Jan. 30, 1968 E. A. OLSSON 3,365,791

METAL CASTING AND ROLLING

Filed Oct. 12, 1965 2 Sheets-Sheet 1

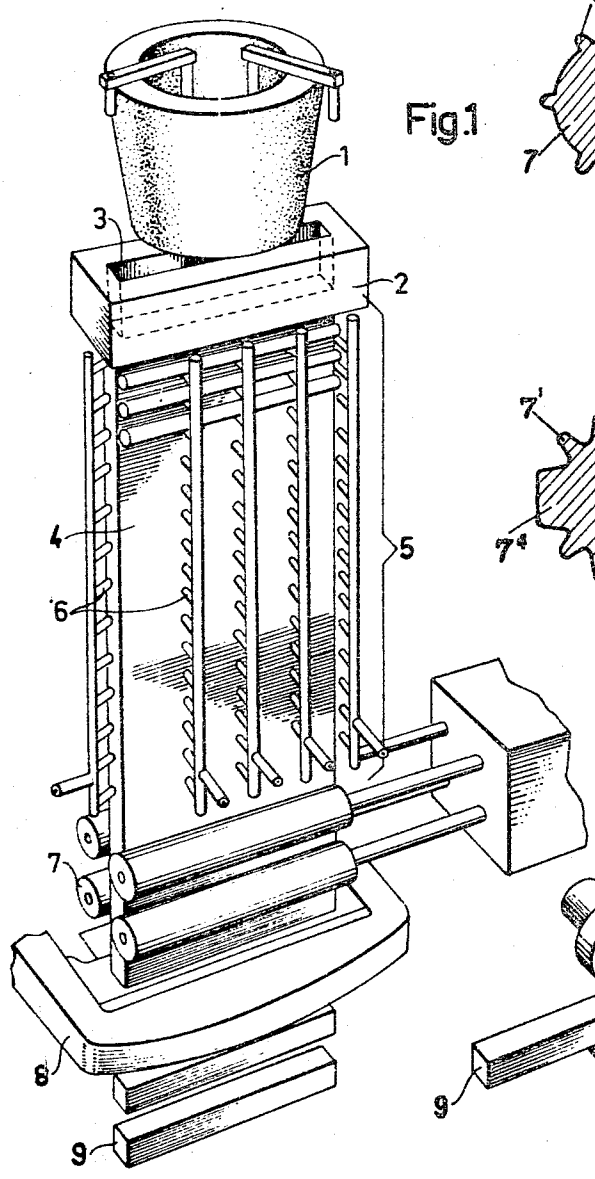


Fig.1

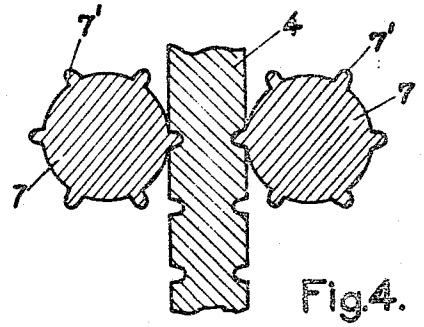


Fig.4.

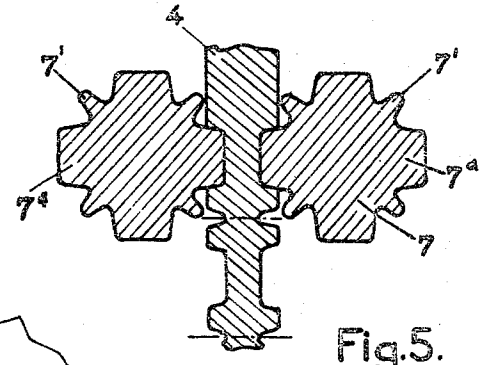
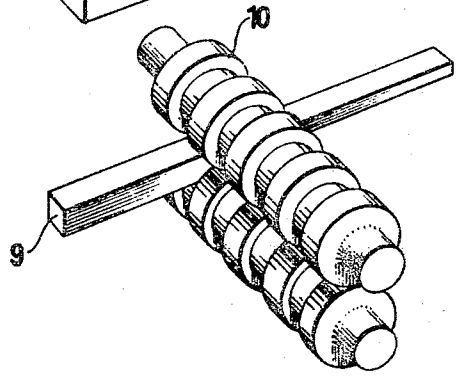


Fig.5.



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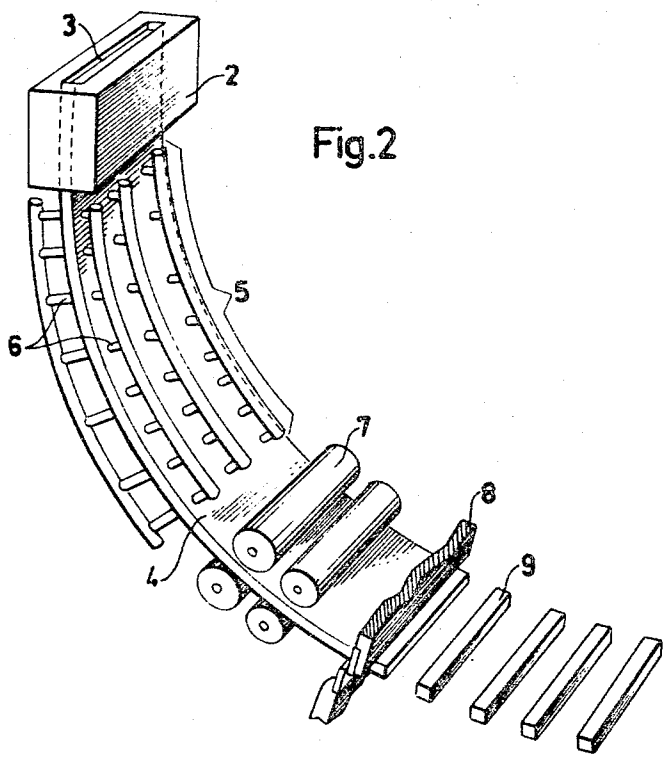
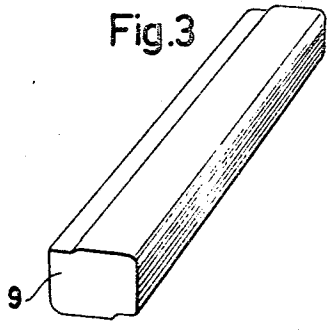


Fig.2

Fig.3



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METAL CASTING AND ROLLING

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This invention relates to the continuous casting of metal and the subsequent rolling thereof, and is for an improved method for more effectively utilizing continuous casting in the making of billets for rolling into small sections, such as rods and bars.

Billets for the manufacture of rods and like small sections are generally continuously cast in a square shape for rolling in the customary manner down to rod and bar sections. The emerging square billet from the continuous casting mold is run out to a standard billet length and cut off and thereafter rolled and elongated in the direction of the axis of the billet. Billets for conversion into plates and sheets are continuously cast in billets of rectangular section in which the width exceeds many times the thickness of the billet. The emerging casting is likewise cut off to form slabs of predetermined length which are also subsequently rolled in the direction of the length of the original casting.

In continuous casting, particularly of steel, it is necessary to extract heat from the molten metal as effectively as possible, so that the problem of cooling imposes a limitation on the dimensions of the billet. A square billet of a size adaptable for rod rolling can only be cast at a rate varying between 12 to 25 tons per hour because of the limited volume of the mold and the rate at which the metal can be cooled. On the other hand, a rectangular billet, having a width many times its thickness can be cast at a much higher rate because of the greater mold capacity and because the distance which heat must travel from the center of the casting to the mold walls does not increase in the direction of the width of the casting. For example, a rectangular billet 200 mm. x 2000 mm. may be cast at a rate of 100 tons per hour, which is from four to five times the rate at which a square billet 200 x 200 mm. can be cast.

For this reason, in order to get a high rate of production when casting square billets, and to avoid retention of the molten metal for an excessively long time in the pouring ladle, multiple strands must be provided when square billets are continuously cast. This resort to multiple strands increases the equipment cost and operating expenses and requires increased personnel.

It has been proposed to divide the rectangular billet longitudinally to provide parallel square billets, and to even so shape the mold as to facilitate separation in this manner. This procedure has certain drawbacks, including the necessity of separating the billets longitudinally as well as severing them transversely.

The present invention provides an improvement wherein the metal is cast in a rectangular shape, the width of which is many times the thickness, thereby gaining the advantage of a high tonnage rate with a single strand, followed by cutting the emerging casting transversely of its length into substantially square or other billet sections where the transverse dimension of the casting becomes the long direction of each individual billet. That is the width of the casting exceeds several times the length of the section which is cut off. These individual sections are then rolled in the direction of their length which is at right angles to the direction of the length of the emerging casting. In this manner individual square or other billets of small section are formed in rapid succession for

rolling, and they may be rolled while still hot, or put aside, cooled, dressed, reheated and rolled.

Contrary to expectation, the rolling of the metal across the direction of the original casting instead of parallel therewith introduces no detrimental metallurgical effect.

An object of the invention is to provide an improved method of continuously casting and thereafter rolling metal, particularly steel, into rods and similar small sections.

A further object is to provide an improved method of forming billets for rolling into rods, wires, and like products of small cross-sectional area.

These and other objects and advantages are secured by my invention which may be more fully understood by reference to the accompanying drawings, wherein:

FIG. 1 is a conventional illustration of a continuous casting plant and rolling mill for practicing the invention;

FIG. 2 is a conventional illustration of another form of continuous casting apparatus with which the invention is adapted to be used;

FIG. 3 is a perspective view of a billet such as may be produced by the practice of the present invention;

FIG. 4 is a schematic view showing in transverse section a pair of rolls engaging the billet for forming identations in the billet prior to the complete severence of the individual sections; and

FIG. 5 is a view similar to FIG. 4 showing a modification of the rolls where the billet is to be subjected to profile rolling, as for example where it is to be reduced to an I-section.

Referring to FIG. 1, there is schematically shown a continuous casting plant adapted to cast a vertical strand. Casting plants of the type herein illustrated are well known in the art and form no part per se of the present invention. From a ladle 1, molten metal is supplied to an open-ended water-cooled mold 2 having an elongated casting opening 3. The resulting casting 4 of rectangular section which has a width substantially exceeding its thickness, passes through a secondary cooling zone 5 wherein the casting is caused to be solidified completely by water from spray nozzle 6. The casting is withdrawn by pinch rolls 7 and passed through a shear 8. While the casting is still at a high heat, that is, at a red heat or higher, the shear operates at regular intervals to cut the strand into successive individual billets which may have a substantially square cross-sectional area, these billets being designated 9 in FIG. 1. The length of the continuous casting sheared off at each operation is exceeded many times by its width. The individual billets then have their long axes transverse to the direction in which the strand is cast. The individual billets so formed may then be passed through a rolling mill as conventionally illustrated at 10, and which may be of any known or preferred construction, usually having a succession of roll passes in which the billet is reduced to a rod, bar, or other small section. Thus the billets produced in the manner described are not rolled in the casting direction, but transverse to the direction in which the casting is formed. As above indicated, the severing of the casting and subsequent rolling in this manner does not impair the metallurgical properties of the finished metal.

Typically the rectangular continuous casting may have a thickness of 200 mm. and a width of 2 meters, the width then being ten times the thickness, and the emerging continuous casting may be severed at intervals of about 200 mm., so that the resulting individual billets are about 200 mm. square and 2 meters in length. These dimensions are illustrative and set forth only as disclosing one specific procedure.

If desired, the rolls 7 or the shear 8 may be so contoured as to shape the leading end of each billet by applying pressure in a plane normal to the wide face of the

casting along that edge of the casting which will form the leading end of the billet. This will facilitate the entrance of the billet into the rolling mill.

While FIG. 1 shows a conventional way of making the billets, wherein the casting moves vertically downward, the invention is applicable to casting methods presently known to the art where the emerging strand is bent to a horizontal direction or is originally cast into an arcuate shape. In such case it is not necessary to straighten the strand, but the billet-length sections can be cut at any point along the arc as illustrated in FIG. 2, wherein similar reference numerals have been used to designate corresponding parts.

The shear itself may be of a conventional type having opposed blades, and which is suspended to travel with the casting as is well known in the art, moving down with the casting as the shearing operation is effected, and then being raised to the starting position for the next cycle of operation. Traveling shears of this type have heretofore been used, but not in the manner herein described, and it is contemplated that instead of a traveling shear, some other cut-off device presently known to the art may be used, as for example a saw.

If the metal is sheared by blunt shears while it is still at a relatively high temperature and therefore comparatively soft, less power is required to operate the shear, but there may be some slight deformation of the metal so that it is not strictly square. This is indicated in FIG. 5, and where this is the case, any beads or deformation can be removed by oxygen planing, or in a conventional manner by burning with cutting burners, milling, chiseling, or the like. For purposes of illustration, FIG. 3 shows the deformation in a somewhat exaggerated form.

To facilitate the cutting of the billets, one pair of pinch rolls 7 which are illustrated as being power-driven, may be provided with axially-extending ribs on the periphery thereof as shown in FIG. 4. The ribs 7' of the opposed rollers coming into conforming relation against the surface of the casting form grooves in the opposite surfaces of the casting at regular intervals along which the cutting or shearing may be subsequently effected. Also these rollers, instead of being one pair of the pinch rolls shown in FIG. 1, may be provided in addition to the pinch rolls of FIG. 1.

In FIG. 5 there is shown another modification of these rolls 7 wherein the periphery of the rolls, in addition to being provided with ribs 7', are also provided with wider ribs 7*a*. The purpose of this is to not only indent the continuously-cast billet along the lines of severance, but to form an indentation for profile rolling, as for example the web-forming portion of an I-beam section. In the drawings I have shown ribs 7' and 7*a* on the same pair of rolls, but the ribs 7*a* could be formed on separate rolls. Also, the casting operation may be so controlled that when the indentations are rolled into the casting, the metal may not have completely solidified.

While I have illustrated and described certain preferred embodiments of my invention, it will be understood that various modifications and changes may be made therein within the contemplation of my invention.

I claim:

1. The method of casting and rolling metal which comprises

(a) continuously casting molten metal into a formed casting of rectangular section the width of which is many times its thickness,

(b) severing said continuously-formed casting at intervals transversely of its length into individual billets the long axis of which is in the direction of the width of the continuous casting,

(c) and thereafter rolling the individual billets so formed in the direction of their length.

2. The method defined in claim 1 in which the intervals at which the casting is severed are approximately the same as the thickness of the continuously-cast billets whereby the overall transverse section of each individual billet is approximately square.

3. The method defined in claim 1 in which the severing of the cast billet is effected progressively as the casting is formed and while it is at high temperature.

4. The method defined in claim 1 in which the casting is formed in an open-ended mold with a secondary cooling zone immediately below the mold below which are pinch rolls and severance of the individual billets is effected adjacent the pinch rolls but at a level where the cast metal has completely solidified.

5. A method of making billets adapted to be rolled into rods or other product of small section by continuous casting comprising

(a) casting molten metal in a rectangular open-end mold and forming a casting of rectangular cross-section,

(b) cutting the casting transversely to its direction of travel at successive equal intervals, the distance between successive cuts being less than the width of the casting to form individual billet sections that are elongated in the direction of the width of the casting.

6. A method of making billets adapted to be rolled into rods or other products of small section by continuous casting as defined in claim 5 wherein the casting is cut after the metal in the casting has solidified but while it retains the casting heat.

7. A method of making billets adapted to be rolled into rods or other products of small section as defined in claim 5 wherein transverse grooves are rolled into the casting to define the lines along which the casting is to be cut and facilitate the cutting.

8. A method of making billets adapted to be rolled into rods or other products of small section as defined in claim 5 wherein transverse depressions are rolled into the surface of the casting before the sections are cut off to shape the subsequently-formed individual billets for profile rolling.

9. A method of making billets adapted to be rolled into rods or other products of small section by continuous casting as defined in claim 5 wherein one edge of the continuous casting is shaped in advance of the cutting step to form on the billet sections an end shaped to facilitate the introduction of the billets into a rolling mill.

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