

United States Patent

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 [73] Assignee **United States Steel Corporation**

[56] **References Cited**

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[54] **CONTINUOUS-CASTING MOLD**
 5 Claims, 6 Drawing Figs.

[52] U.S. Cl..... **164/281,**
 164/283
 [51] Int. Cl..... **B22d 11/02**
 [50] Field of Search..... 164/82, 89,
 273, 281, 283

ABSTRACT: A mold for continuous-casting of metals in which the copper liner can be one-piece construction or four-piece construction used interchangeably. Both forms of liners have their own advantages. The invention enables either form to be used in the same mold.

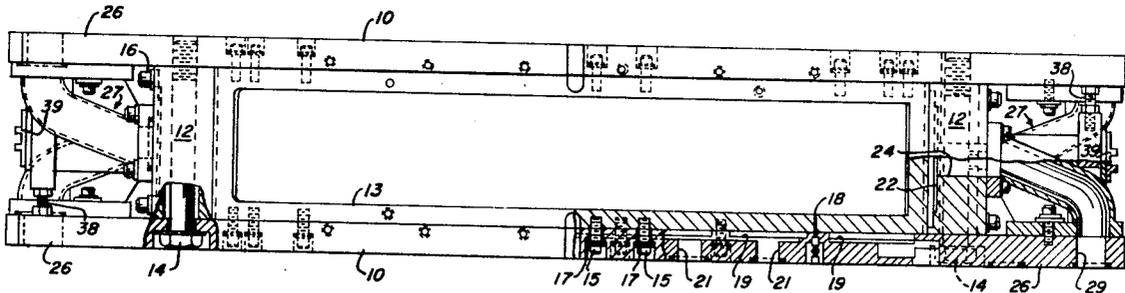


FIG. 1

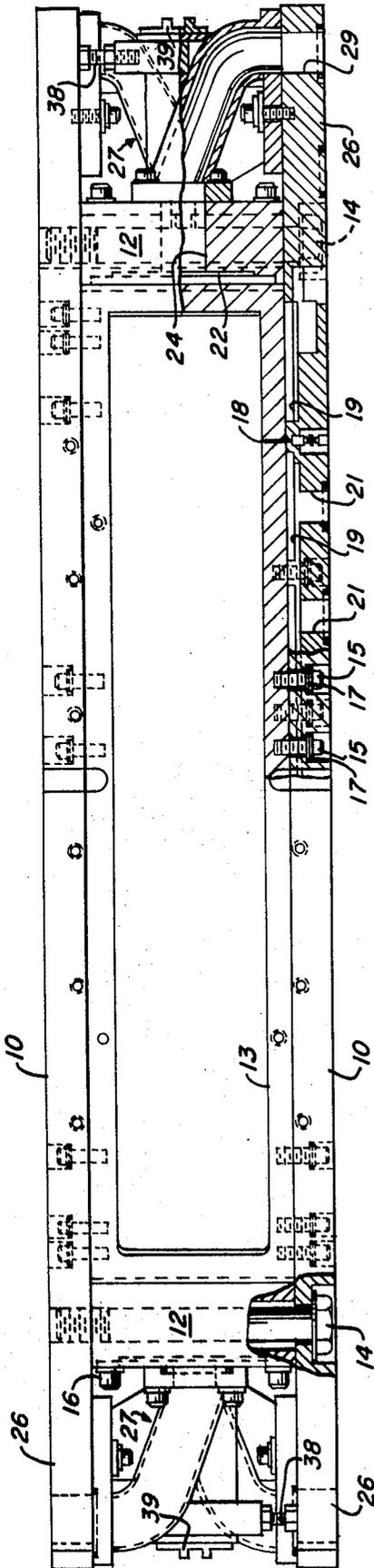


FIG. 5

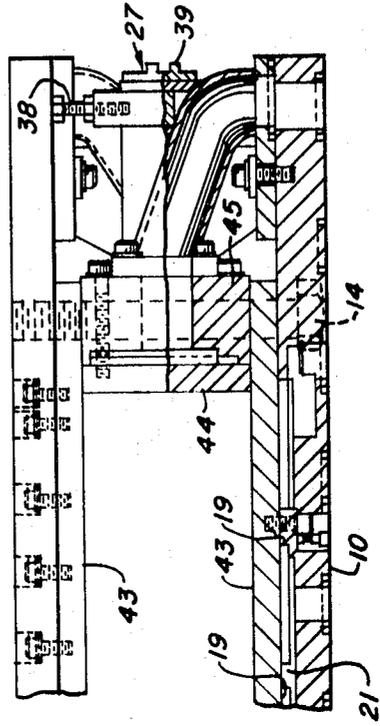
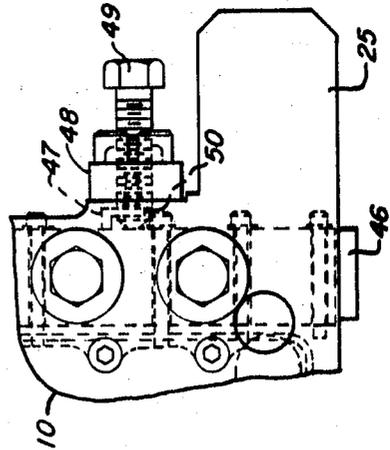


FIG. 6



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FIG. 3

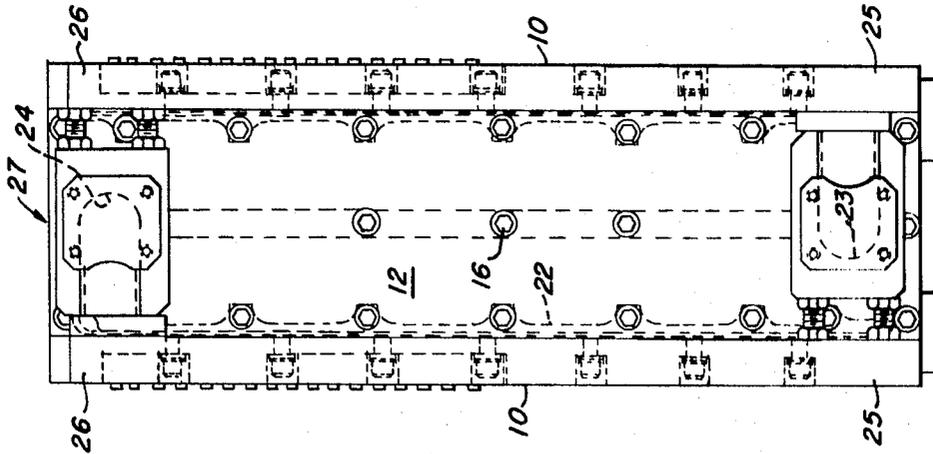
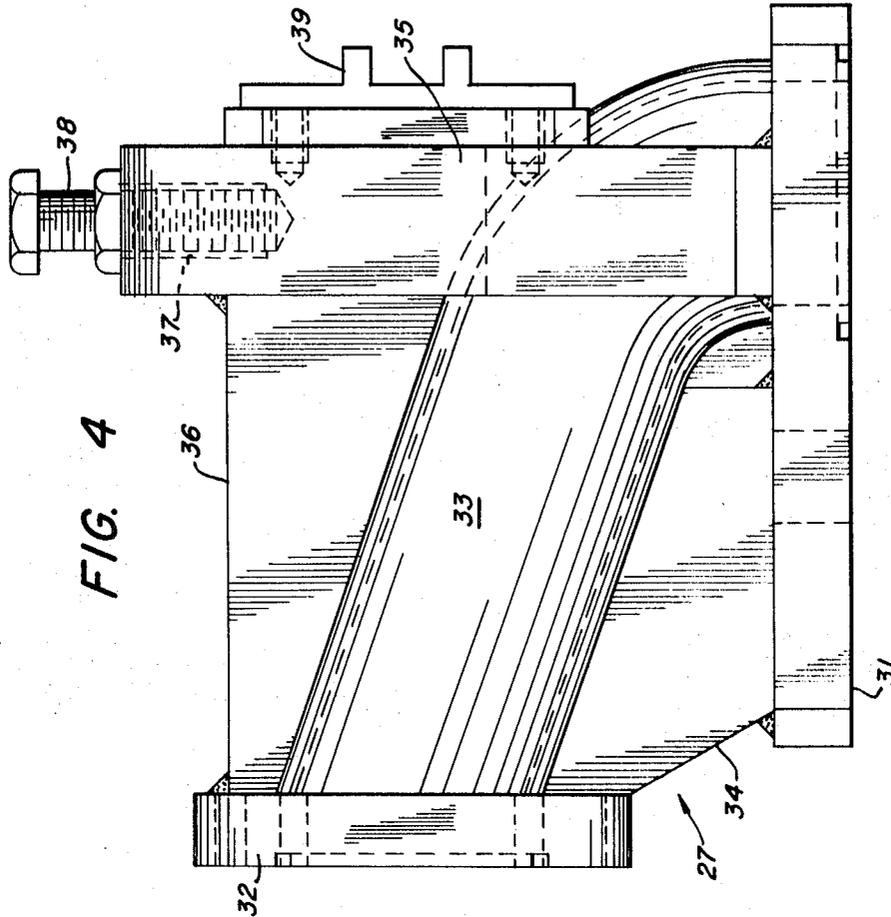


FIG. 4



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CONTINUOUS-CASTING MOLD

This invention relates to an improved heavy-wall mold for use in continuous-casting of metals.

Conventional practice in continuous-casting is to pour a molten metal, such as steel, through an open-ended water-cooled mold, usually of rectangular cross section. An outer skin of the metal solidifies within the mold. The partially solidified casting is withdrawn continuously from the bottom of the mold, and next travels through guide rolls, water sprays which complete its solidification, and pinch rolls which control its movement. Usually the mold has a copper liner which the molten metal contacts. The high thermal conductivity of the copper enables it to extract heat rapidly from the molted metal and thus hasten the formation of a solidified skin. The liner may be either a single copper sleeve (one-piece liner) or it may be formed of four plates fitted together (four-piece liner), as shown for example in Schultz U.S. Pat. No. 3,049,769. A one-piece liner is a more stable structure than a four-piece liner and has longer life, but ever different size of casting requires a different liner. Although less stable, a four-piece liner can be adjusted for different sizes of casting.

An object of my invention is to provide a mold construction which can accommodate either a one-piece liner or a four-piece liner interchangeably.

A more specific object is to provide a mold which includes side plates and fasteners usable with either a one-piece liner or a four-piece liner, so that I can switch from one to the other by changing only two end plates and the liner itself. In the drawings:

FIG. 1 is a top plan view, partly in section, of my improved mold with a one-piece liner installed;

FIG. 2 is a side elevational view of the mold shown in FIG. 1;

FIG. 3 is an end elevational view of the mold shown in FIG. 1;

FIG. 4 is a top plan view of one of the combined spacer and conduit members embodied in the mold;

FIG. 5 is a top plan view, partly in section, of the same mold with a four-piece liner installed; and

FIG. 6 is a side elevational view of a portion of the mold with a four-piece liner installed illustrating a detail.

FIG. 1 shows a mold which is constructed in accordance with my invention and includes opposed pairs of side and end plates 10 and 12 and a one-piece liner 13. Usually the plates are steel and the liner copper. The vertical edges of the two end plates 12 directly abut the inner faces of the two side plates 10. The four plates are held in assembled relation by bolts 14, which have heads countersunk in one side plate, extend through the end plates, and are threadedly engaged with the other side plate. The plates can be made yieldable by including spring washers under the countersunk heads 22. A plurality of capscrews 15 and 16 extend through the side and end plates respectively into the liner to fix the liner within the enclosure formed by the four plates. The capscrews are encircled by O-rings 17 under their heads to afford a seal against leakage from the cooling system, hereinafter described. The heads of cap screws 15 are countersunk in the side plates 10. Preferably I mount a row of vertically spaced thermocouples 18 along one of the side plates 10 to detect the level of molten metal in the mold for control purposes (FIG. 2), as shown in Milnes U.S. Pat. No. 3,204,460 or Wilson U.S. Pat. No. 3,399,568.

The side plates 10 have a plurality of vertically extending water channels 19 in their inner faces, a row of inlets 20 to these channels near the lower ends thereof, and a row of outlets 21 from the channels near the upper end. The end plates 12 have vertically extending water channels 22 in their inner faces and inlets 23 and outlets 24 communicating with the channels near the bottom and top. The side plates 10 have outwardly extending wings 25 and 26 at their lower and upper edges. Four combined conduit and spacer members 27 connect the two inlets 23 and the two outlet 24 with inlet and outlet openings 28 and 29 in the lower and upper wings 25 and 26 respectively. The centers of the various inlet openings 20 and

28 and of the various outlet openings 21 and 29 lie in straight lines to enable the openings to be connected to straight manifold (not shown).

As best shown in FIG. 4, each combined conduit and spacer member 27 includes flanges 31 and 32 which I bolt to the inner face of one of the wings 25 or 26 and to the outer face of one of the end plates 12 respectively. An elbow-shaped conduit 33 extends between the two flanges, and a web 34 is joined to flange 31 and to the conduit. A spacer block 35 extends perpendicularly from flange 31, straddling the conduit. Another web 36 is joined to the spacer block and conduit. The end of the spacer block has a pair of tapped openings 37. I form these parts as an integral welded assembly. Preferably I join the two conduits 33 at the left end of the mold to the wings 25 and 26 of opposite side plates 10, and reverse the two at the right end from those at the left end. Spacer bolts 38 are threadedly engaged with the tapped openings 37 and abut the wings 25 or 26 at the side opposite that to which the conduit is joined. The spacer block 35 also carries a guide 39 adapted to receive a tongue on the frame which supports the mold (not shown).

FIGS. 5 and 6 show a four-piece liner installed in the same mold. The four-piece liner includes two opposed sidewalls 43 and two opposed end walls 44. The end walls fit between the sidewalls and can be adjusted with respect thereto to vary the longer horizontal dimension of a casting. The end walls can be replaced by others of different width to vary the shorter horizontal dimension of the casting. I use the same side plates 10, bolts 14, capscrews 15, and combined conduit and spacer member 27 for the four-piece liner as for the one-piece liner. The end plates 45 likewise are similar, except that they are relatively more narrow since they fit between the side walls 43 of the liner. The bottom edges of the side plates 10 carry inwardly extending tabs 46 (FIGS. 1 and 6) which assist in supporting the end walls 44 and end plates 45. The outer faces of the end plates 45 carry downwardly facing clips 47 (FIG. 6). I bolt adjustment plates 48 to the end edges of the side plates 10 immediately above wings 25 and below wings 26. I threadedly engage pressure-set bolts 49 with the adjustment plates. The ends of these bolts bear against the end plates 45, and the bolts have circumferential grooves 50 which receive the edges of clips 47. The taps 46 are unnecessary when a one-piece liner 13 is installed, but they do not interfere and can remain in place.

In operation, when I wish to change from a one-piece liner to a four-piece liner, I remove bolts 14, cap screws 15 and the combined conduit and spacer members 27. I then slip the one-piece liner 13 and end plate 12 from between the side plates 10. Next I insert the side and end walls 43 and 44 of the four-piece liner and the end plates 45 and fasten them in place with the bolts 14 and cap screws 15 and 16. I replace the combined conduit and spacer member 27 in their original relation, adjusting the spacer bolts 38 as necessary to engage the side plates. I apply the adjustment plates 48 and bolts 49, and adjust these bolts to bear firmly against the end plates 45.

From the foregoing description it is seen that my invention affords a simple construction of mold for continuous-casting, yet allows the mold to be converted readily from a one-piece liner to a four-piece liner. Thus there is no need to supply different mold constructions to make such conversions possible.

I claim:

1. In a mold for continuous casting, which mold includes opposed pairs of side and end plates forming an enclosure, said end plates lying between said side plates with their edges abutting the inside faces of said side plates, a one-piece liner of metal of high thermal conductivity within said enclosure, fastening means extending through said plates into said liner, and means within said plates for water cooling said liner, said liner having open ends to enable molten metal to be poured into the top and to discharge continuously from the bottom as a partially solidified casting, the combination therewith of improved means connecting said side and end plates to enable said mold to accommodate a four-piece liner interchangeably

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with said one-piece liner, said connecting means comprising bolts removably extending through one side plate, an end plate and into the other side plate, and combined conduit and spacer members positioned between and abutting the inside faces of said side plates outside said end plates, the conduits of said members being connected to the water-cooling means in said end plates, the spacers of said members being adjustable to accommodate liners of different width.

2. A mold as defined in claim 1 in which said water-cooling means includes vertically extending water channels on the inner faces of said plates, said plates having inlets to said channels near their bottom edges and outlets therefrom near their upper edges.

3. A mold as defined in claim 2 in which said side plates have openings near the top and bottom at each end, said con-

duits connecting the inlets and outlets of said end plates with said openings.

4. A mold as defined in claim 2 in which said side plates have openings near the top and bottom at each end, said mold including four of said combined conduit and spacer members providing conduits connecting the inlets and outlets of said end plates with said openings, flanges for attaching the members to said side and end plates and spacer blocks having tapped openings, and spacer bolts threadedly engaged with said tapped openings and abutting the opposite side plate.

5. A mold as defined in claim 1 including in addition adjustment plates carried by the edges of said side plates, and set bolts threadedly engaged with said adjustment plates and bearing against said liner.

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