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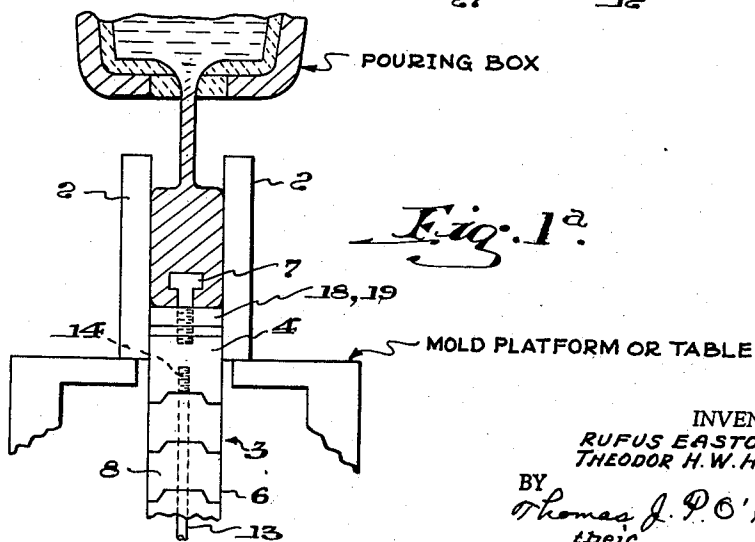
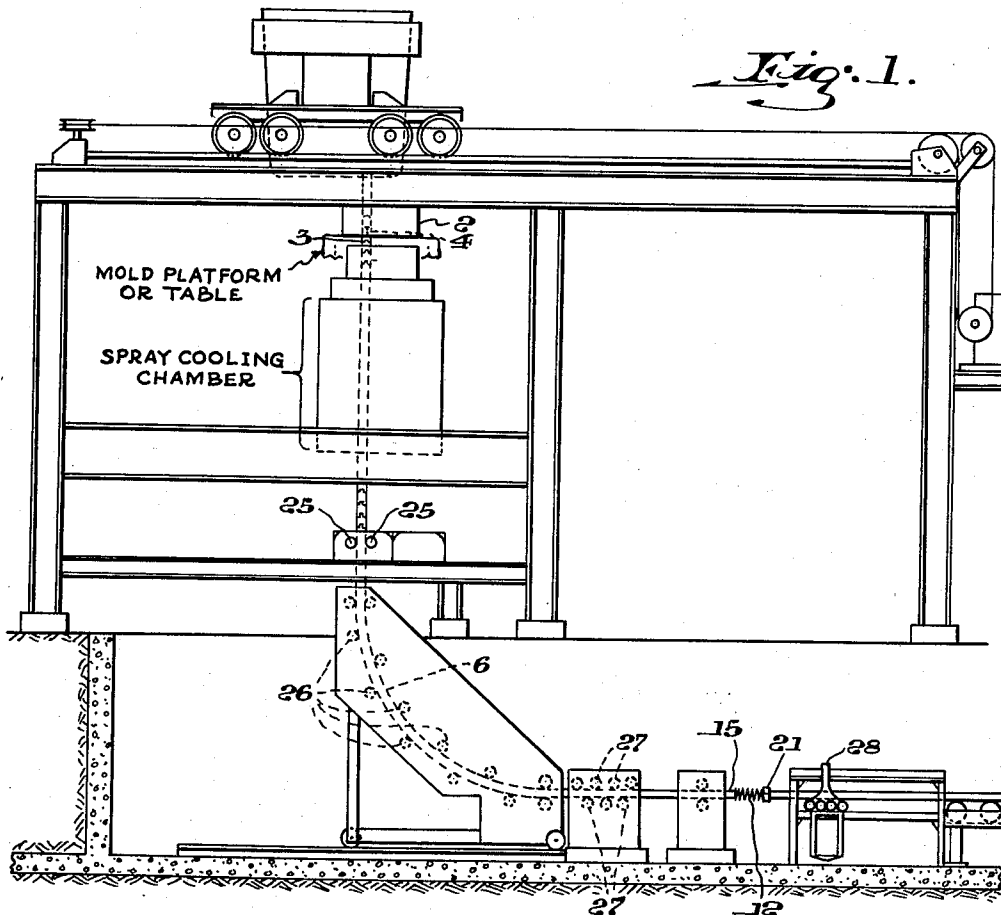
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2,920,359

FLEXIBLE SEGMENTAL STARTING BAR CONTINUOUS CASTING MACHINE

Filed Dec. 26, 1957

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

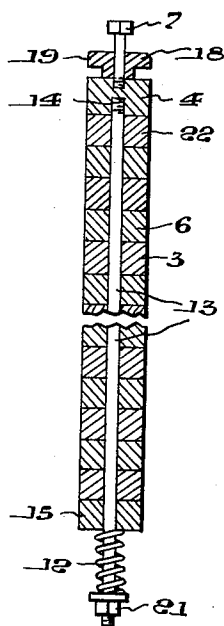


Fig. 2.

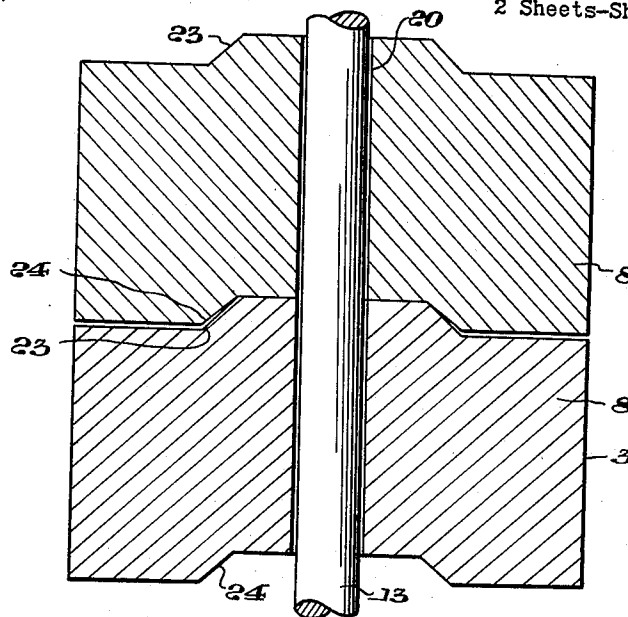


Fig. 3.

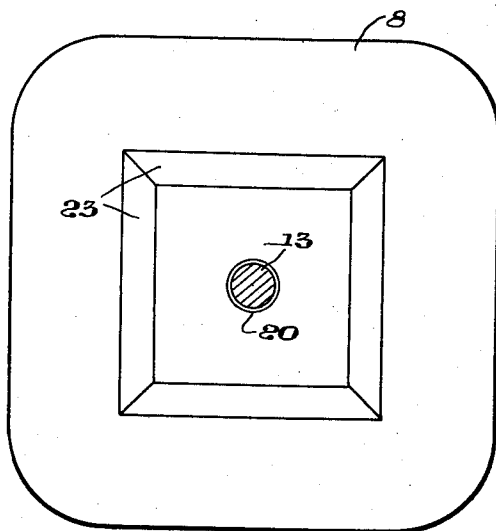


Fig. 4.

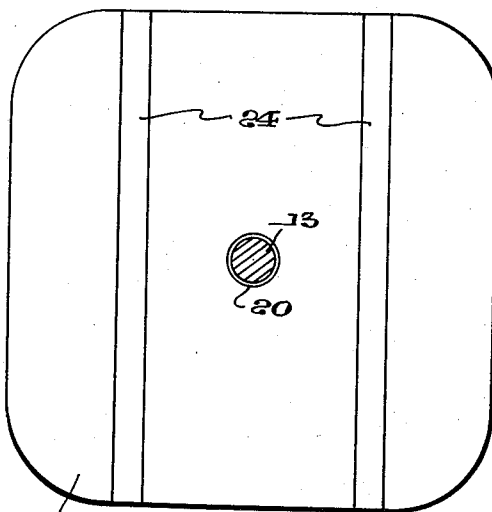


Fig. 5.

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FLEXIBLE SEGMENTAL STARTING BAR CONTINUOUS CASTING MACHINE

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4 Claims. (Cl. 22—57.2)

This invention relates in general to improvements in multiple strand steel casting machines and more particularly, to an improved casting machine of the type comprising a gravity flow, vertical open-ended, fixed mold, with pinch rolls, and bender and straightener rolls angularly displaced relative to the vertical plane of the mold and the pinch rolls, in order to continuously bend and thereafter straighten the hot steel castings as they leave the machine, to discharge them horizontally for cutting into billet lengths.

A principal object of the invention is the provision of a machine of this type having as its novel characteristic a starting bar arrangement operable through the rolls between the mold and the cutting torch in a manner to remain straight and still enough, as a single unitary whole, between the pinch rolls and the mold in order to perform its required function of steadily supporting the head of the starting bar as a temporary bottom in the mold during the starting of the casting, and thereafter remaining inflexible in the vertical plane of the mold, during the withdrawal of the bar from the bottom of the mold under the added weight of the ingot subsequently formed during the continuance of the casting, and yet be capable of being bent and straightened through the same bending and straightening rolls through which the ingot is drawn by the starting bar without damage to either the machinery of the rolls or the starting bar, and which can be used in this manner as an integral element of the casting machine for these functions without change in size, shape, or properties in order to reduce the number of parts constituting the essential elements of such machines.

The use of solid bars of aluminum, brass, or other relatively soft metals is not possible for the purpose in such machines, since after each complete operation of the bar in the machine they are found to be slightly smaller and harder from the compression and bending in the pinch rolls, bender rolls and straightening rolls. The use of the harder, solid steel bars is not possible as the machinery of the rolls used for bending and straightening the hot casting is not strong enough for bending and straightening the cold steel starting or dummy bar.

In such instances it has been necessary to remove the rigid starting bar prior to the bar's reaching such bending and straightening apparatus. If the starting bar should not be removed, the bending and straightening apparatus would deform the bar permanently to such an excess as to render it useless for future operations. On the other hand, this required removal of the rigid steel bar has presented a number of difficult problems since the bar is both heavy and bulky, requiring extra manpower and additional space to manipulate.

Accordingly, the present invention provides a machine of the aforesaid type having a starting bar in the form of a head portion for attachments to the metal in the mold and a main body portion composed of a series of steel or cast iron sections of short height disposed one above the other in a row and held together mechanically so as

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to be straight and stiff in the vertical position in the pinch rolls beneath the mold, but with the holding means sufficiently elastic or sprung to permit slight hinging of each section relative to the next adjacent sections when subjected to bending stresses such as are encountered in the bending and straightening machinery.

For a machine requiring a starting bar of thirty feet in length or longer, the main body portion is preferably composed of 180 sections each of two inches in height. Sections of such short height permit less angular displacement between adjacent sections when the bar is bent by the bender rolls in passing through them from the vertical position beneath the mold to enter the straightener rolls for horizontal cutting of the ingot into billet lengths.

An advantage of using cast iron for the sections is that they may be mechanically held together so as to be straight and stiff as a bar in the vertical position and yet yield at the bender rolls, by means of a tie or draw member in the form of a wire, cable or a solid bar of steel of sufficiently high yield strength to withstand the tensile stresses involved without permanent elongation.

The tie or draw member extends uninterruptedly through aligned apertures in adjacent sections and is removably anchored at one end through a screw threaded engagement with the head portion and is provided in the region of the bottom section of the bar with an oppositely acting thrust member in the form of a nut in screw threaded relation with the tie member for exerting an oppositely acting thrust on the bottom section, to draw the head portion and bottom section toward each other and thus force the sections from top to bottom of the bar into abutting relation all along the bar. A spring is interposed between the nut and the bottom section to yield at the bending rolls to allow for the slight hinging action of the different sections along the length of the bar as a whole. The sections are thus freely separable as independent units along the length of the bar and the tie or draw member is freely moveable relative to the aligned apertures, thus completing the freedom for hinge movement along the different parts of the bar as a unitary whole.

The machine of the present invention thus avoids the aforementioned difficulties of starting bar removal, providing a starting bar which can be fed through the bending and straightening rolls without permanent deformation, which is readily manipulatable, and is of a composition and construction that permits it to pass such bending and straightening apparatus, and which can be used either repeatedly in the same mold or interchanged for use with different size molds.

Various other features of the present invention will become obvious to one skilled in the art upon reading the disclosure set forth hereinafter.

It is to be understood that various changes can be made in the arrangement, and construction of the apparatus as disclosed hereinafter without departing from the scope or spirit of this invention.

Referring to the drawings:

Figure 1 is a diagrammatic elevational view, parts being in section, of an open-ended mold machine having therein a starting bar in accordance with the present invention; Figure 1a is an enlargement of a part of Figure 1;

Figure 2 is a vertical sectional view of the starting bar in Figure 1;

Figure 3 is a vertical sectional view on an enlarged scale of a part of the starting bar of Figure 2;

Figures 4 and 5 are top and bottom plan views of one of the cast iron sections showing the cooperating central equilateral rectangular protruding male and oblong rectangular recess female members with the central aperture for the tie or draw member.

Referring to Figure 1, an open-ended vertical gravity

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flow mold 2 is disclosed having disposed in the lower portion thereof the head portion 4 of a starting bar 3 made up of a head portion 4 and a main body portion 6.

The upper portion of the bar is supported by the pinch rolls 25, the intermediate portion by the bender rolls 26 and the lower end to the center line of the withdrawal straightening rolls 27. As the ingot forms, the starting bar is withdrawn by the concurrent operation of rolls 25, 26 and 27. The bar follows the curve shown in Figure 1 until all of it passes through the straightening rolls 27. Whereupon the continuous ingot is drawn through the same rolls, to be bent and then straightened for horizontal cutting by means of cutting torch 28 into billet lengths.

The head portion 4 is made from a metallic material, advantageously steel, and has cross-sectional dimensions to form a temporary base floor 19 for the mold. The head portion 4 can have fastened thereto at its upper surface a flat plate 18. This plate 18 can constitute a temporary floor or base 19 for the mold 2, separable from the head 4.

The length of the head portion 4 is much shorter than the depth of the mold 2 and is sufficiently short in height to permit subsequent free passage of this head portion through the bending and straightening rolls. On the other hand, the head portion 4 has sufficient height to delay the transfer of heat from the solidifying casting to the main body portion 6 of the bar 3. In a typical example, a mold of approximately 30" in depth is provided with a starting bar having a head portion 4 of approximately 9 inches in height.

In order to anchor the molten metal to the head portion 4 of the starting bar, as by means of plate 18, as the metal freezes around the upper surface of the head portion, an anchor bolt 7 is screw threaded in the head portion 4, the bolt passing through the plate 18 on head portion 4.

The main body portion 6 of the starting bar is made of cast iron sections 8 to provide flexibility for the subsequent bending of the starting bar. The sections are advantageously held together by a tie rod or draw member 13 in the form of a solid bar, wire rope, or chain of steel combined with yieldable means in the form of spring 12 for bending at the binder rolls.

The length of the sections constituting the main body portion 6 is determined by the distance from the bottom portion of the mold 2 to a plane passing through the center line of the first set of withdrawal rolls, and, in some instances, can be 30 feet or more in length, and in such case 2" sections are used amounting to 180 sections.

It is advantageous to have the main body portion 6 of the starting bar connected in a detachable manner with the starting head portion 4 to permit the main body portion 6 to be used with various size heads 4 and to permit rapid changing of the head size in the event different size molds are used. For this, the tie rod or draw member 13 is comprised of a portion screwed at 14 into the starting portion 4 for detachably connecting the sections 8 of the main body portion 6 to the head of the starting bar. The tie rod or draw member 13 also comprises a portion which extends beyond the bottom end section 15 of the main body portion 6 to engage in a nut 21 to comprise an oppositely acting thrust portion at that end of the body portion 4. A coil spring 12 extending between the nut and the bottom section 15 is also comprised as a portion of the draw member to provide the resiliency for movement of the individual sections 8 relative to each other along the length of the bar at the bender rolls.

Referring to Figures 3 to 5, the tie rod or draw member 13 is in the form of a solid bar, rather than a chain or wire linking means. Because of the tightening of nut 21 on spring 12 against the main body portion, the head 4 is held firmly in place against the top section 22 to draw all sections into abutting relation one on top of

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another into a rigid unitary whole in the vertical position between the pinch rolls and the molds.

Each section is freely moveable relative to a next under the bending action of the bender and straightener rolls, and the tie rod or member 13 is free of relative movement in the axially aligned apertures 20.

Referring to Figures 4 and 5, the top of each section is provided with a projecting equilateral rectangular male member 23 and the bottom of each is provided with a complementary oblong rectangular recess, female member 24 to prevent rotation of the sections around their axes relative to each other, thus ensuring their retention in the form of a rigid unitary whole between the pinch rolls and the mold while still allowing them to partake of a small angular displacement in turning from the vertical to the horizontal.

The invention as hereinabove set forth is embodied in a particular form of construction but may be variously embodied within the scope of the following claims.

We claim:

1. In a continuous casting machine comprising the combination with a fixed vertical gravity flow open-ended mold having pinch rolls vertically below the mold and bender and straightener rolls angularly displaced relative to the vertical planes of the mold and the pinch rolls, the improvement comprising: a starting bar arrangement operable through the rolls between the mold and a point beyond the straightener rolls, in a manner to remain straight and stiff enough in the vertical position when between the pinch rolls and the mold to steadily support the head of the starting bar in the mold, and thereafter remain inflexible when in the vertical plane of the mold during withdrawal of the bar from the bottom of the mold upon the subsequent forming of the continuous casting, and also operable through the bending and straightening rolls in a manner to bend and then straighten without change in size, shape or properties for re-use as a part of the machine, said arrangement comprising: a head portion and a main body portion composed of a series of sections of cast iron material, the sections each being of short height relative to their length and each being of a maximum height of two inches and being held together mechanically in abutting relation one above the other in a row so as to be straight and stiff in the aforesaid vertical position between the pinch rolls but with holding means sufficiently elastic for slight hinging of each section relative to the next in the aforesaid bender and straightener rolls, and in which the cast iron sections are held together by a draw member comprising a portion extending uninterruptedly through aligned apertures in the sections, and a portion removably anchored at one end in the head portion, and also comprises in the region of the bottom section of the bar an oppositely acting thrust portion for exerting an oppositely acting thrust on the bottom section, to draw the head portion and bottom section toward each other and thus force the sections from top to bottom of the bar into abutting relation all along the bar, said draw member also comprising a spring portion in the region between the head portion and the oppositely acting thrust portion, to yield at the bender and straightener rolls to allow for slight hinging action of the different sections all along the length of the bar as it passes through said rolls.

2. Apparatus as claimed in claim 1, and in which the spring is interposed between the bottom section of the bar and the aforesaid oppositely acting thrust portion at the bottom of the bar, the sections are freely separable as independent units along the bar at the bender rolls, and the portion of the draw member that extends through the aligned apertures is freely movable relative to the aligned apertures, to afford complete freedom for hinge movement of the different parts at the bender and straightener rolls.

3. A continuous casting machine starting bar com-

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prising: a head portion and a main body portion composed of a series of sections of cast iron material, the sections each being of short height of a maximum of two inches relative to their length and being disposed in abutting relation one above the other in a row, and held together mechanically so as to be straight and stiff in the vertical position between pinch rolls but with the holding means sufficiently elastic for slight hinging of each section relative to the next in the bender and straightener rolls of a continuous casting machine, said cast iron sections being held together by a draw member comprising a portion extending uninterruptedly through aligned apertures in the sections, and a portion removably anchored at one end in the head portion, and also comprises in the region of the bottom section of the bar an oppositely acting thrust portion for exerting an oppositely acting thrust on the bottom section, to draw the head portion and bottom section toward each other and thus force the sections from top to bottom of the bar into abutting relation all along the bar, said draw member also comprising a spring portion in the region between the head portion and the oppositely acting thrust

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portion, to yield at the bender and straightener rolls to allow for slight hinging action of the different sections all along the length of the bar as it passes through said rolls.

4. Apparatus as claimed in claim 3, and in which the spring is interposed between the bottom section of the bar and the aforesaid oppositely acting thrust portion at the bottom of the bar, the sections are freely separable as independent units along the bar at the bender rolls, and the portion of the draw member that extends through the aligned apertures is freely movable relative to the aligned apertures, to afford complete freedom for hinge movement of the different parts at the bender and straightener rolls.

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