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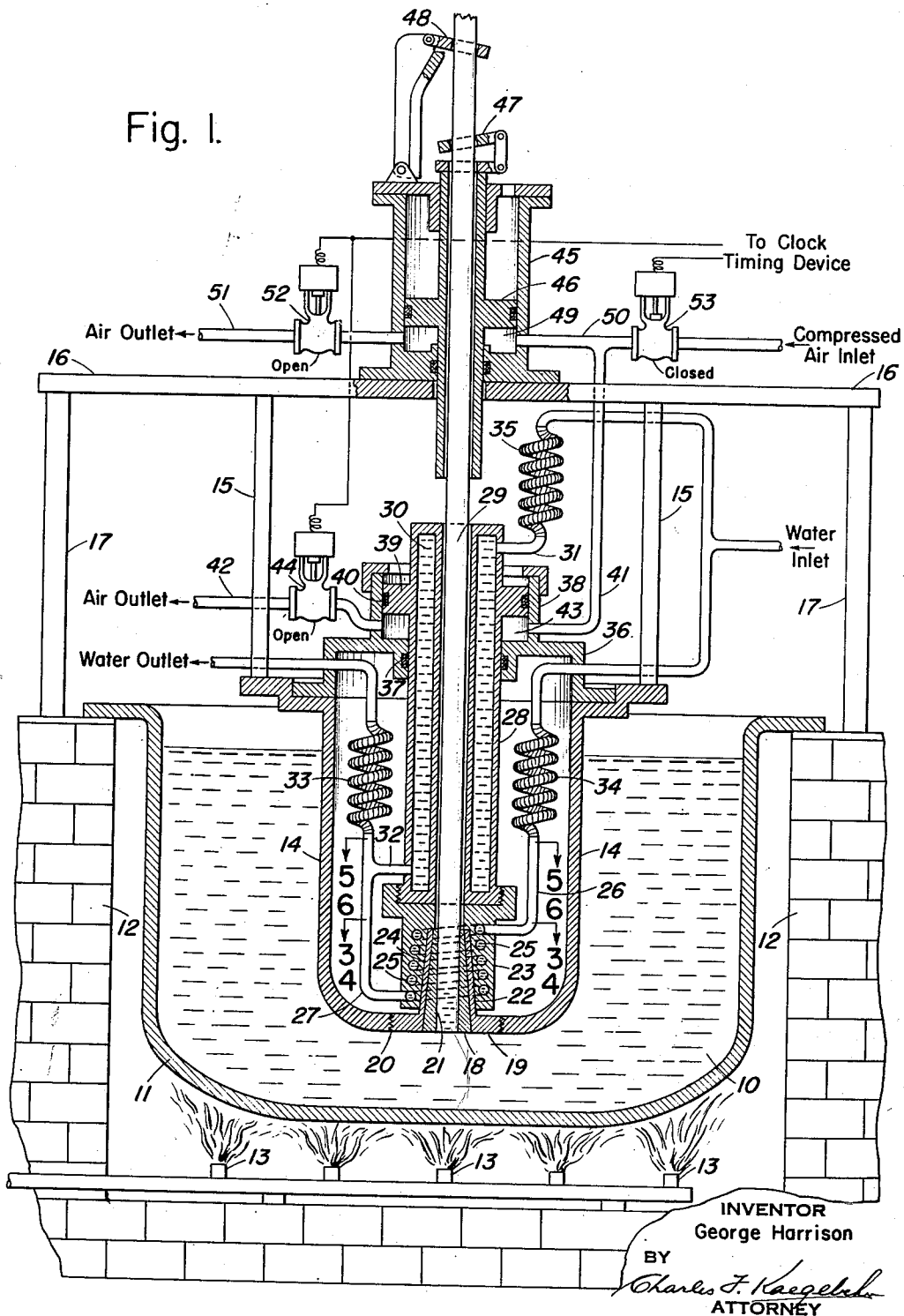
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APPARATUS FOR CASTING METALLIC ROD

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Fig. 1.



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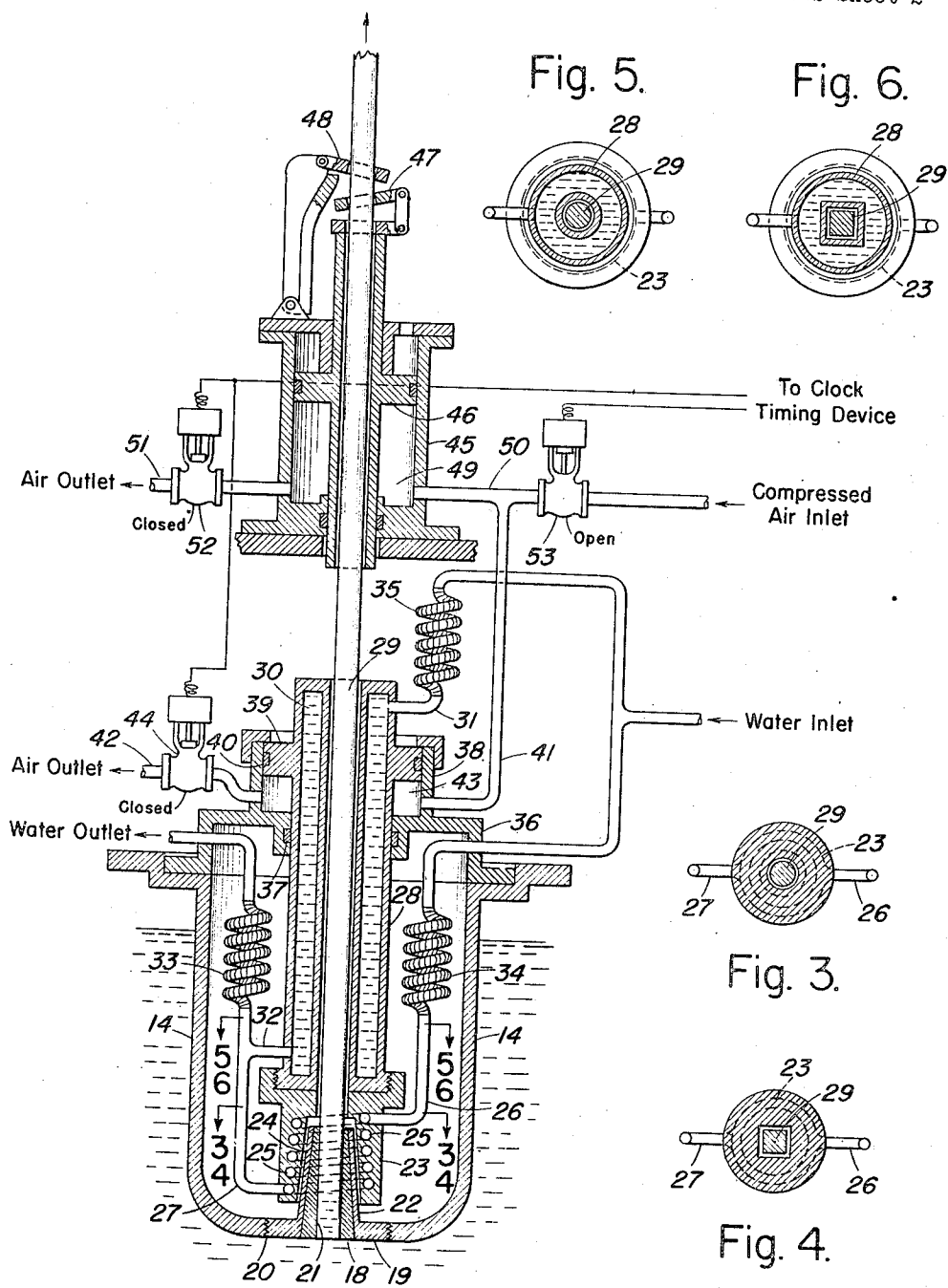


Fig. 2.

Fig. 3.

Fig. 4.

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APPARATUS FOR CASTING METALLIC ROD

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4 Claims. (Cl. 22—57.2)

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This invention relates to apparatus for casting continuous metal rod, and more particularly to apparatus which casts such rod in a continuous length by a series of intermittent casting operations. Such apparatus generally involves a die tube with a cooling jacket which is submerged in a bath of molten metal. The cast rod is withdrawn from the top of the die tube by means of suitable apparatus in a series of intermittent lifting motions. The cycle consists generally of a lifting of the cast rod upward from the die tube followed by replacement of the end of rod in the die by molten metal. This molten metal is solidified by action of the cooling jacket and is attached, of course, to the bottom of the cast rod. Solidification of the metal in the die tube is followed by another withdrawal of the now extended rod and the cycle is repeated. The die tube, in which the solidification of the molten metal takes place, is subject, however, to the severe thermal effects caused by the intermittent introduction on its inside of hot molten metal and the cooling effected on its exterior surface. The metal as it freezes contracts as it cools as also does the die tube. It has been a serious problem, therefore, in such apparatus to provide an efficient cooling jacket which can maintain adequate contact with the exterior of the die tube which is alternately expanding and contracting during the operation cycle. Additionally, the expansion and contraction of the die tube cannot be impaired or throttled by a fixed inflexible cooling jacket since under these conditions, the cast rod will be found to bind in the die tube and successful continuous operation will be substantially impossible. Relatively complicated cooling arrangement such as that shown in Pat. No. 2,405,355 have been successfully employed on alloys which are molten at relatively low temperatures such as zinc die casting alloys. Such arrangements, however, are not feasible when higher melting point metals such as aluminum alloy are to be cast because of the much greater expansion and contraction effects in the die tube and the effect of higher temperatures generally on the elements of the structures involved.

This invention, therefore, has for its object provision of an improved die tube and cooling jacket combination for use in apparatus for casting continuous metal rod. Another object of this invention is to provide a die tube and cooling jacket combination which can be employed to produce continuous cast rod of relatively high melting point metals. Another object of this invention is to provide a die tube and cooling jacket

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combination for casting continuous metal rod in which the die tube is free to expand and contract. These and other objects of this invention will be apparent from the following detailed description thereof and the annexed drawings in which:

Fig. 1 shows a general sectionalized view of the apparatus of this invention.

Fig. 2 shows a sectionalized view of the apparatus in a different stage of operation.

Fig. 3 shows a cross sectional view of the cooling jacket taken along the lines 3—3.

Fig. 4 shows the appearance of the view of Fig. 3 when square rod is being produced.

Fig. 5 is a cross sectional view of the upper guide tube taken along the lines 5—5.

Fig. 6 shows the appearance of the view shown in Fig. 5 when square rod is being produced.

Referring now particularly to Figs. 1 and 2, molten metal, for instance, aluminum 10 is contained in a pot or other suitable container 11. Pot 11 is supported and surrounded by furnace 12 and is heated as by gas burners 13. Any suitable means, not shown, may be employed for maintaining the metal 10 in molten condition, preferably only slightly above its melting point.

The die proper and cooling jacket are contained in sump or metallic housing 14 which is supported by brackets 15 so that generally a major portion thereof is immersed in the molten metal. Brackets 15 may be attached to upper platform 16 which is in turn supported by posts 17. The die in which the molten metal is at least partially solidified is composed of an inner liner and an outer metallic backing piece 19 with which it is mated and maintained in firm contact. The inner member is preferably composed of graphite having an external diameter tapering toward the top with a mating surface on the interior of the backing piece 19. The inner member 18 is firmly pressed in position inside piece 19 which is suitably threaded to enable the die assembly to be screwed in place at the base of the housing 14 as at 20. The inner surface 21 of the die is of substantially uniform diameter but the outer surface 22 is tapered towards the top as shown, the angle of taper being preferably about $3\frac{1}{2}^\circ$ to the vertical.

Surrounding the die is cooling jacket 23 which is provided with a tapered inner surface 24 adapted to mate with the corresponding tapered outer surface of die backing piece 19. The cooling jacket is not attached to the die, but is free to be lifted so that the surfaces 22 and 24 may be alternately in contact and spaced apart as will be described later in more detail. Cooling jacket

23 is provided with cooling fluid channels 25 and with suitable connecting inlet pipe 26 and outlet pipe 27.

The upper portion of cooling jacket 23 is arranged to be rigidly attached as by screw threading as shown to the base of guide tube 28 which also acts as an additional elongated cooling agency for the cast rod 29, being of internal diameter slightly larger than the diameter of the rod. Tube 28 is provided with an internal chamber 30 which communicates with inlet pipe 31 and outlet pipe 32. Outlet pipes 27 and 32 are connected through a flexible pipe section 33 to a common cooling fluid outlet as shown. Inlet pipes 26 and 31 are also connected through flexible sections 34 and 35 to a common cooling fluid inlet.

The upper portion of guide tube 28 passes slidably through the housing cover 36 and the passage is maintained reasonably gas tight by provision of gasket 37. Cylinder 38 is formed as an integral part of the cover 36 and a portion of the upper wall of tube 28 is expanded to form piston 39 riding in cylinder 38 provided in its contact face with gasket 40. Compressed air inlet pipe 41 and outlet pipe 42 are connected to the so-formed chamber 43, the outlet pipe being controlled by solenoid valve 44.

It will be apparent from the foregoing that application of compressed air into chamber 43 with valve 44 closed will result in raising of piston 39 and also, by reason of its interconnection through guide tube 28, cooling jacket 23 essentially as shown in Fig. 2. On shutting off the air supply and opening valve 44, the guide tube and cooling jacket assembly fall by reason of their weight until the cooling jacket 23 is again in contact with the die as shown in Fig. 1.

The cast rod 29 being formed in a continuous length in the die is withdrawn therefrom intermittently through the guide tube by the action of mechanism mounted above. This mechanism comprises, in the embodiment, illustrated cylinder 45 mounted suitably on platform 16 through which is slidably mounted piston assembly 46. The cast rod 29 passes through the center of piston 46 which is provided at its top portion with dog 47 which grips the rod 29 during its upward stroke. Dog 48 is attached as shown to the top of the cylinder assembly and acts, as is evident from the drawings, to hold the rod and prevent it from following the motion of the piston during its downward stroke. Compressed air is admitted to the chamber 49, formed by cylinder 45 and piston 46, through inlet pipe 50, and the outlet pipe 51 from this chamber is controlled by solenoid valve 52.

It will be apparent from the foregoing that compressed air entering the chamber 49 through inlet pipe 50 with the outlet valve 52 closed will cause the piston 46 to rise and, due to the clamping action of the dog 47, will pull the rod 29 upward. On shutting off the compressed air supply and opening of the valve 52, the rod 29 is held by the clamping action of dog 48 while the piston assembly falls by reason of its weight to its lowest position in the cylinder, as in Fig. 1.

The compressed air inlet pipes 50 and 41 may be supplied by a common compressed air inlet controlled as shown by solenoid valve 53. This valve, as well as valves 52 and 44, are controlled and actuated by an electric timing device of conventional design, not shown, to cause periodic opening and closing of these valves in coordinated relation so that the action of pistons 39 and 46

is synchronized as will now be explained in detail.

In operation of the apparatus of this invention, a starting rod is placed in the die of sufficient length to extend upward through the dogs 47 and 48. The molten metal 10 is maintained at a convenient temperature, preferably only slightly above its melting point. The clock timing device opens valve 53 and closes valves 52 and 44 as shown in Fig. 2, thus allowing compressed air to flow into chambers 49 and 43. This air acts on piston 46 which raises dog 47, which in turn grasps the rod and lifts it a predetermined distance. At the same time, compressed air acts on piston 38 which through its connection with die tube 28 lifts the cooling jacket 23 upward and away from the outer surface of the die. At the same time fresh molten metal flows into the die following the end of the rod, which is being withdrawn. During the inflow of metal, the die is free to expand and is not bound by a fixed cooling jacket as will also be clear by reference to Fig. 2. Then the clock-timing device acts to close valve 53 and open valves 52 and 44, thus releasing the air in chambers 49 and 43. Piston assembly 46 thereupon falls by reason of its weight to the bottom of its cylinder and is in position for the next upward stroke, the rod 29 being prevented from falling downwardly by the catching action of dog 48. At the same time, piston 39 also falls downwardly to the bottom of its cylinder, carrying guide tube 28 and the cooling jacket 23, now rests snugly on and around the tapered die assembly surfaces 22 and 24, now being in contact. The cooling medium, water for instance, flowing through the cooling jacket 23 solidifies the metal, at least superficially, in the die and the described cycle is repeated. As described, the cast rod is produced in a continuous length by this series of intermittent casting and withdrawal operations. However, it will be apparent that other means for lowering and raising the cooling jacket with respect to the die tube may be employed if desired, as well as other means for controlling and timing the action. The embodiment described and illustrated has been found to be simple and effective. The action of the rod lifting means is synchronized with the cooling jacket lifting means so that the cooling jacket is lifted away from the die tube while the cast rod is being withdrawn and molten metal is entering the die tube.

The length of the rod withdrawal stroke and its frequency will be adjusted to produce continuous cast rod of the desired characteristics. As will be obvious to those skilled in the art, these controls will be set in accordance with the temperature and heat characteristics of the metal being cast and in accordance with the design and capacity of the cooling agencies and the heat transfer effected. It will be apparent that round as well as square or other shape rod may be produced by the apparatus of this invention employing suitably modified elements. While Figs. 1, 2, 3 and 5 show the device adapted for production of round rod, Figs. 4 and 6 illustrate the appearance of the sections taken when square rod is produced. Provision of the novel design of die tube and cooling jacket of this invention and their method of operation results in casting rod efficiently and continuously without binding or sticking in the die. In addition, long and satisfactory die life is obtained. This invention provides for casting of continuous rod from high melting point metals, such as aluminum, which melts at about 659° C. and it also may be advanced

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tageously employed for casting zinc and zinc alloys which melt at about 400° C. When casting aluminum, the die liner is preferably made of graphite.

While this invention has been described and claimed, it is not intended to be strictly limited thereto and other modifications and variations may be employed within the scope of the following claims.

I claim:

1. In an apparatus for casting metal rod of continuous length from molten metal, the combination comprising a die tube in which molten metal is solidified, said die tube having an upwardly tapering exterior surface, a cooling jacket having an upwardly tapering interior surface adapted to mate with said die tube, means for intermittently withdrawing from said die tube a cast rod of continuous length, means for alternately lowering and raising said cooling jacket so that its interior surface is in and out of contact with the exterior surface of said die tube, means for synchronically and automatically operating said cooling jacket lowering and raising means and said withdrawing means so as to move said cooling jacket surface out of contact with said die tube during the withdrawal of said cast rod and to move said cooling jacket surface in

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contact with said die tube concurrently with said withdrawing means assuming its position preparatory to subsequent withdrawing action.

2. Apparatus according to claim 1 in which the means for lowering and raising the cooling jacket comprises a cylinder having inlet and outlet pipes controlled by solenoid valves, and a piston riding in said cylinder connected to said cooling jacket.

3. Apparatus according to claim 1 in which the means for lowering and raising the cooling jacket comprises a cylinder and a piston riding in said cylinder connected to said cooling jacket by a cast rod guide tube.

4. Apparatus according to claim 1 in which the angle of taper of the outer surface of the die is about 3½° to the vertical.

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