THE NICK AND BREAK TEST IN THE INSPECTION OF STEEL RAILS.*

STEEL metallurgists will recall that prior to the general dependence upon the services of the analytical chemist, that is, in the days when but few steel works had their own laboratories, the grading of crucible steel in the ingot, and before it was drawn down into bars, was based upon the appearance of the fracture of each separate ingot. After the ingots became cold, a piece was broken off one corner and an expert workman judged of the hardness of the metal by the exposed fracture, and marked the ingot accordingly. Thus one would be used for tool, another for drill, another for spring steel, and so on.

In later years, when the dissatisfaction with the results given by steel rails led to much discussion as to what changes should be made in the specifications governing their manufacture, the Rail Committee of the American Railway Association called in consultation the late William Metcalf, Past-President of the American Institute of Mining Engineers, 1881; Past-President of the American Society of Civil Engineers, 1898-99, and for years a steel maker. Previous to that time drop tests of pieces of rail representing each heat of steel had been included in some of the specifications, but the object of such tests had been limited to determining the ductility of the steel. There had not been any prescribed breaking tests with a view of disclosing the internal structure of the rail.

Mr. Metcalf, based no doubt upon his experience as a maker of crucible steel, urged that the then current testing did not go far enough, and that several pieces of rail from each heat should be broken, and by the disclosed fractures the rails from that heat accepted or rejected. The committee, when reporting, did not adopt his suggestions, but, based largely upon his insistence that the drop testing as then conducted did not go far enough, many railroad engineers gradually enlarged the scope of their drop-testing requirements until it became the general practice to break, say, three pieces from each heat of open-hearth steel and to accept or reject certain rails according to whether or not interior defects were revealed. It was argued that the practice should be extended to include the breaking of a piece of rail from the top end of each ingot rolled, and in fact some experimental rollings were made under such provisions, but opposition to the plan of making this fracture test on a piece of rail from each ingot developed among rail makers, with the result that what seems to us to be a perfectly logical method of testing rails to insure against acceptance of defective material, failed to have a fair working trial; and thus it remained, about a year ago, for the Algoma Steel Corporation, whose mill is at Sault Ste. Marie, Ont., to open the door commercially, so to speak, to the possibilities of a specification for rails, marking, we believe, a distinct step forward in the direction of safer and better wearing rails.

A contract for 10,000 tons of rails made by the Canadian Pacific Railway with the Algoma company was the first to require what has been commonly termed "the nick and break test on each ingot," and this was quickly followed by others for rails to be shipped to United States under similar conditions of testing. In justice to the Algoma company it may be said that they have become so appreciative of the logic, as well as the economy, of the nick and break test that they have seen fit to have it incorporated freely and without extra compensation in many of their specifications.

By the nick and break test mentioned above is meant, firstly, the nicking; and secondly, the breaking, by some mechanical means, of a short length of rail selected as required by the specification. This, it will be noted, must be, for the first, or the original test, the top end of the top rail of each ingot rolled, and naturally for this sample, the crop end, which must be cut by the hot saws, from the top of the "A" rail was used. These crop ends were ordinarily from 18 ins. to 24 ins. long, and after being stamped with the heat and ingot number, to permit of identification, were allowed to cool for a little over thirty minutes, and were then quenched in water, pains being taken to insure quenching from a temperature color of near black or natural cold steel, so as to render no appreciable change in steel structure possible. Then the pieces were nicked as desired; and, for the purpose of breaking, inserted in a specially designed anvil of a bulldozer (Fig. 1) so arranged that the ram readily broke the rail where it had been nicked, giving, without trouble in most cases, the square character of fracture desired for examination. Thus the fractures were ready for judging

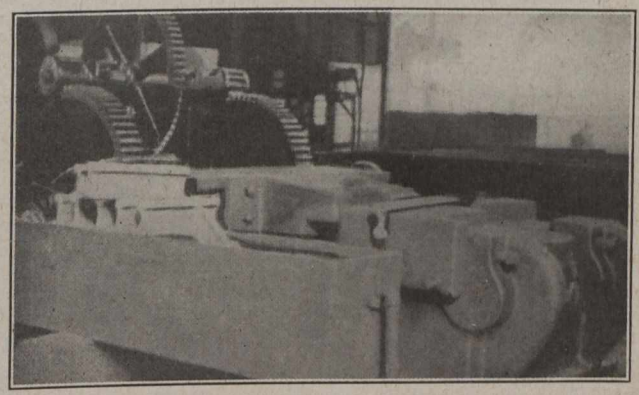

Fig. 1.—View of Bulldozer Used at Algoma Steel Works for Breaking Crop Ends of "A" Rails, Showing also the Quenching Tank.

in an average time of about one hour after the rails were rolled, and in many cases long before the actual drop test pieces were cold enough to test, and even before the rails represented had reached the cold straightening presses. It is interesting to observe that the bulldozer actually broke the rails at a rate of about three per minute, or at a rate, say, of 2,000 pieces in twelve hours; and, as each piece represented an ingot, the rate of breaking possible shows it to be well in excess of any probable tonnage that could be rolled with any present mill equipment. In case of the fracture on this original test showing bad, thus incurring the rejection of the top rail of the particular ingot represented, it was necessary to locate that rail in front of the straightening presses by identifying the heat and ingot number and rail letter on it, and from its bottom end to break a piece to represent the second rail of the same ingot. This requirement continued to all of the rails of the ingot as far as necessary, and it was found possible to accomplish the desired end easily. A little care in the distribution in front of the straightening presses of the rails from the hot beds made the identification possible without the necessity for extended searching, and when the particular rail for retest was located, it was marked and in due course taken to the nearest straightening press, where a piece readily was broken from its lower or back end and the fracture scrutinized by the inspector without

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