Nov. 27, 1928. 1,693,283

A. E. MIX

APPARATUS FOR CASTING METAL BODIES

Filed May 18, 1926 2 Sheets-Sheet 1

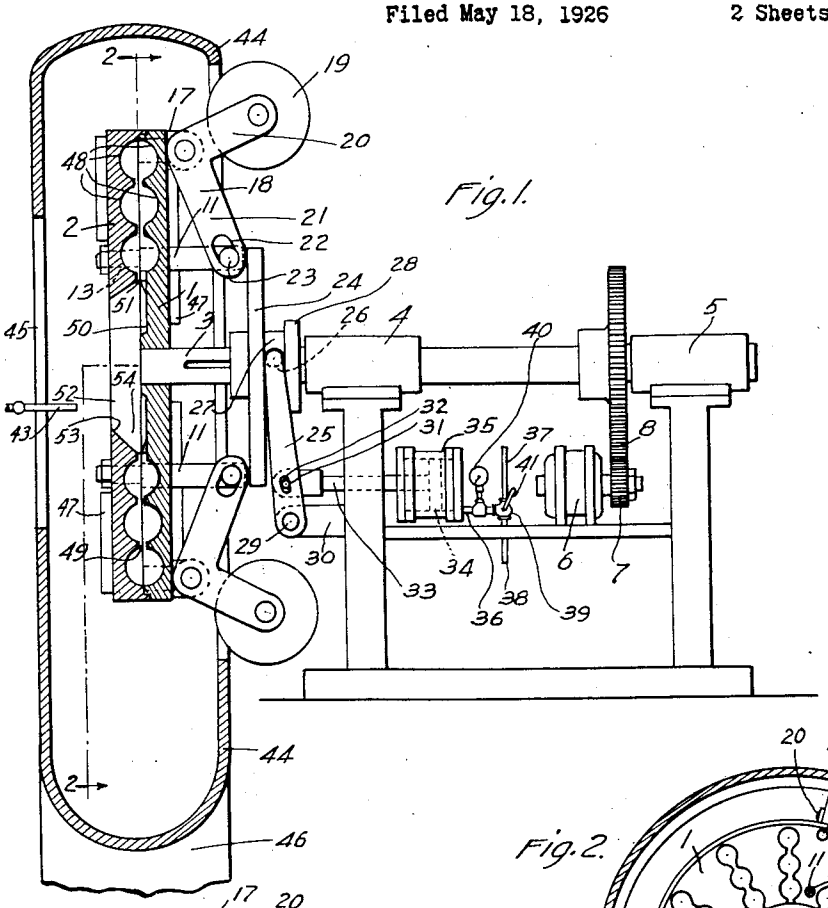


Fig. 1.

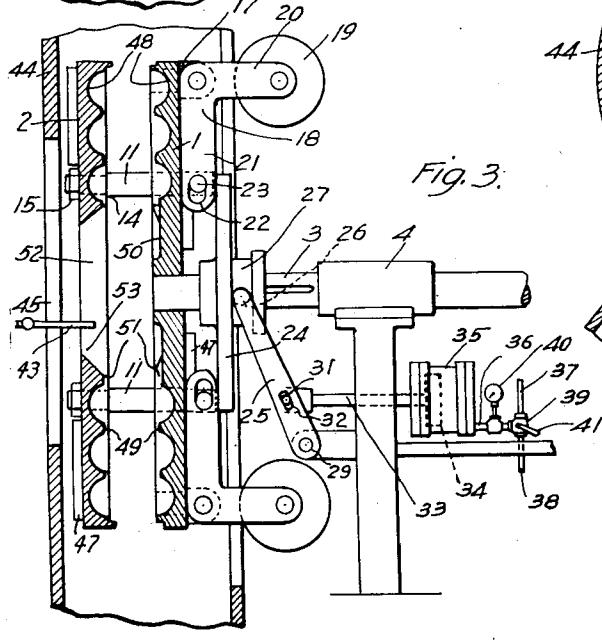


Fig. 3.

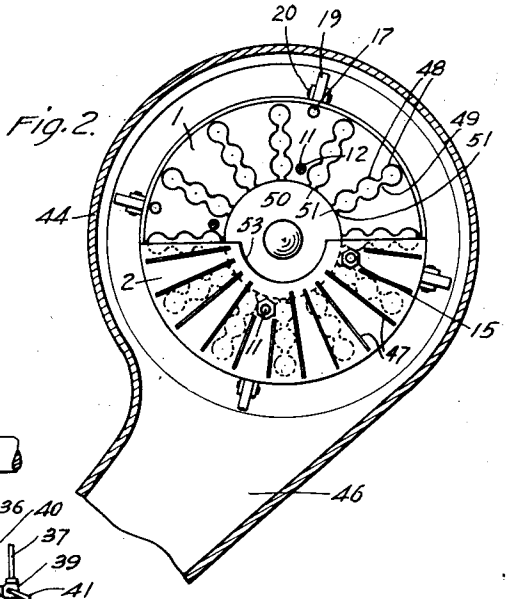


Fig. 2.

INVENTOR.
Albert E. Mix.
BY Arthur P. Knight and
Alfred W. Knight
ATTORNEYS

Nov. 27, 1928. 1,693,283

A. E. MIX

APPARATUS FOR CASTING METAL BODIES

Filed May 18, 1926 2 Sheets-Sheet 2

Fig. 4.

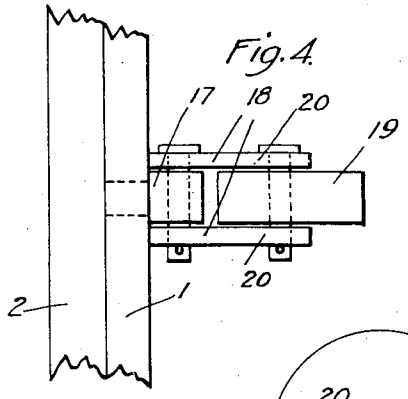


Fig. 5.

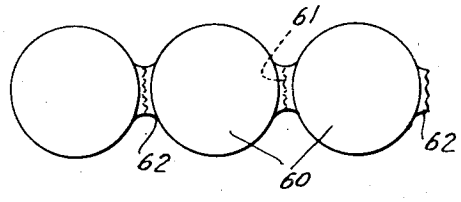


Fig. 7.

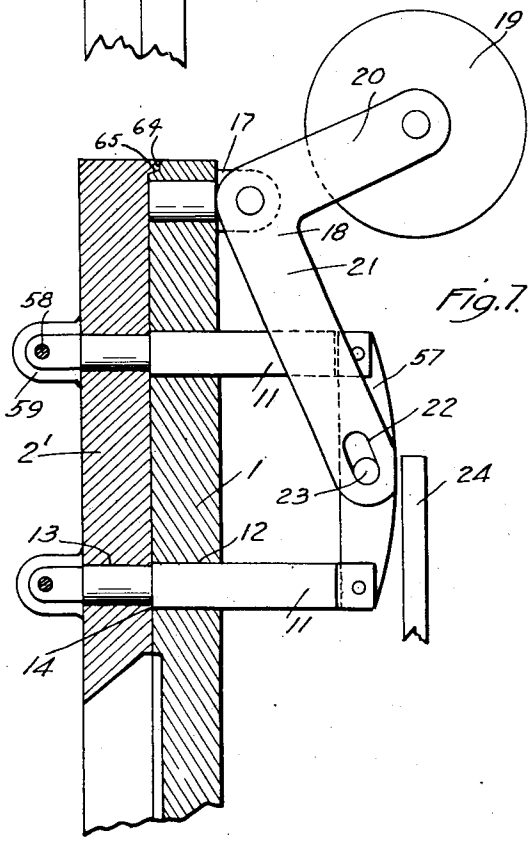
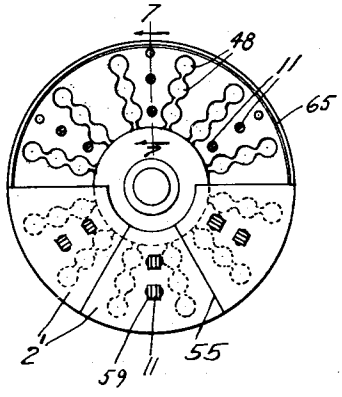


Fig. 6.



INVENTOR.
Albert E. Mix
BY Arthur P. Knight and
Alfred W. Knight
ATTORNEYS

Patented Nov. 27, 1928. 1,693,283

UNITED STATES PATENT OFFICE.

ALBERT E. MIX, OF GARFIELD, UTAH.

APPARATUS FOR CASTING METAL BODIES.

Application filed May 18, 1926. Serial No. 109,825.

This invention relates to means for casting balls or other bodies of metal particularly for use in grinding operations.

The main object of the invention is to provide a machine in which a large number of balls may be rapidly cast, discharged, and broken apart, in a continuous operation or consecutive operations, thereby greatly reducing the manual labor required.

A further object of the invention is to provide means whereby the casting operation is carried out with a minimum of waste metal. In casting balls or other bodies in the ordinary type of stationary molds now in use it is customary to provide molds having long grooves, channels, or other passages or openings known as sprues and gates, with a number of recesses communicating with such passages so that when the molten metal is poured into these passages it flows out into such recesses to form the bodies of the desired shape. The metal remaining in the grooves, commonly known as the "gates" or "sprues", is thus wasted and must be remelted for use. This in turn means a high fuel consumption for the operation and I have found that by providing a machine according to my invention in which there are substantially no "gates" or other long grooves or passages to be filled with molten metal, and in which there is consequently substantially no waste metal, the fuel consumption may be reduced as much as forty per cent.

A further object of the invention is to provide for casting of a more uniform and dense ball than may be otherwise obtained.

A further object of the invention is to provide a machine in which the balls are cast in sets, the balls in each set being joined together by neck portions, and to provide means whereby said balls may be automatically discharged from the casting machine and broken apart by severing of such neck portions.

A further object of the invention is to provide for rapid cooling of the metal after pouring, and also for rapid cooling of the molds.

The accompanying drawings illustrate apparatus embodying my invention and referring thereto:

Fig. 1 is a vertical section of a ball casting machine according to my invention.

Fig. 2 is a section on line 2—2 in Fig. 1.

Fig. 3 is a partial view similar to Fig. 1 showing the two halves of the mold in open position.

Fig. 4 is a plan view of the upper portion of the molds and part of the operating mechanism therefor shown in Fig. 1.

Fig. 5 is a view showing a set of balls as cast in the machine.

Fig. 6 is a partially sectional front elevation of a modified form of mold members.

Fig. 7 is a section on line 7—7 in Fig. 6.

The apparatus shown in Figs. 1 to 4 comprises two circular metal mold members 1 and 2, the member 1 being mounted on shaft 3 which rotates in bearing means 4 and 5, and the member 2 being connected to member 1 so as to rotate therewith while permitting relative movement of said members parallel to the axis of rotation thereof so as to provide for opening of the mold as hereinafter described. Suitable means may be provided for causing rotation of shaft 3 together with the mold members 1 and 2, such means comprising for example electric motor 6 connected to said shaft by gear wheels 7 and 8.

Rods 11 may extend through openings 12 in mold member 1, and through openings 13 in mold member 2, the portion of said rods within the mold member 2 being of somewhat decreased diameter so as to provide shoulders 14 on said rods, against which the mold member 1 is held by means of nuts 15 screwing on the threaded outer ends of rods 11. Lugs 17 corresponding in number and position to rods 11 are provided on mold member 1 and bell crank means 18 are pivotally mounted on said lugs. Said bell cranks are provided with counterweight means 19 mounted at the outer ends of arms 20 thereof, while the arms 21 of said bell crank means are provided with slots 22 engaging studs 23 on rods 11.

A revolving disk 24 is mounted on shaft 3, for example by being keyed thereto in suitable manner so as to rotate with said shaft while being capable of sliding motion thereon, said disk being of sufficient diameter to engage the ends of rods 11 or arms 21 when moved inwardly toward the mold members. The means for causing the revolving disk 24 to be so moved inwardly may comprise lever arms 25 having pins 26 engaging in an annular groove 27 between said revolving disk and flange 28 on the hub of said disk. Lever arm 25 may be pivotally mounted as at 29 on supporting bracket 30 and may be connected by pin and slot means 31 and 32 to rod 33 whose other end carries a piston 34 mounted within pressure cylinder 35. Means are provided for supplying and releasing fluid pressure

from the rear side of piston 34, such means comprising for example pipe 36 communicating with pressure chamber 35, fluid pressure supply pipe 37 connected to any suitable source of fluid pressure such as an air compressor or compressed air storage chamber, exhaust pipe 38 and three-way valve 39 having handle 41 for controlling communication between pipe 36 and pipes 37 and 38 respectively. Pressure gage 40 may be provided if desired for indicating the pressure in pressure chamber 35.

A suitable casing or housing means 44 may be provided surrounding the peripheries of mold members 1 and 2, said housing means being provided with a suitable opening 45 at the front thereof so as to permit access to the mold for pouring metal therein. Said housing means may be further provided with suitable means such as discharge chute 46 for conducting away the cast balls as the same are discharged from the machine.

The mold members 1 and 2 are each provided with a plurality of sets of corresponding mold recesses 48, there being preferably a plurality of recesses in each set, said recesses in each set being arranged radially in line with one another as shown and being connected by grooves, channels, or neck portions 49. Each of the mold recesses corresponds to the shape of one half of the ball or other body to be cast, so that when the two molds are brought together, a cavity or mold recess of the desired shape is provided. For example, for making spherical balls, each mold recess is made hemi-spherical in shape, as shown. The central portion of mold member 1 is cut away as indicated at 50 and such cut away portion is in communication with the inner recesses of all the sets by means of channels or passages 51. A central opening 52 is provided in mold member 2 so as to permit access of suitable means for pouring the molten metal into the molds, and said mold member is provided with an inwardly extending lip 53 so as to provide a space 54 between said lip and the face of mold member 1 for receiving molten metal.

As indicated in Fig. 6 the mold member 2 may if desired be made in a plurality of segmental sections 2′, separated from one another along radial lines as indicated at 55. The mold member 1 may also, if desired, be made in any suitable number of sections. With this sectional type of construction I prefer to provide a plurality of rods 11, for example two of such rods, for each section of the mold member 2, for the purpose of causing the mold members to seat squarely against mold member 1 when drawn inwardly as hereinafter described. Said rods may be secured to the respective mold sections 2′ by means of pins 58 and lugs 59. In this case the arm 21 of each bell crank 18 may be connected by slot and pin means 22 and 23 to a cross-bar 57 which is connected to the rearward ends of the two rods 11 so as to draw both of said rods rearwardly in closing the mold. The rotating disk 24 is in this case adapted to engage either arms 21 or cross-bars 57 for the purpose of opening the mold. The remainder of the construction is substantially the same in this case as in the form first described.

I prefer to provide an offset joint, as at 64, between the opposing faces of the two mold members adjacent the peripheries thereof, for the purpose of preventing leakage of molten metal out between the mold members in case the same do not fit snugly together at all points, due for example to warping. The offset portion of such joint may extend substantially perpendicular to the faces of the mold members (as in Figs. 1 and 2, or obliquely, so as to provide a bevelled seat 65, as shown in Figs. 6 and 7.

In the operation of the above described apparatus, the mold members are rotated, by operation of the driving means above described, at sufficient speed to produce the desired centrifugal action on the molten metal when poured into the mold and also to cause the counterweights 19 to be held outwardly by centrifugal action with sufficient force to hold the mold member 2 or the sections 2′ thereof tightly against mold member 1. This holding together of the mold members is effected by means of bell cranks 18 which exert an inward force on rods 11 in an obvious manner. The molten metal, for example, iron or steel of suitable composition, is introduced through opening 45 in any suitable manner and poured into the metal-receiving space 54 provided between the lip 53 on mold member 2 and the face of the cut-out portion 50 of mold member 1. By centrifugal action such molten metal is forced or caused to flow outwardly into all of the mold recesses or cavities 48 and completely fill the same, the pouring of the molten metal being discontinued when the innermost recesses of all the sets, and if desired the passages 51 communicating therewith, are completely filled with the molten metal. It will be seen that due to the centrifugal action on the molten metal the same is forced tightly against the surfaces of the mold recesses and is caused to completely and uniformly fill the same so that balls of perfect shape and uniform density are thus produced. Furthermore, the rapid rotation of the mold members, together with the circulation of air induced by such rotation causes a comparatively rapid cooling and setting of the metal, resulting in a decrease in the time required for each molding operation. The cooling of the molds themselves is also hastened by their rotation and the induced circulation of air, and the cooling may, if desired, be further facilitated by providing projecting fins on the mold members, said fins preferably extending radially as indicated at

47, so as to serve to increase the air circulation as well as the transfer of heat from the mold members to the air. Furthermore, if desired, a liquid cooling medium such as water may be directed onto the mold members to hasten the cooling thereof; such cooling liquid may be introduced, for example, by means of a hose passed through opening 45 or by means of pipe 43 extending through said opening, so as to direct a jet of water into the central space between the molds, after the cast bodies have been discharged therefrom.

The rotation of the mold members may be continued until the metal has set sufficiently to permit discharge of the balls, at which time the three-way valve 39 is operated by means of handle 41 so as to admit fluid pressure to pressure chamber 35, forcing piston 34 to the left (in Figs. 1 and 3) so as to cause lever arm 25 to throw revolving disk 24 to the position shown in Fig. 3. Such disk engages the ends of rods 11 or arms 21 and causes mold member 2 to move outwardly to open position as also shown in Fig. 3. The mold recesses are thus opened up sufficiently to permit the cast balls 60, a set of which is shown in Fig. 5, to be dislodged therefrom by centrifugal force and thrown outwardly against the peripheral wall of housing 44. Said balls are caused to strike said housing with sufficient force to break the same apart in the neck portions between the balls as indicated for example by dotted lines 61. The severed balls then fall, or are carried around by the rotational velocity imparted thereto in leaving the mold, into discharge chute 46 whence they may be delivered to any suitable place for further treatment or storage or for use.

It will be observed that in the casting of the balls in the above-described machine there is practically no waste metal inasmuch as the entire amount of molten metal which is required or used in making a set of balls comprises, as shown in Fig. 5, only the balls themselves, together with the short neck portions 62 between the balls and at the inner end of the innermost balls of the set.

The neck portions remaining on the balls when broken apart may be removed in any suitable manner if desired before the balls are used, but in grinding operations I prefer to simply use the balls in the shape in which they are discharged from the machine as the slightly projecting neck portions do no harm in the grinding operations and are soon worn off thereby. There is hence a complete absence of waste metal such as "sprues" or "gates" which result in the ordinary methods of casting and which must be severed from the balls and remelted for further use. The elimination of this remelting of the sprues and gates results, as above stated, in a very material reduction in fuel consumption.

While I have described my invention particularly in connection with the casting of balls for use in grinding operations, it will be understood that the same may be applied, with suitable modifications, to the casting of bodies of any shape which permits casting thereof. The principal modification which would be required in any case would be a change in the shape of the recesses 48 to conform to the shape of the bodies to be cast.

I claim:

1. An apparatus for casting metal bodies comprising two mold members each provided with recesses adapted to cooperate when the molds are in closed position to form cavities corresponding in shape to the bodies to be cast, means engaging said members to cause them to rotate together while permitting one of said members to move longitudinally with respect to the axis of rotation toward or away from the other member so as to close or open the mold members, means for rotating said mold members, means mounted on one of said mold members to rotate therewith and adapted for operation by the centrifugal force due to the rotation thereof to hold said mold members in closed position, means at the central portion of said members for receiving molten metal, and passage means connecting said metal-receiving means with said recesses.

2. An apparatus as set forth in claim 1 and comprising in addition means for moving one of said mold members away from the other member so as to open said mold members during rotation thereof and against the action of said centrifugally operated holding means and thus permit the cast metal bodies to be dislodged from said recesses.

3. An apparatus as set forth in claim 1 and comprising in addition means adapted to engage one of said members to move the same away from the other member and open the molds, fluid pressure actuated means operatively connected to said mold opening means, and means for controlling the supply of fluid pressure to said fluid pressure actuated means and for also controlling the release of such pressure therefrom.

4. An aparatus for casting metal bodies comprising two mold members mounted for rotation about a common axis and being relatively movable longitudinally of said axis into closed or open position, said mold members having means on their opposing faces, adapted to cooperate when the molds are in closed position to form cavities corresponding in shape to the bodies to be cast, there being a plurality of radially extending sets of such cavities and a plurality of cavities in each of such sets, and said mold members also having means cooperating to form passages connecting all the cavities of each set in series, means at the central portion of said mold members for receiving molten metal, means connecting said metal receiving means with all of the sets of cavities, means for ro-

tating said mold members, and means for holding said mold members together during the rotation thereof.

5. An apparatus as set forth in claim 4 and comprising in addition means for separating said mold members from one another during the rotation of said members so as to permit the cast bodies to be dislodged from said cavities and discharged from the mold members by centrifugal action.

6. An apparatus as set forth in claim 4 and comprising in addition housing means surrounding the peripheral portions of said mold members and means for separating said mold members during the rotation thereof so as to permit the cast bodies to be dislodged from said mold members by centrifugal action and thrown outwardly against said housing means.

7. An apparatus as set forth in claim 4, and comprising in addition radially extending projecting fins on said mold members to facilitate cooling thereof.

8. An apparatus for casting metal bodies comprising two mold members each provided with recesses adapted to cooperate when the molds are in closed position to form cavities corresponding in shape to the bodies to be cast, means for rotating said mold members, means for holding said mold members in closed position, means at the central portion of said members for receiving molten metal, passage means connecting said metal receiving means with said recesses, housing means surrounding the peripheral portions of said mold members, and means for moving one of said mold members relatively to the other mold member so as to separate said members and permit the cast bodies to be dislodged from said recesses and thrown by centrifugal force outwardly against said housing means.

9. An apparatus for casting metal bodies comprising two mold members mounted for rotation about a common axis and relatively movable longitudinally of said axis into closed or open position, means on the opposing faces of said mold members cooperating to form cavities when the molds are in closed position, means at the central portion of said mold members for receiving molten metal, passage means connecting said metal receiving means with said cavities, means for rotating said mold members together about said axis, bell crank means mounted on one of said mold members, counterweight means on said bell crank means, and means connecting said bell crank means to the other of said mold members, so as to cause said counterweight means to operate to move the mold members into closed position and hold the same in said position upon rotation of said mold members.

10. An apparatus for casting metal bodies comprising two members mounted for rotation about a common axis and relatively movable longitudinally of said axis into closed or open position, said mold members having means on their opposing faces cooperating to form cavities when the molds are in closed position, means at the central portion of said mold members for receiving molten metal, passage means connecting said metal receiving means with said cavities, means for rotating said mold members together about said axis and means operable by the centrifugal force due to rotation of said mold members to move said mold members relatively from open position to closed position and to hold the same in closed position.

11. An apparatus as set forth in claim 10 and comprising in addition means for moving said mold members relatively to open position during rotation thereof and against the action of said centrifugally operated means so as to permit the cast metal bodies to be dislodged from said cavities and thrown outwardly by centrifugal force.

12. An apparatus for casting metal bodies comprising two mold members provided with means on their opposing faces cooperating to form cavities when the molds are in closed position, means for rotating said mold members together, said mold members being mounted to permit relative movement thereof longitudinally of their axis of rotation so as to close or open the mold members, means at the central portion of said mold members for receiving molten metal, passage means connecting said metal receiving means with said cavities, and means operable by centrifugal force due to the rotation of said mold members to hold said members in closed position, one of said mold members comprising a plurality of segmental sections movable independently longitudinally of said axis.

13. An apparatus for casting metal bodies comprising two mold members provided with means on their opposing faces cooperating to form cavities when the mold members are in closed position, means for rotating said mold members together about a common axis, one of said mold members being mounted to move longitudinally with respect to said common axis toward or away from the other mold member so as to close or open said mold members, means at the central portion of said mold members for receiving molten metal, passage means connecting said metal receiving means with said cavities, and means for holding said mold member together during rotation thereof, said mold member which is mounted to move longitudinally of said axis comprising a plurality of segmental sections independent of one another with respect to said longitudinal movement.

In testimony whereof I have hereunto subscribed my name this fifth day of May, 1926.

ALBERT E. MIX.