No. 131

January 7, 1914.

In re investigation of accident on Southern Railway near Oyama, N. C., on March 31, 1913.

On March 31, 1913, there was a derailment of a freight train on the Southern Railway near Oyama, N. C., resulting in the death of 3 employees and the injury of a trespasser on the train. After investigation as to the nature and cause of this accident, and the circumstances connected therewith, the Chief Inspector of Safety Appliances reports as follows:

The Asheville Division of the Southern Railway, on which this accident occurred, is a single track line operated under the manual block system. At the point of derailment the track runs east and west; it is laid with 33-foot, 80-pound steel rails, single spiked to oak ties, 18 or 19 to the rail, with 8 inches of rock ballast, the track being maintained in good condition.

Westbound freight train No. 73, running from Salisbury, N. C., to Asheville, N. C., a distance of 141 miles, consisted of engine No. 646, 17 loaded and 17 empty cars and a caboose, and was in charge of Conductor Boyle and Engineman Nagle. This train left Salisbury at 2:21 a.m., 21 minutes late, and left Newton, the last telegraph station east of the point of derailment, at 4:43 a.m., 28 minutes late. The derailment occurred 2.2 miles east of Oyama, N. C., near mile-post S-21.8, at about 4:50 a.m. The engine, tender and 16 cars were derailed on the south side of the track. 11 cars were destroyed, and the track was torn up for a distance of 330 feet. The conductor, engineer and fireman were killed.

The speed of the train at the time of the derailment was 25 or 30 miles per hour. There was a speed restriction of 30 miles per hour for freight trains in effect on this division. At the time of the accident the weather was foggy.

Approaching the scene of the accident from the east there is a 2 degree curve to the south 2300 feet long, followed by a tangent 3700 feet in length. Following this tangent is a 1 degree curve to the north 5400 feet in length. About 1800 feet of this tangent is on a grade of .95% descending from the east, this grade being immediately followed by an ascending grade of 0.9% about 1400 feet in length. The derailment occurred about 1122 feet from the east end of the tangent, 300 feet from the foot of the descending grade, on a fill 5 feet high on the south and 2½ feet high on the north. It was caused by a broken rail on the south of the track. The rail was broken in 8 places, the shortest piece being about 7 inches long and the longest piece 18 feet 2½ inches long.

Engine 646 weighed 197,750 pounds, with 176,650 pounds on drivers. This engine was built in 1904; it was rebuilt in 1912, and at the time of the accident was in good condition. The last preceding train over this track was eastbound freight train third No. 72, which passed the scene of derailment at approximately 3:05 a.m. This train was hauled by engine 823, of the same class as engine 646, and consisted of 20 loaded cars. The engineer of this train stated that at this point where derailment occurred his train was running at the rate of 20 or 25 miles per hour and he did not notice anything unusual when his train passed that point.

The section on which the derailment occurred included 6½ miles of main track. The section foreman stated that ordinarily he had four men in his gang, but at the time of the accident he had but 3. He stated that this section of the track was carefully gone over by his men 3 times each week and that he made an examination of the track at least twice a week for the express purpose of looking for broken rails; he had not found a broken rail on this division for at least 3 months.

As this accident was caused by a broken rail arrangements were made with the Bureau of Standards, Department of Commerce, for the purpose of having this rail examined and the cause of its failure ascertained. This examination was conducted by Mr. James E. Howard, Engineer-Physicist, of the Bureau of Standards, and the report regarding his examination, with the accompanying illustrations, is attached to and made a part of this report.

The broken rail which caused this accident was manufactured by the Tennessee Coal & Iron Company; it was 33 feet long, weighed 80 pounds to the yard; was rolled in November, 1904, and laid in the track in January, 1905. The first break in this rail was found 16 feet 2¼ inches from the east end, while that part of the rail west of this fracture was broken in 9 pieces, ranging from 6-3/8 inches to 5 feet 5 inches in length, the last break being near the splice plate at the west end. From the appearance of the fractures and the battered ends of the pieces of rail it is believed that the first break occurred either between pieces Nos. 2 and 3 or between pieces Nos. 3 and 4, shown in illustration No. 1. A transverse fissure one inch in diameter was found at the facture between pieces Nos. 3 and 4, and that fact together with other evidence brought out by Mr. Howard's examination indicates that this fracture was the first one to be formed. The fractures to the east of this initial fracture differ from those to the west in that the fragments were bruised on different ends, from which it is inferred that the several fractures were caused by two trains which moved in opposite directions. It also appears that the receiving ends of fragments Nos. 1 and 2 were bruised and displaced in such a manner as to indicate that this had been done by an eastbound train. The manner in which the rail broke is clearly shown in illustrations Nos. 1, 2 and 3. Illustration No. 4 shows the transverse fissure one inch in diameter on the fractured surface of fragment No. 4. It will be noted that this transverse fissure was located on the gauge side of the head nearly over the web. This fissure is similar to the fissures found in the broken rails which caused the accidents on the Lehigh Valley Railroad at Manchester, N. Y., August 25, 1911, and on the Louisville & Nashville Railroad near May's Mill, Oct. 1, 1912, upon which reports have been made.

The 17 other rails which had to be replaced were bent and twisted out of shape but were not fractured.

In view of the fact that the formation of transverse fissures in rails is a grave menace to the safety of railroad travel, the facts disclosed by this investigation and the conclusions reached by Mr. Howard as a result of his study and tests of this rail are of particular interest and value.

Mr. Howard points out that transverse fissures are progressive in their character and development. They have been observed at different stages in their growth from ".30 diameter, to a maximum of 2½". The material and locality in which they exist have been defined. They have been found only in steel rails, where they commonly are developed on the gauge side of the head, or over the web. In their development from a minimum to a maximum diameter the extension takes place while the rails are under service condition in the track.

Furthermore, Mr. Howard calls attention to the fact that:

> "The rate of development of a transverse fissure should be an accelerating one, since the resistance of the rail diminishes as the fissure extends.
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> It is a question of interest whether an effect caused by an excessive load is further accentuated by the application of lesser loads; that is, whether the effect of an overload coming from the drivers of the engine would be further increased by the lesser wheel loads of the train. Laboratory tests on the effects of repeated stresses have shown, however, that many million repetitions of a lesser load may be applied to a steel bar without causing rupture, while substantially the normal number of repetitions of a maximum load will thereafter effect a fracture.
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> This is so vital a feature in the use of railway material that confirmatory data are desirable to acquire from independent sources. Provided these indications are trustworthy, it follows that the limit of endurance of a steel rail is not necessarily measured

> by total tonnage, but rather by the number of repetitions of high wheel loads to which it is exposed.
>
> Frequent rail failures are regarded as sufficient warning that railway practice is approaching the limit of endurance of rail steel."

The facts disclosed by the investigation of this derailment emphasize the statements made in the report regarding the derailment on the Louisville & Nashville Railroad, near Hay's Mill, Ala., where it was stated that the combined bending stresses and intense wheel contact stresses which attend the service conditions of steel rail appear to be the cause of and formation of these fissures. The insidious character of these fissures and their menace to safe travel by rail justify the conclusion reached that there is an absolute necessity of making a complete investigation of track and wheel conditions for the purpose of determining the effect thereon of the recent types of locomotives and cars with their greatly increased wheel loads.