No. 841,293.

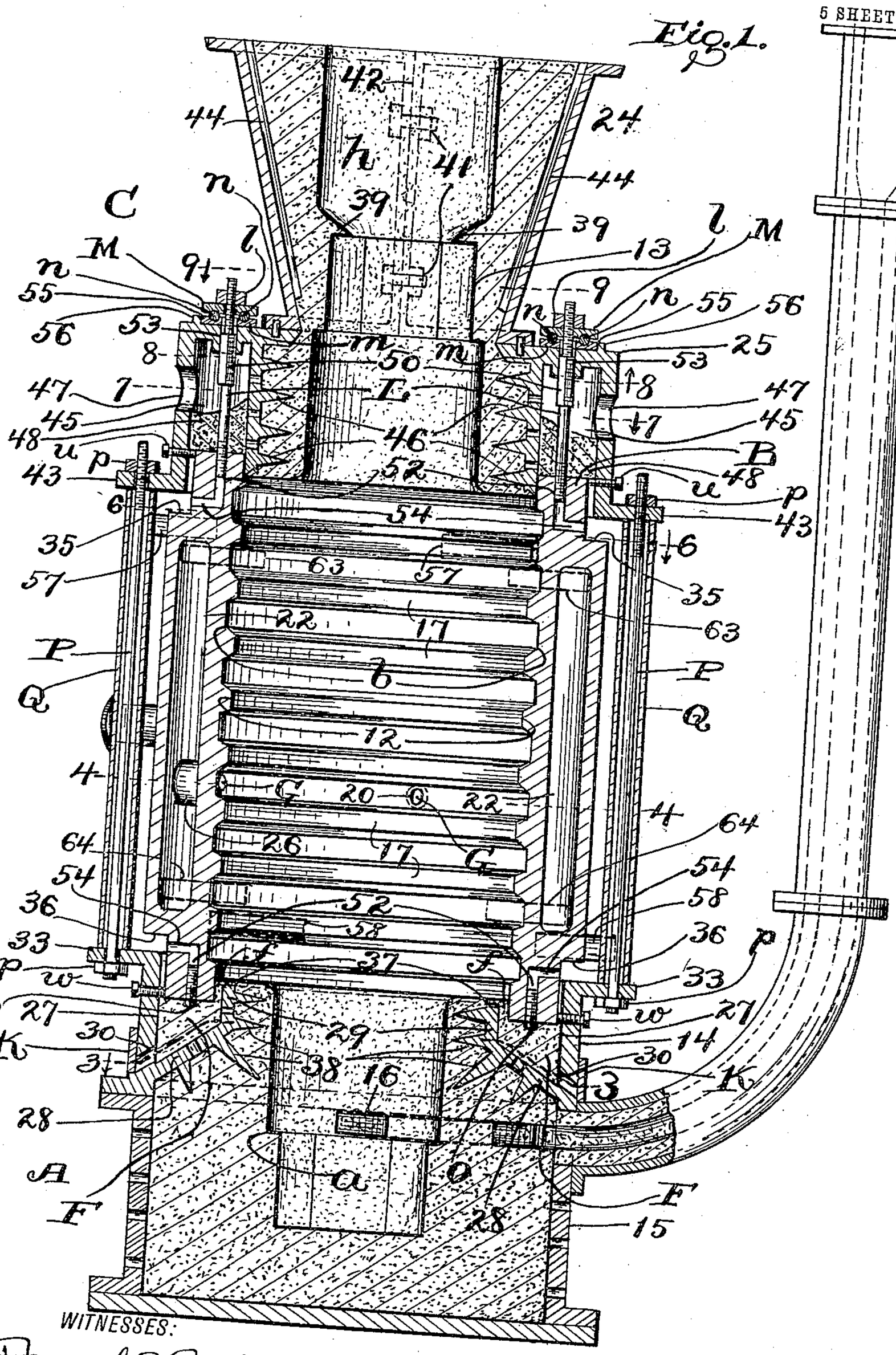
R. H. WEST. PATENTED JAN. 15, 1907.

MOLD FOR CASTING CHILLED ROLLS.

APPLICATION FILED MAY 3, 1906.

5 SHEETS—SHEET 1.

Fig. 1.



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5 SHEETS—SHEET 2.

Fig. 2.

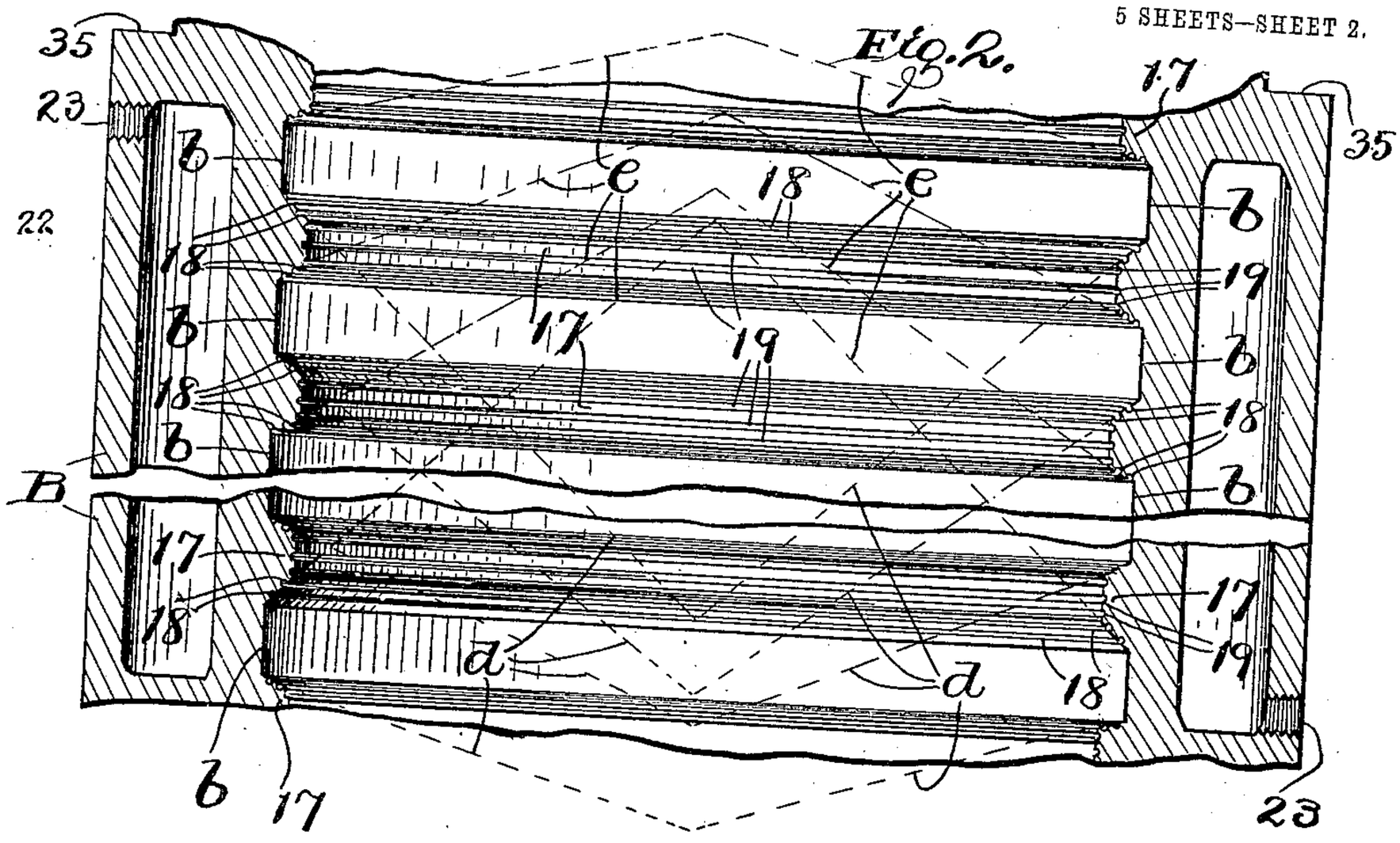
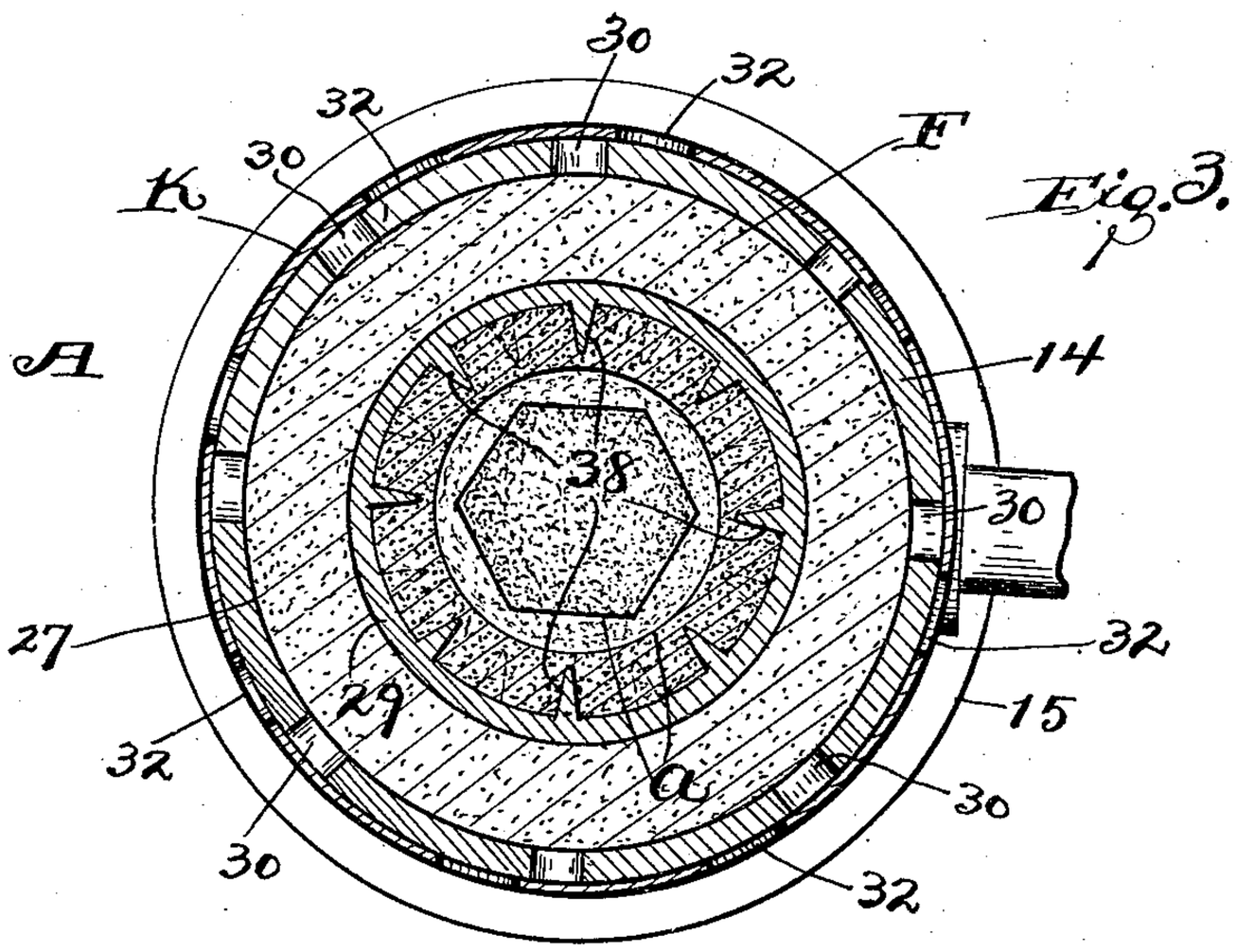


Fig. 3.



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5 SHEETS—SHEET 3.

Fig. 4.

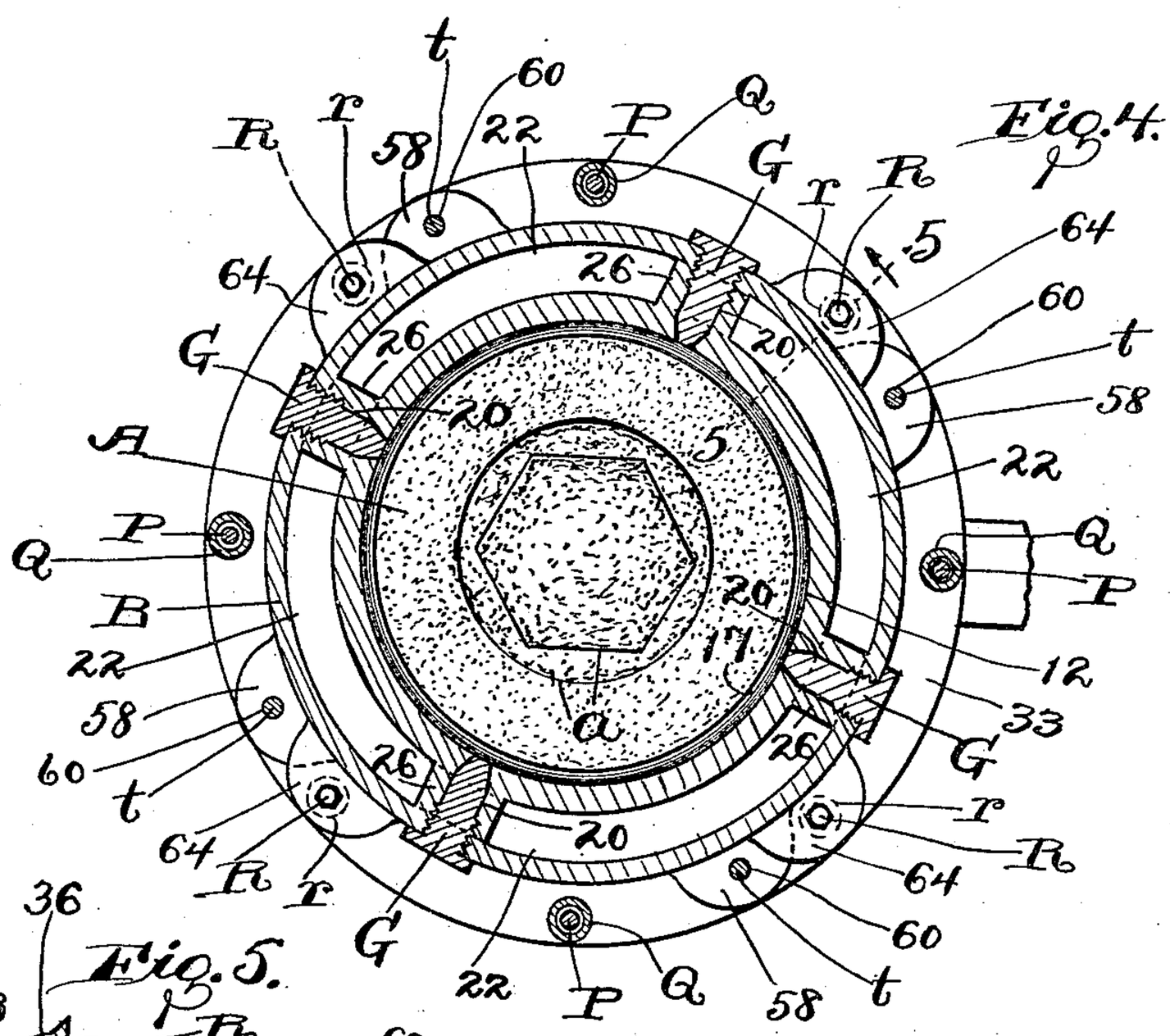


Fig. 5.

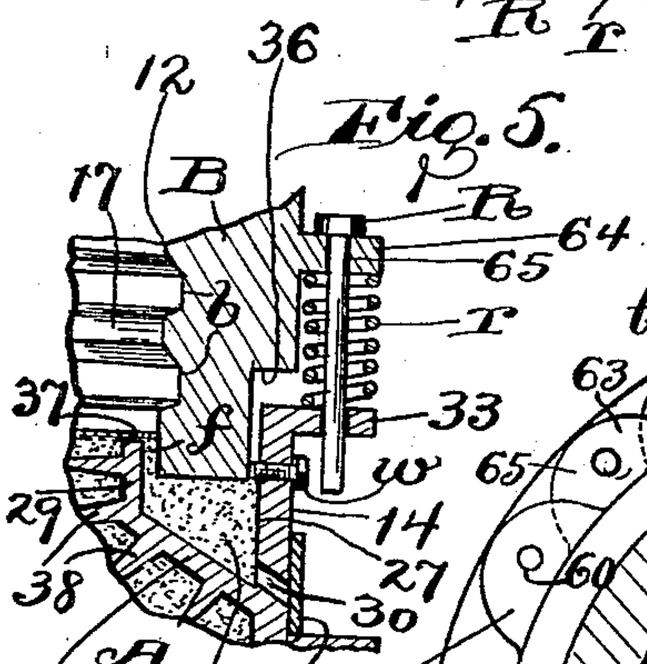
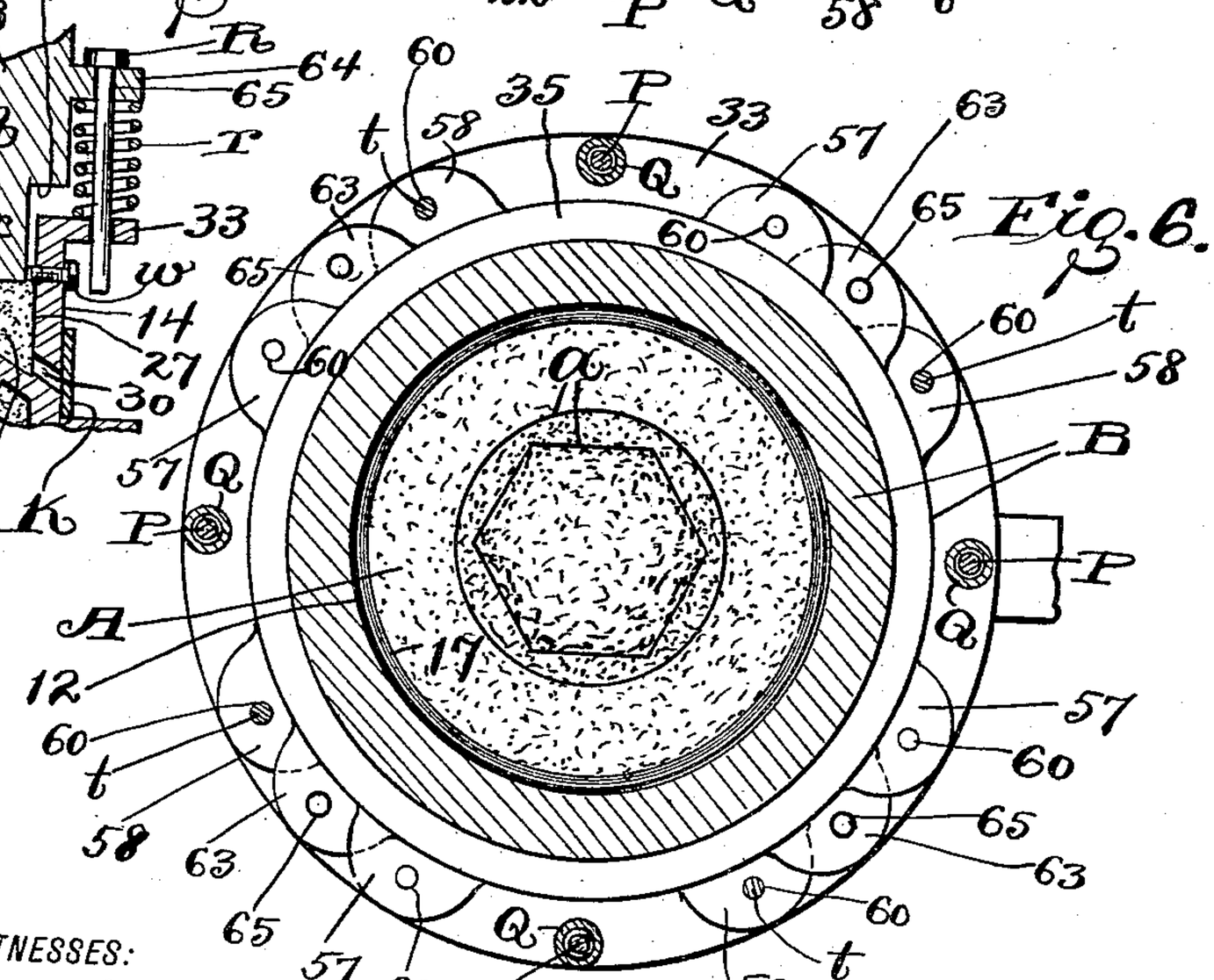


Fig. 6.



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5 SHEETS—SHEET 4.

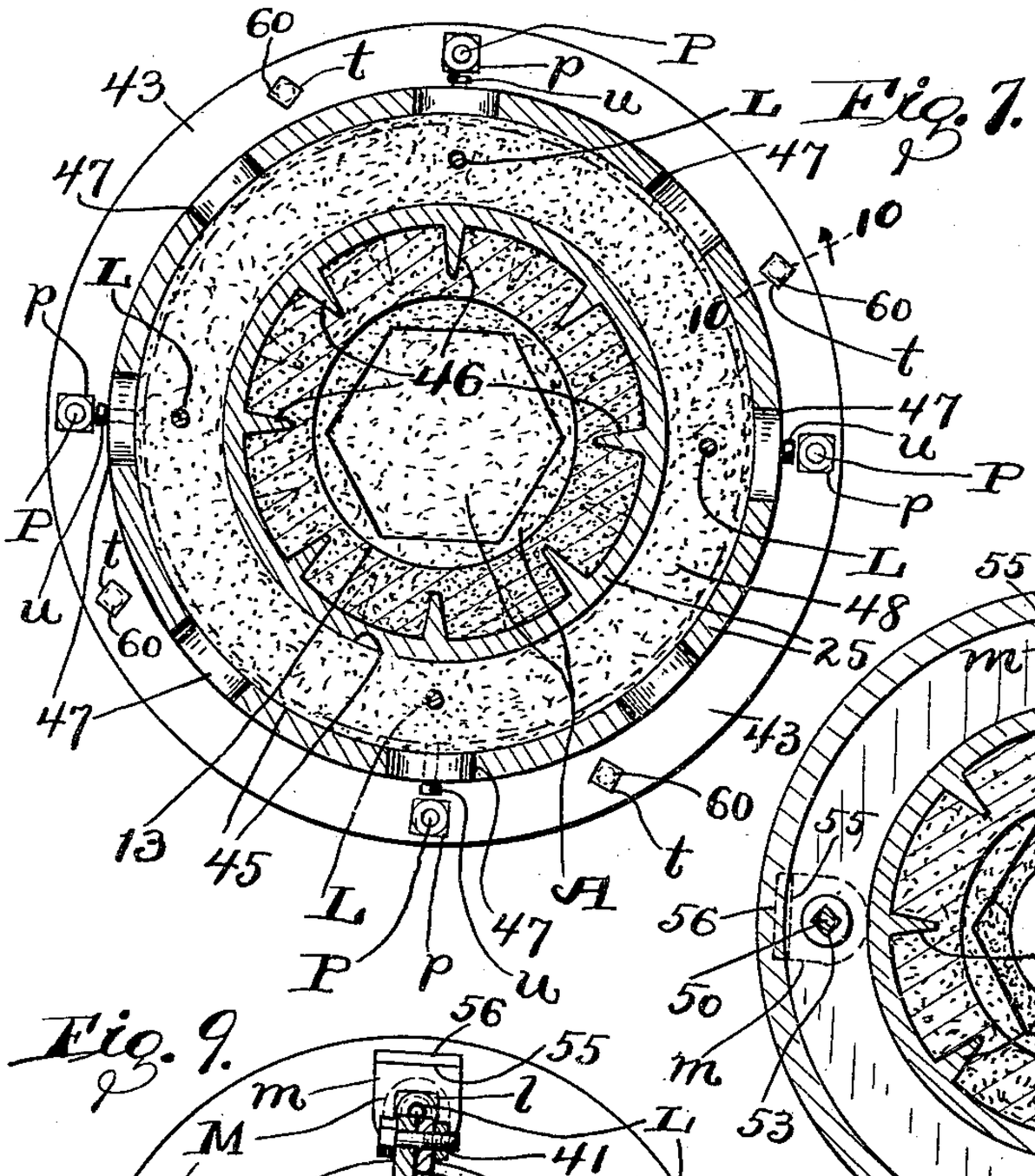

Fig. 7.

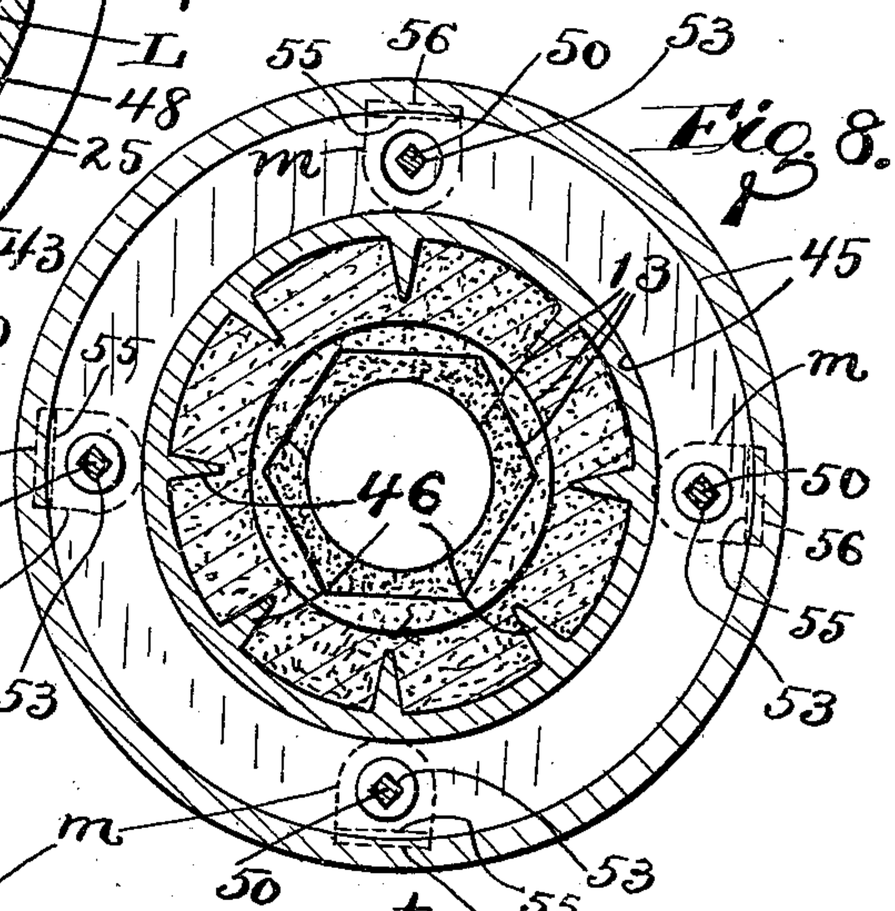

Fig. 8.

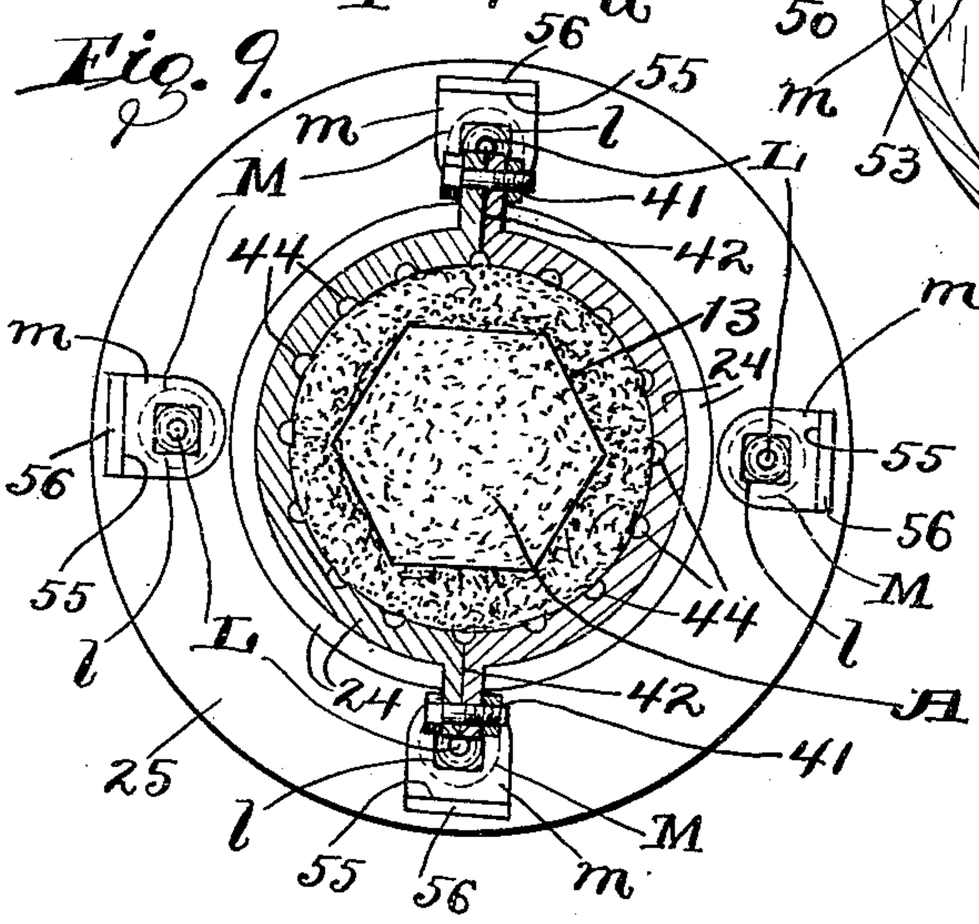

Fig. 9.

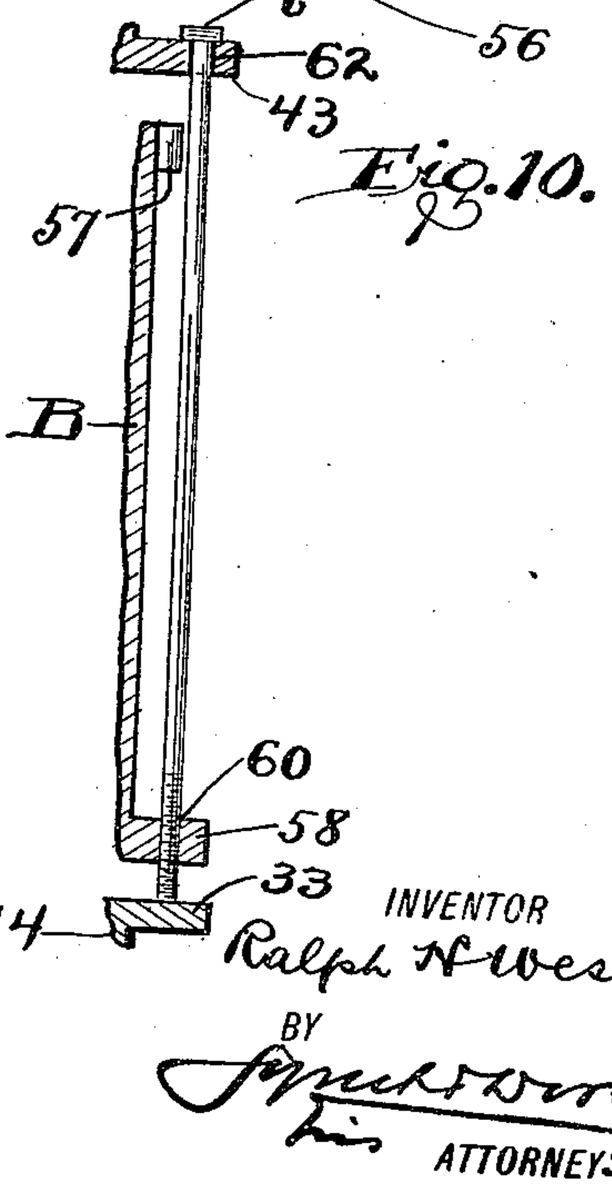

Fig. 10.

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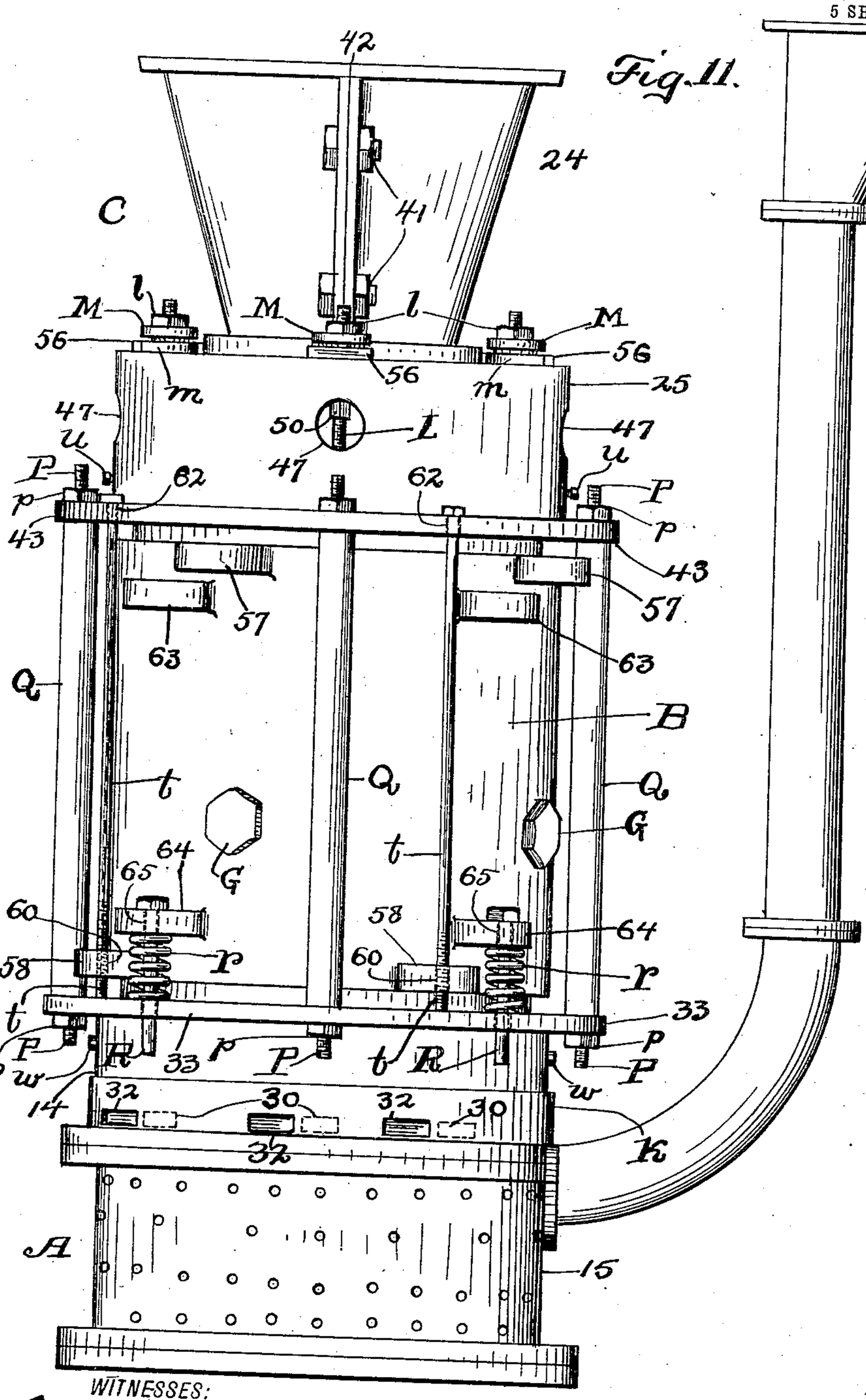
5 SHEETS—SHEET 5.

Fig. 11.



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UNITED STATES PATENT OFFICE.

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MOLD FOR CASTING CHILLED ROLLS.

No. 841,293. Specification of Letters Patent. Patented Jan. 15, 1907.

Application filed May 3, 1906. Serial No. 315,057.

To all whom it may concern:

Be it known that I, RALPH H. WEST, a citizen of the United States of America, residing at Sharpsville, in the county of Mercer and State of Pennsylvania, have invented certain new and useful Improvements in Molds for Casting Chilled Rolls; and I hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it pertains to make and use the same.

This invention relates to improvements in molds for casting chilled rolls.

The primary object of this invention is to provide a roll-casting mold for the successful manufacture of chilled rolls and obtaining castings in daily practice which are acceptable and in which the chilled peripheral crust or shell of the roll-body is uniform in thickness circumferentially of the casting, free from checks or cracks, as well as free from gas-holes and other imperfections, and found to be perfectly round when put in a lathe to be turned.

The objects of my invention, more especially considered, are, first, to cast a roll in a mold comprising a lower mold part or drag in which one of the necks of the roll is cast, a central mold part or chill in which the body of the roll is cast, and an upper mold part or cope in which the other neck of the roll is cast, and to render the chill adjustable or shiftable vertically for the purpose hereinafter appearing; second, to adequately support the upper mold part or cope from the lower mold part or drag without interfering with a convenient vertical adjustment of the central mold part or chill; third, to provide means for centering the chill relative to the cope and drag in providing room for expansion of the chill; fourth, to provide suitably-packed joints between the chill and the cope or drag to prevent the escape of molten metal at the said joints; fifth, to provide a chill having such internal contour as to center the crust or shell of the roll-body-forming portion of the casting relative to the chill and to support the said shell practically from end to end of the chill during the cooling of the casting; sixth, to economically construct the chill to render it capable of being kept in a cool condition during the casting operation or heated to expand it and enlarge its diameter to avoid any difficulty in hoisting the chill from the casting after the cooling of the casting; seventh, to render the chill reversible from end to end; eighth, to interiorly furrow the chill circumferentially of the chill, so as to avoid a substantially smooth inner surface, and thereby prevent the blacking or coating generally used to cover the interior surfaces of chills from scaling off; ninth, to make the cope divisible into two parts horizontally, and thereby render it possible to prevent the operatives or attendants from filling the mold with molten metal any higher than the lower end of the wabble-forming outer end portion of the upper neck of the roll being cast and then to compel the attendants to pour the molten metal required to form the last-mentioned end portion of the said neck from the upper end of the mold for the purpose hereinafter appearing; tenth, to construct the lower mold part or drag to accommodate a lowering of the chill, and, eleventh, to adequately support and steady the cope relative to the drag without interfering with the vertical adjustability of the chill.

With these objects in view and to the end of realizing other advantages hereinafter appearing this invention consists in certain features of construction and combinations of parts hereinafter described, and pointed out in the claims.

In the accompanying drawings, Figure 1 is a central vertical section of a roll-casting mold embodying my invention. Fig. 2 is an enlarged sectional view illustrating a portion of the central mold part or chill. Fig. 3 is a transverse section on line 3 3, Fig. 1, looking downwardly. Fig. 4 is a horizontal section on line 4 4, Fig. 1, looking downwardly. Fig. 5 is a vertical section on line 5 5, Fig. 4, looking in the direction indicated by the arrow. Figs. 6 and 7 are horizontal sections on lines 6 6 and 7 7, respectively, Fig. 1, looking downwardly. Fig. 8 is a horizontal section on line 8 8, Fig. 1, looking upwardly. Fig. 9 is a horizontal section on line 9 9, Fig. 1, looking downwardly. Fig. 10 is a vertical section on line 10 10, Fig. 7, looking in the direction indicated by the arrow. Fig. 11 is a side elevation of my improved mold.

My improved roll-casting mold comprises a lower mold part or drag A, a central mold part or chill B, and an upper mold part or cope C. The drag A is circular and provided with a cavity *a*, arranged centrally of the drag and extending from the upper extremity of the drag downwardly a suitable distance. The chill B is cylindrical and pro-

vided interiorly with a circular chamber 12, which extends vertically through the chill. The upper mold part or cope C is circular and provided centrally with a chamber 13, which extends vertically through the cope. The body of the roll to be cast is cast in the chill B, whereas the necks of the roll are cast in the drag and cope.

The drag-cavity *a* and the cope-chamber 13 are arranged centrally of and diametrically smaller than, but in communication with, opposite ends, respectively, of the chill-chamber 12 and have the general outline required to form the necks of the roll to be cast. The surrounding wall or walls of the cavity *a* and the bottom of the said cavity are built up of loam or molding-sand within and surrounded by a metal casing, which preferably comprises an upper section 14 and a lower section 15. The cavity *a* is provided at one side and a suitable distance below the upper end of the cavity (see Fig. 1) with an inlet 16 for molten metal, and the mold is poured through the said inlet.

The chill B is supported as required to render it capable of being shifted or adjusted vertically independently of the drag and cope.

The surrounding wall of the cope-chamber 13 is formed by a body of loam or molding-sand, which is built up and supported in any approved manner within and surrounded by metal casings 24 and 25, which are supported, as will hereinafter appear, from the upper section 14 of the drag-casing without interfering with the shiftability or adjustability of the chill B.

The chill B is provided internally with annular grooves *b*, which (see Figs. 1 and 2) are spaced longitudinally of the chill and form diametrical or lateral enlargements of the chill-chamber 12. That is, the chill is provided internally with vertically-spaced grooves *b*, which extend circumferentially of the chamber 12. The bottom wall of each groove *b* slopes downwardly and inwardly; but the slope of the bottom wall of the lower of two adjacent grooves *b* is less than the slope of the bottom wall of the upper of the said grooves, as indicated more clearly by the illustrative dotted lines *d* in Fig. 2. The top wall of each groove *b* slopes upwardly and inwardly; but the slope of the top wall of the upper of two adjacent grooves is less than the slope of the top wall of the lower of the said grooves, as indicated more clearly by the illustrative dotted lines *e* in Fig. 2.

It will be observed, therefore, that my improved roll-casting mold comprises a vertically-arranged chill, which is provided with a chamber 12, which extends from end to end of the chill and is enlarged diametrically or laterally at suitable intervals between the ends of the chill to form beads 17, which are spaced vertically and extend circumferentially of the said chamber, with each bead which is formed between two adjacent chamber enlargements *b* beveled top and bottom, with the downwardly-facing surface of the bead sloping upwardly and inwardly and forming the top wall of the lower of the said chamber enlargements, with the top or upper surface of the bead sloping downwardly and inwardly and forming the bottom wall of the upper of the said chamber enlargements, with the slope of the lower surface of the lower of two adjacent beads greater than the slope of the lower surface of the upper of the said beads and with the slope of the top surface of the upper of two adjacent beads greater than the slope of the top surface of the lower of the said beads. Hence the slope of the bottom walls of the enlargements *b* of the chill-chamber 12 gradually increases toward the upper end of the chill, and the slope of the top walls of the said chamber enlargements gradually increase toward the lower end of the chill, so that the chill, so far as its internal grooves or chamber enlargements are concerned, is reversible end for end.

Preferably the top and bottom walls of the grooves *b* are provided (see Fig. 2) with suitably-formed shallow furrows 18, extending circumferentially of the chill and spaced transversely of the said walls. Also those interior surfaces of the chill which extend circumferentially of the chill between the grooves *b* are (see Fig. 2) preferably provided with vertically-spaced shallow furrows 19, extending circumferentially of the chill. It will be observed, therefore, that my improved chill is provided internally with laterally and inwardly projecting furrowed beads extending circumferentially of the chill-chamber 12 and spaced at short intervals vertically between the upper and lower ends of the chill. Fig. 1 is drawn on too small a scale to show the furrows 18 and 19, which therefore are only clearly shown in Fig. 2, which is drawn on a larger scale, and the depth of the grooves *b* and the said furrows are exaggeratively illustrated. The furrows 18 and 19 tender a firmer hold to the blacking or other coating used to coat the interior surfaces of chills. Without the said furrows the said coating or blacking would be liable to scale off.

In casting a roll by my improved mold the peripheral crust or shell of the casting formed in the chill is during its contraction maintained in a strictly central position relative to the chill and supported circumferentially of and upon the downwardly-sloping bottom walls of the grooves or chamber enlargements *b*. The casting is supported until near its final contraction at as many intervals vertically as there are chamber enlargements *b*, so that the said shell or crust is not liable to be cracked or put out of round or rendered defective by the pressure of molten metal within and centrally of the casting.

It is obvious that the grooves should have such depth that when the casting formed in the chill has cooled sufficiently the external annular ribs or beads formed on the casting in the said grooves shall be free from the said grooves, so as to permit the hoisting of the chill from the casting.

By the increase in the slope of the bottom walls of the grooves *b* toward the upper end of the chill the contracting casting is centered relative to the chill and evenly supported along its whole length from the said walls until the casting has contracted enough to become released from the grooves, thereby producing a roll-body which is perfectly round and has a chilled peripheral crust or shell which is uniform in thickness and free from latent, as well as visible, defects or imperfections. By the decrease in the slope of the top walls of the grooves or chamber enlargements *b* toward the upper end of the chill the contracting casting is accurately centered relative to the chill by the said walls during any lowering of the chill while the casting is cooling or contracting and not yet free from the said chamber enlargements.

The surrounding wall of the chill-chamber 12 is provided within it with a fluid-receiving chamber 22, which has its side walls integral with each other and is arranged externally and extends circumferentially and a suitable distance longitudinally of the chamber 12. The fluid-receiving chamber 22 is shown provided with two fluid connections 23, spaced vertically, (see Fig. 2,) and the chill is provided at any suitable point between the upper and lower ends of the said chamber (see Figs. 1 and 4,) with reinforcing stay-forming portions 26, which connect and are integral with opposite walls of the said chamber and spaced circumferentially of the chill. Preferably the stays 26 are spaced circumferentially of a groove or chamber enlargement *b* of the chill, and the chill is provided (see Figs. 1 and 4) with gage-receiving holes 20, connecting at their inner ends with the said chamber enlargement and extending from the latter through the stays to the exterior of the chill, and plugs G normally close the said holes and are removably attached to the chill. Preferably the outer end portion of each hole 20 is screw-threaded, and a correspondingly externally threaded plug G is screwed into the said hole, which plug has an inner tapering end fitting the inwardly-tapering inner end of the hole and is removable to accommodate the application through the said hole of a graduated instrument or gage for measuring the vertical, as well as the horizontal, contraction of the casting being formed in the chill during the operation of the mold.

The drag-casing section 14 is mounted on the drag-casing section 15, with the parting-line between the said sections preferably arranged next the inlet 16 of the drag-cavity *a*. The upper drag-casing section 14 is provided within it with an annular chamber 27, which is arranged externally of and extends around the drag-cavity *a*. The chamber 27 extends from the upper extremity of the upper casing-section 14 downwardly a suitable distance and has a bottom 28, which slopes downwardly and outwardly, and a vertically-arranged inner side wall 29 at the upper end of the said bottom. The surrounding wall of the last-mentioned chamber is provided with discharge-openings or outlets 30, arranged adjacent the lower end of the bottom and spaced circumferentially of the chamber, and the discharge through the said outlets is controlled by valve-forming means comprising, preferably, a ring K, which embraces and is adjustable circumferentially of the drag-casing section 14 and provided (see Fig. 3) with lateral holes 32, adapted to be brought into registry with the outlets 30 of the said chamber. Normally the ring K is in position with its holes 32 out of registry with the outlets 30; but the relative arrangement of the parts is such that the holes 32 are brought into communication with the outlets 30 by adjusting the said ring to the required extent.

The surrounding wall of the chamber 27 is provided at its upper end—that is, at the upper end of the drag-casing—with a laterally and outwardly projecting horizontally-arranged annular flange 33, which is larger in external diameter than the chill. The chill is correspondingly reduced in external diameter at both ends to form an upwardly-facing external annular shoulder 35 and a downwardly-facing external annular shoulder 36 at the upper end and lower end, respectively, of the diametrically larger portion of the chill. The chill is arranged with the lower portion of its lower diametrically smaller end depending into the chamber 27. The drag-casing therefore surrounds the lower portion of the diametrically smaller end of the chill and is arranged in under the shoulder 36. Preferably the chamber 27 is somewhat larger in external diameter than the lower diametrically smaller end of the chill and somewhat larger in internal diameter than the chill, and the said end of the chill is centered relative to the said chamber, and consequently relative to the drag-casing.

The chamber 27 is filled with fine sand F or other readily-displaceable material which is suitable for use in packing the joint between the lower end of the chill and the drag-casing to prevent molten metal from escaping from the chill-chamber into the said chamber in the drag-casing. The body of sand F within the chamber 27 (see Figs. 1 and 2) extends, as at *f*, upwardly between the lower end of the surrounding wall of the chill-chamber and the inner side wall 29 of the chamber 27, and the upper end of the said wall is covered with sand, as at 37. The chamber 27 and the dis-

placeable sand or material F therein permits the lowering of the chill, and the chill is permitted to descend more or less rapidly, according as the valve-forming ring K is adjusted to increase or decrease the flow of sand or displaceable material from the said chamber at the outlets 30.

The upper drag-casing section 14 is provided at the external surfaces of the bottom 28 and wall 29 of the chamber 27 with laterally and inwardly projecting tapering lugs 38, which are embedded in and instrumental in supporting the loam or molding-sand forming the surrounding wall or walls of the drag-cavity *a*.

The upper drag-casing section 14 and its flange 33 constitute an annular member instrumental in supporting the upper mold part or cope, as will hereinafter appear, which annular member is normally arranged far enough below the shoulder 36 of the chill to accommodate a lowering of the chill. The lower portion of the cope-chamber 13 has the outline and dimensions required to form the inner end portion of a roll-neck, and the surrounding wall or walls of the said portion of the cope-chamber are formed by a body of loam or molding-sand built up within and surrounded by the casing 25, and the remainder of the cope-chamber has the contour and dimensions required to form the wabble-forming outer end portion of the said neck and to form a feeding-head *h* above the wabble-casting portion of the said chamber, with the surrounding wall or walls of the feeding-head and the wabble-casting portion of the cope-chamber built up of a body of loam or molding-sand within and surrounded by the casing 24, which is divided vertically, as at 42, (see Figs. 1 and 9,) into two sections, which are removably secured together by suitably-applied bolts and nuts or clamps, as at 41, and rest upon the lower cope-casing 25.

The lower cope-casing 25 is provided interiorly (see Figs. 1, 7, and 8) with a chamber 45, extending from the lower end of the casing upwardly a suitable distance, which chamber is arranged to receive the upper diametrically smaller end of the chill. The inner side wall of the cope-casing chamber 45 is provided at its outer side with laterally and outwardly projecting tapering lugs 46, which are embedded in and instrumental in supporting the loam or molding-sand which forms the lower portion of the surrounding wall or walls of the cope-chamber 13. The lower cope-casing 25 is provided at the lower end of the surrounding wall of the chamber 45 and externally with a laterally and outwardly projecting horizontally-arranged annular flange 43, which is arranged far enough above the upwardly-facing shoulder 35 of the chill to accommodate an upward movement of the chill, and the said flange is diametrically larger than the chill, so as to accommodate the supporting and steadying of the cope at the said flange from the flange 33, formed on the drag-casing. The lower cope-casing 25 is arranged, therefore, with its flange 43 vertically above the flange 33 of the drag-casing. The cope-casing chamber 45 is preferably larger in external diameter than the upper diametrically smaller end of the chill; but the said end of the chill preferably snugly but slidably embraces the inner wall of the said chamber. The cope-casing chamber 45 is provided in its outer surrounding wall with lateral holes 47, which are spaced circumferentially of the cope and accommodate the introduction of sand or other material 48 suitable for the formation between the upper end of the chill and the cope of a packed joint which will prevent the escape of molten metal from within the chill-chamber 12 into the cope-casing chamber 45. The lower portion of the last-mentioned chamber is therefore packed with sand or suitable material 48.

Means for adjusting or shifting the chill vertically is provided and is preferably supported from the lower cope-casing 25. The chill-shifting means (see Figs. 1, 8, and 9) comprises, preferably, studs L. Each stud L has externally-screw-threaded ends and a square or angular portion 50 between the said ends. Each end of the chill is provided with vertically-arranged screw-threaded holes 52, spaced circumferentially of the chill, and the studs L are screwed into the holes 52 in the upper end of the chill. Each stud L extends from the chill upwardly through the chamber 45 and through an angular hole 53, formed in the top wall of the said chamber, which hole conforms in outline to the contour of and is engaged by the angular portion 50 of the stud. Each stud L extends a suitable distance above the top wall of the chamber 45, and a correspondingly-threaded nut *l* is mounted on the stud above and externally of the said chamber. Washers are interposed between the nuts and the external surface of the top wall of the chamber, and each washer is composed, preferably, of two superimposed sections M and *m*, with balls *n* interposed between the two washer-sections, and the lower washer-section *m* is provided with an external flat surface 55, which is engaged by an upwardly-projecting lug or member 56, formed on the lower cope-casing 25 to prevent turning of the said washer-section. The engagement of the angular portions 50 of the studs L with correspondingly angular holes 53 formed in the casing 25 prevents turning of the studs during the manipulation of the nuts *l*, and consequently the studs and the connected chill move endwise in the one direction or the other, according as the nuts are turned in the one or the other direction.

The holes 52 in the lower end of the chill are closed (see Fig. 1) by externally-screw-

threaded plugs *o*, which are screwed into the said holes, which plugs prevent the ingress of sand or other matter to the said holes from the chamber 27. Each hole 52 is, however, provided at its inner end with an outlet for facilitating the removal of any sand or dirt which may get into the said hole, which outlet consists of a lateral hole 54, formed in the chill and extending laterally and outwardly to the exterior of the chill from the connected hole 52.

It will be observed that the provision of holes 52 in each end of the chill renders the chill reversible end for end so far as the shifting of the chill through the medium of the studs L and nuts *l* is concerned.

The means employed in supporting the upper mold part or cope from the casing of the lower mold part or drag and in steadying the cope and the chill relative to the said casing, but without interfering with the vertical shiftability of the chill, comprises the following: Vertically-arranged bolts P (see Figs. 1, 4, 6, and 7) extend loosely through the flange 33 of the drag-casing and loosely through the flange 43 of the lower cope-casing 25 and are spaced circumferentially of the mold. The bolts P are threaded at both ends, and correspondingly-threaded nuts *p* are mounted on the bolts at the top of the flange 43 and at the bottom of the flange 33. Spacing-tubes Q embrace or surround the bolts P between the flanges 33 and 43. The tubes Q rest upon the flange 33, and the cope rests upon the upper ends of the tubes. The tubes Q are therefore instrumental in supporting the cope from the drag-casing.

The chill (see Figs. 1, 4, 6, and 10) is provided externally with two sets of laterally and outwardly projecting lugs, with the lugs 57 of one set and the lugs 58 of the other set preferably arranged at opposite ends, respectively, of the diametrically larger portion of the chill, with the lugs of each set spaced circumferentially of the chill, and with the lugs of each set of lugs arranged out of line vertically with the lugs of the other set. The lugs 57 and 58 are provided with vertically-arranged screw-threaded holes 60, and bolts *t* extend loosely through correspondingly-arranged holes 62, formed in the flange 43 of the lower cope-casing 25 (see Figs. 7 and 10) and are screwed into and through the holes 60 in the lugs 58 of the lower set of lugs to and against the top of the flange 33 of the upper section 14 of the drag-casing.

The lugs 57 are shown idle, but have such arrangement relative to the bolt-holes 62 in the flange 43 that the holes 60 in the said lugs shall be in line vertically with the holes 62 when the chill is reversed end for end. The provision of two sets of lugs 57 and 58 is therefore to accommodate the reversibility of the chill end for end.

The chill is provided externally and between the upper end and lower end of the diametrically larger portion of the chill (see Figs. 1, 4, 5, and 6) with two sets of lugs 63 and 64, which are vertically spaced, preferably, equidistantly from opposite ends, respectively, of the said portion of the chill, with the lugs of each set spaced circumferentially of the chill, with the lugs 63 of the upper set arranged in line vertically with the lugs 64 of the lower set, and (see Figs. 5 and 6) with the lugs of each set having holes 65 extending vertically therethrough. Vertically-arranged pins R extend loosely through the holes 65 in the lugs of the lower set of lugs 64 (see Fig. 5) to and loosely through the flange 33 of the drag-casing, and spiral springs *r* are coiled around the said pins and interposed and confined between the said flange and the said lugs. The springs *r* are normally arranged to be compressed and are instrumental in supporting the chill when the latter is lowered. The provision of two sets of lugs 63 and 64 instead of one set only is for the purpose of rendering the chill reversible end for end.

It will be observed that by the provision of bolts P, nuts *p*, tubes Q, lugs 58, bolts *t*, springs *r*, pins R, and lugs 64 the cope is efficiently supported from the drag-casing, and the chill and the cope are at all times adequately steadied relative to the drag-casing.

Means for centering the chill relative to the lower cope-casing 25 and relative to the upper section 14 of the drag-casing is provided and comprises the following:

Set-screws *u* (see Figs. 1 and 7) are screwed laterally through the outer surrounding wall of the cope-casing chamber 45 into engagement with the upper diametrically smaller end of the chill, which set-screws are spaced circumferentially of the said end of the chill.

Set-screws *w* (see Fig. 1) are screwed into and through the surrounding wall of the drag-casing chamber 27 into engagement with the lower diametrically smaller end of the chill, which set-screws are spaced circumferentially of the chill.

The outer portion of the lower cope-casing 25, with its flange 43, and the outer portion of the upper section 14 of the drag-casing, with its flange 33, constitute annular members which embrace the upper diametrically smaller portion and lower diametrically smaller portion, respectively, of the chill and support the set-screws *u* and *w*, respectively.

By the construction hereinbefore described it will be observed that the nuts *l* on the studs L, the set-screws *u* and *w*, the bolts *t*, and the nuts *p* are conveniently accessible, and the construction is such that tipping or toppling of the cope laterally in any degree when lifting or lowering the chill is prevented.

Referring again to the functions performed by the pins R, springs *r*, lugs 64, bolts *t*, and lugs 58, I would remark that the set-screws *u* and *w*, as already indicated, are instrumental

in accurately centering the chill at the ends; but the bolts *t*, screwed through lugs 58 on the chill against the upper end of the upper section 14 of the drag-casing, are instrumental in maintaining verticality of the chill at all times before and after the cope is placed in position. The bolts *t* are equally applicable before and after the application of the cope. The bolts *t* are of course manipulated to accommodate a lowering of the chill; but if perchance the bolts become unnecessarily loosened relative to or raised from the flange 33 then the whole weight of the chill is brought upon the springs R, which then are important in yieldingly supporting the chill and in saving the casting from any injury which it might sustain by permitting the full weight of the chill to come on the beads or ribs of the casting.

The upper cope-casing 24 is preferably provided interiorly with recesses 44, which (see Figs. 1 and 9) are spaced circumferentially of the cope and extend from the upper extremity of the cope downwardly into suitable proximity to the lower end of the said cope-casing, and the feeding-head-forming portion of the cope-chamber 13 is preferably somewhat restricted at its lower end, as at 39, and there smaller in area transversely than the upper end of the wabble-forming portion of the cope-chamber. (See Fig. 1.)

By the construction hereinbefore described it will be observed that the chill is readily shifted vertically relative to the contracting crust or shell of the casting being formed in the chill, that the chill adapted to afford bearing to the said shell or crust at short intervals vertically, and that the downwardly or inwardly sloping bottom walls of the grooves or chamber enlargements of the chill are adapted to remain in contact with the said shell or crust until the casting has contracted enough to become free from the said chamber enlargements, so that the said crust or shell can be maintained exactly central relative to the chill during the contraction of the said shell or crust. It will be observed also that the upper sloping walls of the said chamber enlargements are adapted during any lowering of the chill while the casting is cooling or contracting to engage the beads or ribs formed on and circumferentially of the said crust or shell and thereby positively hold the said shell or crust central relative to the chill during such lowering of the chill.

Briefly described, the operation of my improved mold is as follows: The molten metal employed in casting a roll is introduced at the inlet 16 of the drag-cavity 10, filling the said cavity and then rising into and filling the chill-chamber 12 and then rising into and within the cope-chamber 13 until the level of the molten metal within the cope-chamber has risen as far as the upper end of the lower cope-casing 25. I would here remark that the upper cope-casing 24 is removed from the mold preparatory to the pouring of the mold, so that the operators or attendants can skim off any dirt or dross appearing at the level of the molten metal when the said level rises to the upper end of the lower cope-casing 25, and then when the molten metal has had all the dross and dirt skimmed therefrom and the fed metal has settled down from the roll-neck-forming lower portion of the cope-chamber 13 to near fully feed the chill-chamber 12 the upper cope-casing is placed in position upon the lower cope-casing, and the cope-chamber (including the feeding-head *h*) is then filled to the upper end thereof by pouring molten metal into the feeding-head from above, after which, by the use of a feeding-rod worked up and down round the wabble-forming portion and inner end or main portion of the roll-neck to be cast within the cope-chamber, a perfect union of the metal below the wabble and the metal introduced from above is effected. By this method, accommodated by improved construction of cope, a better casting, as far as the upper neck of the roll (including its wabble-forming portion) is concerned, is not only obtained, but the necessity of expensive machining of the wabble-forming portion of the upper neck of a roll having a larger body and small necks is avoided without damage by shrinkage to the casting at the junction of the roll-body and upper neck.

The employment of a feeding-head restricted at its lower end so as to overhang at least portions of the wabble-forming portion of the cope-chamber will often permit the feeding-head to be broken from the wabble-forming portion of the roll-neck by means of a sledge or other inexpensively-operated device and avoid the more costly method of machining to sever the feeding-head from the roll-neck in a lathe. The upper cope-casing being divided vertically, as shown, admits of its being readily removed and replaced. Of course preparatory to the pouring of the mold the chill is accurately centered relative to the upper section of the drag-casing and lower cope-casing by a proper manipulation of the set-screws *u* and *w;* but the said set-screws are loosened relative to the chill immediately after the chill has been accurately centered, so that the chill is rendered free to expand during the pouring of the mold without liability of cracking the cope-casings and drag-casing or doing other damage to these and other parts of the mold.

The molten metal introduced into the mold is permitted to stand until the chill has formed a suitable crust or shell. The chill is raised or lowered by a proper manipulation of the nuts *l*. The downwardly and in-

wardly sloping bottom walls of the grooves or chamber enlargements of the chill are instrumental in affording bearing to the beads or ribs formed externally of the said shell or crust. Obviously the upper of two adjacent ribs or beads formed on the casting will lower somewhat more through vertical contraction during the casting of the roll than the lower of the said beads or ribs, and to accommodate this unequal lowering of the ribs or beads formed on the casting the importance of the gradual increase in the slope of the bottom walls of the grooves or chamber enlargements toward the upper end of the chill is apparent. Any lowering of the chill necessary or desirable before or after the completion of the contraction of the contracting shell or crust of the casting is accommodated by that manipulation of the nuts *l* and bolts *t* which is required to lower the chill against the action of the springs *r*. Obviously by the gradual decrease in the slope of the top walls of the chamber enlargements in the chill toward the upper end of the chill the contracting shell or crust of the casting formed in the chill is, during any lowering of the chill before the said casting has been freed from the said chamber enlargements, accurately centered relative to the chill by the said walls. The valve-forming ring K is of course adjusted circumferentially of the drag-casing to permit a proper flow of sand or displaceable material F from the chamber 27 through the outlets 30 of the said chamber to accommodate a lowering of the chill.

The springs *r* are made strong enough to render them capable of supporting the whole weight of the chill when at its lowest descent, and by withdrawing the bolts *t* the weight of the chill will obviously come on the springs when the chill upon the withdrawal of the nuts *l* is permitted to descend by gravity as the casting decreases in diameter.

In ramming up the upper cope-casing, preferably with sand or material which can be easily compressed by pressure, the recesses 44, formed in the sections of the said cope-casing, permit of an easy compression of the said sand or material as the longitudinal contraction of a roll being cast may pull downward all of the casting or feeding-head extending above the roll-body, and upon the completion of the casting the said sections of the upper cope-casing can upon their detachment from each other be readily pried apart and removed to accommodate the hoisting or withdrawing of the lower cope part and the chill from the casting.

I would here remark, however, that to carry out the method hereinbefore described for obtaining a better casting as far as the upper neck of the roll (including its wabble-forming portion) is concerned and for avoiding the necessity of expensive machining of the wabble-forming portion of the said neck in the case of a roll having a large body and small necks without damage by shrinkage to the casting at the junction of the roll-body and upper neck it is not unimportant that the cope of the mold shall be formed in two parts divided horizontally around the inner end of the wabble-forming or outer end portion of the said neck.

What I claim is—

1. In a roll-casting mold, an upright chill provided interiorly with a chamber extending from end to end of the chill and with vertically-spaced grooves extending circumferentially of the chamber, with the top walls of the grooves sloping upwardly and inwardly and provided with shallow furrows which extend circumferentially of the chill and are spaced transversely of the said walls, with the bottom walls of the grooves sloping downwardly and inwardly and provided with shallow furrows which extend circumferentially of the chill and are spaced transversely of the said walls, with the slope of the bottom wall of the lower of two adjacent grooves less than the slope of the bottom wall of the upper of the said grooves, with the slope of the top wall of the upper of two adjacent grooves less than the slope of the top wall of the lower of the said grooves, and with the interior surfaces of the chill between the grooves provided with vertically-spaced furrows extending circumferentially of the chill.

2. In a roll-casting mold, an upright chill provided interiorly with a chamber which extends from end to end of the chill and is enlarged diametrically at suitable intervals between the ends of the chill, with the top walls of the diametrical enlargements of the chamber sloping upwardly and inwardly, with the bottom walls of the said chamber enlargements sloping downwardly and inwardly, with the slope of the bottom wall of the lower of two adjacent chamber enlargements less than the slope of the bottom wall of the upper of the said chamber enlargements, and with the slope of the top wall of the upper of two adjacent chamber enlargements less than the slope of the top wall of the lower of the said chamber enlargements.

3. In a roll-casting mold, an upright chill provided interiorly with a chamber extending from end to end of the chill, with the surrounding wall of the chamber provided with laterally and inwardly projecting vertically-spaced beads which extend circumferentially of the chamber and have shallow furrows extending circumferentially of the chill, with the top surfaces of the beads sloping downwardly and inwardly, with the downwardly-facing surfaces of the beads sloping upwardly and inwardly, with the slope of the lower surface of the lower of two adjacent beads greater than the slope of the lower surface of the upper of the said beads, and with

the slope of the top surface of the upper of two adjacent beads greater than the slope of the top surface of the lower of the said beads.

4. In a roll-casting mold, an upright chill provided interiorly with a chamber extending from end to end of the chill, with the surrounding wall of the chamber provided with laterally and inwardly projecting vertically-spaced beads which extend circumferentially of the chamber, with the top surfaces of the beads sloping downwardly and inwardly and with all of the surfaces of the beads provided with shallow furrows extending circumferentially of the chill.

5. In a roll-casting mold, the combination, with an upright chill provided interiorly with a chamber which extends from the upper end to the lower end of the chill and is enlarged diametrically at suitable intervals between the ends of the chill, which chill is reversible end for end and provided in both upper and lower ends with vertically-arranged screw-threaded holes spaced circumferentially of the chill and with orifices or holes leading laterally and outwardly from the inner ends of the first-mentioned holes to the exterior of the chill, of correspondingly-threaded studs having their inner ends engaging the threaded holes in one end of the chill, correspondingly-threaded suitably-supported nuts mounted on the outer ends of the studs, and means whereby turning of the studs during the manipulation of the nuts is prevented.

6. In a roll-casting mold, the combination, with an upright chill provided interiorly with a chamber which extends from the upper end to the lower end of the chill and is enlarged diametrically at suitable intervals between the ends of the chill, which chill is provided at both upper and lower ends with vertically-arranged screw-threaded holes spaced circumferentially of the chill, of correspondingly-threaded studs having their inner ends engaging the threaded holes in one end of the chill, correspondingly-threaded suitably-supported nuts mounted on the outer ends of the studs, and means whereby turning of the studs during the manipulation of the nuts is prevented.

7. In a roll-casting mold, a vertically-shiftable upright chill provided interiorly with a chamber extending from end to end of the chill; a lower mold part or drag provided centrally of the lower end of the aforesaid chill-chamber with a cavity having an inlet and in communication with the chill-chamber; an upper mold part or cope supported independently of the chill and provided with a chamber arranged centrally of the upper end of and in communication with the chill-chamber; vertically-arranged studs screwed into the upper ends of the chill at suitable intervals circumferentially of the chill; correspondingly-threaded nuts supported from the cope and mounted on the studs, and means whereby turning of the studs during the manipulation of the nuts is prevented.

8. In a roll-casting mold, a vertically-shiftable upright chill provided interiorly with a chamber extending from end to end of the chill; a lower mold part or drag provided with a cavity having an inlet and in communication with the chill-chamber; an upper mold part or cope supported independently of the chill and provided with a chamber which is in communication with the chill-chamber, and means for shifting the chill vertically, said chill-shifting means being arranged at the upper end of the chill and supported from the cope.

9. In a roll-casting mold, an upright chill supported as required to render it capable of being lowered, said chill being smaller diametrically at both ends, with the upper and lower portions of the diametrically larger portion of the chill provided each externally with lugs which are spaced circumferentially of the chill; an annular supporting member arranged below the lower end of the diametrically larger portion of the chill and normally compressible springs interposed and confined between the aforesaid annular member and the lower lugs instrumental in supporting the chill upon lowering the chill.

10. In a roll-casting mold, an upright chill supported as required to render it capable of being lowered, with the upper and lower portions of the chill provided each externally with lugs which are spaced circumferentially of the chill; an annular supporting member arranged a suitable distance below the lower lugs and normally compressible springs interposed and confined between the said annular member and the lower lugs instrumental in supporting the chill upon lowering the chill.

11. In a roll-casting mold, an upright chill having a diametrically-reduced lower end and supported as required to render it capable of being lowered, with the diametrically larger portion of the chill provided externally with lugs which are spaced circumferentially of the chill and provided with holes extending vertically therethrough, and an annular supporting member arranged below the lower end of the diametrically larger portion of the chill and surrounding the diametrically smaller portion of the chill, and normally compressible springs interposed between the said annular member and the lugs.

12. In a roll-casting mold, an upright chill supported as required to render it capable of being lowered and provided a suitable distance above its lower extremity with lugs which are spaced circumferentially of the chill and provided with holes extending vertically therethrough; an annular support-

ing member arranged a suitable distance below the lugs; pins extending loosely through the lugs and loosely through the aforesaid annular member and having members resting upon the lugs, and normally compressible spiral springs coiled around the pins between the said annular member and the lugs.

13. In a roll-casting mold, a vertically-shiftable chill provided a suitable distance above its lower extremity with lugs spaced circumferentially of the chill; means instrumental in supporting the chill and holding the chill above the lower extremity of its range of movement, and suitably-supported springs arranged under and affording a bottom bearing to the aforesaid lugs should the chill become unsupported by the first-mentioned chill-supporting means.

14. In a roll-casting mold, a vertically-shiftable chill; means instrumental in supporting the chill and holding the chill above the lower extremity of its range of movement, and suitably-applied springs instrumental in supporting the chill should the chill become unsupported by the first-mentioned chill-supporting means.

15. In a roll-casting mold, the combination, with an upright chill reduced diametrically at its upper and lower ends, of a suitably-supported lower annular supporting member surrounding the lower portion of the lower diametrically smaller portion of the chill, an upper annular member surrounding the upper diametrically smaller portion of the chill and arranged vertically above the aforesaid supporting member; set-screws screwed laterally into and through the said supporting member and arranged to engage and spaced circumferentially of the lower diametrically smaller portion of the chill; set-screws screwed laterally into and through the upper annular member and arranged to engage and spaced circumferentially of the upper diametrically smaller portion of the chill, and means whereby the upper annular member is supported from the lower annular supporting member.

16. In a roll-casting mold, the combination, with an upright chill, of a suitably-supported lower annular supporting member surrounding the lower portion of the chill, an upper annular member surrounding the upper portion of the chill; set-screws screwed laterally into and through the said lower supporting member and arranged to engage and spaced circumferentially of the chill; set-screws screwed laterally into and through the upper annular member and arranged to engage and spaced circumferentially of the chill, and means whereby the upper annular member is supported from the lower annular member.

17. In a roll-casting mold, the combination, with a suitably-supported upright chill correspondingly reduced diametrically at both ends, of a suitably-supported annular member embracing the lower portion of the diametrically-reduced lower end of the chill and larger in external diameter than the diametrically larger portion of the chill; an upper annular member embracing the upper portion of the upper diametrically-reduced end of the chill and arranged vertically above the aforesaid lower annular member and diametrically larger externally than the diametrically larger portion of the chill, and bolts extending vertically through the aforesaid annular members externally of the diametrically larger portion of the chill, which bolts are spaced circumferentially of the chill and attached to the aforesaid annular members; tubes embracing the bolts and resting upon the lower annular member, which tubes are arranged to support the upper annular member; means for centering the chill relative to the said annular members, and means for adjusting the chill vertically.

18. In a roll-casting mold, the combination, with a suitably-supported upright chill, of a suitably-supported annular member extending circumferentially of the lower portion of the chill and larger in external diameter than the chill; an upper annular member extending circumferentially of the upper portion of the chill and arranged vertically above and supported from the aforesaid lower annular member externally of the chill-chamber and diametrically larger externally than the chill, and means for centering the chill relative to the aforesaid annular members.

19. In a roll-casting mold, the combination, with a vertically-arranged chill reduced diametrically at its upper and lower ends, with the diametrically larger portion of the chill provided with two sets of laterally and outwardly projecting lugs spaced vertically, with the lugs of each set spaced circumferentially of the chill, with the lugs of each set arranged out of line vertically with the lugs of the other set, and with the lugs provided with correspondingly screw-threaded holes extending vertically through the lugs, of a suitably-supported lower annular member surrounding the lower portion of the lower diametrically smaller end of the chill and larger in external diameter than the diametrically larger portion of the chill; an upper annular member surrounding the upper diametrically smaller end of the chill and arranged vertically above the aforesaid lower annular member and larger in external diameter than the diametrically larger portion of the chill; vertically-arranged bolts extending through the upper annular member and screwed into and through the lugs of the lower set of lugs and downwardly against the lower annular member, and supporting means resting upon the lower annular member and bearing the upper annular member.

20. In a roll-casting mold, the combina-

tion, with a vertically-arranged chill provided with two sets of laterally and outwardly projecting lugs, with the sets of lugs spaced vertically, with the lugs of each set of lugs spaced circumferentially of the chill, with the lugs of each set arranged out of line vertically with the lugs of the other set, and with the lugs provided with correspondingly screw-threaded holes extending vertically through the lugs, of a suitably-supported lower annular member extending circumferentially of the chill below the lower set of lugs and larger in external diameter than the chill; an upper annular member extending circumferentially of the chill above the upper set of lugs and larger in external diameter than the chill; vertically-arranged bolts extending through the upper annular member and screwed into and through the lower set of lugs and downwardly against the lower annular member, and supporting means resting upon the lower annular member and bearing the upper annular member.

21. In a roll-casting mold, the combination, with a vertically-arranged chill provided with laterally and outwardly projecting lugs spaced circumferentially of the chill, with the lugs provided with correspondingly screw-threaded holes extending vertically through the lugs, of a suitably-supported lower annular member extending circumferentially of the chill below the lugs and larger in external diameter than the chill; an upper annular member extending circumferentially of the chill above the lugs and arranged vertically above the aforesaid lower annular member and larger in external diameter than the chill; vertically-arranged bolts extending through the upper annular member and screwed into and through the lugs and downwardly against the lower annular member, and supporting means resting upon the lower annular member and bearing the upper annular member.

22. In a roll-casting mold, the combination, with a vertically-arranged chill provided with laterally and outwardly projecting lugs spaced circumferentially of the chill, with the lugs provided with correspondingly screw-threaded holes extending vertically through the lugs, of a suitably-supported lower annular member extending circumferentially of the chill below the lugs and larger in external diameter than the chill; an upper annular member extending circumferentially of the chill above the lugs and arranged vertically above the lower annular member and larger in external diameter than the chill; vertically-arranged bolts extending through the upper annular member and screwed into and through the lugs and downwardly against the lower annular member; bolts extending vertically through and attached to both annular members, and tubes embracing the last-mentioned bolts and snugly interposed between the two annular members.

23. In a roll-casting mold, an upright chill provided interiorly with a chamber which extends from end to end of the chill, with the surrounding wall of the chamber provided within it with a fluid-receiving chamber which has circumferentially-extending opposite side walls which are integral with each other and is arranged externally and extends circumferentially of the first-mentioned chamber, said fluid-receiving chamber being provided with fluid connections, and the chill being provided at a suitable point between the upper and lower ends of the fluid-receiving chamber with a reinforcing portion which connects and is integral with the aforesaid walls, and the chill having also a gage-receiving hole connecting with the first-mentioned chamber and extending from the latter through the aforesaid reinforcing portion to the exterior of the chill, and a plug closing the said hole and removably attached to the chill.

24. In a roll-casting mold, an upright chill provided interiorly with a chamber which extends from end to end of the chill and is enlarged diametrically at suitable intervals between the said ends, with the diametrical enlargements of the chamber extending circumferentially of the chill, with the surrounding wall of the chamber provided within it with a fluid-receiving chamber which is arranged externally and extends circumferentially of the first-mentioned chamber, said fluid-receiving chamber being provided with fluid connections, and the chill being provided at a suitable point between the ends of the fluid-receiving chamber with reinforcing portions which connect opposite walls of the said fluid-receiving chamber and are spaced circumferentially of a chamber enlargement of the chill, and the chill being also provided with gage-receiving holes connecting with the said chamber enlargement and extending from the latter through the aforesaid reinforcing portions to the exterior of the chill, and plugs closing the said holes and removably attached to the chill.

25. In a roll-casting mold, an upright chill provided interiorly with a chamber which extends from end to end of the chill, with the surrounding wall of the chamber provided within it with a fluid-receiving chamber which is arranged externally and extends circumferentially of the first-mentioned chamber, said fluid-receiving chamber being provided with fluid connections, and the chill being provided at a suitable point between the ends of the fluid-receiving chamber with reinforcing portions which connect together opposite walls of the said fluid-receiving chamber and are spaced circumferentially of the chill, and the chill being also provided with gage-re-

ceiving holes leading from the first-mentioned chamber to the exterior of the chill, and removable plugs occupying the said holes.

26. In a roll-casting mold, a lower mold part or drag; an upright vertically-shiftable chill provided interiorly with a chamber extending from the upper end to the lower end of the chill, with the drag provided with a cavity which has an inlet for molten metal and is arranged centrally of the lower end of and in communication with but diametrically smaller than the aforesaid chamber, with the surrounding wall or walls of the said cavity formed by a body of loam or molding-sand, with a chamber formed within the upper end and outer portion of the drag and surrounding and arranged externally of the cavity, with the bottom of the last-mentioned chamber sloping downwardly and outwardly, with the chill arranged with its lower end projecting into the last-mentioned chamber, with the last-mentioned chamber filled with readily-displaceable material and provided with outlets which are arranged adjacent to the lower end of the said bottom and spaced circumferentially of the chamber, and means for controlling the discharge through the said outlets.

27. In a roll-casting mold, a lower mold part or drag; an upright chill supported as required to render it capable of being lowered and provided interiorly with a chamber extending from the upper end to the lower end of the chill, with the drag provided with a cavity which has an inlet for molten metal and is arranged centrally of the lower end of and in communication with but diametrically smaller than the aforesaid chamber, with the surrounding wall or walls of the said cavity formed by a body of loam or molding-sand, with a chamber formed within the drag and arranged externally and around the cavity and with the last-mentioned chamber in position to accommodate a descent of the chill.

28. In a roll-casting mold, a lower mold part or drag, a suitably-supported vertically-shiftable upright chill provided interiorly with a chamber extending from the upper end to the lower end of the chill, with the drag provided with a cavity which has an inlet for molten metal and is arranged centrally of the lower end of and in communication with but diametrically smaller than the aforesaid chamber, with the surrounding wall or walls of the said cavity formed by a body of loam or molding-sand surrounded by a metal casing which is provided at its upper end with an annular chamber surrounding but arranged externally of the upper end of the aforesaid cavity and engaged by and adapted to accommodate the descent of the chill.

29. In a roll-casting mold, a suitably-supported vertically-shiftable upright chill provided interiorly with a chamber extending from end to end of the chill, and a lower mold part or drag provided with a cavity which has an inlet for molten metal and is arranged centrally of the lower end of and in communication with but diametrically smaller than the aforesaid chill-chamber, with the surrounding wall or walls of the said cavity formed by a body of loam or molding-sand surrounded by a casing which is provided at its upper end with an annular chamber arranged to receive and accommodate the descent of the chill, with the last-mentioned chamber surrounding but arranged externally of the aforesaid cavity, and the joint between the chill and the drag-casing being suitably packed to prevent the escape of molten metal from the chill-chamber into the aforesaid chamber of the said casing.

30. In a roll-casting mold, a suitably-supported vertically-shiftable upright chill provided interiorly with a chamber extending from end to end of the chill, and a lower mold part or drag provided with a cavity which has an inlet for molten metal and is arranged centrally of the lower end of and in communication with but diametrically smaller than the aforesaid chill-chamber, with the surrounding wall or walls of the said cavity formed by a body of loam or molding-sand surrounded by a casing which is provided at its upper end with an annular chamber surrounding but arranged externally of the aforesaid cavity and having a downwardly and outwardly sloping bottom and outlets which are arranged at the lower end of the said bottom and spaced circumferentially of the drag; packing-forming displaceable material between the said bottom and the chill and adapted to prevent the escape of molten metal from the lower end of the chill, and means for controlling the feed of material through the said outlets.

31. In a roll-casting mold, a lower mold part or drag provided with a cavity which has an inlet for molten metal, with the surrounding wall or walls of the cavity formed by a body of loam or molding-sand surrounded by a metal casing which is provided at its upper end with an annular chamber surrounding but arranged externally of the aforesaid cavity and adapted to accommodate the descent into it of a chill employed in casting the body of a roll, which chamber is provided with suitably-arranged outlets.

32. In a roll-casting mold, a lower mold part or drag provided with a cavity which has an inlet for molten metal, with the surrounding wall or walls of the cavity formed by a body of loam or molding-sand surrounded by a casing which is provided at the upper end with an annular chamber surrounding

but arranged externally of the aforesaid cavity and adapted to accommodate the descent into it of a chill employed in casting the body of the roll, with the surrounding wall of the chamber provided with downwardly and outwardly sloping discharge-openings, and means for controlling any discharge through the said openings.

33. In a roll-casting mold, a lower mold part or drag provided with a cavity which has an inlet for molten metal, with the surrounding wall or walls of the cavity formed by a body of loam or molding-sand surrounded by a casing which is provided at the upper end with a chamber adapted to accommodate the descent into it of a roll-body-casting chill, with the bottom and inner side wall of the said chamber provided with laterally and inwardly projecting tapering projections embedded in and instrumental in supporting the aforesaid body of loam or molding-sand.

34. In a roll-casting mold, a lower mold part or drag provided with a cavity which has an inlet for molten metal, with the surrounding wall or walls of the said cavity formed by a body of loam or molding-sand surrounded by a casing which is provided at the upper end with a chamber adapted to accommodate the descent into it of a roll-body-casting chill and having a vertically-arranged inner side wall, a downwardly and outwardly sloping bottom, and outlets spaced circumferentially of the casing.

35. In a roll-casting mold, an upper mold part or cope provided with a chamber which extends upwardly from the lower end of the cope, with the surrounding wall or walls of the said chamber formed by a body of loam or molding-sand surrounded by a suitably-supported metal casing which is provided with an annular chamber surrounding and arranged externally of aforesaid body of loam or molding-sand, with the casing-chamber arranged to receive and accommodate an upward movement of a chill employed in casting the body of the roll, with the inner side wall of the casing-chamber provided with tapering projections embedded in and instrumental in supporting the aforesaid body of loam or molding-sand.

36. In a roll-casting mold, an upper mold part or cope provided with a chamber which extends upwardly from the lower end of the cope, with the surrounding wall or walls of the said chamber formed by a body of loam or molding-sand surrounded by a suitably-supported metal casing which is provided with an annular chamber surrounding the aforesaid body of loam or molding-sand, with the casing-chamber extending upwardly from the lower end of the casing a suitable distance, and with the outer and surrounding wall of the casing-chamber provided with lateral holes spaced circumferentially of the casing; an upright chill supported as required to render it capable of being shifted vertically and provided interiorly with a chamber which is in communication with and diametrically larger than the first-mentioned chamber, which chill has its upper end projecting into the aforesaid casing-chamber, and packing-forming material packed upon the upper end of the chill and adapted to prevent the passage of molten metal from within the chill into the casing-chamber.

37. In a roll-casting mold, an upper mold part or cope provided with a chamber which extends upwardly from the lower end of the cope, with the surrounding wall or walls of the said chamber formed by a body of loam or molding-sand surrounded by a suitably-supported casing which is provided with an annular chamber surrounding the aforesaid body of loam or molding-sand and extending upwardly from the lower end of the casing a suitable distance, and an upright chill supported as required to render it capable of being shifted vertically and provided interiorly with a chamber which is in communication with and diametrically larger than the first-mentioned chamber, which chill has its upper end projecting into the aforesaid casing-chamber.

38. In a roll-casting mold, an upper mold part or cope provided with a chamber which extends upwardly from the lower end of the cope, with the surrounding wall or walls of the said chamber formed by a body of loam or molding-sand surrounded by a suitably-supported casing which is provided with an annular chamber surrounding the aforesaid body of loam or molding-sand and extending upwardly from the lower end of the casing; a vertically-adjustable chill provided interiorly with a chamber which is in communication with and diametrically larger than the first-mentioned chamber, which chill has its upper end projecting into the aforesaid casing-chamber, and means supported from the aforesaid casing and instrumental in shifting the chill vertically.

39. In a roll-casting mold, an upper mold part or cope provided with a chamber which extends upwardly from the lower end of the cope, with the surrounding wall or walls of the said chamber formed by a body of loam or molding-sand surrounded by a suitably-supported casing which is provided with an annular chamber surrounding the aforesaid body of loam or molding-sand and extending upwardly from the lower end of the casing, with the outer and surrounding wall of the casing-chamber provided with lateral holes spaced circumferentially of the casing; a vertically-adjustable upright chill provided interiorly with a chamber which is in communication with and diametrically larger than the first-mentioned chamber, which chill is arranged to move upwardly into the casing-chamber; sand packed upon the up-

per end of the chill within the lower portion of the casing-chamber, and means for shifting the chill vertically.

40. In a roll-casting mold, a suitably-supported vertically-shiftable upright chill provided interiorly with a chamber extending from end to end of the chill, and an upper mold part or cope provided with a chamber which extends upwardly from and is in communication with but diametrically smaller than the aforesaid chill-chamber, with the surrounding wall or walls of the cope-chamber formed by a body of loam or molding-sand surrounded by a casing which has an annular portion snugly but slidably embraced by the upper end of the chill to accommodate upward movement of the chill.

41. In a roll-casting mold, an upper mold part or cope provided with a chamber which extends upwardly from the lower end of the cope, with the surrounding wall or walls of the said chamber formed by a body of loam or molding-sand surrounded by a suitably-supported casing which is provided with a chill-receiving chamber whose top wall is provided with angular holes extending vertically through the wall and spaced circumferentially of the mold; an upright chill provided interiorly with a chamber which is in communication with and diametrically larger than the first-mentioned chamber, which chill is arranged to move upwardly within the aforesaid chill-receiving chamber; studs attached to the upper end of the chill and extending upwardly through and a suitable distance above the aforesaid holes, which studs have correspondingly annular portions engaging the said holes and are screw-threaded at their upper ends; nuts mounted on the said ends of the studs, and washers interposed between the nuts and the outer surface of the last-mentioned wall, which washers are each divided into two sections horizontally, with the lower washer-section locked against rotation, and with antifriction-balls interposed between the washer-sections.

42. In a roll-casting mold, an upper mold part or cope provided with a chamber which extends upwardly from the lower end of the cope, with the surrounding wall or walls of the said chamber formed by a body of loam or molding-sand surrounded by a suitably-supported casing which is provided with a chill-receiving chamber whose top wall is provided with angular holes extending vertically through the wall and spaced circumferentially of the mold; an upright chill provided interiorly with a chamber which is in communication with and diametrically larger than the first-mentioned chamber, which chill is arranged to move upwardly within the aforesaid chill-receiving chamber; studs attached to the upper end of the chill and extending upwardly through and a suitable distance above the aforesaid holes, which studs have correspondingly-angular portions engaging the said holes and are screw-threaded at their upper ends; nuts mounted on the ends of the studs, and washers interposed between the nuts and the outer side of the last-mentioned wall.

43. In a roll-casting mold, an upper mold part or cope provided with a chamber which extends upwardly from the lower end of the cope, with the surrounding wall or walls of the said chamber formed by a body of loam or molding-sand surrounded by a suitably-supported casing which is provided with a chill-receiving chamber extending upwardly from the lower end of the casing; an upright chill provided interiorly with a chamber which is in communication with and diametrically larger than the first-mentioned chamber, which chill is arranged to move endwise within the aforesaid chill-receiving chamber; studs attached to the upper end of the chill and extending upwardly through the top wall and spaced circumferentially of the said chill-receiving chamber, and means whereby the studs and connected chill are shiftable vertically.

44. In a roll-casting mold, a suitably-supported chill provided interiorly with a chamber extending from end to end of the chill; a lower mold part or drag arranged at the lower end of the chill and provided with a cavity having an inlet and arranged centrally of the lower end of and in communication with the chill-chamber, and an upper mold part or cope arranged at the upper end of the chill and provided with a chamber which is arranged centrally of the upper end of and in communication with the chill-chamber, with the lower portion of the cope-chamber having the outline and dimensions required to form the inner end portion of a roll-neck, with the surrounding wall or walls of the said portion of the cope-chamber formed by a body of loam or molding-sand surrounded by a sutiably-supported casing, with the remainder of the cope-chamber having the outline and dimensions required to form the wabble-forming outer end portion of the said neck and to form a feeding-head above the wabble-forming portion of the said chamber, and with the surrounding wall or walls of the last-mentioned portion and the feeding-head-forming portion of the cope-chamber built up of a body of loam or molding-sand within and surrounded by a casing which is divided vertically into sections which are removably secured together and rest upon the first-mentioned cope-casing.

45. In a roll-casting mold, a suitably-supported chill provided interiorly with a chamber extending from end to end of the chill; a lower mold part or drag arranged at the lower end of the chill and provided with a cavity having an inlet and arranged centrally of the lower end of and in communica-

tion with the chill-chamber, and an upper mold part or cope arranged at the upper end of the chill and provided with a chamber which is arranged centrally of the upper end of and in communication with the chill-chamber, with the lower portion of the cope-chamber having the outline and dimensions required to form the inner end portion of a roll-neck, with the surrounding wall or walls of the said portion of the cope-chamber formed by a body of loam or molding-sand surrounded by a suitably-supported casing, with the remainder of the cope-chamber having the outline and dimensions required to form the wabble-forming outer end portion of the said neck and to form a feeding-head above the wabble-forming portion of the cope-chamber, with the surrounding wall or walls of the feeding-head-forming portion and wabble-forming portion of the cope-chamber built up of a body of loam or molding-sand within and surrounded by a suitably-supported casing which is provided interiorly with normally empty recesses spaced circumferentially of the cope and extending from the upper end of the last-mentioned casing into suitable proximity to the lower end of the said casing.

46. In a roll-casting mold, a suitably-supported chill provided interiorly with a chamber extending from end to end of the chill; a lower mold part or drag provided with a cavity which has an inlet and is arranged centrally of the lower end of and in communication with the chill-chamber, and a cope provided with a chamber which is arranged centrally of and in communication with the chill-chamber, which cope is divided horizontally into two parts, with the line of division at the inner end of the wabble-forming portion of the cope, with the lower portion of the cope-chamber formed in the lower cope part and having the outline and dimensions required to form the inner end portion of a roll-neck, with the surrounding wall or walls of the said portion of the cope-chamber formed by a body of loam or molding-sand surrounded by a suitably-supported casing, with the remainder of the cope-chamber formed in the upper cope part and having the outline and dimensions required to form the wabble-forming outer end portion of the said neck and to form a feeding-head above the wabble-forming portion of the cope-chamber, with the surrounding wall or walls of the feeding-head-forming portion and wabble-forming portion of the cope-chamber built up of a body of loam or molding-sand within and surrounded by a suitably-supported casing which removably rests upon the first-mentioned cope-casing.

47. In a roll-casting mold, an upright chill supported as required to render it capable of being shifted vertically and provided interiorly with a chamber extending from end to end of the chill; a lower mold part or drag provided with a cavity which has an inlet for molten metal and is arranged centrally of the lower end of and in communication with but diametrically smaller than the chill-chamber, with the surrounding wall or walls of the said cavity formed by a body of loam or molding-sand surrounded by a casing which is provided at its upper end with an annular chamber arranged to be engaged by the lower end and accommodate the descent of the chill; an upper mold part or cope provided centrally of the upper end of the chill with a chamber communicating with but diametrically smaller than the chill-chamber, with the surrounding wall or walls of the cope-chamber formed by a body of loam or molding-sand surrounded by a suitably-supported casing which is provided with a chamber extending from the lower end of the casing upwardly a suitable distance and arranged to be engaged by the upper end and accommodate upward movement of the chill, and means for shifting the chill vertically.

48. In a roll-casting mold, a vertically-shiftable upright chill provided with a chamber which extends from end to end of the chill and is enlarged diametrically at suitable intervals between the ends of the chill, with the top walls of the enlargements of the chill-chamber sloping upwardly and inwardly, and with the slope of the said walls decreasing toward the upper end of the chill; a lower mold part or drag arranged at the lower end of the chill and provided with a cavity having an inlet in communication with the chill-chamber; an upper mold part or cope arranged at the upper end and supported independently of the chill and provided with a chamber which is in communication with the chill-chamber, and means whereby the chill may be lowered.

49. In a roll-casting mold, a suitably-supported vertically-adjustable upright chill provided interiorly with a chamber extending from end to end of the chill; a lower mold part or drag provided with a cavity which has an inlet for molten metal and is arranged centrally of the lower end of and in communication with but diametrically smaller than the chill-chamber, with the surrounding wall or walls of the said cavity formed by a body of loam or molding-sand surrounded by a casing; an upper mold part or cope provided with a chamber arranged centrally of the upper end of and in communication with but diametrically smaller than the chill-chamber, with the surrounding wall or walls of the cope-chamber formed by a body of loam or molding-sand surrounded by a casing which is supported from the aforesaid drag-casing, and means for centering the chill relative to the aforesaid casings.

50. In a roll-casting mold, an upright chill supported as required to render it capable of

being shifted vertically and provided interiorly with a chamber extending from end to end of the chill; a lower mold part or drag provided with a cavity which has an inlet for molten metal and is arranged centrally of the lower end of and in communication with but diametrically smaller than the chill-chamber, with the surrounding wall of the said cavity formed by a body of loam or molding-sand surrounded by a casing; an upper mold part or cope provided with a chamber arranged centrally of the upper end of and in communication with but diametrically smaller than the chill-chamber, with the surrounding wall or walls of the cope-chamber formed by a body of loam or molding-sand surrounded by a casing which is supported from the aforesaid drag-casing, and means for shifting the chill vertically.

51. In a roll-casting mold, an upright chill supported as required to render it capable of being shifted vertically and provided interiorly with a chamber extending from end to end of the chill, with the chill reduced in external diameter at the ends to form two annular shoulders arranged at the upper end and lower end respectively of the diametrically larger portion of the chill and facing upwardly and downwardly respectively; a lower mold part or drag provided with a cavity which has an inlet for molten metal and is arranged centrally of the lower end of and in communication with the chill-chamber, with the surrounding wall or walls of the said cavity formed by a body of loam or molding-sand surrounded by a casing arranged in under the aforesaid lower shoulder and provided at its upper end with an annular chamber arranged to be engaged by the lower diametrically smaller end and accommodate downward movement of the chill; an upper mold part or cope provided with a chamber arranged centrally of the upper end of and in communication with the chill-chamber, with the surrounding wall or walls of the cope-chamber formed by a body of loam or molding-sand surrounded by a suitably-supported casing which is provided with a chamber extending from the lower end of the casing upwardly and arranged to be engaged by the upper diametrically smaller end and accommodate upward movement of the chill, and means for shifting the chill vertically, and the joints between the chill and the aforesaid casings being suitably packed.

52. In a roll-casting mold, an upright chill supported as required to render it capable of being shifted vertically and provided interiorly with a chamber extending from end to end of the chill; a lower mold part or drag provided with a cavity which has an inlet for molten metal and is arranged centrally of the lower end of and in communication with the chill-chamber, with the surrounding wall of the said cavity formed by a body of loam or molding-sand surrounded by a casing which is provided at its upper end and externally with a laterally and outwardly projecting annular flange larger in external diameter than the chill; an upper mold part or cope provided with a chamber arranged centrally of the upper end of and in communication with the chill-chamber, with the surrounding wall or walls of the cope-chamber formed by a body of loam or molding-sand surrounded by a casing which is provided at its lower end and externally with a laterally and outwardly projecting annular flange which is larger in external diameter than the chill and supported from the aforesaid flange on the drag-casing, and means for shifting the chill vertically, and the joints between the chill and the aforesaid casings being suitably packed.

53. In a roll-casting mold, an upright chill for casting the body of the roll, a lower mold part or drag arranged to cast one of the roll-necks, and an upper mold part or cope arranged to cast the other neck and supported independently of the chill.

54. In a roll-casting mold, a vertically-adjustable upright chill for casting the body of a roll, a lower mold part or drag comprising a casing and arranged to cast one of the roll-necks, an upper mold part or cope arranged to cast the other neck and supported from the drag-casing, and means whereby the chill may be raised or lowered while the cope is in position relative to and supported from the drag-casing.

In testimony whereof I sign the foregoing specification in the presence of two witnesses.

RALPH H. WEST.

Witnesses:
FRANK PIERCE,
C. E. AGNEW.