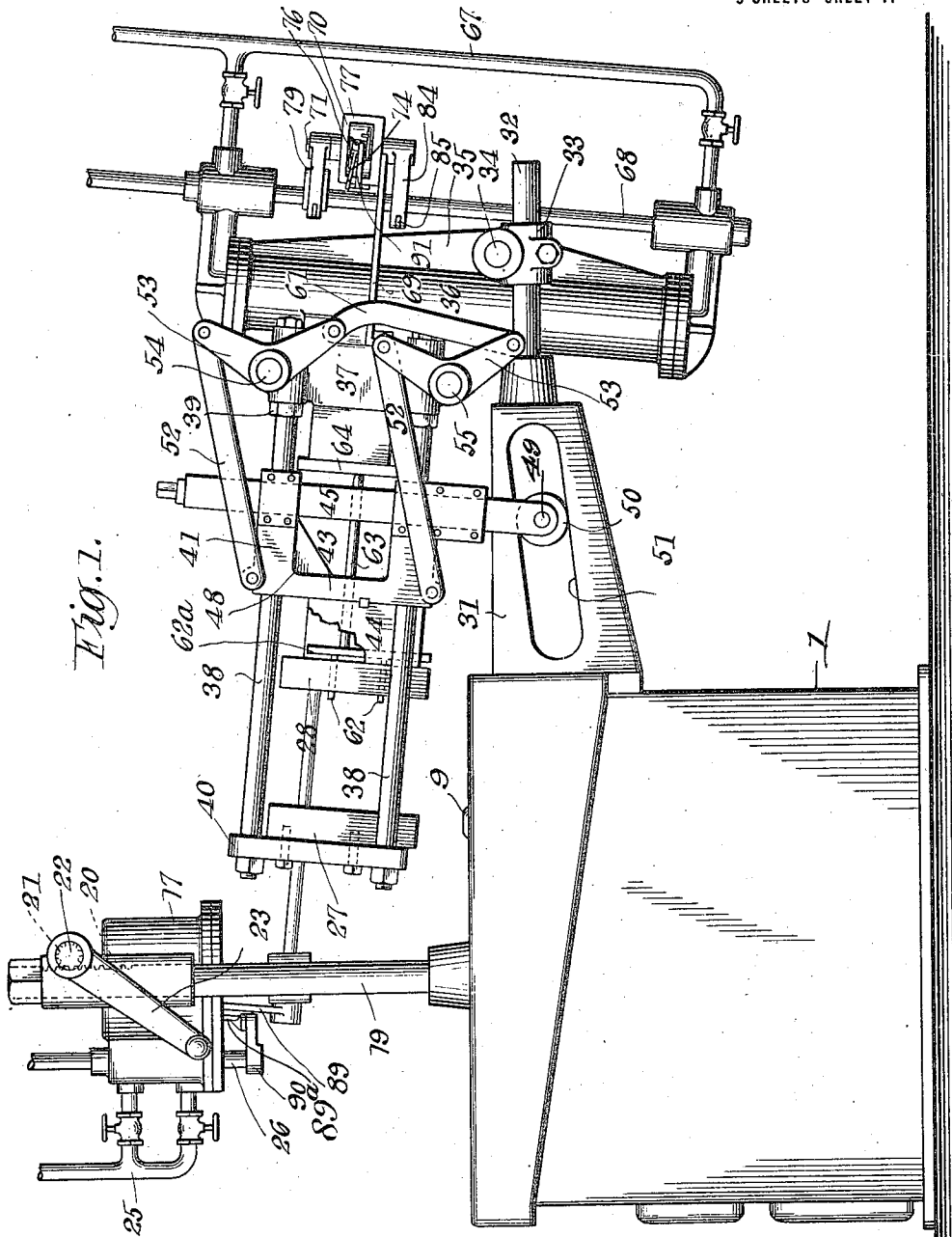


G. W. BUNGAY.
CASTING APPARATUS.
APPLICATION FILED OCT. 5, 1915.

1,279,249.

Patented Sept. 17, 1918.

5 SHEETS—SHEET 1.



INVENTOR
George Waldemar Bungay
BY
Henry K. Williams
ATTORNEY

G. W. BUNGAY.
CASTING APPARATUS.
APPLICATION FILED OCT. 5, 1915.

1,279,249.

Patented Sept. 17, 1918.
5 SHEETS—SHEET 2.

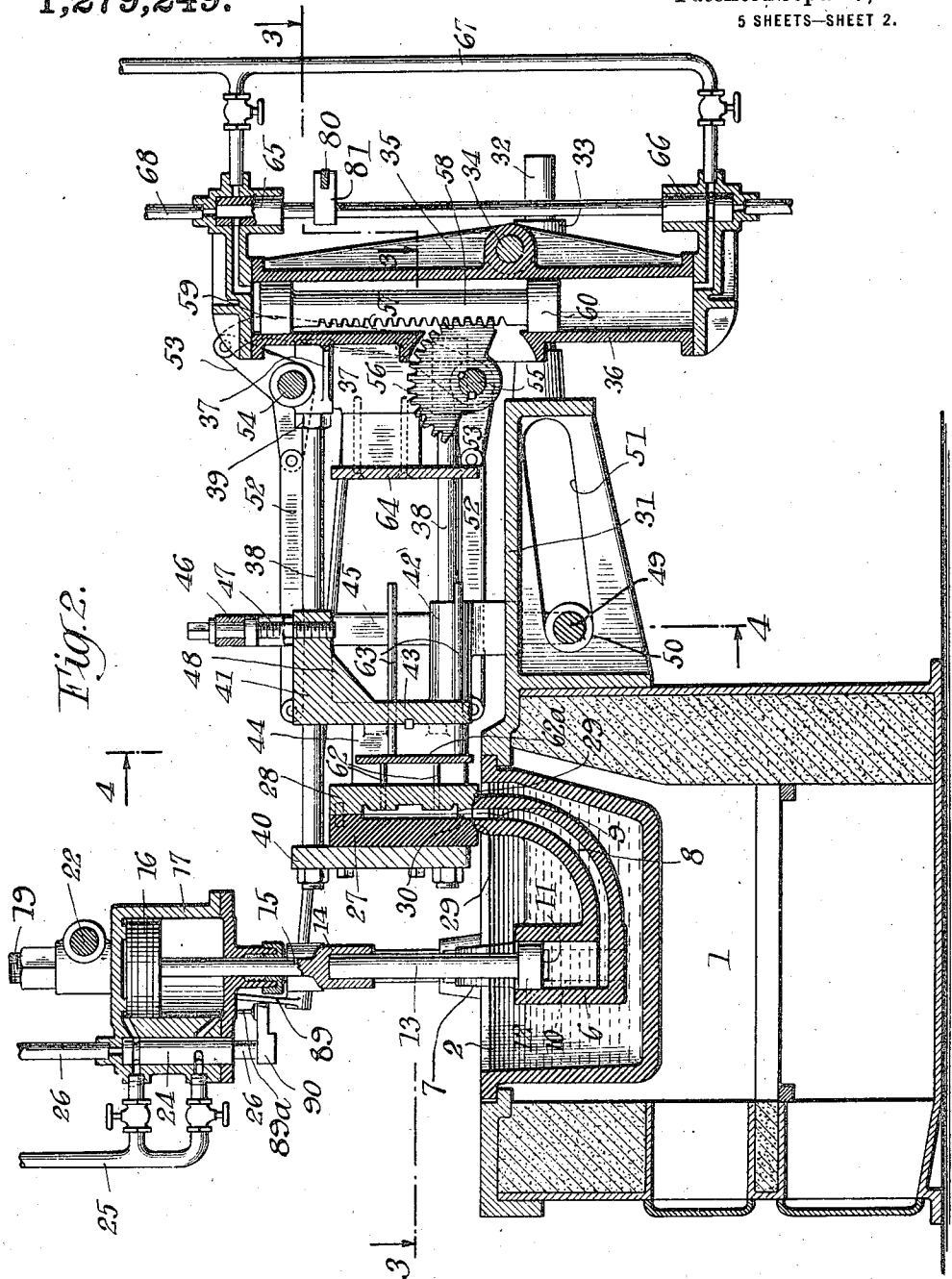


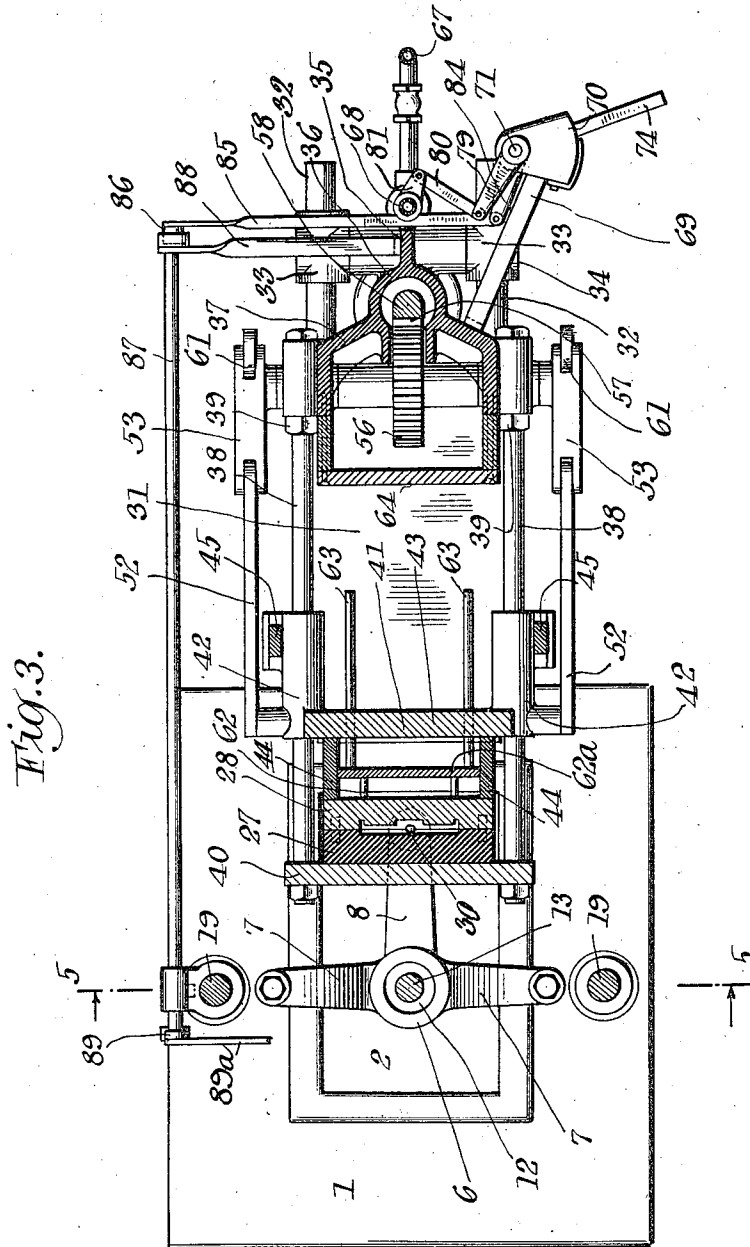
Fig. 2.

INVENTOR
George Waldemar Bungay
BY
Henry K. Williams
ATTORNEY

G. W. BUNGAY.
CASTING APPARATUS.
APPLICATION FILED OCT. 5, 1915.

1,279,249.

Patented Sept. 17, 1918.
5 SHEETS—SHEET 3.



INVENTOR
George Waldemar Bungay
BY
Henry H. Williams
ATTORNEY

1,279,249.

Fig. 4.

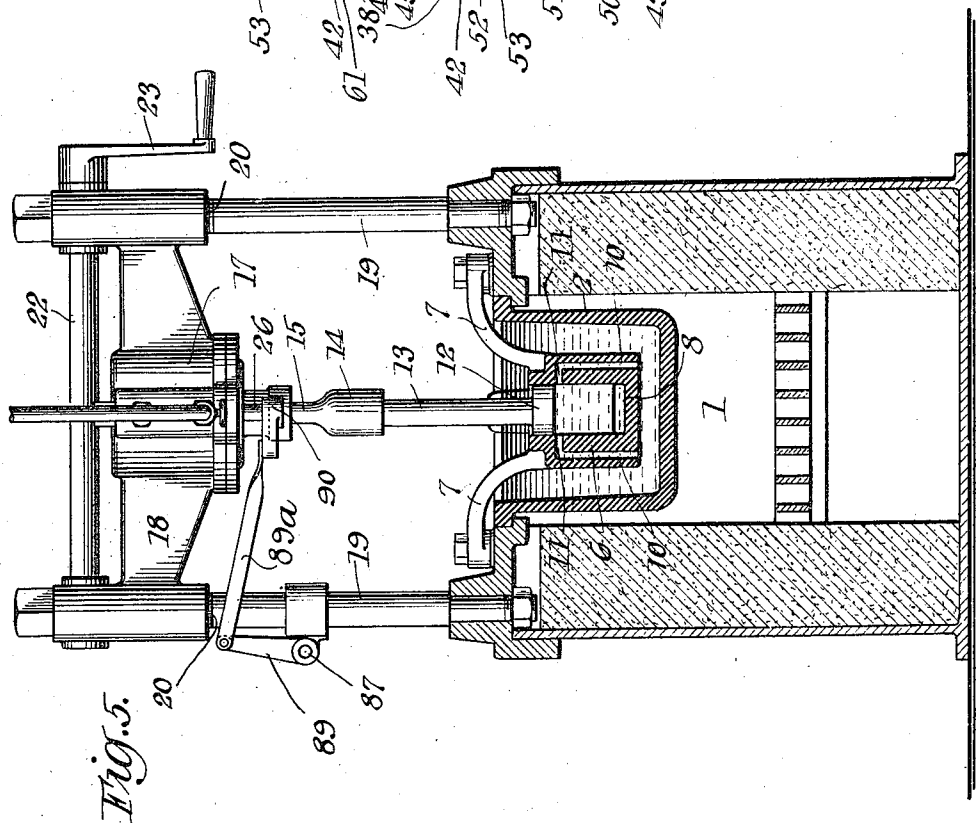
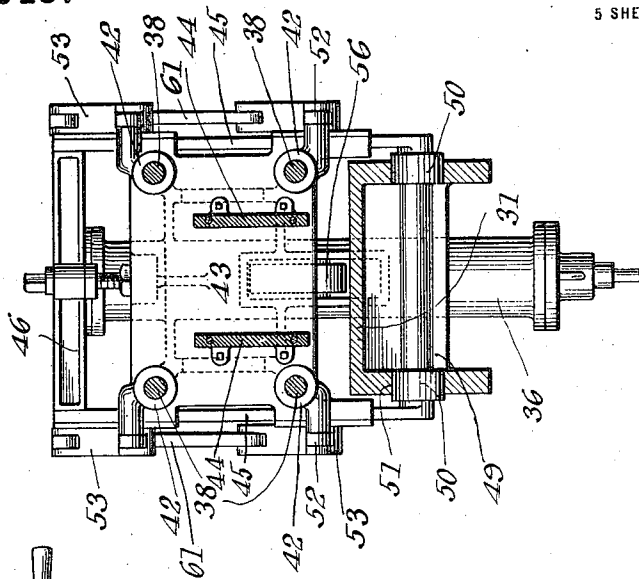


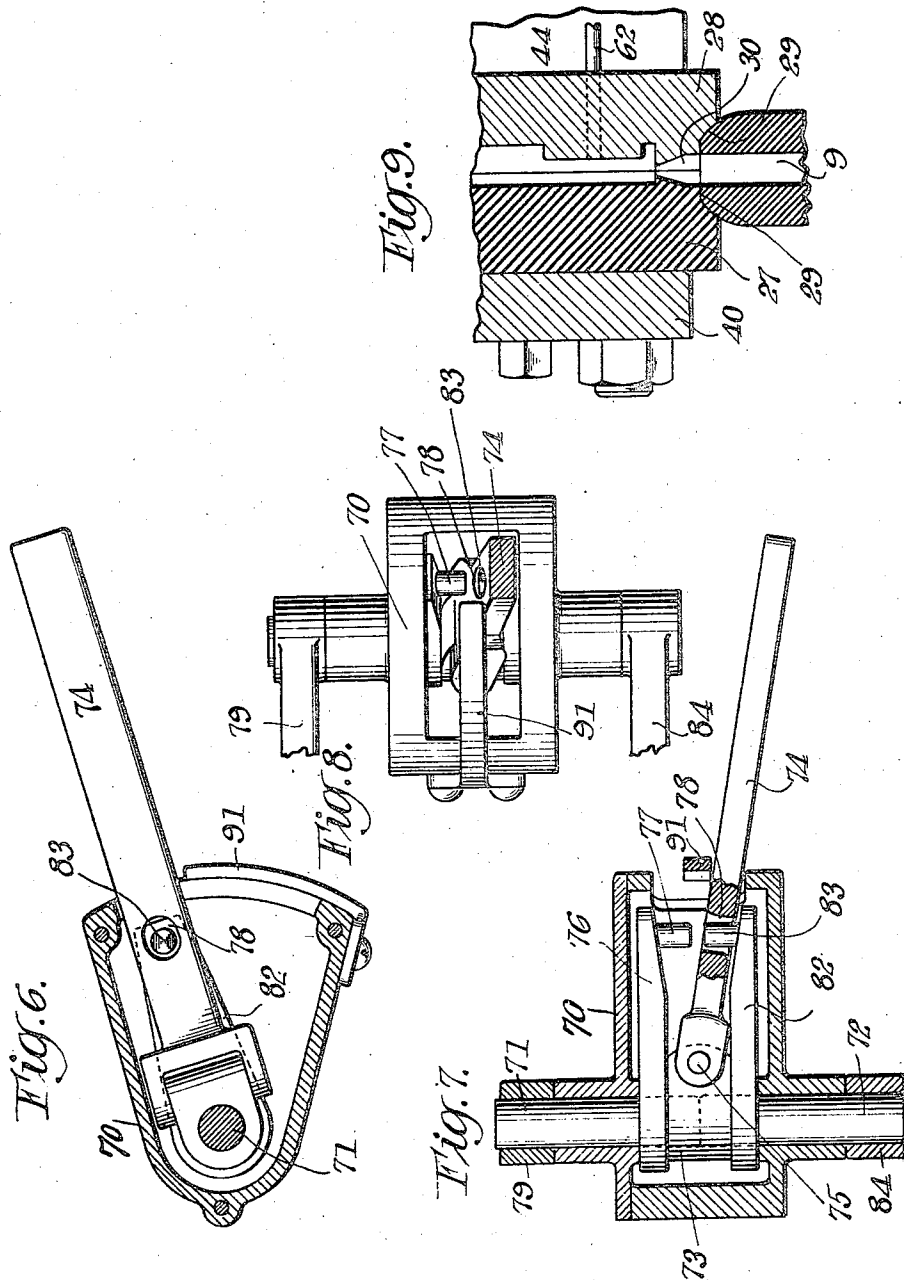
Fig. 5.

INVENTOR
George Waldemar Bungay
BY
Henry K. Williams
ATTORNEY

1,279,249.

G. W. BUNGAY.
CASTING APPARATUS.
APPLICATION FILED OCT. 5, 1915.

Patented Sept. 17, 1918.
5 SHEETS—SHEET 5.



INVENTOR
George Waldemar Bungay
BY
Henry D. Williams
ATTORNEY

UNITED STATES PATENT OFFICE.

GEORGE WALDEMAR BUNGAY, OF BROOKLYN, NEW YORK, ASSIGNOR TO ACME DIE CASTING CORPORATION, A CORPORATION OF NEW YORK.

CASTING APPARATUS.

1,279,249.

Specification of Letters Patent. Patented Sept. 17, 1918.

Application filed October 5, 1915. Serial No. 54,123.

To all whom it may concern:

Be it known that I, GEORGE WALDEMAR BUNGAY, a citizen of the United States, residing at 499 E. 24th St., borough of Brooklyn, in the county of Kings, city and State of New York, have invented certain new and useful Improvements in Casting Apparatus, of which the following is a specification, reference being had therein to the accompanying drawings, forming part thereof.

This invention relates to improvements in casting apparatus and more particularly relates to that kind of casting apparatus used in making what are commonly known as "die castings." An object of the invention is to provide for forcing the molten metal into the molds under pressure with the greater number or all of the working parts operated by fluid pressure instead of by hand or other means. Another object is to provide for operation at high speed with safety to the operator. Another object is to obviate the necessity of cutting the sprue while the casting is in the mold. Another object is to minimize the length of the neck between the nozzle and the interior of the die so that the amount of air to be expelled from the die will be reduced to a minimum thereby reducing the likelihood of blow holes in the casting and thereby increasing the quality of the casting. In other words my object is the production of a mechanically simple and strong machine which will perform the operations reliably, safely, successfully and quickly with a minimum of human attendance.

I shall now describe the machine embodying my invention shown in the accompanying drawings and shall thereafter point out my invention in claims.

Figure 1 is a side elevation of the complete machine showing the two members of the die separated.

Fig. 2 is a longitudinal section of the machine, but with the members of the die closed together in position for casting.

Fig. 3 is a horizontal section of the machine taken on the line 3—3 of Fig. 2.

Fig. 4 is a section of the machine taken on the line 4—4 of Fig. 2.

Fig. 5 is a section taken on the line 5—5 of Fig. 3.

Fig. 6 is a plan view of the controlling mechanism, with parts in horizontal section.

Fig. 7 is an end view of the controlling mechanism, with parts in vertical section.

Fig. 8 is a side view of the controlling mechanism, with the operating lever in vertical section.

Fig. 9 is a section of the die.

In the drawings 1 represents a fire-box, mounted in the usual manner, in which is arranged a melting pot 2 in which the metal is heated preparatory for casting. Within the pot 2 and surrounded by the molten metal, is a vertical cylinder 6 which is supported by a cross bar 7 carried by the fire-box 1 (shown in Fig. 5). Leading from the bottom of the cylinder 6 is a duct 8 which terminates in a vertical nozzle 9 through which the molten metal is delivered to the die. The nozzle 9 is located just above the edge of the melting pot 2 so that it partakes of the heat of the melting pot and the molten metal therein. The duct and nozzle are held rigidly in place by a cross bar (not shown) similar to the cross bar 7. The cylinder 6 is supplied with molten metal from the bottom of the pot 2, where the metal is the purest, through ducts 10 which are contained in the walls of the cylinder 6 and extend from the bottom of the cylinder to a point near the top of the cylinder and terminate in ports 11 in the inner walls of the cylinder. A plunger 12 operates in the cylinder 6 to force the metal from the cylinder 6, through the duct 8 and the nozzle 9 and into the die.

The plunger 12 is connected by its piston rod 13, through a coupling 14 to a piston rod 15 which is operated by an actuating piston 16 in a cylinder 17 located above the cylinder 6. The cylinder 17 and its piston 16, together with the plunger 12, are supported by a cross-yoke 18 which is shown as cast integral with the cylinder 17. The cross-yoke 18 is supported by vertical rods 19 which rest upon and are secured to the top of the fire pot 1. Racks 20 are cut in the vertical rods 19 and engage gears 21 which are secured to a shaft 22 which is journaled in the cross-yoke 18. Secured to the end of the shaft 22, is a crank 23. The crank 23, the shaft 22, the gears 21 and the racks 20 provide means for raising the cylinder 17 with its piston 16 and the plunger 12 so that the plunger 12 may be lifted clear of the cylinder 6 when the machine is not in operation,

thereby preventing the plunger 12 from freezing in its cylinder. Steam is admitted to the cylinder 17 through rotary valves 24 from a steam supply pipe 25. The valves 24 also control the exhaust through a pipe 26 which rotates and forms a means for controlling the valves 24.

The die consists of two relatively movable members 27 and 28. Each member of the die has a recess 29 in its lower edge so located that when the die members 27 and 28 are together in the position for casting the recess 29 fits over the nozzle 9. Leading from the recess 29 is a port 30 (see Fig. 9), which in this embodiment of my invention consists of a groove in the surface of each die member. The port 30 is in alinement with the opening in the nozzle 9 and forms a means for the admission of the molten metal into the die. The port 30 I purposely make very short so that little opportunity is offered for the metal to cool before reaching the die and so that little or no opportunity is allowed for the entrapment of air which if permitted would cause defective castings. It will be noted that since the nozzle 9 is just above the surface of the metal in the melting pot 2 and since the port 30 is very short and since the metal is cast under pressure, which is maintained until the metal in the die hardens, the casting will have only a very short sprue which is further contributed to by the fact that the metal in the nozzle 9 does not harden being kept warm by the heat of the nozzle. The port 30 opens upon the opening of the die members 27 and 28 allowing the casting to be removed without the necessity of cutting the sprue. The sprue may be removed from the casting after the casting is removed from the die.

I will now consider the means for supporting the die members and moving them relatively to each other and to the nozzle 9 and describe it in detail. A frame 31 is cast integral with the top plate of the fire-box 1 and is supported by the fire-box. The frame 31 ends in two rods 32 on each of which is slidably mounted an adjustable bearing 33. Each bearing is split and clamped into position by a bolt, as more clearly appears in the drawings, and forms a bearing for trunnions 34 which project from a reinforcing rib 35 of a cylinder 36. The adjustable bearings form an adjusting means whereby the whole die-supporting mechanism may be moved toward or away from the nozzle 9 in order to accommodate dies of various sizes. The trunnions 34 form pivots on which the whole die supporting means is moved when in operation. Cast integral with the double cylinder 36 and projecting therefrom is a frame 37 to which are adjustably secured four rods 38 by nuts 39, which provide additional means for ad-

justment of the die in relation to the nozzle 9. These rods 38 when adjusted to permit the proper alinement of the die and the nozzle are held in position by the nuts 39. To the other or outermost end of the rods 38 is secured a die head 40 which serves to keep the rods in proper relative position and which also supports the die member 27 which is secured to it.

A die carrier 41 for the die member 28 is slidably mounted on the rods 38 by means of bearings 42. This die carrier consists of the four bearings 42 and a connecting plate 43. To this plate 43 are secured two plates 44 to which the die member 28 is secured. Extending vertically through the bearings 42 are two bars 45 which are connected at the top by a cross bar 46. This cross bar is secured to the die carrier 41 by an adjusting screw 47 which engages in a bracket 48 which is shown cast integral with the plate 43, and forms a part thereof. The screw 47 forms a means for adjusting the die head 40 vertically in relation to the nozzle 9 to accommodate dies of various sizes. At the lower end of the bars 45 is a shaft 49 which carries rollers 50. These rollers operate in inclined slot guideways 51 of the frame 31. These rollers bearing upon the lower surface of the inclined slot guideways 51 form a means for swinging the die supporting means on the trunnions 34 to bring the die into or out of contact with the nozzle 9 and also assist the trunnions in supporting the weight of the die-supporting means when out of contact with the nozzle. The rollers 50 also perform a clamping function and, when the die members 27 and 28 are together and in contact with the nozzle 9, by bearing upon the upper surface of the guideways 51, securely clamp the die to the nozzle 9 so that the molten metal which is under pressure cannot spurt out to the injury of the operator nor escape back into the melting pot but is forced up into the die. This clamping function is one of the most important functions of the rollers 50 and the guideways 51. The force of the clamping action can be regulated or adjusted by means of the screw 47, hereinbefore described.

Connected to the die carrier 41 are four links 52, two on each side of the machine, which are also connected to four bell cranks 53. The bell cranks 53 are secured to rock shafts 54 and 55. Secured to the rock shaft 55 is a gear sector 56 which meshes in a rack 57 cut in a piston rod 58 which piston rod connects two pistons 59 and 60 operating in the cylinder 36. The bell cranks 53 are connected by connecting rods 61. The downward travel of the pistons 59 and 60 (as is clearly seen in Fig. 2) causes the rock shaft 55 to be turned by means of the rack 57 and sector 56. The rock shaft turns the

bell cranks 53 thereby drawing up the links 52 which causes the die carrier 41 to slide along the rods 38, thereby causing the die member 28 to separate from the die member 27. The slightest movement of the die carrier 41 causes the rollers 50 to unclamp the die from the nozzle and at the same time to travel up the inclined guideway 51 thereby swinging the die-supporting means on the trunnions 34 which causes the die member 27 to move upward and away from the nozzle 9 at the same time the die member 28 moves away from the die member 27. The casting which is carried with the die member 28 is ejected from the die member 28 by means of ejector pins 62; the ejector pins are secured to a plate 62^a which is carried by rods 63 passing through the plate 43 of the die carrier 41 and these rods 63 upon the rearward movement of the carrier 41 strike against a plate 64 which plate is secured to the frame 37. Steam is admitted to the double cylinder 36 through rotary valves 65 and 66 from a steam supply pipe 67. The valves 65 and 66 also control the exhaust from the double cylinder 36 through an exhaust pipe 68. The portion of exhaust pipe 68 between the valves 65 and 66 is secured to the valves and forms a means for controlling them.

The operating parts of my machine are controlled by a controlling means which I will now describe. Extending from the frame 37 and secured thereto is an arm 69 to the opposite end of which is secured a sector 70. Pivoted in the sector 70 are an upper and a lower rock shaft 71 and 72. A collar 73 surrounds the inner ends of the rock shafts 71 and 72 to which is pivoted an operating lever 74 by means of a pin 75. The collar 73 turning loosely about the rock shafts 71 and 72 permits of the lever 74 moving horizontally while the pin 75 permits the lever 74 to move vertically. Secured to the lower end of the upper rock shaft 71 is a short lever 76 at the outer end of which is a stud 77 which is engageable in a hole 78 in the operating lever 74. Secured to the upper end of the upper rock shaft 71 is another lever 79 which is connected by a short link 80 to a short lever 81. The lever 81 is secured to the pipe 68 the movement of which controls the valves 65 and 66. Secured to the upper end of the lower rock shaft 72 is a short lever 82 at the outer end of which is a stud 83 which is also engageable in the hole 78 in the operating lever 74. Secured to the lower end of the lower rock shaft 72 is a short lever 84 the outer end of which is connected by a link 85 to a short lever 86. The lever 86 is secured to a shaft 87 which is supported by a bearing in an arm 88 and by a bearing on the vertical rod 19. The other end of the arm 88 is secured to the rib 35 of the double cyl-

inder 36. Secured to the end of the shaft 87 is a short lever 89 which, through a link 89^a, operates a lever 90 secured to the pipe 26. The movement of this pipe 26 operates the valves 24. A tongue 91 in the sector 70 forms two guideways for the operating lever 74.

One complete operation of the machine will now be described. Assuming the machine to be in the position shown in Fig. 1, the operation is as follows: The operating lever 74 which is connected with the lever 76 through the engagement of the stud 77 in the hole 78 is moved to the extreme end of the guideway formed by the tongue 91. This causes the rock shaft 71 to move which motion is transmitted through lever 79, the link 80 and lever 81, to the valve controlling means 68. The movement of the valve controlling pipe 68 causes steam to be admitted to the lower part of the double cylinder 36 from the steam supply pipe 67 through the intake part of the rotary valve 66. At the same time the exhaust part of the rotary valve 65 is opened allowing the steam in the upper part of the double cylinder 36 to exhaust through the exhaust pipe 68. This causes the pistons 59 and 60 to move upwardly. The upward movement of the pistons with connecting piston rod 58, through the rack 57 and the geared sector 56 rocks the rock shaft 55. The rotation of the rock shaft 55 causes the lower bell cranks 53 which are secured thereto and the upper bell cranks 53 through the connecting rods 61 to rotate thereby moving the die carrier 41 along the rods 38 by means of the connecting links 52. The movement of the die carrier along the rods 38 causes the die member 28 to close upon the die member 27 and at the same time causes the rollers 50 to travel down the inclined guide slot 51, thereby causing the die supporting means to swing downwardly on the trunnions 34 until die members 27 and 28 are brought tightly together and the recess 29 of the die fits over the nozzle 9 in such a position that the port 30 is in register with the opening in the nozzle 9. The final thrust of the connecting links 52 causes that portion of the weight of the die supporting means heretofore carried on the lower surface of the inclined slot 51 by means of the rollers 50 to be shifted to the nozzle 9 at the same time causing the rollers 50 to bear firmly against the upper surface of the guide slot 51. The weight of the die supporting means is now upon the nozzle 9 and the pressure of the rollers 50 against the upper surface of the inclined guideway 51 clamps the die firmly to the nozzle 9 so that during the casting operation the molten metal cannot escape between the nozzle and the die, thereby spoiling the casting and injuring the operator.

The die being closed and in position for

casting, the operating lever 74 is moved vertically downward past the end of the tongue 91, thereby disengaging the stud 77 of the lever 76 from the hole 78 in the operating lever 74 and causing the hole 78 to engage the stud 83 of the lever 82. The operating lever is then moved horizontally along the lower guideway formed by the tongue 91 thereby rocking the shaft 72. The rock shaft 72 transmits its rotary motion to the shaft 87 through the lever 84, the link 85 and the lever 86. The rotation of the shaft 87, by means of the lever 89, link 89^a and lever 90, operates the valve controlling means 26. This movement of the valve controlling means 26 causes the steam to enter the upper part of the cylinder 17 from the steam supply pipe 25 through the intake port of the upper rotary valve 24, at the same time allowing the steam to exhaust through exhaust port of the lower rotary valve 24. The actuating piston 16 moves downward forcing the plunger 12, to which it is coupled, downward in the metal containing cylinder 6, thereby closing the ports 11 in the cylinder 6 and forcing the molten metal through the duct 8, the nozzle 9, the port 30, up into the die. The pressure exerted by the steam in the cylinder 17 holds the molten metal in the die until it hardens so that no gate is needed to hold the molten metal in the die until the casting is formed. During this casting operation the die has been firmly locked by pressure of the steam on the lower piston 60 through the toggle arrangement of the bell cranks 53 and the links 52, as clearly appears in Fig. 2.

When the casting has hardened the operating lever is reversed through the lower guideway of the sector 70 causing the valve controlling means 26 to return to its original position, thereby reversing the operation of the piston 16 in the cylinder 17, causing the plunger 12 to be raised in the metal forcing cylinder 6. This removes all pressure from the metal in the cylinder 6, the duct 8 and the nozzle 9 and uncovers the ports 11 in the wall of the cylinder 6 allowing a fresh supply of metal to enter the cylinder from the bottom of the pot 2 through the ducts 10. As soon as the operating lever has reached the end of the guideway it is lifted vertically to disengage the stud 83 of the lever 82 and to engage the stud 77 of the lever 76. The operating lever 74 is then moved horizontally along the upper guideway of the sector 70 causing the valve controlling means 68 to open the exhaust port of the rotary valve 66 and the intake port of the rotary valve 65. This causes the pistons 59 and 60 to descend, thereby causing the clamping means to be released. The die carrier 41 moves backward along the rods 38 at the same time the rollers 50 travel upwardly along the inclined guideway 51 causing the die member

28 to recede from the member 27 and at the same time causing the die supporting means to swing on the trunnions 34, thereby lifting the die member 27 upwardly and away from the nozzle 9. The rearward movement of the die carrier 41 causes the rods 63 to strike against the plate 64, thereby causing the ejector pins 62 to force the casting from the die member 28. The machine is now ready for another operation.

It is apparent that the controlling means is also a safety device, since the casting operation cannot take place until the die is locked firmly in position by means of the toggles formed by the bell cranks 53 and links 52 and by means of the clamping action of the rollers 50 against the upper surface of the guide slot 51, all of which are held firmly in position by the pressure of steam in the lower part of cylinder 36. Should the operator, after bringing the die into position for casting, inadvertently move the operating lever 74, back along the upper guideway of the sector 70, no harm could result the die would merely be opened and moved out of relation with the nozzle. The molten metal cannot be forced up into the die until the operating lever is disengaged from the levers which control the die movement and the die is locked into position for casting. On the other hand should the operator, after releasing the pressure in the metal forcing cylinder 6, inadvertently move the operating lever back along the lower guideway of the sector 70 instead of up and along the upper guideway, the result would be that the pressure would be reapplied to the metal in the metal forcing cylinder 6. The molten metal cannot escape nor can harm result for the die members are firmly locked together and the die firmly clamped to the nozzle 9.

From the above description it is clear that the rate of operation of this machine is limited only by the rate of cooling the metal.

It is obvious that various modifications may be made in the construction shown in the drawings and above particularly described within the principle and scope of my invention.

I claim:

1. A casting machine comprising a receptacle for the material to be cast, a nozzle just above the surface of such material and communicating therewith, a die adapted to receive directly from the nozzle the material to be cast, and means for forcing such material into the die.

2. A casting machine comprising a receptacle for the material to be cast, a nozzle just above the surface of such material and communicating therewith, a die adapted to receive directly from the nozzle the material to be cast, and means for forcing such material into the die and for holding said material in the die during cooling.

3. A casting machine comprising a receptacle for the material to be cast, a cylinder within said receptacle communicating therewith, a duct connected with said cylinder terminating in a nozzle just above the surface of the material to be cast, a die adapted to receive directly from the nozzle the material to be cast, means for forcing said material into the die and for holding said material in the die during cooling.

4. A casting machine comprising a receptacle for the material to be cast, a vertical cylinder within said receptacle communicating therewith, a duct connected with said cylinder terminating in a nozzle just above the surface of the material to be cast, a die adapted to receive directly from the nozzle the material to be cast, means for forcing said material into the die, and means for holding said material in the die during cooling.

5. A casting machine comprising a receptacle for the material to be cast, a vertical cylinder within said receptacle communicating therewith, a duct leading from said cylinder and terminating in a nozzle just above the surface of the material to be cast, a die adapted to receive directly from the nozzle the material to be cast, a plunger operating in said cylinder for forcing said material into the die and holding it therein during cooling, and means for operating said plunger.

6. A casting machine comprising a receptacle for the material to be cast, a cylinder within said receptacle communicating therewith, a duct leading from said cylinder and terminating in a nozzle just above the surface of the material to be cast, a die adapted to receive directly from the nozzle the material to be cast, a plunger operating in said cylinder for forcing said material into the die and holding it therein during cooling, and fluid-pressure means for operating said plunger.

7. A casting machine comprising a receptacle for the material to be cast, a vertical cylinder within said receptacle, a duct within the walls of said cylinder and leading from a lower point in such material and terminating in an inlet port for said cylinder, an outlet duct for said cylinder terminating in a nozzle just above the surface of the material to be cast, a die adapted to receive directly from the nozzle the material to be cast, a plunger operating in said cylinder for forcing said material into the die and holding it therein during cooling, and means for operating said plunger.

8. A casting machine comprising a receptacle for the material to be cast, a cylinder within said receptacle communicating therewith, a duct leading from said cylinder and terminating in a nozzle adapted to project from within the receptacle above the surface

of the material to be cast, a die adapted to receive directly from the nozzle such material, a plunger operating in said cylinder for forcing said material into the die, and means for raising the fluid forcing plunger out of its cylinder when the machine is not in use.

9. A casting machine comprising a receptacle for the material to be cast, a cylinder within said receptacle communicating therewith, a duct leading from said cylinder terminating outside the material to be cast in a nozzle, a die adapted to receive directly from the nozzle such material, a fluid forcing plunger operating in the cylinder, and a fluid pressure cylinder supported above the fluid forcing plunger the piston of which is connected therewith.

10. A casting machine comprising a furnace, a receptacle for the material to be cast situated therein, a cylinder within such receptacle communicating therewith, a die adapted to receive the material to be cast, means for conducting such material from the cylinder into the die, a fluid forcing plunger in said cylinder, two substantially vertical rods secured to the top of the furnace, a fluid pressure cylinder adapted to slide on the rods the piston of which is coupled to the fluid forcing plunger, racks cut in said rods, and gears journaled on the fluid pressure cylinder engaging said rack and means for rotating said gears, whereby the fluid forcing plunger is lifted out of its cylinder when the machine is not in use.

11. A casting machine comprising a frame, die-supporting means pivoted thereon, a sectional die mounted upon said die-supporting means, a receptacle for the metal to be cast, a duct leading therefrom terminating in a nozzle, means for moving the die-supporting means on its pivot whereby the die sections are moved relatively to the nozzle and to each other, and means for forcing the material to be cast through the nozzle directly into the die.

12. A casting machine comprising a frame, die-supporting means pivoted thereon, a sectional die mounted upon said die-supporting means, a receptacle for the material to be cast, a duct leading therefrom terminating in a nozzle, means for moving the die-supporting means on its pivot whereby the die sections are moved relatively to the nozzle and to each other, means for clamping said die firmly to said nozzle, and means for forcing the material to be cast through the nozzle directly into the die.

13. A casting machine comprising a frame, die-supporting means pivoted thereon, means for adjusting the pivotal bearing on said frame to accommodate dies of varying sizes, a sectional die mounted upon said die-supporting means, a receptacle for the material to be cast, a duct leading therefrom

terminating in a nozzle, means for moving the die-supporting means on its pivot whereby the die sections are moved relatively to the nozzle and to each other, means for
 5 clamping said die firmly to said nozzle, and means for forcing the material to be cast through the nozzle into the die.

14. A casting machine comprising a frame, die-supporting means pivoted thereon, a sectional die mounted upon said die-supporting means, a receptacle for the material to be cast, a duct leading therefrom terminating in a nozzle, means for moving the die-supporting means on its pivot whereby
 10 the die sections are moved relatively to the nozzle and to each other, means for clamping said die firmly to said nozzle, means for forcing the material to be cast through the nozzle directly into the die, and means for
 15 ejecting the hardened casting from the die.

15. A casting machine comprising a frame, die-supporting means pivoted thereon, a sectional die mounted upon said die-supporting means, a receptacle for the material to be cast, a duct leading therefrom terminating in a nozzle, fluid pressure means for moving the die-supporting means on its pivot whereby the die sections are moved
 20 relatively to the nozzle and to each other, and means for forcing the material to be cast through the nozzle directly into the die.

16. A casting machine comprising a frame, a die supporting frame pivoted thereon, a sectional die mounted on said die supporting frame, a receptacle for the material to be cast, a duct leading therefrom terminating in a nozzle, a sliding member mounted on the die supporting frame, guide-
 35 ways, guide-followers on the sliding member engaging the guideways, means for moving the sliding member along the guideways whereby the die supporting frame is rocked on its pivot and the die clamped to and un-
 40 clamped from the nozzle, and means for forcing the material to be cast through the nozzle into the die.

17. A casting machine comprising a frame, a die supporting frame pivoted thereon, a sliding die carriage slidably mounted on the die supporting frame, a sectional die a portion of which is secured to the sliding die carriage and another portion of which is secured to the die supporting frame,
 50 guideways which, engaging with the sliding die carriage, form means for rocking the die supporting frame on its pivot, guide-followers on the sliding die carriage engaging the guideways, means for moving the sliding die carriage along the die supporting frame and along the guide-
 55 ways whereby the die is closed and clamped to the nozzle and whereby the die is lifted from contact with and away from the nozzle

and the die is opened, and means for forcing
 65 the material to be cast into the die.

18. A casting machine comprising in combination a frame, a fluid pressure cylinder pivoted thereon, rods each secured to the cylinder at one end, a die head secured to
 70 the other ends of the rods, a die carriage slidably mounted on the rods, means co-operative with the fluid pressure cylinder to actuate the die carriage, and a sectional die, a portion of which is mounted on the die head and another portion of which is mounted on the die carriage.

19. A casting machine comprising in combination a frame, a fluid pressure cylinder pivoted thereon, rods each secured to the cylinder at one end, a die head secured to the other ends of the rods, a die carriage slidably mounted on the rods, guideways, guide-followers on the die carriage adapted to engage the guideways, a sectional die
 85 one portion of which is mounted on the die head and another portion of which is mounted on the die carriage, and means co-operative with the fluid pressure cylinder to reciprocate the die carriage along the rods
 90 and along the guideways.

20. A casting machine comprising a frame, a fluid pressure cylinder pivoted thereon, rods each secured to the cylinder at one end, a die head secured to the rods at the other end, a die carriage slidably mounted on said rods, a sectional die a portion of which is mounted on the die carriage and another portion of which is mounted on the die head, a receptacle for the material to be cast, a duct leading therefrom terminating in a nozzle, guideways, guide-followers on the die carriage engaging the guideways, means co-operative with the fluid pressure cylinder to reciprocate the die carriage along the rods and along the guideways whereby the die is closed and clamped to the nozzle and whereby the die is opened and lifted away from the nozzle, and means for forcing the material to be cast into the die and holding it there during hardening and means for ejecting the hardened casting from the die.

21. A casting machine comprising a frame, die supporting means pivoted thereon, a sectional die mounted upon said die-supporting means, a receptacle for the material to be cast, a duct leading therefrom terminating in a nozzle, a fluid pressure cylinder adapted to move the die-supporting means on its pivot whereby the die sections are moved relatively to the nozzle and to each other, a fluid pressure cylinder adapted to force the material to be cast through the nozzle into the die, and fluid pressure
 120 controlling means for operating the fluid pressure cylinders successively, whereby the die sections are closed and clamped to the
 125

nozzle and thereafter the material is forced into and held in the die and whereby the pressure on the material to be cast is released and thereafter the die sections are un-

clamped from the nozzle and opened.

22. A casting machine comprising a receptacle for the material to be cast, a nozzle just above the surface of such material and communicating therewith, a sectional die adapted to be clamped directly to the nozzle, and means for forcing the material to be cast directly into the die.

23. A casting machine comprising a receptacle for the material to be cast, an upwardly directed nozzle communicating therewith, a sectional die adapted to receive directly from the nozzle the material to be cast through a port the walls of which are formed by the sections of the die, and means for forcing the material to be cast into the die.

24. A casting machine comprising a receptacle for the material to be cast, an upwardly directed nozzle communicating therewith, a sectional die adapted to receive directly from the nozzle the material to be cast having a port adapted to open upon the separation of the die sections, and means for forcing the material to be cast into the die.

25. A casting machine comprising a receptacle for the material to be cast, an upwardly directed nozzle communicating with the receptacle and exposed at its outside to the heated material in the receptacle, a die adapted to receive directly from the nozzle the material to be cast, and means for forcing the material into and holding it in the die.

26. A casting machine comprising a receptacle for the material to be cast, a nozzle communicating therewith and adapted to project above the surface of such material therein, a sectional die adapted to receive directly from the nozzle the material to be cast through a port the walls of which are formed by the sections of the die, and means for forcing the material to be cast into the die.

27. A casting machine comprising a receptacle for the material to be cast, a nozzle communicating therewith and adapted to project above the surface of such material therein, a sectional die adapted to receive directly from the nozzle the material to be cast having a port adapted to open upon the separation of the die sections, means for clamping the die directly to the nozzle, and means for forcing the material to be cast into the die.

28. A casting machine comprising a receptacle for the material to be cast, a nozzle communicating therewith and adapted to project above the surface of such material therein, a die adapted to receive directly

from the nozzle the material to be cast, and means for forcing the material to be cast into the die.

29. A casting machine comprising a receptacle for the material to be cast, a nozzle communicating therewith, a die adapted to receive directly from the nozzle the material to be cast, means for clamping the die directly to the nozzle, and means for forcing the material into the die.

30. A casting machine comprising a receptacle for the material to be cast, a nozzle communicating therewith, a sectional die adapted to receive directly from the nozzle the material to be cast through a port the walls of which are formed by the sections of the die, means for clamping the die directly to the nozzle, and means for forcing the material to be cast into the die.

31. A casting machine comprising a receptacle for the material to be cast, a nozzle communicating therewith, a sectional die adapted to receive directly from the nozzle the material to be cast through a port the walls of which are formed by the sections of the die, means for clamping the die sections together, means for clamping the die directly to the nozzle, and means for forcing the material to be cast into the die.

32. A casting machine comprising a frame, die-supporting means movable thereon, a sectional die mounted upon said die-supporting means, a receptacle for the material to be cast, a duct leading therefrom terminating in a nozzle, means for moving the die-supporting means whereby the die sections are moved relatively to the nozzle and to each other, and means for forcing the material to be cast through the nozzle directly into the die.

33. A casting machine comprising a frame, die-supporting means movable thereon, a sectional die mounted upon said die-supporting means, a receptacle for the material to be cast, a duct leading therefrom terminating in a nozzle, means for moving the die-supporting means whereby the die sections are moved relatively to the nozzle and to each other, means for clamping said die firmly to said nozzle, and means for forcing the material to be cast through the nozzle directly into the die.

34. A casting machine comprising a receptacle for the material to be cast, a nozzle communicating therewith, a sectional die having a port formed between the sections of the die through which the material is received into the die directly from the nozzle, means for concurrently closing together the die sections and seating the die upon the nozzle, means for forcing the material into the die, and means for concurrently moving the die away from the nozzle and separating the die sections.

35. A casting machine comprising a re-

ceptacle for the material to be cast, an upwardly directed nozzle communicating therewith, a sectional die having a port formed between the sections of the die
5 through which the material is received into the die directly from the nozzle, means for concurrently closing together the die sections and lowering the die upon the nozzle, means for forcing the material into the die,

and means for concurrently raising and separating the die sections. 10

In testimony whereof I have affixed my signature.

GEORGE WALDEMAR BUNGAY.

Witnesses:

CHARLES G. GOLDMAN,
EDWIN N. WOLF.