United States Patent

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[73] Assignee **John Fowler (Don Foundry) Limited**
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[33] **Great Britain**
[31] **50927/67**

[54] **CASING OF MOLTEN METAL**
7 Claims, 3 Drawing Figs.

[52] **U.S. Cl.** **249/156, 249/165**
[51] **Int. Cl.** **B22c 9/06**
[50] **Field of Search** ..... 249/89, 95, 117, 118, 121, 143, 154, 155, 162, 166, 173, 174, 119, 156, 157, 158, 160, 161, 163, 165, 170, 105, 107, 108, 109, 110, 50, 126, 168, 171, 17, 21, 86; 164/133, 323, 337, 342, 363, 364, 341, 137, 283; 266/34; 18/30 LM

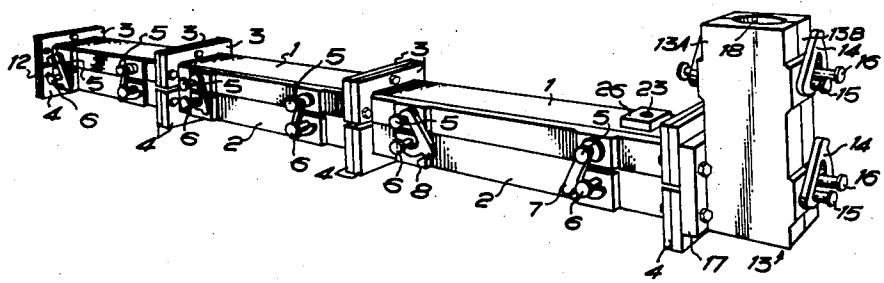
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ABSTRACT: A metal mold for use in the horizontal casting of molten metal comprising at least one upper and at least one lower mold section removably secured together and to a vertical end section containing a pouring hole, the mold cavity forming a horizontal extension to the vertical pouring hole, and closure means for the end of the mold cavity remote from the end section.



Patented Aug. 3, 1971 3,596,870

2 Sheets-Sheet 1

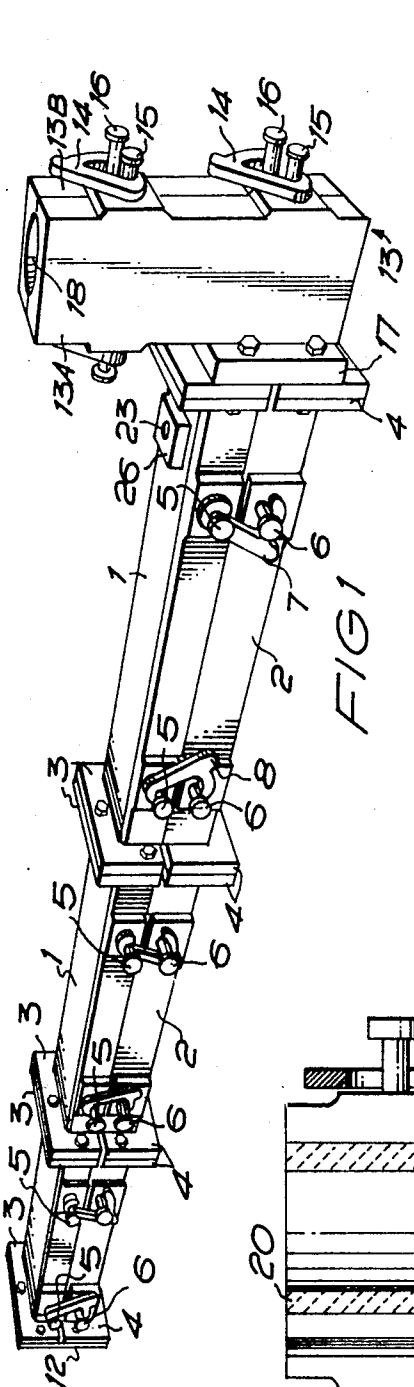


FIG 1

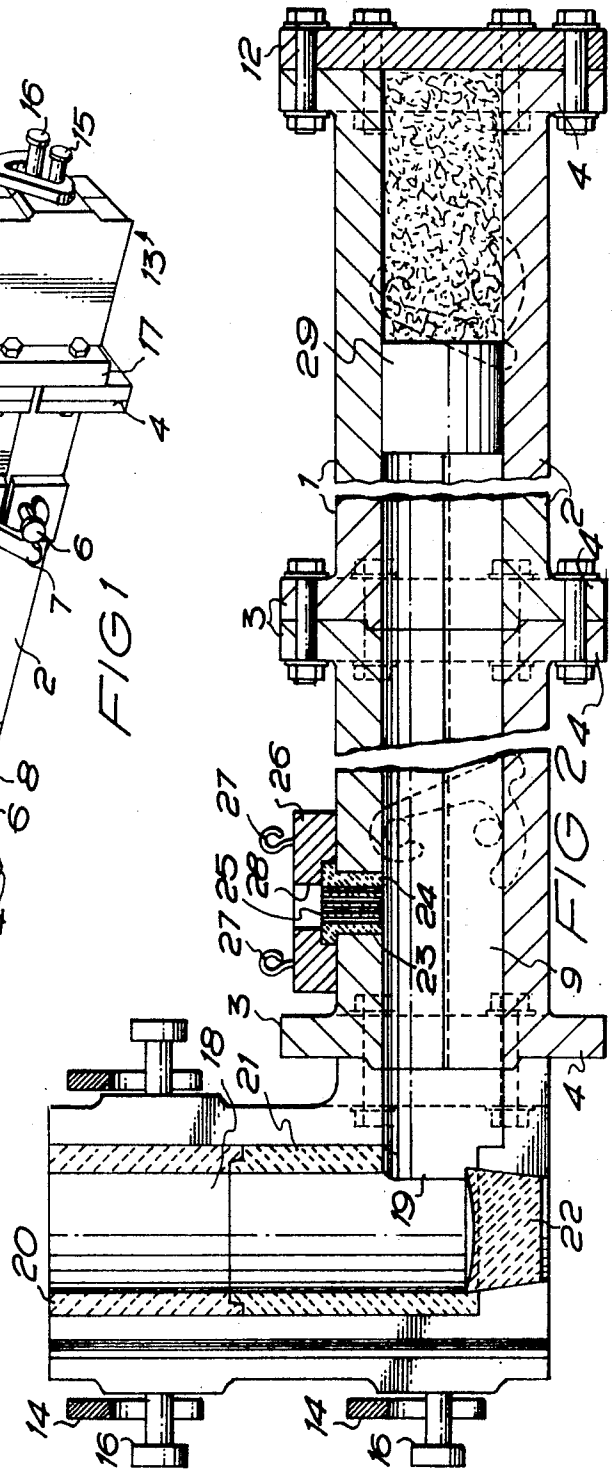


FIG 2

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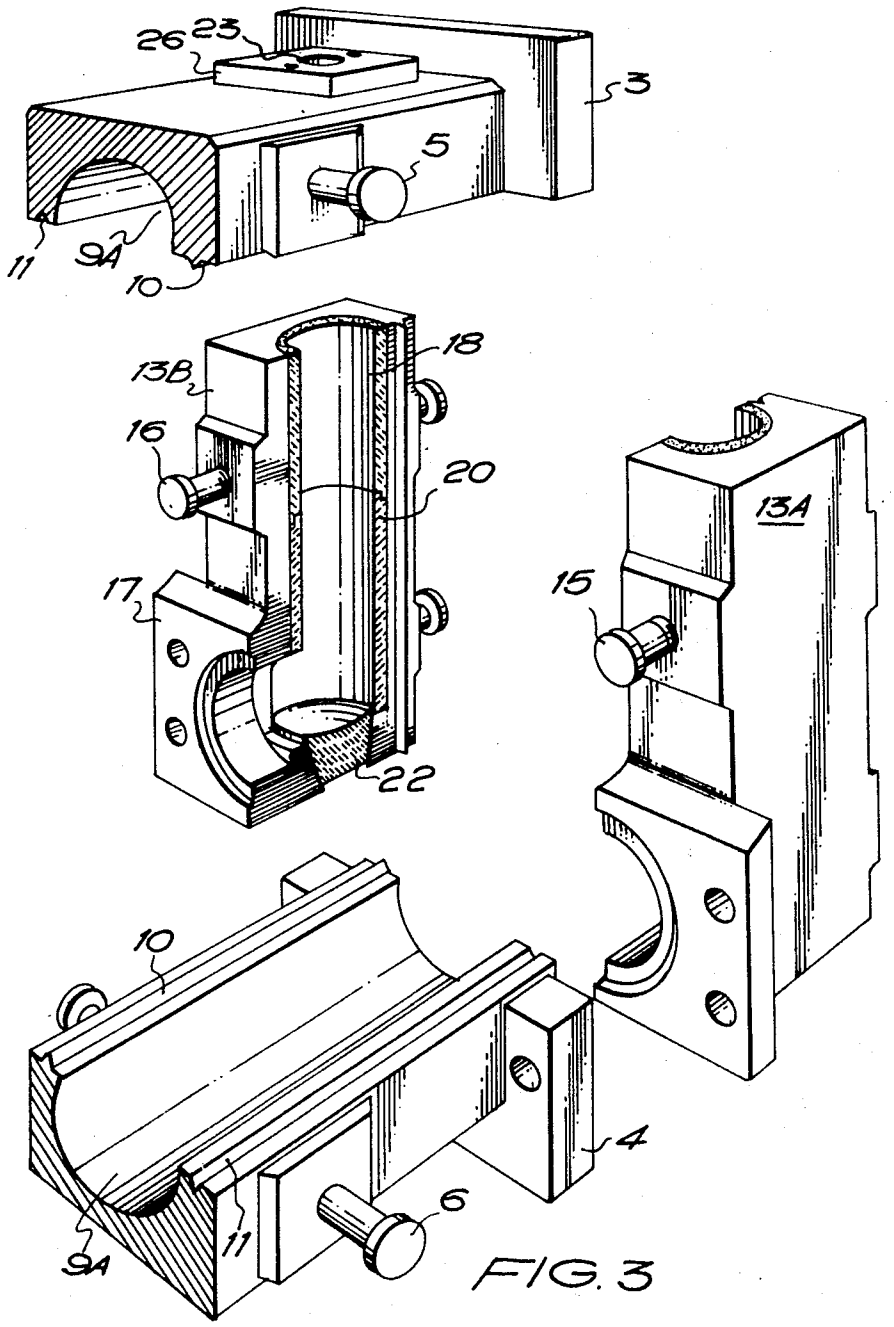


FIG. 3

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CASING OF MOLTEN METAL

This invention relates to the casting of molten metal, and is particularly concerned with a mold for use in horizontal casting.

Normally, a mold for use in casting molten metal is set vertically. However, when using an unlined metal mold, great care must be taken when teeming to ensure that initially, the teemed metal strikes a refractory plug in the bottom of the mold for if the molten metal strikes the mold other than on the plug, the mold will be damaged, and a defective casting produced. A damaged mold cannot be reused, and as metal molds are extremely expensive, this must be avoided. The greater the length of the casting, he more difficult it is to ensure that the teemed metal hits the plug and not the mold wall, until eventually it is impossible to guarantee that the mold will not be damaged by the teemed metal.

Attempts have been made to cast lengthy castings horizontally, but hitherto the molds used have been refractory molds which have several disadvantages. Firstly, such molds are not reusable, it being necessary to break the mold from the solidified casting, a laborious and time consuming operation. Secondly, a large volume of gases are given off during the teeming and consequently a large number of blow holes need to be provided to allow the gases to escape but even so, the surface finish of a casting from a refractory mold is not nearly so good as that provided by a metal mold.

The object of the present invention is to provide a reusable metal mold that can be used to cast long castings and which can easily and quickly be stripped from the casting.

According to the present invention a metal mold for use in the horizontal casting of molten metal comprises at least one upper and at least one lower mold section removably secured together and to a vertical end section containing a pouring hole, the mold cavity forming a horizontal extension to the vertical pouring hole, and closure means for the end of the mold cavity remote from the end section. Preferably, the closure means is an end plate removably secured to the mold sections at the end remote from the end section.

The height of the end section is considerably less than the length of the mold sections and therefore teeming of molten metal into the end section can be effected with the certainty that the metal will hit the conventional refractory plug at the bottom of the pouring hole, and not the wall thereof, thereby eliminating the possibility of damage to the end section. From there the metal flows into the horizontal mold cavity until it has been filled. Gases emitted from the teemed metal and already present in the mold cavity are forced out through the pouring hole, although a single blowhole may be provided in the upper mold section, close to the end section, which hole may be filled with a permeable (e.g., oil/sand) core to prevent ingress of metal into the blowhole. On solidification, the mold sections can simply be stripped of the end plate and the end section, and the mold sections easily and rapidly stripped from the solidified casting, which has the good surface finish expected of a metal mold.

Preferably, the mold sections are clamped together. Thus, the upper and lower mold sections may each be provided with corresponding lugs at each side, and a clamping member to engage corresponding lugs at each side. Thus with the sections clamped together round a casting, they can readily be disconnected simply by knocking of the clamping members from off the lugs, when the top mold section can be lifted clear of the casting and the bottom section. The connection between the mold sections and the end plate and the end section may be by bolts passing through aligned holes in flanges at each end of the mold sections and on the end plate and end section.

Such a mold can readily be adapted to cast any desired length of casting, simply by providing additional upper and lower sections identical to the sections bolted to the end section, the additional upper and lower sections being removably secured, to the existing upper and lower sections respectively, e.g., by bolts, and to each other, the end plate being secured to the free end of the mold sections remote from the end section. Any number of such additional sections may be provided to make up the desired length of mold cavity. Also, there may be provided a plug to fill the mold cavity, to allow the casting of a length which is not a multiple of the length of the mold sections, the mold cavity behind the plug being packed to hold the plug in place. To strip such a composite mold from a casting, the end plate and end section are removed from the ends of the mold sections, and all the clamping members knocked off the lugs. With all the upper sections remaining secured together, they are lifted as one piece from the casting, when the casting can be removed.

To prevent escape of metal at the junction of the upper and lower mold sections, they may be provided with a tongue and groove interconnection.

To facilitate the removal of the mold from the casting, it may, of course, be painted, with any suitable mold paint prior to assembly and casting taking place.

While the specification refers throughout to "horizontal" casting it will be understood that this embraces placing the mold sections at a slight angle to the horizontal, say 4°, to ensure that molten metal flows to the very end of the mold cavity.

The invention will now be described with reference to the accompanying drawings, in which:

FIG. 1 is a perspective view of a horizontal mold formed from three mold sections;

FIG. 2 is a section on the line 2–2 of FIG. 1; and

FIG. 3 is an exploded perspective view of the vertical end section and first mold sections of FIG. 1.

A mold for use in the horizontal casting of molten metal has the mold formed from a number of upper and lower mold sections 1, 2 (three shown in FIG. 1) each provided with flanges 3, 4 perpendicular thereto to enable the upper sections to be bolted together and the lower sections to be bolted together with the flanges in face-to-face contact to rigidify the assembly. The upper sections are provided with lugs 5 to each side, and the lower sections with lugs 6, the upper and lower mold sections being held together by clamps 7 engaging round the lugs 5, 6 and having a projection 8 whereby the clamps can be hammered on to and off the lugs 5, 6.

Internally of the mold sections 1, 2 there a mold 9, half mold section 1 and half in the lower mold section 2, as shown particularly by FIG. 3, and while each mold section is shown formed with a semicircular recess 9A to form the circular mold cavity 9, it will be understood that they could be formed such that a noncircular section results when the mold sections are clamped together. As can also be seen in FIG. 3, there is a tongue 10 and groove 11 connection between the upper and lower mold sections which serve to locate positively the two mold sections (more particularly the mold cavity halves) in relation to each other, and which serve to seal the joint to the upper and lower mold sections.

The mold sections shown in the FIGS. are 4 ft. 6 ins. in length so that by using an appropriate number of upper and lower sections, a casting mold 4 ft. 6 ins., 9 ft., 13 ft. 6 ins., 18 ft. and greater can be formed. When the requisite number of sections have been bolted together, the entire upper half of the mold is placed on the lower half, and the two halves clamped securely together by the clamps 7. An end plate 12 (FIG. 1) is bolted to the end of the last mold sections to close the mold cavity 9 at that end. A pouring head 13 is formed by two halves 13A, 13B held together by clamps 14 engaging round lugs 15, 16 on the halves 13A, 13B, is secured to the end of the mold section by bolts or fasteners passing through holes in the flanges 3 on the mold sections and flanges 17 on the head halves 13A, 13B. A pouring hole 18 is formed centrally of the head 13, the hole 18 leading to the mold cavity 9 by way of a bee-hive opening 19. The pouring hole 18 has a refractory lining made up of refractory sleeves 20 and 21, the sleeve 20 nesting on the sleeve 21 and the latter nesting on the upper periphery of a refractory plug 22 in the bottom of the

pouring head, the joints between the sleeves **20, 21** and the plug **22** being sealed with refractory clay in the usual manner.

Towards the pouring head end of the first upper mold section **1** is provided a blow hole **23** in which is located a refractory plug or core **24** with a plurality of parallel, fine holes **25** to allow for the escape of gases from the mold during casting. Since the core **24** is sufficiently impervious to restrict the flow of molten metal, over the core is placed a weight **26** (shown in FIG. **2** only) to prevent the plug from being forced out of the hole **23** by the molten metal, the weight **26** having suitable eyebolts **27** for lifting purposes and a hole **28** to surround the holes **25** of the plug.

Thus, with the mold sections assembled as shown in FIG. **1**, and with the end plate **12** and pouring head **13** bolted in place, and assisting in clamping the two halves together, as is obvious from the drawings, the mold is ready to receive molten metal from, e.g., a ladle. In certain circumstances, it is desirable to cast the metal in an inert atmosphere, when the mold cavity may be filled with an inert gas such as argon, there then being a temporary seal (not shown) closing the inlet to the pouring hole, this seal being broken either by the molten metal as it is poured, or by means on the bottom of the ladle immediately prior to the metal being poured.

As the molten metal falls through only the short height of the pouring head, there is negligible risk of damage to the pouring head or its lining, and as the molten metal flows into the mold cavity, there is no possibility of damage to the metal mold.

After a reasonable time has elapsed after pouring to allow the molten metal in the mold to solidify, the clamps **7** are knocked off the lugs **15, 16**, and the end plate **12** is removed. The pouring head **13** is unbolted, and the clamps **14** knocked off the lugs **15, 16**. The entire top or upper assembly of the mold is then lifted as a rigid assembly, and the casting or cast body removed from the bottom half or lower assembly when only the metal in the pouring head needs to be cropped off.

In certain circumstances, mold may be necessary to cast a length that is not a multiple of the length of each mold section. Thus, as is shown in FIG. **2**, a plug **29** is provided, to fill the mold cavity at any desired distance from the pouring head, the remainder of the mold cavity behind the plug being packed to prevent the plug from moving.

The surface finish of the mold cavity is such that castings ideally suited for the electrodes of an electroslag refining vessel can be produced which do not require additional machining operations to ensure that they will be received by the vessel, molds as all the impurities are confined to the short length of metal in the pouring head there is a saving in the amount of metal that needs to be scrapped. This saving in material and removal of the necessity to have additional machining operations results in a very large saving in the cost of producing articles such as the above mentioned electrodes, particularly as the risk of damage to the mold even when casting lengths of 20 ft. or more is removed, so that the expensive metal moulds can be repeatedly reused.

It will be understood that while the above description described a "horizontal" mold, the mold, in practice, will be at a slight incline of, say 4° to the horizontal, to ensure the flow of molten metal to the end of the mold.

What I claim is:

1. A metal mold combination for use in the substantially horizontal casting of molten metal into a body comprising a plurality of corresponding upper and lower mold sections, first means for securing said upper sections together to form an upper mold assembly, second means for securing said lower sections together to form a lower mold assembly, said upper and lower assemblies together forming a mold having a cavity corresponding to the length of said body being cast, means for clamping said mold together, a substantially vertical pouring head, a pouring hole formed in the top of said head, means for attaching said pouring head to one end of said mold, closure plate means and means for attaching said plate means to the other end of said mold, whereby said mold may be provided in any selected length that is a function of the length of the individual mold sections.

2. The mold as claimed in claim **1** wherein said attaching means for said plate means includes fasteners connected to both said upper and lower assemblies of said mold, whereby said plate means assists in clamping said upper and lower assemblies together.

3. The mold as claimed in claim **1** wherein said attaching means for said pouring head includes fasteners connected to both said upper and lower assemblies of said mold, whereby said pouring head assists in clamping said upper and lower assemblies together.

4. The mold as claimed in claim **1** wherein is provided a plug positioned in said cavity in blocking relationship thereto at an intermediate point along one of said sections, whereby said body may be cast in lengths not a function of the length of the individual mold sections.

5. The mold as claimed in claim **1** wherein is provided a blowhole in the upper mold section adjacent said pouring head and a core in said blowhole permeable to gas, but sufficiently impervious to resist the flow of molten metal therethrough whereby gas may escape from said cavity but not metal.

6. The mold as claimed in claim **1** wherein said first and second securing means are operative to maintain said assemblies rigid to facilitate handling.

7. The mold as claimed in claim **6** wherein said sections are provided with flanges extending in a plane perpendicular to the horizontal axis thereof, said first and second securing means including fasteners engaging said flanges and maintaining the same in face-to-face contact to maintain said assemblies rigid.