G. W. BUNGAY.

DIE CASTING MACHINE.

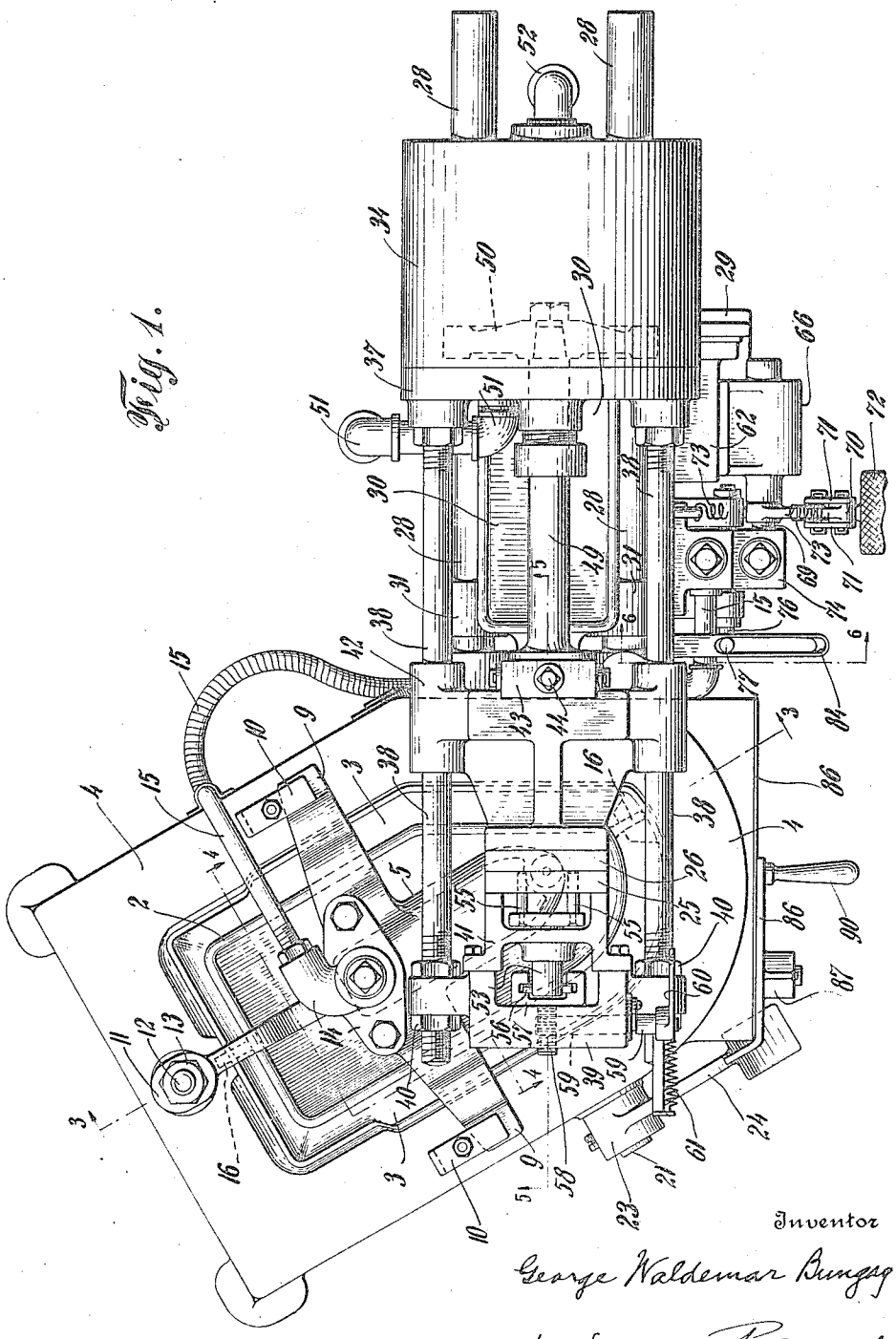
APPLICATION FILED APR. 14, 1919.

1,398,314.

Patented Nov. 29, 1921.

4 SHEETS—SHEET 1.

Fig. 1.



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4 SHEETS—SHEET 2.

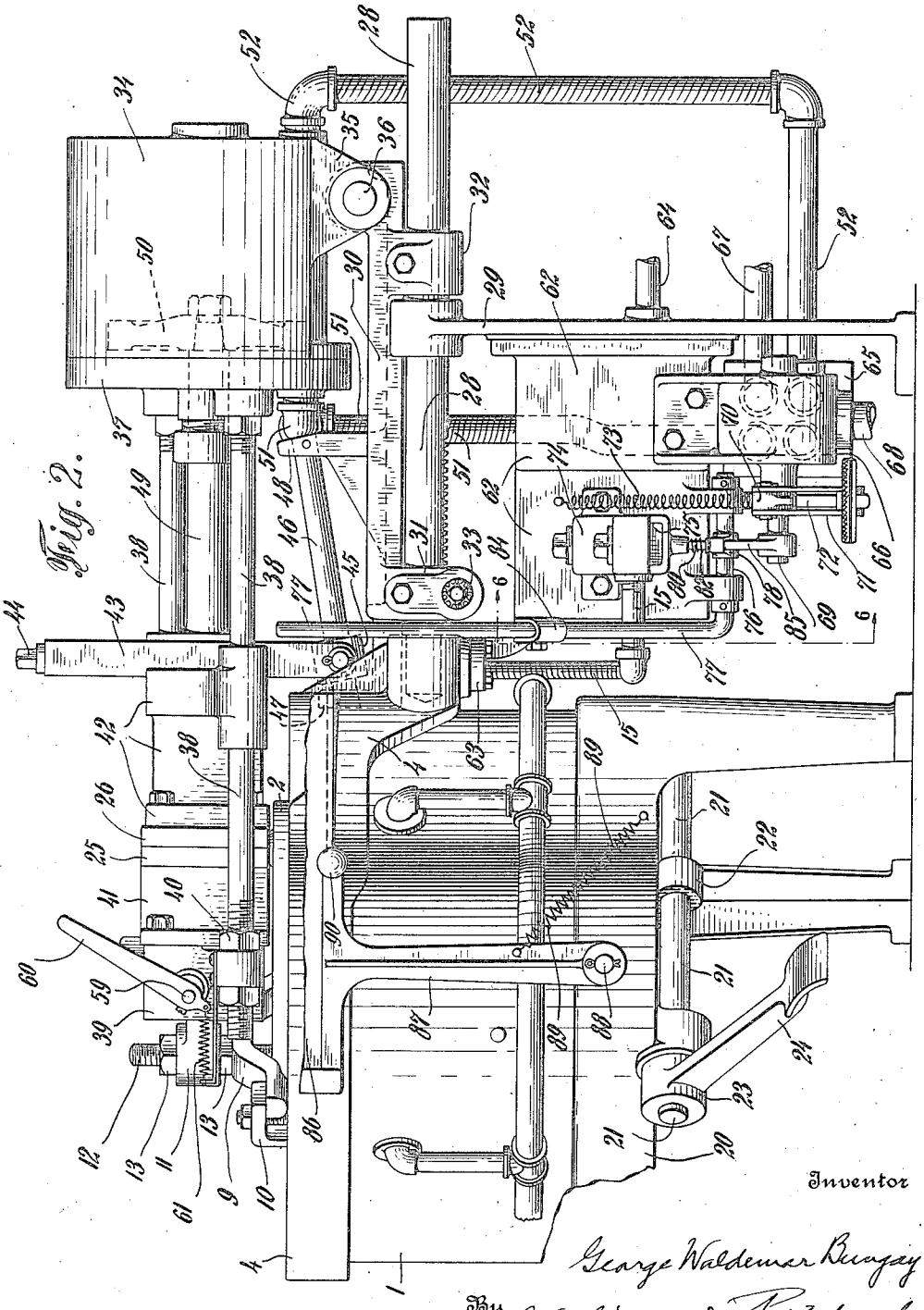


Fig. 2.

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4 SHEETS—SHEET 3.

Fig. 3.

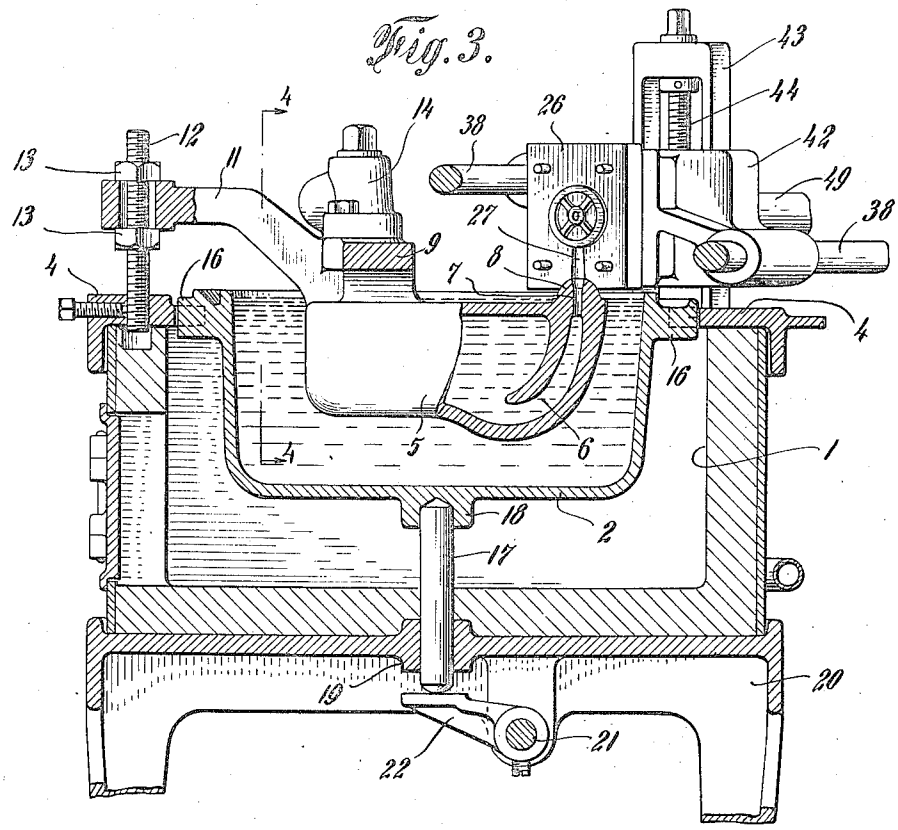
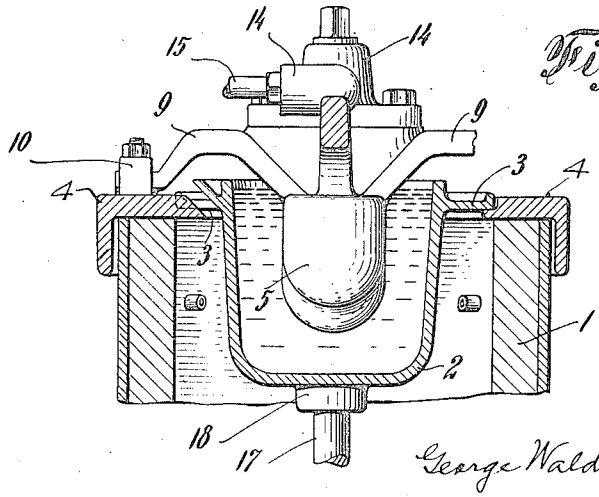


Fig. 4.



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4 SHEETS—SHEET 4.

Fig. 5.

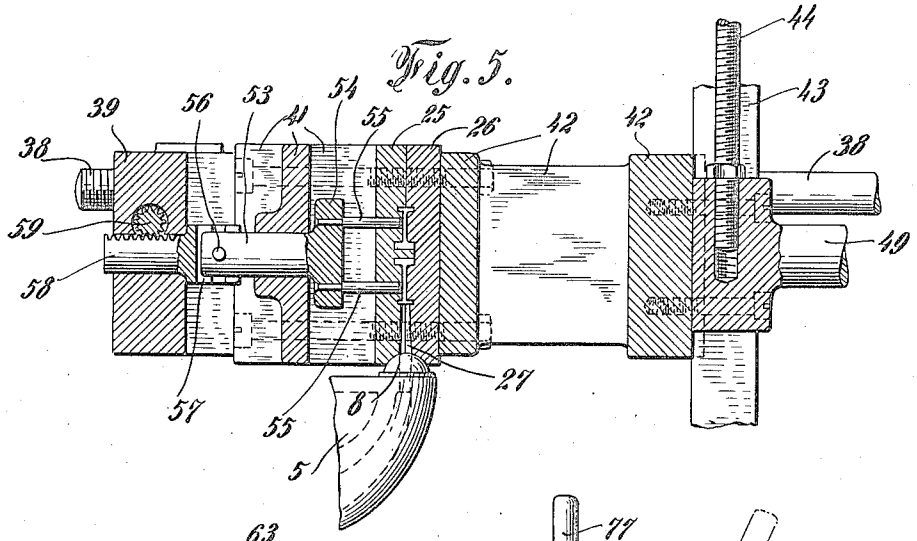
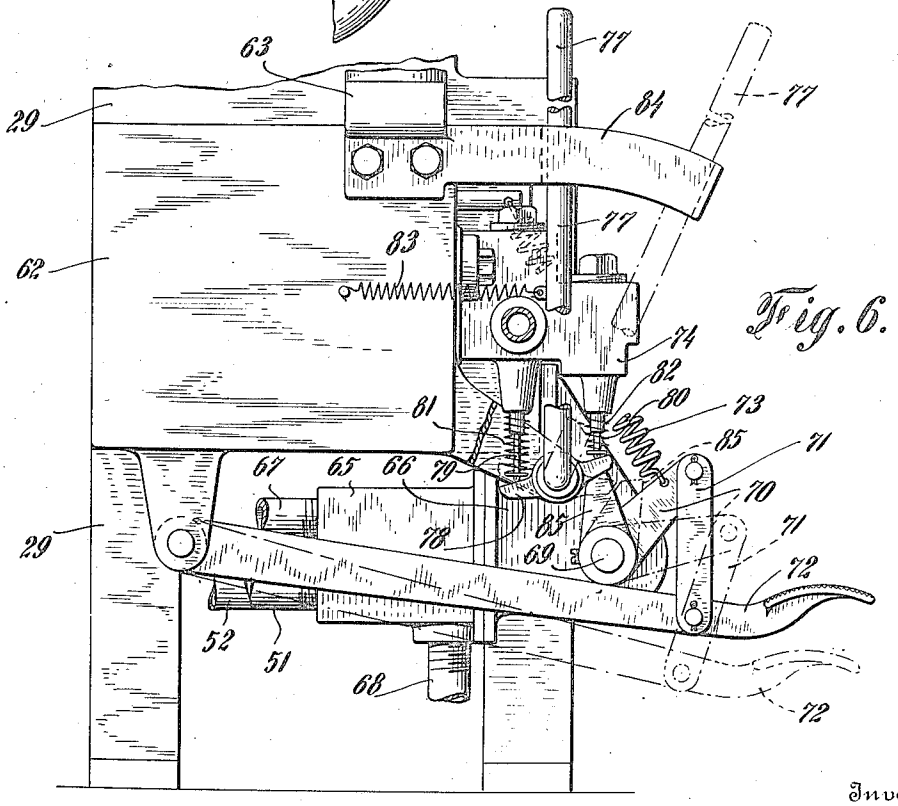


Fig. 6.



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UNITED STATES PATENT OFFICE.

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

DIE-CASTING MACHINE.

1,398,314. Specification of Letters Patent. Patented Nov. 29, 1921.

Application filed April 14, 1919. Serial No. 289,849.

To all whom it may concern:

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

My invention relates to casting machines for casting metals under pressure, such machines being commonly known as die casting machines. Objects of my invention are to produce such a machine that will do the work rapidly and which can be manipulated by a single operator. Other objects of my invention are to produce a machine which will be durable, effective, safe, reliable, and which will be comparatively inexpensive to manufacture. Other objects and advantages of my invention will hereinafter appear.

My invention includes features of construction and combinations of parts as will appear from the following description.

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

Figure 1 is a plan view of the complete machine as it appears in the casting position of the parts thereof.

Fig. 2 is a front elevation as viewed from below in Fig. 1, with parts broken away.

Fig. 3 is a vertical section on a diagonal plane indicated by the line 3—3 of Fig. 1 as viewed from the left and upwardly.

Fig. 4 is a vertical section on planes indicated by the lines 4—4 of Figs. 1 and 3 as viewed from the left and downwardly in Fig. 1 and as viewed from the left in Fig. 3.

Fig. 5 is an enlarged partial longitudinal section on a vertical plane indicated by the line 5—5 of Fig. 1 as viewed from below, and shows the ejecting mechanism and other parts.

Fig. 6 is a partial transverse section on a vertical plane indicated by the lines 6—6 of Figs. 1 and 2 as viewed from the left, and shows in elevation the operating devices for the fluid pressure controlling means, these parts being shown in Fig. 6 in full lines in the position corresponding to the idle condition of the machine and being shown in broken lines in the position corresponding to the casting position of the machine, the position of these parts in Fig. 6 being different from that appearing in Figs. 1 and 2 of the drawings.

Excepting as to features involving my present invention, the casting machine illustrated in the accompanying drawings as an embodiment of my invention is generally of a construction similar to that forming the subject of my patent for die casting machine No. 1,279,650 of September 24, 1918. In the present machine a suitable frame which may be of iron supports or has formed therein a furnace 1, and a melting pot 2, forming a receptacle for the material to be cast, is located in the upper part of the furnace 1. At its top the melting pot 2 is provided with an external flange 3 which rests upon the inner edge of a cap plate 4 for the furnace 1, as shown most clearly in Fig. 4, the cap plate 4 forming a part of the machine frame. An elongated pressure chamber 5 forming a casting pot is located in the upper part of the melting pot 2 so as to be surrounded by the molten metal, and this pressure chamber is stationarily but adjustably supported upon the cap 4 of the furnace 1. The pressure chamber 5 has formed therein at one end thereof an upwardly curved duct 6 extending from a depressed part of the bottom thereof and opening at its upper end into the nozzle port 7 of an outwardly rounded upwardly directed nozzle 8. The pressure chamber 5 adjacent to its other end from the nozzle 8 is provided with upwardly bent supporting arms 9, the downturned ends of which rest upon the furnace cap 4, where they are held in place by means of suitable clips 10. The pressure chamber 5 is further supported by means of a rearwardly and upwardly directed arm 11, the elevated outer end of which is supported for vertical adjustment upon the furnace cap 4 by means of a screw 12 provided with nuts 13 engaging at opposite sides of the supporting arm 11, as shown in Fig. 3. This provides for

adjusting the vertical position of the nozzle 8, as will be readily understood. For forcing out the molten metal from the pressure chamber through the port 7 of the nozzle 8, suitable pressure fluid, such as compressed air, is admitted into the upper part of the pressure chamber through a head or cap 14 to which there is connected a supply pipe 15, further referred to hereinafter.

As a feature of my present invention, means are provided for bodily lifting the melting pot 2 so as to cause the molten material therein to rise above and overflow into the pressure chamber 5 through the nozzle port 7 for thereby filling the pressure chamber with molten material from the melting pot 2. At its top the melting pot 2 is guided by means of lugs 16 vertically slidable in guide notches shown as provided in the inner edge part or margin of the furnace cap 4, as shown in Figs. 1 and 3. The melting pot 2 at its bottom is further guided and is adapted to have lifting movement imparted thereto by means of a lifting rod 17, the upper end of which is fixed in a boss 18 formed on the bottom of the melting pot 2. This lifting rod 17 extends downward through and is guided by a bearing 19 formed in a lower frame part 20 of the machine, as is shown in Fig. 3. For imparting pot-lifting movement to the lifting rod 17, a transversely extending rock shaft 21, journaled in bearings on the lower frame part 20, is provided medially with a short lifting arm 22 fixed thereon and engageable at its free end with the lower end of the lifting rod 17, as shown in Fig. 3. The outer end of the rock shaft 21, appearing at the bottom and left in Figs. 1 and 2, has fixed thereon a hub 23 from which there projects a treadle lever 24. Pressure of the foot upon the treadle lever 24 will raise the melting pot 2 for thereby filling the pressure chamber 5 with molten metal through the nozzle port 7. The pressure chamber 5 is made of a capacity to hold sufficient material so that several casting operations, for example, ten or twelve commonly, may be performed with one filling of the pressure chamber, thereby contributing to the ease and convenience of operation of the machine. When the pressure chamber 5 has thus been filled, relief of pressure of the foot on the treadle lever 24 will permit the melting pot 2 to descend by its own weight to the casting position thereof shown in the drawings, in which the flange 3 thereof rests upon the inner margin of the furnace cap 4, as hereinbefore noted.

The die or mold comprises two relatively movable members or sections 25 and 26, each of which has a recess formed in its lower edge and so located that when the die members 25 and 26 are brought together in the position for casting, this recess will fit over the rounded nozzle 8, as shown in Figs. 3 and 5. An inlet port 27 is shown as formed by a similar groove in the surface of each die member and extends from the above noted recess into the mold cavity at the inside of the die, and in the casting position of the die members 25 and 26, this inlet port 27 registers with the nozzle port 7, as shown in Fig. 3.

The parts of the machine for supporting the mold-forming die members 25 and 26 and for moving them relatively to each other and to the nozzle 8, are generally of a construction resembling that disclosed in my above mentioned Patent, No. 1,279,650 of September 24, 1918, for die casting machine, but the machine illustrated in the drawings embodies features of my present invention. Two horizontal parallel rods 28, one at each side, at their inner ends are fixed in a depending part of the furnace cap 4 and near the middle are further supported by a plate-like frame part 29. It is to be noted that these horizontal rods 28 extend at an angle of about forty-five degrees to the length of the elongated pressure chamber 5, this arrangement being for a purpose which will presently appear. A supporting plate 30 extends between and above the horizontal rods 28, and this supporting plate is provided near its inner end with a pair of split bearings 31, and is also provided near its outer end with a similar pair of split bearings 32, these split bearings 31 and 32 being slidable along and adapted to be clamped upon the rods 28 so that the supporting plate 30 may be adjusted longitudinally along the horizontal rods 28. For readily effecting this adjustment, racks are formed on the lower sides of the rods 28 and are engaged by pinions formed on a transverse shaft 33 journaled in the inner pair of split bearings 31 and adapted to be rotated by the application of a crank to one of its ends.

A die-operating cylinder 34 has on its lower side at the outer end thereof a pair of lugs 35, one of which appears in Fig. 2, and these cylinder lugs 35 are pivoted to the outer end of the supporting plate 30 by means of a transverse trunnion-forming shaft 36. The cylinder 34 has a head 37 which rigidly carries a pair of diagonally arranged parallel rods 38, the outer ends of which project in overhanging relation over the melting pot 2 and there support a die head or die carrier 39, which is adjustable along these rods by means of nuts 40. The die member 25 is supported by this outer die head 39 through the intermediary of an interposed ejector block 41, hereinafter more particularly referred to, and which virtually forms a part of the die member 25, being adapted to be removed therewith from the die head 39 when the dies are to be changed.

A second die head or die carrier 42 is

slidably mounted upon the guide rods 38, and the other above noted die member 26 is secured to and supported by this die head 42. The slidable die head 42, together with the guide rods 38 and outer die head 39, is supported by a yoke 43, the legs of which are slidably guided by the die head 42 and from the upper cross-piece of which the die head 42 is adjustably supported by an adjusting screw 44, providing for the vertical adjustment of the die heads 39 and 42 relatively to the nozzle 8 for accommodating dies of various sizes. The lower ends of the legs of the yoke 43 are pivoted to a bearing block 45 which is slidable along an inclined guide rod 46, which inclines downward from the cylinder 34 toward the melting pot 2. At its ends the inclined guide rod 46 is rigidly supported upon the supporting plate 30 by means of upstanding brackets 47 and 48.

The above described means for adjusting this supporting plate 30 along the rods 28 provides for adjusting both of the die carriers 39 and 42, together horizontally, so that dies of various sizes may be brought into proper casting relation with the nozzle 8, the corresponding vertical adjustment for a similar reason being provided by the yoke 43 and adjusting screw 44, as above described. In this connection it is to be particularly noted as a feature of my present invention that the inclined guide rod 46 which supports the yoke 43 is not mounted upon the main frame of the machine but is mounted upon and carried by the cylinder-supporting plate 30, so that when this plate 30, together with the several parts carried thereby, is adjusted along the rods 28, this inclined guide rod 46 will partake of the adjusting movement thereby imparted to yoke 43 and its pivot block 45, so that the vertical adjustment of the die carriers 39 and 42 and of the dies carried thereby will not be disturbed by the horizontal adjustment effected by sliding the supporting plate 30 along the rods 28, as will be readily understood, thereby providing complete independence between the vertical and horizontal adjustment of the die carriers 39 and 42.

The sliding pivot block 45 and inclined guide rod 46 operate to move the die members 25 and 26 downward upon the nozzle 8 so that these die members will be securely clamped to the nozzle 8 when the inner slidable die carrier 42 is operated to slide along the guide rods 38 for moving the die member 26 up to the die member 25 in the casting position, as shown in Figs. 1, 2, 3 and 5. When the die member 26 is moved away from the die member 25 by the sliding of the inner slidable die carrier 42 in the opposite direction upon the guide rod 38, the slidable pivot block 45 and the inclined guide rod 46 operates to raise the die members 25 and 26 away from the nozzle 8 and to a position above the melting pot 2 in the separated position of the die members 25 and 26 for discharging the casting from the die, as will be readily understood although this position of the parts of the machine is not illustrated in the drawings, but the operation in this respect is substantially the same as described in my hereinbefore mentioned patent for die casting machine, No. 1,279,650, of September 24, 1918.

For sliding the slidable die carrier or die head 42 along the guide rods 38 and for also at the same time sliding the bearing block 45 of the supporting yoke 43 along the inclined rod 46, a piston rod 49 is connected to the die head 42 and to a double-acting piston 50 in the die-operating cylinder 34. A suitable pressure fluid, such as steam, for operating the piston 50, is admitted to the cylinder 34 through pipes 51 and 52 connected to the opposite ends of this cylinder and the used pressure fluid is exhausted through the same pipes. When the piston-operating pressure fluid is admitted to the cylinder 34 through the pipe 52, at the right end thereof as the machine is viewed in the drawings in Figs. 1 and 2, the die member or die section 26 carried by the slidable die head 42 will be moved to the left toward the other die member or die section 25 carried by the other or outer die head 39, and at the same time the slidable bearing block or pivot block 45 traveling down the inclined guide rod 46 will lower the approaching die members 25 and 26 upon the nozzle 8, so that these die members 25 and 26 will be closed together and firmly clamped upon the nozzle 8. When pressure fluid is admitted to the die operating cylinder 34 through the pipe 51, at the left end of this cylinder, the die carrier 42 together with the die member 26 carried thereby will be retracted, causing the bearing block 45 to travel up the inclined guide rod 46, thereby first to unclamp the die from the nozzle 8 and then to raise the die members 25 to 26 as the die member 26 moves away from the die member 25 until these die members are separated to the desired extent and raised to a suitable distance away from the nozzle 8 over the melting pot 2.

It is to be noted that the projecting guide rods 38 are disposed in vertical planes parallel to the vertical planes occupied by the adjustment-providing supporting rods 28. It is to be further noted that a vertical plane passing through the axes of the cylinder 34, piston rod 49 and transversely of the die members 25 and 26 through the inlet port 27 and the registering nozzle port 7 will occupy an angle of about forty-five degrees to a vertical plane on the section line 3—3

longitudinally of the elongated pressure chamber 5 and intersecting the first-named vertical plane at the registering nozzle port 7 and inlet port 27, as will be clear from an inspection of Fig. 1. The die-carrying guide rods 38 are substantially unyielding longitudinally, but will yield to a certain extent transversely, providing for slight lateral yielding movements horizontally of the die members 25 and 26. Similarly the pressure chamber 5 at the nozzle 8 is substantially unyielding in a horizontal direction longitudinally of the elongated pressure chamber 5, in the direction of the section line 3—3, but is slightly yieldable transversely, providing for a slight horizontal yielding movement of the nozzle 8 transversely to the length of the pressure chamber 5.

This above noted angular arrangement of the die-supporting guide rods 38 and elongated pressure chamber 5 provides for horizontal self-adjusting relative movement of the die or mold comprising the sections 25 and 26, and of the nozzle 8. This self-adjusting yielding of course takes place horizontally in vertical planes respectively substantially at right angles to the above noted intersecting vertical planes. This above described angular arrangement of the parts of the machine provides for the tight and secure clamping of the recessed die sections 25 and 26 upon the upwardly directed rounded nozzle end 8, and also provides for the correct alining or registering of the nozzle port 7 and inlet port 27. This self-adjusting angular arrangement forms a feature of my present invention.

It is to be noted of the machine embodying my invention illustrated in the drawings and as will be clear from an inspection of Fig. 2, that the pivotal movement of the cylinder 34 for raising and separating the die sections 25 and 26 will cause the outer die section 25 to travel upwardly and slightly to the right in an arc described by the outer ends of the die-supporting rods 38. This die section 25 moves almost straight upward away from the nozzle 8, the lateral component of the arc of its movement being very slight and being least and practically negligible at the beginning of such movement when the die is being separated from the nozzle. On the other hand it is to be noted that the other die section 26 will be moved laterally away from the nozzle 8 to a greater extent than it is moved upwardly, the lateral component of its movement being greater than the vertical component. Commonly heretofore in die casting machines having die supporting and operating means of a construction similar to this, the arrangement has been such that when the die sections, such as 25 and 26, separated, the casting would stick to or be retained by the inner die section, such as 26. It has been found in operation that when the casting is thus carried by the die section having the large component of lateral movement, such as the die section 26, this lateral movement relatively to the nozzle 8 tends and often does break the sprue from the completed casting, thereby sometimes disfiguring the casting, it being desirable that the sprue shall remain attached to the casting from which it may be duly removed as an after operation. In the machine of my present invention illustrated in the drawings, this difficulty is overcome by a reverse arrangement, or by arranging the die sections 25 and 26 so that as the die sections are raised and separated the casting will adhere to the outer die section 25, and in view of the fact as above noted that this die section moves almost straight upward away from the nozzle 8, the projecting sprue will not be broken from the casting, but will remain attached thereto, thereby preventing in many cases the damaging of the casting.

Commonly heretofore in die casting machines, ejector mechanism for ejecting the finished casting from the die section by which it is carried has been constructed as a part of one of the die sections and of an ejector block forming a part of such die section and removable from the die carrier therewith, thereby necessitating the construction of a complete ejector mechanism for each separate die. In the machine illustrated in the drawings as an embodiment of my present invention, the major part of the ejector mechanism is carried by the die head and is adapted to be employed in connection with any number of different dies. In the construction illustrated in the drawings, the ejector block 41 hereinbefore referred to as forming a part of the die section 25, guides an ejecting plunger rod 53, having a head 54 carrying ejector pins 55 passing through the die member 25, as shown in Figs. 1 and 5. The outer end of the ejector rod 53 is provided with a cross pin 56, the projecting ends of which detachably engage in vertical slots shown as provided in a yoke-shaped head 57, provided with a rack 58 in the form of a stem guided in the outer part of the outer die carrier or die head 39. A pinion-forming ejector shaft 59 engages the rack teeth of the rack stem 58 and at the front of the machine is provided with a manually operable actuating handle 60 to the lower projecting end of which there is connected a retractile spring 61 for retracting the ejector pins 55 to the non-operative position thereof appearing in Figs. 1 and 5 of the drawings. When the die is changed the ejector block 41 is disconnected from the die head 39, the die section 25 remaining attached to the block 41, these parts being removed together, the cross pin 56 merely

being lifted out of the slot in the yoke head 57 leaving the ejector-operating means, comprising the rack and pinion device just described, as a permanent part of the die-carrying head 39 and in position ready for use with the next die that may be installed upon the machine, and thereby saving the reproducing of the operating parts over and over again for each die, as has commonly been done heretofore.

In the machine of my present invention a local air tank or compressed air chamber 62 forms a part of the frame of the machine. This air tank 62 has one end thereof closed by a head formed by the frame plate 29 and the other end of the air tank 62 at the top thereof is connected by means of a supporting member 63 with the furnace cap 4 adjacent to the inner end of the adjustment-providing supporting rods 28. This frame-forming air tank 62 provides supporting means for several of the operating parts of the machine hereinafter to be described. The air tank or reservoir 62 may be kept supplied with compressed air or other suitable pressure fluid by means of a supply pipe 64 entering through the tank head 29 and which may be connected to any suitable source of pressure fluid.

Any suitable valve mechanism may be employed for causing the proper operation of the piston 50 in the cylinder 34, and in the machine illustrated in the drawings, such mechanism is substantially the same as that forming the subject of my patent for control box, No. 1,309,611 of July 15, 1919, and also disclosed in my hereinbefore mentioned patent for die casting machine No. 1,279,650 of September 24, 1918, and such valve mechanism will therefore be illustrated and described herein only to the extent necessary for present purposes. Secured to and supported by the tank 62 below and at the front thereof is a two-part casing comprising a rear casing part 65 which may be a valve chamber for containing the valves and a front casing part 66 which may be a cam-containing chamber containing the operating mechanism for the valves. The pipes 51 and 52, connected to the opposite ends of the cylinder 34, are connected at their other ends to the valve chamber 65, as shown in the drawings. Also there is connected to this valve chamber 65, a steam supply pipe or inlet pipe 67, and an exhaust pipe 68. A valve-operating shaft or cam shaft 69, horizontally arranged longitudinally of the machine, is journaled in the cam chamber 66, and is adapted to be rocked for operating the valves in proper order. The valve-operating cam shaft 69 is adapted to be rocked by means of an operating arm 70 fixed thereon and pivotally connected by a two-part link 71 to a pedal 72 projecting to the front of the machine and pivoted at its rear end to lugs shown as formed upon the lower side and at the rear of the frame-forming air tank 62, as shown in Fig. 6.

The arrangement is such that when the pedal 72 is depressed to the position appearing in Figs. 1 and 2 and appearing in broken lines in Fig. 6, then steam will be admitted to the right end of the operating cylinder 34 through the pipe 52 and will be exhausted through the pipe 51, for closing together and lowering the die sections 25 and 26 to the casting position thereof shown in Figs. 1, 2 and 5. A comparatively strong retractile spring 73 is connected to the lever arm 70 and to the frame part 62 of the machine, so that when the pedal 72 is released it will be raised to the position shown in full lines in Fig. 6, and the valve-operating cam shaft 69 will be correspondingly rocked in a counterclockwise direction to the position indicated by the operating lever arm 70 in Fig. 6, thereby to operate the valves for admitting steam to the cylinder 34 through the pipe 51 connected to the left end thereof and for exhausting steam from the cylinder 34 through the other pipe 52 connected to the right end thereof, thereby to unclamp, separate and raise the die sections 25 and 26, for discharging the casting, as hereinbefore described.

Any suitable valve mechanism may be provided for controlling the compressed air or other suitable pressure fluid which is supplied through the pipe 15 to the pressure chamber 5 for forcing out the molten metal therefrom through the port 7 of the nozzle 8 into the mold formed by the closed die sections 25 and 26, and the mechanism for this purpose appearing in exterior elevation in the accompanying drawings is substantially the same as that which is disclosed in my hereinbefore mentioned patent for die casting machine, No. 1,279,650, of September 24, 1918, and therefore need not be herein particularly described but only sufficiently described for present purposes.

The arrangement is such that pressure fluid from the supply reservoir 62 may be supplied through a valve casing or valve chamber 74 shown as secured to the front of this air tank to the hereinbefore mentioned supply pipe 15, or this pressure fluid may be exhausted or permitted to escape from the pressure chamber 5 back through the supply pipe 15 to the valve chamber 74 and through a port 75 therein to the atmosphere, as desired, by means of a manually actuable valve-operating rock shaft 76 having an upstanding handle lever 77. The air-controlling rock shaft 76 is journaled in bearings formed on and projecting from the front and lower part of the frame-forming air tank 62, and extends below the valve casing 74 where it is provided with a two-arm rock lever 78, the opposite ends

of which respectively engage the lower projecting ends of valve stems 79 and 80, which project below the valve casing 74, and which are surrounded respectively by valve-closing thrust springs 81 and 82, as shown in Fig. 6.

The arrangement is such that when the upstanding lever 77 is pulled toward the operator and away from the machine, pressure fluid will be admitted to the pressure chamber 5 to force the molten metal into the die, and when this lever 77 is moved in the other direction, away from the operator and toward the machine, pressure fluid will be permitted to exhaust from the pressure chamber 5 to the atmosphere through the port 75 of the valve casing 74. This valve-operating lever 77 is adapted to be moved in the latter direction, that is toward the machine and away from the operator, by means of a comparatively strong retractile spring 83 connected thereto and to the tank-forming frame part 62 of the machine, as shown in Fig. 6. This spring 83 is of sufficient strength to overcome and compress the valve-closing spring 82 of the valve stem 80, as shown in Fig. 6. The valve-operating movements of the lever 77 are conveniently limited in each direction by means of a slotted guide member 84, shown as secured to and projecting from the reservoir-forming frame part 62.

A safety device, forming a feature of my present invention, is provided to prevent the admission of pressure fluid to the pressure chamber 5 excepting when the die members 25 and 26 are securely clamped to the nozzle 8, and also to prevent the unclamping of the die members from the nozzle 8 excepting when the pressure has been relieved in the pressure chamber 5. This safety device is in the form of an interlocking device operative between the rock shaft or cam shaft 69 which controls the supply of steam to the cylinder 34, and the air-controlling rock shaft 76 which controls the supply of air to the pressure chamber 5. A locking finger 85 is fixed upon the projecting outer end of the steam-controlling rock shaft or cam shaft 69 and projects upwardly in a position to engage the forwardly projecting arm of the two-arm air-controlling rock lever 78 in the non-operative position of the parts of the machine, illustrated in Fig. 6, in which, as shown in full lines, the air-controlling lever 77 is at the position for exhausting the air from and relieving the pressure in the pressure chamber 5 and in which, as also shown in Fig. 6 in full lines, the steam-controlling pedal 72 is in the elevated position corresponding to the elevated and separated condition of the die members 25 and 26, and to produce which, as hereinbefore described, steam is admitted to the left end of the cylinder 34 through the steam pipe 51, and is exhausted from the other end of this cylinder through the steam pipe 52, as will be readily understood, although this position of the parts of the machine is not illustrated in the drawings, excepting in Fig. 6, in full lines. In the position of the parts illustrated in Fig. 6, it will be clear that the air-controlling lever 77 cannot be operated to admit pressure fluid into the pressure chamber 5, such movement being prevented by the engagement of the upper end of the interlocking finger 85 beneath the forwardly projecting arm of the rock lever 78. When the pedal 72 has been depressed to the position shown in broken lines in Fig. 6, then thereby the locking finger 85 will be rocked to the position also shown in broken lines in Fig. 6, and in which the rock lever 78 is released so that the air-controlling lever 77 may be moved to the position shown in broken lines in Fig. 6, thereby then admitting pressure fluid into the pressure chamber 5, but only after the die sections 25 and 26 have been closed together and clamped upon the nozzle 8. Also it is to be noted that the movement of the air-controlling lever 77 from the position shown in full lines in Fig. 6 to that shown in broken lines will move the rock lever 78 so that its forward end will be at the rear of and in the path of the upper end of the locking finger 85, thereby effectively preventing the spring 73 from changing the position of the steam valves for unclamping and separating the die sections 25 and 26 in this position of the air-controlling lever 77 in which pressure is being applied to the molten metal within the pressure chamber 5. It will be noted that the forward arm of the air-controlling rock lever 78 performs also the function of a locking finger, similar in this respect to that performed by the locking finger 85 fixed upon the steam-controlling cam shaft 69. In the position of the interlocked parts shown in full lines in Fig. 6, in which die members 25 and 26 are in the raised and separated position, it will be readily understood that it is impossible to admit air under pressure into the pressure chamber 5. Also it will be clear that in the other interlocked position of the parts shown in broken lines in Fig. 6, in which air under pressure is contained in the pressure chamber 5, it will be likewise impossible to unclamp the die sections 25 and 26 from the nozzle 8. It is clearly evident that if either of these prevented operations were permitted to occur, the molten metal from the pressure chamber 5 would be forced out through the nozzle port 7 into the atmosphere with disastrously dangerous results to the operator. The interlocking device embodied in the die casting machine of my present invention is extremely simple and effective in operation.

Although the contacting marginal surfaces of the die members 25 and 26 are sur-

faced as smoothly and truly as possible to form a tight joint, and in spite of the fact that these die members are held together and upon the nozzle 8 with great force, yet the pressure of compressed air by which the molten metal is forced into the die often shoots out hot particles of this metal from between the die members into the atmosphere. In order to protect the operator, who sits at the front of the machine, from these small flying particles, a front shield 86 is provided, as shown in Figs. 1 and 2, the upper part of this shield being omitted in Fig. 2 so as not to hide the parts of the machine at the rear thereof. The shield 86 is carried by the upper end of a T-shaped arm 87, the lower end of which is pivoted on a stud 88 projecting from the lower frame part 20 of the machine. A diagonally arranged retractile spring 89 anchored to the frame of the machine and connected to the supporting arm 87 normally holds this supporting arm in the upright position with the shield 86 in the protective position shown in Figs. 1 and 2 of the drawings. At the upper end and right side the pivoted supporting arm 87 is provided with a handle 90, so that the operator may swing the shield 86 to the left and out of his way for removing the casting from the mold. The arrangement is such that the weight of the shield 86 will maintain it in this inclined non-operative position from which it is readily returned by the operator to the protective position illustrated in the drawings.

The operation of the machine with particular reference to the features involving my present invention has been hereinbefore so fully described, that no further and separate description of the operation would seem to be necessary.

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 having, in combination, a receptacle for the material to be cast, a pressure chamber having an inlet opening normally above the level of the surface of the material in the receptacle, and means for lifting the receptacle for causing the material to flow therefrom through said inlet opening into the pressure chamber.

2. A casting machine having, in combination, a receptacle for the material to be cast, a pressure chamber having an inlet opening normally above the surface of the material in the receptacle, means for bodily lifting the receptacle as a whole for causing the material therein to flow into said pressure chamber through said opening, and guiding means for the receptacle to prevent it tipping when lifted.

3. A casting machine having, in combination, a receptacle for the material to be cast, a machine frame, means for guiding said receptacle for vertical movement in said frame, a pressure chamber extending down into said receptacle and having a nozzle normally occupying a casting position above the surface of the material in the receptacle, said pressure chamber being stationarily supported by said frame, and means for lifting the receptacle for thereby causing the material therein to flow into the pressure chamber through said nozzle for thereby filling the pressure chamber with material from the receptacle.

4. A casting machine having, in combination, an elongated pressure chamber supported at one end thereof and having its other end projecting and provided with an upwardly directed nozzle, a die support supported at one end and extending at the other end over the nozzle-carrying end of said pressure chamber in overhanging relation, and a die carried by said overhanging die support and adapted to receive the material to be cast from said pressure chamber through said nozzle, said elongated pressure chamber and overhanging die support being arranged at an angle to each other thereby to provide for slight lateral self-adjusting movements between said die and said nozzle when the coöperating parts are brought into the casting position.

5. The invention claimed in claim 4 in which said die is of sectional construction and has one member thereof mounted for sliding movement upon the die support for opening and closing the die sections and in which the die support is pivoted for rocking movement, whereby the die sections may be raised and separated or lowered and brought together in coöperative relation with the nozzle in the casting position.

6. A casting machine having, in combination, a die carrier for one part of a sectional die, a second die carrier for another part of a sectional die, an overhanging die carrier support upon the outer end of which one of said die carriers is fixed, the second die carrier being mounted for sliding movement along the die carrier support to and from the first said die carrier, means for effecting such sliding movement of the second die carrier for thereby separating or closing together the die sections, means including an inclined guideway for raising the outer end of said support and both of said die carriers and die sections when the die carriers and dies are separated and for lowering said die carriers and die sections to the casting position when said die carriers and die sections are brought together, and a support in common upon which said inclined guideway is fixed and to which the other end of said overhanging die support

is pivoted, so that said inclined guideway and the pivot for said pivoted die-carrying support maintain a fixed relation relatively to each other.

7. The invention claimed in claim 6 in combination with a machine frame having guideways upon which said common support is adjustable, whereby said inclined guideway and said pivoted die-carrying support have a movement of adjustment in common so as to preserve their relative relation undisturbed.

8. A casting machine of the kind in which fluid pressure operated means are employed for closing the die and moving it to the casting position and for moving the die away from the casting position and separating its sections to discharge the casting, and in which other pressure fluid operated means are employed for forcing the material to be cast from a pressure chamber into the die at the casting position, such machine having, in combination, a valve device in control of the pressure fluid for operating the die, another valve device in control of the pressure fluid for forcing the material to be cast from the pressure chamber into the die in the casting position of the latter, operating means for the first said valve device, operating means for the second said valve device, and an interlocking device between the two said operating means for compelling the proper sequence of operation of the valve devices.

9. A casting machine of the kind in which fluid pressure means are provided for operating the die to move the die sections to the casting position and to clamp them together and for separating the die sections and moving them away from the casting position to discharge the casting, and also having other fluid pressure means for forcing the material to be cast from a pressure chamber through a nozzle into the die at the casting position of the latter, such machine having, in combination, a valve device in control of the pressure fluid for operating the die sections, a second valve device in control of the pressure fluid for forcing the material from the pressure chamber into the die, operating means for the said first valve device, operating means for the said second valve device, and an interlocking device between the two said operating means adapted to compel the closing together of the die sections at their casting positions before pressure fluid can be admitted to the pressure chamber and also adapted to compel the exhausting of pressure fluid from the pressure chamber before the die sections can be separated and moved away from the casting position.

10. A casting machine having, in combination, a receptacle for the material to be cast, a pressure chamber having an inlet opening above the level of the surface of the material in the receptacle, and means for moving the receptacle for causing the material to flow therefrom through said inlet opening into the pressure chamber.

11. A casting machine having, in combination, a receptacle for the material to be cast, a nozzle above the surface of the material to be cast and adapted to communicate therewith upon moving of said receptacle.

12. A casting machine having, in combination, a receptacle for the material to be cast, a pressure chamber having a nozzle projecting above the level of the surface of the material in the receptacle and forming a combined inlet and outlet for the pressure chamber, and means for moving the receptacle in such manner as to cause the material therein to flow therefrom through the nozzle into the pressure chamber.

13. A casting machine having, in combination, a receptacle for the material to be cast, a nozzle adapted to communicate therewith, a nozzle-carrying pressure chamber and a die support arranged to provide for slight lateral self-adjusting movements at an angle to each other between said die and said nozzle when the coöperating parts are brought into casting position.

14. A casting machine having, in combination, a receptacle for the material to be cast, a nozzle adapted to communicate therewith and mounted for slight lateral self-adjusting movement, and a die supported for slight lateral self-adjusting movement at an angle to the direction of said lateral self-adjusting movement of the nozzle, whereby self-adjusting movements may take place between the die and the nozzle when these coöperating parts are brought into the casting position.

15. In combination in a die casting machine having a die and a discharge nozzle, means for compensating for lack of alinement between the die opening and the nozzle opening.

In testimony whereof, I have affixed my signature to this specification.

GEORGE WALDEMAR BUNGAY.