

Oct. 24, 1939.

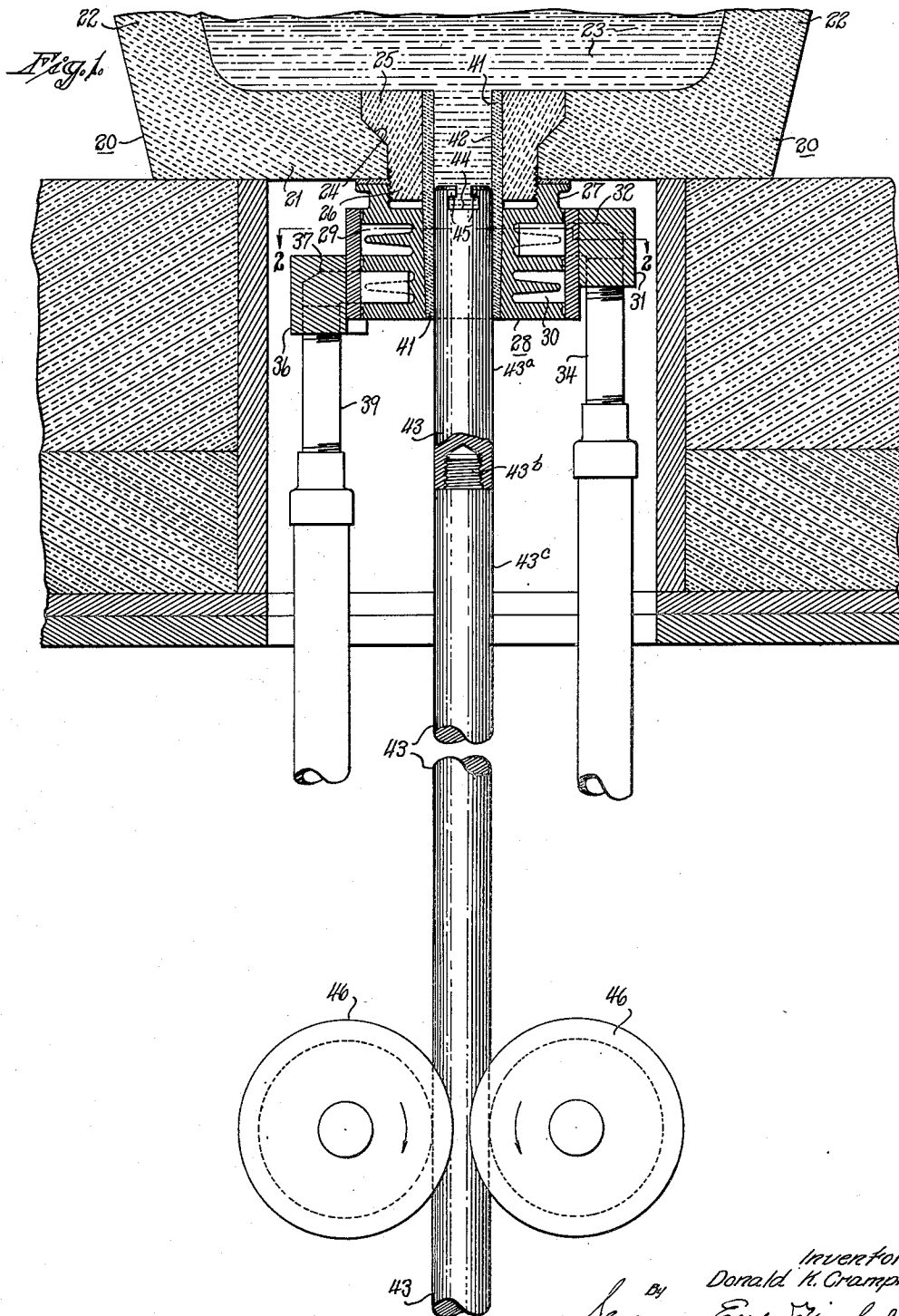
D. K. CRAMPTON

2,176,990

APPARATUS FOR CONTINUOUSLY CASTING METALS

Filed Aug. 18, 1937

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

Fig. 2.

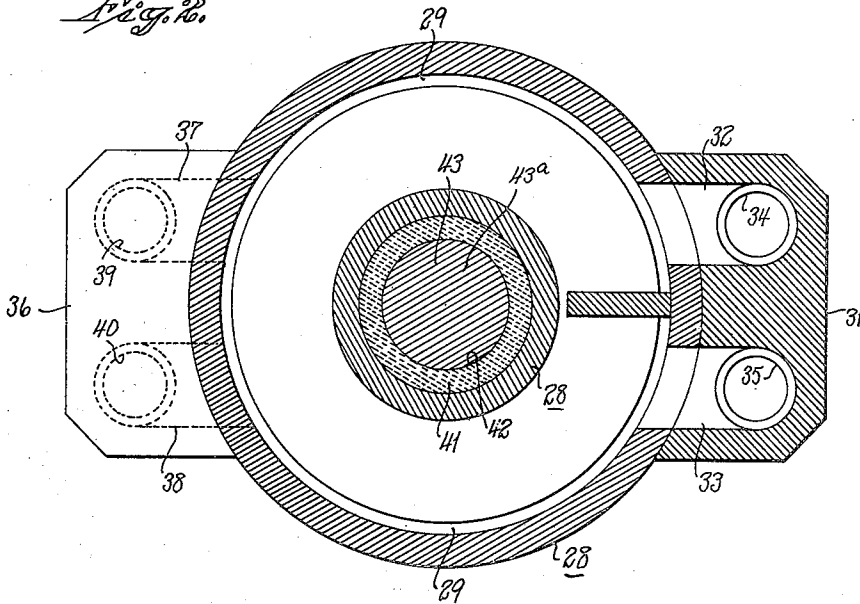


Fig. 3.

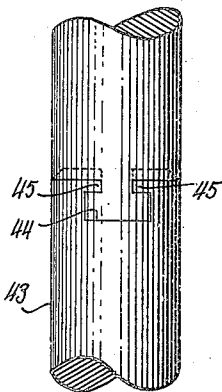


Fig. 5.

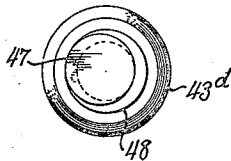


Fig. 7.

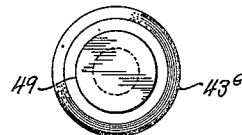


Fig. 6.

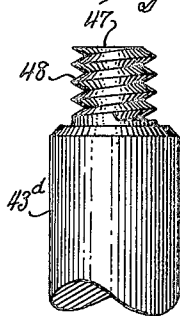


Fig. 8.

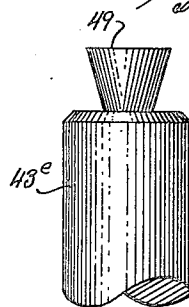
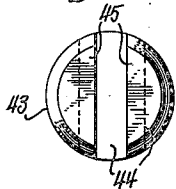


Fig. 4.



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UNITED STATES PATENT OFFICE

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APPARATUS FOR CONTINUOUSLY CASTING METALS

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Application August 18, 1937, Serial No. 159,672

2 Claims. (Cl. 22—57.2)

This invention relates to apparatus for casting metals, and more particularly to apparatus for continuously casting rods, tubes, bars, or the like.

One of the objects of the present invention is to provide a superior apparatus for continuously casting rods, tubes, bars, or the like, by means of which the starting of a casting operation or cycle is facilitated.

A further object is to provide superior apparatus which will minimize the tendency of molten metal to freeze or solidify above the die or casting-passage of the container from which metal is continuously withdrawn.

Another object of the present invention is to provide a superior apparatus for continuously casting metal objects of the general type referred to, by means of which the likelihood of molten metal emerging from the outlet of the die or casting-passage of the container is eliminated or substantially eliminated.

With the above and other objects in view, as will appear to those skilled in the art from the present disclosure, this invention includes all features in the said disclosure which are novel over the prior art and which are not claimed in a separate application.

In the accompanying drawings:

Fig. 1 is a broken view in vertical central section of an apparatus for continuously casting metals and in which the present invention is embodied, and by which the said invention may be carried out;

Fig. 2 is a transverse sectional view taken on the line 2—2 of Fig. 1;

Fig. 3 is a view in side elevation of the upper portion of the starting-rod shown in Fig. 1 and the immediately-adjacent portion of a cast rod which has been solidified in and withdrawn from the forming-passage of the container by the said starting-rod;

Fig. 4 is a top or plan view of the starting-rod shown in Figs. 1, 2 and 3;

Fig. 5 is a top or plan view of another form of starting-rod contemplated by the present invention;

Fig. 6 is a broken view thereof in side elevation;

Fig. 7 is a top or plan view of still another form of starting-rod contemplated within the scope of the present invention; and

Fig. 8 is a broken view thereof in side elevation.

The particular continuous casting apparatus herein chosen for illustration of the present invention includes a cup-shaped container or crucible, generally designated by the reference character 20, and which may be formed of a wide variety of suitable materials, such, for instance, as a clay-graphite material commonly used in the manufacture of crucibles and the like. The said container or crucible 20 includes a bottom-wall 21 and an upstanding annular side-wall 22, and may be enclosed in a housing, if desired, so as to conserve the heat of the molten metal 23 contained within the crucible or container 20, before referred to.

The bottom-wall 21 of the container 20 is provided with a shouldered aperture 24 in which is fitted a shouldered retaining-member 25 having an externally-threaded tubular shank 26, which latter projects below the under-surface of the bottom-wall 21 of the container 20, as is shown particularly well in Fig. 1. The said retaining-member 25 is preferably formed of a suitable refractory material.

Threaded onto the downwardly-projecting portion of the externally-threaded shank 26 of the retaining-member 25 is the internally-threaded coupling-sleeve 27 of a cooling-chamber, generally designated by the reference character 28, which, in the instance shown, is provided with an upper cooling-compartment 29 and a lower cooling-compartment 30, through which water or other suitable coolant may be passed, in a manner as will hereinafter appear. The said cooling-chamber 28 is preferably formed of copper or other high heat-conducting material.

Secured to one side of the cooling-chamber 28 is a water-head 31 having two L-shaped water-passages 32 and 33 which communicate with the upper water-compartment 29 and respectively act as water-inlet and water-outlet passages for the coolant flowing therethrough. The passage 32 above referred to has connected to it a coolant-supply tube 34 and, similarly, the passage 33 has connected to it a coolant-outlet tube 35.

At a point diametrically opposite the water-head 31 the cooling-chamber 28 has secured to it a second water-head 36 which corresponds substantially to the water-head 31, before described, and like the same has an L-shaped coolant-inlet passage 37 and a similarly-shaped coolant-outlet passage 38, to which are respectively connected a coolant-inlet tube 39 and a coolant-outlet tube 40. The upper end of each of the coolant-passages 37 and 38 communicates with the lower cooling-compartment 30.

Extending centrally through both the retaining-member 25 and the cooling-chamber 28, in intimate thermal engagement therewith, is a tubular member 41, which may be formed of a wide variety of suitable materials, such, for instance, as a clay-graphite material commonly used in the manufacture of crucibles and the like. The said tubular member 41 includes a bottom-wall 42 and an upstanding annular side-wall 43, and may be enclosed in a housing, if desired, so as to conserve the heat of the molten metal 23 contained within the crucible or container 20, before referred to.

The bottom-wall 42 of the tubular member 41 is provided with a shouldered aperture 44 in which is fitted a shouldered retaining-member 45 having an externally-threaded tubular shank 46, which latter projects below the under-surface of the bottom-wall 42 of the tubular member 41, as is shown particularly well in Fig. 1. The said retaining-member 45 is preferably formed of a suitable refractory material.

bular forming-die 41 having an axial forming-passage 42 and formed of any suitable material which will withstand the heat of molten copper, brass, or other metal, though it has been found that for this purpose a very fine grain graphite is suitable.

If desired, or if conditions require, additional cooling-means other than the cooling-chamber 28, above described, may be employed for extracting heat from the molten metal to insure the proper solidification of the same.

Prior to loading or charging the crucible or container 20 with molten metal, the upper portion of a starting-rod such as 43 (Figs. 1, 2, 3 and 4) will be inserted upwardly into the forming-passage 42 of the forming-die 41, as illustrated in Fig. 1. The said starting-rod 43 has a terminal-portion 43a securely coupled, as by a threaded joint 43b, with a body-portion 43c, though, if desired the said terminal-portion may be integral with the said body-portion.

The terminal-portion 43a of the starting-rod 43 may be formed of various materials but it, and the body-portion 43c also if desired, is preferably formed of a material combining all the following characteristics:

(a) A thermal conductivity markedly lower than the metal to be cast (preferably less than one-half);

(b) Sufficient hardness and strength to withstand the mechanical stresses involved in the handling and use of a starting-rod;

(c) A melting point at least as high or preferably higher than the metal which is to be cast.

Among the materials suitable for use as starting-rod terminals, the following may be mentioned: various types of refractory or carbonaceous materials, such for instance as graphite; metals or alloys having a very low thermal conductivity, such for instance as stainless steel, cupro-nickel (70% Cu, 30% Ni). A starting-rod of the latter composition will be wetted by most copper alloys and possesses a higher melting point (about 2230° F.) than copper and many of its alloys and has a thermal conductivity less than one-tenth that of copper.

If the metal to be cast is not of such character as will readily wet or alloy with the material of the terminal-portion of the starting-rod, then the upper terminal of the starting-rod should be provided with coupling-means of the general nature hereinafter described.

In Figs. 1, 3 and 4 of the accompanying drawings, the starting-rod 43 is shown as formed in its upper end with an inverted T-shaped groove 44 extending diametrically thereacross and resulting in the formation upon the said coupling-rod of two coupling-ledges or shoulders 45-45 beneath which the metal being cast will solidify and thus provide a coupling between the said starting-rod and the newly-solidified metal 23 from the container or crucible 20.

At a point sufficiently below the cooling-chamber 28, the starting-rod is passed between suitable withdrawing-rolls 46 which may be driven in any suitable manner at a rate which will allow sufficient time for the molten metal to solidify in the forming-passage 42 of the forming-die 41 before such molten metal can emerge from the lower end of the said passage 42.

After the starting-rod 43 has been installed in the forming-passage 42, as above described, the container or crucible 20 will be charged with the desired quantity of molten metal 23. Owing now to the low thermal conductivity of the starting-

rod 43, heat will pass but very slowly through the said starting-rod and from the same through the forming-die 41 and the inner-wall of the cooling-chamber 28 to the water or other coolant in the compartments 29 and 30 of the said chamber. Until such time as the casting operation is about to start by starting the downward movement of the starting-rod 43, the flow of coolant through the cooling-chamber 28 may be restricted or may be entirely shut off from either or both of the cooling-compartments 29 and 30 thereof.

As the rod 43 is drawn downwardly by the withdrawing-rolls 46 or other suitable mechanism, the molten metal within the forming-passage 42 will solidify or freeze as soon as sufficient heat has been extracted therefrom by the now active coolant flowing through the cooling-chamber 28, before such molten metal can reach the lower end of the said passage 42. In a relatively-short time after the starting of the casting operation, the upper end of the starting-rod 43 will be drawn downwardly completely out of the forming-passage 42 to be followed by a freshly-cast and ever-lengthening rod or the like formed of the molten material initially placed in the crucible or container 20. Ultimately, the newly-cast rod referred to will itself come within the grip of the withdrawing-rolls 46 and at any time thereafter the starting-rod 43 may be detached and after removing the stub of cast metal therefrom it may be re-employed for another starting operation in the same or another continuous casting apparatus of the general character described.

From the foregoing, it will be seen that instead of employing a starting-rod of substantially the same material as the material being cast, a starting-rod is employed which has a markedly lower thermal conductivity than the said material being cast. By this means, during the necessary delays in starting the casting operation, the too rapid withdrawal of heat from the molten metal is avoided, so that the freezing or solidification of the metal 23 at a point above the forming-passage 42 is avoided. It may be explained in this connection that one of the greatest difficulties in the operation of a continuous casting apparatus is the solidification of the metal at a point above the forming-passage, so that the withdrawal of the solidified metal is not only rendered difficult, but in many instances rendered impossible, and requires the complete emptying of the contents of the crucible or container in order to remove such solidified metal and enable a fresh start to be made.

In Figs. 5 and 6 is shown another form of starting-rod which is generally designated by the reference character 43d and which is provided with an upstanding stem 47 having threads 48 extending around its periphery and in effect forming coupling-ledges or shoulders functioning in substantially the same way as the coupling-ledges 45 of the starting-rod 43, before described.

In Figs. 7 and 8 is illustrated still another form of starting-rod, which form is generally designated by the reference character 43e, and which, as shown, is provided with an upwardly-projecting inverted-cone-shaped stem 49 which functions in substantially the same way as the coupling-ledges 45 and 48 of the previously-described starting-rods.

The invention may be carried out in other specific ways than those herein set forth without

departing from the spirit and essential characteristics of the invention, and the present embodiments are, therefore, to be considered in all respects as illustrative and not restrictive, and all changes coming within the meaning and equivalency range of the appended claims are intended to be embraced therein.

I claim:

1. In an apparatus for continuously casting metal, the combination with a molten-metal container provided with a forming-die comprising successive portions having relatively-lower and -higher heat-conductive capacities respectively, of a starting-rod having a sealing portion movably closing increasing lengths of said forming-die, the said sealing-portion of the starting-rod being capable of being wetted by and alloyed with the metal to be cast in said metal-casting apparatus and having a markedly-lower heat-conductive capacity and a higher melting-point than said metal.

2. In an apparatus for continuously casting copper, the combination with a molten-metal container; of a forming-die of uniform cross-

section opening at its upper end into said container, a retaining-member surrounding the upper end of said forming-die for mounting the latter in the bottom wall of said container with the lower end of the former depending from the latter, said forming-die and retaining-member being formed of material having a lower heat-conductive capacity than copper; means for cooling the lower end of said forming-die; and a starting-rod having a terminal portion composed of carbonaceous material to fit within and movably seal the forming-die during a constrained continuous downward movement of said starting-rod terminal portion from a position adjacent the upper end of said forming-die through and past the lower end of said die whereby the molten copper entering said forming-die during an initial stage of relatively-slow cooling, is subjected to a reducing action by the carbonaceous material in said terminal portion of the starting-rod and solidified during a subsequent stage of relatively-rapid cooling prior to its exit from the forming-die.

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