

## INTERSTATE COMMERCE COMMISSION

### REPORT OF THE DIRECTOR OF THE BUREAU OF SAFETY IN RE INVESTIGATION OF AN ACCIDENT WHICH OCCURRED ON THE MISSOURI PACIFIC RAILROAD AT REILY LAKE, ILL., ON DECEMBER 10, 1927

JANUARY 25, 1928

#### TO THE COMMISSION

On December 10, 1927, a freight train was derailed at a switch and collided with the head end of a train standing on a siding on the Missouri Pacific Railroad at Reily Lake, Ill., resulting in the death of one employee and the injury of one employee

#### LOCATION AND METHOD OF OPERATION

This accident occurred on the Chester district of the Illinois division, extending between North Junction and Valley Junction, Ill., a distance of 119.33 miles, in the vicinity of the point of accident this is a single-track line over which trains are operated by time table and train orders, no block-signal system being in use. The derailment occurred at the south switch of the siding at Reily Lake, while the resultant collision occurred on the siding at a point 211 feet north of the switch points. The siding is 1,356.8 feet in length and parallels the main track on the west. The switch is a facing-point switch for northbound trains, and has a No. 10 turnout. The switch stand is about 8 feet in height and is located on the west side of the main track. Approaching the switch from the south the track is tangent for a distance of 4,498.2 feet and then there is a 2° curve to the left 406.7 feet in length, followed by more than 1 mile of tangent, the switch being located on this tangent at a point 407.5 feet from its southern end. The grade at the switch is 0.30 per cent descending for northbound trains.

The weather was cloudy at the time of the accident, which occurred at about 3.50 a. m.

#### DESCRIPTION

Southbound freight train extra 1408 consisted of engine 1408 and a caboose, and was in charge of Conductor Furness and Engineman Plummer. It headed in at the north switch of the siding at Reily Lake, pulled through the siding, and was brought to a stop clear of the main track with the front end of the engine 211 feet north of the south switch, to await the arrival of extra 1320. While standing at this point it was struck by extra 1320.

Northbound freight train extra 1320 consisted of 75 cars and a caboose, hauled by engine 1320, of the 2-8-2 type, and was in charge of Conductor Poth and Engineman Goley. This train left Ford, 11.2 miles south of Reily Lake and the last open office, at 3.05 a. m., entered the south switch of the siding at Reily Lake, which was open, although a clear indication was displayed by the switch lamp, and collided with extra 1408 while traveling at a speed estimated to have been between 20 and 25 miles per hour.

Engine 1408 was not derailed but was driven backward a distance of 347 feet, coming to rest with its front end locked with the front end of engine 1320. All of the wheels of engine 1320, and also its tender, were derailed, as was the forward truck of the third car in its train, none of the cars, however, sustained damage. The employee killed was the fireman of extra 1320.

#### SUMMARY OF EVIDENCE

Engineman Goley, of extra 1320, stated that the speed of his train was about 25 miles per hour when approaching Reily Lake, that he asked the fireman whether extra 1408 had arrived and that the fireman replied in the affirmative. Engineman Goley then dimmed the headlight and sounded the whistle, whereupon Brakeman Jordan, of extra 1408, who was standing on the east side of the main track opposite engine 1408, gave a proceed signal. Engineman Goley switched on the headlight fully, at which time his engine had about reached the end of the curve and he could see the green or proceed indication of the switch lamp, and continued at the same rate of speed, and on reaching the switch he felt the engine truck derail and the engine enter the siding, he then applied the air brakes in emergency and shouted a warning of danger to the fireman, the accident occurring immediately afterwards. Engineman Goley further stated that the only wheels to be derailed up to the point of accident were the engine-truck wheels, and that although the headlight was burning brightly when closely approaching the switch he did not notice that the switch points were open. After the accident he went back to the point where the engines had collided and found the fireman, the fireman was still alive at that time and when asked by the engineman as to whether he jumped the fireman replied that he was knocked off the engine. The engineman's examination of the switch disclosed that the head rod was broken and the switch points were lined for the siding. The fracture referred to by Engineman Goley occurred at the rail clip on the west end of the head rod, nearest the switch stand, with the result that the switch points were free to move independently of the operation of the switch-stand lever.

Head Brakeman Rainwater, of extra 1320, stated that when his train was approaching Reily Lake he got back on the tender and

looked over the train while rounding a curve, and that he also looked ahead and saw extra 1408 standing on the siding with the headlight cut out, while the switch lamp was displaying a green or proceed indication. He then got back in the cab of the engine and shortly afterwards the accident occurred, at which time the speed was about 20 miles per hour. After the accident he saw that the switch points were lined for the siding and that the head rod was broken.

Conductor Poth, of extra 1320, was riding in the caboose and the first he knew of anything wrong was when the air brakes were applied in emergency, at which time the speed was about 20 miles per hour. When the train had stopped he started toward the head end and on reaching the switch he noticed that the train had headed in on the siding, although the switch lamp was displaying a green indication, he also found that the head rod of the switch was broken. Flagman Downs estimated the speed to have been about 25 miles per hour at the time of the accident, he immediately went back to flag.

Fireman Howell, of extra 1408, stated that the headlight on his engine was cut out after the engine and caboose had been brought to a stop on the siding near the south switch. As extra 1320 approached he looked out of the cab window and noticed that the switch lamp was displaying a green indication and that the headlight of engine 1320 was burning brightly. After the accident the switch lamp was still displaying a green indication, although the switch points were lined for the siding, he also noticed the broken head rod.

Brakeman Jordan, of extra 1408, stated that as extra 1320 approached he left the caboose, crossed to the east side of the main track and stood opposite the caboose, he had not been at the switch prior to the arrival of extra 1320. When extra 1320 reached a point about 10 car-lengths south of the switch the whistle of that engine was sounded and as the switch lamp was displaying a green indication Brakeman Jordan gave a proceed signal, which was answered, the accident occurring very shortly afterwards.

Conductor Furness, Engineman Plummer, and Brakeman Bean, of extra 1408, were in the caboose at the time of the accident. Before the accident occurred Conductor Furness and Brakeman Bean had observed that the switch lamp was displaying a green indication. After the accident they noticed that it was still displaying a green indication and that the switch lever was locked for a main-track movement, the switch points, however, were lined for the siding and the head rod was broken. These two employees stated that Brakeman Jordan would not have had time to reach the switch between the time he left the caboose and the time the accident oc-

curred Owing to injuries received, Engineman Plummer was not interviewed

Conductor Adams, of extra 1527, stated that his train, consisting of 37 cars and a caboose, arrived at Reily Lake, southbound, at 1 10 a m, and as a northbound train had headed in on the siding at the south switch extra 1527 pulled by on the main track and backed in at the south switch While at this point a northbound extra passed on the main track and then extra 1527 headed out of the siding at the south switch Conductor Adams said that he stood on the rear platform of the caboose as his train headed out of the south switch and watched Brakeman Giles close the switch and look at the switch points, he also saw the switch lamp change from red to green, indicating that the switch was closed

Brakeman Giles, of extra 1527, stated that his train backed in the south switch of the siding at Reily Lake as the train then on the siding headed out of the north switch On the departure of his train from the siding, southbound, after the arrival of another northbound train, he got off the rear end of the caboose, lined the south switch for the main track, locked it looked at the switch points with his lantern and saw that they fitted properly, he then boarded the caboose, which was just barely moving, and gave a proceed signal The switch lamp displayed a green indication on the departure of his train

Roadmaster Holm stated that the switch was installed in June or July, 1919, and that a new switch stand was installed about the year 1924 While he had not inspected the head rod in its entirety since the switch was installed, he said he gives all switches an ordinary inspection once a month for defects in material He last inspected this switch on November 28, 1927, but found no defects To his knowledge the bend which existed in the head rod near the point where the fracture took place had been there practically since its installation, he did not think, however, that this bend would tend to place any undue strain on the rod at the point where it passed through the lug or clip connecting it with the west switch point The hole for the bolt securing the rod in the clip had become elongated through continued usage, both from the vibration of passing trains and from the throwing of the switch Roadmaster Holm further stated that the normal diameter of this bolt hole which was the point at which the fracture occurred, was 1 inch, and that the rod was  $2\frac{1}{2}$  inches wide and five-eighths inch thick

Section Foreman Stinaman stated that after the accident he examined the broken head rod and the indications were that about 75 per cent of the surface of the break represented an old fracture The switch points showed no evidence of having been run through or damaged, they were lined for the siding and the switch lamp was displaying a green indication He last inspected the switch involved

about 8 a m the day prior to the accident but noticed no defects, this inspection consisted of unlocking and operating the switch and seeing that the points fitted properly, that the switch stand was securely fastened, the bolts, nuts, and cotter keys in place and well secured, and that the gauge, alignment and surface of the track were all right and the ties properly tamped. He also said that on December 5 he placed a new bolt in the clip on the end where the head rod broke, as the old bolt was worn and loose, it was not necessary to force the new bolt in place. Section Foreman Stinnaman further stated that it was not the practice or custom to take switches apart, other than the switch stand, to inspect them for defects or faulty material and that the defect that was evident in this particular switch could not have been detected by ordinary inspection but only by disconnecting the head rod and taking it out of the clips, this was something he had not done.

#### CONCLUSIONS

This accident was caused by an open switch, due to a broken head rod

This switch was last used by the crew of southbound extra 1527, at about 1 40 a m, and the brakeman who closed the switch after that train had pulled out on the main track said he noticed that the switch points fitted properly after the switch had been closed. Between that time and the time of the accident three southbound trains passed this point without incident, there were no indications that the switch had been run through by any of these trains. It was not determined exactly when the head rod broke and thus allowed the switch points to move independently of the position of the switch-stand lever.

An examination as to the reason for the fracture of the head rod of this switch was made by Mr. James E. Howard, engineer-physicist, whose report follows.

#### REPORT OF THE ENGINEER-PHYSICIST

The accident at Reily Lake, Ill., on December 10, 1927, was due to the fracture of the head rod of the switch rails of the siding at that place.

Testimony, taken at the investigation of the accident, showed that a defective head rod was installed in 1919, defective in shape but not in respect to the metal of which it was composed.

About 1924 a new switch stand was installed. The defective head rod was allowed to remain in place. On December 5, or five days prior to the accident, a new bolt was inserted connecting the switch rail clip with the head rod, replacing a worn one.

During the interval of time in which the defective head rod was in service a progressive fracture had formed across the body of the

rod at the bolt hole for the rail clip. The completion of this progressive fracture was the immediate cause of the accident.

There are no data at hand which indicate the time when this progressive fracture had its origin. The character of the fractured surfaces indicates that a partial fracture of the head rod had been in existence for a considerable time prior to the accident. The interval of time within which final rupture occurred was definitely fixed. It occurred within the period of 2 hours and 10 minutes on the morning of December 10. Train movements apparently were responsible for the inception and progress of the fracture and train movements were likewise responsible for the final fracture of the head rod. The bent shape of the head rod explains why ordinary traffic conditions caused this result.

Southbound train extra 1527 left the siding at 1 40 a. m. on the morning of December 10, 1927. The switch was thrown by the rear brakeman of that train. It properly functioned. The switch points were set for main-line traffic, with corresponding signal indications given by the target and lamp of the switch stand. Three southbound trains passed over the switch rails between 1 40 and 3 50 a. m. During this interval of 2 hours and 10 minutes, and under one of these trains, the rupture of the head rod was completed.

It is immaterial which of the three trains completed the fracture of the head rod. For each of these trains the switch was a trailing one, hence the flanges of the wheels of these trains would tend to close the switch rails, permitting southbound trains to pass in safety.

Northbound train extra 1320 approached the siding at 3 50 a. m. with signals set for the main line. Due to the broken head rod the switch rails, entirely detached from the switch stand, had become opened enough to divert this train to the siding where it collided head on, with train extra 1408, which was standing on the siding near its south end.

Analysis of the action of wheel loads on the point of the switch rail explains why the head rod was broken. It was exposed to a succession of bending stresses under ordinary service conditions.

The switch rail clip was bolted to the bent head rod on the sloping face of the latter. The righting of the switch rail caused the clip to abrade the metal of the head rod at diagonal corners. Bending stresses, incident thereto, concentrated at the minimum cross section of the head rod—that is, across the bolt hole. Final rupture ensued as the result of repeated bending stresses. Repeated bending stresses, of sufficient degree, will ultimately cause the rupture of any grade of steel.

The head rod was made of mild steel of good quality. The body of the rod was subsequently bent cold through 180° of arc, and closed down with only partial fracture of the metal.

Figure No 1 shows the appearance of the head rod as it was received after the accident. The rail clip appears on the cut near its location on the head rod. A short distance from its outer end the rod was bent upward  $10^{\circ}$ . There was a long upward bend in the body of the rod, the crest of which was just inside the position of the rail clip. The maximum deflection, on a chord of 30 inches, was  $1\frac{1}{2}$  inches. These were the bends referred to in the testimony at the investigation as having been present when the head rod was first installed in 1919.

Describing the condition of the head rod immediately after the accident, about one-quarter of the fractured surface was new and bright colored. Three-quarters of the cross section was dark colored and smooth, representing a portion of the fracture of earlier formation. The section of metal first to fracture was located next the root of the jaws of the rail clip.

The bolt hole was elongated one-fourth inch in diameter, parallel to the length of the head rod. The semicylindrical surface of the bolt hole was rounded axially on the side toward the middle of the track, the counter-surface of the worn bolt which was replaced by a new one five days prior to the accident. The looseness of the rail clip was therefore one-fourth of an inch plus whatever the bolt was worn.

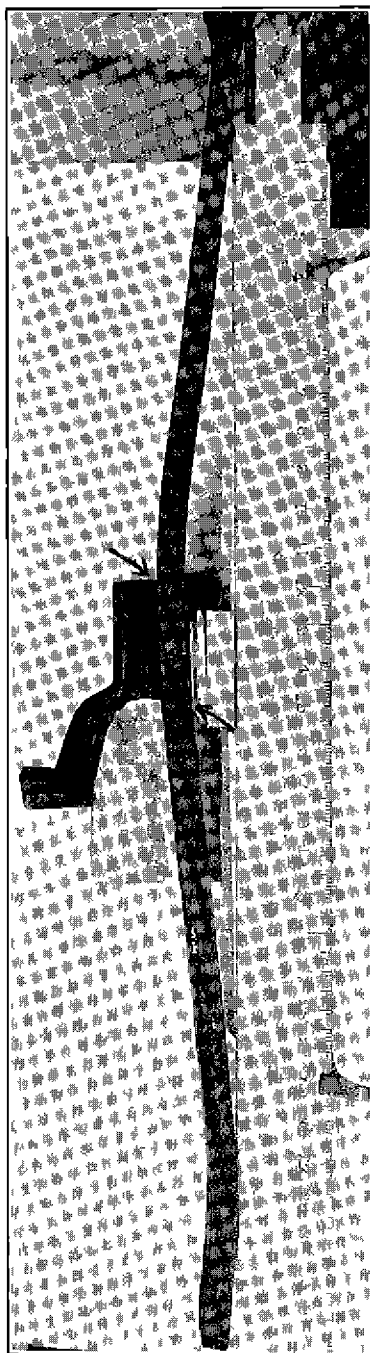


Fig 1 —Side view of fractured head rod showing its original bent shape. Arrows point to places where abrasions of upper and lower faces were deepest.

The section of metal between the bolt hole and the inner edge of the head rod was not materially reduced in thickness. On the opposite side the metal was drawn down 0.03 of an inch in thickness.

The upper face of the head rod was worn a depth of 0.02 of an inch. The under face, diagonally opposite, was worn to a depth of 0.04 of an inch. This loss of metal was due to the abrasive action of the jaws of the rail clip. The diagonal wear was incident to the bent shape of the head rod. Arrows on the cut indicate the places of maximum abrasion.

In conclusion it appears that a defective head rod was installed in 1919, which under the influence of repeated bending stresses developed a progressive fracture, eventually terminating in complete rupture. Responsibility for the accident therefore appears to attach to the installation of this defective member in the switch mechanism.

#### SUMMARY

The head-end collision at Reily Lake, Ill., on December 10, 1927, was apparently due to a broken head rod of the switch rails of the siding, facing points for the colliding train. Train No. 1320 was diverted from the main line track to the siding which was occupied by train No. 1408.

The signal at the switch stand indicated clear for the main line track, but the switch rails detached from the stand were open sufficiently to divert train No. 1320 from the main line rails to the siding.

Testimony taken at the investigation of the accident disclosed the fact that a defective head rod was initially installed at that place in 1919. The head rod was kept in service until a progressive fracture across the bolt hole for the rail clip was completed.

The rod was defective in respect to shape. The quality of the metal, mild steel, of which it was made was good.

By reason of the initial bend the head rod was exposed to bending stresses by the wheels which passed over the switch rail. A progressive fracture was thus formed, ending in complete fracture, thereby destroying connection between the switch rails and the switch stand.

A new bolt was inserted at the rail clip five days prior to the accident. Opportunity was then offered to inspect the condition of the head rod, the bolt hole in which was finally elongated one-quarter of an inch. The feature of chief importance attached to the use of a bent head rod. It is not justifiable to install members in a track structure which are of distorted shapes, and thereby expose them to strains for which they were not designed nor adapted to resist.

Respectfully submitted

W. P. BORLAND, *Director*