

Nov. 21, 1933.

C. PACK

1,936,141

DIE CASTING MACHINE

Filed Nov. 20, 1929

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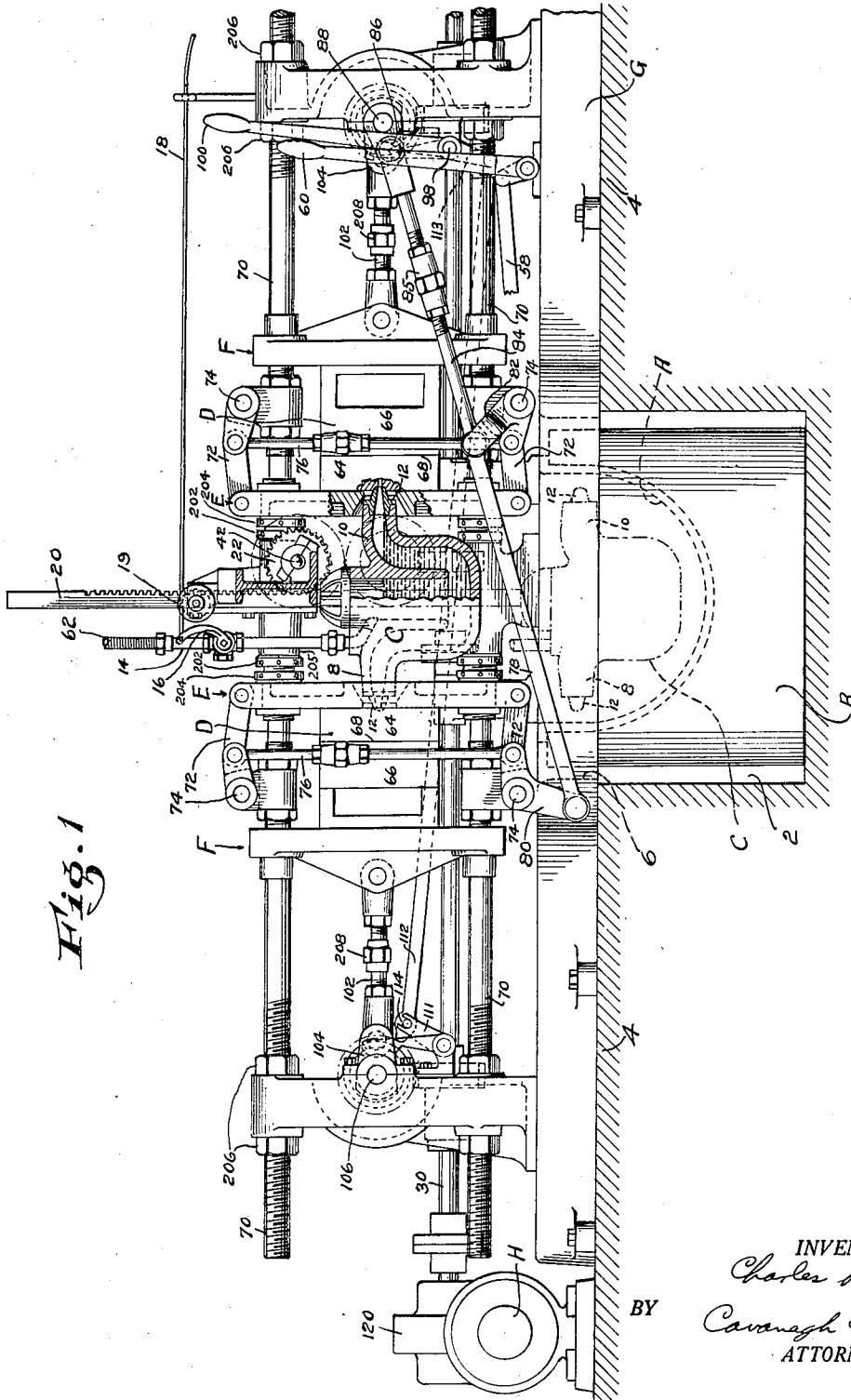


Fig. 1

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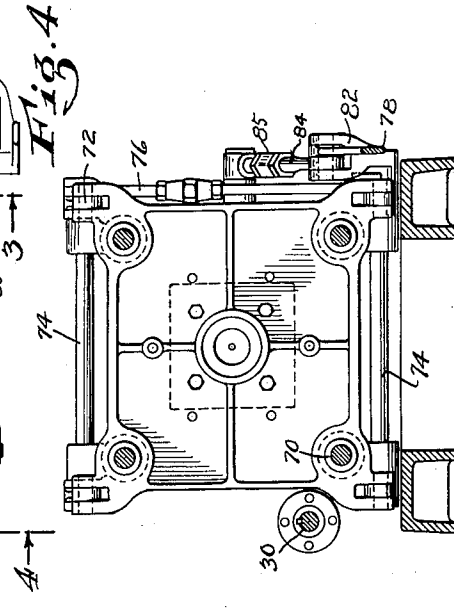
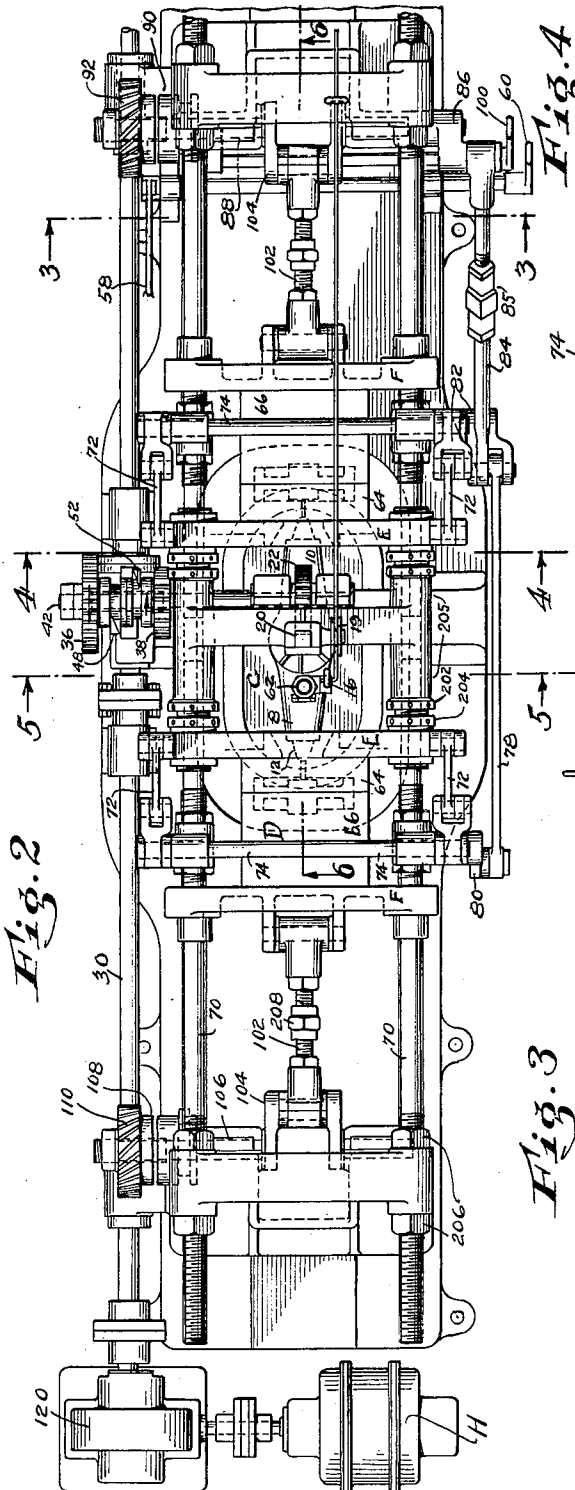
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4 Sheets-Sheet 2



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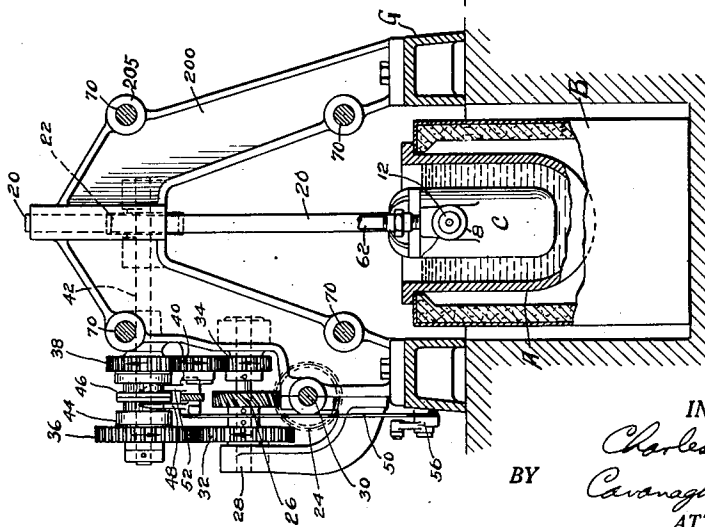
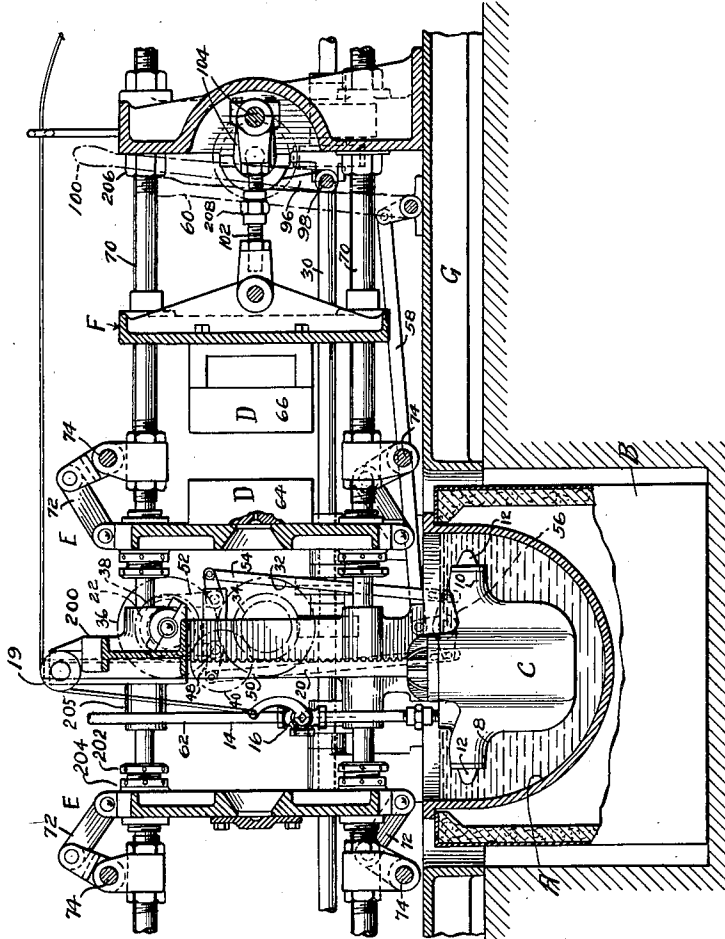
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DIE CASTING MACHINE

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4 Sheets-Sheet 3



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DIE CASTING MACHINE

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Fig. 7

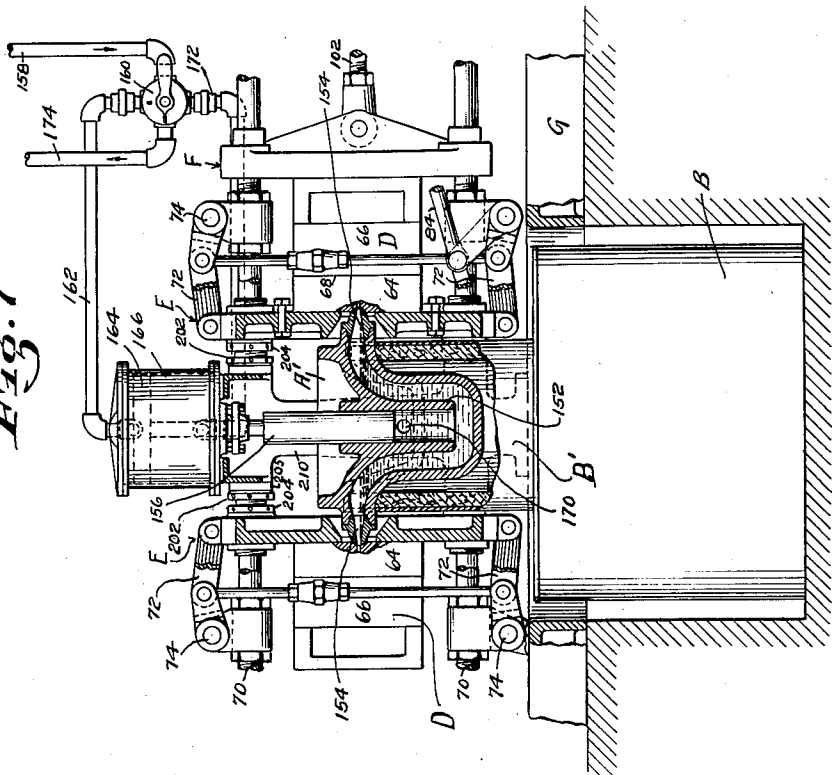
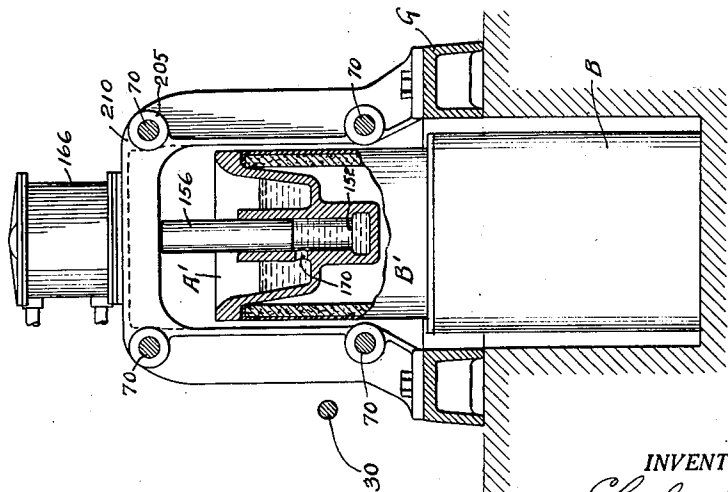


Fig. 8



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UNITED STATES PATENT OFFICE

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DIE-CASTING MACHINE

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Application November 20, 1929
Serial No. 408,441

15 Claims. (Cl. 22-69)

This invention relates to die-casting machines, and more particularly to a multiple die-casting machine.

Die-casting machines usually embody a reservoir of molten metal, a furnace for heating the same, a die in which the metal is cast, and associated operating mechanism for feeding the metal into the die under pressure and for permitting removal of the finished castings from the die. The primary object of the present invention is to multiply the output of a die-casting machine without proportionately increasing the consumption of fuel and power and the necessary floor space and labor.

The surface of the metal in the reservoir is exposed to the atmosphere and is oxidized, forming a dross which must be frequently removed therefrom. This dross difficulty is especially great in the goose-neck type of die-casting machine because the horizontal reciprocation of the goose-neck ladle needed to disengage the nozzle from the die necessitates an increased exposed reservoir surface. A further object of my invention is to diminish the loss caused by the formation of dross, and to this end the ladle is given solely a vertical reciprocation so that the exposed surface of the reservoir may be only slightly larger than the ladle. Even more importantly, the multiple operation before mentioned is employed, that is, the ladle is provided with a plurality of goose-necks each used to transfer molten metal to a different one of a plurality of dies so that the exposed metal in the reservoir is very greatly reduced in proportion to the output of the machine. This also reduces the loss due to alloy contamination.

The simple vertical reciprocation of the goose-neck ladle leads to the difficulty of disengaging the die from the outlet nozzle on the goose neck. For this purpose in the present machine the die holder is provided with suitable mechanism for reciprocating the entire die into and out of engagement with the nozzle of the ladle.

The die ordinarily consists of separable portions to permit of the removal of the finished castings therefrom. In the ordinary die-casting machine the inner portion remains stationary and the goose-neck ladle is reciprocated horizontally as well as vertically in order to engage the goose-neck nozzle with the stationary inner portion of the die. The outer portion of the die is mounted reciprocally so that it may be separated from the inner portion and the finished castings removed therefrom. In the present machine it has already been pointed out that the goose-neck

ladle is reciprocated solely vertically between a loading position immersed in the reservoir and a casting position above the reservoir, and that it is therefore necessary for the inner die portion to reciprocate. A further object of the present invention is to permit of separation of the inner and outer die portions for the removal of castings without loss of time, and to this end the inner and outer die portions are reciprocated simultaneously, but the outer die portion is reciprocated further than the inner die portion, thereby separating the die with the same rapidity and ease as though only the outer die portion were being reciprocated.

In the ordinary die casting machine the mechanism for reciprocating the goose-neck ladle both vertically and horizontally must be very strongly constructed in order to permit of forcing the goose-neck ladle against the die with considerable pressure in order to form a leakproof joint in spite of the great pressure under which metal is ejected from the ladle into the die. It is apparent that if a multiple machine were provided merely by employing a plurality of parallel similarly directed nozzles the force of engagement would have to be proportionately increased and that additional difficulty would arise because of the possibility of the pressure of one of the nozzles tending to relieve the pressure of another of the nozzles. Accordingly, another object of my invention is to insure that the multiple nozzles will be engaged with the respective dies with equal pressure and to obviate the necessity of an extremely rigid supporting and moving mechanism for the goose-neck ladle. This object is fulfilled by providing the ladle with oppositely directed goose necks and bringing the dies into forceful engagement with the nozzles by moving them simultaneously and oppositely into engagement therewith. With this arrangement it will be obvious that the ladle itself may be lightly and preferably floatingly supported so that it may freely position itself between the oppositely moving dies and that the pressure between the nozzles and the dies will be exactly equal at each side.

In the ordinary die-casting machine the reservoir and furnace for heating the same are ordinarily mounted directly on the machine frame or foundation. Considerable heat is therefore transferred from the reservoir and furnace to the machine which increases the heat radiation loss of the machine and which shortens the life and lessens the accuracy of the mechanism of the machine, inasmuch as the tolerances in the machine mechanism must be made large in order

to allow for the expansion and contraction caused by the changes in temperature to which such mechanism is subjected when the machine changes from a cold to hot condition. One object of the present invention is to overcome these disadvantages caused by transfer of heat to the machine mechanism, and for this purpose the reservoir and furnace are mounted independently of and disconnected from the machine frame in order to very greatly reduce the heat transfer thereto.

Die-casting machines are commonly of two types, the plunger type and the air type, each respectively suitable to the casting of different metals and alloys. A die-casting plant which is to be capable of handling various metals and alloys heretofore had to be equipped with both kinds of die-casting machines, which is wasteful of investment, floor space, and so on. A still further object of the present invention is to provide a combined air and plunger type of die casting machine which will consist of a single frame with cooperating die holders and mechanism for operating the same, and which will be adapted for receiving either a goose-neck ladle and mechanism for operating the same, or a plunger and mechanism for operating the same.

To the accomplishment of the foregoing and such other objects as will hereinafter appear, my invention consists in the elements and their relation one to the other as hereinafter are more particularly described in the specification and sought to be defined in the claims. The specification is accompanied by drawings in which:

Fig. 1 is a partially sectioned elevation of the die-casting machine;

Fig. 2 is a plan view of the same;

Fig. 3 is a section taken in the plane of the line 3-3 in Fig. 2;

Fig. 4 is a section taken in the plane of the line 4-4 in Fig. 2;

Fig. 5 is a section taken in the plane of the line 5-5 in Fig. 2;

Fig. 6 is a longitudinal section taken in the plane of the line 6-6 in Fig. 2;

Fig. 7 is a longitudinal section through the machine when arranged for plunger operation; and

Fig. 8 is a transverse section through the same machine.

Referring to Figs. 1 through 6 of the drawings, there is a reservoir of molten metal A which is heated by a furnace B. A gooseneck ladle C is vertically reciprocable between a loading position immersed in the reservoir and a casting position above the reservoir, as is in the drawings shown. There are dies D, the inner portions 64 of which are mounted on reciprocable die holders E, and the outer portions 66 of which are mounted on reciprocable die holders F. The machine frame G carries suitable mechanism for operating the ladle C, the inner die holders E, and the outer die holders F, all of this mechanism being operated from a single driving motor H.

The reservoir A is made with an open or exposed upper surface only slightly larger than the ladle C, this being made possible by the simple vertical movement of the ladle. The furnace B is preferably simply a gas furnace. The reservoir is supported on the upper edge of the furnace, and the reservoir and furnace are mounted in a recess 2 in the foundation 4 of the machine. The machine frame G is provided with an opening 6 greater in diameter than the diameter of the furnace B, and the reservoir and furnace are

mounted independently of and disconnected from the frame G, so that there is a great reduction in the transfer of heat to the machine frame and mechanism. This reduces the heat loss due to radiation, and increases the life of the machine because the operating parts may be made with closer tolerances than would be the case were the machine exposed to large temperature variations.

The ladle C is a multiple gooseneck ladle, and preferably is provided with a pair of oppositely directed goosenecks 8 and 10, each provided with a substantially horizontally directed outlet or nozzle 12 through which the metal ejected from the ladle flows into the dies D. The ladle is fully enclosed, and has connected thereto a compressed air inlet pipe 14 provided with a valve 16 controlled through a cord 18 passing over a stationary pulley 19, so that the metal may be ejected into the dies under considerable pressure.

The ladle is supported at the lower end of a vertically reciprocable rack 20, which meshes with a pinion 22. The drive for the pinion 22 is best shown in Figs. 2 and 5, referring to which rotation of a continuously driven line shaft 30, itself driven by motor H through gearing 120, rotates a spiral gear 24 meshing with a spiral gear 26 on a counter shaft 28. The shaft 28 carries gears 32 and 34 for respectively causing immersion and emersion of the ladle. Gear 32 meshes directly with a gear 36, while gear 34 meshes with a gear 38 through an intermediate idler gear 40, so that gears 36 and 38 rotate in opposite directions. Pinion 22 is mounted on a shaft 42, to which are fixed the driven portions of single revolution clutches 44 and 46, respectively arranged to engage with either the gear 36 or the gear 38. Clutch 44 is operated through a finger 48 and an operating rod 50, best shown in Figs. 5 and 6, while clutch 46 is operated through finger 52 and a rod 54, best shown in Fig. 6. Rods 50 and 54 are simultaneously and oppositely moved by a pair of bell crank levers 56, in turn operated through rod 58 by a manually operable control lever 60, best shown in Fig. 1. It will be obvious from the description so far that motion of lever 60 in one direction will cause descent and immersion of the ladle C, while motion in the opposite direction will cause ascent and emersion of the ladle C. The clutches 44 and 46 are single revolution clutches or otherwise similarly arranged to automatically disengage when the ladle has been moved to either of its extreme positions. The compressed air pipe 14 is provided with a flexible connecting portion 62 to permit the desired movement of the ladle C.

The dies D each consist of separable portions, the inner and outer portions being respectively marked 64 and 66, these portions being separable on a parting line 68. The inner die portions 64 are fixed to die holders E which are mounted reciprocably on rods 70, die holders E being made reciprocable in order to permit the inner die portions 64 to be moved out of engagement with the gooseneck nozzles 12 to permit vertical movement of the ladle C. The desired reciprocation of the die holders E is obtained through toggle arms 72 having a fixed bearing on shafts 74, the bearings of which are mounted rigidly on rods 70. The toggles at both sides of the machine are locked together and simultaneously operated through the shafts 74 extending transversely of the machine, as is best indicated in Figs. 2 and 4 of the drawings. The upper and lower toggles are operated simultaneously through vertical

connecting rods 76, while the toggles for each half of the duplex machine are moved simultaneously through a connecting link 78, and oppositely by reason of the bell crank levers 80 and 82 being oppositely disposed. The initial drive of bell crank lever 82 is through a connecting rod 84 in turn operated by a crank 86 on a shaft 88.

As is best indicated in Figs. 2 and 3, the crank shaft 88 has at its extremity opposite to crank 86 a clutch 90, which is preferably a half revolution clutch, engageable with a worm gear 92, in turn driven by a worm 94 on the main shaft 30 previously mentioned. Clutch 90 is operated through a finger 96 in turn operated through an oscillatable shaft 98 by a manually operated lever 100. By manipulation of the lever 100 the crank shaft 88 may be given a half revolution and all of the toggles 72 moved simultaneously into near alinement, so as to bring the die holders E and the inner portions 64 of the dies D into engagement with the nozzles 12 of the ladle C. Similarly, under the further control of lever 100 the crank shaft 88 may be given another half revolution, thereby breaking the toggles 72 and moving the inner portions 64 of the dies D outwardly a sufficient distance to clear the nozzles of the ladle C and so to permit the ladle C to be immersed in the metal in the reservoir A by manipulation of the ladle controlling lever 60.

The outer portions 66 of the dies are mounted on die holders F, which, like die holders E, are reciprocable on the eight longitudinal rods 70. Die holders F are reciprocated simultaneously with die holders E, but a greater distance in order to separate the outer die portions 66 from the inner die portions 64, so as to permit the removal therefrom of the finished castings. The die holders F are moved by connecting rods 102, in turn operated by cranks 104, made integrally with crank shafts 88 and 106. Crank shaft 88 and its drive and clutch mechanism have already been described. Crank shaft 106 is provided with a similar half revolution clutch 108 for engagement with a worm gear 110 itself meshing with a worm mounted on the main shaft 30. Clutch 108 is controlled through a lever 111, best shown in Fig. 1, operated by a link 112 extending to the other end of the machine and there operatively connected to a crank 113 on shaft 98 of lever 100. In this manner upon operation of the lever 100 both the clutches 90 and 108 are engaged, and the outer die holders F are simultaneously and oppositely reciprocated. At the same time the inner die holders E are simultaneously and oppositely reciprocated a lesser amount, as was previously described.

It may at some time be desired to operate the machine with only one of the dies D. For this reduced output it is necessary that the gooseneck 8 of ladle C be stoppered against loss of metal, and to this end a blank inner die portion may be used to seal off the nozzle on gooseneck 8. This blank must be reciprocated outwardly when the ladle is to be immersed in the reservoir, and it is for this reason that the die holders E are both connected to the single crank shaft 88, and thereby are always simultaneously and oppositely reciprocated. Meanwhile the link 112 which interconnects clutch 108 and operating lever 100 may be dropped from active position by lifting it out of the bifurcation 114 on lever arm 111. The shaft 106 and the corresponding die holder F may thus be left stationary in retracted position when only one die is to be used. However, it will be understood that if

desired it is also possible to permit full operation of both die holders E and F and to merely employ a blank die on one side of the machine.

It will be noted from the construction of the machine that the dies are forced oppositely against the nozzles of the ladle C, placing the ladle, the dies D, the connecting rods 102, and the toggles 72 all under compression, which compression is taken up directly by the eight longitudinal rods 70, which are designed and anchored in the central yoke of the machine with sufficient strength to take the tension. With this construction the ladle C may be mounted yieldably or floatingly with its elevating rack 20, so as to center itself between the oppositely moving dies. This insures equal pressure on the two nozzles and equal pressure on the two parting faces of the dies, and dispenses with the necessity of buttressing the ladle and mechanism thereof against movement. The design of the machine is such that the toggle levers 72 come nearly into dead center and the cranks 104 come into dead center when the halves of the dies are being clamped together and to the gooseneck nozzles, so that extreme pressures are obtainable for sealing these parts against leakage during the casting operation. Toggles 72 do not quite come into alinement in order to prevent them from ever being placed under tension by the pressure of connecting rods 102. When both sides of the machine are in operation the pressure of the toggles 72 may be augmented more than necessary by the pressure of connecting rods 102. The inner die holders E are therefore provided with adjustable capstan screws 202, locked in adjustment by capstan nuts 204. The screws 202 act as stops by butting against the stationary bosses 205, as is best illustrated by a comparison of these parts in Figs. 1 and 6. The adjustment of the desired toggle pressure is made at the turnbuckle 85 on connecting rod 84, and stops 202 are adjusted to leave a slight additional clearance. The pressure between the halves of the dies is adjusted by turnbuckles 208 on connecting rods 102, and if this is considerably greater than the pressure needed at the nozzles 12 the stops 202 act to apportion the pressures as desired. The stops 202 serve with especial usefulness when only one side of the machine is in operation, for in that case in the absence of stops the entire pressure of connecting rod 102 would be placed upon the toggles 72 located at the opposite side of the machine.

It will be appreciated that while the present machine has been illustrated as mechanically operated it is equally possible to apply the principles of and construction for hydraulic and pneumatic operation to good advantage in my multiple die-casting machine, using opposed pistons for moving the dies against a floating ladle. It will also be appreciated that the controlling mechanism, which has here been illustrated as being manual through the use of levers 60, 100, and cord 18, may be suitably mechanically interconnected and interlocked for automatic operation if desired, so that the entire machine may be put through a complete cycle of operations from one removal of finished castings to the next removal of finished castings through the manual operation of only a single controlling means. These refinements have been dispensed with in the present case in order not to obscure the salient features of a multiple die-casting machine in contra-distinction to a single die-casting machine.

So far I have described an air type of die-casting machine. This type of machine is useful with all metals, but is open to the disadvantage of having a relatively low pressure limit. It is mostly used for aluminum alloys or other alloys having a high melting point, with which other machines cannot be employed very satisfactorily.

The other general class of die-casting machine is known as the plunger type, and is preferable to the air type of machine because it is readily possible to attain much higher casting pressures than may be attained in the air machine. However, the plunger machine is limited to alloys of comparatively low melting point, say 850 degrees F., which class includes the zinc, tin, and lead alloys, because at higher temperatures difficulty is experienced due to expansion and freezing of the plunger in the cylinder.

I have illustrated the application of some of the features of my invention to a plunger type of machine in Figs. 7 and 8 of the drawings. Referring to these figures, it will be understood that the machine is generally similar to that previously described except that the reservoir A' in this case includes a cylinder 152 and oppositely directed nozzles 154. A plunger 156 is fitted to cylinder 152 and is driven by pneumatic pressure, applied through a pipe 158, valve 160, and pipe 162, to a piston 164 reciprocating within a cylinder 166. Piston 164 is made large in diameter relative to the diameter of plunger 156 so that extremely high casting may be exerted upon the molten metal in the reservoir 150.

Cylinder 152 is provided with an opening 170 which in cooperation with plunger 156 acts as a valve for the plunger system. The plunger 156 during its descent covers aperture 170, thereby sealing the lower portion of cylinder 152 from the open supply of metal in reservoir A', and thereafter the plunger acts to eject metal through the nozzles 154 under high pressure.

Plunger 156 is retracted by shifting the valve 160 so as to admit air from pipe 158 through pipe 172 to the lower side of piston 164, and simultaneously disconnecting pipe 162 from pipe 158 and connecting it with a discharge pipe 174, so as to relieve the pressure from the upper side of the piston. When plunger 156 is drawn upwardly additional metal runs from the reservoir A' through opening 170 into cylinder 152.

The reservoir A' and associated pump mechanism is heated by a furnace B', which, like the furnace B, in the air type of machine previously described, is supported independently of the frame G of the machine, and is disconnected therefrom, thereby reducing heat transfer to the machine.

The inner portions 64 of the dies D mounted on die holders E are moved away from the nozzles 154 during each cycle to prevent freezing of metal in the nozzles, the dies being kept cold, whereas the nozzles should preferably be kept hot like the reservoir. The outer portions 66 of the dies may be mounted on die holders F which may be reciprocated as in the case of the air machine.

In accordance with a further feature of my invention the same machine is designed so that it may be used interchangeably as either an air machine or a plunger type of machine. The manner in which this is done is almost self-evident from the drawings, Figs. 7 and 8 showing only a fragment of the plunger machine, the remainder of the machine being exactly like that described in Figs. 1 through 6. To make the necessary change the yoke 200, best shown in

Fig. 5 of the drawings, is released from the bed frame G of the machine, and from the eight longitudinal tension rods 70 by slightly loosening the nuts holding the bearings of transverse shafts 74, and considerably loosening the nuts 206, and thereafter unthreading the rods 70 from the bosses 205. Yoke 200 is then replaced by the yoke 210, best shown in Fig. 8, by reversing the above process. Yoke 210 carries the cylinder 166, and must take the reaction of the plunger pressure, and is therefore appropriately bolted to frame G, which is itself made sufficiently rigid to take the resulting bending stress. This is in contrast with its operation as an air machine, in which no bending stress is placed upon frame G, and in which the tension placed on rods 70 is the main operating stress in the machine. This same tension stress occurs also when the machine is used as a plunger type of machine, for it is necessary to obtain leakproof joints between the inner die portions 64 and the nozzles 12 or 154, and between the inner and outer die portions.

The pressure between these members may be adjusted and apportioned by manipulation of turnbuckle 35, the capstan screws 202 and 204, and turnbuckles 208 on connecting rods 102, as previously explained. Adjustment for large variations in the size of the dies D may be made by adjustment of nuts 206, thereby altering the spacing of crank shafts 88 and 106 from the inner die portions, and corresponding movement of the worms 94 on shaft 30.

Besides changing the yoke 200 to the yoke 210 the reservoir A is changed to the reservoir A', and gas furnace B is changed to the smaller gas furnace B', which may be supported on top of a temporary cover placed over furnace B, as shown. The ladle C is incidentally and automatically replaced by the plunger mechanism formed integrally with the reservoir A'.

It is believed that the operation of the machine will be evident from the foregoing description thereof. With the air machine the lever 60 is manipulated to cause the ladle C to be immersed in the reservoir and then to be lifted to the casting position. By movement of lever 100 the dies D are reciprocated into engagement with the nozzles of ladle C, and a pull on cord 18 admits air pressure to the ladle and ejects metal therefrom into the dies. Lever 100 is then operated to retract the dies from the nozzles, permitting lever 60 to again be used to cause the ladle C to go through another loading cycle, and meanwhile during the retraction of the dies D the outer portions 66 are reciprocated much further than the inner portions 64, so that the finished castings may be removed without loss of time.

In the plunger type of machine shown in Figs. 7 and 8 it is merely necessary to manipulate lever 100 to clamp the dies D and thereafter to operate valve 160 to eject metal into the dies. Valve 160 is then restored so as to retract plunger 156, whereupon lever 100 is operated to open the dies and permit removal of the finished castings. The inner die portions are meanwhile separated from the nozzles, thereby preventing solidification of metal in the nozzles.

The advantages of the machine may be outlined somewhat as follows. Because of the multiple operation there is a lower machine investment for a given output, and less floor space is required. For a similar degree of automatic operation less labor is needed to operate the machine, less fuel is consumed in keeping the metal in a molten state, less compressed air is needed for the op-

eration of the machine, and there is a general saving in time and necessary supervision of the production facilities of the plant.

Because only a single reservoir is used in conjunction with a single ladle or plunger cylinder, in place of two, there is great reduction in alloy contamination. This contamination is caused by the gradual solution of the iron of the ladle and reservoir in the molten metal, resulting in an alloy of higher melting point some of which therefore rises to the surface of the metal like dross, but which in reality represents a consumption of the machine parts and a contamination of the alloy. With my invention the reduction in this alloy contamination results in a better product, and in less replacement of the machine parts such as the gooseneck ladle.

Only one reservoir with its exposed surface of molten metal is employed in place of two, and this greatly reduces the formation of dross or oxidation of metal at the surface thereof, and attendant dross loss. This reduction is less than half in the case of the air machine because of the reduction in the exposed surface in the reservoir made possible by the simple vertical reciprocation of the gooseneck ladle employed in the present machine. This simple vertical reciprocation makes possible the use of a relatively large gooseneck ladle and a relatively small reservoir, with the attendant advantages of accommodating the increased capacity of the machine without increasing the losses.

The furnace is not made an integral part of the machine, and this reduces the heat transfer to the machine, and makes possible closer tolerances in the mechanism thereof, which increases its life as well as improves the accuracy of the work performed thereby.

Furnace maintenance cost such as relining is reduced, because of the reduced number of furnaces in use. There is a great fuel saving, particularly when "lighting up" the furnaces in the morning.

The interchangeability of the air and plunger types of machine still further reduces the machine investment and overhead in a complete plant, and correspondingly reduces the floor space needed for the machine equipment.

It will be apparent that while I have shown and described my invention in one preferred form, many changes and modifications may be made in the structure disclosed without departing from the spirit of the invention, defined in the following claims.

I claim:

1. A multiple die-casting machine comprising a reservoir for the metal to be cast, a furnace for heating the same, a plurality of dies, an enclosed gooseneck ladle, a plurality of oppositely directed enclosed outlets thereon for transferring metal therefrom to said dies, means to move the ladle into and out of the reservoir, and pneumatic pressure means for ejecting the metal under pressure from the ladle into the plurality of dies simultaneously.

2. A multiple die-casting machine comprising a multiple goose-neck ladle, a reservoir having a small exposed surface relative to the size of the ladle, and means for reciprocating said ladle solely in a vertical direction between a loading position immersed in the reservoir and a casting position above the reservoir.

3. A multiple die-casting machine comprising a reservoir, a furnace for heating the same, a multiple gooseneck ladle, means for reciprocating

said ladle solely in a vertical direction between a loading position immersed in the reservoir and a casting position above the reservoir, a nozzle outlet on each gooseneck of said ladle, and a plurality of dies each arranged movably for interengaging with a corresponding nozzle.

4. A multiple die-casting machine comprising a reservoir, a furnace for heating the same, a multiple gooseneck ladle, means for reciprocating said ladle solely in a vertical direction between a loading position immersed in the reservoir and a casting position above the reservoir, a horizontally directed nozzle outlet on each gooseneck of said ladle, a plurality of dies each arranged for interengaging with a corresponding nozzle, and means for horizontally reciprocating the dies into and out of engagement with the nozzles.

5. A multiple die-casting machine comprising a reservoir, a furnace for heating the same, an enclosed multiple gooseneck ladle, means for reciprocating said ladle solely in a vertical direction between a loading position immersed in the reservoir and a casting position above the reservoir, a nozzle outlet on each gooseneck of said ladle, a plurality of dies each consisting of separable inner and outer portions, each inner portion being arranged for interengaging with a corresponding nozzle, means for reciprocating the dies into and out of engagement with the nozzles, means for separating the inner and outer portions to permit of the removal of the castings, and means to apply pressure to the metal in the ladle in order to eject the metal therefrom into the dies when casting.

6. A multiple die-casting machine comprising a reservoir, a furnace for heating the same, an enclosed multiple gooseneck ladle, means for reciprocating said ladle solely in a vertical direction between a loading position immersed in the reservoir and a casting position above the reservoir, a nozzle on each gooseneck of said ladle, a plurality of dies each consisting of separable inner and outer portions, each inner portion being arranged for interengaging with a corresponding nozzle, means for reciprocating the inner portions into and out of engagement with the nozzles, means for simultaneously reciprocating the outer portions a greater distance in order to separate the inner and outer portions to permit of the removal of the castings, and means to apply pressure to the metal in the ladle in order to eject the metal therefrom into the dies when casting.

7. A duplex die-casting machine comprising a reservoir, a ladle having a pair of goosenecks, means for reciprocating said ladle between a loading position immersed in the reservoir and a casting position above the reservoir, and a pair of dies arranged for interengaging with the goosenecks.

8. A duplex die-casting machine comprising a reservoir, a ladle having a pair of goosenecks, means for reciprocating said ladle solely in a vertical direction between a loading position immersed in the reservoir and a casting position above the reservoir, and a pair of dies arranged movably for interengaging with the goosenecks.

9. A duplex die-casting machine comprising a reservoir, a furnace for heating the same, a ladle having a pair of oppositely directed goosenecks, means for reciprocating said ladle solely in a vertical direction between a loading position immersed in the reservoir and a casting position above the reservoir, a nozzle on each gooseneck, a pair of dies arranged for interengaging with

the nozzles, and means for simultaneously and oppositely reciprocating the dies into and out of engagement with the nozzles.

10. A duplex die-casting machine comprising a reservoir, a furnace for heating the same, an enclosed ladle having a pair of oppositely directed goosenecks, means for reciprocating said ladle solely in a vertical direction between a loading position immersed in the reservoir and a casting position above the reservoir, a nozzle on each gooseneck, a pair of dies each consisting of separable portions, the dies being arranged for interengaging with the nozzles, means for simultaneously and oppositely reciprocating the dies into and out of engagement with the nozzles, means for separating the inner and outer portions to permit of the removal of the castings, and means to apply pressure to the metal in the ladle in order to eject the metal therefrom into the dies when casting.

11. A duplex die-casting machine comprising a reservoir, a furnace for heating the same, an enclosed ladle having a pair of oppositely directed goosenecks, means for reciprocating said ladle solely in a vertical direction between a loading position immersed in the reservoir and a casting position above the reservoir, a nozzle on each gooseneck, a pair of dies each consisting of separable inner and outer portions, the inner portions being arranged for interengaging with the nozzles, means for simultaneously and oppositely reciprocating the inner portions into and out of engagement with the nozzles, means for simultaneously and oppositely reciprocating the outer portions a greater distance in order to separate the inner and outer portions to permit of the removal of the castings, and means to apply pressure to the metal in the ladle in order to eject the metal therefrom into the dies when casting.

12. An interchangeable plunger and air type of die-casting machine comprising a frame, a reservoir of metal, a furnace for heating the reservoir, a plurality of die holders on said frame, mechanism mounted on said frame for operating the die holders, a gooseneck ladle having a plurality of outlets, mechanism for operating said gooseneck ladle, a plunger pump having a plurality of outlets, mechanism for operating said plunger pump, said frame being so arranged as to interchangeably receive either the gooseneck ladle and operating mechanism therefor, or the plunger pump and operating mechanism therefor.

13. An interchangeable plunger and air type of die-casting machine comprising a frame, a plurality of die holders on said frame, mechanism mounted on said frame for operating the die holders, a multiple gooseneck ladle and reservoir of metal therefor, mechanism for operat-

ing said gooseneck ladle, a multiple outlet plunger pump and reservoir of metal therefor, mechanism for operating said plunger pump, said frame being so arranged as to interchangeably receive either the ladle and operating mechanism therefor, or the pump and operating mechanism therefor, a furnace for heating the reservoir, said furnace being mounted independently of and disconnected from said frame.

14. A die-casting machine comprising an enclosed gooseneck ladle, a heated reservoir, said reservoir having a small exposed surface relative to the size of the ladle, elevating means to reciprocate said ladle solely in a vertical direction between a loading position immersed in the reservoir and a casting position above the reservoir, a sidewardly directed outlet nozzle on said gooseneck ladle, a die consisting of separable inner and outer portions the inner portion of which is arranged for engagement with the nozzle, means for reciprocating the entire die into and out of engagement with said nozzle, support means independent of the elevating means against which the side of the ladle opposite the nozzle bears for support when the ladle is in the casting position and the die is forced into engagement with the nozzle, whereby said elevating means need be designed solely for the vertical stress of elevating the ladle, means to apply pressure to the metal in the ladle in order to eject the metal therefrom into the die, and means to separate the portions of the die for removing the finished casting.

15. A die-casting machine comprising a heated reservoir, an enclosed gooseneck ladle, a relatively slender upright post projecting upwardly from the ladle for a substantial distance above the same and serving to suspend the ladle, means coacting with the post to reciprocate the same solely in a vertical direction in order to move the ladle between a loading position immersed in the reservoir and a casting position above the reservoir, a sidewardly directed outlet nozzle on said ladle, a die consisting of separable inner and outer portions the inner portion of which is arranged for engagement with said nozzle, means for reciprocating the entire die into and out of engagement with said nozzle, support means independent of the elevating post against which the opposite side of the ladle bears for support when the ladle is in the casting position and the die is forced into engagement with the nozzle, whereby said elevating post need be designed solely for the vertical stress of elevating the ladle, means to apply pressure to the metal in the ladle in order to eject the metal therefrom into the die, and means to separate the portions of the die for removing the finished casting.

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