Merchant Mill Inspection

By C. A. Becker.

I shall discuss in a brief manner the inspection of the product of merchant mills, also called bar mills, with which I have been somewhat associated in the past.

Before coming to the inspection itself, let me recall to your minds the processes which convert the raw ore into the finished products. First, we find the ore, after being mined and transported by water or rail or both to the blast furnace, being mixed with coke and limestone and dumped into the huge throat of the furnace, being changed during its downward course into the molten pig iron which is tapped at the bottom, completing the first stage in the making of steel.

Then this molten pig iron is charged into the open-hearth furnace along with some steel scrap and limestone and in the course of about eight hours, after many chemical reactions have taken place which space does not allow me to even touch upon, the furnace is tapped and from it pours the liquid steel which is carried by huge cranes, in the ladle into which it ran, to the teeming platform. The operation of teeming consists in pouring, from a hole in the bottom of the ladle, the steel into ingot molds. After sufficient cooling, the ingots are stripped, i. e., the molds are lifted off and the ingots are taken to the soaking pits. These pits are kept at a high temperature and the ingots are heated to an even heat before being removed to take their trip through the rolls where they are reduced to smaller and more easily usable sizes.

The first mechanical operations in the reduction of the ingot are done in the blooming mills. Here the ingot is rolled down from a mass of metal maybe 20 inches square and 6 feet high to say one 4 inches square and of quite a length. The products of the blooming mills are blooms and billets which supply the wants of the merchant or bar mills.

After the blooms and billets leave the blooming mills they are chipped. Chipping consists in removing from the surface of the product, by use of the chipping hammer, any surface laps or slivers which if not removed would appear in the finished product of the bar mill. With some grades of steel the blooms and billets are pickled. Pickling consists merely of placing the steel in a vat of sulfuric acid solution to dissolve off some of the surface oxides. The blooms and billets after being thus treated are sent to the bar mill in which they are to be rolled into rounds, flats, squares, etc.

Every time an open-hearth furnace or electric furnace is tapped, the metal, which constitutes a heat, is given a heat number which follows the metal in any particular heat through all its various processes until the steel is rolled into its final form. All steel is not made of the same composition so that heat numbers must be accurately watched through every operation.

The billets and blooms upon being received at the bar mill are used on the proper order, i. e., are rolled for a certain customer whose specifications are stated on a mill order. The first operation in the bar mill is the heating of the charge to a correct working temperature. After leaving the furnace the blooms and billets are rolled to a size and shape as ordered on the mill order. The steel after leaving the last set of rolls is cooled and sheared into the proper length. After weighing and bundling, it is ready for loading. It does not leave the mill, however, until it is finally checked by the inspection departments to the requirements in the customer's order.

The mill has its own inspectors to look over the final product and to pick the flaws and defects which are to be expected in any product of a steel works.

I shall enumerate a few of the defects found in the product of the merchant mills and explain their cause, if possible, as they are generally acceptetd today.

1. Slivers.—If the metal is torn, we might say, in any part of the rolling operation, the surface of this part thus torn will easily become oxidized at the high temperature of rolling and cannot be made to reunite with the body of the bar even with the aid of the great pressure exerted by the rolls. Slivers are sometimes called laminations and are easily seen by the eye.

2. Seams.—If a layer of iron oxide should in any way interpose itself between any parts of a steel bar, the enclosing steel parts will have no attraction for each other and consequently this condition produces a weak steel. This state is brought about by the improper manufacture of the steel.

3. Pipes.—When a steel ingot cools it leaves more or less of a cavity, usually in the top of the ingot, which as the ingot is rolled down stays with it as a source of weakness due to the oxidized surface of the cavity remaining in the center. The top part of the ingot should be cropped off in the blooming mills. It can be seen as a brilliant spot in the center of the finished bar.

4. Laps.—Laps may be formed by improper rolling in which part of the metal is folded over another part. This defect occurs along the length of the bar in the direction of the axis of the bar. They differ from seams in that seams are of short lengths.

(Continued on page 22)

MERCHANT MILL INSPECTION

(Continued from page 12)

5. Blow-holes.—Blow-holes are generally caused by insufficient removal of the oxygen in the steel. The oxygen combines with the carbon in the steel to form a gas which is imprisoned in the steel as it cools. This conditions weakens the steel and looks like a piece of Swiss cheese.

6. Overheated Steel.—Over-heating the steel before being rolled has a deteriorating effect on the product. This condition should not occur in a well regulated furnace.

7. Finned Bars.—Finns are caused by over-filling the passes in the rolls, the excess metal squeezing out between the rolls. Finned bars cannot be used in forgings, etc., until the finn is removed. In mill practice the whole bar is generally scrapped and sent back to the open-hearth.

9. Bars Out of Round.—If in the rolling of rounds the difference between any two diameters is greater than the rolling tolerance, the bar is called out of round. The tolerance, spoken of, means the allowable variation from a true geometrical shape of the size required. This tolerance is sometimes stated by the customer and at other times the tolerance is as set forth by the mill inspection department.

10. Roll Marks.—The bars must be watched for roll marks. Passes wear out after a certain amount of usage and give a rough surface to the bar and sometimes roll it out of tolerance.

11. Waviness.—A wavy effect sometimes occurs in rolling. This is especially noticed on light flats.

12. Cambered Bars.—Cambered bars form a bow on the shuffle bars, i. e., the bars which shuffle the steel from the cooling bed to the shear rolls. This happens mostly in the case of alloy steels and is due in great part to uneven heating in the heating furnace.

I have mentioned a few common defects found in mill practice but they are by no means all which may happen. Many new defects are continually occuring, so that a good inspector must use, along with a knowledge of the further use to which the product will be put, a good share of common sense. He must weigh in his own mind whether or not any defect will or will not cause rejection by the customer, judged by the customer's uses for the steel. His first duty, however, is to see that the customer gets a suitable product.

If at any time any of my readers should become an inspector, along any line in fact, where one associates with men producing the product to be inspected, make it your first task to become friends of the men. An inspector who is well liked by the men will find his work more easy, pleasant and efficient.

After the bars are inspected on the mill, the inspection department "pulls" tests on every heat and size when required. This consists in placing the test pieces between two jaw like devices and exerting a pull to see at what tension the piece will break. Other tests are made when thought advisable.

Drillings are sometimes sent to the chemical laboratory to be analyzed as a recheck on the composition of the steel.

Seams are generally detected by heating short pieces, of the bars rolled, to a good working tempera-

ture and then hammering them down under a drop hammer. Any seams if present will become evident by opening up. They may also be hammered cold but open up more easily when hot. Seams may be seen with the naked eye.

The product is finally inspected in the car after loading and before being sent out. The inspection thus becomes quite thorough, as it must, since today the steel maker and roller must deliver the goods in order to meet competition. The customer is becoming more particular as to the condition and quality of the steel he receives and so inspection is becoming more and more critical to meet his demands.