APPARATUS FOR MAKING CAST CHAIN

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ABSTRACT

A method and apparatus for casting a plurality of spaced apart chain links and connecting links therebetween in the same molding apparatus. The molds for casting the spaced apart links are formed in the cope and drag portions of the molding apparatus, and the adjacent sides of the molds are intersected by elongated vertical recesses which receive upstanding core assemblies containing arcuate passages to complete the molds for the spaced apart links. The upstanding core assemblies also contain molds for casting vertical connecting links between the horizontally spaced apart links. After casting two or more such plural link chains, they may be connected together to provide a chain of any desired length by casting connecting links between the end links of each chain using other core assemblies.

5 Claims, 10 Drawing Figures
Fig. 5

Fig. 6

Fig. 7

Fig. 8

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This invention relates generally as indicated to a method and apparatus for making cast chain by casting plural spaced apart links and connecting links therebetween using the same molding apparatus to reduce handling of the chain links and setup time.

Hereinafore, it was the usual practice to make individual preformed chain links from wire or bar stock by rolling the wire or bar stock to the desired configuration and welding the ends of the links together. These preformed links were then made into a chain by welding connecting rings or links between pairs of the preformed links.

It was also common practice to precast every other link and then cast connecting links between the precast links in a subsequent operation using connecting link cores to completely core around the precast links. Regardless of which procedure was used, the amount of handling and setup time that was required first to form the individual links and later on form connecting links therebetween resulted in relatively high manufacturing costs for the chain.

With the foregoing in mind, it is a principal object of this invention to provide a method and apparatus by which both the spaced apart links and connecting links of a chain are cast in the same mold assembly at a substantial reduction in handling and setup time.

Another object is to provide a method and apparatus for connecting the end links of two or more plural link chains together to provide a chain of any desired length.

These and other objects of the present invention may be achieved using a molding apparatus in which plural spaced apart molds are provided for casting the spaced apart horizontal links, and elongated vertical recesses are also provided in the molding apparatus intersecting the adjacent sides of the molds for the spaced apart links. The recesses are filled by upstanding core assemblies which contain accurate passages therethrough to connect the spaced apart links and also contain molds for casting vertical connecting links between the horizontal links.

After casting two or more of the plural link chains, they may be connected together using other core assemblies to cast connecting links between the end links of each chain.

To the accomplishment of the foregoing and related ends the invention, then, comprises the features hereinafter fully described and particularly pointed out in the claims, the following description and the annexed drawings setting forth in detail a certain illustrative embodiment of the invention, this being indicative, however, of but one of the various ways in which the principles of the invention may be employed.

In the annexed drawings:

FIG. 1 is an isometric view showing one form of chain which may be made utilizing the method and apparatus of the present invention;

FIG. 2 is a top plan view of the drag portion of the molding apparatus of the present invention in which a pattern has been formed providing one half of the molds for making the spaced apart links of the chain of FIG. 1;

FIG. 3 is a bottom plan view of the cope portion of such molding apparatus in which a matching pattern has been formed to complete the molds for making the spaced apart chain links of FIG. 1;

FIG. 4 is a partially exploded isometric view of the entire molding apparatus with upstanding core assemblies for casting the vertical connecting links shown in place in the drag portion of the molding apparatus;

FIG. 5 is an enlarged isometric view of one of the core assemblies of FIG. 4, the core halves being shown separated and facing upwardly to illustrate the internal configuration thereof;

FIG. 6 is an isometric view showing the pattern used to form the various indentations in the drag half of the molding apparatus of FIG. 2;

FIG. 7 is an isometric view showing the pattern used to form the indentations in the cope half of the molding apparatus of FIG. 3;

FIG. 8 is an enlarged isometric view showing the core assembly used to connect two chains together;

FIG. 9 is a vertical section through the core assembly and chain of FIG. 8, taken on the plane of the lines 9—9 thereof; and

FIG. 10 is a horizontal section through the core assembly and chain of FIG. 8, taken on the plane of the lines 10—10.

Referring now in detail to the drawing and first especially to FIG. 1, there is illustrated by way of example a chain 1 consisting of plural spaced apart links 2 with connecting links 3 between adjacent pairs of links 2. Preferably, all of the links 2, 3 are cast in the same molding apparatus to reduce handling and setup time, as will be more fully explained hereafter.

The chain links 2, 3 may be of any desired configuration depending upon the type of chain being cast and particular use for which the chain is made. Where the chain is to be used in rotary kilns, the links 2, 3 are preferably circular as shown in FIGS. 1, 9 and 10 so that the wear point engagement between links is continuously repositioned during rotation of the kiln, and the inner surface 4 of each link is also desirably convex but substantially flatter than a conventional link which is cylindrical in transverse section to distribute the wear-contacting engagement over wider areas than conventional links. The links 2, 3 also desirably have annular concave surfaces 5 which extend inwardly from opposite sides of the links to provide a generally triangular cross-sectional configuration including a circular band portion 6 and a bracing rib 7 which reinforces the band portion (see FIGS. 9 and 10).

Such a link configuration substantially reduces the overall weight of the links without sacrifice in the total exterior heat-transferring surface of the links, and also aids in self-cleaning of the links because of the manner in which the links tumble and rub against each other during rotation of the kiln to remove accumulated material therefrom. Of course, a reduction in weight of the links also saves in material and reduces the power requirements for rotating the kiln. A more complete disclosure of the preferred link configuration for use in rotating kilns may be found in U.S. Pat. No. 3,281,134, granted to Charles F. Feiser, Jr. on Oct. 25, 1966, which is incorporated herein by reference.

To cast the plural spaced apart links 2 and connecting links 3 therebetween in the same molding apparatus 10 requires the use of special core assemblies 11 which are inserted in vertical aligned recesses 12 and 13 in the cope and drag portions 14 and 15 of the mold assembly. As clearly shown in FIGS. 4 and 5, each such core assembly 11 desirably consists of two identical
halves 16 having annular grooves 17 therein which cooperate to define a mold of the desired cross sectional configuration for casting a connecting link 3 when the core halves 16 are properly assembled and cemented together. The core halves 16 are each slotted at 18 along the upper edge 19 to provide a gate 20 communicating with the annular grooves 17 therein for introduction of metal into the core assembly. Notches 21 and 22 may be provided in the outer peripheries of the grooves 17 at the gate 20 and on the opposite side thereof to provide symmetrical lugs 23 (see FIGS. 1 and 8–10) on opposite sides of the links. Providing a lug 23 in the region of the gate 20 facilitates removal of the excess metal from the links and the purpose of the other lug 23 is to provide symmetry.

Also provided in the core halves 16 centrally of the annular grooves 17 therein are a pair of arcuate passages 24 and 25 having a configuration corresponding to the cross-sectional configuration of the cooperating grooves 26 formed in the cope and drag portions 14 and 15 of the molding apparatus 10 for casting the spaced apart links 2. As shown in FIGS. 2 and 3, the grooves 26 which provide the molds for casting the spaced apart links 2 are substantially annular except where intersected by the recesses 12 and 13 for the upstanding core assemblies 11 previously described. Of course, with the core assemblies 11 inserted in the recesses 12 and 13 in the molding apparatus, the molds for the spaced apart links are completed by the arcuate passages 24 and 25 in the core assemblies which line up with the grooves 26 in the cope and drag portions (see FIG. 4). The grooves 26 may also be provided with notches 27 and 28 on opposite sides to form symmetrical lugs 30 on the spaced apart links 2, similar to the connecting links 3.

For introducing molten metal into the core assemblies 11 within the finished molding apparatus 10, there is provided a pair of riser passages 31 and 32 which extend through the cope portion 14 into the elongated recess 12 therein in vertical alignment with the core assembly gates 20. Also formed in the cope portion 14 is a pouring basin or reservoir 33 into which the molten metal for filling the molds for the spaced apart links is introduced. As best seen in FIGS. 2 through 4, the pouring basin 33 communicates with a runner 34 in the drag portion 15 of the molding apparatus 10 for conducting the metal from the pouring basin to the various gates 35 in the cope portion 14 adjacent each mold from which the metal enters the molds.

FIG. 6 illustrates the pattern 36 used to form the various grooves 26, runner 34, and elongated recess 13 in the green sand of the drag portion 15 of the molding apparatus 10, whereas FIG. 7 illustrates the pattern 37 for forming the corresponding grooves 26, elongated recess 12, gates 35, and pouring basin 33 in the cope portion 14. The risers 31 and 32 in the cope portion 14 are formed by attaching riser pins 38 to the upper surface of the elongated recess forming portion 39 of the cope forming pattern 37.

The number of interconnected chain links which may be cast in a single molding apparatus 10 may of course be varied, but it has been found that a single molding apparatus may be effectively used to cast five links at one time; that is, three spaced apart links 2 with connecting links 3 therebetween. After the casting operation, the chain 1 may be tumbled and/or sand blasted for improved appearance and flash removal, and the chain may also be heat treated if desired.

Chains of substantially greater length may be made by casting connecting links between the ends of the chains 1 formed as previously described. In FIGS. 8 through 10 there is shown a preferred form of core assembly 40 which may be used to cast connecting links between the end links of such plural link chains. Each core assembly 40 desirably consists of an upper half 41 and a lower half 42 having cooperating grooves 43 and 44 in the mating faces thereof for receipt of a portion of the end links 2 of two chains to be connected. Each mold half 41 and 42 is also vertically divided to provide two upper parts 45 and 46 and two lower parts 47 and 48 containing cooperating semi-circular grooves 49 and 50 that define a mold cavity surrounding the grooves 43 and 44 for casting the connecting link 51. A gate 52 extends through the top of the core assembly 40 for introducing molten metal into the mold when the various parts of the core assembly are properly assembled and cemented together as shown in FIG. 8. Opposite sides of the mold may be notched at 53 and 54 as shown to provide symmetrical lugs 55 on the connecting links 51, similar to the links 2 and 3. The ends of the core assembly 40 are also desirably notched at 56 and 57 to provide clearance space for the next link of each chain being connected together. Any number of such plural link chains 1 may be connected together at the same time using additional core assemblies 40 between the end links of each pair of chains to be connected.

From the foregoing, it will now be apparent that the method and apparatus disclosed herein provide for the casting of a plural link chain in a single molding apparatus at a substantial savings in handling and setup time, and also provide for connecting any number of such plural link chains together as desired.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. Molding apparatus for casting a plurality of interconnected chain links comprising upper and lower mold portions having plural spaced apart grooves therein which provide plural spaced apart molds for casting plural spaced apart links, means within said mold portions providing additional molds extending through adjacent pairs of said spaced apart molds for casting connecting links between the spaced apart links, said means providing additional molds comprising core assemblies received in aligned recesses in said upper and lower mold portions intersecting the adjacent sides of said spaced apart molds, said core assemblies having arcuate passages therein completing the portions of the spaced apart molds removed by the recesses, said core assemblies also containing said additional molds for casting such connecting links, and passage means in said molding apparatus communicating with said molds through which molten metal is introduced to said molds.

2. The molding apparatus of claim 1 wherein said passage means for introducing molten metal to said spaced apart mold comprises gates in said upper mold portion adjacent each of said spaced apart molds, said spaced apart molds having notches adjacent said gates and on the opposite side thereof which provide sym-
metrical lugs on such spaced apart links, a runner in said lower mold portion communicating with said gates, and a reservoir in said upper mold portion communicating with said runner.

3. The molding apparatus of claim 1 wherein said core assemblies consist of two halves cemented together, each of said halves having annular grooves therein which cooperate to define said additional molds for casting such connecting links, said arcuate passages extending through said core assembly halves centrally of said annular grooves therein.

4. The molding apparatus of claim 1 wherein said passage means for introducing molten metal to said molds in said core assemblies comprises gates in said core assemblies communicating with said molds therein, and passages in said upper mold portion communicating with said gates in said core assemblies.

5. The molding apparatus of claim 4 wherein said molds in said core assemblies have notches adjacent said gates and on the opposite side thereof which provide symmetrical lugs on such connecting links.