INTERSTATE COMMERCE COMMISSION

REPORT OF THE DIRECTOR OF THE BUREAU OF SAFETY IN RE INVESTIGATION OF AN ACCIDENT WHICH OCCURRED ON THE BALTIMORE & OHIO RAILROAD NEAR ENGLE, W.VA., ON NOVEMBER 25, 1928.

April 29, 1929.

To the Commission:

On November 25, 1928, there was a derailment of a freight train on the Baltimore & Ohio Railroad near Engle, W. Va., the wreckage of which was struck by a passenger train moving in the opposite direction on an adjoining track, this accident resulting in the death of 2 employees, and the injury of 4 passengers, 2 Pullman employees and 15 railroad employees.

Location and method of operation

This accident occurred on that portion of the Cumberland Division extending between Cumberland and Weverton, Md., a distance of 95.5 miles; in the vicinity of the point of accident this is a three-track line over which trains are operated by time-table, train orders and an automatic block-signal system. The tracks are numbered from south to north 2, 1, and 3, the derailment occurring on track 2 at a point approximately 2,800 feet west of Engle. Approaching this point from the west there is a 1° 37' curve to the left 1,403.9 feet in length, from which point the track is tangent for a distance of 2,399.4 feet, the accident occurring on this tangent at a point 802.6 feet from its eastern end. The grade is descending for eastbound trains for about 6 miles, being 0.5 per cent at the point of accident.

The weather was clear at the time of the accident, which occurred at about 8.19 p.m.

Description

Eastbound freight train extra 6166 consisted of 99 cars and a caboose, hauled by engine 6166, and was in charge of Conductor Ambrose and Engineman Huffman. This train left Hobbs, 5.8 miles west of Engle, at 8.08 p.m., and was approaching Engle when it was derailed by a broken wheel while traveling at a speed estimated at about 25 miles per hour.

Westbound passenger train No. 1, known as the National Limited was running on track 1; it consisted of one club car, one dining car and six Pullman sleeping cars, hauled by engine 5312, and was in charge of Conductor Richards and Engineman Fraley. This train passed Engle at 8.18 p.m., 30 minutes late, and shortly afterwards it collided with the wreckage of extra 6166 while traveling at a speed estimated at 50 miles per hour.

The 66th to the 77th cars, inclusive, in the freight train were derailed and came to rest in various positions fouling track 1. Engine 5312 and its tender were overturned, coming to rest on their right sides north of track 3. The first and second cars in the passenger train were derailed and came to rest in upright positions on top of some of the derailed freight cars; the forward truck of the third car was also derailed. The employees killed were the engineman and fireman of train No. 1.

Summary of evidence

Examination of the track showed that the first evidence of something unusual was a wheel mark on the ball of the north rail of track 3 at a point 663 feet west of a trailing-point switch which led off track 2 to the south. Similar marks were found on the same rail eastward until the frog was reached where the derailment occurred.

Engineman Huffman, of extra 6166, stated that a test of the brakes was made by the car inspectors before leaving Cumberland and that no defective brakes were reported to him. He said that only one air-brake application was made after leaving Hobbs, this being the first time they had been applied since departing from Martinsburg, a distance of about 15 miles. When the speed was reduced to about 18 miles per hour he released the brakes and was drifting toward Engle when he saw train No. 1 approaching and dimmed his headlight. He then noticed the air pressure gradually reducing and at the time he thought it was caused by a burst air hose and to prevent damage to the train he placed the brake valve in the lap position and opened the sanders. Engineman Huffman further stated that his train appeared to drag rather heavy at different points but he attributed this to cold weather, as when he looked back he did not notice any indications of brakes sticking. He also said that his train was carrying a brake-pipe pressure of 70 pounds and that he experienced no difficulty with the brakes en route.

The statements of Fireman Berry, of extra 6166, substantiated those of Engineman Huffman as to the handling of the train approaching the point of accident. He also looked back after the brakes had been released but did not see any signs of brakes sticking other than on a few of the cars near the head end on which the retainers had been set up.

Head Brakeman Dolan, of extra 6166, stated that after his train departed from Hobbs he set up the retainers on 24 cars at the head end of the train and that he remained on the 24th car watching the movement of his train but saw nothing unusual. After train No. 1 passed him his own train traveled a distance of about 15 car-lengths and then came to a stop. He then proceeded to the engine end, as the engineman informed him that he believed it was a burst hose, he removed the hose from the front end of the enigne and started back along the train. He did not know what had happened until he met the flagman of train No. 1. Brakeman Dolan estimated the speed of that train at the time it passed him as between 45 and 55 miles per hour while the speed of his own train at the time of the accident was about 25 miles per hour.

The statements of Conductor Ambrose and Flagman Danner, of extra 6166, were to the effect that they were riding in the cupola of their caboose, one on either side, looking ahead while the train was approaching the point of accident and they did not observe any fire flying or any other evidence of sticking brakes. The train was being handled in the usual manner and was traveling at a speed of about 25 miles per hour when they felt an unusual motion of the caboose shortly after which the train came to a stop, the flagman at the same time observing that the gauge in the caboose showed there was no air pressure. They both left the caboose immediately and heard a whistling sound which indicated that steam was escaping, the flagman further adding that he had seen the headlight of train No. 1 coming around the curve just before his train was derailed. Conductor Ambrose inspected his train on several occasions during the trip but did not find any brakes which failed to release while Flagman Danner stated that when they passed a westbound train at Kearneysville, 7.5 miles from Engle, the brakeman of that train gave him a proceed signal, indicating that nothing was wrong.

Conductor Richards, of train No. 1, stated that he was riding in the dining car at the time of the accident and that just before its occurrence he heard the rumble of a freight train on an adjoining track. He received no warning of danger and did not believe the engineman had received any warning as it did not appear that the brakes were applied prior to the accident; he estimated the speed of his train at the time of the accident at 50 miles per hour.

Flagman Easton, of train No. 1, stated that he was riding in the forward end of the rear car as his train approached the point of accident and that when he heard the passing freight train he went to the rear of the car to get a better view. He noticed that the front end of the train was moving but that it had parted, and the collision of his own train with the wreckage occurred immediately afterwards. He also estimated the speed of his train at 50 miles per hour at the time of the accident, and did not think that the brakes had been applied as in his opinion the first shock was due to the collision and not by a brake application.

Operator Hobbs, on duty at Hobbs at the time extra 6166 passed that point, stated that the train was moving slowly and that he watched it as it passed, he saw no fire flying from the wheels while if brakes were sticking he would have heard the noise.

Investigation developed that there was a broken wheel under the first of the derailed freight cars, B&O hopper 222537, about 40 inches of the tread and 20 inches of the flange having been broken off from the balance of the wheel. The discoloration of the metal on the tread of the wheel and the burned appearances of the brake shoes indicated that the wheel had been overheated. Examination of the rear pair of wheels in the same truck showed evidence of overheating and the wheels under the opposite end of the car also bore evidence of having been subjected to excessive brake action. This car was equipped with a K-2 triple valve and a three-position spring-type retaining valve; the triple valve had last been cleaned on November 4, 1927. Both the triple valve and the retaining valve were tested subsequent to the accident and found to be in good condition.

The evidence having indicated that this accident was caused by a broken wheel, an investigation to ascertain the reason for the failure of the wheel was made by Mr. James E. Howard, engineer-physicist, whose report follows:

Report of the Engineer-Physicist

On November 25, 1928, a broken wheel caused an accident near Engle, W. Va. The broken wheel was the lead wheel, fireman's side, of the front truck of coal car No. 222537, a side-swing dump, hopper car, 110,000 pounds capacity, the 66th car of a 99-car train. The broken wheel was 33 inches in diameter, cast by the Central Car Wheel Company, Pittsburgh, Pa., January 4, 1921. It was a chilled iron, double plate wheel, 725 pounds weight, No. 185490, branded in part, "MCB 1909".

A segment 40 inches long was detached from the plate of the wheel near the rim. This occurred some 19 or 20 rail-lengths before the train was derailed. Small fragments were successively detached from another part of the circumference during the time the train was running 660 feet, when a frog was encountered and derailment occurred. A number of cars, in the rear of the 66th car, were thrown crosswise the track, fouling the adjacent track, and into which train No. 1 plunged.

Marks at regular intervals were made on the heads of the rails from the point at which the 40-inch segment was detached until the frog was reached. The distances between the marks on the rail heads corresponded in general with the circumference of the broken wheel. Some were farther apart, indicating the rotation of this axle had received a check, but consistent with the explanation that the cause of the accident was due to the fracture of this wheel.

The mate of the broken wheel, also branded in part, "MCB 1909", was tested diametrically with a load of 200,000 pounds. It sustained this load without injury, showing structural strength in excess of the wheel load under which it had worked, estimated at less than 20,000 pounds.

The general cause of the fracture of the wheel was said to be over-heating, not an uncommon occurrence in wheels. Heat is a destructive force under some conditions, wherever it is experienced. This wheel was reported as having been hot when dug out of the coal on the morning following the accident. The 40-inch segment, which at the time recovered was broken into halves, showed oxide tints on the surface of the tread. On circular spots of the tread there were higher oxides, magnetic oxides.

The 40-inch segment was doubtless detached as one piece, but broken into halves by striking some object. The initial point of rupture was located near the middle of its length, from whence it extended in each direction, obliquely through the rim. The exact point of rupture, with some exceptions, is not clearly indicated on gray iron or white iron surfaces of fracture. On steel surfaces the reverse is generally true.

Concerning the strength of gray iron at different temperatures. Earlier tests have shown that the tensile strength of cast (gun) iron bars was substantially the same over the range from atmospheric temperatures to nearly 1000 degrees Fahr. A little higher strength in fact was displayed at 900 degrees over that at 70 degrees.

Differences in temperature are vital matters. To say that a wheel failed because it was hot does not have an exact significance. If it was uniformly heated the relations between the rim, plate and hub would remain unaffected, and the strength of the wheel would remain unimpaired. The manner and rapidity of heating, or rapidity of cooling, introduce destructive strains, by reason of the differences in temperatures in different parts of the wheel which are thus involved. Heating in service begins at the rim, at the frictional surface between the tread and the brake shoe. The rim for the time being is put into compression, the plate into a state of tension. The most severe strains of tension in the plate are expected when the rim first is being heated. Heat waves are slow of transmission compared with those of strains.

When the place reaches a high temperature the strains of tension are relieved. Time is an important element in the heating and cooling of metals. A definite amount of mechanical work is necessary to retard the speed of moving trains, but uniform brake action and the time consumed are vital factors which favor the strains in the wheels.

The rate of cooling is not under the same control as the rate of heating. Condition of radiating surfaces and temperature of the air are factors in the rate of cooling. Thick and thin parts of a wheel, of course, cool at different rates. The mass of metal in the rim is such that strains in cooling induce thermal cracks, in that part of the wheel independent of the general relations between rim and plate. The broken wheel and its mate exhibited thermal cracks in the rims. In some parts of the circumference they were only an inch and a half apart. Those cracks were parallel to the length of the axle, and did not contribute to the fracture of the broken wheel.

It has been shown in laboratory tests that repeated alternate stresses of tension and compression eventually weaken the strength of cast irons, ultimate fracture occurring under reduced load. It is immaterial how alternate stresses are introduced, whether by thermal or mechanical means. Such influences are doubtless at work on the plates of wheels. Combined with them are the flange thrusts, which introduce alternate strains on opposite sides of the wheel. These are additional strains over the direct radial compression of the axle load. If an estimate was made as to the magnitudes of these components it would seem that the direct axle loads were often the inferior ones.

The cooling strains of fabrication must be given consideration in judging of the total strains to which the several parts of a wheel are exposed. They in turn are expected to be modified by the operation of annealing.

A specific cause for fractures of the type exhibited in the present broken wheel does not admit of being advanced. It is believed that this wheel, in common with others, was exposed to service conditions which had a progressive tendency to culminate in rupture. The service conditions referred to are repeated thermal strains in the plate and repeated side thrusts from flange blows against the side of the rail. The results of side thrusts has been clearly shown in the fracture of the plates of forged steel wheels. In fact an example of this kind was presented shortly after this accident in the fracture of a forged steel coach-wheel. The origin of the fracture was at the fillet next the hub, the point of inception being on the face of the plate opposite the flange.

In the majority of cases the explanation of the cause of rupture has a direct relation to the service conditions to which the material had been exposed. This fact makes the usual laboratory examination of fractured material a perfunctory affair. Tests for physical properties and analyses for chemical composition have their purpose. They hardly can be called explanatory data in cases of this kind. Knowledge of what transpired in service is commonly indispensable upon which to base judgment of the causes of rupture. Efforts are being made to acquire definite information upon some of the conditions which lead to rupture as they are experienced in the track.

Summary

In respect to the fracture of the wheel involved in the present accident, it would appear that events immediately prior to the time of derailment would not adequately explain its occurrence. The significant feature exhibited by the wheel was the presence of patches of magnetic oxide on the surface of the rim. This oxide is formed at a high temperature. Time for its formation is required. It can be conceived that upon some earlier occasion rapid heating of the rim occurred; that strains of tension of high degree

were introduced in the plate; that these strains of tension occurred during heating of the rim and again when the plate cooled more rapidly than the mass of metal in the rim; that severe flange blows were received during these critical periods; that the strength of the plate was impaired by repeated flange thrusts.

Nothing is shown to have taken place outside of conditions which are common in railroad service. A recurrence of fractures of this kind might be averted by exposure to less severe track conditions. Relief in that direction, however, does not appear a practical solution of the problem, although some amelioration in braking conditions might be reached. Definite information upon the disposition and magnitude of the strains introduced in service together with a determination of the initial strains of fabrication may be looked upon as capable of furnishing useful data and which might be suggestive of methods of improvement.

Respectfully submitted,

W. P. BORLAND,

Director.