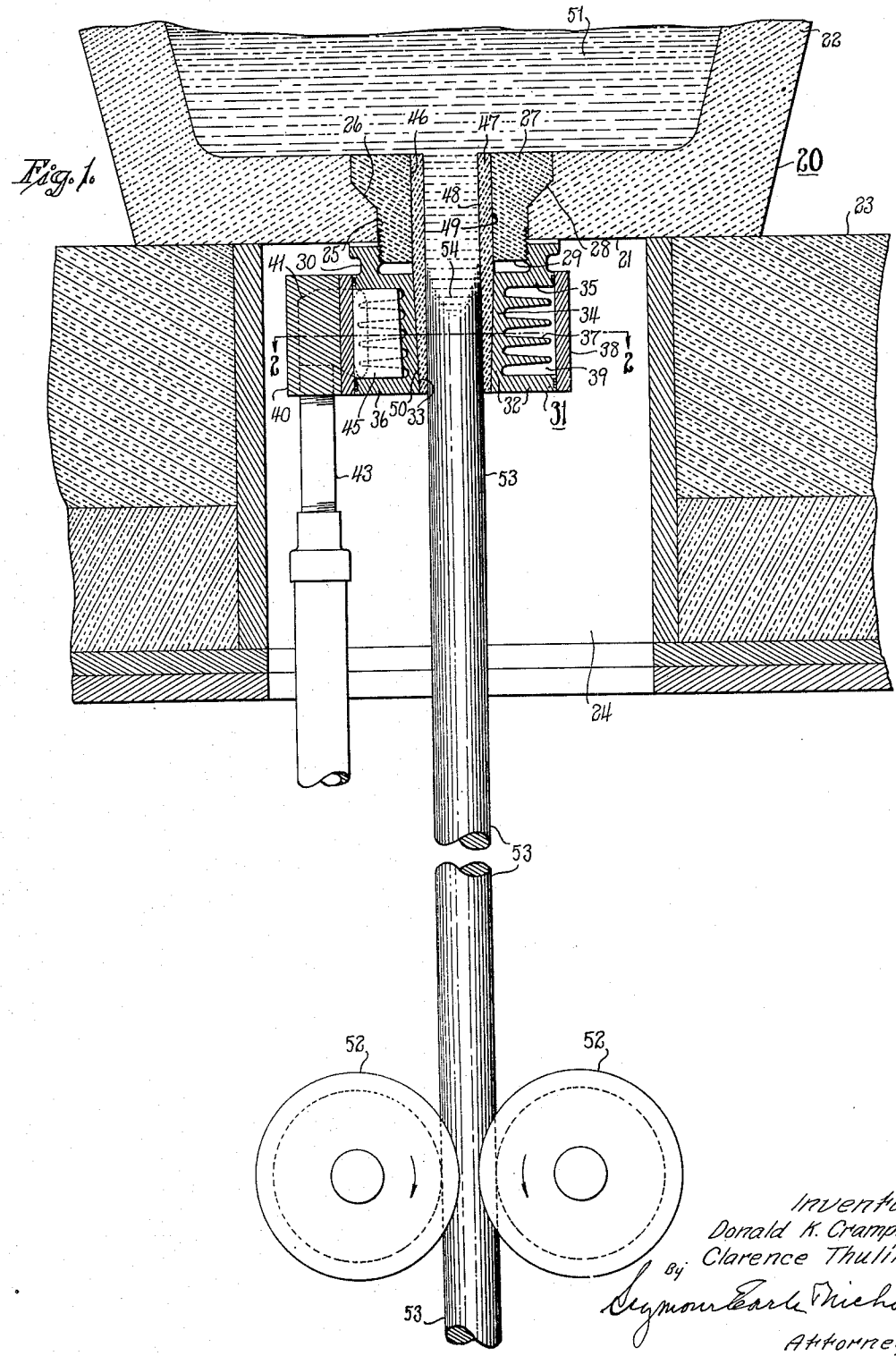
Oct. 24, 1939. D. K. CRAMPTON ET AL 2,176,991

FORMING-DIE ASSEMBLY FOR CONTINUOUS-CASTING APPARATUS

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Fig. 1.



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Fig. 2.

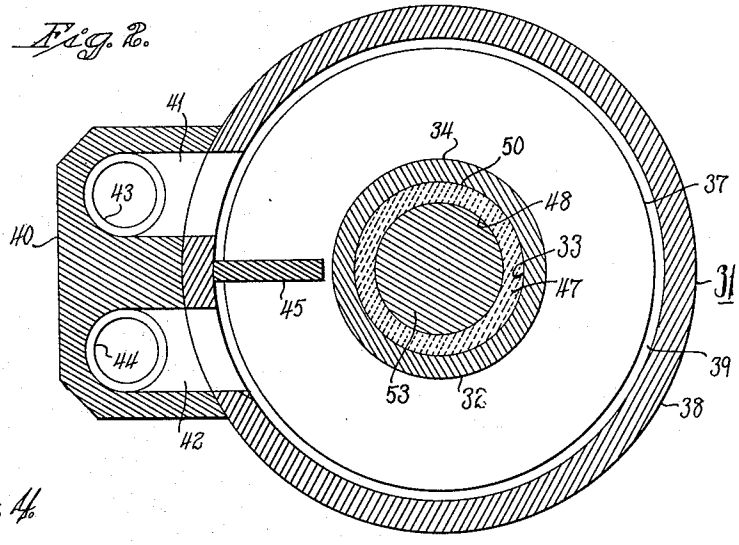


Fig. 4.

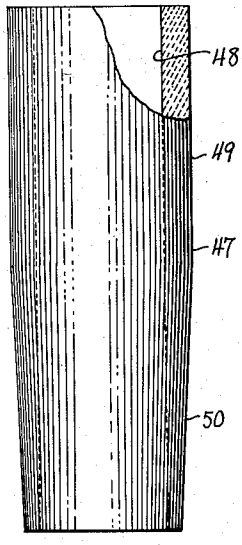


Fig. 3.

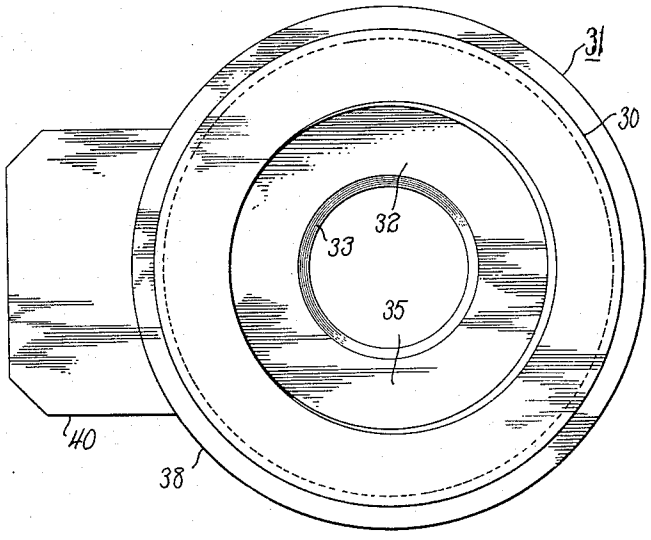
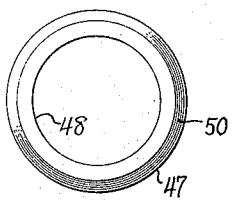


Fig. 5.



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FORMING-DIE ASSEMBLY FOR CONTINUOUS-CASTING APPARATUS

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Application October 27, 1937, Serial No. 171,188

4 Claims. (Cl. 22—57.2)

This invention relates to apparatus for continuously casting metal such as copper, brass, etc., in the form of rods, bars, tubes or the like, and relates more particularly to the forming-die assembly for such apparatus.

One of the objects of the present invention is to provide superior continuous-casting apparatus wherein the effective cooling of the forming-die is assured to thus minimize damage to the said die and increase the speed of casting.

Another object of the present invention is to provide a superior forming-die and cooling-chamber assembly for continuous-casting apparatus, wherein intimate heat-conducting engagement between the two said features of the assembly is assured.

A further object of the present invention is to provide a superior forming-die and cooling-chamber assembly for continuous-casting apparatus, wherein the draft imposed upon the forming-die by the withdrawal of the rod-like cast metal will automatically insure the intimate thermal engagement of the said forming-die with its complemental cooling-chamber.

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, in which certain modes of carrying out the present invention are shown for illustrative purposes:

Fig. 1 is a broken view mainly in vertical central section of an apparatus for continuously casting metal and embodying the forming-die assembly of the present invention;

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

Fig. 3 is a top plan view of the cooling-chamber unit;

Fig. 4 is a view in side elevation of the forming-die; and

Fig. 5 is a view looking toward the lower end of the said forming-die.

The particular continuous-casting apparatus herein chosen for the purpose of illustrating 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 clay-graphite materials 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. The said container 20 may, as shown, rest upon a platform 23 having a vertical clearance-passage 24 extending vertically therethrough in line with the vertical longitudinal axis of the said container. Preferably, the platform 23, just referred to, is formed of a heat-insulating material reinforced and supported.

The bottom-wall 21 of the container or crucible 20 is provided with an axial passage or aperture 25 having a stop-shoulder 26 therein. Fitted into the aperture 25, just referred to, is a retaining-member 27 formed of refractory material and having a stop-shoulder 28 thereon engaging with the stop-shoulder 26 in the said aperture 25, as is clearly shown in Fig. 1. The said retaining-member 27 is also formed with an externally-threaded tubular shank 29 which projects below the under-surface of the bottom-wall 21 of the container 20, and slightly into the clearance-passage 24 in the platform 23.

Threaded onto the lower portion of the downwardly-projecting externally-threaded shank 29 of the retaining-member 27 is the internally-threaded coupling-sleeve 30 of a cooling-chamber unit, generally designated by the reference character 31, and which is preferably formed of copper or other high-heat-conducting material. The said cooling-chamber unit includes an inner member 32 provided with an axial downwardly-and-inwardly-tapering seat 33 formed in its inner wall 34, and with an upper end-wall 35 and a lower end-wall 36 extending outwardly from the respective opposite ends of the said inner wall 34 in vertically-spaced relationship. The said inner member 32 of the cooling-chamber unit is also provided with a series of horizontally-extending cooling-fins 37 which are preferably formed integral with the inner wall 34 and which extend outwardly into close proximity to an outer ring 38 which extends vertically between the upper end-wall 35 and the lower end-wall 36 of the inner member 32, before referred to. The parts 35 and 36 are preferably secured at their outer edges to the adjacent inner-face portions of the outer ring 38 by means of solder, brazing, or the like, so as to produce a water-compartment 39 for the reception of a cooling fluid, as will hereinafter appear.

Secured to one side of the outer ring 38 of the cooling-chamber 31, by means of brazing, silver soldering, or the like, is a water-head 40 having an inlet passage 41 and an outlet passage 42 respectively communicating with an inlet-pipe or tube 43 and an outlet-pipe or tube 44. The cooling-chamber 31 may assume a wide variety

of forms, and as herein shown, it is provided with a vertically-extending partition 45 which serves to divide the interior of the compartment 39 in such manner as to compel most of the water or other coolant circulating therethrough to flow entirely around the ring-like compartment before discharging to the outlet-passage 42 and the tube 44.

By reference to the drawings, it will be seen that the retaining-member 27 is formed with a vertical central passage 46 which is preferably of cylindrical form and which is coaxial with the tapered socket 33 in the cooling-chamber 31 before referred to.

Extending axially through both the passage 46 in the retaining-member 27 and the socket or seat 33 in the cooling-chamber 31 is a tubular forming-die 47 having a central longitudinal forming- or casting-passage 48 and formed of any suitable material which will withstand the heat of the molten copper, brass or other metal, though it has been found that for this purpose a very fine grain graphite is preferable. Substantially the entire upper half 49 of the exterior surface of the forming-die 47 is of cylindrical form and snugly fits the similarly-shaped vertical central passage 46 in the retaining-member 27. Substantially the entire lower half 50 of the exterior surface of the forming-die 47 is conically contoured or otherwise downwardly and inwardly tapered so as to conform to the surface of the socket or seat 33 in the cooling-chamber 31.

Owing to the action of the coolant flowing through the interior of the cooling-chamber unit 31 in combination with such auxiliary cooling means as it may be desired to employ, the molten metal 51 from the crucible or container 20 will solidify or freeze as soon as sufficient heat has been extracted therefrom and before such molten metal can reach the lower end of the casting-passage 48 and emerge therefrom. For the purpose of illustration, let it be presumed that power-driven withdrawing-rolls 52—52 are withdrawing the solidified metal in the form of a rod 53 at a speed which will cause the cooling means to effect the freezing or solidification of the molten metal 51 to take place at about the point 54 in the forming or casting-passage 48.

As the cast rod 53 is drawn downwardly by the withdrawing-rolls 52—52, the said rod will, owing to its frictional engagement with the inner surfaces of the forming or casting-passage 48 in the forming-die 47, tend to draw the said forming-die downwardly. The downward draft upon the forming-die 47 as just referred to will in turn tend to more firmly or intimately engage the tapered portion 50 of the said forming-die with the correspondingly-shaped surface of the socket or seat 33 in the cooling-chamber unit 31.

As will be seen from the foregoing, the downward movement or outward movement of the rod 53 automatically serves to seat the forming-die 47 into intimate thermal engagement with the adjacent surfaces of the cooling-chamber unit 31 so that the utmost efficiency of heat-exchange between the said forming-die and the said cooling-chamber unit is assured under all operating conditions. In this connection it may be explained that even a thousandth of an inch clearance between the outer surface of the forming-die 47 and the inner surfaces of the cooling-chamber unit 31 will serve to cut down the removal of heat from the said forming-die and hence from the metal being solidified, and so retard the solidification of the metal as to prevent the apparatus from being operated at economical speeds, in order to prevent the catastrophic emergence of molten metal through the lower end of the said forming-die. Any such clearance between the cooling-chamber unit 31 and the forming-die 47 is effectively prevented as before described, by the automatic seating action occasioned by the withdrawal of the cast rod 53 itself.

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.

We claim:

1. A forming-die assembly for continuous casting apparatus having a molten-metal container from which molten metal is withdrawn in rod-like form, comprising: a retaining-member immovably connected to the said molten-metal container and having a substantially-untapered axial passage therethrough for the reception of a portion of a forming-die; a cooling-chamber unit having a compartment therein for the flowage of a coolant therethrough, and also having a tapered seat for the reception of a portion of a forming-die; means for connecting the said cooling-chamber unit to the said retaining-member whereby the former is retained in axial alignment with the passage in the said retaining-member; and a tubular forming-die of continuous form in cross-section and having an axial casting-passage extending therethrough, the said forming-die also having a substantially-untapered portion for extension into the passage in the said retaining-member and a tapered portion engaged with the tapered seat in the said cooling-chamber unit and shaped to intimately fit the said tapered seat.

2. A forming-die assembly for continuous casting apparatus having a molten-metal container from which molten metal is withdrawn in rod-like form, comprising: a retaining-member mounted in a wall of the molten-metal container and having a cylindrically-contoured axial passage therethrough for the reception of a portion of a forming-die; a cooling-chamber unit having complemental inner and outer walls and complemental upper and lower walls providing a compartment for the flowage of a coolant therethrough, the said inner wall being formed with an interior tapered seat for the reception of a portion of a forming-die; means for connecting the said cooling-chamber unit to the said retaining-member whereby the said interior tapered seat in the inner wall of the said compartment is retained in coaxial alignment with the said cylindrically-contoured axial passage in the said retaining-member; and a tubular forming-die of continuous form in cross-section and having an axial passage extending through the said wall of the molten-metal container, the said forming-die also having an exterior cylindrically-contoured portion for extension within the similarly-contoured passage in the said retaining-member, and a tapered exterior portion engaged with the tapered seat in the inner wall of the said cooling-chamber unit and shaped to intimately fit the said tapered seat.

3. A forming-die assembly for continuous casting apparatus having a molten-metal container

from which molten metal is withdrawn in rod-like form, comprising: a retaining-member having a substantially-untapered axial passage therethrough for the reception of a portion of a forming-die; a cooling-chamber unit having complemental inner and outer walls and complemental upper and lower walls providing a compartment for the flowage of a coolant therethrough, the said inner wall being formed with an interior tapered seat for the reception of a portion of a forming-die, and with vertically-spaced horizontal heat-radiating fins projecting therefrom into the said compartment; a radial partition extending into the said compartment from the outer wall thereof into close proximity to the inner wall of the said compartment and intersecting the said vertically-spaced cooling-fins, the said compartment being provided with inlet and outlet openings for a coolant in the outer wall thereof and on opposite sides of the said partition to provide vertically-spaced peripheral channels for the coolant through the said cooling-chamber unit; means for connecting the said cooling-chamber unit in fixed relation to the said retaining-member whereby the said inner wall of the cooling-chamber and the interior tapered seat formed therein are retained in coaxial relation to the said axial passage through the retaining-member; and a tubular forming-die of continuous form in cross-section and having an axial passage extending therethrough, the said forming-die also having an exterior substantially-untapered portion for extension within the passage in the said retaining-member, and a tapered exterior portion engaged with the tapered seat in the inner wall of the said cooling-chamber unit and shaped to intimately fit the said tapered seat.

4. A forming-die assembly for continuous casting apparatus having a molten-metal container from which molten metal is withdrawn in rod-like form, comprising: a retaining-member having a substantially-cylindrical axial passage therethrough for the reception of a portion of a forming-die; a cooling-chamber unit having complemental inner and outer walls and complemental upper and lower walls providing a compartment for the flowage of a coolant therethrough, the said inner wall being formed with an interior conically-contoured seat for the reception of a portion of a forming-die; means for connecting the said cooling-chamber unit to the said retaining-member with the said compartment of the former in coaxial arrangement with the said axial passage through the latter; a radial partition extending into the said compartment from the outer wall thereof and between the upper and lower walls of the said compartment into close proximity to the said inner wall of the compartment, the said outer wall of the compartment being provided with inlet and outlet openings for coolant arranged on opposite sides of the said radial partition; and a tubular forming die of continuous form in cross-section and having an axial passage extending therethrough, the said forming-die also having an exterior cylindrically-contoured portion for extension within the substantially-cylindrical passage in the said retaining-member, and a conically-contoured exterior portion engaged with the conically-contoured seat in the inner wall of the said cooling-chamber unit and shaped to intimately fit the said conically-contoured seat.

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