No. 889,547. PATENTED JUNE 2, 1908.

A. G. RAUH & L. OLSEN.

DIE CASTING APPARATUS.

APPLICATION FILED APR. 20, 1907.

7 SHEETS—SHEET 1.

Fig 1

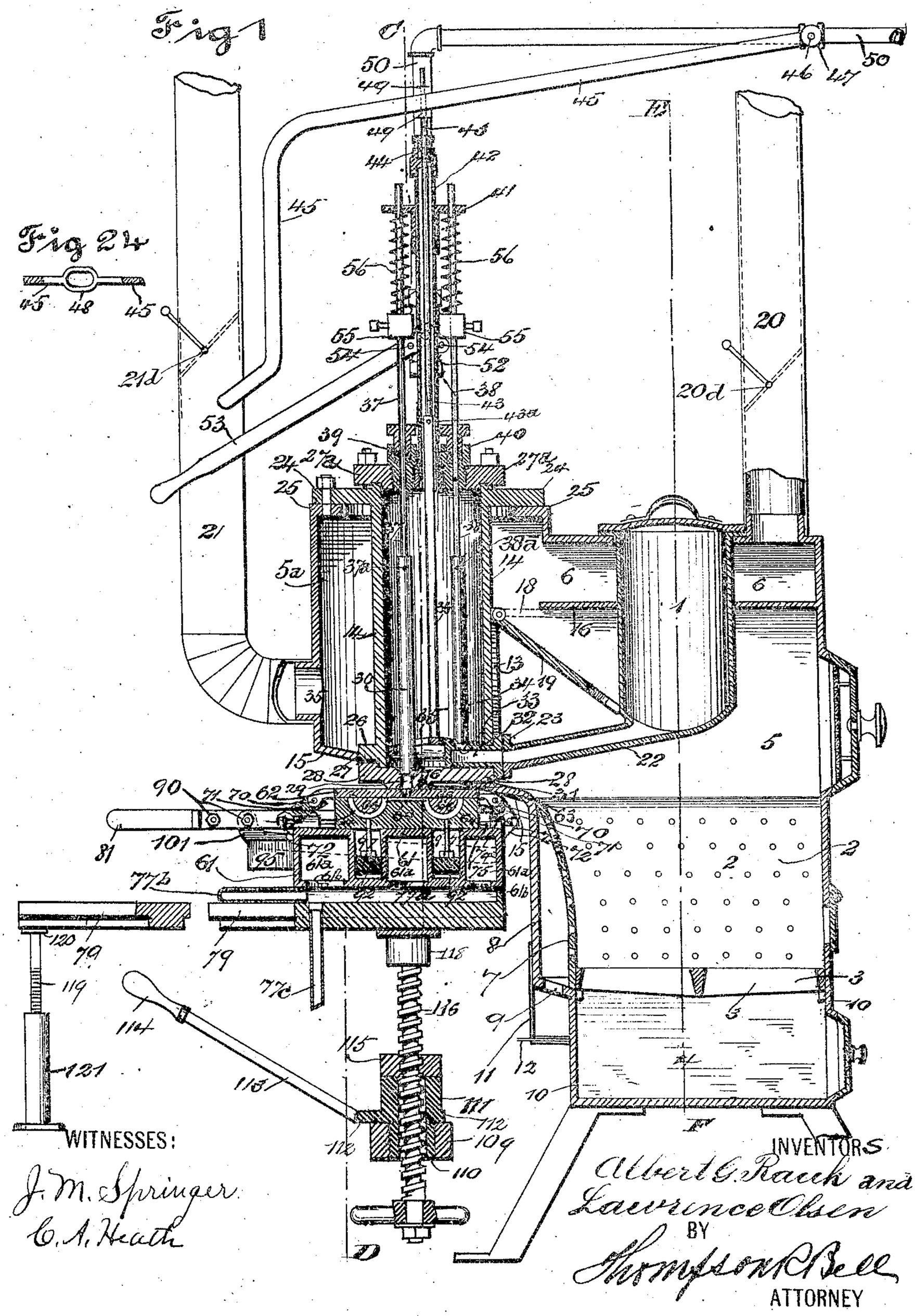

Fig 24

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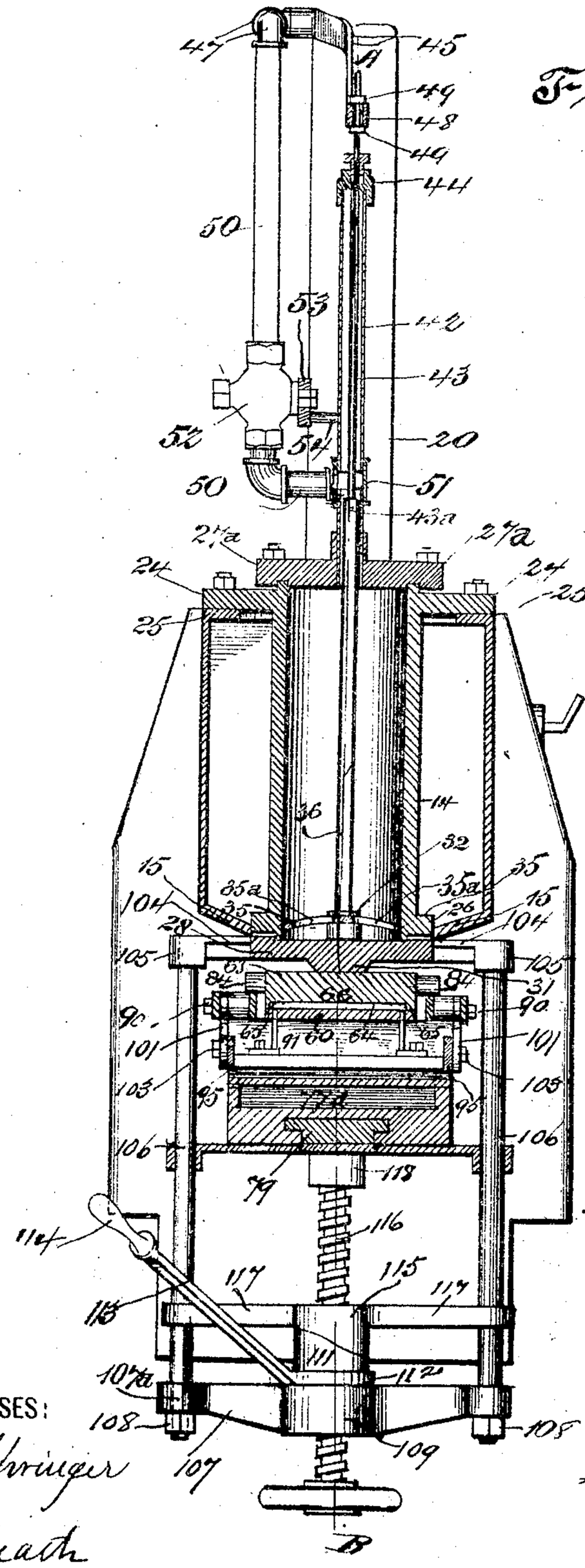
7 SHEETS—SHEET 2.

Fig 2



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C. A. Heath

INVENTORS

Albert G. Rauh and

Laurence Olsen

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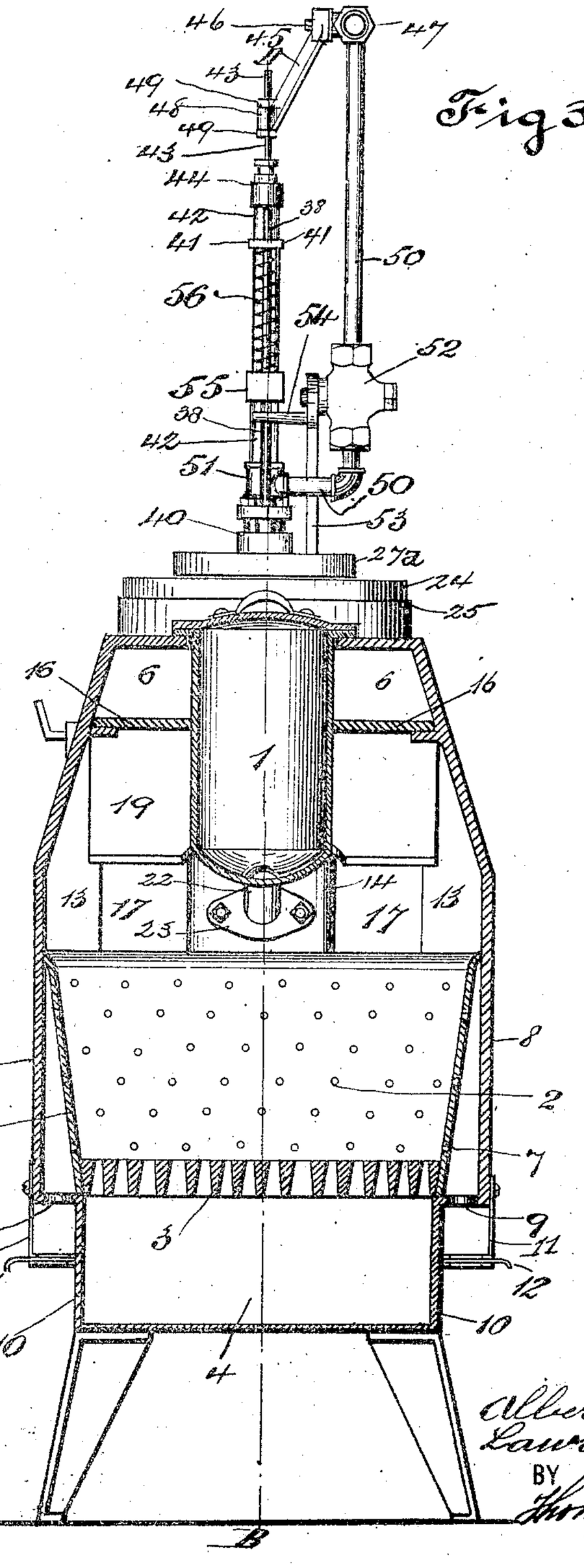
7 SHEETS—SHEET 3.

Fig 3



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C. A. Heath

INVENTORS

Albert G. Rauh and Laurence Olsen

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Fig 4

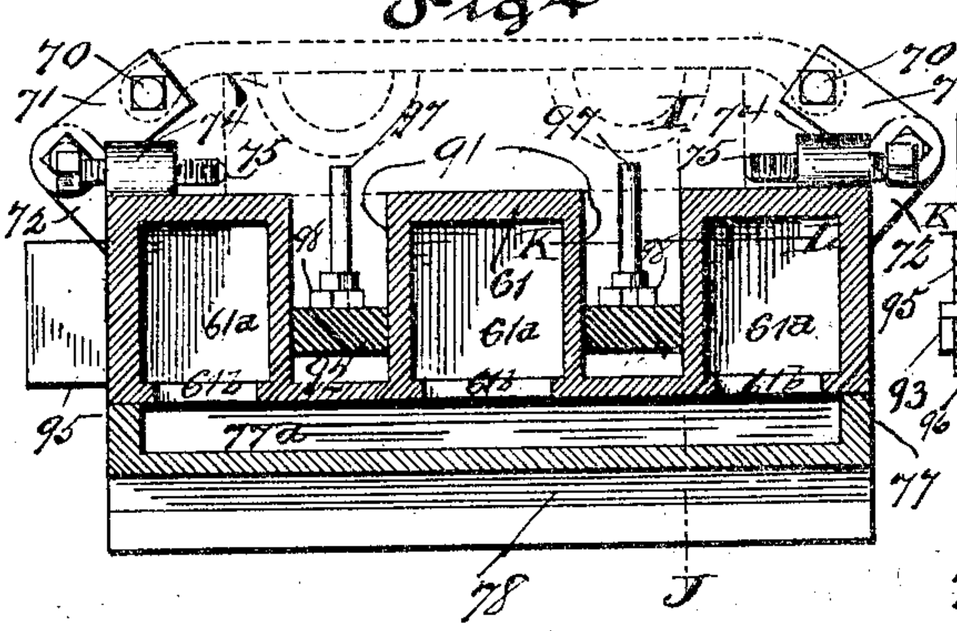

Fig 5

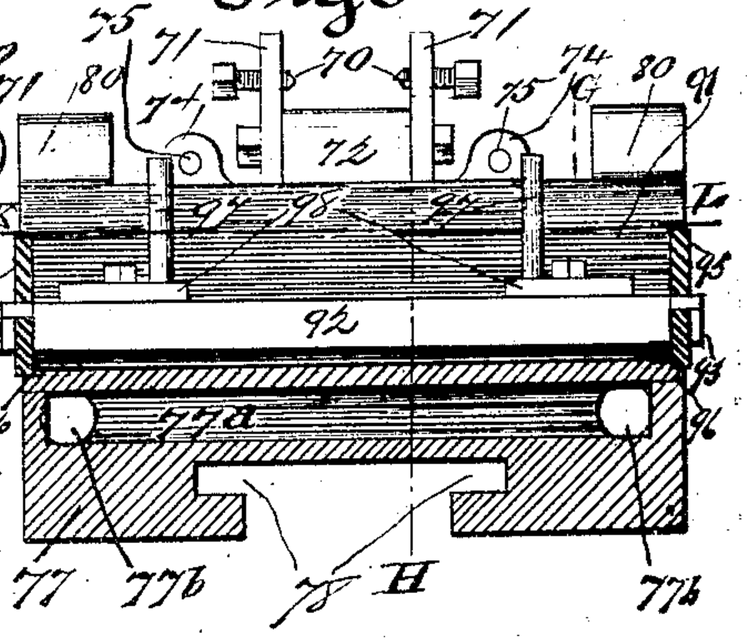

Fig 6

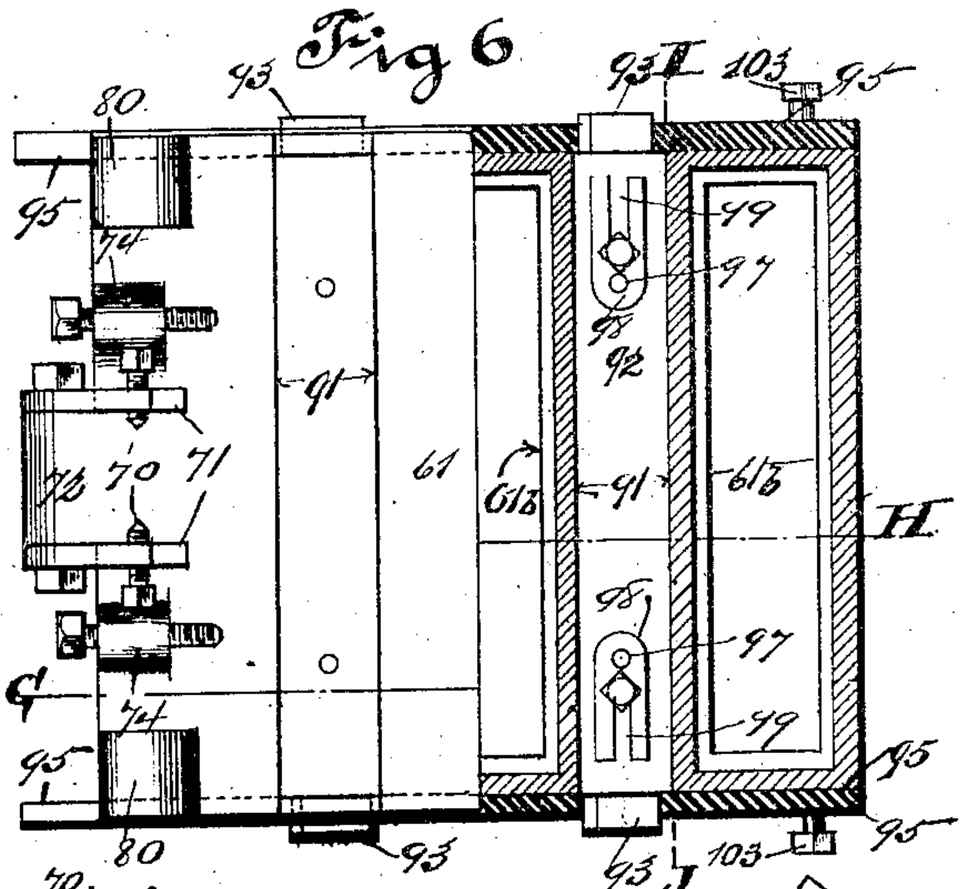

Fig 9

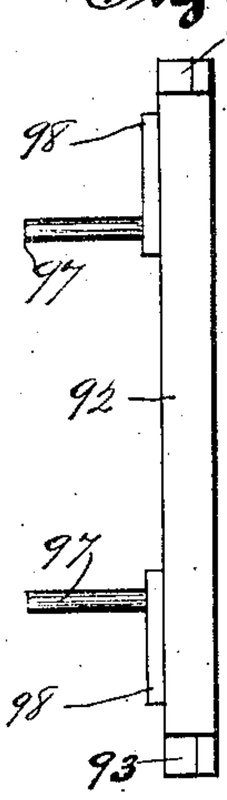

Fig 8

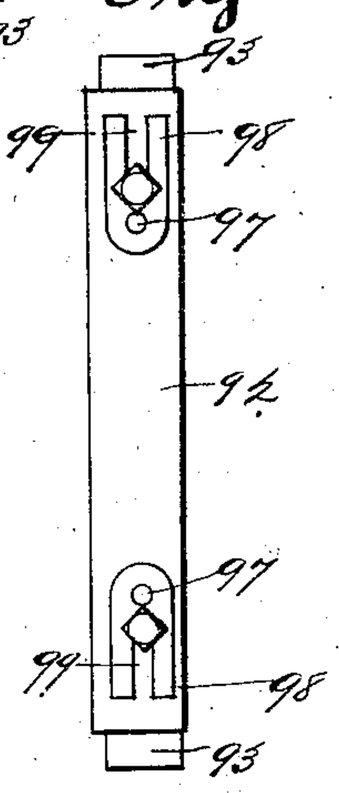

Fig 7

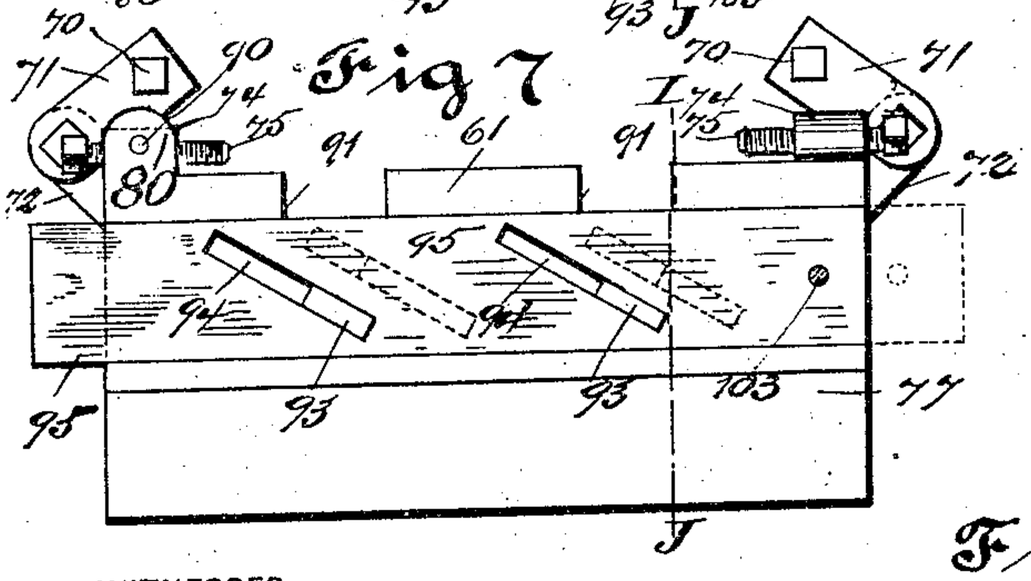

Fig 10

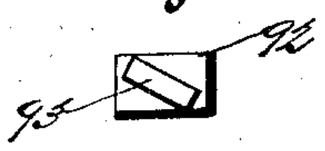

Fig 11

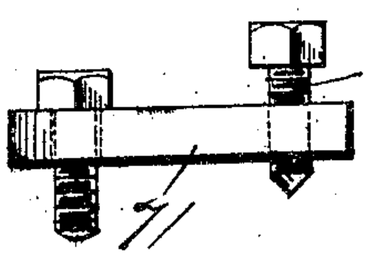

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Fig 12

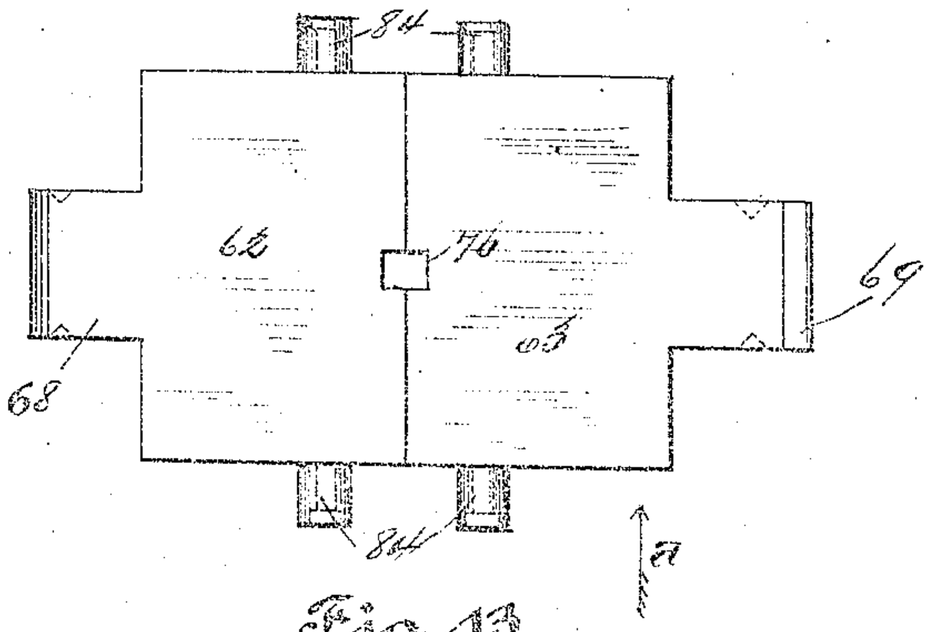


Fig 15

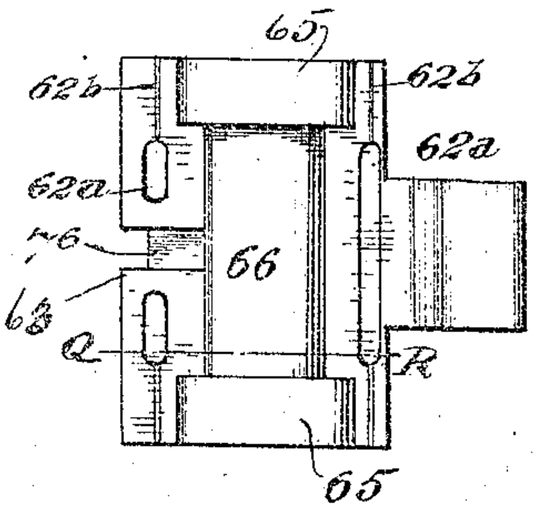


Fig 13

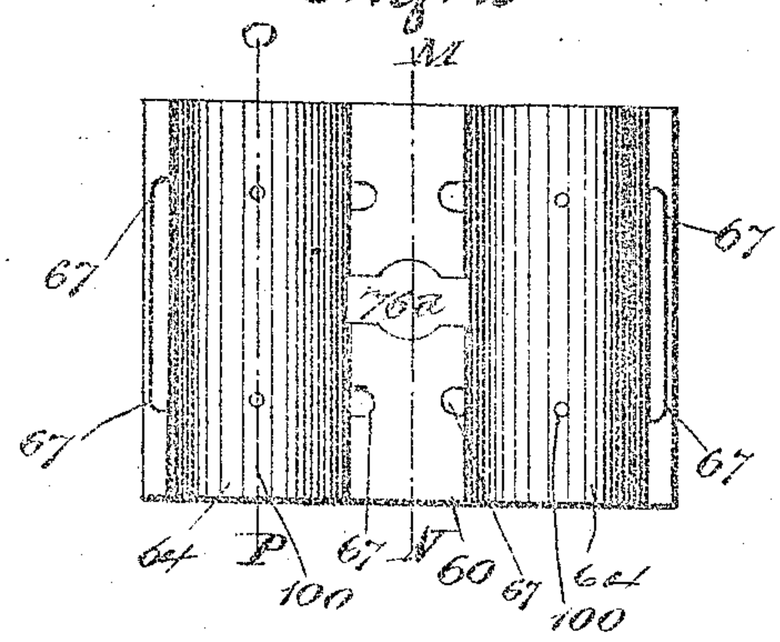


Fig 16

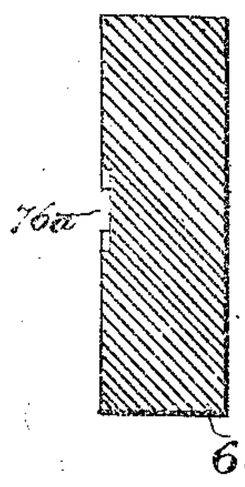


Fig 17

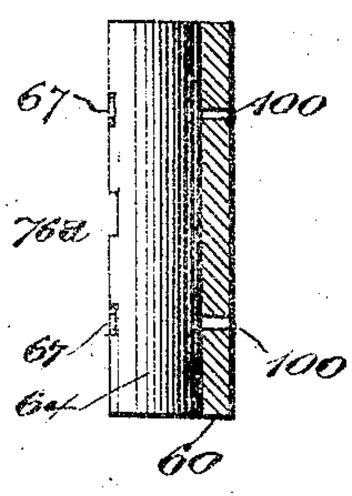


Fig 14

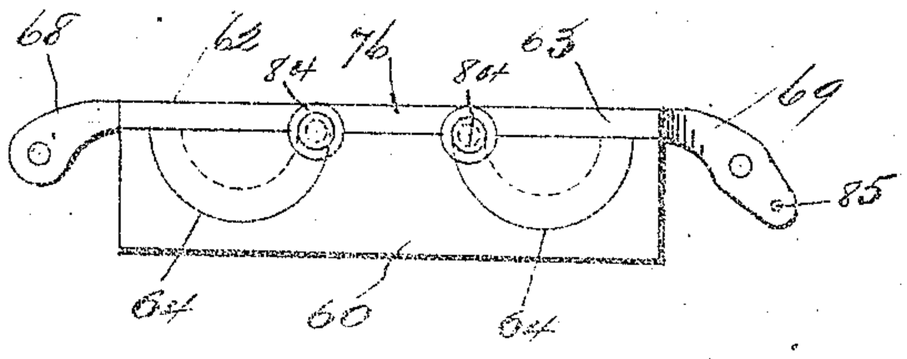


Fig 18

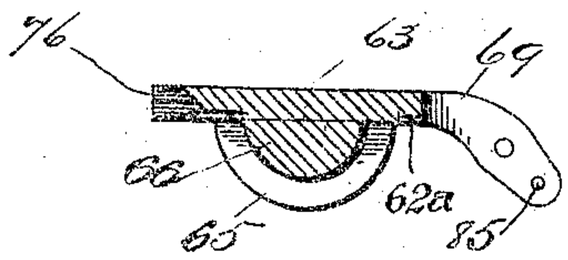
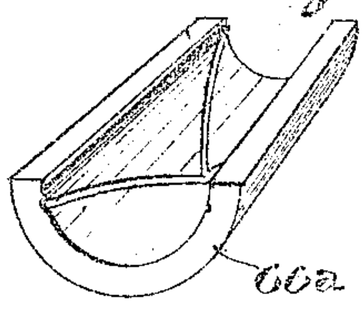


Fig 30



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C. A. Heath

INVENTORS

Hubert G. Rauh and

Laurence Olsen

BY

Thompson & Bell

ATTORNEY

No. 889,547. PATENTED JUNE 2, 1908.

A. G. RAUH & L. OLSEN.

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APPLICATION FILED APR. 20, 1907.

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Fig 19

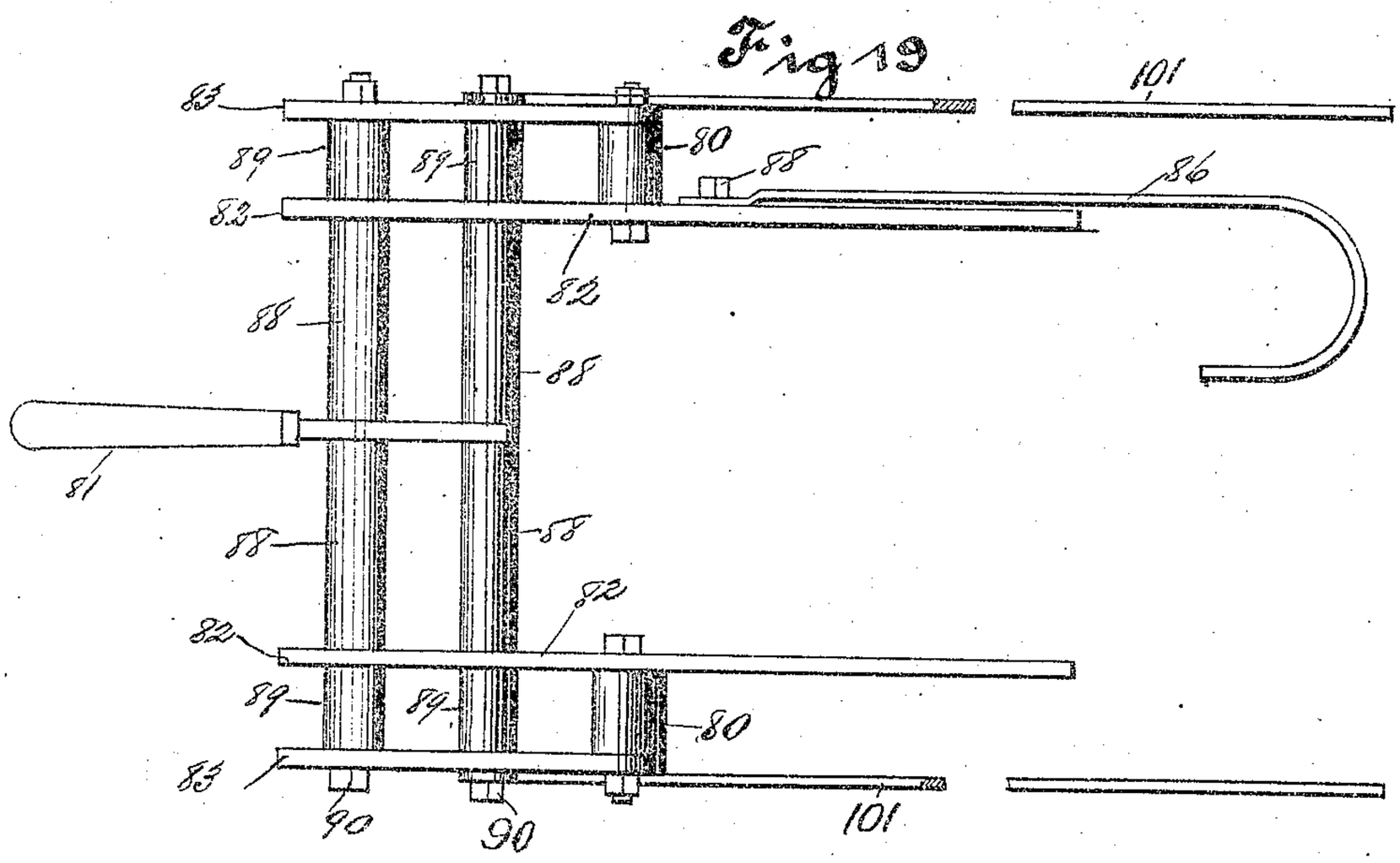


Fig 20

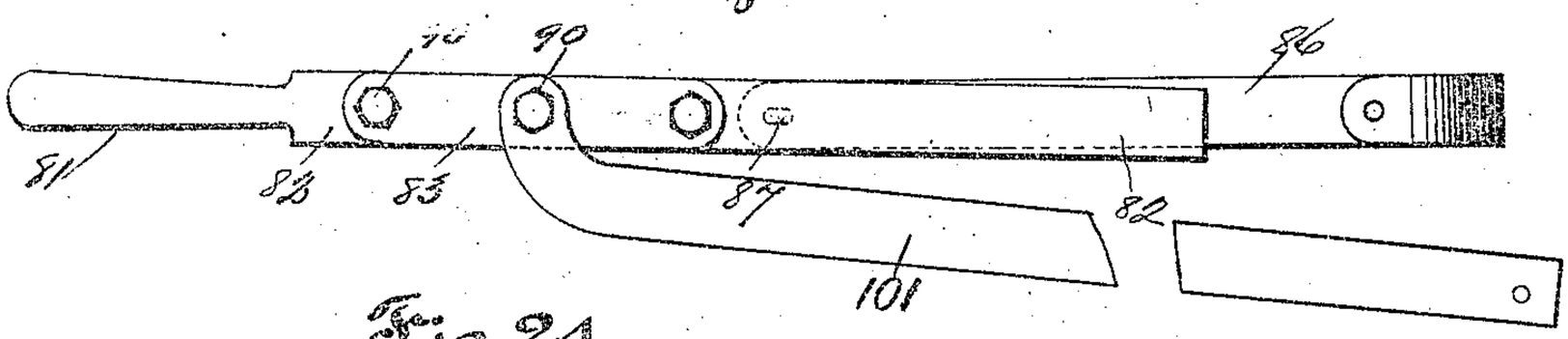


Fig 21

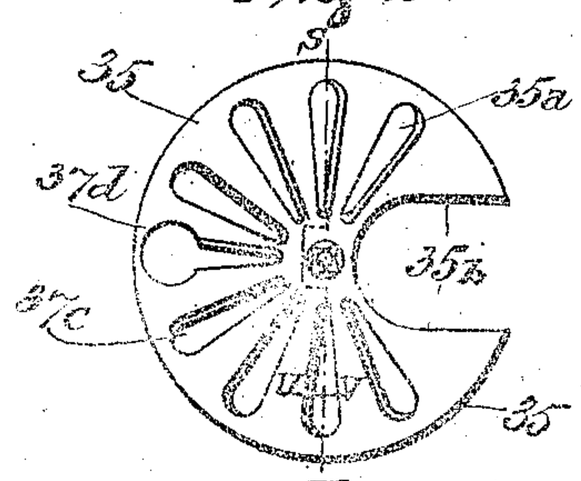


Fig 22

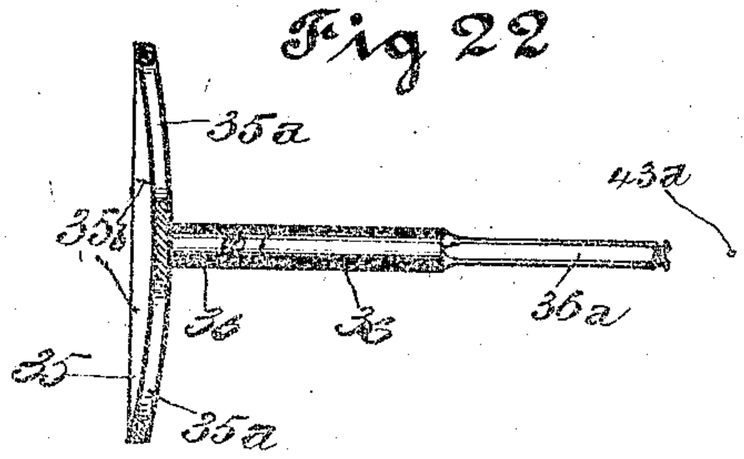
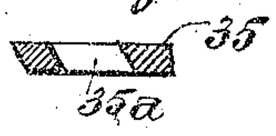


Fig 23



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C. A. Heath

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7 SHEETS—SHEET 7.

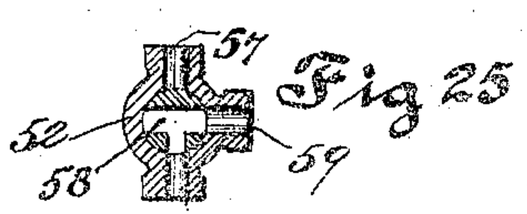


Fig 25

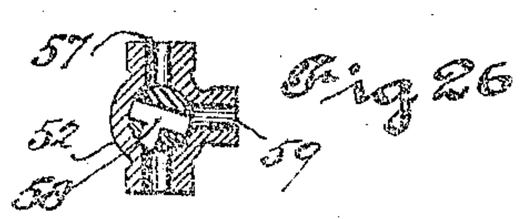
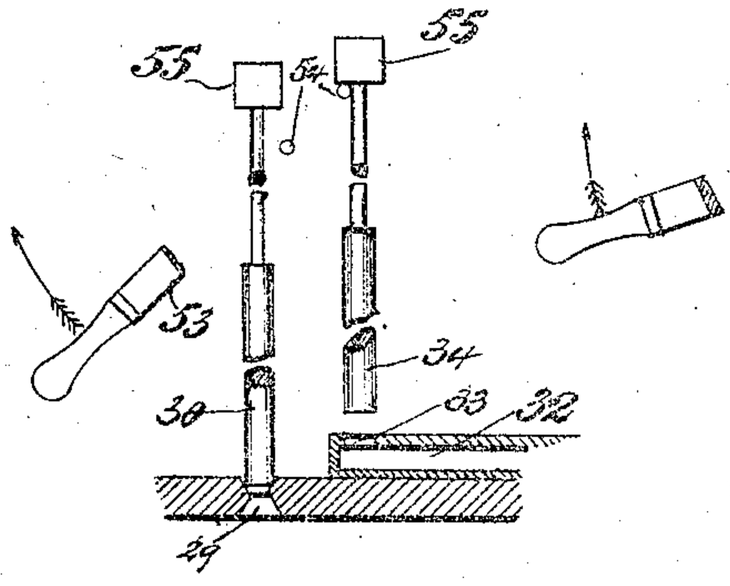
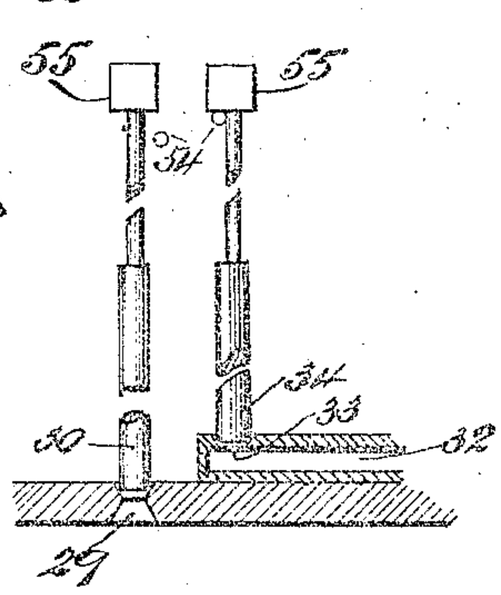


Fig 26





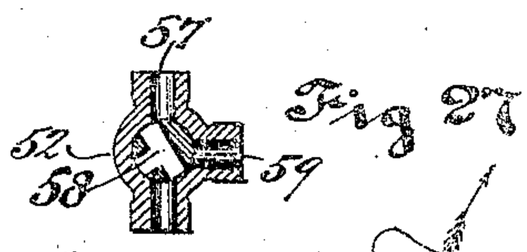


Fig 27

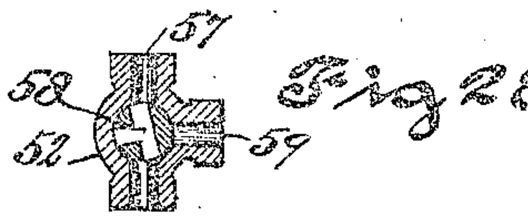
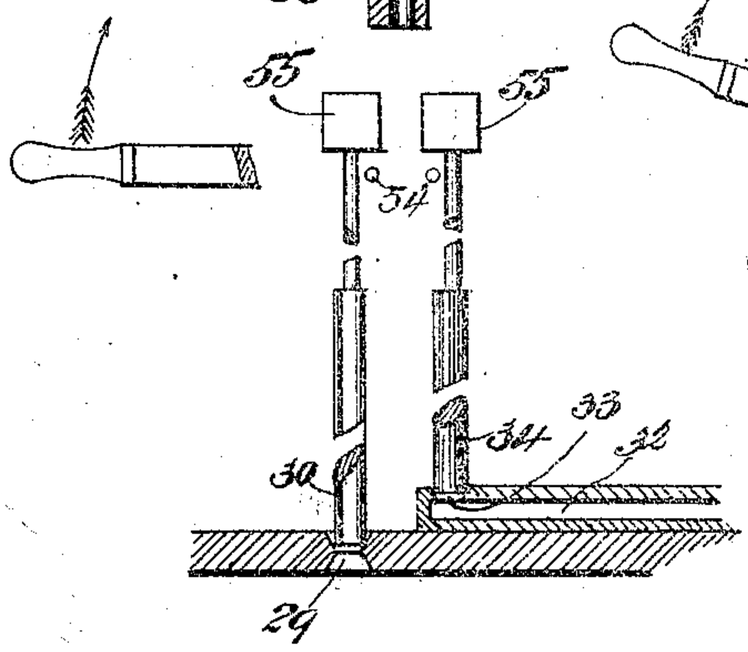
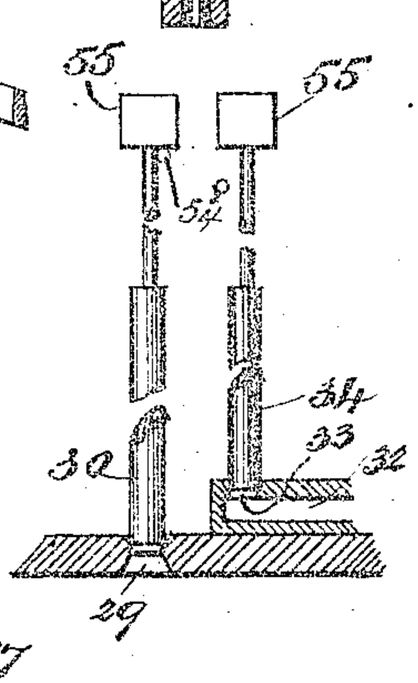


Fig 28





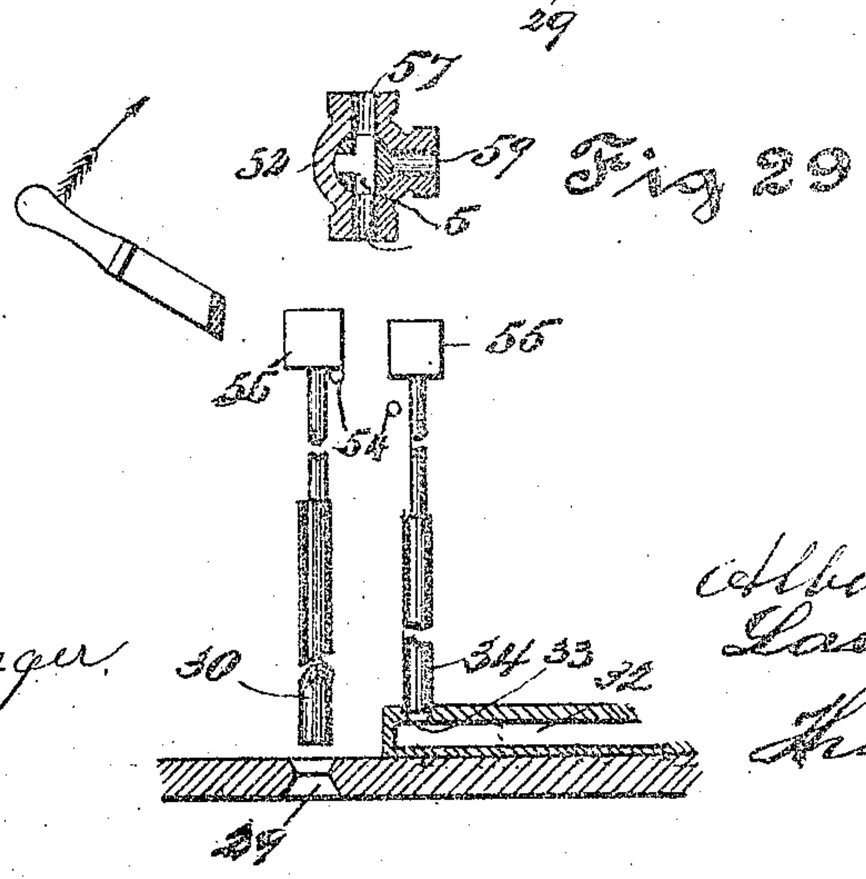


Fig 29

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C. A. Heath

INVENTORS

Albert G. Rauh and

Lawrence Olsen

BY

Thompson & Bell

ATTORNEY

UNITED STATES PATENT OFFICE.

ALBERT G. RAUH AND LAWRENCE OLSEN, OF INDIANAPOLIS, INDIANA, ASSIGNORS TO AMERICAN DIE CASTING COMPANY, OF INDIANAPOLIS, INDIANA.

DIE-CASTING APPARATUS.

No. 889,547. Specification of Letters Patent. Patented June 2, 1908.

Application filed April 20, 1907. Serial No. 369,306.

To all whom it may concern:

Be it known that we, ALBERT G. RAUH and LAWRENCE OLSEN, citizens of the United States, residing at Indianapolis, in the county of Marion and State of Indiana, have invented certain new and useful Improvements in Die-Casting Apparatus, of which the following is a specification, reference being had therein to the accompanying drawing.

This invention relates to an apparatus for molding soft or white metal, under pressure, into dies to obtain accurate, smooth, and true castings, as hereinafter described and particularly pointed out in the claims.

The object of this invention is to provide an apparatus whereby metal castings may be produced so as to be true to measure and form, equal and homogeneous in composition, and to produce such castings as will be smooth, true, and so accurate as to measurement as not to require to be machine finished in order to closely fit into the piece or pieces for which they are designed.

We attain these objects by means of the mechanism illustrated in the accompanying drawings in which like numerals of reference designate like parts throughout the several views.

Figure 1 is a longitudinal sectional elevational view of our invention of a die molding apparatus taken along the line A. B. in Figs. 2 and 3; Fig. 2 is a transverse sectional elevational view of the same taken along the line C. D. in Fig. 1; Fig. 3 is a similar view taken along the line E. F. in Fig. 1; Fig. 4 is an enlarged detail sectional view of the cooling block upon which the die of the apparatus rests and is taken along the line G. H. in Figs. 5 and 6; Fig. 5 is a similar view taken along the line I. J. in Figs. 4, 6 and 7; Fig. 6 is an enlarged detail top view of said cooling block or table one half of which is shown in section which section is taken along the line K. L. in Figs. 4 and 5; Fig. 7 is a side view of said cooling block showing the sliding cam-bar whereby the push-pin carrying bars are operated; Fig. 8 is an enlarged detail top view of one of the casting push-pin carrying bars; Fig. 9 is a side view of the same; Fig. 10 is an end view of the same; Fig. 11 is an edge view of one of the hinge bars or clamps of the lid of a die; Fig. 12 is an enlarged detail top view of a die; Fig. 13 is a similar top view showing the hinged lids thereof removed to expose the interior of said die; Fig. 14 is a side view of the same looking in the direction of the arrow *a* in Fig. 12; Fig. 15 is an inverted view of one of the hinged lids of said die; Fig. 16 is a sectional view of said die taken along the line M. N. in Fig. 13; Fig. 17 is a sectional view of said die taken along the line O. P. in Fig. 13; Fig. 18 is a detail sectional view of the lid of said die taken along the line Q. R. in Fig. 15; Fig. 19 is a top view of the handle lever for operating the lids of said die; and sliding cam-bars; Fig. 20 is a side view of the same; Fig. 21 is a top view of the plunger agitator of the charging cylinder; Fig. 22 is a side sectional view of the same taken along the line S. T. in Fig. 21; Fig. 23 is a detail enlarged broken sectional view of a portion of said plunger taken along the line U. V. in Fig. 21; Fig. 24 is a broken off portion of the lever for operating the agitator plunger; Fig. 25 is a diagram view of the fluid pressure controlling valve of the charging cylinder showing the relative position of the ports of the three-way valve corresponding to the positions of the inlet and outlet valves of the charging cylinder when admitting metal into the latter; Fig. 26 is a similar diagram view of the three-way valve corresponding to the positions of the valves of the charging cylinder when both the latter valves are closed; Fig. 27 is a similar diagram view of the three-way valve when moved into position to admit fluid under pressure into the charging cylinder and corresponding to the closed positions of the inlet and outlet valves of the charging cylinder, at about the time the outlet valve of said charging cylinder is about to be opened; Fig. 28 is a similar diagram view showing the three-way valve moved into almost full open position to admit fluid under pressure into the charging cylinder and showing the position of the valves of the latter and the handle when about to move the outlet valve into position to discharge the molten metal from the charging cylinder; Fig. 29 is a similar diagram view showing the three-way valve in full open position to admit fluid under pressure into the metal charging cylinder, and showing the position of the three-way valve operating lever when the outlet valve of said charging cylinder is moved open its full extent, and, Fig. 30 is a perspective view of a casting as it appears when removed from a die and trimmed.

We shall now proceed to describe our in-

vention and the manner of constructing and using the same in such full, clear, concise, and exact terms, so as to enable others skilled in the art to which it appertains to construct and use the same.

The furnace whereby the metal in the crucible 1 is melted or reduced to the fluid state, is composed of the fire-box 2 having the grates 3, the ash-pit 4, the upper combustion chamber 5 which is connected to the flue way or passage 6 and the rear combustion chamber 5^a. The fire-box lining 7 is provided, as shown in Figs. 1 and 3, with a number of air holes situated at suitable distances apart and an air space is situated between the said fire-box lining 7 and the outer casing 8 which is provided not only for the purpose of an air heating chamber for heating the air collected therein before passing through the air openings in the fire-box liner 7 into the fire box to promote the combustion of the fuel therein, but also for protecting the outer casing 8 from the direct action of the heat of the furnace. Air inlet openings 9 are formed in the offset portion of the casing situated between the casing 8 of the furnace and the casing 10 of the ash-pit 4. A casing 11 covers the air openings 9 and the same is provided with dampers 12 whereby the supply of air to the said air openings 9 is regulated and adjusted to maintain the required degree of combustion in the fire-box of the furnace. Walls 13 are situated rearwardly of the crucible 1 and in a position slightly in advance of the charging cylinder 14, when looking from the firing or furnace end of the apparatus, and the said walls 13 extend from the bottom wall portion 15 of the casing of the furnace to a plane level with the partition 16. A damper opening 17 is situated between the walls 13 and permits, when open, the gases from the furnace to impinge against and encircle the charging cylinder 14, and a damper opening 18 is situated between the top ends of the walls 13 and the rear end of the partition 16 and a damper door 19 is situated between and hingedly connected to the walls 13 at or near the top edges thereof to be in position to close either of the damper openings 17 or 18, so that the course of the heated gases generated in the fire-box 2 of the furnace may be directed either around the charging cylinder 14 and out through the chimney 21 or said heated gases may be entirely shut off from said charging cylinder by closing the damper opening 17. In order to rapidly heat the charging cylinder 14 the damper 21^d of the chimney 21 is opened and the damper opening 18 is closed by the damper 19 thereby permitting the heated gases to impinge against said charging cylinder 14 and to pass around the latter to and into said chimney 21. In order to shut off the heat from the charging cylinder 14 the damper 20^d of the chimney 20 is opened and the damper 21^d of the chimney 21 is closed, next, the operator closes the damper opening 17 by the damper door 19 thereby permitting the heated gases to pass through the opening 18 to impinge against the top portion of the crucible 1 thence around the latter into and through the way 6 to and into the chimney 20. It is evident from the foregoing that the degree of heat applied to the charging cylinder is and must be at all times under the control of the operator and is readily regulated by a proper adjustment of the damper door 19 and the chimney dampers 20^d and 21^d. The chimney 21 is provided for the purpose of causing the heat created in the fire-box 2 to directly impinge against the charging cylinder 14 when an intense heat is required.

The crucible 1 which extends downwardly through the flue 6 into the combustion chamber 5, so that its bottom portion will be subjected to the direct heat of the fire box 2 to properly melt the metal contained therein, is provided with a spout 22 which is situated to extend from its bottom end portion, so that all the metal contained in said crucible will be capable of flowing into said spout 22. The spout 22 is provided with a flanged end portion 23 whereby this end of the spout is secured to the charging cylinder 14, see Figs. 1 and 3.

The charging cylinder 14 is provided with a top flange portion 24 which fits closely to the top portion 25 of the furnace and is securely bolted thereto to form a close joint therewith, and the said charging cylinder 14 depends from said flange 24, so that the bottom flange portion 26 will project into and close the opening 27 formed in the bottom wall 15. A removable top cover 27^a is securely bolted to the top flange 24 and a removable bottom end cover 28 is securely bolted to the flange 26 of said charging cylinder 14 and a valve opening 29 is formed in said cover for the passage therethrough of the charge of metal collected and stored in said charging cylinder 14. The valve opening 29 is provided with the valve 30 whereby the flow of the molten metal from said charging cylinder may be controlled. The valve 30 is preferably of cast iron and of such a length as to extend above the top surface of the hot liquid metal contained in the charging cylinder 14 when the latter has been charged to its full capacity, so as to avoid said heated metal contacting with the stem connected to the top end of said plug valve 30 which, owing to the nature of the melted metal and its chemical action on the finer grades of steel and iron, would soon corrode the steel stem 37 connected to said plug valve.

The under bearing face of the seat 31 is faced to form a true surface to provide a close bearing surface which surface is adapted to closely fit upon the top surface of a die to pre-

vent the escape of metal in the molten state through said joint when the latter is forced by high pressure into a die. The purpose and construction of one of a series of the dies used in connection with this apparatus we will hereinafter describe and which will suffice to illustrate the purpose and use of any one or all the different kinds of dies used.

An interior projecting spout tip 32 is formed integral with the charging cylinder 14 and the same is provided with a valve opening 33 through which the molten metal from the crucible 1 is admitted into the charging cylinder 14 and into said valve opening is fitted a plug valve 34, similar to the valve 30 and of the same material, whereby the flow of the molten metal into said charging cylinder is controlled and regulated.

An agitator plunger 35 is of such a diameter as to loosely fit into the charging cylinder 14 so as to be readily moved upwardly and downwardly therein and said plunger is constructed of cast iron so that it may be immersed at all times in the hot fluid metal without injury. The said agitator plunger 35 is of a disk form and is provided with radial openings 35[a] the opposing sides of which radial openings are parallel and inclined all in the same direction, to approximate a helix, so that when said plunger 35 is moved in a downwardly direction in the cylinder 14 the fluid metal in passing through the radial openings 35[a] shall have a surging and whirling motion imparted to the metal. The disk formed agitator plunger 35 is preferably recessed or dished on its under side for the purpose of more readily crowding the fluid metal toward the center of the charging cylinder in order to hold said metal to force a greater body or volume of the metal through the radial openings 35[a] instead of around the outer peripheral edge of said disk and between the latter and the interior surface of the charging cylinder. It will be noted that the natural result of this construction of a plunger is calculated to force the metal passed through said radial openings 35[a] upwardly and outwardly when on the downward motion and vice versa. The reverse motion of the fluid metal is the result obtained when the plunger 35 is moved in the opposite or upward direction. An opening 35[b] is formed in the plunger 35 which is provided to permit said plunger to clear the spout 32 in passing and thereby permit the free operation of said plunger in the charging cylinder. An opening 35[c] is also provided to permit the plug valve 30 to be passed to the valve opening 29 and to permit the said plunger 35 to be operated freely and without interruption.

The agitator plunger 35 is preferably formed integral on its stem 36 which latter is also of cast iron, and said stem extends upwardly to and into the supply pipe 42 which supplies the fluid under pressure to the charging cylinder. The top portion of the said stem which is situated in the pipe 42 is provided with the longitudinally extending grooves 36[a] for the purpose of creating an increased area between said stem and the bore of said pipe 42 for the passage of the fluid under pressure therethrough into the charging cylinder 14. The said agitator plunger 35 is provided for the purpose of securing the proper admixture of the various metals entering into the composition of an alloy, some of which elements vary and are different in their specific gravity and may not possess any chemical affinity for each other and therefore those elementary metals entering into the composition which are of greater specific gravity would naturally descend and settle at the bottom of the charging cylinder and the metal element next lesser in specific gravity would settle on the top surface of the former elementary metal element of greater specific gravity, and thus the various elementary parts of the composition would tend to settle in layers or strata according to their relative specific gravities, and by the use of a suitable agitating means such as has been described, the various elements of the metallic composition are thoroughly mixed. The manner of agitating the metal contained in the crucible 1 will be hereinafter described. The plug valves 30 and 34 are bored at their top ends to receive the bottom ends of the valve stems 37 and 38 which latter are secured therein by suitable fastening pins 37[a] and 38[a]. The valve stems 37 and 38 extend upwardly through their packing boxes 39 and 40 and are guided and steadied at their top ends in the bores of the arms of the fixed crosshead 41 which latter is secured on the vertically extending pipe 42. The agitator stem 43 is secured at its bottom end in the bore formed longitudinally and centrally of the top end of the stem 36 of the agitator plunger 35 and is secured therein by a pin 43[a], and said stem 43 extends upwardly in the bore of the pipe 42 through the packing box 44 secured on the top end of said pipe.

A hand lever 45 is pivoted at one end to a fulcrum pin 46 which projects from the side of the coupling casting 47 and said lever is constructed with a loop 48 which is adapted to surround that portion of the stem 43 situated between the collars 49 secured on said stem, and said loop is of such a depth as to fit between said collars 49, so that a movement of the hand lever 45 upwardly or downwardly will move the stem 43 to raise or lower the plunger 35 to agitate the molten metal contained in the charging cylinder 14 and mix the constituents thereof. The pipe 50 extends from a source of supply of air or other fluid under pressure, and is connected to the pipe 42 by a suitable T-coupling 51. A three-way valve 52 is provided on said pipe 50 to regulate and control the supply of

the fluid under pressure therethrough and to the cylinder 14, and the said valve is operated manually by means of the hand-lever 53. Projecting from the side of the hand-lever 53 are the lifting pins 54 which are situated at the side of the head portion of said lever so as to be situated under the blocks 55 which are adjustably secured on the stems 37 and 38. Coil springs 56 surround those portions of the stems 37 and 38 situated between the blocks 55 and the arms of the fixed crosshead 41 and are provided for the purpose of closing the plug valves 30 and 34 except when said valves are operated to open by means of the hand-lever 53 which latter, it will be observed, performs a double function, that is to say, it coöperates with each of the plug-valves 30 and 34 to open and close each of the valve openings 29 and 32 alternately to admit and discharge the fluid metal into and from said charging cylinder; also, to coöperate with the three-way valve 52 to supply the fluid under pressure to and into the charging cylinder 14 to force the metal out of the latter and also to exhaust said fluid therefrom at the proper times. The three-way valve 52 is provided with the ports 57 and 58 and the outlet or exhaust port 59 the purpose of which will be hereinafter described.

The molding die into which the molten metal is forced to be formed or molded into the desired shape and true size or dimension, is composed of a base portion 60 which is machined or planed on said base surface to form a true bearing face to secure a true surface bearing of said die upon the face or top surface of the cooling block 61. The top open portion of the die is closed by the front and rear covers 62 and 63, each of which covers a one half portion of said die and meet at the center of the latter to abut at their edges to form a close joint. The said covers 62 and 63 are truly planed or otherwise machined to closely fit the true bearing surface of the open top of the body of the die. The body of the die is provided with the duplicate molds or forms 64, the open ends of which are closed by the half cylinders or end closures 65 formed integral on the under sides of said lids 62 and 63, and cores 66 are also formed on the under sides of the lids 62 and 63 and are situated between the end closures 65 to be concentric therewith and with tl eir molds 64, so that by means of such a die a pair of castings similar to that of the casting 66^a shown in Fig. 30, would be produced. Air vents 67 are formed in the top surface of the body of the die to be situated directly under the under surface of the lids 62 and 63 to connect with the air vents 62^a formed in the under surfaces of said lids of said die and the same are provided for the purpose of permitting the escape of air from the die to reduce the resistance to the flow of the metal thereinto to facilitate the flow particularly of that metal or composition of metals which can only be heated to a semi-fluid state by reason of the volatile nature of some of the metals in the mixture when raised above a certain temperature, and to avoid an air bubble formation in the castings. The hinge lugs 68 and 69 are formed integral on the outer edges of the lids 62 and 63 and the said hinge lugs are provided with cone formed bearings at their hinge centers which bearings are adapted to be engaged by the pointed conical ends of the hinge screws 70. Adjustable hinge clamps 71 are adjustably secured to the ends of the lugs 72 formed integral on the cooling block 61, by the securing screws 73 which latter are screwed into the tapped ends of said lugs 72 to secure the said clamps 71 against the ends of the lugs 72. The lugs 74 are also formed integral on the cooling block 61 and the clamping bolts 75 are secured in their tapped bores, and said bolts are situated so as to clamp the four corners of the base of the die 60 to properly adjust and secure said die in position on the cooling block 61 under the face of the seat 31 to cause the gate opening 76, situated in the joint formed by the abutting edges of the die covers 62 and 63, to fall directly under the valve outlet opening 29 of the charging cylinder 14.

The cooling block 61, upon the truly planed top surface of which the correspondingly trued under surface of the die 60 rests, is provided with water chambers 61^a at the bases of which are the ways 61^b which connect the chambers 61^a to the water feed chamber 77^a. The cooling water is conveyed from some convenient source of supply and fed into the water chamber 77^a by a supply pipe 77^b and the said cooling water after circulating through the chambers 61^a, is discharged through a suitable outlet pipe 77^c. The lower or base section 77 is provided with a slide way 78 which is adapted to fit on the supporting guide 79 and to slide longitudinally thereon so that the said cooling block and the die resting and secured thereon may be readily moved from under the seat 31 of the charging cylinder 14 to permit the lids 62 and 63 of the die 60 to be freely opened to remove the casting contained in said die. The cooling block 61 is provided with the lugs 80 to which the die lid opening handle 81 is hinged. The handle 81 is provided with the inner and outer lever bars 82 and 83 and these bars are arranged to be interchangeable, that is to say, the shorter bars 83 may be replaced by the inner bars 82 and the shorter bars 83 made to take up the space occupied by the longer bars when in their inner positions, so that the full width of the handle combination may be maintained. This arrangement of the handle bars 83 and 82 is provided for the purpose of setting the

longer bars 82 so as to be situated sufficiently far beyond the outer ends of the various dies which may differ in dimensions or sizes, to fall directly under the lid projections or projecting rollers 84 whereby the lids 62 and 63 of the die are elevated to partially open the lids of the die. The bars 82 are of a sufficient length to extend under the said lifting rollers 84 so that when the handle 81 is depressed or moved downwardly said bars 82 are elevated at their ends which are situated under said lifting rollers 84 and therefore operate to elevate the lids 62 and 63 of the die. The handle bars 82 will not completely open the die lid 63 to permit the removal of a casting therefrom, but will, when depressed a certain extent, recede from said rollers 84 of the rear die lid 63 and said lid 63 would consequently drop when released from said bars and close were no other means provided to avoid this trouble. To accomplish this we provide an auxiliary opening means which consists in the extending of the hinge lug 69 of the rear lid 63 of the die, as shown in Figs. 14 and 18, and the end of the extended portion of said hinge lug is provided with a bore 85 whereby the looped or bent end of the connecting rod 86 is connected to a suitable connecting pin. The opposite straight end of said connecting rod 86 is provided with an elongated bore 87 through which a cap screw 88 extends which latter is screwed into the bar 82, as shown in Fig. 19. The elongated bore 87 permits the handle 81 to be depressed sufficiently to slightly raise the lid lifting rollers 84 to assist the connecting rod 86 to open said rear lid 63 of the die, in other words, the bars 82 operate to open said lid at the beginning of its movement and when such initial movement has been completed, the connecting rod 86 performs the remainder of the operation by coöperating with the hinge lug 69 whereby said lid 63 is raised sufficiently to remove a casting from the die. The distance pieces 88 and 89 maintain the bars 82 and 83 in parallel relation and at their proper distance apart and said bars are securely clamped together by their connecting bolts 90. The bars 82 and 83 are hingedly connected to their lugs 80 formed integral on the forward top portion of the cooling block 60. The recesses 91 are formed in the cooling block 61 to receive the discharging bars 92 which bars are of a width sufficient to closely fit in said recesses, and said bars are adapted to be raised or lowered in said recesses for the purpose hereinafter described. On the ends of said discharging bars 92 are formed the inclined end portions 93 which are adapted to fit in the inclined slots 94 formed in the sliding bars 95.

The sliding bars 95 are fitted in their guide ways 96 formed in the opposing sides of the cooling block 61, and the said sliding bars are so situated that the inclined slots 94 of one bar will be directly opposite and in alinement with the other opposite bar, so that when the opposing sliding bars 95 are moved simultaneously and longitudinally in the same direction and equal distances in their guide ways 96 the said discharging bars 92 will be moved upwardly or downwardly according to the direction the said sliding bars are moved, forwardly or backwardly, and said discharging bars 92 will be maintained in horizontal position at all points of their paths.

The vertically extending casting ejecting pins 97, are provided with supporting feet 98 which are adjustably secured on the top sides of the discharging bars 92 by suitable screws which latter extend through the slot 99 of said supporting feet to be screwed into the tapped bores formed in said discharging bars to maintain said casting ejecting pins 97 in vertical position to freely enter the ejecting pin holes 100 of the die 60 and to be adjusted to suit thr differently situated ejecting pin holes of the different forms of dies used in connection with this machine. Side connecting rods 101 extend from the pivotal pins 90 of the handle bars 83 to the pivotal pins 103 secured on the outer end sides of the sliding bars 95, so that, when the handle 81 is depressed, the connecting rods 101 operate to transverse the said sliding bars 95 to slide backwardly simultaneously to elevate both ends of the discharging bars 92 to cause the casting ejecting pins 97 to ascend into the bores 100 simultaneously to eject the castings from the die.

On the bottom cover 28 of the charging cylinder 14 are the arms 104 on the ends of which are formed the bosses 105 which bosses are bored and tapped to receive the screw ends of the depending rods 106 which latter are securely screwed therein. The yoke 107 is provided with the end bores 107ª which are adapted to receive the lower ends of the depending rods 106 whereto said yoke is secured by suitable screw nuts 108. The center portion of the yoke 107 is provided with the larger boss 109 which is bored to receive the reduced neck portion 110 of the lower cam member 111 to form a bearing therefor. A collar 112 is also formed on the cam member 111 and the lever arm 113, terminating in a suitable handle or hand grip 114, is formed integral on said cam member and provided for the purpose of rotating the lower cam member 111. The cam 111 cooperates with the cam 115 to elevate the screw 116 and the parts supported by it to press the top surface of the lids of a die against the seat 31 or to release the same therefrom without revolving said screw 116 which is used only for the purpose of adjusting the position of the cooling block, 61 to suit the various sizes of dies used in connection with this apparatus. The upper adjusting cam

115 is threaded to be screwed upon the adjusting screw 116 and said upper cam member 115 is provided with the arms 117 which extend outwardly on directly opposite sides of said cam member and said arms are bored to loosely receive the depending rods 106 to slide thereon and thereby prevent a rotation of the top cam member 115 at such times as when the adjusting screw 116 is revolved. The top end of the adjusting screw 116 is provided with a loosely fitting collar 118 in the bore of which the reduced bearing end of said screw may revolve, and said collar has its top end surface fitted to the underside of the supporting guide 79 situated under the center of the outlet 29 of the valve 30 of the charging cylinder 14 to not only support the cooling block 61 and its base 77, but also to support the die 60 which rests thereon. The adjusting screw 116 is provided to adjust the top surface of the die lids 62 and 63 to a position sufficiently close to and under said seat 31, so as to be within the scope of the coöperating cams 111 and 115 which are employed solely for the purpose hereinbefore set forth.

An outer guide support is composed of the screw 119, the bearing collar 120 pivoted on the top end of said screw and adapted to contact the under side of the supporting guide 79, and the base portion 121 into which said screw 119 is screwed, so that the end of said guide 79 may be adjusted to be in a horizontal position by a proper movement of the screw 119.

In order to more fully comprehend the construction, operation and use of this apparatus we will now proceed to describe the manner of producing die castings by our invention of a die casting machine.

The alloy or the different metals selected and intended to enter into the composition of the metallic mixture are placed into the crucible 1, a fire having first been made in the fire box 2 to heat the crucible. When it is desired to hasten the melting of the metals contained in the crucible 1 immediately after the latter has been charged the damper 19 is dropped till it contacts with the walls 13 to close the way or opening 17 and fully open the way 18 and the damper 20^d is also opened which permits a direct draft to flow from the fire box 2 through the opening 18 to and through the flue way 6 into the chimney 20 thereby shielding the charging cylinder 14 from excessive heat during the time the metal or metals contained in the crucible 1 are heated to reduce them to the fluid state. The combustion in the fire-box 2 is increased to the desired intensity at the will of the operator by a judicial manipulation of the dampers 12 to admit air through the air inlet openings 9 into the air space situated between the outer casing 8 and the perforated fire-box lining 7, wherein said air is heated thoroughly before passing through the perforations formed in the firebox lining 7 into the fire-box to support the combustion of the fuel contained therein without reducing the temperature thereof.

Immediately the metal contained in the crucible 1 begins to liquefy or reach the semi-liquid state the damper 19 is moved into the position shown in dotted lines, in Fig. 1, to close the way 18 and fully open the way 17 to cause the current of hot gases to impinge against the lower portion of the charging cylinder 14 to heat the latter sufficiently to be prepared to receive the said metal as it is supplied from the crucible 1 without reducing the temperature of the metal or in any degree chilling said metal to change its quality. It is absolutely necessary that the damper 19 and the dampers 12, 20^d and 21^d be properly adjusted to control the combustion in the furnace to regulate the temperature of the metal contained not only in the crucible 1 to avoid overheating the contents thereof, but also to maintain the charging cylinder 14 at a proper temperature or at a temperature sufficient to barely keep the metal charge contained therein in the fluid state or to maintain the metal in a semi-fluid state which conditions depend on the nature of the metal used and on the varying conditions of molding by the method of forcing the metal into a die or form by pressure when in a semi-fluid or plastic state to compress it therein to fully fill the mold to that extent to cause the density or specific gravity of the casting to exceed that of the metal contained in the crucible from which it was cast, thereby increasing the durability of the casting produced by the method described by which the metal in the die is compressed by means of fluid pressure which castings are utilized particularly in the production of shaft journal bearings and small finished castings that are required to be duplicated and produced in large quantities, so as to be cheap and possess the quality and appearance of machined work. The metals or components of the alloy contained in the crucible 1 being now reduced to a sufficiently liquid state to flow and be thoroughly mixed, is ready to be used for the castings to be made and the operator next places a die, as the die 60, in position on the cooling block 61 whereon it is properly adjusted and secured.

The cooling-block 61 is maintained at a fixed temperature by means of the cooling water circulation which is supplied by suitable pipes 77^b and is regulated by suitable valves on said supply pipes which are under the control of the operator. It is very important that the temperature of the die be maintained at a certain fixed temperature without variation, it must not be so cold that the molten metal will either chill on en-

tering the die or shrink unevenly, on the other hand, the die must not be too hot in which case the molten metal would weld itself to the die, the necessity, therefore, of maintaining the die at a certain fixed temperature between these extremes is apparent in order that smooth, true and accurate castings be produced by this apparatus and method of molding. The proper temperature at which to operate the die is better arrived at by making a trial casting, which, if the temperature of the die is correct, will be smooth and regular on its surface and free from flaws, and should defects continue to appear as the castings are made, all that is required to be done, is to gradually increase the temperature of the die till the castings produced are apparently without flaw. The temperature of the die 60 is readily increased by reducing the supply of the cooling water to the cooling-block 61 and of course the temperature of said die is reduced by increasing the supply of the cooling water to said cooling-block 61 which may be regulated by the operator. The operator next moves said cooling-block 61 on its guides 79 to move the die 60 into position under the seat 31 and till the gate opening 76 of said die is situated directly under the outlet opening 29 formed in the bottom cover 28 of the charging cylinder 14. The cam 111 is next revolved by means of the cam operating lever arm 113 to move the guide 79 situated under the cooling-block 61 to tightly press the top surfaces of the die lids 62 and 63 against the under surface of the seat 31 to form a close joint therewith to prevent the escape of the liquid metal between the contacting surfaces of said die lids and seat especially when the metal flowing from the charging cylinder 14 into the die 60 is subjected to a high pressure to compress it into said die.

The die 60 is now in position and ready to receive its charge of metal which operation is accomplished by first raising the inlet valve 34 gradually by means of the operating lever 53 to permit the metal to flow from the crucible 1 through the spout 22 to and through the valve opening 33 of the spout 32 into the charging cylinder 14, as shown in diagram view Fig. 25, and said plug valve 34 is held in open position till at least a sufficient quantity of molten metal needed for a charge for a die is admitted into the charging cylinder 14.

The movement of the handle 53 to the position shown in the diagram view Fig. 25, first opens the exhaust port 59 of the three-way valve and maintains it open while in that position, to permit the air confined in the charging cylinder 14 to be expelled therefrom, next the fluid metal is admitted into said cylinder, thereby removing all resistance to the inward flow of the molten metal and permitting a more rapid flow of said metal into said charging cylinder. The lever 53 is next moved upwardly into the position shown in the diagram view, Fig. 26, to almost close the exhaust or vent port 59 at the same time lowering the plug valve 34 on its valve opening to prevent a further supply of metal entering said charging cylinder 14. At about this time the metal in the charging cylinder should be agitated to prevent the weightier elements or elementary metals of which the alloy is composed and be kept in constant agitation to prevent a precipitation or stratification of said elementary metals; for this purpose the plunger 35 is reciprocated through the molten metal by means of the plunger lever 45 which is connected to the stem 43, as previously described. The lever 53 is next moved upwardly into the position shown in the diagram view Fig. 27, to slightly open the admission port 57 of the three-way valve to at first gradually admit the fluid under pressure into the charging cylinder 14 to gradually raise the pressure of said fluid in said charging cylinder, which when attained the lever 53 is moved into the position shown in the diagram view Fig. 28, to almost fully open the admission port 57 and the through port 58 of the plug valve to permit a full pressure of the fluid under pressure to the charging cylinder 14 above the fluid metal contained therein, so as to provide against a sudden falling of the fluid pressure in said charging cylinder when its metal outlet valve opening 29 is suddenly opened to permit the quick discharge of the metal charge from said charging cylinder, during this time the plug valves 30 and 34 are each closed to prevent the fluid metal from flowing either into the die or being forced back into the crucible. The lever 53 is next moved upwardly into the position shown in the diagram view Fig. 29, to fully open the admission port 57, the exhaust port 59 being still closed, of the three-way-valve to permit a free flow of the fluid under pressure into said charging cylinder 14 without loss of pressure and at the same time to raise the plug valve 30 to fully open the outlet valve opening 29 to permit the molten metal or the metal in the fluid or semi-fluid state to be forced by the pressure of the fluid under pressure, out of said charging cylinder 14 into the die 60 to completely fill it and compress the molten metal therein, thereby expelling all air bubbles from the casting and completely filling any void that might exist and which would exist and plainly appear in the casting were not a sufficient fluid pressure employed to force the metal into the die.

Immediately the die has been fully charged with the metal the lever 53 is first returned into the position shown in the diagram view Fig. 26, to close the valves 30 and 34 and to fully open the exhaust port 59 of the three-way valve 52 to exhaust the fluid under pressure confined in the charging cylinder 14,

which when done, the said charging cylinder is again prepared to receive another charge of the molten metal. The cam 111 is now turned by means of the hand lever arm 113 to lower that portion of the guide 79 situated directly under the charging cylinder 14 to release the die from pressure to withdraw the latter and the cooling block 61 upon which it rests from under the seat 31 of the bottom cover of the charging cylinder by sliding said cooling block outwardly on its guide 79 so that the lids 62 and 63 of the said die 60 are cleared to be opened their full extent to remove the casting from said die.

The lids 62 and 63 of the die may be raised open a small extent at the beginning by the handle 81 and then fully opened by the means hereinbefore described, after which the casting is removed from the die 60. The die 60 is now closed and returned to its former position along with its cooling block upon which said die rests, till the gate opening 76 of said die is situated directly under the outlet opening 29 of said charging cylinder 14. The lever 113 is next operated as before described to rapidly move said die into position against said seat 31 to tightly clamp and firmly press the top surfaces of the lids 62 and 63 of said die to said seat, and the operation of casting may be continued indefinitely.

It is frequently necessary to agitate the molten metal contained in the crucible 1 to prevent a stratification of the different elementary metals which enter into the composition of the alloy. To accomplish this purpose all that is required to be done is to admit a back pressure of the fluid under pressure from the charging cylinder 14 into said crucible 1, which is readily done by first moving the three-way valve into the position shown in the diagram view Fig. 27 to slightly open the admission port to admit the fluid under pressure into said charging cylinder 14. The operator then raises the stem 38 by applying a pry under the block 55 of said stem to raise said plug valve 34 to permit the flow of the fluid under pressure through the valve opening 33 into and through the spout 22 into the crucible 1 at the bottom portion thereof and under the molten metal contained therein which thoroughly agitates the latter.

It is sometimes desirable to return a charge of molten metal from said charging cylinder 14 to and into the crucible 1; this is readily accomplished by moving said three-way valve into the position shown in Fig. 27, and raising the plug valve 24, as previously described to permit the chilled metal to be returned into said crucible to be reheated.

We claim:—

1. In a die casting apparatus, the combination with a crucible, a charging cylinder, means connecting said charging cylinder and said crucible, and a die situated under and contacting said charging cylinder, of a fluid pressure and a molten metal supplying means, and a lever common to both said means whereby the molten metal and the fluid pressure are alternately admitted into and exhausted from said charging cylinder.

2. In a die casting apparatus, the combination with a crucible, a removable die, a cooling block supporting said die, a charging cylinder situated between said crucible and said die, and means connecting said crucible and said charging cylinder, of inlet and outlet valves situated within said charging cylinder for controlling the supply and the discharge of the molten metal into and out of said charging cylinder, a fluid pressure supplying means connected to said charging cylinder and means situated exteriorly of said charging cylinder common to said fluid pressure supplying means and said charging cylinder valves whereby the fluid pressure supplying means and the charging cylinder valves are operated alternately to first admit the molten metal, then the fluid under pressure, then discharge the molten metal and finally exhaust the fluid pressure.

3. In a die casting apparatus, the combination with a crucible, a charging cylinder having a bottom metal discharging opening, a spout connecting said crucible and said charging cylinder having its outlet end projecting interiorly of said charging cylinder, a removable die situated under said charging cylinder opening, a die support, and means for clamping said die to the bottom of said charging cylinder, of a fluid pressure supplying means, a fluid pressure controlling means, a metal charging valve on the outlet end of said spout, a metal discharging valve over the bottom opening of said charging cylinder, and means common to said fluid pressure controlling means and said molten metal charging and discharging valves whereby the molten metal is first admitted into said charging cylinder, next the fluid pressure, then the molten metal is discharged therefrom, and finally, the fluid pressure is exhausted.

4. In a die casting apparatus, the combination with a crucible, a charging cylinder having an outlet opening at its base, a die situated under said base opening, and a die clamping means, of gravity closing valves situated within said charging cylinder, a fluid pressure supplying means connected to the latter, a three-way valve connected to said fluid pressure supplying means and situated exteriorly of said charging cylinder, a lever connected to said three-way valve, and means on said lever coöperating with said three-way valve and said gravity valves to operate each alternately.

5. In a die casting apparatus, the combination with a crucible, a charging cylinder,

a die, and an agitating means situated within said charging cylinder for agitating the molten metal contained therein, of an inlet and an outlet valve situated within said charging cylinder for controlling the flow of the molten metal thereinto and therefrom, a fluid pressure supply controlling means situated exteriorly of said charging cylinder, a controlling lever common to said fluid pressure supply-controlling means and said charging cylinder valves.

6. In a die casting apparatus, the combination with a crucible, a charging cylinder, and means connecting said charging cylinder and said crucible, of a vertically reciprocating agitating disk plunger situated within said charging cylinder, and means for vertically reciprocating said plunger.

7. In a die casting apparatus, the combination with a crucible, a charging cylinder and means connecting said crucible and said charging cylinder, of a vertically reciprocating agitator disk plunger situated within said charging cylinder having its under surface dished and its upper surface spherical in form, said disk provided with a series of radially extending openings, and means situated externally of the said charging cylinder for vertically reciprocating said plunger.

8. In a die casting apparatus, the combination with a crucible, a charging cylinder and a spout connecting said crucible and said charging cylinder, of an agitator disk plunger in said charging cylinder having its under surface dished and its upper surface spherical in form said plunger provided with a series of radially extending openings, an upwardly extending stem projecting through said cylinder and an operating lever connected to said stem and situated exteriorly of said cylinder.

9. In a die casting apparatus, the combination with a furnace comprising a fire-box an air heating chamber situated to surround and inclose said fire-box and provided with air inlet openings, damper doors over said openings, a combustion chamber, a wall extending transversely of said combustion chamber to divide the same into forward and rear compartments and provided with a damper opening, a flue way situated over said forward compartment, and a damper door situated to close either said damper opening or said flue way, of a crucible extending downwardly through said flue way into said forward compartment, a charging cylinder in said rear compartment, a spout connecting said crucible and said charging cylinder, and suitable dampers for controlling the temperature of each of said compartments.

10. In a die casting apparatus, the combination with a crucible, a charging cylinder, a spout connecting said crucible and said charging cylinder, and a removable die situated under the latter cylinder, of a supporting guide situated horizontally under said charging cylinder, a cooling block mounted on said guide and upon which said die rests, means whereby said guide is quickly elevated to clamp said die against said charging cylinder, and means for lowering said guide to release said die so that said block and the die resting thereupon may be slid outwardly upon said guide to open the die.

11. In a die casting apparatus, the combination with a crucible, a charging cylinder, a spout connecting said crucible and said charging cylinder, and a removable die situated under the latter cylinder, of a supporting guide, a cooling block situated under said die and slidably mounted on said supporting guide, an adjusting screw situated under said supporting guide and means whereby said screw is quickly lowered to release or elevated to engage said supporting guide to either release said charging cylinder or to clamp it thereto.

In testimony whereof we affix our signatures in presence of two witnesses.

ALBERT G. RAUH.
LAWRENCE OLSEN.

Witnesses:
THOMPSON R. BELL,
C. F. BRANDOM.