ACCIDENT ON THE UNION PACIFIC RAILROAD ORCHARD, COLO.
FEBRUARY 8, 1937
INVESTIGATION NO. 2141

SUMMARY
Railroad: Union Pacific
Date: February 8, 1937
Location: Orchard, Colo.
Kind of accident: Derailment
Train involved: Passenger
Engine number: M10003 - Diesel electric
Consist: 10 cars - 6 of which were articulated units
Speed: 80 m.p.h.
Track: Tangent; grade 0.130 percent ascending
Weather: Clear
Time: 8:25 A.M.
Casualties: 11 injured
Cause: Journal burned off.

March 30, 1937.
To the Commission:
On February 8, 1937, there was a derailment of a passenger train on the Union Pacific Railroad at Orchard, Colo., which resulted in the injury of 10 passengers and 1 employee.

Location and method of operation
This accident occurred on the Sterling Subdivision of the Colorado Division, which extends between Sterling, Cob., and LaSalle, Colo., a distance of 93.6 miles; in the vicinity of the point of accident this is a single track line over which trains are operated by timetable, train orders and an automatic block signal system. At Orchard, Colo., 60.2 miles west of Sterling, a passing track 4,195 feet in length, parallels the main track on the south; the accident occurred at a point 22 feet east of the east switch of this passing track, or 4,383 feet east of the station.
Approaching the point of accident from the east the track is tangent for more than 2 miles, then there is a 30' curve to the left 3,680 feet long, then tangent track for 4,422 feet to the point of accident and for a considerable distance beyond. The grade in this vicinity is slightly ascending for west-bound trains, varying from 0.072 to 0.130 percent.
The track is laid with 90 pound rail, 33 feet in length, with 20 treated pine ties to the rail length; it is ballasted with gravel to a depth of 18 inches and is well maintained.
The weather was clear and the temperature was about zero at the time of the accident which occurred at about 8:25 a.m.

Description
Train No. 111, a west-bound passenger train known as "The City of Denver" consisted of baggage and mail car 11700, mail car 12203, tap car 11701, articulated coaches 11407-11408, diner 10303, articulated sleepers Cache La Poudre and Squaw Bonnet and articulated sleeper and observation cars Silver Dollar and Ogallala, in the order named, hauled by Diesel-electric tractor M-l0003 and was in charge of Conductor McIntire and Engineman Peacock.

Train No. 111 is one of a group of streamlined trains owned by the Union Pacific railroad and operated between Chicago, and Denver, over the lines of the Chicago and Northwestern Railway and the Union Pacific Railroad. These trains are composed of light-weight equipment and some of the units consist of 2 complete cars mounted on 3 trucks, one truck at each of the extreme ends and one truck under the abutting ends of the two cars, the cars being joined by an articulated connection; this latter truck is called an articulating or intermediate truck; other units have two trucks arranged in the conventional manner. The trucks, which are of special design, are of the four wheel type with four air brake cylinders per truck; each cylinder operates the brake gear on one wheel and is located on the outside of the truck frame above the wheel upon which it spends its force. All of these cylinders are supplied with air from the same source; clasp brakes are installed, with two brake shoes in each brake head making a total of 16 shoes per truck. Molybdenum alloy, wrought steel wheels, 34 inches in diameter, with standard A.A.R. contour, are used, and all journals are mounted on roller bearings of either SKF or Timken manufacture. The truck embracing the journal which failed weighed 18,600 pounds and supported a total weight of 76,075 pounds; the journals were 6 inches by 11 inches and Timken bearings were used on this truck.

Summary of evidence

Conductor McIntire stated that his train left Sterling at 7:29 a.m., 17 minutes late; approaching Snyder he was notified that the brakes were sticking on the two rear cars and the train was brought to a stop. He and Flagman Olds inspected the brakes and wheels on the right side of the rear articulating truck; they found the brakes released, and there was no smoke or other indication of stuck brakes, nor were there any hot wheels. No inspection was made on the left side of the train, but since the brake cylinders on each truck are all connected with one another, the condition existing on the right side is indicative of that on the left side. After leaving Snyder Conductor McIntire remained at the rear of the train for about five minutes and during that time did not observe any unusual vibration or noise. He was in the center of the train when the stop was made at Orchard and felt an emergency application of the brakes but was unaware of the reason until he dismounted from the train. He had been informed by the porter that there were some flat spots on the rear articulating truck, but these had been noticed shortly after leaving Chicago. The train usually stops at North Platte for about 7 to 10 minutes, during which time a thorough inspection is made, but at Sterling there is not time for more than a running inspection to be made. He was under the impression that roller bearings would not run hot.

The statement of Flagman Olds regarding the inspection of the train at Snyder agreed with that of Conductor McIntire. After leaving Snyder the flagman rode in the vestibule over the truck which they had just inspected and after the train had traveled about 11 miles farther he opened the door on the left side of the vestibule but did not notice anything further being wrong until the train was about five miles east of Orchard, when the brakes appeared to be sticking again. Using the train telephone, he notified Supervisor Getty, who was in the Diesel cab, and was informed that an application and release of the brakes would be made; this was done and Flagman Olds observed that the operation was as desired. He was knocked down by the force of the derailment but arose immediately and applied the brakes by opening the emergency valve. He had never had any experience with roller bearings running hot but he was not under the impression that they would not run hot. He did not think that an examination of the left side of the train at Snyder would have disclosed the condition of the defective bearing and at no time had he noticed any indication of oil leaking

out of the journal boxes.
Head Brakeman Maguiness stated that when passing through Fort Morgan he looked back along the left side of the train but noticed nothing wrong. He had not noticed oil leaking from the boxes.
Supervisor Getty and Engineman Peacock corroborated the statements of others concerning the stop at Snyder and the application and release of the brakes which were made in response to the telephone request received from the rear of the train. Engineman Peacock stated that when the train was approaching Orchard and running about 80 miles per hour he felt a couple of slight jerks and then a heavy application of the brakes.
Supervisor Getty stated that about 3 minutes after the application and release of the brakes made in response to the telephone request from the train, he felt a jerk followed by an emergency application of the brakes. He also stated that there had been one other instance in which a roller bearing had become heated on these streamline trains, but he could not recall the type of bearing in use.
Superintendent Coly stated that after the accident parts of the failed bearing were found at intervals along the north side of the track between milepost 97, which is 10 miles west of Snyder, and milepost 112, which is 4 miles east of the point of derailment; the detached portion of the journal was found about midway between mileposts 111 and 112.
The first mark of derailment was a flange mark on top of the south rail of the main track beginning at a point 22 feet west of the east passing-track switch. There were marks on the ties on the south side of both main track rails between points 40 feet and 3,250 feet west of the east passing-track switch, and at a point 105 feet west of the switch the derailed trucks climbed over and dropped outside of the north rail of the passing track.
Machinist Anderson, employed in the wheel shop at Denver, stated that when wheels mounted on roller bearings are shopped for turning, a very thorough inspection is made of the bearing. Since being assigned to the work of caring for roller bearings at the wheel shop in July, 1936, he has examined over 600 bearings and during that time had discovered no defects in Timken bearings although two cracked enclosure plates were found on journal boxes and at times small metal cuttings and gravel were also found in the boxes. In assembling Timken bearings he has been instructed to line the enclosure-plate oil ports with the oil channels at the bottom of the bearing box, and he has been careful to do this, but it is possible to apply these plates with the oil ports in several positions and boxes have come to the shop with the enclosure plates applied in numerous positions. After the accident he inspected the parts of the failed equipment and found that the enclosure plate was 1/8th of a turn out of its proper position. His record shows that this pair of wheels was turned at Denver on January 1, 1937, the boxes were assembled on January 3, and the wheels were installed in the lead position on the truck involved in the accident on January 15.
Car Foreman Nelson employed in the Chicago and Northwestern Ry. passenger-car yard at Chicago, Ill., stated that inspection of streamline trains at that point is made on a track elevated about 40 inches above the ground, which permits a thorough examination. Inspection of journal boxes is confined to an examination of the oil, particular regard being given to quantity and cleanliness; water in the oil is readily detected by the color, the oil being much lighter when thus contaminated; furthermore, water in the box during cold weather, creates frost on the inner side of the filler plug. When water is found in a box, all of the oil in that box is renewed, and at all times the oil is kept at the maximum level indication of the measuring gauge. No periodical inspection, requiring removal of the box covers, is made; however, if for any reason this appears necessary, it is done. No defective bearing

has ever been found at Chicago on any of these trains nor has gravel or dirt been found in any box cleaned. After the accident here under discussion all enclosure plates were examined but none was found to be improperly applied. Water contamination of the oil in the boxes has been detected frequently. No reclaimed oil is used.

C. R. Pflasterer, Test Engineer for the Union Pacific Railroad, stated that no test was made of the failed material. At the time these axles were purchased both physical and chemical properties were measured and as they conformed to all specification requirements they were accepted as satisfactory. The fact that this journal became elongated to the extent that the cross sectional area was reduced more than 50%, indicates that the material was of excellent physical properties. So far as the roller bearings are concerned, they are made according to the manufacturer's specifications and are bought on their guarantee. With respect to the failure of the roller bearing mentioned by Supervisor Getty as having occurred on a motor unit arriving in Omaha some time ago, Engineer Pflasterer's investigation developed that the failure had occurred through loss of oil from the box as a result of the breaking off of the drain plug at the bottom of the box. This was an SKF bearing.

W. C. Sanders, General Manager of the Railway Division of the Timken Roller Bearing Co., stated that it is his opinion the cause of the accident was the failure of a roller in the bearing, due to a restricted circulation of oil in the box which resulted from an improperly applied rear enclosure plate. Numerous complaints have been received concerning the entrance of water through the axle fit of these plates and since water has a deteriorating effect on the bearing, it is important that rear enclosures be effective in excluding dampness from the box; for this reason this part of the box assembly has been redesigned with a view to eliminating the trouble. Careful tests of the new type of enclosure plate have been made for the purpose of determining the efficacy of the design in preventing the entrance of water and the loss of oil and these tests have shown such satisfactory results that it is the intention of the Timken Company to incorporate the new type of plate in all new installations on this type of equipment, and to replace the enclosures now in use on streamline trains of the Union Pacific railroad. Provision is made in the new design for making impossible the wrong application of the rear enclosure plate.

He further stated that as a safeguard against accident resulting from failure of a bearing, a fusing stench bomb is to be applied to all boxes in such a manner that heat generated in the raceway of the bearing will be transferred directly to the bomb and when a temperature of about 220 degrees is reached, a plug in the bomb will fuse, emitting smoke having a strong odor.

Superintendent of Motive Power Burnett stated that while he has no doubt that the misapplication of the rear enclosure plate had the effect of restricting the circulation of oil in the journal box, he did not think that this was the primary cause of the bearing failure. It was his opinion that the failure was due to the breaking down of one or more of the bearing rollers. Several instances of water in the journal boxes have come to his attention, and while he does not think that this condition would cause serious consequences while the bearing is in motion, he does believe that when the bearing is at rest, such of its parts as stand in the water are subject to a deteriorating effect.

The Timken roller bearing of the type involved in this accident consists of a double cone resting against the top and bottom of the journal box, forming an outer raceway for two sets of steel rollers, housed in cages and tapering toward the center; two single cones having ribs at both inner and outer edges, and spaced by a spacer ring, form inner raceways for the two bearings. In addition to these principal parts there is an oil flinger ring designed to

assist in keeping oil from leaking from the box at the axle fit, a tapered sleeve to fix the outermost of the inner-raceway cones in position on the axle, an axle nut to adjust the position of this sleeve and a locking key, keybolt and lock-washer, to prevent loosening of the axle nut after the tapered sleeve has been adjusted. The housing of the bearing assembly consists of three parts, i.e., the box, the front cover plate and the rear enclosure plate. The inside of the box is designed so that the outer raceway of the bearing fits snugly between retaining lugs; the bottom of the box serves as an oil reservoir which is required to carry, at all times, sufficient oil to insure that the rollers will continually pass through lubricant. The revolution of the bearing acts as a pump, causing the oil to circulate in the box, and in order to facilitate this circulation, channels which permit the oil to rise to the top of the box under the pressure thus created, are provided in the bottom of the box and in the rear enclosure plate.

The rear enclosure plate is an annular disc which fits around the axle and is attached to the rear of the box by 8 uniformly spaced studs. The wall of this plate is 1/2 inch thick except at the axle fit where it forms a collar 1 7/16 inches wide having 8 grooves or lands 1/8 inch deep and 1/8 inch wide, cut entirely around the inner surface of the collar. A flange 1.85 inches wide and 5/8 inch in thickness is cast on the outer rim of the inner surface of the enclosure plate; when the plate is secured to the box the inside edge of the flange fits closely against the inside edge of the double cone of the bearing. Two recesses are cut in this flange at the bottom of the plate, which when in proper position, are aligned with the oil channels in the bottom of the box, thus permitting free passage of oil to the recess. However, since the studs which hold the enclosure plate in position, are of uniform size and uniformly spaced, it is possible to apply the enclosure plate to the box in eight positions, only one of which permits an unrestricted flow of oil, while when applied in two other positions the opening is very small.

In order to prevent the entry of foreign substances, such as water and dirt, between the axle and the axle fit of the enclosure plate, the diameter of the enclosure plate axle fit, over that of the axle, is restricted to a maximum of 0.040 inches, and the grooves cut in the inner surface of the enclosure plate axle fit are filled with hard grease at the time the bearing and box are assembled on the journal.

In assembling the box and bearings on the axle the rear enclosure plate is first slipped over the journal to the hub of the wheel; the oil flinger ring is then applied so that its edge extends over the wheel-fit collar of the enclosure plate, after which the inner single cone, with a set of rollers in place, is pressed on the journal under a pressure of from 15 to 18 tons. The double cone is then placed in position after which the outer single cone, with rollers in place, is set on the axle and secured from turning by the tapered sleeve which is forced between the axle and the inner surface of the cone and adjusted tightly against the outer end of the sleeve by the axle nut.

An inspection of the truck which failed made by the Commission's inspectors, disclosed that the wheel flanges were well above A.A.R. gauge limits, and the wheel treads, while considerably worn, were not beyond gauge limits. The wheels were tight, properly mounted and concentric with the axle; there were some small slid flat spots on the wheel treads. The burned off journal showed that heat had been developed sufficiently to burn and fuse the metal of both the journal and roller bearing assembly. Approximately one half of the outer end of the journal was entirely separated from the journal being drawn to a cone shape at the point of separation. The rollers, raceways and other parts of the bearing assembly were generally destroyed, being either broken, fused, distorted, or cut by heat and friction. The bearing assembly on the opposite end of the axle was dismembered and the rollers and

raceways were found to be in good condition. Some grit and viscous residue was found at the bottom of the journal box, but as the front cover plate had been removed for some time, this substance may have entered the box after the accident. The inside diameter of the axle fit of the rear enclosure plate was 0.039 inches greater than the diameter of the axle at the fit and the lands were free of grease, indicating that entrance of dirt or water at that point would be probable.

The journal box which housed the failed bearing still contained the double cone or outer raceway and one of the inner raceways with most of its rollers, but these parts were welded to the outside upper portion of the box nearest the wheel. Just above the point where the welding of the bearing assembly had occurred, there was a deep gouge mark, evidently made by the turning of the end of the journal against the side of the box after it had pulled out of the journal box. The upper half of the enclosure plate was missing but the lower half remained attached to the box; the lands in this portion were considerably worn.

Discussion

The testimony shows that the wheel bearing which later failed gave evidence of improper functioning at a point approximately 30 miles east of the point of derailment, and that a stop for the purpose of inspection was made shortly after the first warning was received. The inspection made, however, was most cursory, and consisted merely of an examination of the brake, pistons on the right side of Truck 20; had the inspection been extended to include the left side of the truck it is probable that evidence of the defect would have been noted; this is supported by the fact that parts of the failed bearing were found within ten miles of the point at which the inspection was made.

Roller bearing journals lubricated by free oil have no waste to burn and when heating occurs the usual odor of a hot journal is absent, however, there should have been some odor of overheated oil or hot metal, but since considerable heat is developed by the wheels and brake shoes in bringing a train to a stop when running at high speed, it is possible that the crews on these high speed trains have become so accustomed to the odor resulting from braking that on this occasion any odor from the hot journal may have been associated with that caused by the braking operation.

There can be little doubt but that the immediate cause of the overheating of the bearing was the failure of one or more of the rollers, but as to the cause of this there is some difference of opinion. Representatives of roller bearing company attribute the failure to lack of lubrication brought about by a misapplied rear enclosure plate; officials of the railroad company disagree with this theory and point to the fact that before failure occurred this bearing had run approximately 25,000 miles with the enclosure plate in the wrong position. Furthermore, other bearings, with misapplied enclosure plates have run the complete mileage between wheel turnings with no apparent damage to the bearing. Except for this showing of great mileage having been made with improperly applied enclosure plates, the theory of the bearing manufacturer seems reasonable. The roller or rollers which seized in the raceways belonged to the inner set on the journal; the rotation of the bearing would act as a pump tending to force the oil away from the bearings so that with no circulation on one side, sufficient oil might be drawn away to deprive that section of sufficient lubrication.

After the derailment, the oil reservoir of the journal box was tested and found free from leakage. No record of oil replenishment to individual boxes is kept at Denver, but at Chicago a record of all supply oil used is charged to the individual box; in addition, this record shows when complete renewal of the oil has been necessitated by water seepage. A check of this record shows that since the application of the wheels to this truck on January

15, 1937, it had not been necessary to renew or to add oil to either box.
The officials of both the railway company and the roller bearing company are agreed that water contamination of the oil has a deteriorating effect on the bearing. While the evidence introduced in this investigation indicates that water contamination had no direct part in causing the failure of the bearing assembly, there has been some complaint that water was entering the boxes on the streamline trains through the rear enclosure plates, and as a result of these complaints the bearing manufacturer has designed and tested a new type of rear enclosure which will be incorporated in all new installations of this type of assembly, and which will be used to replace all of those now in service on the Union Pacific R. R. In addition, as a safeguard against accident resulting from failure of a bearing, a fusing stench bomb is to be applied to all new boxes in such a position that the heat from the raceway will be transferred directly to it. A temperature of about 220 degrees will fuse a plug in the bomb and permit an omission of smoke having a strong odor.

Conclusion
This accident was caused by the failure of a roller bearing which resulted in the burning off of a journal.