

PATENT SPECIFICATION

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(54) IMPROVEMENTS IN OR RELATING TO CASTING APPARATUS

(71) We, UNION CARBIDE CORPORATION, a corporation organized and existing under the laws of the State of New York, United States of America, of 270
 5 Park Avenue, New York, State of New York 10017, United States of America, (assignee of OGDEN LESLIE TURNER), do hereby declare the invention, for which we pray that a patent may be granted to us,
 10 and the method by which it is to be performed, to be particularly described in and by the following statement:

The invention relates to an apparatus for casting metal objects of substantially
 15 uniform shape and weight.

Many batteries in commercial use today employ cylindrical zinc cans in their construction. These zinc cans serve the dual purpose of being the negative electrode,
 20 and at the same time, the container for the remaining components of the cell. The zinc cans are often produced by reverse impact extrusion from small zinc discs called "calots". It is essential that the zinc calots
 25 being fed to any particular reverse impact extrusion apparatus be substantially void-free and uniform in weight and shape. One method in use today for producing such uniform calots is a stamping operation
 30 wherein a hot rolled strip of zinc is stamped into the appropriately shaped discs. This operation is expensive because a significant proportion of the hot rolled zinc is excess trim or web which must be
 35 remelted and reprocessed. Further, this procedure is a multi-step operation (melting the zinc, casting billets which must be trimmed thereby causing more loss in efficiency-rolling the billets, and punching
 40 the rolled strips) having a yield of calots vs. amount of zinc melted as low as about 50 per cent when punching round stock. Also, relatively large capital outlays are required (for rolling mill and punch press,
 45 for example), and the labor and main-

tenance costs are relatively high. In addition, a lubricant is used during the punching operation which must be cleaned off prior to extrusion, where a different lubricant is used.

U. S. Patent No. 2,292,266 describes an apparatus for casting slugs suitable for impact extrusion to produce zinc cups, tin containers, and the like. This apparatus includes a conveyor for passing a plurality of
 55 molds sequentially under a spout where a measured quantity of molten metal is deposited in each mold. The means for measuring and dispensing the metal is, however, extremely awkward. The means
 60 for measuring the molten metal includes a cylinder and a plunger having a circular cross section and two peripheral longitudinal grooves about 120° apart. As the plunger rises in the cylinder, a first groove
 65 communicates with an inlet passage and molten metal is drawn into the cylinder. At the top of the stroke, the plunger is rotated so that the second groove communicates with an upwardly inclined outlet
 70 passage. Then, as the plunger descends, molten metal is ejected from the cylinder into the outlet passage, from the top of which the molten metal spills over through
 75 a pouring spout into the mold that is in receiving position under the spout. Preferably, the pouring spout oscillates so that it moves in the same direction as the conveyor during the pouring operation. A vibrator is also employed during the pouring
 80 operation to cause the surface of the molten metal to level off in the mold.

A number of disadvantages are apparent in the operation of the apparatus of U.S. Patent No. 2292266. First, the means for
 85 metering and dispensing the molten metal is awkward. Several distinct motions in the dispensing apparatus must be coordinated, for instance, the rotation and reciprocation of the plunger and, in the preferred version
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of the apparatus, the oscillation of the pouring spout. Second, it would not appear that the measuring of the amount of molten metal would be very precise, since, for instance, the metal dispensed to each mold is obtained by overflowing from the outlet passage. Any turbulence in the outlet passage would cause varying amounts of metal to overflow from one cycle to another. Third, there is disclosed the filling of only one mold cavity at a time, thereby limiting the number of discs that can be cast per unit of time.

U. S. Patent No. 1,646,854 discloses another apparatus for casting non-ferrous metal slugs suitable for use in extrusion processes. The apparatus disclosed in U.S. Patent No. 1646854 includes a rotatable table having a single row of mold cavities around the periphery thereof. The table rotates in stepwise fashion, stopping when each mold cavity is in receiving position below a discharge tube where a measured amount of molten metal is dispensed to the mold cavity. The means for measuring the molten metal includes an oscillating cutoff and measuring valve. The valve has a recess or pocket therein of sufficient capacity to receive just enough molten metal for the production of a single slug. The pocket receives molten metal from a reservoir, and when it is filled, the valve is rotated to discharge the metal through the discharge tube into a mold cavity.

The present invention seeks to provide an apparatus for casting metallic objects such as zinc, aluminum, lead, copper, and other non-ferrous metal castings, wherein the cast objects can be produced relatively inexpensively in high yield, and within close weight and shape tolerances that are suitable for subsequent operations such as, for example, reverse impact extrusion and coining.

The invention further seeks to provide an apparatus for casting metal to form objects having substantially uniform predetermined shapes and weights.

The invention also seeks to provide an apparatus for producing, at a relatively high rate, non-ferrous discs suitable for use in subsequent reverse impact extrusion processes.

The invention further seeks to provide an apparatus for metering and dispensing molten metal in precise predetermined amounts.

According to the present invention apparatus for casting articles comprises a plurality of molds, each mold having at least one cavity; conveying means for carrying said molds sequentially through a feed zone disposed below a reservoir for molten metal; means for automatically

maintaining a constant head of molten metal in the reservoir; feed means which includes a substantially vertically oriented member in said reservoir, and an orifice in the bottom of said reservoir and located beneath said member, the bottom end of said member being arranged and constructed to define a closure for said orifice and said member being operatively attached to means for lifting said member to thereby disengage said member from said orifice to permit a predetermined amount of molten metal to flow through said orifice into a mould cavity while said cavity is in said feed zone; and mechanical means for synchronizing the action of said conveying means with said feed means in a manner such that molten metal is discharged from said feed means at a time when said cavity is in receiving relationship to said feed means. In one preferred aspect of the invention, the apparatus includes means for vibrating the molds while the molds are in the feed zone.

The invention will now be described further by way of example with reference to the accompanying drawings, in which:—

Fig. 1 is a side elevational view of an apparatus constructed in accordance with the present invention;

Fig. 2 is a plan view of the apparatus of Fig. 1;

Fig. 3 is a side elevational view partly in cross section, of a mold suitable for use in the apparatus of the present invention;

Fig. 4 is a plan view of the mold of Fig. 3;

Fig. 5 is a front elevational view partly in section, of the constant head tank;

Fig. 6 is a plan view of the constant head tank;

Fig. 7 is a side elevational view of the constant head tank;

Fig. 8 is a front elevational view partly in cross section, of a portion of the apparatus including the constant head tank, taken along line 8-8 of Fig. 1;

Fig. 9 is a plan view of Fig. 8;

Fig. 10 is another side elevational view in cross section taken along line 10-10 of Fig. 2, showing a portion of the apparatus in greater detail, including the valve rod, the metering orifice, the vibrator, and a portion of the means for synchronizing the action of the conveyor with the valve rod;

Fig. 11 is a front elevational view partly in cross section, looking in the direction of the arrows 11-11 of Fig. 2, showing a portion of the apparatus in greater detail;

Fig. 12 is a side elevational view looking in the direction of arrows 12-12 of Fig. 2, showing a portion of the apparatus in detail, including a portion of the means for synchronizing the action of the conveyor

with the valve rod;

Fig. 13 is a plan view of Fig. 12;

Fig. 14 is a front elevational view partly in cross section, showing in detail a safety device for insuring that the valve rod will close the metering orifice in the event of a power failure;

Fig. 15 is a front elevational view of the vibrator bracket;

Fig. 16 is a plan view of Fig. 15;

Fig. 17 is a side elevational view of Fig. 15;

Fig. 18 and 19 are plan and front views, respectively, of a pump and associated conduits for delivering molten metal from a reservoir to the constant head tank;

Fig. 20 is an enlarged sectional view showing the metering plug and orifice and valve rod;

Fig. 21 is a plan view of a bushing insert for the metering orifice which serves as a valve rod guide;

Fig. 22 is a sectional view taken along the line 22-22 of Fig. 21; and

Fig. 23 is a partially schematic plan view of an apparatus of the invention disposed above a molten metal reservoir and furnace for melting the molten metal.

Referring now to Figs. 1 and 2, an apparatus embodying the principles of the invention is shown. The apparatus includes a frame having a pair of longitudinal braces 31, support legs 32, intermediate cross braces 33, a front end brace 34, and a rear end brace 35. The apparatus is disposed as shown in Figs. 1 and 23 above a reservoir tank 36 for holding a supply of molten metal 37, and an associated furnace 38 (see Fig. 23). The reservoir tank 36 communicates with a further reservoir in the form of a constant head tank 39 by means of a pump 41 and associated piping (see Figs. 18 and 19) for transferring the molten metal 37 from the reservoir tank 36 to the constant head tank 39. The constant head tank 39 can be equipped with suitable heaters (not shown) to maintain the molten metal 37 at the desired temperature.

In operation of the apparatus, a pair of endless chain link belts 42 (shown in greater detail in Figs. 10 and 11), which are disposed in planes parallel to each other and to the longitudinal braces 31 and which have a plurality of mold mounting bars 43 disposed transversely between them along the entire length of the chain link belts 42 describe a conveyor, which is shown in Fig. 1 as 44. The conveyor 44 revolves around a pair of front sprocket wheels 45 and a pair of rear sprocket wheels 46 in the direction of the arrow A. The conveyor 44 continuously carries a series of molds 47 through a feed zone below the constant head tank 39. Each mold 47 has at least one mold cavity 48

(see Figs. 3 and 4). While the mold 47 passes below the constant head tank 39, a metered quantity of molten metal is discharged from the constant head tank 39 into each cavity 48 of the mold 47. A suitable heater 40 (Fig. 1) can be provided on the apparatus to preheat the molds, if desired.

If desired, the molds 47 can be vibrated while they are in the feed zone. The vibration is done in order to prevent the formation of a meniscus on the molten metal in the mold cavities 48, or to break down such a meniscus before the metal solidifies, in the event that a meniscus does form. Thus, the vibration serves to ensure the production of cast objects with substantially flat upper surfaces.

The cast metal objects produced in the cavities 48 of the molds 47 are carried along the conveyor 44 until the molds 47 reach the front end of the apparatus, shown generally as 49. At this point, the conveyor 44 carries the molds 47 around the front end sprocket wheels 45 (which are driven by a motor 51 through a speed controller 100 and chain drive 50) and, the contour of the cast object permitting, dumps the cast metal objects into a receiving trough (not shown). By constructing the molds 47 out of a material such as graphite or porcelain that has a relatively low coefficient of expansion, the necessity for the use of knock-out pins or similar devices in order to eject the cast metal objects from the mold cavities 48 is eliminated. Thus, the cast metal objects simply fall out of the cavities 48 upon inversion. If desired, a small vibrator 52 can be attached to the front end 49 of the apparatus to assist in discharging the cast objects from the mold cavities 48.

Material other than graphite or porcelain can be used for constructing the molds 47, if desired. If the contour of the cast metal object does not permit removal from the mold cavities 48 by dumping, the mold 47 can be arranged and constructed to open up by conventional procedures in order to remove the cast objects from the molds 47. For instance, a row of split molds could be used which would automatically pull apart at the front end 49 of the apparatus for discharge of the cast objects.

Figs. 3 and 4 show one form of a mold 47 that can be used in the apparatus of the invention. These molds 47 have five cavities 48. The molds 47 are attached to the conveyor 44 by bolts passing through mounting holes 53, which fasten the molds 47 to the mold mounting bars 43. (See Fig. 11 for a detailed view of the mode of attachment of the molds 47 to the mold mounting bars 43).

The constant head tank 39 is more

particularly shown in Figs. 5, 6 and 7. The constant head tank 39 is constructed of a heat resistant inert material. Molten metal 37 from the reservoir tank 36 is pumped (see Figs. 18 and 19) into the constant head tank 39. The molten metal in the constant head tank 39 is maintained substantially at a predetermined level by conventional means such as by utilizing an overflow 54 having a V-shaped opening (Fig. 7) in one side of the constant head tank 39. Excess molten metal flows out through the overflow 54 back to the reservoir tank 36 through conduit means, shown as 55 in Figs. 8 and 9. The constant head tank 39 can be completely drained of molten metal by removing a drain plug 56 (see Fig. 11) to permit the molten metal to discharge out of a drain 57 through a conduit 58 (see Fig. 8) into the reservoir tank 36.

In Figs. 18 and 19, the pump which transfers molten metal from the reservoir tank 36 to the constant head tank 39 is shown generally as 41. The pump 41 has a liquid metal transfer pipe 61, an impeller drive shaft 62, and a support column 63. The pump 41, which is conventional in the art, can be driven by any convenient means, such as an air motor.

In Figs. 8 through 11, the vibrating and the molten metal feed operations are shown. In operating the apparatus, the molds 47 are carried through a feed zone below the constant head tank 39 where a metered amount of molten metal is discharged into each cavity 48 of the molds 47. The molten metal is discharged through a metering orifice 64 (see Figs. 10 and 20) in the bottom of the constant head tank 39. The metering orifice 64 is an opening in a plug 70 that fits tightly in an opening in the constant head tank 39. The metering orifice 64 is closed by the bottom end of a valve rod 65 (see Figs. 10 and 20), said bottom end being machined to seat snugly in the valve seat 66 of the metering orifice 64. The valve rod 65 and the plug 70 are suitably made of an inert heat resistant material such as a molybdenum-tungsten alloy. Molten metal is discharged through the metering orifice 64 when the valve rod 65 is lifted free of the valve seat 66. The valve rod 65 is lifted by a valve rod lifter, shown generally as 67 in Figs. 8 through 11. The valve rod 65 can be maintained in precisely the desired position over the valve seat 66 by passing the valve rod 65 through a snugly fitting guide hole 68 in a molybdenum-tungsten alloy bushing 69 (see Figs. 20-22) seated in the top of the plug 70, as shown in Fig. 20. The bushing 69 has a plurality of holes 71 through it to enable the molten metal to flow freely down through the metering

orifice 64. The constant head tank 39 can also have a steel cover 80, as shown in Fig. 8 with holes 111 (Fig. 2) therein for the valve rod 65 to pass through. These holes also act as guides for the valve rod 65.

The operation of the valve rod lifter 67 is shown most clearly in Figs. 8, 9 and 10. At its upper end, the valve rod 65 passes through a loosely fitting hole 72 in a rocker arm 73. An adjustable lifting collar 74 is tightly fastened around the valve rod 65 at a preselected position above the rocker arm 73. An adjustable lifting collar when the rocker arm 73 moves upwardly and engages the collar 74. The point of contact between the rocker arm 73 and the collar 74 is a round topped bearing button 75 that is fastened securely to the rocker arm 73. The rocker arm 73 pivots up and down about a first pivot bar 76 mounted over the constant head tank 39. At the end of the rocker arm 73 opposite the first pivot bar 76, the rocker arm 73 is pivotally attached at a pivot point 77 to an adjusting arm 78. The adjusting arm 78 rests freely on the top of a lifting bar 79, which is attached to a pair of support arms 81 at both ends. The support arms 81 pivot up and down about a second pivot bar 82 that is rotatably mounted in supports 83 that are attached to the longitudinal braces 31 behind the constant head tank 39, as is shown in Fig. 1. The support arms 81 and lifting bar 79 are lifted up and down as a unit by a push rod 84 (Figs 8 and 12) that is attached to the second pivot bar 82 by an arm 112. The operation of the push rod 84 is described below.

Alternative means for lifting the valve rod free of the metering orifice can be used, if desired. For instance, a rotating cam synchronized with the conveyor could be employed to engage with means such as the adjustable lifting collar to lift the valve rod free of the metering orifice.

The operation of the valve rod 65 is synchronized with the motion of the conveyor 44, and hence with the molds 47 passing under the constant head tank 39 so that the molten metal is discharged through the metering orifice 64 only when a mold cavity 48 is in receiving relationship to the metering orifice 64. The amount of molten metal that is discharged through the metering orifice 64 is regulated by the vertical distance that the valve rod 65 is lifted from the valve seat 66, as well as the time duration that the valve rod 65 is in the raised or open position. The distance that the valve rod 65 is lifted can be adjusted by any suitable means, such as an adjusting set screw 85, as well as by adjusting the position of the lifting collar 74. The collar 74 provides a coarse adjustment of the

amount of metal discharged through the metering orifice 64, while the adjusting set screw 85 provides the fine adjustment.

The manner by which the adjusting set screw 85 regulates the operation of the valve rod 65 is shown most clearly in Fig. 10. For instance, when the adjusting set screw 85 is screwed down, the adjusting arm 78 tends to pivot counterclockwise (as viewed in Fig. 10) about the pivot point 77. This counterclockwise pivoting motion of the adjusting arm 78 has the effect of causing the adjusting arm 78 to bear down on the lifting bar 79, and to thereby raise the pivot point 77. In turn, the raising of the pivot point 77 causes the rocker arm 73 to pivot upwardly about the first pivot bar 76, and to thereby engage the adjustable collar 74 on the valve rod 65 at an earlier point in the cycle of operation. The metering orifice 64 is thereby open for a longer time in the cycle, and more molten metal is fed therethrough.

The adjusting set screw 85 provides a very sensitive adjustment for the molten metal feed. For instance, it has been found that the weight of a zinc calot weighing 20 grams can be kept to within a tolerance of about ± 1 per cent, when such zinc calots are made by apparatus in accordance with this invention. By the means described hereinabove, precisely controlled amounts of molten metal are discharged directly from the constant head tank through the metering orifices into the mold cavities. By discharged "directly" is meant that there is no intervening measuring receptacle or similar means between the constant head tank and the mold cavities. By eliminating such intervening measuring means, the speed of the molten metal dispensing operation is considerably increased. At the same time, the invention permits precise control of the amounts of molten metal dispensed.

In one preferred aspect of the invention, there is provided a vibrator (shown generally as 86 in Figs. 8 and 11) to vibrate the molds 47 while they are in the feed zone under the constant head tank 39. As indicated above, the vibration is provided to either prevent the formation of a meniscus on the molten metal in the mold cavities 48, or to break down such a meniscus if it does form momentarily. This vibration is one way to ensure the production of cast metal objects having reproducibly flat tops. Any conventional vibrator can be employed in the invention. It is preferred, however, that the vibrator impart vertical vibration to the molds. One vibrator that has been employed is simply a circular race with a steel ball-bearing driven by compressed air to travel around the race. A commercially available vibrator that has

been used is a "Vibrolator UCV-6" (Registered Trade Mark), available from Watson Power Equipment Co., Cleveland, Ohio 44124. This vibrator has been successfully operated at an air pressure of 15 to 20 psi. 70

Referring now to Figs. 8, 10, 11 and 15-17, the vibrator 86 is attached to the apparatus by means of a vibrator support bar 87, which is attached by an angle iron 90 at one end thereof to one of the longitudinal braces 31. Vibrations from the vibrator 86 are transmitted to the mold mounting bar 43 through a vibrator bar 88. The mold mounting bar 43, which (as is shown in Fig. 11) is composed of an insulating layer 89 and a metallic support layer 91, is attached to opposite individual links of the two chain link belts 42 by a bolt and lock nut assembly 92 that is not completely tightened (as shown in Fig. 11) in order to give the mold mounting bar 43 freedom to vibrate in a vertical direction. The vibrator bar 88 extends longitudinally for a distance sufficient to impart vibration to the molds 47 for a period of time sufficient to keep the molds 47 vibrating while at least the top layer of the molten metal solidifies. The vibrator bar employed with the vibrator described above was 1/2-inch wide by 3-3/4 inches long, including the 15° beveled front and rear edges shown in Fig. 17. 85

Turning now to Figs. 12, 13, and 14, the operation of the push rod 84 and the synchronization of the molten metal feed with the operation of the conveyor 44 is shown. As was explained hereinabove, the conveyor 44 is driven through one of the front end sprocket wheels 45 by a motor 51, operatively connected therewith as through a chain drive 50 (see Fig. 1). As is also shown in Figs. 1 and 2, the conveyor 44 revolves about and drives the rear sprocket wheels 46. One of these rear sprocket wheels 46 is operatively coupled to a synchronizing sprocket wheel 93 by a shaft 97. The synchronizing sprocket wheel 93 drives a chain 94 which, in turn, drives a gear 95. An adjustable idler sprocket wheel 98 maintains the desired degree of tension on the chain 94. The gear 95 meshes with an eccentric 96 which imparts vertical reciprocating motion to the push rod 84. Synchronization of the operation of the push rod 84 (and hence the discharge of the molten metal through the metering orifice 64) with the motion of the conveyor 44 is achieved by appropriate adjustment by way of adjusting slots 99 of the angular position of the synchronizing sprocket wheel 93 with respect to the rear sprocket wheel 46 to which it is operatively coupled. 100 105 110 115 120 125

As is shown in Figs. 12 and 14, the push rod 84 is equipped with a disconnect 130

mechanism, shown generally as 101, to enable the conveyor 44 to run without activating the molten metal feed operation and also to act as a safety device in case, for example, a power failure occurs and the motor 51 stops while the metering orifice 64 is open. The disconnect mechanism 101 would thus automatically allow the valve rod 65 to drop down and close the metering orifice 64.

Any conventional type of disconnect mechanism can be employed. In Fig. 14, a disconnect mechanism 101 is shown in the closed or safety position. The disconnect mechanism 101 includes a cylinder 102, a piston 103, a pressure release valve (not shown), and an air inlet valve 104. When used with this type of disconnect mechanism 101, the push rod 84 is composed of two pieces — an upper portion 105 and a lower portion 106. The upper portion 105 is slidably connected to the lower portion 106 by means of a cylinder 107 and guide rod 108. The guide rod 108 is allowed to freely reciprocate in the cylinder 107 by a vent 109.

The piston 103 of the disconnect mechanism 101 is attached to the upper portion 105 of the push rod 84, and the cylinder 102 of the disconnect mechanism 101 is attached to the lower portion 106. As shown in Fig. 14, when there is no air pressure in the cylinder 102, the piston 103 falls to the closed or safety position, bringing the upper portion 105 of the push rod 84 down into close proximity to the lower portion 106. In this position, the push rod 65 does not extend high enough to lift the valve rod 65 free of the metering orifice 64 by the means that was described above. When air enters the cylinder 102 through the air inlet valve 104, the piston 103 is moved upward and the upper portion 105 of the push rod 84 is moved away from the lower portion 106, thereby extending the push rod 84 so that it can operate the valve rod 65. As was indicated above, when the power is turned off, air pressure is released from the cylinder 102, allowing the piston 103 to fall into the closed or safety position shown in Fig. 14.

One apparatus constructed in accordance with the invention had a length of 8 feet between the axles of the front end sprocket wheels and the rear end sprocket wheels. The conveyor contained 137 molds, each of which had five disk-shaped cavities whose dimensions were about 1-1/4 inches in diameter by 9/32 inch in depth. In operation, at a production rate of 500 20-gram zinc calots per minute, the temperature of the zinc in the constant head tank is maintained at about 850°-900°F., and the molds are kept at a temperature of about 550° to 600°F. When no heaters are em-

ployed in the constant head tank, sufficient molten zinc overflow should be maintained in order to maintain the temperature of the zinc at the desired level. This apparatus, with mold cavities ranging from about 1/2 inch to about 1-1/4 inches in diameter, can be used to produce zinc calots ranging in weight from about 6 to about 90 grams.

To briefly summarize, a preferred apparatus according to the present invention is one which can be placed near a tank or reservoir for molten metal. The apparatus includes a suitable frame on which is mounted an endless conveyor that revolves about sprockets located at the front and rear of the apparatus. The conveyor can be driven by a variable speed motor which is operatively connected to one of the sprockets by suitable means such as a chain drive. The conveyor is constructed to carry a plurality of molds, each having at least one cavity, through a feed zone wherein a carefully metered amount of molten metal is deposited in each cavity.

A constant head tank is disposed above the feed zone. The constant head tank is arranged and constructed to maintain a constant level of molten metal therein to facilitate the deposition of metered portions of molten metal in the mold cavities. The level of molten metal in the constant head tank is maintained by cooperation of a suitable feed pump and overflow arrangement. The feed pump introduces molten metal from the reservoir into the constant head tank, and the overflow discharges excess molten metal back into the reservoir, thereby maintaining the predetermined liquid level in the constant head tank.

The molten metal is discharged directly from the constant head tank into the mold cavities through one or more metering orifices in the floor of the constant head tank. The metering orifices are opened and closed by the action of valve rods which are machined to seat snugly in the top or valve seat portion of the metering orifice. The action of the valve rods to open and close the metering orifices is synchronized with the motion of the conveyor belt so that the metering orifices will be opened to discharge molten metal only when mold cavities are appropriately positioned under them.

In one preferred aspect of the invention, there is provided a vibrator to vibrate the molds while at least the top surface of the molten metal solidifies in the mold cavities. This vibration ensures that the cast metal objects produced by the apparatus of the invention will have reproducibly uniform substantially flat tops. The cast metal objects produced by the apparatus can be removed from the mold cavities by gravity

alone, the contour of the cast object permitting, as the conveyor belt carries the molds around the front sprockets.

While the invention has been described in terms of certain specific embodiments, various modifications thereof can be made in the light of the foregoing disclosure without departing from the scope of the invention. For instance, the conveyor belt need not move continuously. The conveyor can have intermittent movement, to index the mold cavities under the feeding means, in order to apply the invention to those cases where the quantity of molten metal to be fed for each casting is too much to readily deposit the requisite amount of molten metal in the mold cavities when they are moving continuously. Any step-wise advance mechanism, e.g., a slot wheel and pin gear, can be used to achieve this purpose.

WHAT WE CLAIM IS:—

1. Apparatus for casting metal objects of a substantially uniform predetermined shape and weight and which comprises a plurality of molds, each mold having at least one cavity; conveying means for carrying said molds sequentially through a feed zone disposed below a reservoir for molten metal; means for automatically maintaining constant head of molten metal in the reservoir; feed means which includes a substantially vertically oriented member in said reservoir, and an orifice in the bottom of said reservoir and located beneath said member, the bottom end of said member being arranged and constructed to define a closure for said orifice and said member being operatively attached to means for lifting said member to thereby disengage said member from said orifice to permit a predetermined amount of molten

metal to flow through said orifice into a mould cavity while said cavity is in said feed zone; and mechanical means for synchronizing the action of said conveying means with said feed means in a manner such that molten metal is discharged from said feed means at a time when said cavity is in receiving relationship to said feed means.

2. Apparatus as claimed in claim 1 wherein said conveying means comprises an endless belt.

3. Apparatus as claimed in claim 1 or 2 wherein each mold has a plurality of cavities.

4. Apparatus as claimed in claim 1, 2 or 3, wherein vibration means is provided to vibrate the molds when said molds are in said feed zone.

5. Apparatus as claimed in any of claims 1 to 4, further comprising heating means for heating the molds prior to having the molten metal fed into the molds.

6. Apparatus as claimed in any of claims 1 to 5 wherein the molds are split molds which can be pulled apart for facilitating the removal of cast objects.

7. Apparatus as claimed in any of claims 1 to 6 further comprising means for urging said member into closing engagement with said orifice in the bottom of the reservoir responsively to a failure of a power operating means of the conveyor.

8. Apparatus for casting metal objects substantially as hereinbefore particularly described with reference to and as illustrated in Figs. 1 to 23 inclusive of the accompanying drawings.

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WHAT WE CLAIM IS:—

1. Apparatus for casting metal objects of a substantially uniform predetermined shape and weight and which comprises a plurality of molds, each mold having at least one cavity; conveying means for carrying said molds sequentially through a feed zone disposed below a reservoir for molten metal; means for automatically maintaining constant head of molten metal in the reservoir; feed means which includes a substantially vertically oriented member in said reservoir, and an orifice in the bottom of said reservoir and located beneath said member, the bottom end of said member being arranged and constructed to define a closure for said orifice and said member being operatively attached to means for lifting said member to thereby disengage said member from said orifice to permit a predetermined amount of molten

metal to flow through said orifice into a mould cavity while said cavity is in said feed zone; and mechanical means for synchronizing the action of said conveying means with said feed means in a manner such that molten metal is discharged from said feed means at a time when said cavity is in receiving relationship to said feed means.

2. Apparatus as claimed in claim 1 wherein said conveying means comprises an endless belt.

3. Apparatus as claimed in claim 1 or 2 wherein each mold has a plurality of cavities.

4. Apparatus as claimed in claim 1, 2 or 3, wherein vibration means is provided to vibrate the molds when said molds are in said feed zone.

5. Apparatus as claimed in any of claims 1 to 4, further comprising heating means for heating the molds prior to having the molten metal fed into the molds.

6. Apparatus as claimed in any of claims 1 to 5 wherein the molds are split molds which can be pulled apart for facilitating the removal of cast objects.

7. Apparatus as claimed in any of claims 1 to 6 further comprising means for urging said member into closing engagement with said orifice in the bottom of the reservoir responsively to a failure of a power operating means of the conveyor.

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