for the purpose of strengthening the track and straightening it, the rails having begun to turn and cut into the ties At the coroner's inquest the evidence brought out from the men who did this work was to the effect that many of the ties in the vicinity of this accident were in a decayed condition, and that none of them was removed The foreman in charge of the work stated that they were only in fair condition while the men under him stated that no shims were used and that many of the tie plates were left loose, although the attention of the different foremen who were present was called to this condition At the time the work was done and up to the time of the accident the ground was frozen so hard that the ties could not be tamped

An investigation made by an engineer of the Wabash Railroad after the accident showed that there was irregularity in the surface of the track This irregularity no doubt contributed to the failure of the rail Arrangements were made with the Bureau of Standards of the Department of Commerce and Labor for the purpose of having this broken rail examined and the cause of its failure ascertained This examination was conducted by Mr James E Howard, engineer-physicist and his report covering the results of his examination with the illustrations accompanying the same is attached to and made a part of this report

The broken rail causing this accident was an 80-pound steel rail made by the Illinois Steel Co South Works heat 777 799 It was rolled in June, 1903 but there is no record available as to when it

was placed in the track It was the only rail manufactured by the Illinois Steel Company that was found in the vicinity of the accident, the other rails were manufactured by the Carnegie Steel Company, and according to the railroad record they were laid new in August, 1904 It is probable that the rail which caused the accident was placed in the track at the same time

After the accident the receiving end of the broken rail was found to be intact for a distance of 27$\frac{1}{4}$ inches This end remained securely fastened to the preceding rail by the splice bars The leaving end of the rail was intact for 22 feet 9 inches The intervening section of 6 feet 11$\frac{3}{4}$ inches was broken into six pieces All the pieces of the broken rail were sent to the Bureau of Standards for examination and test As shown in illustration No 5 accompanying Mr Howard's report about 27 per cent of the head of the rail was worn off The initial rupture evidently occurred under fragment No 2, there being a seamy streak 7$\frac{9}{10}$ inches long on the under surface at the base of the rail at that place the fracture separating flange fragment No 2a from a missing fragment of the inner flange It will be noted that the rupture occurred over a tie The receiving end of each fragment was bent downward, evidently by the blows of the wheels of the engine and cars as the different portions of the rail were broken, as shown in illustrations Nos 8 and 9

The immediate cause of the failure of this rail seems to have been the seaminess of the metal in the base of the rail In a preceding report on a rail failure on the Great Northern Railroad, at Sharon N Dak this same condition existed Attention is directed to that part of Mr Howard's report calling attention to the initial line of rupture occurring along the seamy streak in the metal such rail failures being numbered by thousands Statistics show that a large majority of the broken rails reported are defective in much the same manner as this rail In the former report mentioned crescent-shaped flange breaks such as occurred in this rail were given particular attention Careful track inspection should have disclosed the worn condition of the head of this rail, but the seamy streak in the base of the rail, which no doubt caused its rupture could not have been detected by inspection This was a defect of manufacture which current specifications and tests are not adequate to discover In view of the fact that streaks and seams in the metal are common and well-recognized causes of rail failures it would seem that definite action should be taken toward eliminating this source of danger

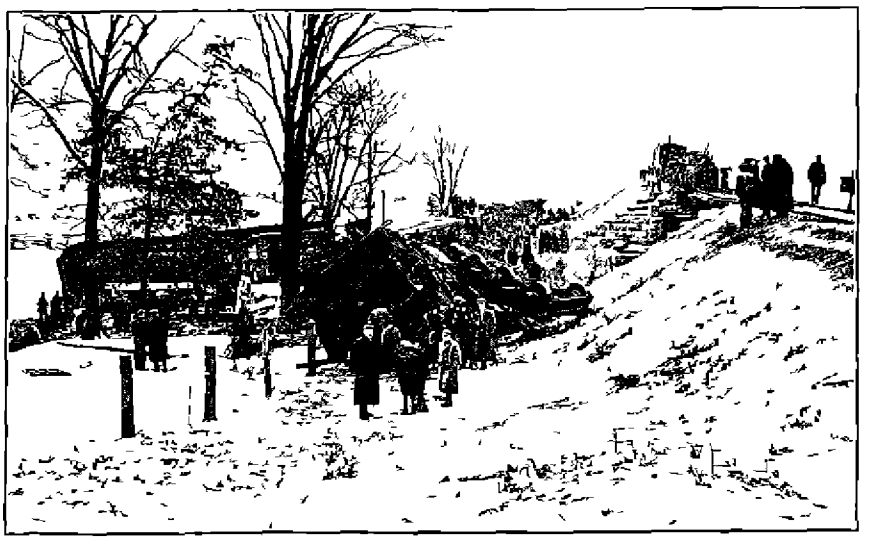
Respectfully submitted

H W Belnap
Chief Inspector of Safety Appliances

REPORT OF THE ENGINEER-PHYSICIST

I have the honor to report upon the examination of a steel rail from the Wabash Railroad, which appeared to have caused the wreck of the Continental Limited train No 1 at Redwood curve near West Lebanon Ind on March 7 1912 at about 4 42 p m

The wrecked train consisted of locomotive No 619 Atlantic type engine and seven cars as follows An express car a mail car a com-

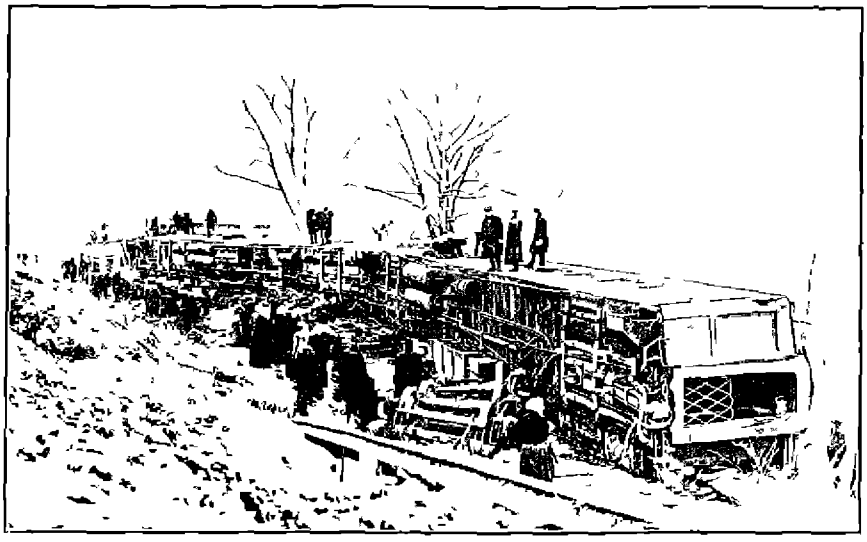


No 1 —General view of the wreck looking east

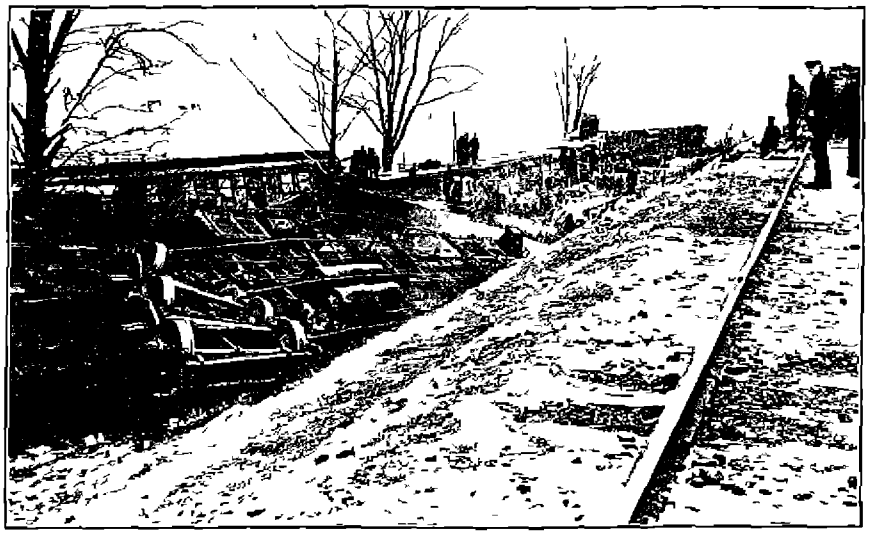
bination baggage and passenger car a day coach two Pullman sleepers and a dining car

The train was running in a westerly direction when near the westerly end of Redwood Creek curve a 2° curve the seven cars of the train were derailed and thrown down an embankment on the north side of the track the outer side of the curve The locomotive remained on the track passed off the curve over a trestle bridge and stopped a short distance beyond The north rail of the track was torn up for a distance of about 400 feet

Two passengers were killed, and 83 passengers and employees were injured The estimated damage to the equipment was $24 100



No 2 —General view of the wreck looking west

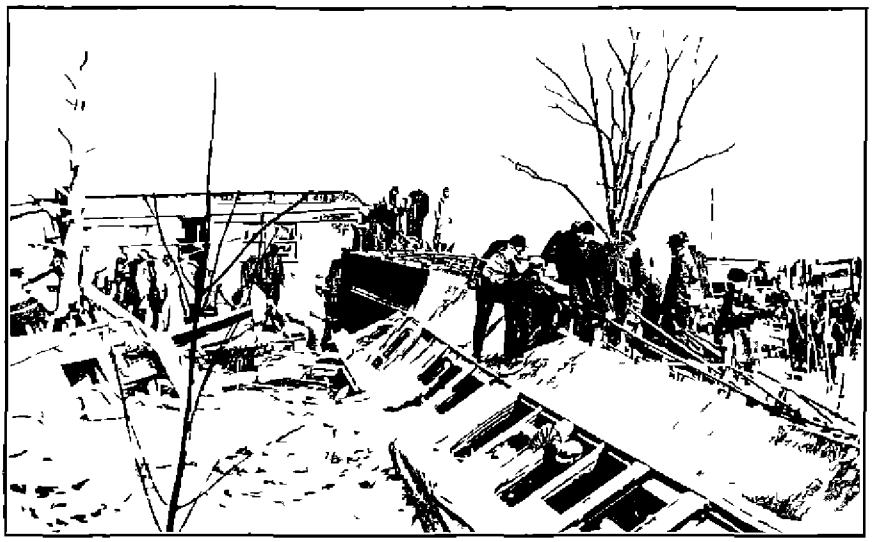


No 3 —General view of the wreck, looking east

The derailment was caused apparently by the breaking of a rail on the north side of the track and located near the westerly end of the curve The fractured rail was branded ' 8001 Illinois Steel Co So Wks 1903 It was an American Society of Civil Engineers sec-

tion of rail, and originally 80 pounds weight It was laid in 1904, on white oak ties, 17 to the rail, 33 feet in length The track at this place had been laid and used without tie plates until the month preceding the derailment The rails had begun to turn and cut into the ties whereupon tie plates were put in, which was done when the roadbed was in a frozen condition The roadbed continued frozen up to the time of the derailment

The rail showed considerable flange wear, as indicated by Figure No 5 It was estimated that 12 per cent of the whole section or 27 per cent of the metal of the head, had been worn away during its period of service



No 1—General view of the wreck, looking east

Data concerning the locomotive are as follows

	Pounds
Locomotive, No 619 engine and tender, weighed	310 700
Weight of the engine	180, 700
Weight on front truck	46, 000
Weight on drivers	96, 700
Weight on trailer	38, 000

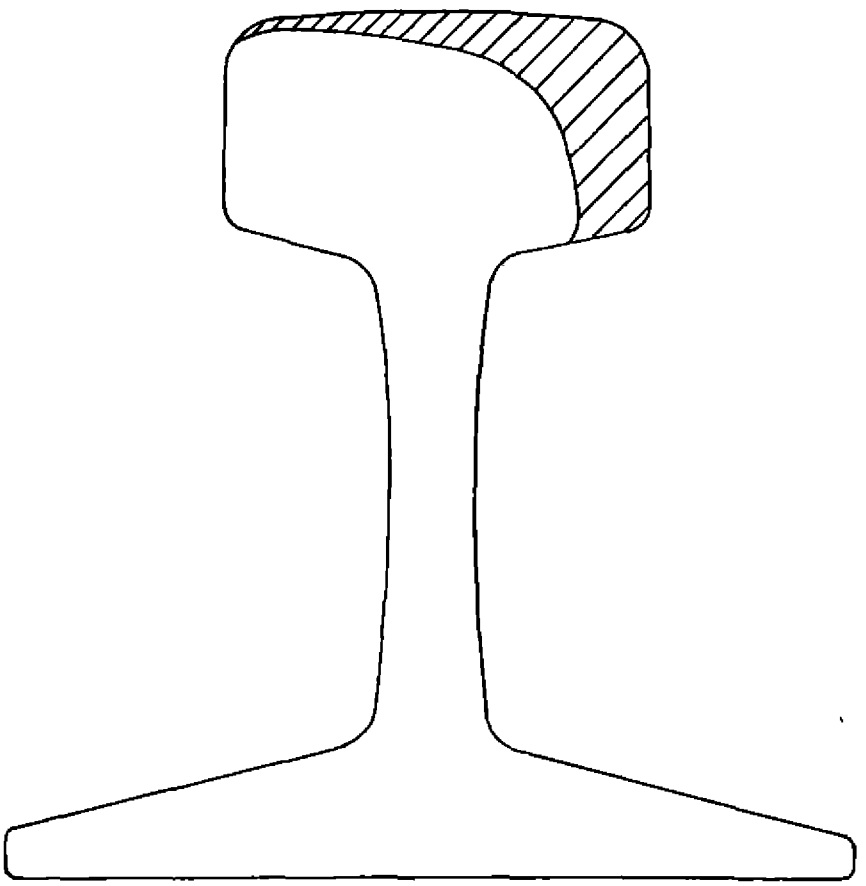
Total wheel base of locomotive, 56 feet, total wheel base of engine 30 feet 11¼ inches rigid driver wheel base, 7 feet, 6 inches

The engineer of the wrecked train testified that he applied brakes and approached Redwood curve under reduced speed, estimated at 30 to 35 miles per hour That he felt a driver of his engine drop as he passed over the broken rail

The fireman stated that he also felt the jar of the engine at the broken rail, and that he was thrown across the cab from the left to the right side that is toward the outside of the curve

A series of photographic cuts shows the appearance of the broken rail as received for examination Figure No 6 is a general view of the rail looking upon it from east to west The several fragments are marked for identification from 1 to 8, inclusive Piece No 8 was 22 feet 9 inches long, the others were comparatively short

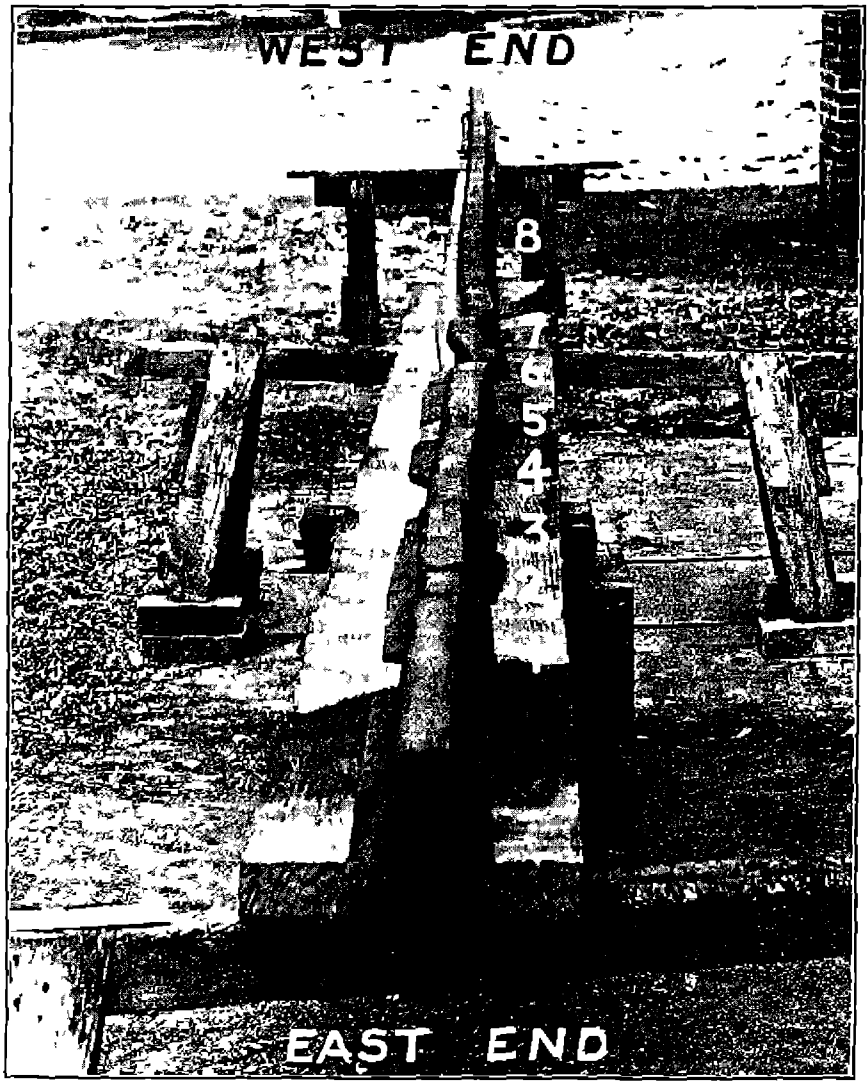
In regard to the condition of these fragments the heads of pieces Nos 1, 2 and 3 were nearly straight in respect to alignment The



No 5—Cross section of rail which fractured at Redwood Curve March 7 1912 Eighty pounds American Society of Civil Engineers section 12 per cent of whole section or 27 per cent of head worn away in service Part worn away indicated by shaded section

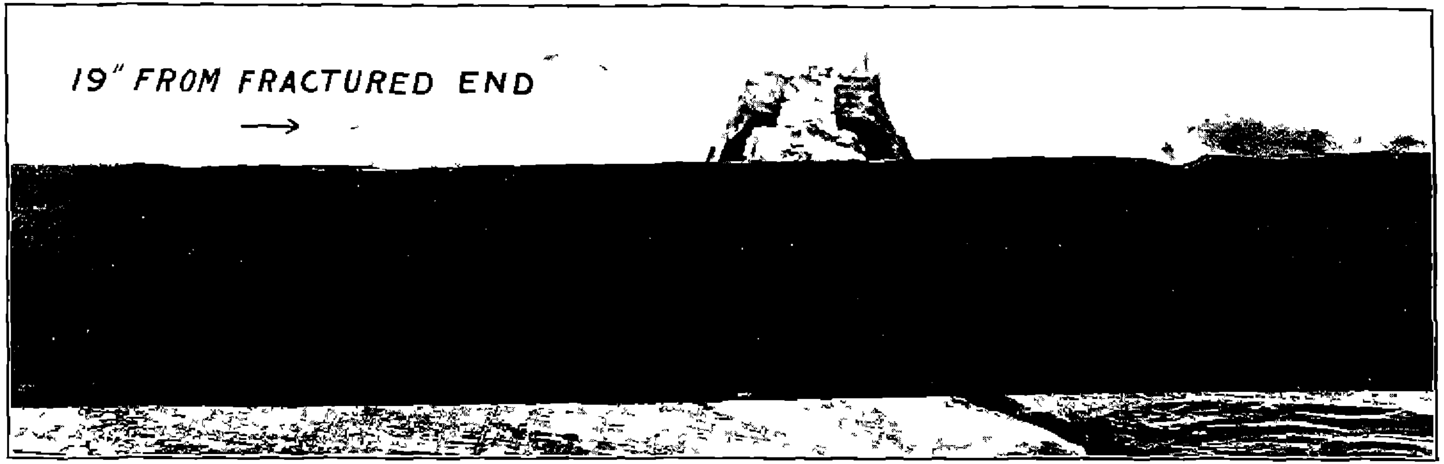
receiving ends of each of the other pieces were bent outward and also downward Fragments Nos 6 and 7 were the most distorted the head of No 6 being detached from the web Doubtless fragments Nos 4, 5 6, and 7 were in succession detached from the forward part of the rail Such short bends as these pieces assumed could have been formed only when each was attached to the main part of the rail It would seem furthermore, that the wheels which

caused the rupture of the rail drifted their farthest over pieces Nos 6 and 7 and the receiving end of No 8 Not unlikely there was a buckling of the train resisted at the time these fragments were detached



No 6—General view of fractured rail from east end Piece marked 1 is 2 feet 3½ inches long Piece marked 8 is 22 feet 9 inches long Total length of rail is 32 feet

This outside rail of the curve during its period of service had been subjected to an outward thrust, which had caused abrasion of the outer flange of the base against the spikes Figure No 7 shows two such places This abrasion, of course occurred before the tie-plates were used



No 7 —View of base of rail piece marked S showing notches in edge of base, outside flange, caused by abrasive effect of spikes Nearest spike notch 19 inches from fractured end of this piece

Figure No 8 shows fragments Nos 1 to 4 inclusive viewed from the gauge side of the rail The initial fracture is believed to have been the base fracture under piece marked 2 There was a seamy streak at the under surface of the base at this place 7 8 inches long, where the fracture had its origin, separating flange fragment 2a from a missing fragment of the inner flange This line of rupture occurred over a tie

The rupture of the rail was completed, the lines of fracture at each end of piece No 2 extending from the upper surface of the base through the web and then the head It is probable that these two lines of fracture occurred nearly simultaneously

The base fracture, between fragments 4a and 4b, appears to have been the next to develop This line of rupture occurred over a tie and where there was a longitudinal streak or seam 11 inches long which opened but could be traced a further length of 3 inches in the base of piece No 4, making a total length of 14 inches

Next followed the upward line of rupture through the web and head between pieces Nos 3 and 4 These three lines of rupture through the web constitute all of this class of fractures displayed by the rail The other fractures were formed in quite a different manner

The running surface of fragments 1 and 3 was decidedly concave, that of No 2 slightly so All other pieces were convex on the running surface of the head and with the receiving end of each bent downward

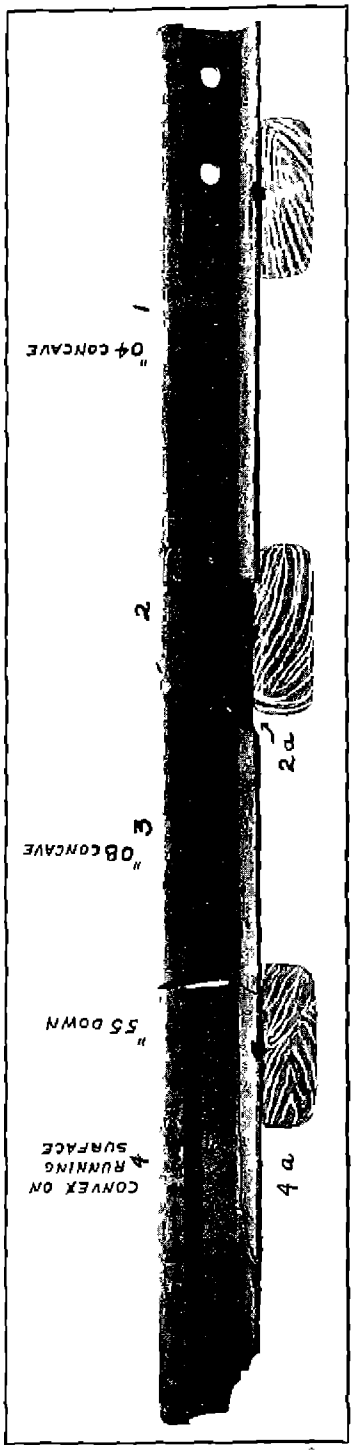
Pieces Nos 4 5 6, and 7 were detached by fractures having their origins at the lower edge of the head at the gauge side—that is each of these fragments was broken by a horizontal force or one having a horizontal component

Figure No 9 shows fragments Nos 4 to 7, inclusive, viewed from the gauge side of the rail The receiving ends of these pieces were bent downward 0 55, 0 48, 1 45, and 0 60 inches respectively The receiving end of the long piece, marked 8 was bent downward 0 70 inch The positions of the ties are sketched on cuts 8 and 9

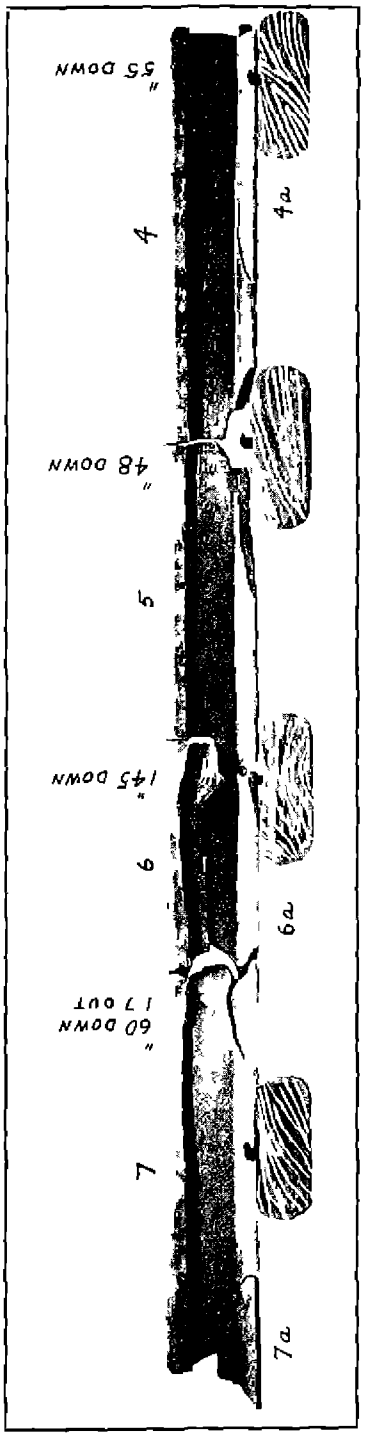
Figures Nos 10 and 11 are views of the base of the rail along the ruptured section The initial line of rupture at 2a and the second base fracture at 4a appear on figure No 10 The subsequent lines of rupture were of a different order They are shown on figure No 11

A larger view of the middle of the length of piece No 5 is shown by figure No 12 The flaky condition of the metal of the running surface of the head is shown This illustrates the cold-rolling effect of the wheels on the head of the rail

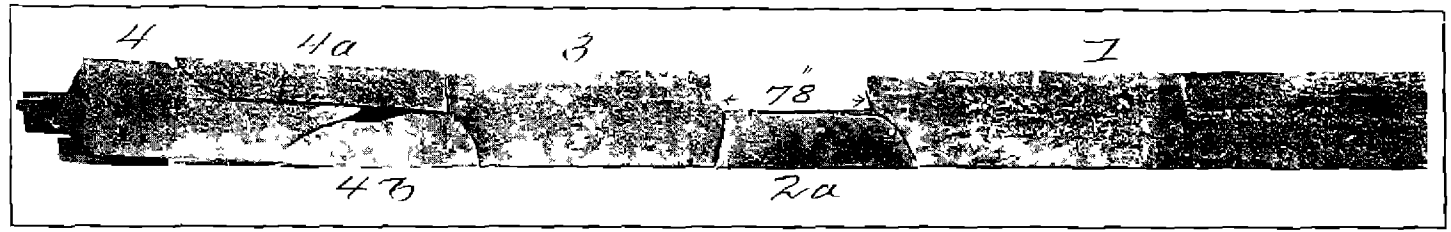
It will be noted that this rail was very much worn, since some 27 per cent of the metal of the head had been lost by abrasion and wear Furthermore that there was evidence in the indented condition of the outer flange of the base that the rail had endured an outward



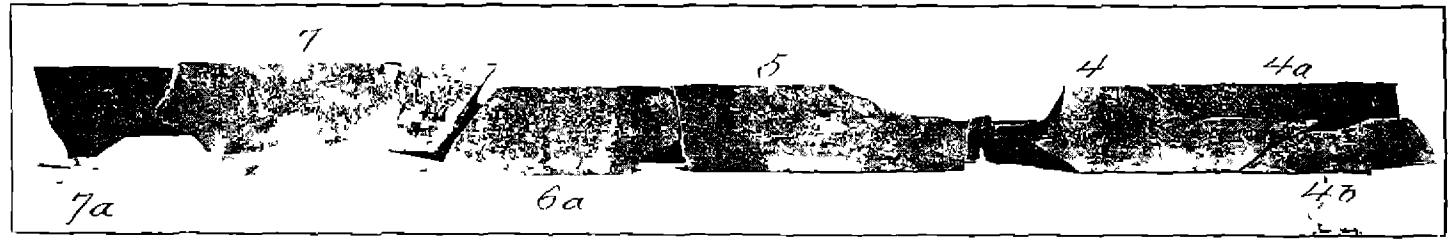
No 8.—View of fragments marked 1 to 4 inclusive, at last end of fractured rail taken from gauge side. Position of ties sketched on the cut. Initial rupture of rail believed to be the big fracture under fragment marked 2 or coming at a seamy spot in the steel



No 9.—View of fragments of rail marked 4 to 7 inclusive, taken from the gauge side. Position of the ties sketched on the cut



No. 10.—View of fragments marked 1 to 4 inclusive, at each end of fractured rail, showing under surface of the base. Initial rupture of rail believed to be the base fracture of fragment marked 2a, which is 7 8 inches long.



No. 11.—View of fragments marked 1 to 7 inclusive, showing under surface of base. Same rail base as fragments 1 and 1a is 31 inches long.

No. 12. View of middle of length of fragment marked 5 from gauge side, showing flaky condition of metal at edge of running surface of head

thrust repeatedly, which had caused the spikes to wear away and slightly notch the edge of the flange on the outside of the curve But these indications are not thought relevant to the wreck nor directly contributory to it The actual, immediate cause of the failure of the rail is believed to be found in the seaminess of the metal, which induced the base fracture under piece No 2, and the fracture which immediately followed under piece No 4

From the evidence presented by the fractured rail it is believed the rupture was caused by the engine of the wrecked train in substantially the following manner

The weight on the drivers caused the initial line of rupture a base fracture, along the line of a seam, under piece marked 2 The rail was weakened by reason of the presence of the seam in the base and yielded under a load which structurally sound metal would have sustained without fracture Base fracture at 4a followed that at 2a and was in turn followed by the fracture through the web and head between pieces Nos 3 and 4, piece No 2 having been entirely detached prior to these events

There next followed the several lines of rupture which detached pieces 4 5, 6, and 7 in succession from the main part of the rail The receiving ends of these fragments were bent outward and downward Comparatively very short bends were introduced in the head of the rail at pieces 6 7 and 8 The weight of the drivers of the engine would seem adequate to cause these short bends but the spiking would, unaided be insufficient to hold the rail against the force necessary to bend the rail The weight of the front truck 46 000 pounds, would however, supplement the strength of the spiking in holding the rail at its leading end and was probably sufficient to enable the observed results to be accomplished in the manner here suggested

The fireman was thrown from his side of the cab to that of the engineer, which would signify a sudden lurch of the engine toward the inside of the curve The bends in the head of the rail would call for such a lurch, if they were caused by the driving wheels of the engine, by the reaction It is believed there was a buckling tendency in the train, the retardation of speed of the engine while rupturing the rail permitting the rear portion of the train to force it toward the outside of the curve Such action would account for the outward bending of the head for which the centrifugal force of the engine alone would appear insufficient

The downward bends would result from raising the engine to the track level after having dropped through a certain space by reason of an opening in the track made by the detaching of pieces 2 and 3 and succeeding fragments The results are not inconsistent with the testimony that the train was not moving at a very high rate of speed at the time of the disaster

It was noticed that piece marked 8 had a long, sweeping curve, concave on the running surface of the head covering the westerly end for a distance of 14 feet 7 inches This was preceded by an abrupt bend 1 foot in length in which distance the rail was bent downward 0 15 inch Apparently the engine had made a partial leap when it came up the incline of the bent receiving end, touching the rail lightly for a length of about 3 feet 9 inches and then causing the abrupt bend just mentioned The receiving end was bent downward for a length of 3 feet 5 inches

There was a crescent fracture in the base on the gauge side of the rail 6 feet 9 inches from the leaving end Very near the leaving end there was a sharp bend, the head bending inward horizontally one-half an inch

In this effort to trace the probable manner in which the rail was ruptured the evidence indicates that the engine caused the breaks and that the cars of the train occasioned the stripping of the outer rail some 400 feet in length

In conclusion, it is believed that the direct cause of the rupture of the rail which occasioned the wreck of this train was the defective metal in the base of the rail The steel was seamy and the initial line of rupture occurred along the line of a seamy streak

Such fractures are numbered by the thousands From statistics it appears that not less than 80 per cent of broken rails reported, covering certain periods, were of the type here encountered

Herein is exhibited a structural defect which is prevalent, to a marked degree, in many rails It is a defect the presence of which is well recognized and admitted It has been the cause of occasional wrecks and a large number of renewals of rails Notwithstanding these circumstances, rails are accepted under specifications and tests in which this the most common cause for breakage, is not guarded against Revisions of specifications have gone on still omitting reference to this prolific cause of rail failures

An overwhelming majority of rail failures is reported as due to base fractures fractures which disclose the presence of streaks and seams in the steel This seaminess of the metal can be revealed by crosswise bending of the flanges, and such a test for structural soundness is easily made In fact such a method of examination has been employed in the past by the undersigned to show the prevalence of streaks in rails which had or had not displayed seamy fractures in the track Tests governing the acceptance of a finished product should undoubtedly be directed to show the fitness of that product against its most common manner of failure in service

Respectfully submitted

JAMES E HOWARD
Engineer-Physicist

○