INTERSTATE COMMERCE COMMISSION

REPORT OF THE DIRECTOR OF THE BUREAU OF SAFETY IN RE INVESTIGATION OF AN ACCIDENT WHICH OCCURRED ON THE SOUTHERN RAILWAY NEAR RUTHERFORDTON, N C, ON OCTOBER 1, 1925

MARCH 15, 1926

TO THE COMMISSION

On October 1, 1925, there was a derailment of a work train on the Southern Railway near Rutherfordton, N C resulting in the death of 3 employees and the injury of 11 employees

LOCATION AND METHOD OF OPERATION

This accident occurred on that part of the Charleston division extending between Marion, N C, and Rock Hill, S C, a distance of 108 7 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 accident occurred about five-eighths mile north of the station at Rutherfordton, on a wooden trestle 571 5 feet in length with a maximum height of 59 feet and a height of about 30 feet at the point where the equipment fell off approaching this point from the south the track is tangent for a considerable distance followed by an 8° curve to the right 388 feet in length and then tangent a distance of 152 5 feet to the south end of the trestle and for some distance beyond The grade is 1 58 per cent, descending for northbound trains The track is laid with 60-pound rails, 30 feet in length, the rails on the trestle are single-spiked to 8 by 10 inch by 11-foot yellow-pine ties Outside wooden guardrails are bolted to the ends of the ties

The weather was clear at the time of the accident, which occurred at about 3 40 p m

DESCRIPTION

Work train extra 18 northbound consisted of Southern coal cars Nos 196365 and 191147 loaded with rock-screening ballast engine 18, headed north, a flat car loaded with ties and a caboose in the order named, and was in charge of Conductor Betts and Engineman Baber This train departed from Rutherfordton and shortly afterwards, while crossing the trestle at a speed estimated to have been about 15 miles an hour was derailed on account of the breaking of the truck under the rear end of car 191147, immediately ahead of the engine

Car 191147 derailed on the trestle at a point 364 feet from its southern end, permitting the side frame to drop to the ties outside the west rail The broken truck frame bunched the ties, forced the rails out of alignment, and then encountered the wooden guardrail, sliding along on it and finally breaking it at a point about 67 feet south of the north end of the trestle, this car and the engine then fell off the trestle The flat car behind the engine, and also the caboose, were derailed but remained on the trestle, while the leading coal car was not derailed and stopped at a point north of the trestle Engine 18 came to rest on its left side, parallel with the trestle, while car 191147 was bottom up The employees killed were the engineman, fireman, and an extra gang foreman

SUMMARY OF EVIDENCE

Conductor Betts stated that he was riding on the leading car while crossing the trestle, and the first he knew of anything wrong was on feeling the car lurch, and on looking back he saw the engine falling from the trestle He said there was nothing unusual about the speed of his train while crossing the trestle Brakeman Hinton was also riding on the leading car at the time of the accident, and at first he thought the trestle had collapsed just before the leading car came to a stop, about 40 feet north of the trestle, he felt the air brakes apply, but was of the opinion that this air-brake application was a result of the parting of the air hose Brakeman Altman, who was riding in the caboose, said the first intimation he had of anything wrong was on feeling the caboose lurch, he did not know whether or not the air brakes were applied by the engineman, and did not observe the air gauge in the caboose

Master Mechanic Henderson stated that on examining the engine on the day following the accident he found the reverse lever in forward motion, about three notches from center, the engine cab was demolished and the brake valve broken off, together with all pipe fittings, cocks, and appurtenances, including the running boards and brackets He said he had no way of determining when the Vulcan truck involved in the accident was placed under car 191147

Southern coal car 191147 weighed 45,500 pounds, its stenciled rated capacity was 100,000 pounds At the time of the accident its loaded weight was 116,800 pounds, this being 16,800 pounds above its rated capacity Under the revised A R A loading rules, however, the axle load limit of this car was 169,000 pounds

This accident was caused by the fracture of a truck frame An investigation into the reason for the failure of this truck frame

was conducted by Mr James E Howard, engineer physicist, whose report immediately follows

Report of the Engineer Physicist

The derailment of work train extra No 18, near Rutherfordton, N C, on October 1, 1925, was caused by the fracture of a truck frame under gondola car No 191147 The fracture of the frame occurred at the inner corner of the journal-box jaw Its origin was at the angle made by its inner vertical face with the seat across the top of the jaw Starting from this inner angle the fracture extended obliquely upward through the remaining part of the casting, completely separating the portion which carried the journal box from the body of the frame

The surface of rupture presented two distinct phases, an earlier and progressive type of fracture for a part of the fractured surface, and the final stage at which time rupture was completed The latter stage and the derailment coincided in point of time

The origin of the earlier part of the fracture was located at the inner angle of the jaw, where bending stresses reach their maximum under the loads which are carried by the frame It is a vital feature in the design of the frame to provide adequate strength at this place

The frame was a green-sand steel casting, branded "Vulcan," and was made by the American Foundries Co It bore the identifying letter E, signifying that it was cast at the East St Louis foundry of the company

The frame was cast on its side The outside face of the frame was in the drag, the inside face was in the cope of the mold Gases disengaged at the time of casting rise into the portion of the frame which is uppermost, and which in this case was the inner side of the frame Commonly this side has a less finished appearance and is also less sound structurally than the lower part of the casting

Figure 1 is a diagrammatic outline of the truck frame, showing the location of the fracture This frame was on the left-hand side of the rear truck of the gondola car with reference to the train movement, the fracture occurring at its forward end

Figure 2 represents a photographic view of the frame The line of fracture is just beyond the embossed letter E in the circle on the casting

Figure 3 shows the appearance of the fractured surface, as exhibited on the detached fragment A portion of the fracture existed prior to the accident, the balance occurred at the time of derailment

Figure 4 shows the fractured surface of the opposite end of the frame. This fracture was made by a steam hammer on the dismantled frame. Blowholes in the metal and variations in the thickness of the walls of the frame are shown by Figures 3 and 4.

Figure 5 *a* and *b* are photomicrographs, representing the metal in the vicinity of the original fracture. Photomicrograph *a* shows the structure as found in the casting, photomicrograph *b* as it appeared after laboratory annealing. These structures were displayed by a nitric-acid etch, and are shown at a magnification of 100 diameters.

The truck frame was partially fractured prior to the time of the derailment. The preexisting portion of the fractured surface is shown by Figure 3, embracing the portion between the stars which have been placed on the cut. This portion was the edge along the inner angle of the jaw and the inside rib of the frame. The fracture of the outside rib and the top web took place at the time of the accident.

The casting showed numerous blowholes in the inside rib. Blowholes exist in many if not in most steel castings. They are necessarily a source of weakness wherever found. At one place, as shown by Figure 4, the blowholes represented nearly 100 per cent of the cross section of the rib of the frame. It is not held that blowholes were primarily responsible, possibly not remotely accountable, for the fracture of this frame.

This was a cored casting. The core was not set concentric with the ribs. There were variations in thickness of the ribs, ranging from a maximum of 0.58 inch to a minimum of 0.24 inch at the end fractured under the gondola car. At the opposite end, where fractured by a steam hammer, the thickness of the ribs ranged from 0.30 inch minimum to 0.64 inch maximum. This variation in thickness of the metal is correctable in the foundry by the exercise of care in setting the cores.

The direct cause of the fracture of the frame is attributed to error in the design, resulting in deficiency of metal at a vital place where working stresses attain maximum values. This part of the truck frame, carrying the journal boxes, represents a beam fixed at one end, the bending stresses being greatest at the inner angle of the jaw, at the root of the angle, where, as a matter of fact, the fracture of the frame had its origin. A few additional pounds of metal in the casting at this critical place would have added greatly to the strength of the frame. A few pounds of metal, judiciously disposed, in all probability would have averted this accident.

There is general knowledge of the fact that severe shrinkage strains are set up in steel castings, with the possibility of cracks forming at critical places. Such a condition is referred to as a

"draw" in a casting Strains not relieved by actual separation of the metal are measurably diminished by annealing This casting was doubtlessly annealed

Blowholes, thick and thin parts of the casting, were noticeable in this truck frame, but did not constitute leading factors in its fracture The cause of fracture of the frame specifically attaches to deficiency of metal at a vital place, namely, at the junction of the seat of the axle box with the body of the frame, this being the point of departure of the fracture which caused this accident

SUMMARY

The derailment of work train extra No 18 was caused by the fracture of a truck frame, a steel casting The origin of fracture was located at the inner angle of the axle-box jaw Service stresses concentrate at this place and bending stresses here reach a maximum An incipient fracture had formed at this place prior to the accident, and ultimate rupture was certain to follow

This accident may be classified as an avoidable one Blowholes were present in the frame There is recognized difficulty in preventing their formation It is believed that few steel castings are free from their presence Eccentricity of cores admit of correction, a foundry matter Deficiency of metal at a vital place is a matter of design when establishing the dimensions of the cast member This frame appears to have been weak at a vital place, and fractured at that place The addition locally of a few pounds of metal would doubtlessly have given it sufficient strength to sustain working loads and probably would have averted this accident

Respectfully,

W P Borland, *Director*

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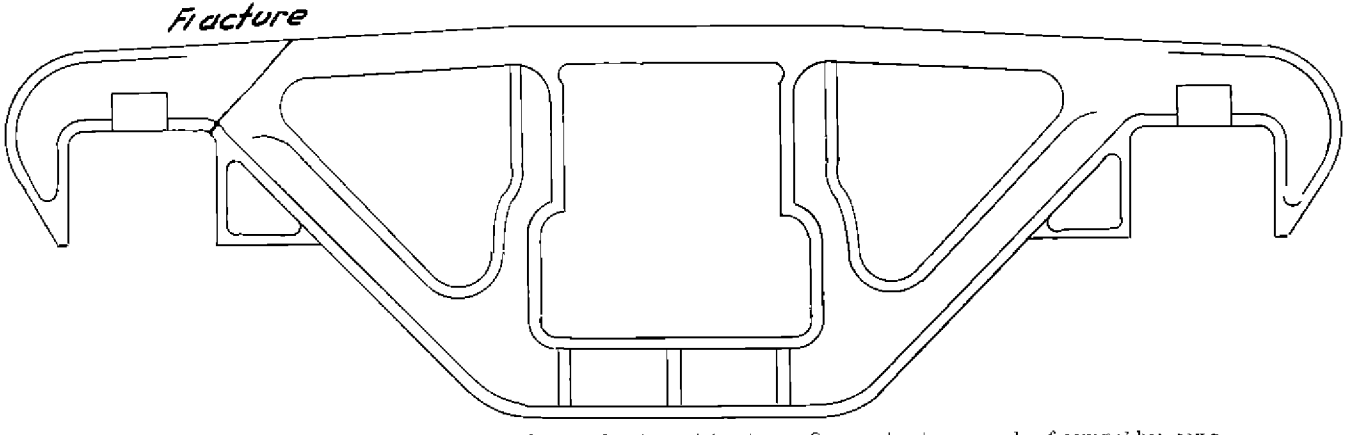


FIG. 1 — Diagram of Vulcan truck frame showing location of fracture. Origin at interior angle of journal box jaws

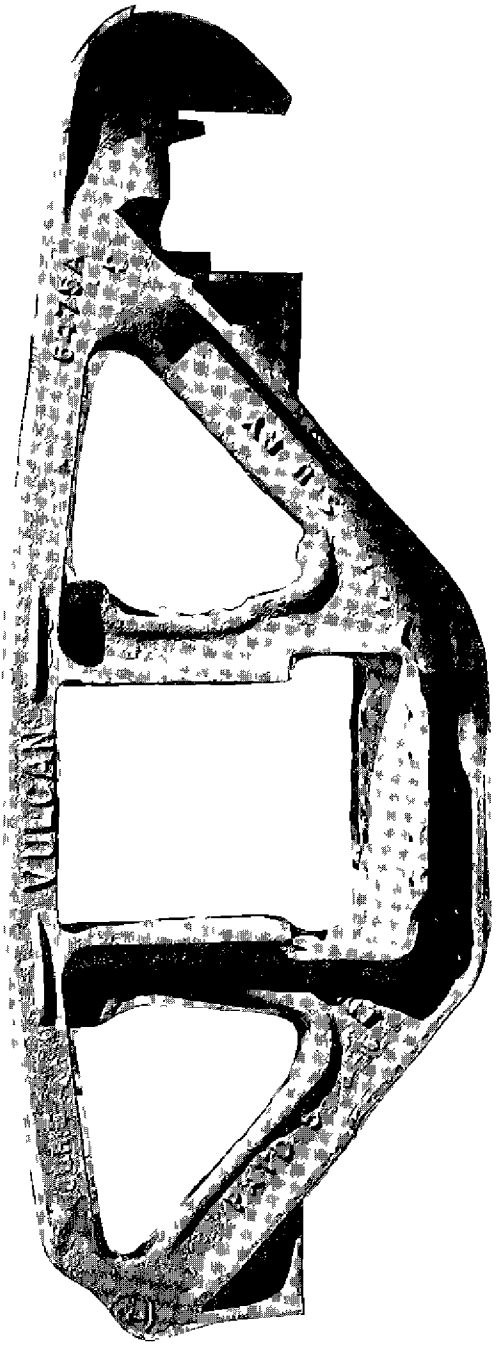


FIG 2.—Photograph of fractured Vulcan truck frame

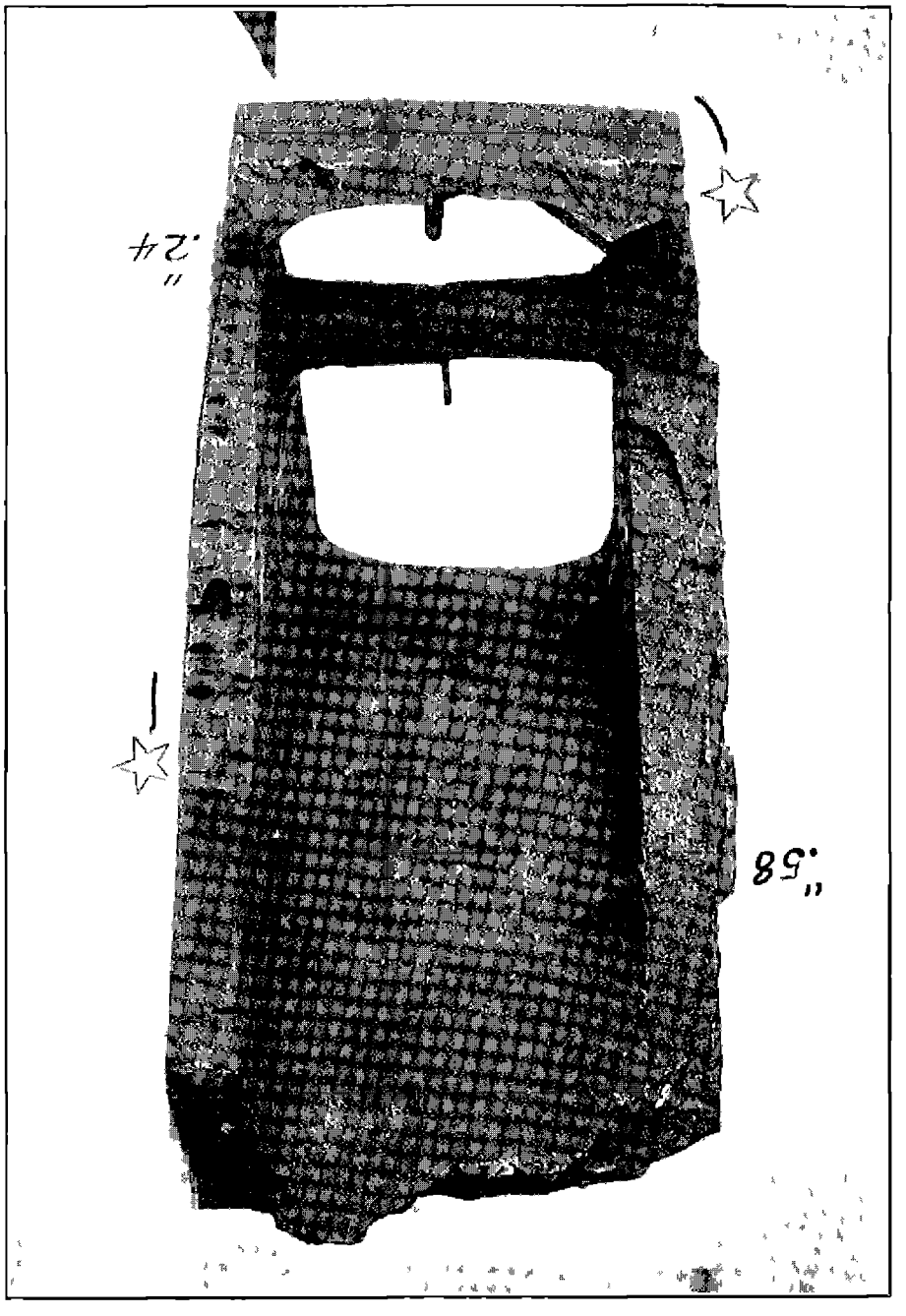


FIG 3.—Photograph of fractured surface of Vulcan truck frame end which fractured under gondola car between stars Balance of fracture made at time of derailment Preexisting fracture section

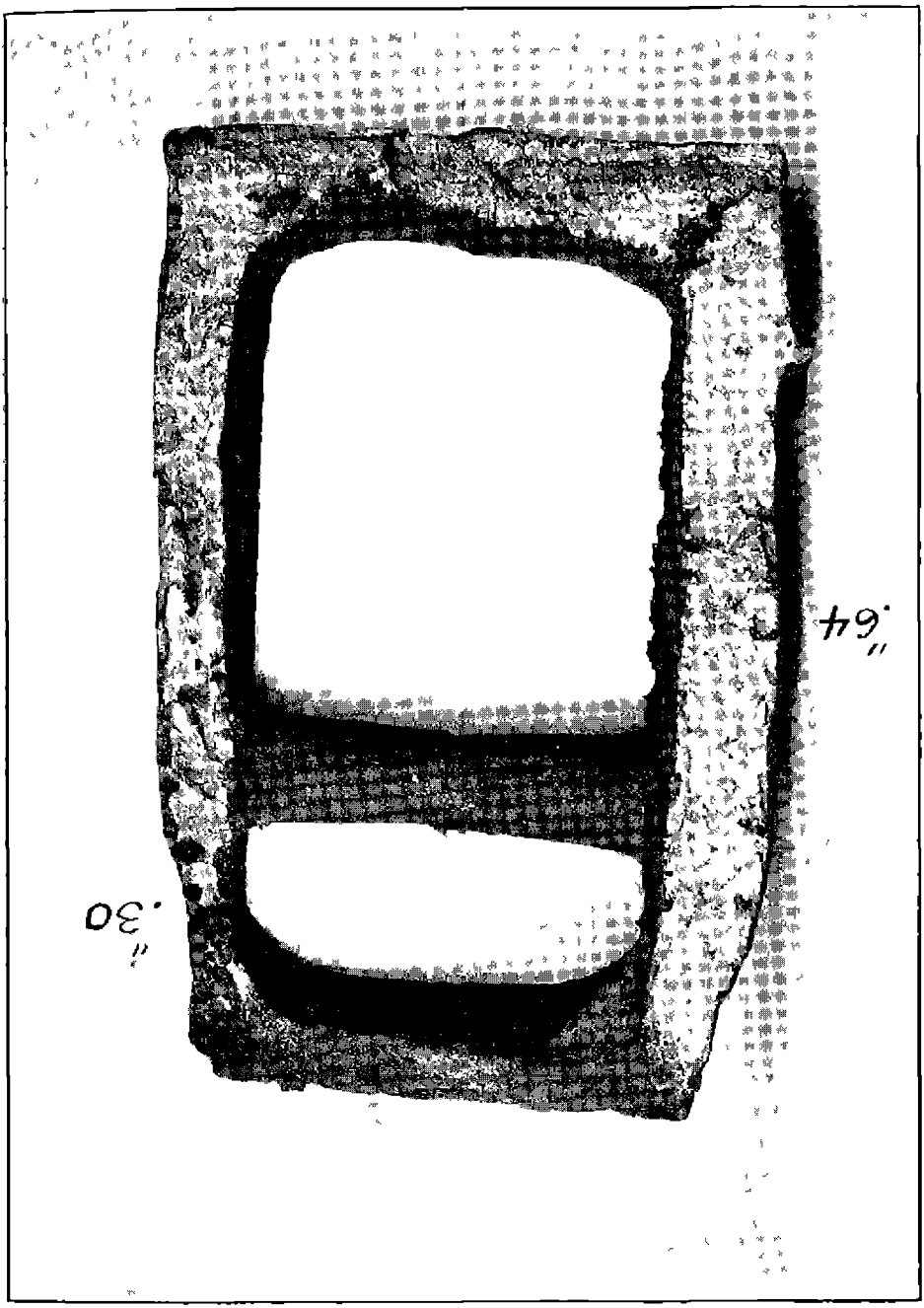
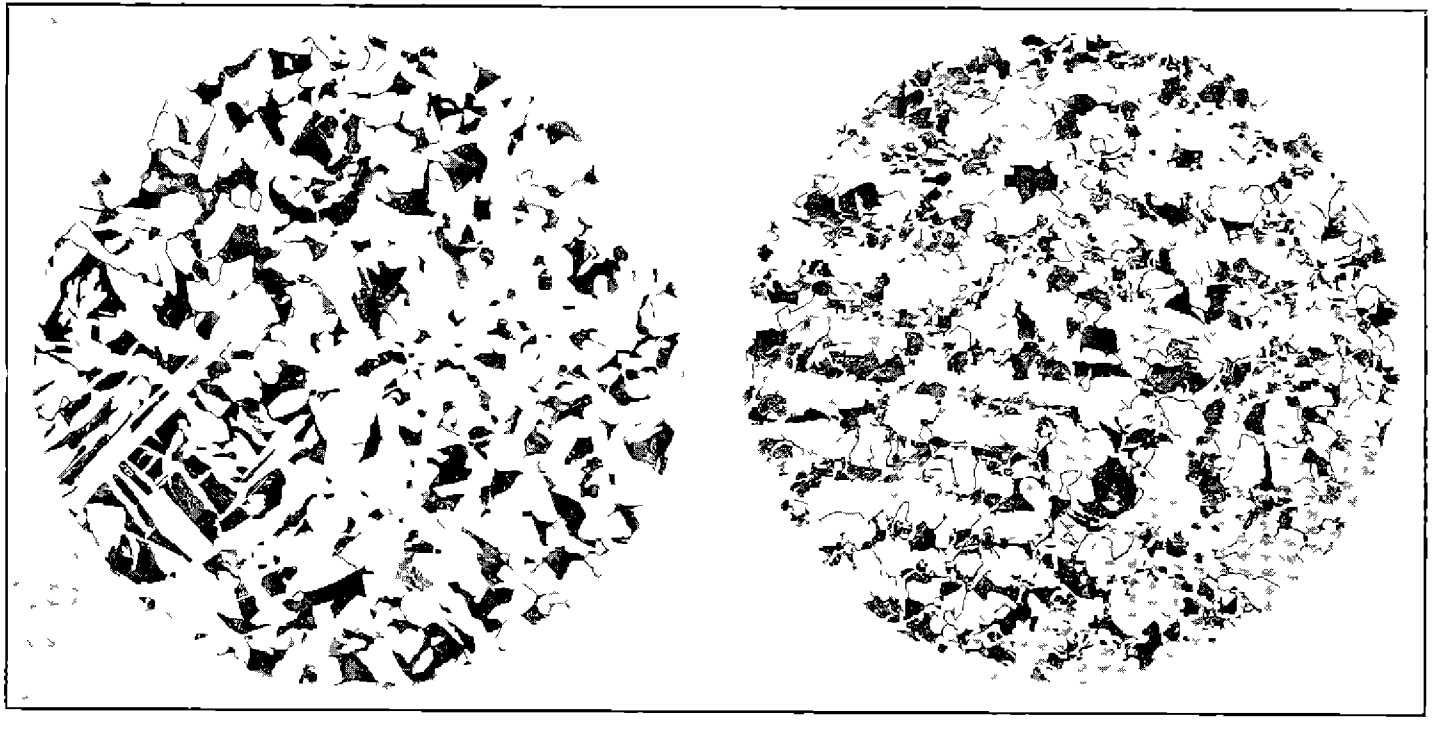


FIG 4.—Photograph of fractured surface of Vulcan truck frame. Fracture made with steam hammer end opposite fracture wheel



a *b*

FIG 5.—Photomicrographs of steel of Vulcan truck frame *a* Appearance of metal as found in the frame *b* Appearance of metal after laboratory annealing Nitric acid etch Magnification 100 diameters

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