July 16, 1935. Y. MURAKAMI 2,008,626

METHOD FOR MANUFACTURING METALLIC MATERIALS BY ROTATING ROLLS OR WHEELS CONTAINING A MOLTEN METAL BETWEEN THEM

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Fig. 1.

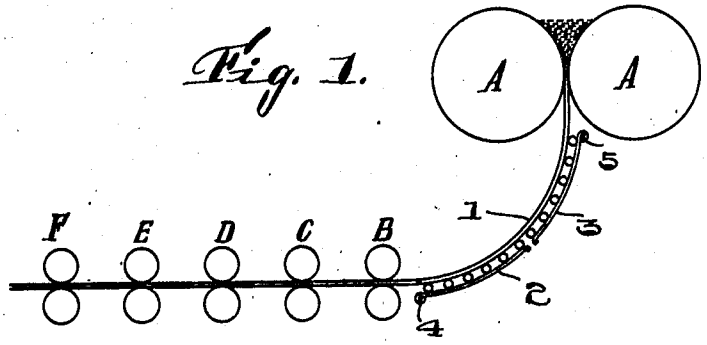


Fig. 2.

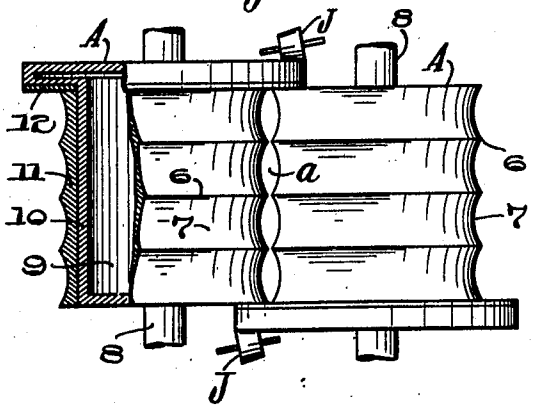


Fig. 3.

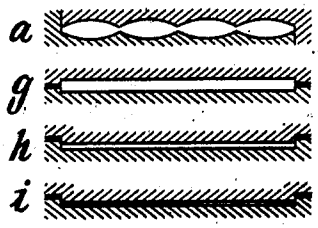
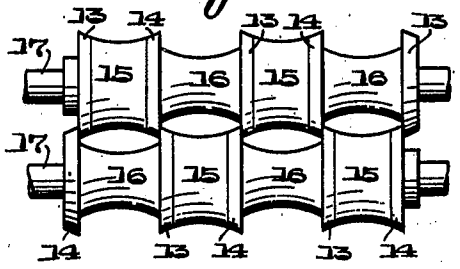


Fig. 4.



C.

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METHOD FOR MANUFACTURING METALLIC MATERIALS BY ROTATING ROLLS OR WHEELS CONTAINING A MOLTEN METAL BETWEEN THEM

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13 Claims. (Cl. 29—148)

This invention is an improvement in the method of manufacturing metallic materials in which molten metal is discharged between rotating rolls or wheels, the improvement consisting in forming the hot metal delivered by the rotation of the rolls or wheels with longitudinal alternately swollen and narrow parts, not corresponding to the shape or the transverse section of the final product. The objects of the invention are to strengthen the consolidated crust of the hot metal delivered from the rolls or wheels and to prevent injurious swelling or cracking thereof.

The appended drawing diagrammatically illustrates apparatus for carrying the improved method into practice.

Fig. 1 shows an arrangement of an apparatus for making a bar, billet, etc.

Fig. 2, the plan of the rolls partly cut off, which rotate as they contain a molten metal;

Fig. 3, the passes formed by a group of rolls for the manufacture of a plate, sheet, etc. and

Fig. 4, the front view of special rolls for the manufacture of a bar, billet, etc.

In the method of manufacturing metallic materials which comprises rotating the rolls which contain a molten metal without first making it into an ingot, it is necessary to rotate the rolls or wheels containing the molten metal in such a manner as to deliver a hot metal, which has a fluid or very weak central portion within its solidified crust, as otherwise said rolls or wheels have their producing capacity lowered and are damaged by heat. Consequently, in the known method when a wide metal is delivered from said rolls, it is difficult to obtain a strong crust of the hot metal economically. In my present invention, to remove such drawback, one or both of the rolls have corrugated surfaces to form alternately swollen and narrow parts, not corresponding to the shape of the product on the transverse section of the metal delivered by the rotation of the rolls, so that the cooled area is increased and the crust of the hot metal is solidified comparatively well. Moreover, its shape makes the hot metal strong, and even when there is the fear of the central portion of the hot metal being swollen by the pressure from the liquid portion of the interior of the solidified crust, such swelling is prevented beyond a negligible limit, because the solidified crusts of both surfaces are joined at the narrow part on the section of the hot metal to divide the liquid portion into slender parts.

In many cases, the hot metal delivered by the rotation of the rolls maintains an internally liquid state for some time. Therefore, in order to divide such a liquid portion into two or more slender parts by joining the solidified crusts of both surfaces at the narrowest part on the section of said hot metal, it is preferable to determine the speed of rotation of the rolls containing molten metal in such a manner that the time (in seconds) during which solidified portions of the upper portion of the poured metal (which are in contact with the peripheral surfaces of the said rolls when said rolls contain maximum quantity of the poured metal) are moved downwardly and leave the peripheral surfaces of the rolls, is between 0.015 times the square of the thickness (in millimeters) of the narrowest part and that of the most swollen part of the hot metal delivered from said rolls.

As the above time must not normally exceed 60 seconds, in view of the producing capacity of an apparatus and the damage of the rolls to be done by heat, it is advisable to design and adjust the rolls so that the thickness of said narrowest part is not very great, namely, less than 65 millimeters.

In the present method, in many cases, the corrugations formed on the surfaces of the rolls of a big diameter which contain a molten metal are at substantially a right angle to the axes of the rolls and the hot metal delivered by the rotation of the rolls is preferably fed to a continuous rolling mill placed at a suitable distance and is rolled while it still has a high temperature, and as regards the difference temporarily produced between the quantity of the hot metal delivered from the rolls of a big diameter and that caught in the continuous rolling mill, it is preferable to provide a swingable or movable guide table between the big rolls and the continuous rolling mill so as to increase or reduce the curving of the hot metal between the big rolls and the continuous rolling mills. Further, although it is preferable to cool the rolls containing a molten metal from inside with water, there is the apprehension that an explosion and other accidents are caused by the vapor produced between the rolls and the consolidated crust of the molten metal contained therein owing to the leakage of the water from the cracks on the surfaces of the rolls. Therefore, the part of the rolls that comes into contact with the molten metal had better be equipped with a metallic facing. This is convenient in using the better material for it than any other part of the rolls or changing it when damaged.

In the manufacture of a wide material accord-

ing to this method, roll flatly with another roll the swollen and narrow parts on the section of the hot metal delivered from the rotating rolls, and then the corrugation will disappear.

Further, in the manufacture of a slender metallic material such as a bar, rod, etc., according to this method, the hot metal from the rolls which deliver the molten metal is preferably allowed to continue its travel to receive the next stage of operation to be split lengthwise on the way into two or more parts while it still has a high temperature (in many cases over red heat) due to the heat retained by it in a molten state. Then, it is rolled. Thus, it is possible to obtain a product at a stroke. In this way, the utilization of the heat retained by the molten metal economizes the cost of heating, and as a metal can be worked in a fluid state, it is possible to manufacture two or more articles at the same time. Therefore, this method is very productive and economical.

In the drawing, A, A are rolls or wheels containing a molten metal 1. 2 and 3 are the guide tables pivoted at 4 and 5 respectively. B, C, D, E and F are rolls of a continuous rolling mill. A wide hot metal sheet delivered by rolls A may be split lengthwise into two or more parallel parts by rolls C (see Fig. 4). Said parts are preferably separated upward and downward alternately by rolls C and are then rolled by the rolls D. 6 and 7 are projecting and sunken parts of circumferential corrugations formed on the surface of the rolls A transversely to the shaft 8. 9 is a chamber into which cooling water is introduced to absorb heat through the wall 10. 11 and 12 are the facings applied to the roll A where it comes into contact directly with the molten metal, and J is a roller for setting up side pressure. *a* is the pass formed by and between the rolls A containing a molten metal. *g*, *h* and *i* are the passes of a continuous rolling mill adapted for the manufacture of a plate, sheet, etc., from the hot metal delivered from *a* by utilizing the heat retained by it. The longitudinal swollen and narrow parts on the sheet of the hot metal from pass *a* are rolled flatly to remove the corrugation at *g*. The pass *a* sometimes has swollen ends to reduce the percentage of the compression of the crust of the poured metal which has been consolidated by the flange of the roll A during the operation. The special roll C acts almost as a rotatable shearing machine and it is advisable that the metallic discs 13 and 14 which work as the blades of the shearing machine be inserted in the axis 17, so that the blocks 15 and 16 forming a pass come between said discs, as by this means they can be changed when damaged.

I claim:

1. In the method of manufacturing metallic materials from molten meal discharged between rolls, the improvement consisting in delivering the hot metal in a continuous sheet containing parallel alternate swollen and narrow parts extending longitudinally of said sheet.

2. In the method of manufacturing metallic materials, as set forth in claim 1; subsequently rolling said sheet to flatten the narrow parts while said sheet is maintained at the high temperature suitable for hot rolling by the heat retained by the metal in said sheet.

3. The improved method of manufacturing metallic materials from molten metal discharged between rolls consisting in delivering hot metal in a continuous sheet from the rolls, said sheet containing bodies of liquid metal between its solidified surface crusts, the liquid metal in the sheet being divided into two or more parts extending longitudinally of said sheet and the solidified crusts of the surfaces being joined between the liquid parts.

4. The method of manufacturing metallic materials from molten metal discharged between rolls which comprises delivering the hot metal by rotating the rolls at such speed that the time (in seconds) during which solidified portions of the top surface of the delivered sheet of metal (in contact with the peripheral surfaces of said rolls when said rolls contain maximum quantity of the molten metal) are moved downwardly along said peripheral surfaces and leave the same is between 0.015 times the square of the thickness (in millimeters) of the narrowest part and that of the most swollen part of the sheet delivered from said rolls or wheels.

5. A method of manufacturing metallic materials from molten metal discharged between rolls which comprises delivering hot metal by the rolls in the form of a sheet having longitudinal alternately swollen and narrow parts and also having unsolidified metal in said swollen parts; and then dividing said sheet lengthwise into two or more parts while said sheet is maintained at the high temperature suitable for hot rolling by the heat retained by the metal in said sheet.

6. In a method of manufacturing metallic materials, as set forth in claim 5, subsequently rolling the divided parts to flatten them while said sheet is maintained at the high temperature suitable for hot rolling by the heat retained by the metal in said sheet.

7. In the method of manufacturing metallic materials from molten metal discharged between rolls, the improvement consisting in delivering the hot metal in a plate containing parallel alternate swollen and narrow parts extending longitudinally of said plate.

8. In the method of manufacturing metallic materials, as set forth in claim 7; subsequently rolling said plate to flatten the narrow parts while said plate is maintained at the high temperature suitable for hot rolling by the heat retained by the metal in said plate.

9. The improved method of manufacturing metallic materials from molten metal discharged between rolls consisting in delivering hot metal in a plate from the rolls, said plate containing bodies of liquid metal between its solidified surface crusts, the liquid metal in the plate being divided into two or more parts extending longitudinally of said plate and the solidified crusts of the surfaces being joined between the liquid parts.

10. A method of manufacturing metallic materials from molten metal discharged between rolls which comprises delivering hot metal by the rolls in the form of a plate having longitudinal alternately swollen and narrow parts and also having unsolidified metal in said swollen parts; and then dividing said plate lengthwise into two or more parts while said plate is maintained at the high temperature suitable for hot rolling by the heat retained by the metal in said plate.

11. In a method of manufacturing metallic materials, as set forth in claim 10, subsequently rolling the divided parts to flatten them while said plate is maintained at the high temperature suitable for hot rolling by the heat retained by the metal in said plate.

12. The method of manufacturing solid metal material discharged between rolls, consisting in

causing a length of partially solidified metal having surface crusts to issue from the gap between the rolls in corrugated-surface form, the corrugations of the opposed crusts of the metal being of such form and position that the valleys between the corrugations of one crust are opposite the valleys between the corrugations of the other crust, the operative conditions of the process being so controlled that the metal is solidified at the valleys while the metal is still molten or semi-molten elsewhere in the interior.

13. The method of manufacturing solid metal material discharged between rolls, consisting in causing a length of partially solidified metal having surface crusts to issue from the gap between the rolls in corrugated-surface form, controlling the speed of rotation of the rolls in relation to the depth of the metal in the space above the gap between them, that the time (in seconds) during which the solidified portions of the top surface of the delivered metal (which are in contact with the peripheral surfaces of the rolls when said rolls contain a maximum quantity of the molten metal) are moved downwardly along said peripheral surfaces and leave the same, is between 0.015 times the square of the thickness (in millimetres) of the narrowest part, and 0.015 times the square of the thickness (in millimetres) of the widest part of said issuing metal.

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