Jan. 22, 1929. 1,699,848

N. M. LOWER ET AL

CENTRIFUGAL CASTING MACHINE

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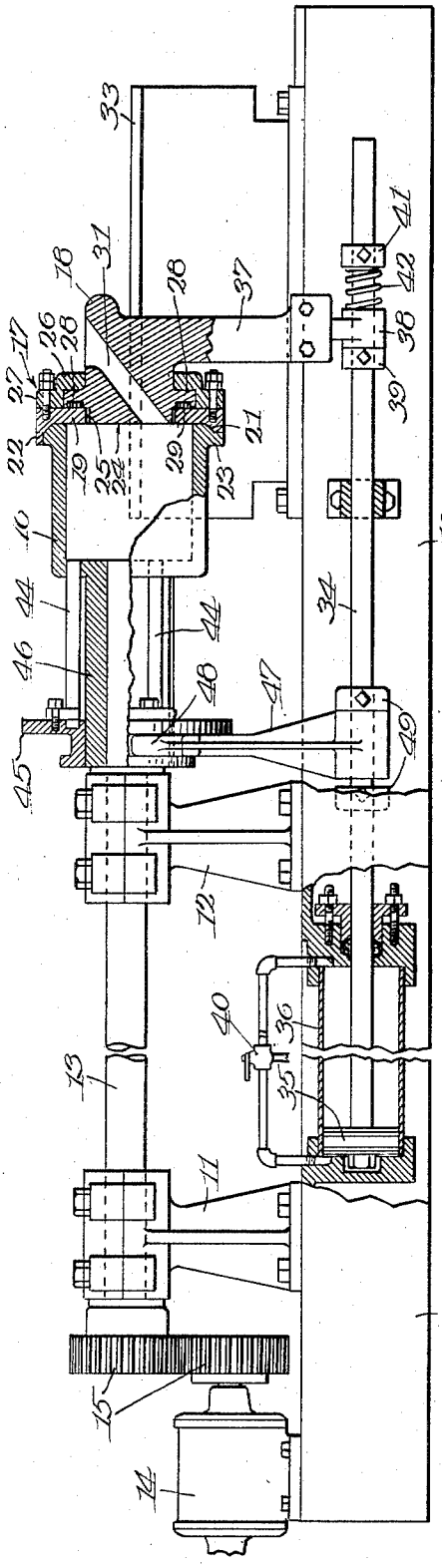


Fig. 1

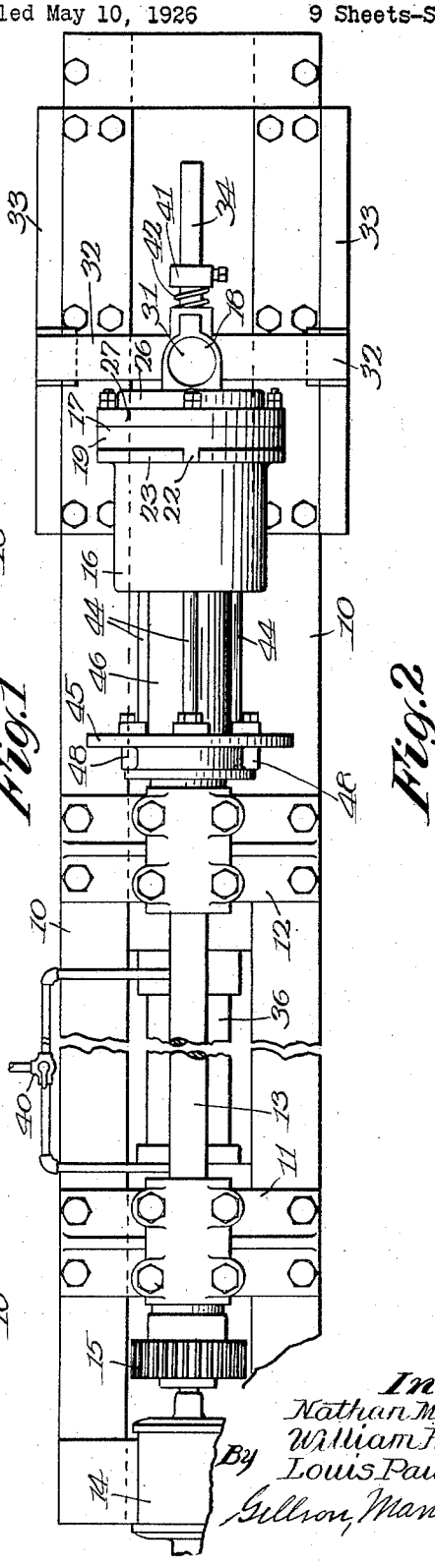


Fig. 2

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CENTRIFUGAL CASTING MACHINE

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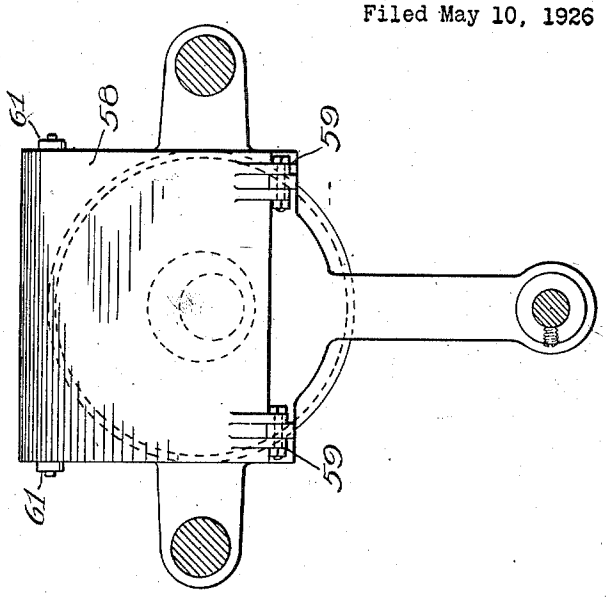


Fig. 4

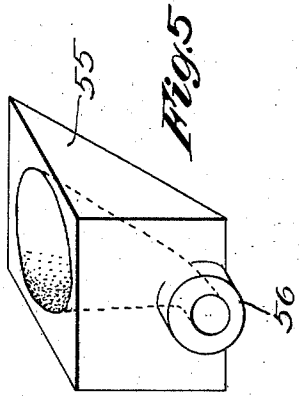


Fig. 5

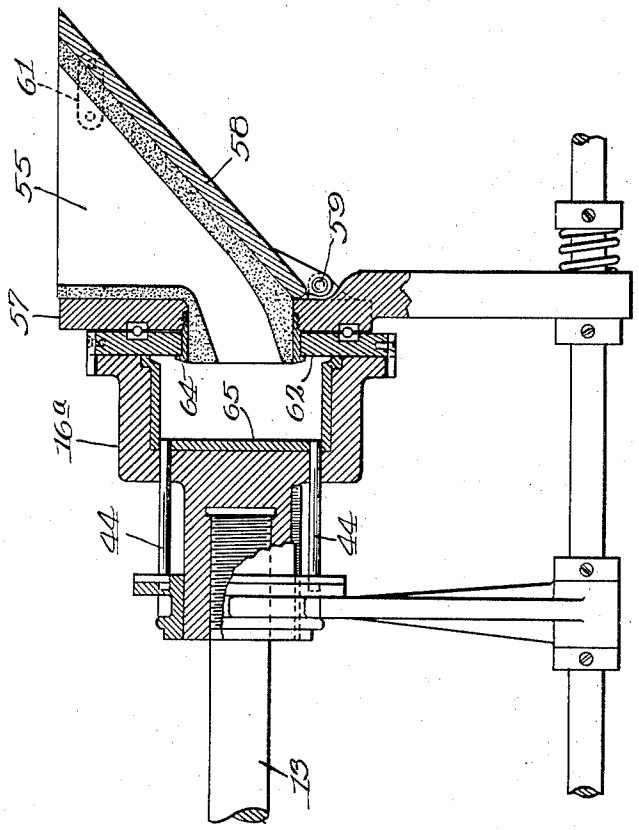


Fig. 3

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CENTRIFUGAL CASTING MACHINE

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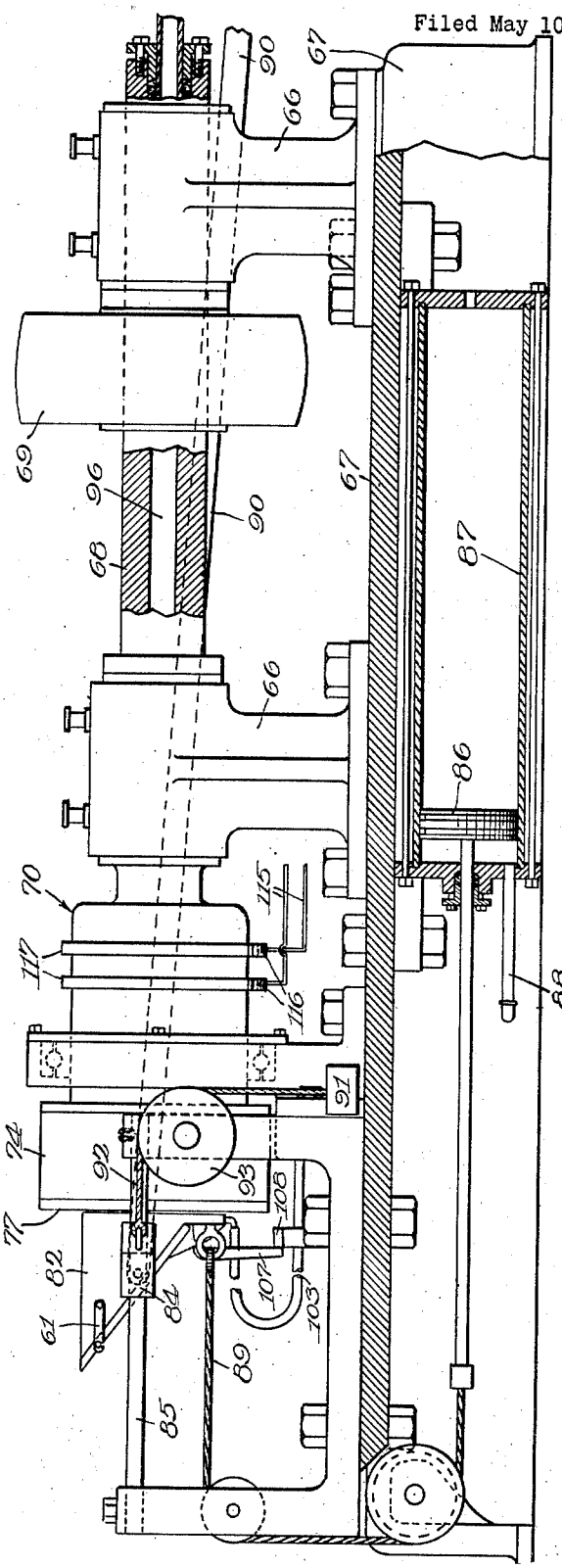


Fig. 6

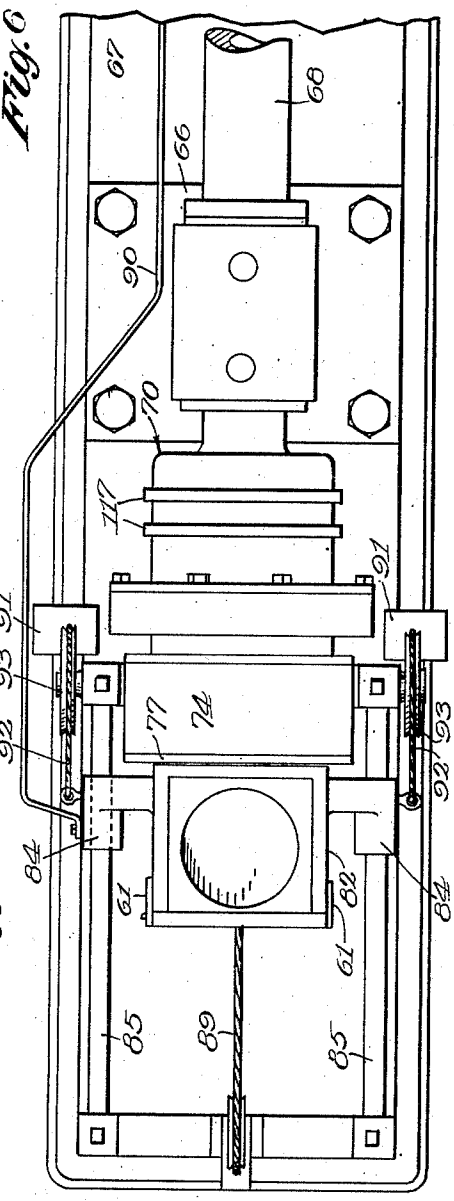


Fig. 7

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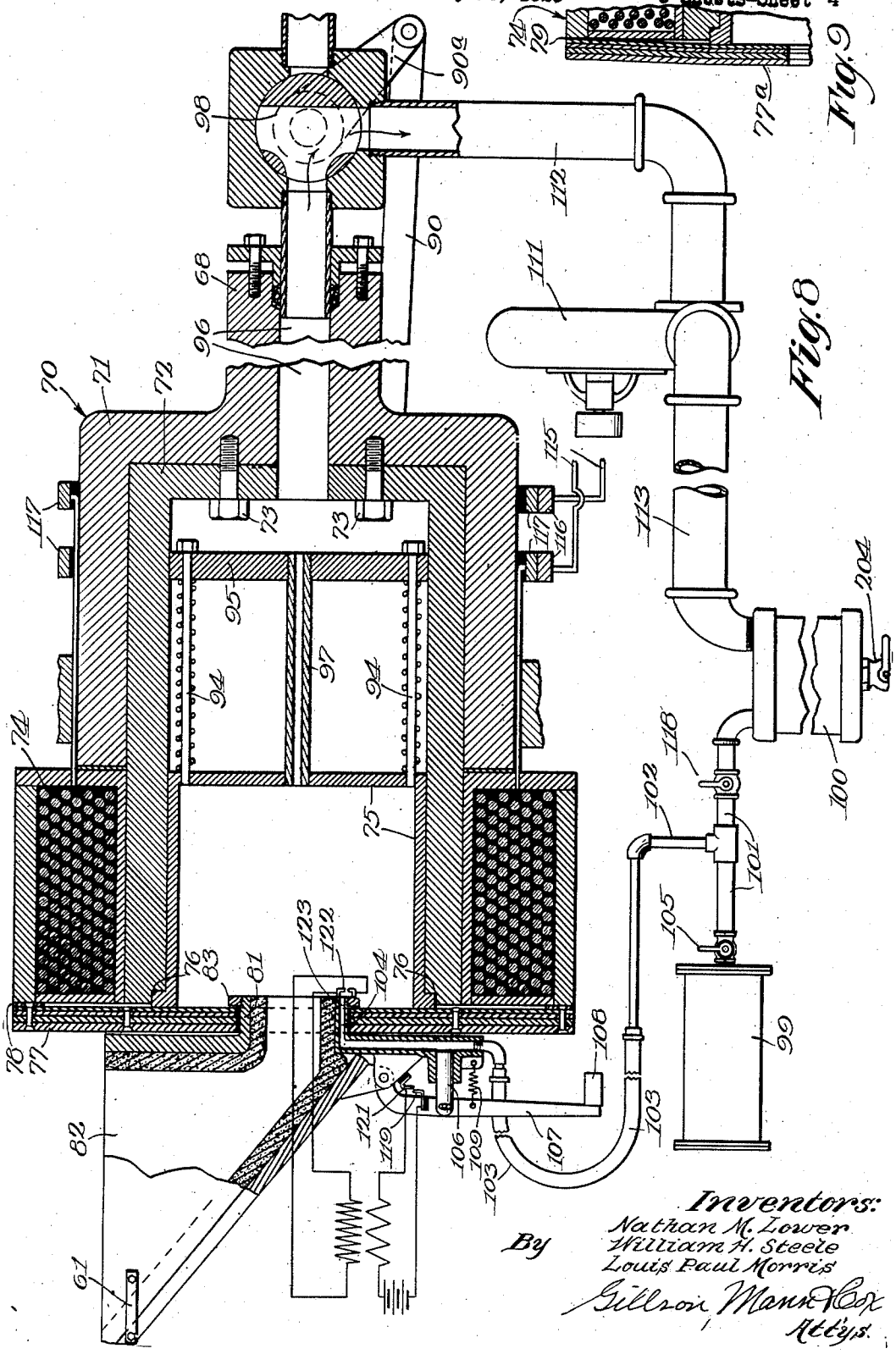


Fig. 8

Fig. 9

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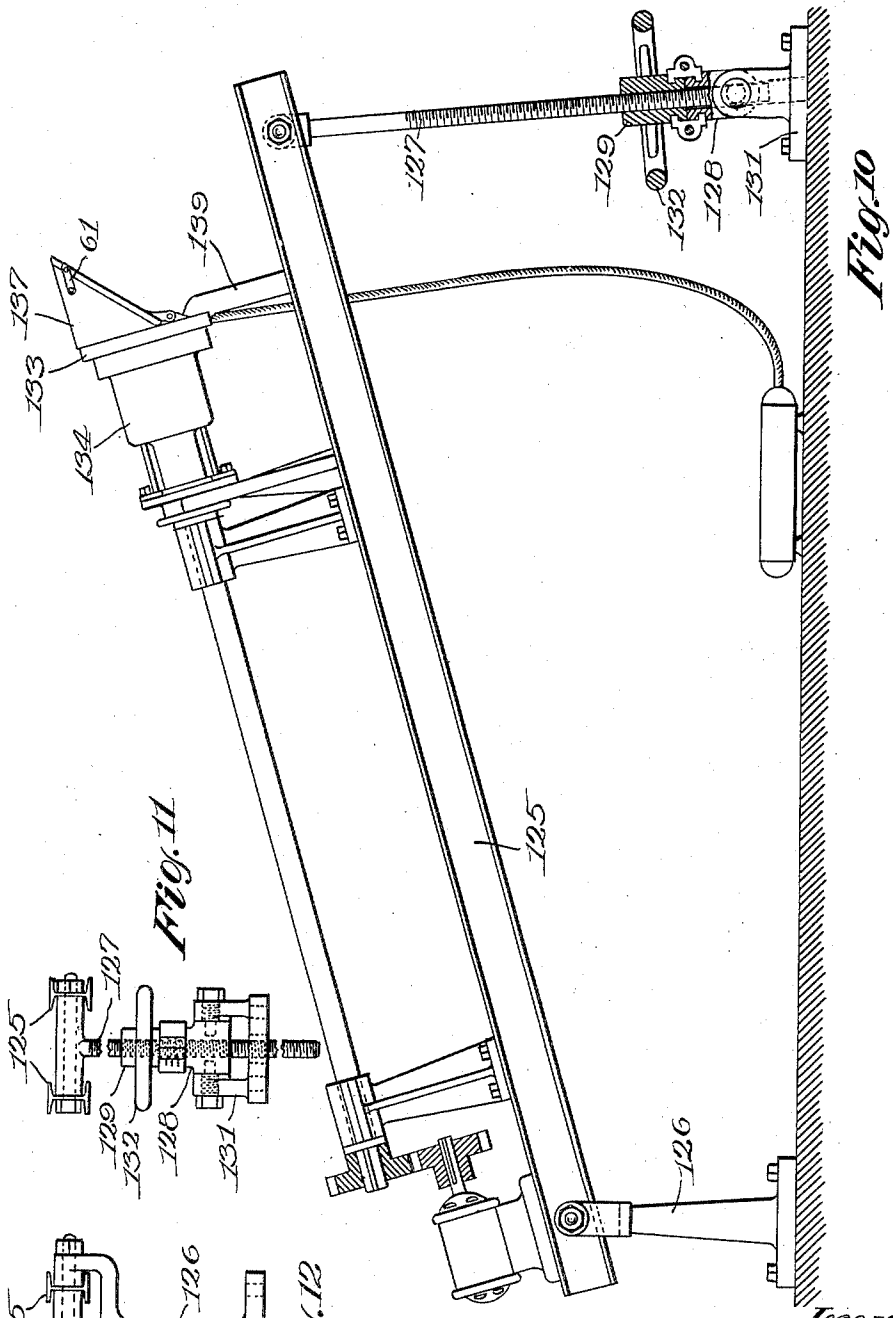


Fig. 10

Fig. 11

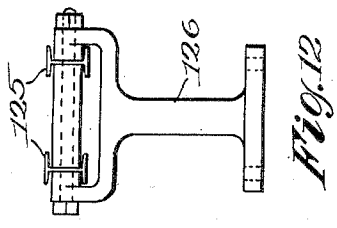


Fig. 12

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CENTRIFUGAL CASTING MACHINE

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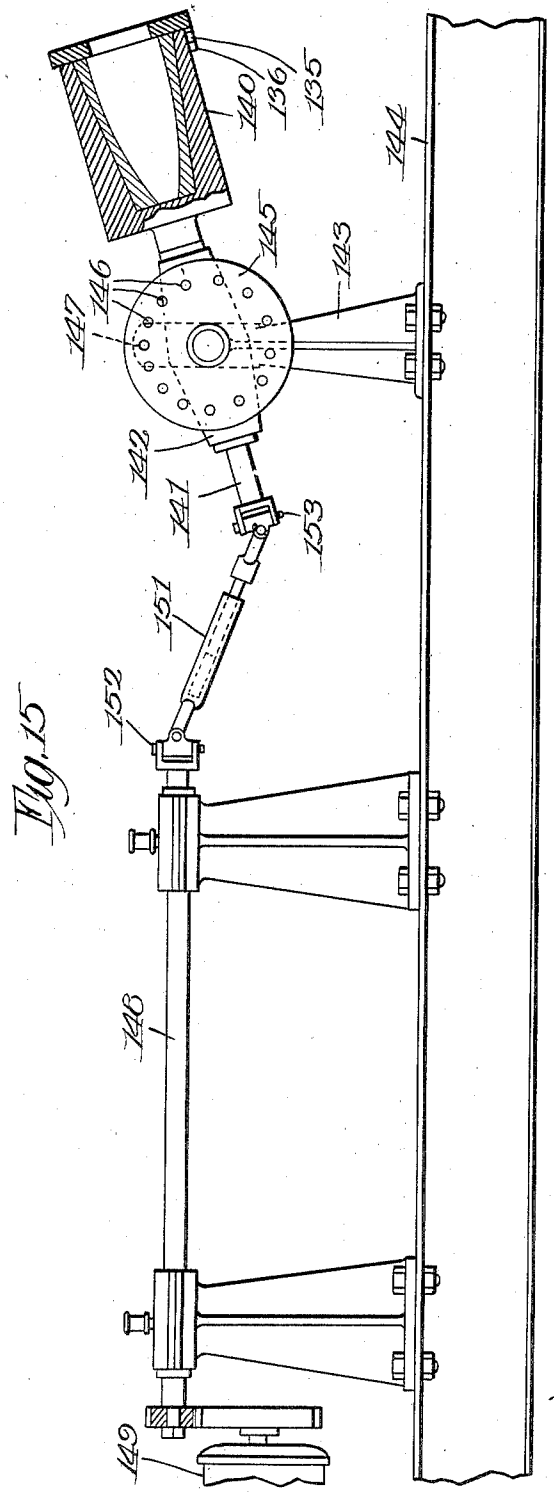


Fig. 15

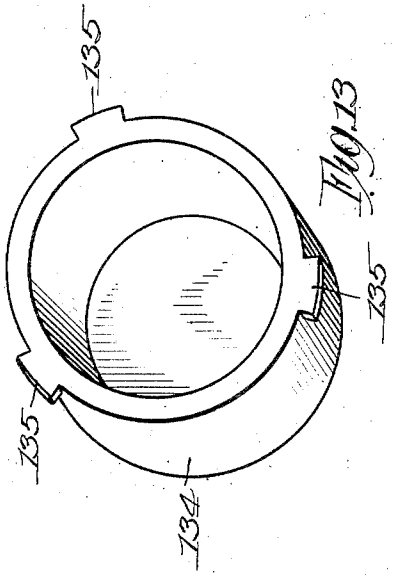


Fig. 13

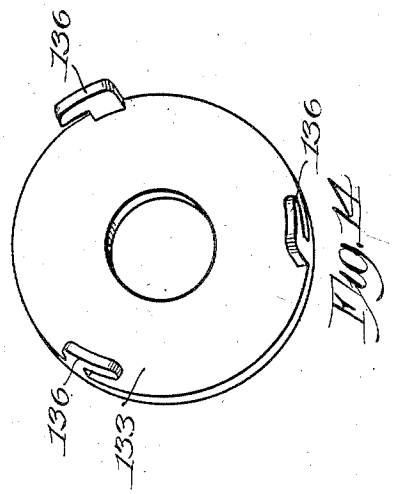


Fig. 14

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CENTRIFUGAL CASTING MACHINE

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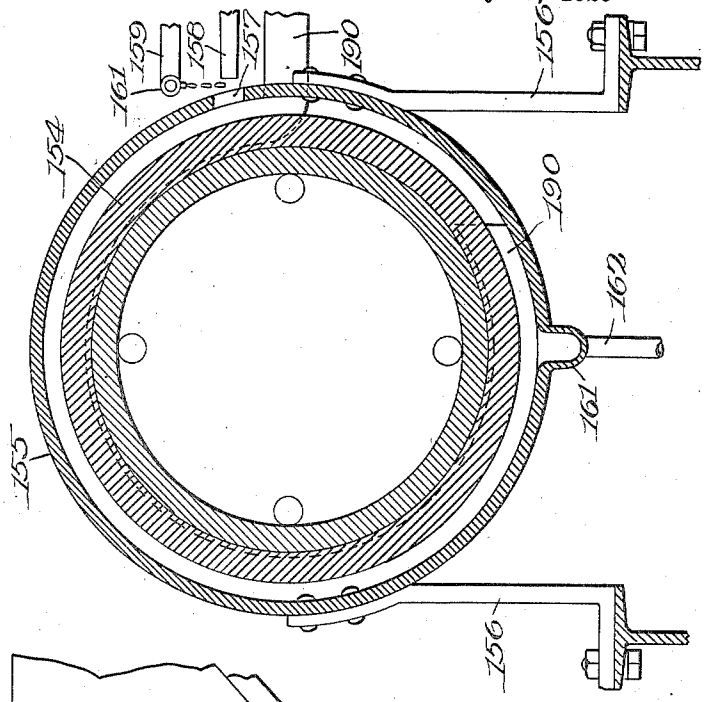


Fig. 17

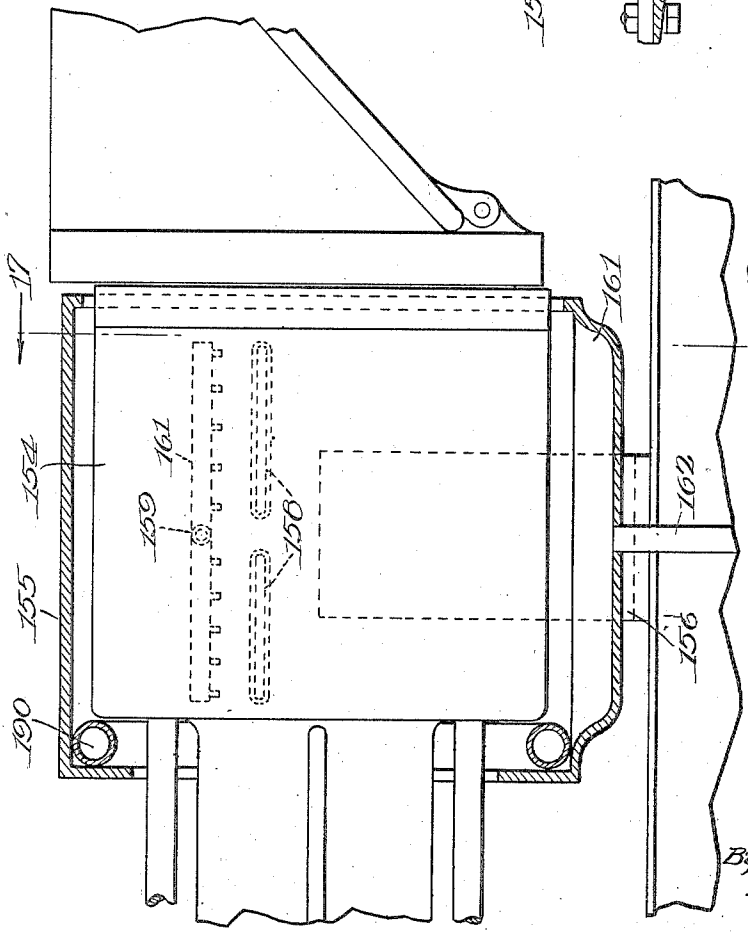


Fig. 16

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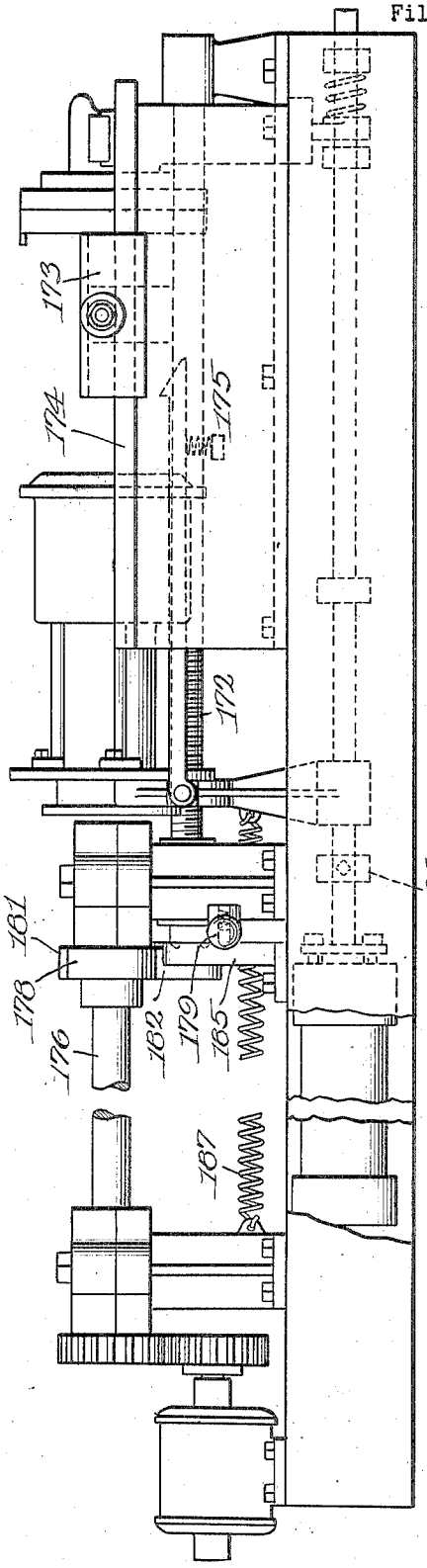


Fig. 20

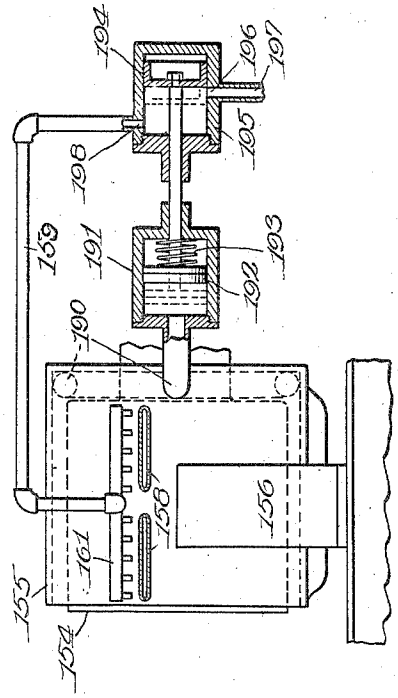


Fig. 18

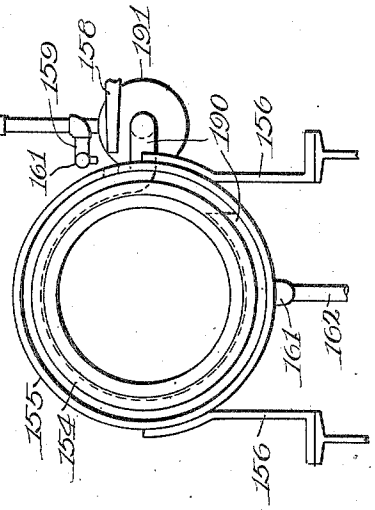


Fig. 19

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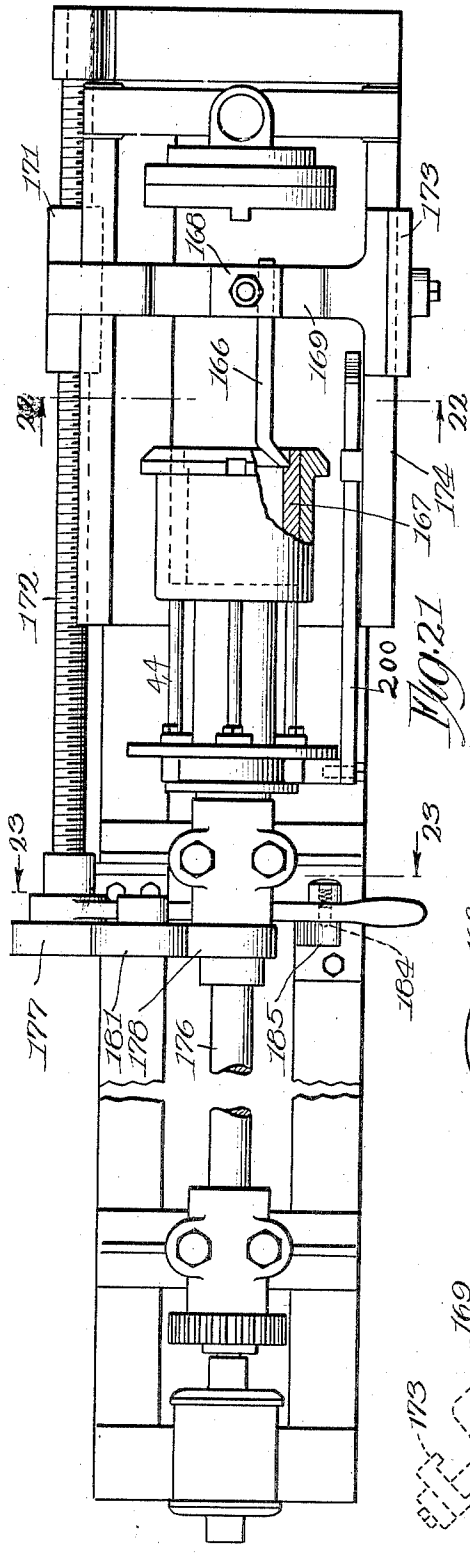


Fig. 21

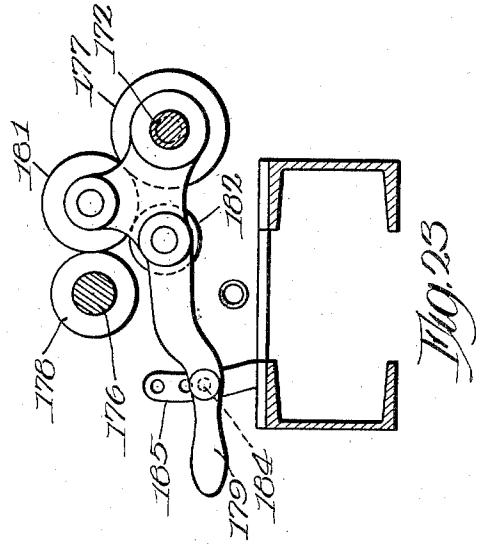


Fig. 23

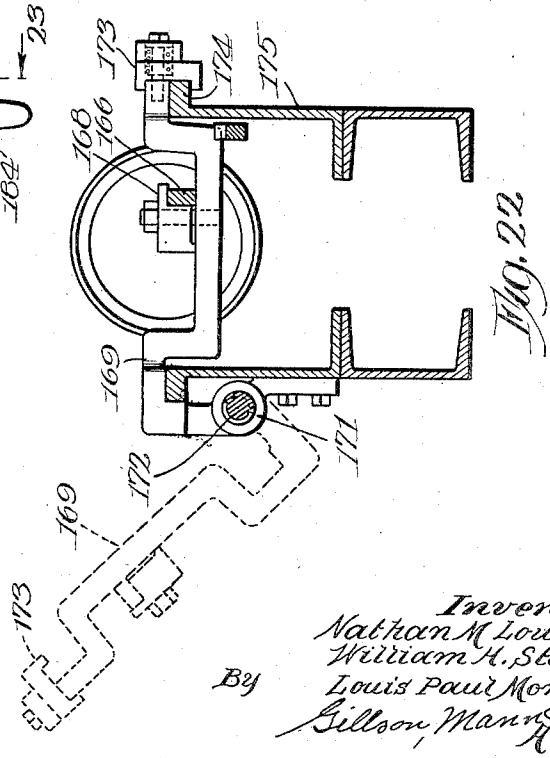


Fig. 22

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Patented Jan. 22, 1929. 1,699,848

UNITED STATES PATENT OFFICE.

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CENTRIFUGAL CASTING MACHINE.

Application filed May 10, 1926. Serial No. 107,862.

This invention relates to molding machines, and more particularly centrifugal machines for molding metallic bearings and other tubular members.

One of the objects of the invention is the provision of new and improved means for securing the closure to the rotating mold during the molding operation.

Another object of the invention is the provision of new and improved means for partially cooling the cast metal prior to its ejection from the mold.

Another object of the invention is the provision of new and improved means for adjusting the mold angularly relatively to a horizontal plane.

A further object of the invention is the provision of a centrifugal mold for casting tubular members that is provided with a new and improved combined closure and pouring spout.

A further object of the invention is the provision of new and improved means for maintaining the rotating mold at a uniform temperature during the molding operation.

A still further object of the invention is the provision of new and improved means for preventing the oxidation of the metal during the casting operation, thereby insuring a homogeneous structure.

Another object of the invention is the provision of a new and improved centrifugal casting machine that is cheap to manufacture, easily assembled, efficient in operation, composed of few moving parts, economical to operate, and that is not likely to become broken or get out of order.

Other and further objects and advantages of the invention will appear from the following description taken in connection with the accompanying drawings, in which

Fig. 1 is a side elevation of one form of the device, with parts in section and parts broken away;

Fig. 2 is a plan view thereof, with parts broken away;

Fig. 3 is a side elevation, with parts in section and parts broken away, of a modified form of mold box and pouring spout or gate;

Fig. 4 is an elevation thereof;

Fig. 5 is a perspective view of a refractory liner for the pouring spout or gate;

Fig. 6 is a side elevation, with parts in section and parts broken away, of a modified form of the device;

Fig. 7 is a plan view thereof, with parts broken away;

Fig. 8 is a side elevation of a modified form of the device shown more or less diagrammatically, showing the mold box and a portion of the pouring spout in vertical section, with parts broken away and parts removed for convenience in illustration;

Fig. 9 is a fragmentary sectional view showing a modified form of closure;

Fig. 10 is a side elevation of a further modified form of the device, with parts in section;

Fig. 11 is a detail view showing the front adjustable standard;

Fig. 12 is a rear elevation of the rear standard of the device shown in Fig. 10;

Fig. 13 is a perspective view of a modified form of mold box;

Fig. 14 is a perspective view of the closure therefor;

Fig. 15 is a side elevation of a further modified form of the device, with parts in section and parts broken away;

Fig. 16 is a side elevation of a mold box and adjacent mechanism with parts in section and parts broken away, showing means for cooling the mold box;

Fig. 17 is a section on line 17—17 on Fig. 16;

Fig. 18 is a side elevation of a mold box with means for controlling the cooling mechanism shown in Figs. 16 and 17, with parts in section and parts broken away;

Fig. 19 is an end elevation thereof;

Fig. 20 is a side elevation of the device showing a boring attachment mounted thereon;

Fig. 21 is a plan view thereof;

Fig. 22 is a section on line 22—22 of Fig. 21; and

Fig. 23 is a section on the broken line 23—23 of Fig. 21, looking in the direction of the arrow.

The invention may be embodied in various forms. In Figs. 1 and 2 is shown one of the simplest forms, and for convenience this form will be described first.

Referring to Figs. 1 and 2, the reference character 10 designates a supporting base or frame of any approved construction, that shown being rectangular in form, on which are mounted the supporting standards 11 and 12. Journaled in suitable bearings carried by the standards 11 and 12 is a suitable power shaft 13 which is adapted to be operated by

any suitable means such as the motor 14 operating through the gears 15.

A rotating or centrifugal mold member or casting box 16 is rigidly mounted on the forward end of the drive or power shaft 13. For convenience of description that portion of the device seen in Figs. 1 and 2 at the observer's right will be termed the front. The mold box 16 is provided with a cylindrical interior. The box has a closed rear end and is provided with a removable closure, lid or gate 17 for its front end. The closure 17 is provided with a spout or pouring spout member 18 through which the molten metal is introduced into the box. As shown, the closure 17 comprises an annular plate or disk 19 which is provided with an inwardly extending beveled flange 21 for engaging the corresponding beveled or conical surface on the end of the box. The disk 19 is provided with one or more lugs or fingers 22 which engage in recesses in the flange 23 of the box 16, for causing the disk 19 to rotate with the box.

The spout member 18 has a hub 24 which is concentric with the interior of the mold box and which extends through an axial opening 25 in the disk 19. The spout 18 is also provided with an annular flange 28 which is engaged by the offset flange 26 of the sectional ring 27. An antifriction thrust bearing 29 of any approved type is inserted between the plate 19 and the flange 28.

The spout member 18 is provided with a pasage 31 through which the molten metal is introduced into the mold box. The molten metal may be and preferably is introduced into the box during its rotation. This member is mounted on a carriage 32, see Fig. 2, which slides on suitable guideways 33 at each side of the supporting frame.

Suitable means are provided for removing the closure when it is desired to remove the casting. Suitable means are also provided for ejecting the casting after the casting operation.

One manner of accomplishing the removal of the lid and the ejecting of the casting from the mold is shown in Figs. 1 and 2, and will now be described.

A rod or bar 34 is slidably mounted in suitable bearings beneath the mold box 16. The rear end of the rod is connected to a piston 35 operating in the cylinder 36. The admission of a fluid under pressure to either end of the cylinder and its release from the other end is controlled by a suitable manually operated valve 40 in the usual manner.

The spout member 18 is provided with a depending leg 37 which has an extension 38 slidably engaging a rod 34. An adjustable collar 39 limits its movement in one direction and a collar 41 is provided for limiting its movement in the other direction. A spring 42 is preferably interposed between the extension 38 and the collar 41 whereby the closure 17 is resiliently held against the mold box 16 when the compressed fluid is admitted to the front side of the piston as shown in Fig. 1.

The means for ejecting the casting after the casting operation comprises a plurality of fingers 44 slidably mounted in corresponding openings in the rear wall of the mold box 16. These fingers are arranged to operate in proximity to the interior wall of the mold box whereby they will operate to eject hollow castings having thin walls as well as those having thick walls. These fingers are rigidly mounted on a grooved collar 45 which is slidably keyed to the hub extension 46 of the box 16. A standard 47 provided with a yoke 48 engaging in the groove of the collar 45 is slidably mounted on the rod 34. The standard is held in adjusted position on the rod 34 by the adjustable collars 49.

By means of the adjustable collars 39, 41 and 49 the standards 37 and 47 may be so adjusted that when the closure is in proper position the front ends of the fingers will be flush with the inner surface of the rear wall of the mold box. The collar 39 and the rear collar 49 may be so adjusted that the removal of the closure and the ejecting of the casting will be either successive or simultaneous as desirable,—preferably they are so adjusted that the two standards 37 and 47 move simultaneously.

In the operation of the device the valve 40 is operated to admit the motive fluid to the front end of the cylinder 36 which will cause the closure 17 to be forced to position to close the mold box 16. The mold is rotated by the motor 130 and the proper amount of molten metal to make a casting is poured into the passage 31 and runs into the mold. The centrifugal force of the mold will cause the metal to flow out against the cylindrical wall of the box and make a cylindrical casting, the thickness of the walls of which will depend on the amount of metal poured into the box. After the metal cools or congeals the valve 40 is operated to cause the piston to move forwardly to open the closure and at the same time eject the casting by means of the fingers 44.

It is desirable to provide a lining of a suitable refractory material for protecting the metal of the pouring spout. In Figs. 3 to 5 is shown one form of this construction. It consists of providing a pouring spout in a single unit formed from suitable refractory material such as sand. The unit comprises the body 55 having the projection 56, which are adapted to be placed in the pouring spout with the projection 56 extending through the closure 62 for protecting the same. The unit has an opening of substantially the same shape as the opening through the spout, through which the molten metal passes into the mold box. The front end 58

of the spout is hinged at 59 and is held in closed position by catches 61. When it is desired to remove the lining the lid or end member 58 is released and turned down after which the lining member may be removed and a new one replaced, if desired.

In these figures the form of the closure and the means for attaching the same to the spout support 57 is slightly different from that shown in Figs. 1 and 2, in that these members are held in assembled position by means of an annular flanged member or thimble 64 which extends through an opening in the closure 62 having its flanged end engaging the closure 62 and having its other end threaded into the support 57. Ball or other suitable anti-friction bearings are inserted between said closure and support.

In Figs. 6 to 9 is shown a type that is more adapted to commercial purposes than the form disclosed in Figs. 1 and 2. In this form of the device the closure is held in position by an electromagnet.

It has been proposed to provide a vertically arranged mold box having an electromagnetically operated closure or bottom, but the device is necessarily complicated in construction and since the mold box rotates about a vertical axis great difficulty is experienced in molding castings properly inasmuch as gravity tends to cause the walls of the castings to be thicker at their lower ends than at their upper. The present construction obviates these difficulties in a simple and efficient manner.

As shown, a pair of standards 66, mounted on a hollow base 67, are provided for supporting the hollow drive shaft 68, which is journaled in the upper ends thereof. The shaft is rotated by a pulley 69 or any other suitable driving mechanism. The forward end of the shaft 68 is provided with a mold box 70, see Fig. 8, which comprises an outer casing 71 rigidly secured to the shaft as by being integral therewith, and an inner casing 72 which is secured within the outer casing 71 as by means of the bolts 73. The forward end of the inner casing 72 extends beyond that of the outer casing 71 and a coil of wire forming an electromagnet 74 is mounted thereon.

A liner 75 for receiving the molten metal is mounted in the forward end of the inner casing 72 and is provided with a flange 76 which extends slightly beyond the forward end of said inner casing. A suitable closure 77 is provided for the mold box. The closure 77 preferably comprises a plurality of flexible plates secured together by rivets or other suitable means. The closure is of suitable material to form an armature for the electromagnet 74 whereby when the magnet is energized the closure will be held against the outer end of the liner 75 for closing the mold box. In the operation of the device it is necessary that the liner 75 be closed, and for this reason it is extended slightly beyond the inner casing 72 whereby the closure will form a tight joint with the liner. If desired, a ring 78 may be secured to the outer portion of the closure for engaging the electromagnet.

If desired, the ring 78 may be omitted, in which event the resiliency of the plates forming the closure 77^a will permit the same to be bent rearwardly into contact with the electromagnet, as shown at 79 in the modified form of the device shown in Fig. 9.

The closure 77 is rotatably mounted on a rearward extension 81 on the pouring spout 82. A nut 83 on the inner end of the extension 81 is provided for retaining the closure plate in position on said extension. The pouring spout 82 is mounted on a carriage 84 that engages the slide-ways 85, see Fig. 7. The carriage 84 is adapted to be moved forwardly by means of the piston 86 mounted in the cylinder 87.

Steam or other fluid under pressure is admitted to the forward end of the cylinder 87 through suitable pipes or passages 88 controlled by valves 90 as clearly shown in Fig. 6. A flexible member 89 is secured to the forward end of the pouring spout 82 and extends over suitable pulleys for moving the spout forwardly when steam or fluid under pressure is applied to the forward side of the piston 86. The carriage 84 is returned by means of weights 91 which are connected to the carriage as by means of the flexible members 92 extending over the pulleys 93.

Suitable means are provided for forcing the casting out of the liner 75 after the casting operation. As shown, this is accomplished by means of a plurality of fingers 94 which extend through suitable openings in the rear wall of the liner 75 adjacent the outer edge thereof. The fingers 94 are carried by a piston 95 which is adapted to be operated by a fluid through the passage 96 extending through the shaft 68.

It is desirable that means be provided for causing the casting to be contracted after the casting operation in order that it may be more easily ejected. In Fig. 8 is shown one manner of accomplishing this function. As shown, a tube 97 of small caliber is rigidly connected to the liner 75 and slidably engages the piston 95. When the valve 98 is operated to admit a suitable fluid to move the piston 95 for ejecting the casting, a portion of the fluid will pass through the tube or passage 97 into the interior of the casting, thereby cooling the same and causing it to contract whereby it may be readily ejected from the mold box.

In this form of the device, the fluid admitted to the inner casing 72 for ejecting the casting will absorb the heat and prevent overheating of the mold box during its continued use. This is considered an important feature

of the invention inasmuch as it will permit the device to be used continuously for forming castings at a rapid rate.

Since most metals at high temperatures readily oxidize, it is highly desirable in molding such metals, to provide means for excluding the air during the molding operation. A simple manner of accomplishing this is disclosed in Figs. 6 to 8 in which means are shown for flooding the mold box with an inert gas during the molding operation. As shown, a reservoir 99 which may be mounted in the base of the machine is provided for containing an inert gas. A passage is provided for supplying the gas to the mold box. This passage comprises the pipe 101 and a branch passage 102 including a flexible hose 103 for permitting the travel of the carriage. The gas is delivered to the interior of the mold box through an opening 104. A valve 105 is placed in the pipe 101 for manually shutting off the supply of gas when desired or in case of emergency.

Suitable means are provided for automatically turning on the supply of gas and for cutting off the same. A valve 106 is employed for this purpose. The valve is operated by a lever 107 the lower end of which engages a contact member 108 and opens the valve when the carriage containing the closure is moved rearwardly to close the box. When the carriage is moved forwardly to open the mold box the lever 107 is moved by the spring 109 to close the valve and cut off the gas supply.

In order to use the gas over and over again the valve 98 is preferably a three-way valve whereby the same may be employed for the gas and for the fluid used for operating the piston 95. A fan 111 is employed for circulating the gas. A pipe 112 connects the valve 98 with the fan and a pipe 113 leads from the fan to a separator 100 to which one end of the pipe 101 is attached. In the operation of the device a suitable amount of the inert gas from the tank 99 is permitted to escape into the pipe 101 through the valve 105 and the fan 111 will cause the same to continue to circulate through the mold box, the pipe 97, the bore 96, valve 98, fan and separator, back to the mold box.

Mechanism is preferably provided for automatically operating the three-way valve 98. As shown the valve is provided with a crank 90^a which is connected to the carriage 84 by a link 90 whereby when the carriage is moved forwardly to open the closure of the mold box the valve will be operated to close the passage to the pipe and open the passage to supply fluid to the mold box to eject the casting.

In the operation of the device, when the molding process is completed the circuit through the electro-magnet 74, the current of which is supplied through the leads 115, brushes 116 and contact rings 117, is opened by a suitable switch and the valve turned to apply pressure to the front face of the piston 86 for moving the carriage rearwardly for operating the valve 106 to cut off the gas, and for simultaneously moving the valve 98 to open the fluid passage for supplying fluid to the mold box for operating the piston 95 to eject the casting. After the casting is ejected, the pressure on the front face of the piston is released and the weights 91 will return the carriage 84 which in turn will operate the valves 106 and 98. The water, steam or other fluid and gas in the mold box pass out from the device through the passage 96 and the pipe 112 into the separator 100 where the water or other fluid is extracted and permitted to escape through the discharge valve 204, and the gas returned to the mold box. The current is turned on and the molten metal poured into the pouring spout, thus completing the cycle of operation.

It has been found by experiment that if the interior of the mold box be dusted with finely divided foreign matter, as finely ground graphite, plumbago, whiting and the like, between each casting operation, the tendency of the casting to stick to the mold is greatly lessened and the life of the mold box considerably extended. A convenient manner of coating the interior of the mold box is to smoke the same. This is preferably accomplished by means of an inflammable gas. If the use of an inert gas is not required the inflammable gas, as acetylene is placed in the tank 99, see Fig. 8, and the valve 118 closed, and the fan not operated. If the use of the inert gas is desired a separate arrangement for each is necessary. Where an inflammable gas is employed the use of an additional inert gas is unnecessary inasmuch as the burning of the gas will consume the oxygen in the mold. Suitable means are provided for igniting the gas when the carriage 84 is moved rearwardly to close the mold box. A convenient manner of igniting the gas is to provide a make-and-break contact in an electric circuit to be operated manually or automatically as shown. As shown in Fig. 8 a spring contact member 119 carried by the lever 107 is adapted to engage a fixed contact member 121 mounted on the carriage. As the lever moves in and out the spring contact will make and break the circuit and cause a spark between the two points 122 adjacent the passage 123 through which the gas enters the mold box. The amount of gas used and the time of burning is controlled by the valve 105. If desired the gas may be permitted to continue to burn until shut off by the valve 106 when the carriage is moved forwardly.

It is often desirable that the castings be in the form of a truncated cone. In this event, the interior of the mold box is of similar form and suitable means are provided for tilting the mold. Since different forms

may be desired, means are provided for adjusting the angle of the mold box. In the form of the device shown in Figs. 10 to 12 the mold box and operating mechanism are mounted on a frame or platform 125 which is pivoted to a standard 126 as shown in Fig. 12. The front end of the frame or platform 125 is adjustable vertically. A standard 127 is pivotally connected to the front end of the frame 125 and extends into a bore in the support 128. The lower end of the standard 127 is screw-threaded and the nut 129 holds the standard in adjusted position on the support 128. The support 128 is pivotally connected to a base member 131, see Fig. 10, whereby the support is free to turn so as to remain in alinement with the standard 127 during the angular adjustment of the frame 125. The nut 129 may be provided with a hand wheel 132 for operating the same.

In Figs. 13 and 14 is shown a modified form of means for securing the closure 133 to the mold box 134 as employed in Fig. 10. The mold box 134 is provided with a plurality of lugs 135 and the closure 133 is provided with corresponding slotted projections 136 for engaging the lugs 135. The lugs are slightly inclined and are adapted to engage the slots in the projections. The parts are so arranged that the rotation of the mold will tend to force the inclined lugs into the slots to clamp the closure in position. The closure is rotatably mounted on the spout 137 carried by a standard 139 in the manner described above.

In Fig. 15 is shown a modified form of mechanism for tipping the mold box 140. In this form of the device the mold box is mounted on a shaft 141 which is journaled in a bearing 142 pivoted to a standard 143 mounted on the frame 144.

Suitable means are provided for holding the bearing 142 at any adjusted angle. As shown, it is provided with a disk 145 having a series of apertures 146 therethrough each of which is adapted to be brought into alinement with an aperture 147 in the standard 143. A pin, not shown, is adapted to be inserted in the alined apertures for rigidly holding the mold in adjusted position. The disk 145 is preferably graduated to indicate the different angles to which it may be turned.

The mold 140 is rotated by a suitable shaft 148 which may be operated by the motor 149. In order to accommodate the angular adjustments of the mold 140 the power shaft 148 is connected to the mold box operating shaft 149 by the telescopic shaft 151 through the universal joints 152 and 153, as clearly shown in Fig. 15 of the drawings.

If desired, the mold box of the different forms of the device may be provided with means for cooling the same. As shown in Figs. 16 to 19 inclusive, the mold box 154 is surrounded by an envelope or jacket 155 supported by the standards 156 in spaced relation to said box. The jacket 155 is provided with one or more slots or opertures 157 through which a blast of air under more or less compression may be directed against the mold box by one or more nozzles 158.

Means are also provided for preventing the temperature of the mold box from rising materially above a predetermined maximum.

In the form of the device selected to illustrate one embodiment of the invention, water is sprayed on the rotating mold box when the temperature of the same exceeds a predetermined amount, a thermostat being employed to control the valve for supplying water.

The water pipe 159 terminates in a cross tube 161 which is provided with a series of small apertures on its under side through which water may pass in drops or small streams, the parts being so arranged that the water will fall in front of the air nozzle or nozzles 158. The air escaping through the nozzles will blow the water through the opening 157 in the form of a spray against the rotating mold box, thereby cooling the same. The lower portion of the jacket 155 is provided with a sump or depression 161 for collecting the water and discharging the same through a pipe 162.

Suitable means are provided for automatically opening and closing the water valve for supplying the necessary amount of water to cool the mold box and prevent the temperature of the same from rising above a predetermined maximum. As shown, a fluid thermostat has its inner end in the form of a tube 190 extending about the mold box between the same and the jacket 155 and has its opposite end terminating in a cylinder 191 in which reciprocates a piston 192. The tube 190 and a portion of the cylinder 191 are filled with an expansible fluid which, when the mold box becomes heated, will expand and move the piston outwardly, against the compression spring 193. The movement of the piston 192 is employed for operating a water valve for controlling the water supplied to the tube 159 for cooling the mold box. Any suitable valve mechanism may be employed for this purpose. By way of example, the valve may be in the form of a piston 194 operating in a cylinder 195. The cylinder is provided with an intake port 196 in communication with a water supply pipe 197 and with a port 198 in communication with the pipe 159.

When the mold box becomes heated, it will cause the volatile fluid in the thermostat to expand and move the parts to the position shown in full lines in Fig. 11, thus opening the port 196 and permitting water to flow through the pipe 197, port 196, cylinder 195, port 198 and pipe 159 for spraying the mold box. When the box cools, the volatile fluid in the thermostat will contract and the spring

193 will move the piston 192 toward the dotted line position shown in Fig. 11, for diminishing or stopping the flow of water through the port 196.

It is often desirable at least to rough bore the inner surface of the castings before they are removed from the mold. Mechanism for accomplishing this function is disclosed in Figs. 20 to 23, inclusive.

The molding machine is the same, substantially, as previously described, and it is not thought necessary to repeat the description of the detail parts.

The tool 166 for boring the casting 167 is carried by the tool holder 168 mounted on the carriage 169. The carriage is provided at one end with an internally threaded sleeve 171 through which the threaded shaft or feed screw 172 extends for feeding the tool toward the casting during the boring operation. The opposite end of the carriage 169 is provided with a spring-pressed latch 173 for engaging the guide rail or way 174 of the frame 175.

The feed screw 172 is operated from the power shaft 176 through a series of friction gears. The feed screw 172 is provided with a friction gear 177 and the power shaft 176 with a friction gear 178. In order to enable the operator to reverse the rotation of the feed screw for withdrawing the tool from the casting a reversing mechanism is employed. This mechanism comprises a lever 179 pivotally mounted on the shaft 172 and carrying two friction gears 181 and 182, the gear 181 being in frictional engagement with the gear 182 and also with the gear 177 on the screw shaft 172. By lowering the lever 179 the gear 181 is brought into engagement with the gear 178 on the drive shaft 176 for driving the feed screw 172 in one direction, and by moving the lever upwardly until the gear 182 engages the gear 178 the feed screw will be driven in the opposite direction, as is obvious from an inspection of Fig. 23. A suitable spring-pressed detent 184, see Fig. 21, is adapted to engage recesses in the bracket 185 for holding the lever 179 in adjusted position.

When the boring mechanism is not in use the lever 179 is moved to neutral position so that both gears 181 and 182 are out of contact with the gear 178; the latch 173 is released and the carriage 169 turned to the dotted line position shown in Fig. 22.

After the casting operation is complete, the clamp or collar 186, see Fig. 20, is released and the closure removed in the usual manner. The collar 186 is released so that the discharging mechanism will not be moved forward to eject the casting when the closure is removed. A spring 187 will hold the discharging mechanism in retracted position. The carriage 169 and the lever 179 are both moved to the full line positions shown in Figs. 21 and 23 respectively. As the tool 166 nears the bottom of the mold in the boring operation a spring-pressed catch pivoted to the discharging mechanism will automatically engage the carriage 169 whereby when the operating mechanism is reversed to retract the carriage 169 the discharging mechanism will be moved forward to cause the fingers 44 to eject the casting from the mold box.

While in the diagrammatic showing in Fig. 8 mechanism is disclosed for employing either an inert gas or an inflammable gas in the mold, it is understood that under ordinary conditions the inflammable gas will be sufficient for the reason that when the inflammable gas is ignited it will immediately consume the oxygen in the closed box, thereby not only smoking the interior of the box but also removing the free oxygen from the air within the box. In this event the bore of the tube 97 may be greatly reduced, or if it is not desired to use the fluid for cooling the casting the tube 97 may be altogether dispensed with.

It is thought from the foregoing taken in connection with the accompanying drawings that the construction and operation of our device will be apparent to those skilled in the art, and that various changes in size, shape, proportion and details of construction may be made without departing from the spirit and scope of the appended claims.

We claim as our invention:

1. In a centrifugal molding machine, a mold box for casting hollow articles, means for rotating said box, a closure for the box, power operated means for opening and closing said closure, fingers extending through the rear end of said box for engaging the peripheral edge of said article for ejecting the same, and means independent of said first named means for reciprocating said fingers.

2. In a molding machine, a rotatable mold box and automatically operated means for cooling said box when the temperature thereof rises above a predetermined maximum, said means comprising mechanism for spraying a liquid on said mold.

3. In a molding machine, a rotatable mold box, a jacket about said box and thermally controlled means to spray water onto said box through an opening in said jacket when the temperature of said mold rises above a predetermined maximum.

4. In a molding machine, a mold box, means for rotating said box, a laminated metallic closure for said box, means for opening and closing said closure, and electro-magnetic means on said mold for holding said closure in closed position.

5. In a centrifugal mold, a mold box, means for rotating said box, and thermally con-

trolled means for automatically spraying water on said box when the temperature thereof rises above a predetermined maximum.

6. In a molding machine, a mold box, and means for supplying an inert gas to said box during the molding operation, said means comprising a conduit, a valve for opening and closing said conduit, and means for automatically opening and closing said valve.

7. In a molding machine, a mold box in which articles are adapted to be cast, means for ejecting the cast articles from said mold, and means for applying water to the interior of said article for cooling the same prior to its ejection.

8. In a centrifugal molding machine, a mold box, a cylinder associated therewith, a piston in said cylinder, said piston adapted to be operated in one direction by a fluid and provided with means for ejecting a casting from said box when operated on by said fluid, and a passage from said cylinder to said box whereby fluid from said cylinder may escape into said box for cooling the casting therein.

9. In a molding machine, a closure for a rotating mold box, a pouring spout carried by said closure, said spout comprising side walls having an annular lateral extension on which said closure is rotatably mounted, and a hinged plate forming with said side walls a receptacle and latches for holding said plate in operative position.

10. In a molding machine, a mold box, means for rotating the same, a closure for said mold box, electro-magnetic means for holding said closure in contact with said box, a pouring spout on said closure, a liner in the outer end of said box, a piston in the other end thereof, ejecting fingers carried by said piston, a passage leading to said box, a three-way valve in said passage for controlling the flow of fluid through said passage for operating said piston, means for supplying an inert gas to said box during the casting operation, and a fan for circulating said gas through said box, valve and passage.

11. In combination, a mold member having its axis substantially horizontal and having an open end, a closure member for said open end, an armature on one of said members, an electro-magnet on the other of said members for attracting said armature for holding said closure member in closed position, and means for removing said closure.

12. In a molding machine, a mold box, means for rotating said box, a closure for said box, means for supplying molten metal to said box, a conduit for supplying gas to the interior of said box, a valve for said conduit, and means operated by the opening and closing of said closure for controlling the operation of said valve.

In testimony whereof we affix our signatures.

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