No. 785,210. PATENTED MAR. 21, 1905.

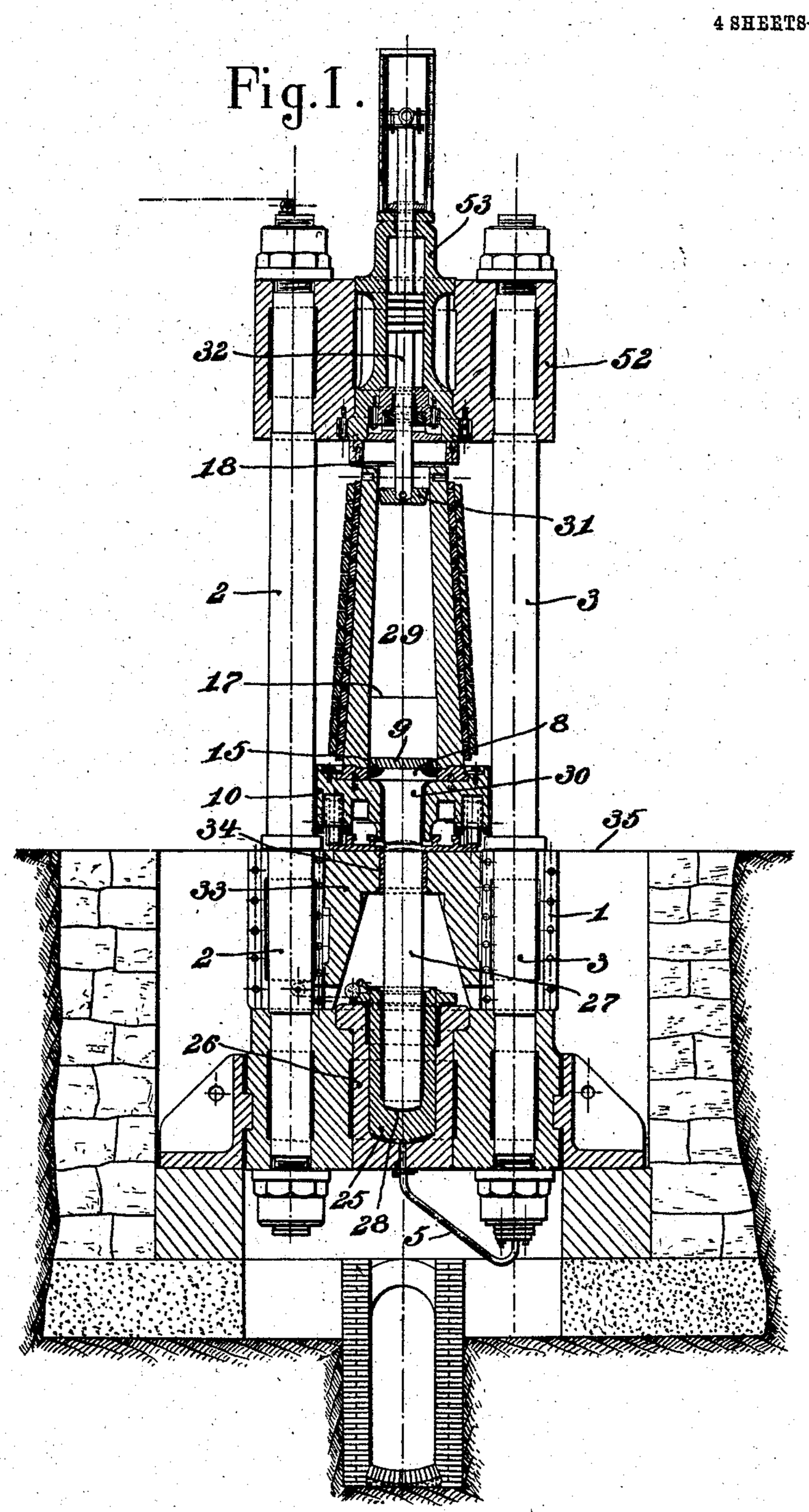
H. HARMET.

PRESS FOR COMPRESSING AND DRAWING INGOTS IN CONICAL MOLDS.

APPLICATION FILED NOV. 23, 1904.

4 SHEETS—SHEET 1.

Fig. 1.



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4 SHEETS—SHEET 2.

Fig. 8.

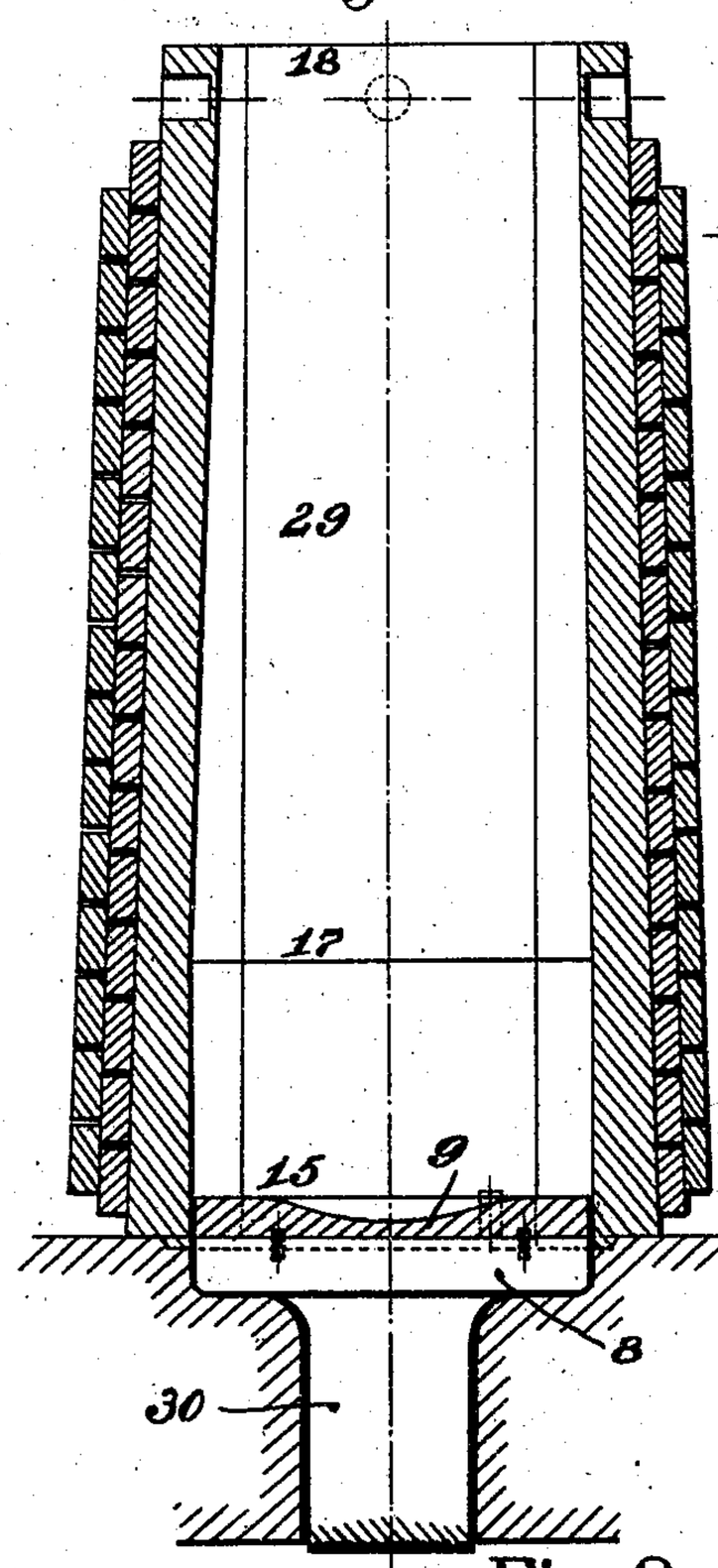


Fig. 2.

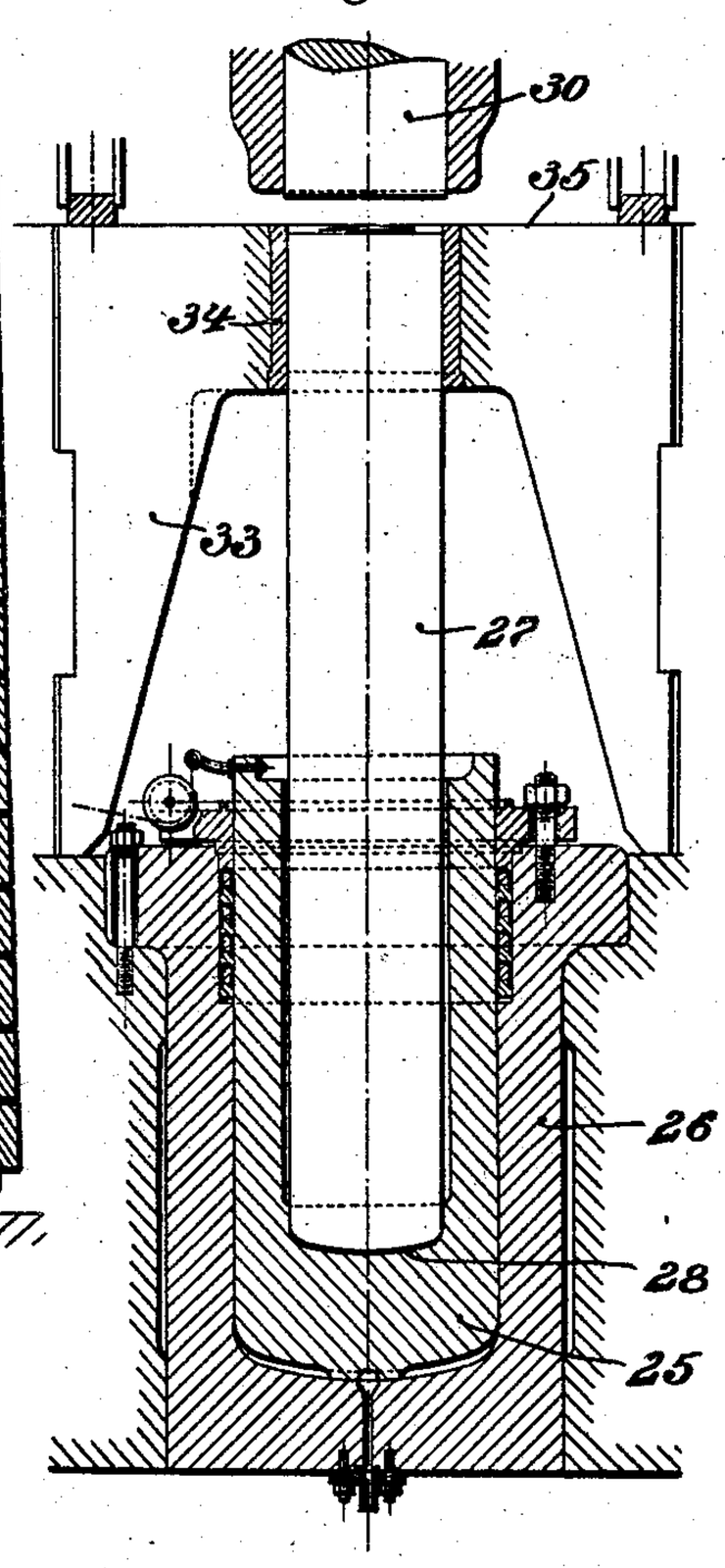


Fig. 9.

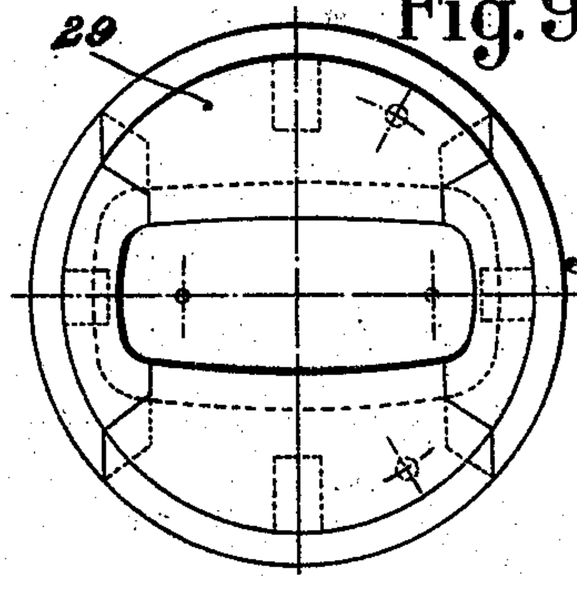


Fig. 3.

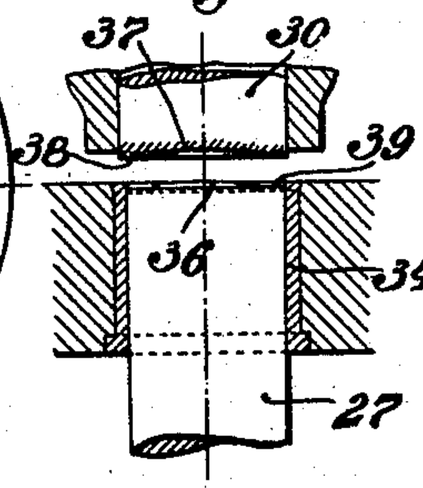
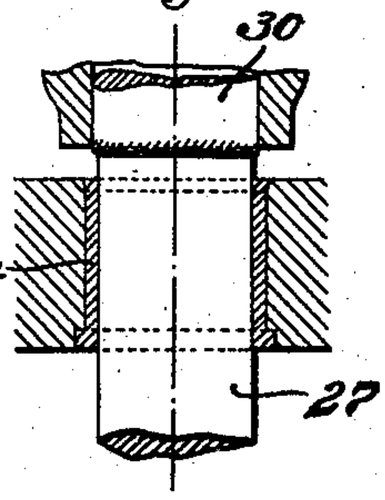


Fig. 4.



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4 SHEETS—SHEET 3.

Fig. 5.

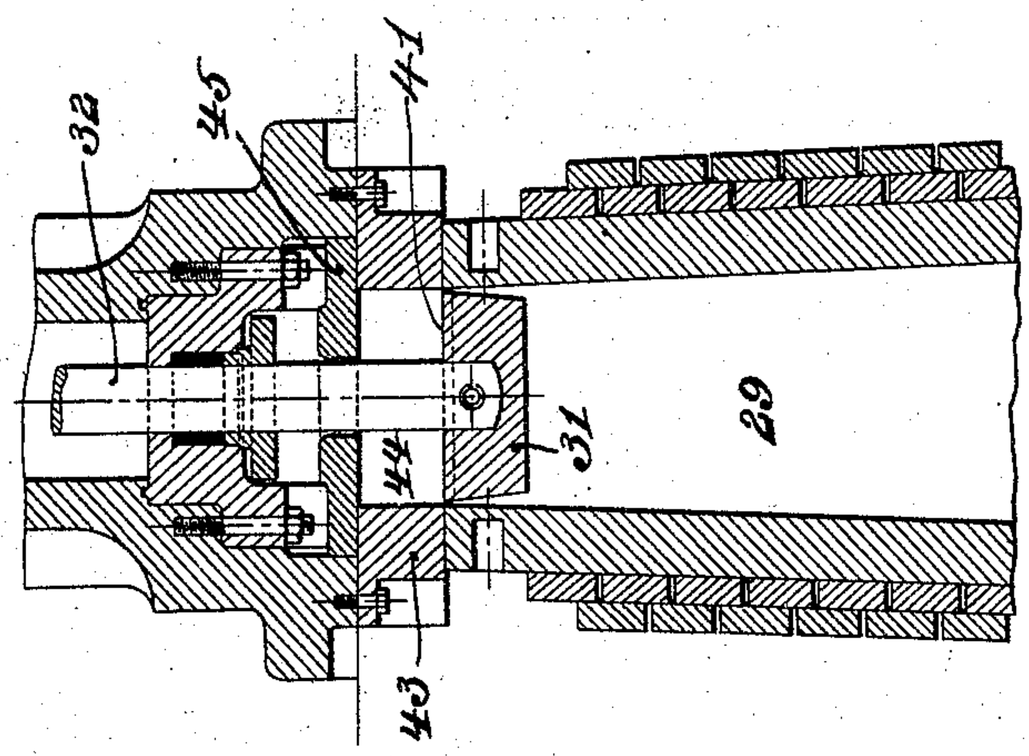


Fig. 6.

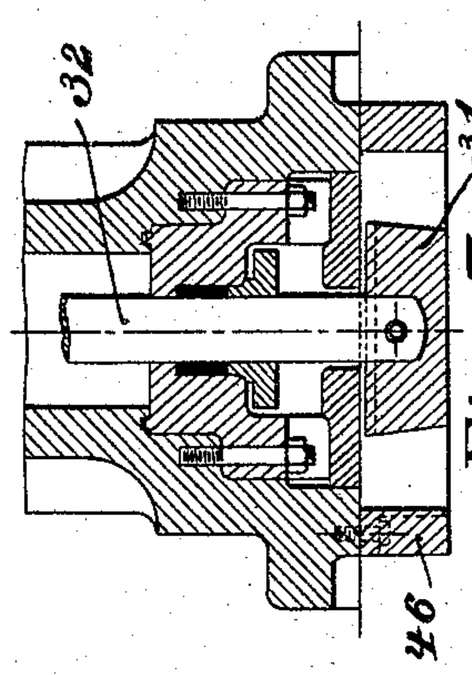
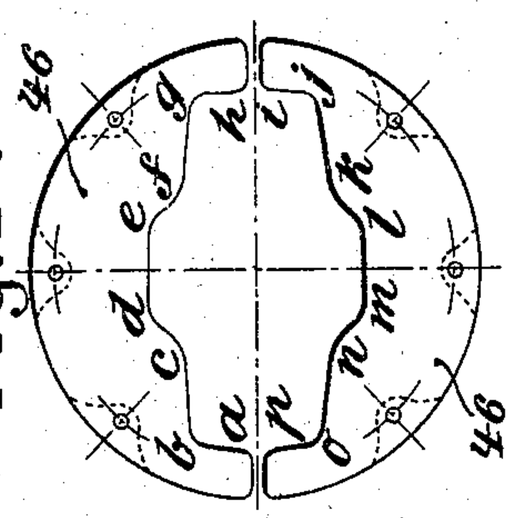


Fig. 7.



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4 SHEETS—SHEET 4.

Fig. 10.

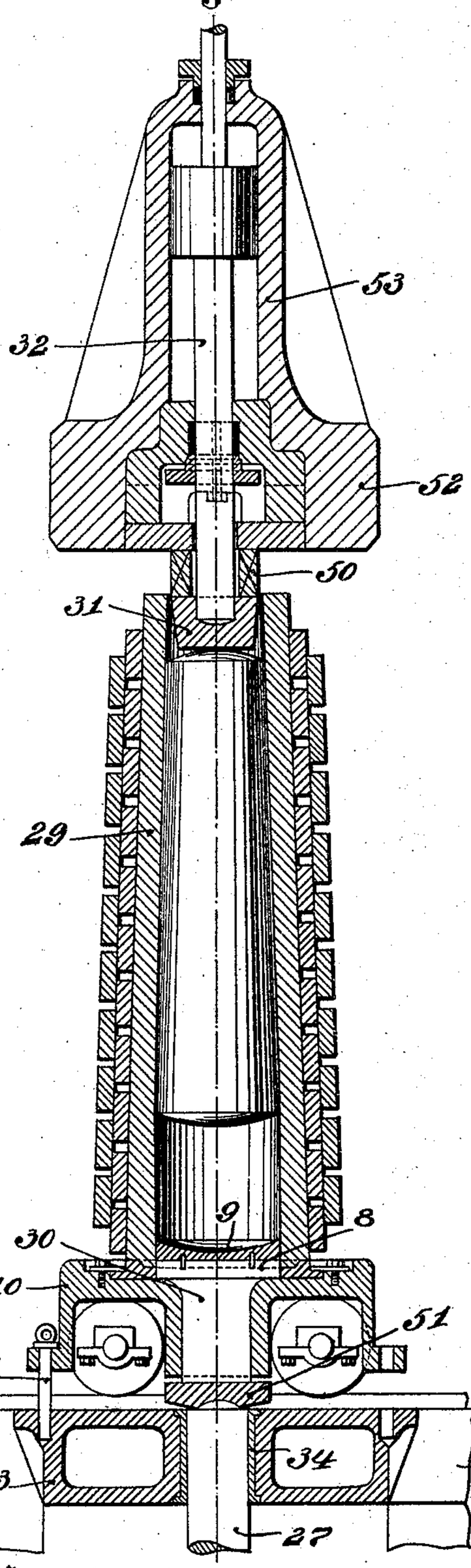
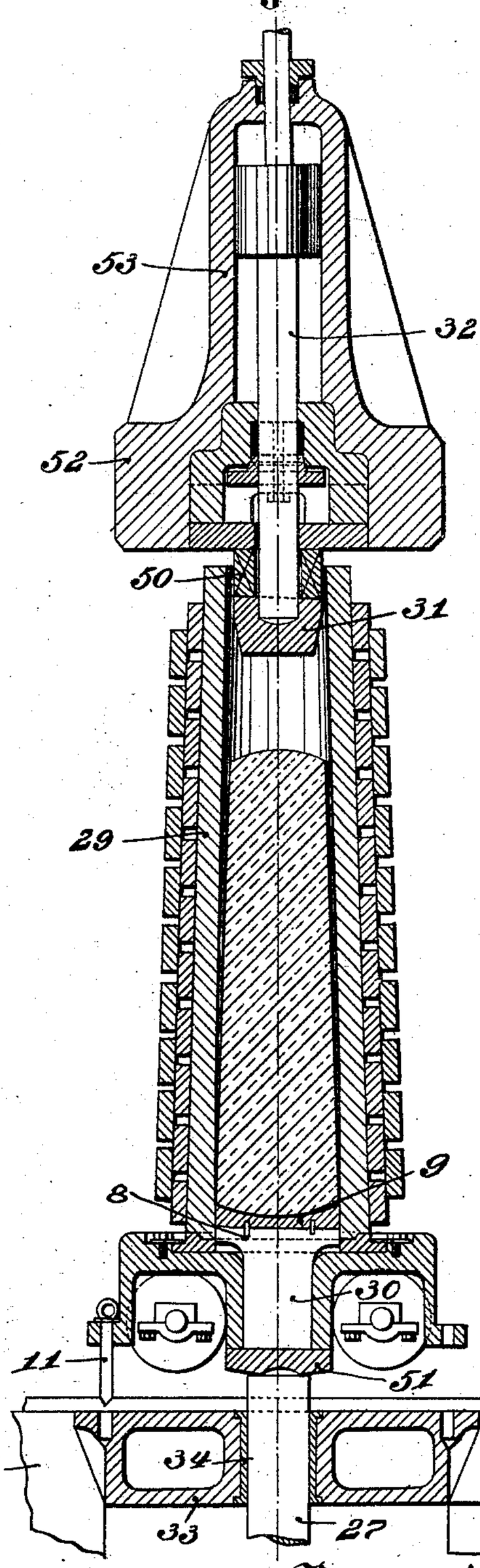


Fig. 11.



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No. 785,210. Patented March 21, 1905.

UNITED STATES PATENT OFFICE.

HENRI HARMET, OF ST. ETIENNE, FRANCE.

PRESS FOR COMPRESSING AND DRAWING INGOTS IN CONICAL MOLDS.

SPECIFICATION forming part of Letters Patent No. 785,210, dated March 21, 1905.

Original application filed March 21, 1902, Serial No. 99,335. Divided and this application filed November 23, 1904. Serial No. 233,973.

To all whom it may concern:

Be it known that I, HENRI HARMET, a citizen of the Republic of France, residing at St. Etienne, Loire, in the Republic of France, have invented certain new and useful Improvements in Presses for Compressing and Drawing Ingots in Conical Molds, of which the following is a specification.

My invention has relation to presses for compressing and drawing ingots in conical molds, and in such connection it relates more particularly to the construction and arrangement of such presses especially adapted for forming large compressed ingots and being a division of an application for a patent filed by me under date of March 21, 1902, under Serial No. 99,335.

The compression of liquid steel to form large compressed ingots is accomplished in the present invention by a press in which two rams entering a conical and vertically-disposed mold from opposite directions exert a varying pressure on the liquid steel previously introduced therein to permit of a compression of the same assisted by the mold for advancing the steel toward the narrower end of the mold, thus causing a sort of drawing action, resulting in preventing the formation of pockets or spaces which otherwise would be formed in the ingot, eliminating internal strain which otherwise would arise, and improving the metal generally in constitution or setting, as well as rendering it more homogeneous, both at the top and bottom of the ingot.

The principal objects of my invention are, first, to provide means for actuating the lower ramrod by engaging its lower end only, so as to reduce the friction between the ramrod and its actuating means to a minimum, to insure the movement of the same in a vertical plane, and to prevent any side thrust of the rod causing leakage in the packing between the actuating means and a cylinder; second, to provide a washer arranged in the head of the press adapted to limit the upward movement of a plug carried by the upper ramrod, and, third, to provide the head of the press with an abutment with which the plug may be withdrawn and against which the mold is normally adapted to rest.

My invention, stated in general terms, consists of a press, as hereinafter fully described, taken in connection with the accompanying drawings, forming part hereof, in which—

Figure 1 is a vertical central sectional view of an ingot-press embodying main features of my invention. Fig. 2 is a detail view, enlarged, illustrating, partly in section and partly in elevation, the lower portion of the press and the manner of guiding a ramrod. Figs. 3 and 4 are detail views, enlarged, illustrating, partly in section and partly in elevation, the abutting ends of the ramrod and a movable bottom actuated by the same in and out of engagement with each other. Fig. 5 is a detail view, enlarged, illustrating in section a portion of the upper ram, a plug connected therewith, abutments for the plug, and the upper end of the conical mold. Fig. 6 is a similar view without the mold, illustrating the ramrod and plug in their inoperative positions. Fig. 7 is a top or plan view of a sectional abutment. Fig. 8 is a detail view, enlarged, illustrating in section a sectional mold. Fig. 9 is a top or plan view of Fig. 8, and Figs. 10 and 11 are sectional views illustrating the manner of disengaging the ingot from the mold.

Referring to the drawings with special reference to Fig. 1, 29 is an ingot-mold which is frusto-conical from 18 to 17 and cylindrical from 17 to 15, and its inner perimeter when viewed in horizontal section is either annular or elliptical, as shown in Fig. 9. The mold 29 is supported by a movable carrier 10. Within the cylindrical portion of the mold 29 is arranged a movable bottom 8 of a diameter somewhat less than the diameter of the cylindrical portion of the mold 29. This bottom 8 is protected from the heat of the metal by a removable plate 9, and its extension 30 in the normal position of the bottom 8 extends slightly beyond the carrier 10 and directly above a ramrod 27. The movable carrier 10 of the mold 29 is supported by a guide 33 for the upper end of the ramrod 27, which passes through a bushing 34, carried by the same. The guide 33, by means of rods 2 and 3, is secured to the framing 1 of the press, in which is arranged a ram 25, engaging the ramrod 27 at its lower end only, and a cylinder 26,

into which water is conducted by a pipe 5. The rods 2 and 3 also serve to support a head 52 above the mold 29, in which is arranged a cylinder 53, actuating the upper ramrod 32, to the free end of which is secured a plug 31.

The compression of an ingot in a conical mold requires a great pressure of water; but the quantity of water necessary is relatively very small if the packings of the hydraulic apparatus are well made and especially if the apparatus is arranged in such a manner that strain on the packing is always regular—that is, if the pressure is merely pressure of water, and thereby no abnormal thrust caused by outside parts of metal. This point is vital for the compression of large ingots which requires some considerable time and would be rendered difficult if there was the slightest leakage of water. For this purpose the ram 25, Fig. 1, in the large hydraulic cylinder 26 is arranged in such a manner that it forces the ramrod 27 not from the top, but from the bottom 28 of the chamber formed in it for this purpose. The ramrod 27, the outside diameter of which is smaller than the inside diameter of the chamber, only touches the ram at the bottom 28. The resistance opposed by the ramrod 27 to the ram 25 thus combines to a single vertical force directed at the axis of the ram 25, and consequently having no action upon the lateral packings. This arrangement, adapted for a well-determined object, is so arranged that the compression may be properly carried out and the power at hand usefully applied to "compression," properly so called, without wasting itself in lateral strains. For this purpose all forces applied should be symmetrical relative to the common axis. In other words, the resultant of all the forces should be directed at this common axis. It results if all the parts of the apparatus be symmetrical relative to this axis that symmetry will be maintained by properly guiding the portions which move while compressing. The movable portions to be guided are the ram 25, the ramrod 27, extending from the ram, the ingot-mold 29, the movable bottom 8, with its extension 30, the plug 31, and the ram 32, carrying the plug. These moving parts are caused to move vertically in accordance with the common axis of the press by means of the following arrangement: The compressing force transmitted by the ramrod 27 must be vertical and be kept vertical during the whole period of compression. This result is obtained by dividing the hydraulic ram into two separate parts—first, the ram 25, pushed vertically upward by the water and guided vertically by the cylinder 26, and, second, the ramrod 27, pushed vertically upward by the bottom 28 of the ram 25 and having its upper end guided vertically by the guide 33, fixed upon the framing of the press, and the bushing 34, carried by the guide. The compressing power commences at the ground level 35 and is in a vertical direction, owing to the method of guiding indicated above. It must now be transmitted vertically to the movable bottom 8 through its extension 30 without the possibility of any deviation in direction. This result is obtained by making the top of the ramrod 27 (see Figs. 3 and 4) convex at 36 and the bottom of the extension 30 concave at 37, the convex portion exactly fitting into the concave portion. When the ramrod 27 pushes the extension 30 of the bottom 8, the convex surface 36 keeps the concave portion 37, and consequently the whole bottom 8, axial. If an outside force were to tend to tilt the bottom 8 out of the vertical, the flat horizontal surfaces 38 and 39, which are very near one to the other, as shown at 40 in Fig. 4, will touch each other at the side which is tilted, and from that time the ramrod 27 will bring the bottom 8 back into the vertical.

The bottom 8, to which power is transmitted vertically, is maintained vertical in its passage through the ingot-mold. For this purpose the ingot-mold must itself be guided at both ends. The bottom of the ingot-mold is maintained axial by its carrier 10, which is itself kept stationary by pins 11, which fixes it to the guide 33 of the press.

The top of the ingot-mold may be guided in its small vertical movement by making the plug 31, Figs. 1 and 5, conical in order to facilitate the entrance of the same into the mold and making the upper portion 41 to exactly fit into the ingot-mold at the level 47, there being about two millimeters of play between them. With this arrangement when the ingot-mold carrier 10 is axial with the press and has been fixed by the pins 11 to the press it is only necessary to lower the plug 31 into the position shown in Fig. 5 in order to guide the top of the ingot-mold. Pressure may then be applied by causing the ramrod 27 to advance without danger of the ingot-mold being tilted.

As shown in Figs. 5, 6, and 7, an abutment 43, suitable for a conical ingot-mold 29, such as is secured to the head 52, may be employed. The abutment 43 is of sufficient size in a vertical direction to allow of a clear space 44 remaining for the lodgment of the plug 31. This arrangement, together with the addition of a washer 45, of forged steel, against which the plug 31 abuts when it has finished its upward travel, insures lifting the ingot-mold off from the ingot with the entire power of the press in case of accident. If, however, by accident the ingot cannot be removed from the ingot-mold 29 by the feeble power of the ram 32, the abutment 43 is removed and for this purpose is made in two parts, as shown in Fig. 7. The plug 31 is now wedged against the steel washer 45 by an interposed block 50, of metal, as shown in Figs. 10 and 11, and the plug 31 is held in engagement with the

ingot. The ramrod 27 is then caused to descend, and between it and the movable bottom extension 30 a forged-steel washer 51 is placed, which is of larger diameter than the ramrod 27 and supports the mold 29. When the ramrod 27 is raised with the entire power of the press, the washer 51, of greater diameter than the ramrod 27, is raised and lifts the mold-carrier, together with the mold. The ingot-mold being free to rise, the abutment 43 having been removed, the ingot is prevented from rising by the plug 31, which presses upon it, and therefore forces it to descend into the ingot-mold 29, as illustrated in Fig. 11 of the drawings. In Figs. 6 and 7 are shown in section and in plan the abutment 46, which is made in two pieces in order that it can be easily removed. It is so shaped in the inside *a b c d e f g h i j k l m n o p* so as to fit the outside of all plugs fitting the ingot-molds used in the press. This novel arrangement allows the same abutment to be used with all ingot-molds, and thus avoids the necessity of changing this part, which is a great advantage.

As shown in Fig. 9, the ingot-mold may be made elliptical in horizontal section, and the mold proper, 29, of cast-iron in the present instance, is made in four parts. It is advantageous to make the cast portion of large ingot-molds in several pieces, the strain being taken by the outside hoops. Their division into parts, with vertical joints, is a feature of the mold.

Having thus described the nature and objects of my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In a press, two rams arranged to press in opposite directions upon the ingot within a conical mold, a plug connected with one of said rams and arranged to enter the smaller end of the mold to guide said mold in proper vertical position, a support or head carrying the ram to which the plug is connected, an abutment projecting below the head and surrounding the plug to form a space for the reception of the plug, and a washer arranged in the head above the plug and forming a limitation for the upward movement of the plug in said head.

2. In a press, an ingot-mold having a frusto-conical interior for the formation of the ingot, two rams arranged to press in opposite directions upon the ingot within the mold, a head carrying one of said rams, and means for permitting the smaller end of the mold to bear upon said head, in combination with means controlled by the other of said rams for raising the ingot-mold against said head, and means for correspondingly depressing the ram in said head to eject the ingot from the mold.

In testimony whereof I have hereunto set my signature in the presence of two subscribing witnesses.

HENRI HARMET.

Witnesses:
J. BARLCH,
F. BOOTH.