No. 891,309.

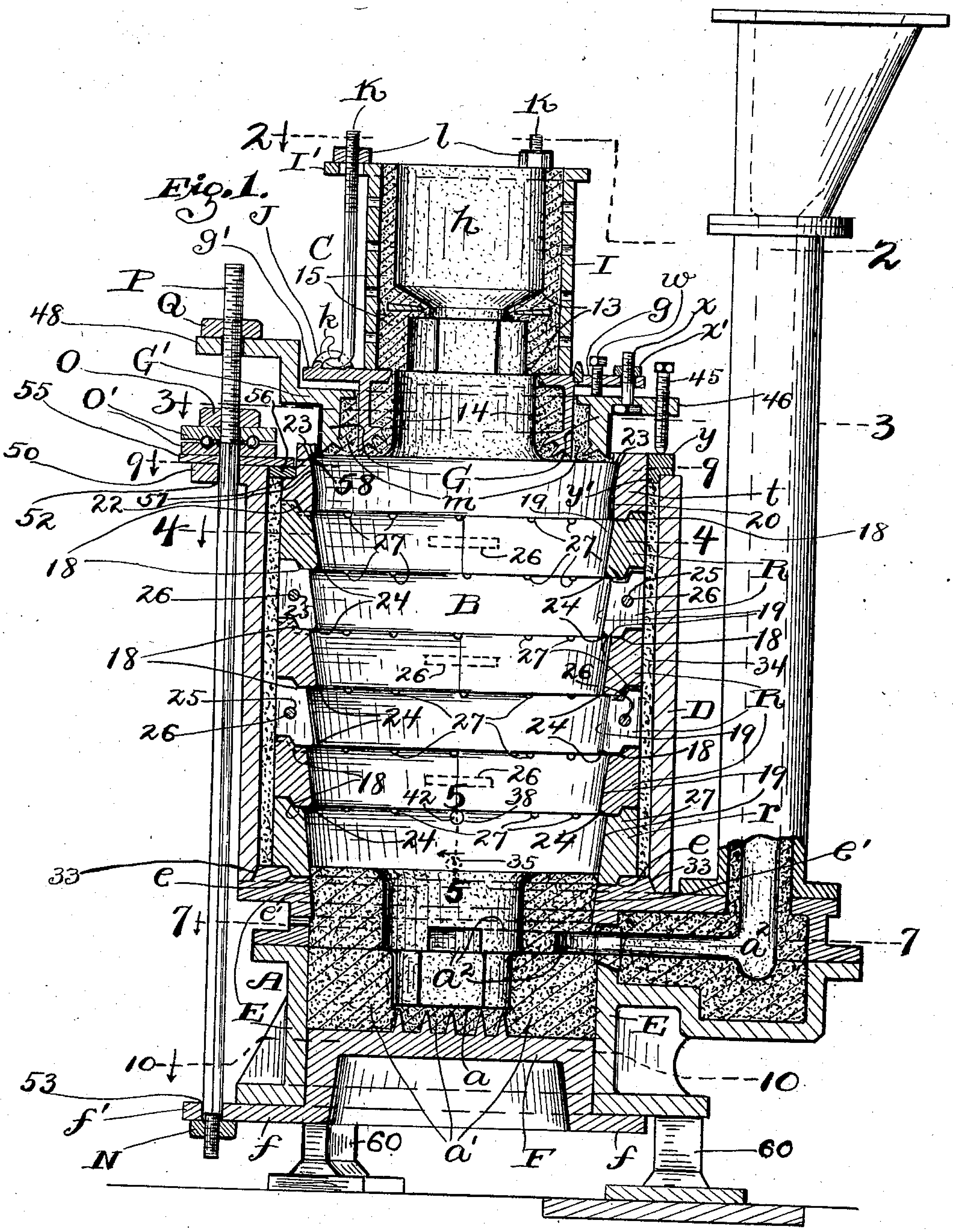
PATENTED JUNE 23, 1908.

R. H. WEST.

MOLD FOR CASTING CHILLED ROLLS.

APPLICATION FILED DEC. 1, 1906.

5 SHEETS—SHEET 1.



WITNESSES:

Daniel E. Daly.

B. C. Brown.

INVENTOR

Ralph H. West

BY

Munn & Co.

his ATTORNEYS

No. 891,309. PATENTED JUNE 23, 1908.

R. H. WEST.

MOLD FOR CASTING CHILLED ROLLS.

APPLICATION FILED DEC. 1, 1906.

5 SHEETS—SHEET 2.

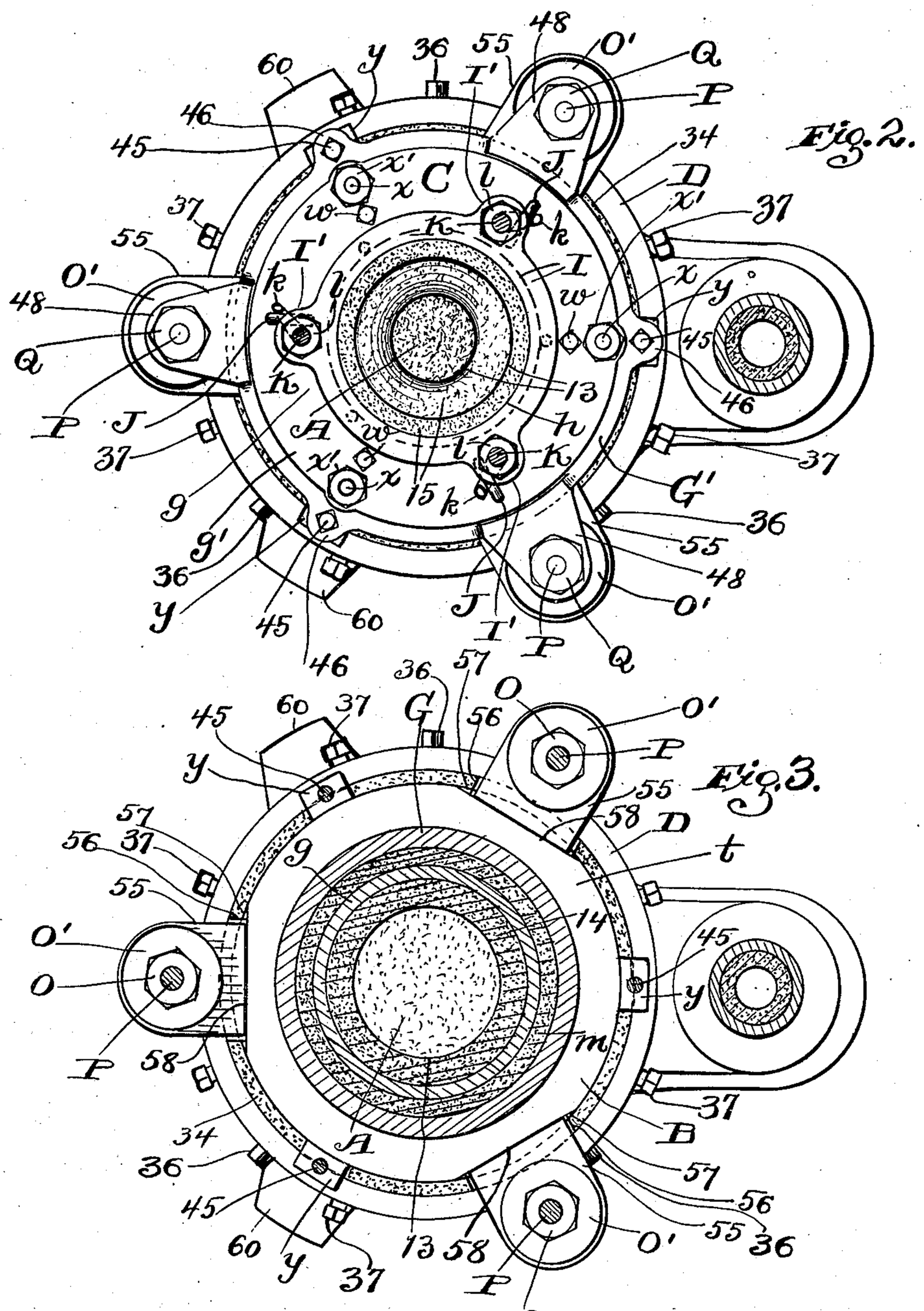


Fig. 2.

Fig. 3.

WITNESSES:
Daniel E. Daly.
B. C. Brown.

INVENTOR
Ralph H. West
BY
Munn & Co.
his ATTORNEYS

No. 891,309. PATENTED JUNE 23, 1908.

R. H. WEST.

MOLD FOR CASTING CHILLED ROLLS.

APPLICATION FILED DEC. 1, 1906.

5 SHEETS—SHEET 3.

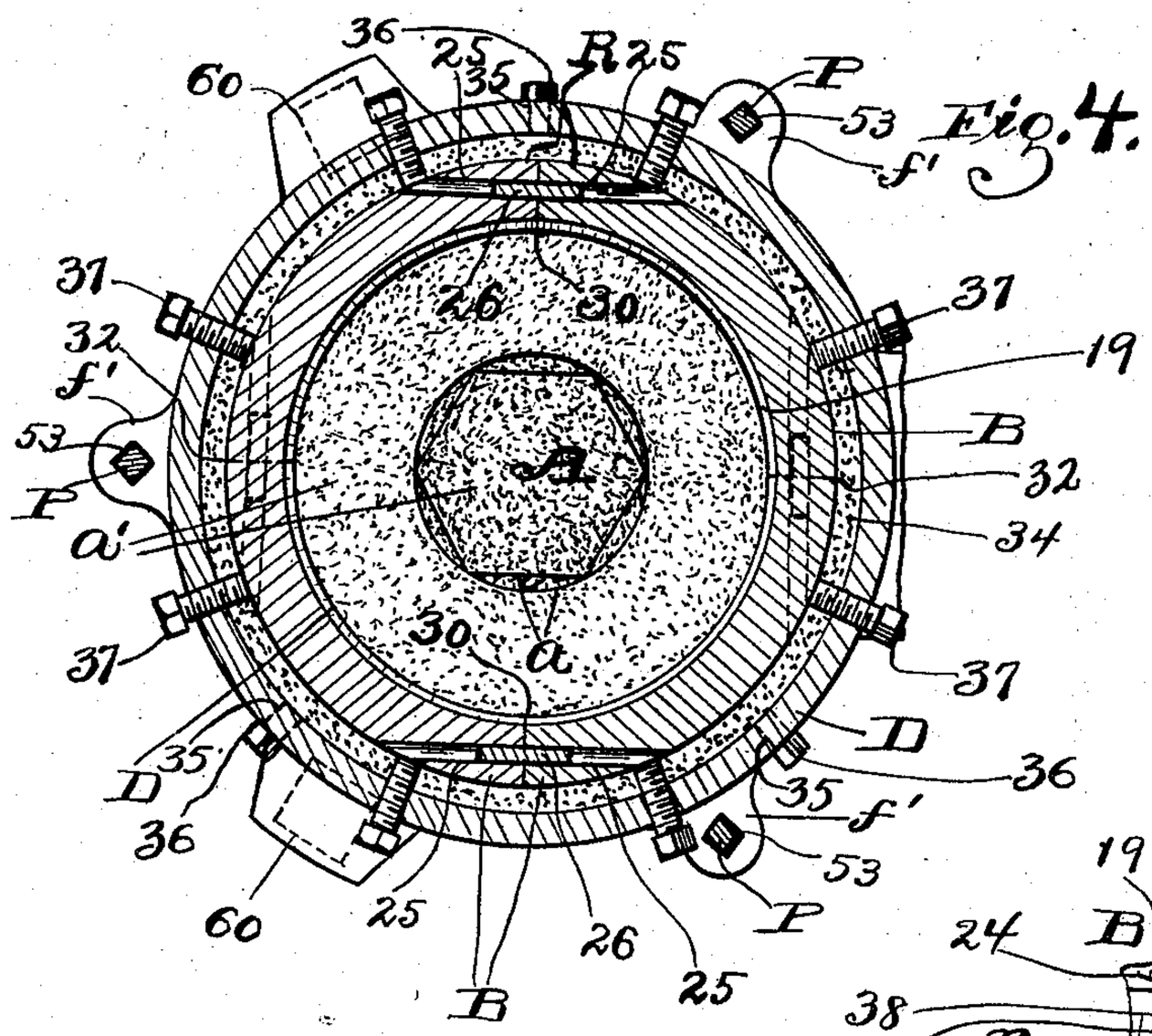


Fig. 4.

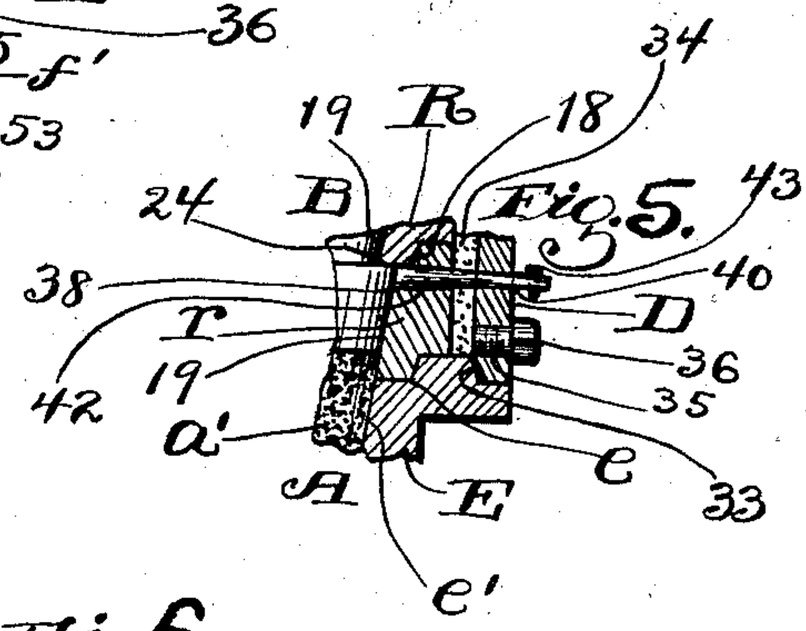


Fig. 5.

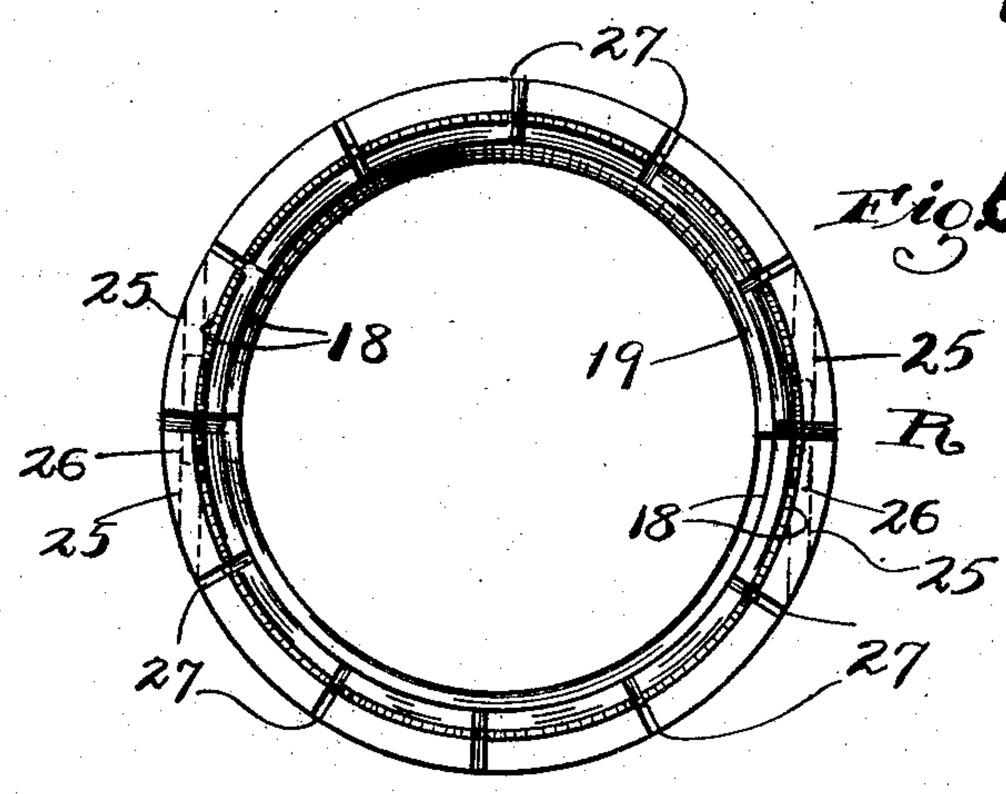


Fig. 6.

WITNESSES:
Harold E. Daly.
B. C. Brown.

INVENTOR
Ralph H. West
BY
Munn & Co
ATTORNEYS

No. 891,309. PATENTED JUNE 23, 1908.

R. H. WEST.

MOLD FOR CASTING CHILLED ROLLS.

APPLICATION FILED DEC. 1, 1906.

6 SHEETS—SHEET 4.

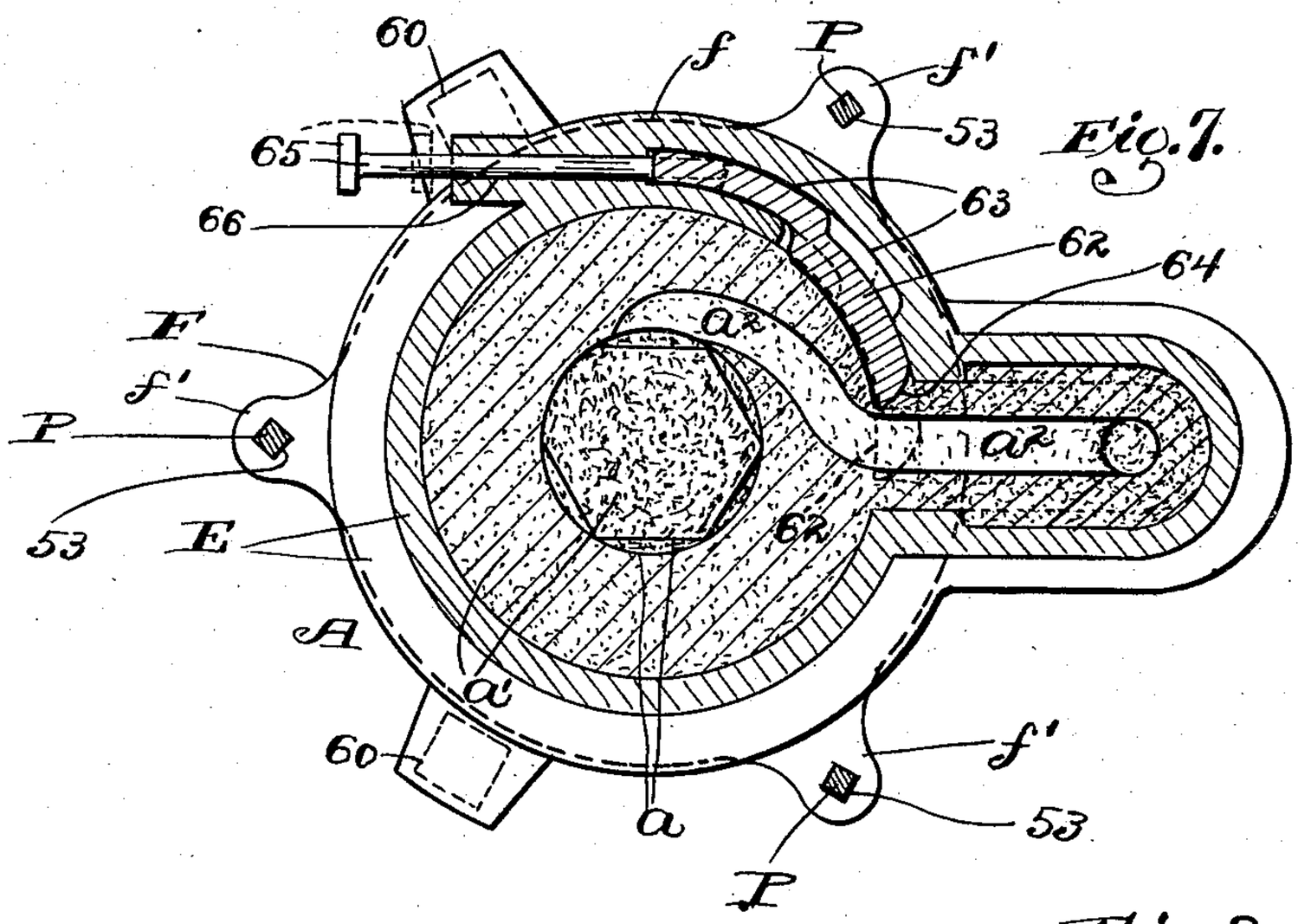
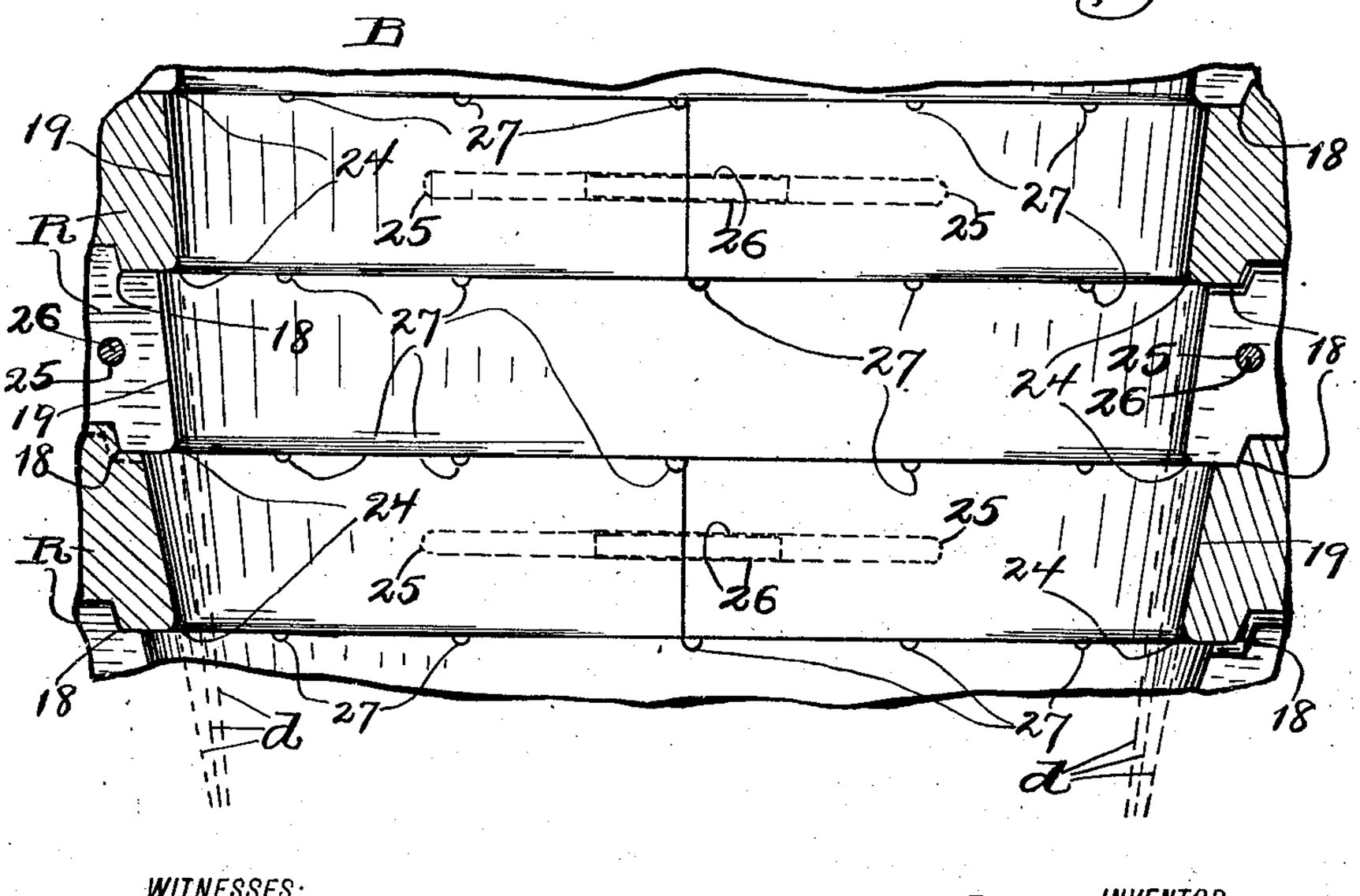


Fig. 7.

Fig. 8.



WITNESSES:
Harold E. Daly.
B. C. Brown.

INVENTOR
Ralph H. West
BY
Munn & Co
ATTORNEYS

No. 891,309. PATENTED JUNE 23, 1908.

R. H. WEST.

MOLD FOR CASTING CHILLED ROLLS.

APPLICATION FILED DEC. 1, 1906.

5 SHEETS—SHEET 5.

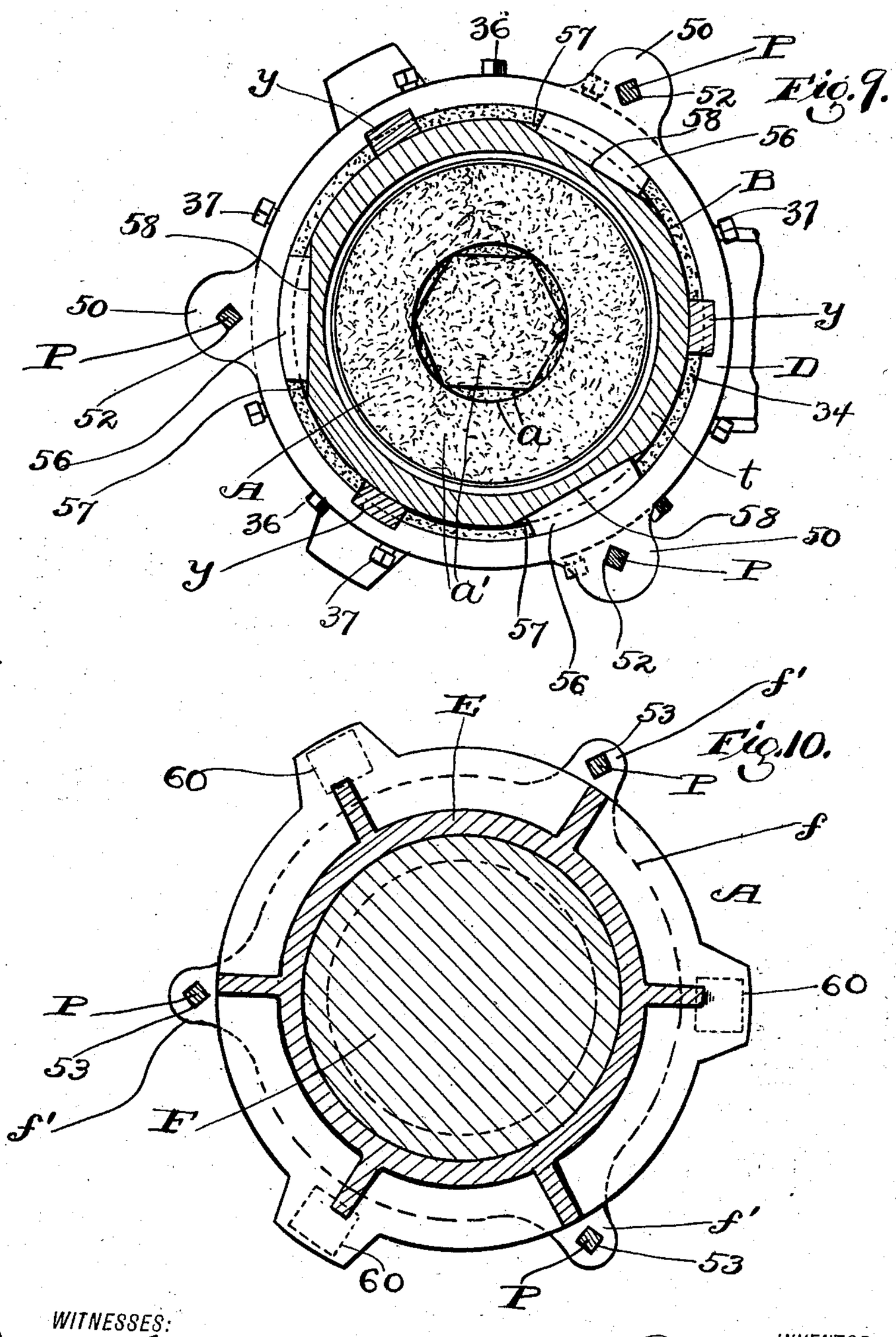


Fig. 9.

Fig. 10.

WITNESSES:

Daniel E. Daly.

B. L. Brown.

INVENTOR

Ralph H. West

BY

Munn & Co

ATTORNEYS

UNITED STATES PATENT OFFICE.

RALPH HENRY WEST, OF CLEVELAND, OHIO.

MOLD FOR CASTING CHILLED ROLLS.

No. 891,309. Specification of Letters Patent. Patented June 23, 1908.

Application filed December 1, 1906. Serial No. 345,858.

To all whom it may concern:

Be it known that I, RALPH HENRY WEST, a citizen of the United States of America, residing at Cleveland, in the county of Cuyahoga and State of Ohio, 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 my invention is to provide a roll-casting mold which is beneficial in the manufacture of chilled rolls in obtaining castings which have the requirements essential for the production of a chilled roll in which the chilled peripheral crust or shell of the roll-body is uniform in thickness circumferentially and from end to end of the roll, free from checks or cracks and other imperfections and found to be perfectly round when put in a lathe to be turned.

With this object in view, my invention consists, first, in the provision of a roll-casting mold in which the upper mold-part or cope and a head which forms a bottom or support for the body of loam or sand forming the surrounding wall or walls and bottom of the roll-neck-forming cavity of the drag are shiftable vertically to accommodate a lowering of the casting and a depression by the descent of the casting of the said body of loam or sand while the chill and the drag-casing which surrounds the said body of loam or sand remain stationary; second, to provide a chill which is composed of separable superimposed rings which have such contour or shape interiorly as to afford bearing to and support the casting during and until after the contraction of the casting in the operation of the mold and cause the crust or shell of the roll-body-forming portion of the casting to be accurately centered during the whole or greater part of the cooling or contraction of the casting; third, to so construct the cope that during the operation of the mold the metal between the peripheral crust or shell of the body of metal forming the roll-body and the neck-forming metal in the cope is depressible independently of the said shell or crust during the cooling or contraction of the casting to thereby better insure a good union between the inner end-portion of the upper neck and the body of the roll and to largely avoid the necessity of expensive machining of the wabble-forming portion of the said neck and damage by shrinkage of the casting at the junction of the said neck and the roll-body; fourth, to render the vertically movable head of the drag and the vertically movable cope shiftable simultaneously by a simple operative connection between the cope and the said head, as, for instance, by means of screw-threaded rods and nuts; fifth, to positively prevent upward displacement of the cope during the pouring of the mold; sixth, to prevent too great a strain coming upon the operative connection between the said head and the cope during vertical expansion of the chill-composing rings; seventh, to provide means for the liberation of confined air and gases at the joints of the superimposed chill-rings, eighth, to form the chill by superimposed rings that are interiorly provided with such sloping seats that the roll-body can be centered and supported by each chill-ring until after or near the finish of the cooling or contraction of the casting is completed, and ninth, to attain other advantages hereinbefore appearing.

In the accompanying drawings, Figure 1 is a side view, mainly in central vertical section, of a roll-casting mold embodying my invention. Figs. 2, 3 and 4 are transverse sections on line 2—2, line 3—3 and line 4—4, respectively, Fig. 1, looking downwardly. Fig. 5 is a vertical section on line 5—5, Fig. 1, looking in the direction indicated by the arrow. Fig. 6 is a top plan of one of the intermediate chill-composing rings. Fig. 7 is a transverse section on line 7—7, Fig. 1, looking downwardly. Fig. 8 is a sectional view of a portion of the chill. Figs. 9 and 10 are transverse sections on line 9—9 and line 10—10, respectively, Fig. 1, looking downwardly.

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 chill B (see Figs. 1, 3 and 4) is stationary, being supported as will hereinafter appear. The chill B is annular and arranged vertically.

The upper mold-part or cope C (see Figs. 1 and 2) is circular and provided centrally with a chamber 13 which extends vertically through the cope and is arranged centrally of the upper end of and in communication with the chamber of the chill. The cope C

depends into and snugly but slidably fits within the upper end of the chill-chamber. The cope C is supported as will hereinafter appear from a stationary annular chill-surrounding jacket D in such a manner as to render the cope capable of being lowered within the chill.

The drag A (see Figs. 1 and 7) is provided with a cavity *a* arranged centrally of the drag and extending downwardly from the upper end of the drag a suitable distance. The cavity *a* is arranged centrally of the lower end of and in communication with the chill-chamber. The body of the roll to be produced 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 of course enough smaller diametrically than the chill-chamber and have the general outline required to form the necks of the roll to be cast.

The surrounding wall or walls and the bottom of the drag-cavity *a* are formed by a body of suitable sand or material such, for instance as what is known in the art as loam or loam sand *a'*, which body is contained and depressible within and surrounded by a stationary metal casing E which surrounds the upper portion of a circular head F which forms a bottom for the said body of loam or sand and is adapted to be lowered within the casing E. The head F is instrumental in supporting the body of loam-sand *a'* and movable with the cope as will hereinafter more fully appear. The upper end of the body of loam-sand *a'* projects somewhat into the chill-chamber and snugly fits the lower end of the chill interiorly.

The cavity *a* is provided at one side and a suitable distance below the upper end of the cavity (see Figs. 1 and 7) with an inlet for molten metal, and the mold is poured through the said inlet which is formed by the discharging end of a gate or passage-way a^2 by which the molten metal is fed to the said cavity.

The lower or inner end-portion of the cope-chamber 13 (see Fig. 1) has the outline and dimensions required to form the inner end-portion of a roll-neck between the outer and wabble-forming end-portion of the said neck and the body of the roll, and the surrounding wall or walls of the said portion of the cope-chamber are formed by a body of loam-sand 14 built up within and surrounded by and supported in any approved manner from the inner section *g* of a metal casing which comprises the said inner section and an outer section G which surrounds the inner casing-section *g* (see Figs. 1 and 3) 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 wabble-casting portion of the cope-chamber built up of a body of loam-sand 15 within and surrounded by and supported in any approved manner from a metal casing I which is seated on but removable from the top of the inner section *g* of the lower cope-casing. It will be observed therefore that the cope comprises an upper part which consists of the casing I and body of loam-sand 15 and a lower part which consists of the casing-sections G and *g* and body of loam-sand 14.

The inner section *g* of the casing of the lower cope-part, is provided at its upper end and externally with a laterally and outwardly projecting annular flange *g'* which (see Figs. 1 and 2) is provided at its upper side with staples J spaced circumferentially of the cope and engaged by the hook-shaped heads *k* of hook-bolts whose screw-threaded shanks K extend upwardly through ears I' formed on and externally of the upper end of the upper cope-casing I, and correspondingly threaded nuts *l* are mounted on the said shanks and arranged to be tightened against the upper surfaces of the said ears and instrumental in preventing displacement of the upper core-part upwardly from or laterally of the lower mold-part. By means of the said staples, hook-bolts and nuts the upper cope-part is detachably secured to the lower cope-part, and only the withdrawal of the nuts *l* is required to accommodate the separation of the upper cope-part from the lower cope-part.

The outer section G of the casing of the lower cope-part is preferably larger in internal diameter than the external diameter of the inner section *g* of the said casing, and the space formed between the opposing surfaces of the said casing-sections (see Figs. 1 and 3) is preferably filled with sand *m* to decrease any chilling tendency of the lower extremities of the said casing-sections, which sand is supported in any approved manner from the outer casing-section G.

The outer section G of the casing of the lower cope-part is supported from the jacket D as will hereinafter appear. The inner casing-section *g* is supported at its upper end as will hereinafter appear from the outer casing-section G.

The chill B (see Fig. 1) is composed of superimposed metal rings arranged in line vertically, and the intermediate chill-composing rings R between the bottom chill-composing ring *r* and the top chill-composing ring *t* are preferably interchangeable and of corresponding construction for convenience and for economy in the manufacture of the same. The chill is supported from the drag-casing E, as already indicated, and preferably the said casing is provided at its upper end and interiorly with an annular recess *e* whose surrounding wall is beveled, which

recess is arranged concentrically relative to the drag-cavity *a* and snugly engaged by the externally diametrically reduced lower end of the bottom chill-ring *r* whose body-portion rests upon the said casing, which chill-ring is therefore accurately centered relative to the drag-cavity.

Each chill-ring, save the top chill-ring, (see Figs. 1, 6 and 8) is provided in its upper end and internally with an annular recess 18 whose surrounding wall is preferably beveled, which recess is engaged by the externally diametrically reduced lower end of the next upper chill-ring. It will be observed therefore that the lower end of the upper of adjacent chill-rings snugly engage a recess formed in and extending circumferentially of the lower of the said chill-rings, that each intermediate chill-ring is consequently locked by and between the adjacent chill-rings, and that the upper of said chill-rings is accurately centered relative to and prevented from displacement laterally of the lower of the said chill-rings.

The opening which extends vertically through each chill-ring, save the top chill-ring *t*, flares upwardly and is consequently gradually enlarged transversely toward its upper end so that the surrounding wall of the said opening forms an upwardly and outwardly sloping seat 19 extending circumferentially of the chill from the lower end of the respective ring to the recess 18 in the upper end of the ring. Obviously therefore each chill-ring (see Figs. 1 and 8) overhangs the seat 19 of the next lower chill-ring circumferentially of the chill.

The top chill-ring *t* (see Fig. 1) has the lower portion of the opening which extends vertically therethrough substantially or approximately corresponding in diameter with the diameter of the upper end of the sloping seat formed interiorly of the second uppermost chill-ring, and the lower portion 20 of the surrounding wall of the said opening is therefore arranged vertically, whereas the said wall above its lower vertically arranged portion 20 is provided with an upwardly flaring annular recess 22 whose surrounding wall forms an upwardly and outwardly sloping seat for the upper end of the roll-body-forming portion of the casting to be produced by my improved mold.

The lower portion of the solid top ring *t* of the chill, substantially corresponding in internal diameter with the diameter of the upper end of the sloping seat formed internally of the uppermost intermediate sectional chill-ring, permits the hoisting of the said top chill-ring from the casting so as to liberate the said sectional chill-ring and permit the sections of the said sectional chill-ring to be removed laterally to free the casting, and obviously the lateral removal of the sections of the upper of adjacent intermediate chill-rings renders the sections of the next lowermost intermediate chill-ring free to be removed laterally.

The top chill-ring *t* (see Fig. 1) is provided at the upper end of its recess 22 with holes 23 which extend upwardly and outwardly from the said recess to the exterior of the chill and form outlets for permitting the escape of air and gases from within the chill during the pouring and operation of the mold.

Each intermediate chill-ring R (see Fig. 8) is preferably rounded, as at 24, at the junction of its sloping seat 19 with the bottom or downwardly facing surface of the ring.

To render the construction simple and inexpensive and to accommodate an independent renewal of different portions of the chill and to readily accommodate the separation of the intermediate chill-rings from the casting formed in the chill, each intermediate chill-ring R is preferably divided vertically into two halves or sections, and preferably the adjacent ends of the sections of each chill-ring are provided with registering holes 25 which extend through the said sections and are engaged by a pin or member 26 which is instrumental in properly joining and holding the said ends together (see Fig. 8) but adapted to be driven endwise from one or both of the engaging holes to facilitate the separation of the said sections when required.

Each chill-ring below the top chill-ring *t* is provided in its upper end with grooves or recesses 27 arranged radially and spaced circumferentially of the chill. The grooves or recesses 27 in the lower of adjacent chill-rings form holes at the joint between the said rings for the escape of air and gases from interiorly of the chill during the pouring and operation of the mold.

By the construction hereinbefore described it will be observed that the chill is provided internally with vertically spaced upwardly and outwardly sloping seats 19 formed one in each chill-ring and extending circumferentially of the respective chill-ring, and that the joint between adjacent chill-rings is formed at the upper end of the sloping seat of the lower of the said chill-rings.

The slope of the sloping seats 19 of the lower of two adjacent chill-rings is less than the slope of the sloping seat 19 of the upper of the said chill-rings as only clearly indicated by the illustrative dotted lines in Fig. 8.

By the increase in the slopes of the sloping seats of the chill-rings toward the upper end of the chill the contracting casting can be accurately centered relative to and from end to end of the chill by the said seats during and until after any lowering of the casting while the casting is cooling or contracting. In casting a roll by my improved mold the peripheral crust or shell of the casting formed in the chill is during and upon its contraction

maintained in a strictly central position relative to the chill and supported circumferentially of and upon the aforesaid sloping seats of the chill-rings. The casting is supported until and after its final contraction at as many intervals vertically as there are sloping seats provided for the casting interiorly of the chill 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 will also be observed that by the extension of each sloping seat-forming surface from end to end of the chill-ring interiorly of which the said surface is formed so that the lower end of the upper of adjacent sloping surfaces is arranged substantially in line horizontally with the upper end of the lower of the said surfaces, the largest possible bearing is afforded to the casting during the cooling or contraction of the casting.

To form a structure which has the requisite rigidity and is convenient in the assemblage of the parts the top and bottom chill-rings are preferably made respectively in one solid piece whereas each intermediate chill-ring is preferably arranged with the joints between its halves or sections alternating with the joints between the sections of the adjacent chill-ring or chill-rings. It will be observed therefore that the chill of my improved roll-casting mold preferably comprises superimposed intermediate sectional-rings R arranged in line vertically and locked between a suitably supported solid bottom ring *r* and a solid top ring *t*, with the lower portion of each intermediate ring snugly embraced by the upper portion of the next lower ring, with the said intermediate rings preferably divided vertically into halves or sections, with the joints formed between the sections of each intermediate ring not only alternating with but spaced equidistantly from the joints formed between the sections of the next adjacent intermediate ring or rings so that the upper or adjacent intermediate rings is overlapped interiorly at each joint thereof by a section or sections of the lower of the said adjacent rings. For instance, in Fig. 4 the joints formed between the halves of the upper of two adjacent intermediate rings R are shown in solid lines, as at 30, whereas the joints formed between the halves of the next lower intermediate ring are shown in dotted lines, as at 32.

The chill is surrounded by a jacket-forming tubular metal shell D which is larger in internal diameter than the external diameter of the chill-rings and extends from around the lower portion of the top chill-ring *t* and around all of the intermediate chill-rings R and bottom chill-ring *r* and rests at its lower end upon the drag-casing E, snugly embracing an outwardly and upwardly facing beveled shoulder 33 formed on the said casing.

The annular space formed between the chill B and the jacket D is filled with sand or other readily displaceable or fluent material 34. The said space is filled by dropping the filling-forming material 34 into the space at the upper end of the space and is emptied of the said material (see Figs. 4 and 5) through lateral apertures 35 with which the jacket is provided at its lower end, which apertures are closed by suitably applied removable plugs 36.

It will be observed that the filling 34 and jacket D brace the superimposed chill-rings exteriorly from end to end of the chill, but to positively avoid any inadequacy in the external bracing of the sectional intermediate chill-rings B, each section of each intermediate chill-ring, as shown in Fig. 4, is engaged at its outer side by set-screws 37 which engage correspondingly threaded holes formed in and are consequently borne by the jacket D, which screws are preferably spaced equidistantly circumferentially of the chill, and said ring is preferably arranged with each joint thereof midway between two of the said set-screws.

The jacket D preferably consists of an annular cylinder composed of a single piece, as shown, and the set-screws 37 constitute adjustable members whereby the sections of the intermediate and sectional chill-rings can be adjusted with the greatest accuracy.

The outer section G of the casing of the lower cope-part (see Figs. 1 and 2) is adjustable vertically as will hereinafter appear. The said cope-casing-section G is provided at its upper end and externally with a laterally and outwardly projecting annular flange G′. The flange *g′* of the inner section of the casing of the said lower cope-part overhangs the flange G′ and in the normal and upper position of the casing-section *g* relative to the section G is arranged a suitable distance above the said flange G′. Screws *w* are screwed from above the flange *g′* downwardly through correspondingly threaded holes formed in the said flange at suitable intervals circumferentially of the cope and extend into engagement with the adjacent upper surface of the cope-casing-section G. The screws *w* constitute vertically adjustable bottom bearings for the flange *g′* of the inner cope-casing-section *g* as hereinbefore indicated.

Bolts *x* extend through the flange G′ of the cope-casing-section G and loosely through the flange *g′* of the cope-casing-section *g*. The bolts *x* are arranged with their heads countersunk in the underside of the flange G′, and correspondingly threaded nuts *x′* are mounted on the shanks of the bolts at the top of the flange *g′*. The nuts *x′* when tightened prevent displacement of the cope-casing-section *g* upwardly independently of the cope-casing section G. It is obvious that the cope-casing-section *g*, and consequently the casing

I and the bodies of loam or molding sand 14 and 15, can be lowered upon a proper manipulation of the screws *w* and nuts *x* independently of the cope-casing-section G. Obviously by lowering the cope-casing-section *g* and with it the casing I and the bodies of loam-sand 14 and 15 independently of the cope-casing-section G during the operation of the mold a downward pressure is exerted upon the upper end of the roll-body-forming metal within the chill and next around the inner end of the upper neck of the roll being cast without exerting like pressure downwardly upon the upper end of the contracting crust or shell of the roll-body-forming portion of the casting.

The chill B (see Figs. 1 and 5) is provided at the upper end of the sloping seat 19 formed internally of the bottom chill-ring *r* with a lateral hole 38 extending from the interior to the exterior of the chill, which hole tapers toward its outer end and is directly opposite and in registry with an outwardly tapering transversely smaller hole 40 formed in the jacket D and extending from the interior to the exterior of the jacket, and a correspondingly tapering plug 42 engages the said hole and is shiftable inwardly. The plug 42 extends a suitable distance outwardly beyond the exterior of the jacket D and has its inner end beveled and arranged flush in the outer and normal position of the plug with the sloping seat 19 of the bottom ring of the chill. A tapering pin 43 extends through the plug 42 exteriorly of the jacket D. In the outer and normal position of the plug 42 the pin 43 is spaced such a distance from the exterior of the jacket that the plug can only be shifted inwardly far enough to render it capable of measuring the horizontal contraction of the roll-body-forming portion of the casting. The pin 43 obviously therefore forms a stop for limiting the inward movement of the plug whose outward movement is prevented as desired by the taper of the plug and plug-engaging holes.

The upper end of the chill-jacket D (see Figs. 1, 2, 3 and 9) forms a seat for blocks *y* which are removably seated upon the said jacket and spaced circumferentially of the chill. Each block *y* is reduced transversely at its lower end, as at *y'*, and the lower transversely reduced end *y'* of the said blocks depends into and snugly fits within the space formed between the chill and the jacket. It will be observed therefore that several blocks *y* are removably supported from the jacket and spaced circumferentially of the top chill-ring *t*.

It will be observed that the engagement of the transversely reduced lower ends of the blocks *y* with the space interiorly of the jacket prevents displacement of the said blocks laterally from off the jacket.

Each block *y* is engaged on top by the shank of a screw 45 which extends vertically through and engages a correspondingly threaded hole formed in a laterally and outwardly projecting lug 46 which is formed on the flange G' of the section G of the casing of the lower cope-part. The cope-casing-section G is provided externally therefore with laterally and outwardly projecting members 46 which are spaced circumferentially of the cope and overhang the blocks *y*, and the screws 45 are screwed vertically through the said lugs into engagement with the upper surfaces of the said blocks and form vertically adjustable bottom bearings for the cope.

Upright rods P (see Figs. 1, 2, 3, 4, 7, 9 and 10) which have externally screw-threaded ends are vertically arranged externally and spaced circumferentially of the jacket D and extend loosely through laterally and outwardly projecting members 48 formed on the flange G' of the cope-casing-section G and loosely through holes 52 formed in the laterally projecting lugs 50 with which the upper end of the jacket is externally provided and loosely through holes 53 formed in lugs *f'* which are formed on a laterally and outwardly projecting flange *f* with which the head F is provided under the lower end of the drag-casing E, which flange abuts against the said end of the said casing in the upper and normal position of the said head. Preferably the rods P where they extend through the holes 52 and 53 are angular in cross-section, and the said holes are correspondingly angular so that turning of the rods is prevented.

Nuts Q are mounted on the rods P above the members 48 of the flange G' of the cope-casing-section G.

The rods P are threaded from their upper ends downwardly into suitable proximity to the jacket D, and nuts O are mounted on the rods above washers O' which are interposed between the said nuts and plates 55 which rest upon the upper end of the jacket and overlap blocks or pieces 56 of wood or somewhat compressible material borne by the chill. Preferably the compressible members 56 rest on upwardly facing shoulders 57 with which the top chill-ring *t* is externally provided and each member 56 snugly fits between a shoulder 57 and the plate 55 overlapping the said shoulder. The compressible members 56 prevent undue strain upon the rods P by any tendency of the chill to expand upwardly, and the top chill-ring *t* is provided externally with laterally and outwardly facing flat surfaces 58 and the plates 55 extend and conform at their inner ends to the said flat surfaces to prevent turning of the plates.

Nuts N are mounted on the rods P next below the lugs *f'* of the flange *f* of the head F and support the said head.

The nuts O are instrumental in supporting

the rods P and in holding the plates 55 down on the compressible members 56 and prevent upward displacement of the top chill-ring *t* during the pouring of the mold.

It will be observed that the rods P and the nuts Q and N form an operative connection between the head F of the drag and the cope, and the cope and the said head together with the body of loam or sand *a'* of the drag and the casting can be lowered simultaneously while the chill remains stationary, and the cope and head are lowered by gravity upon properly manipulating the screws 45 and nuts O after severing the metal in the gate a^2 by a suitably applied cut-off 62 shown in Fig. 7.

By the construction hereinbefore described it will be observed that the chill and the chill-surrounding jacket are supported from the drag-casing; that the chill is held downwardly upon the said drag-casing and consequently prevented from displacement upwardly from the drag-casing E by the nuts O, washers O', plates 55 and compressible members 58; that the cope is supported from the drag-casing E through the medium of the chill-surrounding jacket and blocks *y* interposed between said jacket and the screws 45; that in the upper and normal position of the cope the flange *f* of the head F abuts, as already indicated, against the lower end of the drag-casing E, and together with the nuts N, rods P and nuts Q prevent upward displacement of the cope during the pouring of the mold; that the drag-casing E is stationary, resting upon stationary posts or supporting members 60 arranged under the said casing externally of the flange *f* of the head F; that the whole weight of the chill and casting is borne by the drag-casing E, and that, of course, preparatory to any lowering of the head F continuity in the gate or passage-way a^2 is interrupted at the junction of the casing E with the body of loam or sand *a'* by properly operating the cut-off 62 which preferably comprises a curved metal bar shown only in Fig. 7 and engaging a guideway 63 which is formed in and extends circumferentially of the drag-casing E from a point in close proximity to one side wall of the gate or passage-way a^2 a suitable distance circumferentially of the drag, and the cut-off 62 is actuated endwise of the guideway 63 into or against the opposite side wall of the said gate or passage-way to separate any molten metal within the said passage-way where the latter extends through the body of loam or sand *a'* from any metal in the said passage-way where the latter is arranged externally of the said body of loam or sand. To facilitate its operation the cut-off 62 is beveled at its forward end and outer side, as at 64, and during the operation of the cut-off the sloping surface 64 tends to shove back any metal within the gate or passage-way a^2 externally of the body of loam or sand *a'*.

The means for actuating the cut-off 62 consists preferably of an endwise movable bar 65 which loosely engages a hole 66 formed in the drag-casing E and connecting with the guideway 63 at the outer end of the cut-off 62.

In solid lines Fig. 7 the cut-off 62 is shown in its normal and inoperative position, whereas in dotted lines in the same figure the cut-off is shown in its operative position interrupting continuity in the passage-way a^2.

The drag-casing E is provided at its upper end and internally with an upwardly and outwardly sloping seat *e'* which extends circumferentially of the said casing and is arranged flush with and forms a downward extension of the sloping seat 19 of the bottom chill-ring *r*. The casting in lowering the same during the contraction of the casting descends from the sloping seat 19 of the bottom chill-ring *r* onto and adown the seat *e'*.

Briefly described the operation of my improved mold is as follows:—The molten metal employed in casting a roll is introduced through the gate or passage-way a^2 to the drag-cavity *a*, filling the said cavity and then rising into and filling the chill 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-part. I would here remark that the upper cope-part can be kept off 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-part, and that when the molten metal has had all the dross and dirt skimmed therefrom and the fed metal has settled down from the lower cope-part to nearly fully feed the roll-forming chill the upper cope-part is placed and fastened in position upon the lower cope-part, and the cope-chamber (including the feeding head *h*) is then filled to the upper end of the upper mold-part 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 a good union of the metal below the wabble and the metal introduced from above is effected. By this method accommodated by my improved construction of cope a desirable 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 not inexpensive machining of the wabble-forming portion of the upper neck of a roll is avoided without damage by shrinkage to the casting at the junction of the roll-body and upper neck. The molten metal introduced into the mold is permitted to stand until it

shall have formed a suitable shell or crust in the chill whereupon the cope and the head F and with them the body of loam or sand *a'* and the casting being formed in the mold are lowered by a proper manipulation of the screws 45 and nuts O to insure the maintenance of the beads or ribs which are formed externally of the crust or shell and over the sloping seats of the chill-rings, in contact with the said seats until after the contraction has ceased, or until after the desired maximum descent of the roll-body-forming portion of the casting on the upwardly and outwardly sloping seat *e'* of the drag-casing E is obtained. Obviously the upper of two adjacent ribs or beads formed on the roll-body-forming portion of 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 said ribs or beads the importance of the gradual increase in the slopes of the sloping seats of the chill-rings toward the upper end of the chill is apparent.

If pressure is to be exerted downwardly upon the upper end of the roll-body-forming metal to form a more desirable union between the upper neck and the roll-body, or for other reasons, the inner section *g* of the casing of the lower cope-part and with it the surrounding wall or walls of the cope-chamber 13 and the casing I of the upper mold-part are lowered independently of the outer section G of the casing of the lower mold-part by a proper manipulation of the screws *w* and nuts *x*.

It is quite apparent that the construction hereinbefore described accommodates the employment of several methods suitable for use in separating the casting from the mold after the removal of the cope. The cope is of course readily removed upon withdrawing the nuts Q. One simple method of liberating the casting from the chill after the removal of the cope comprises a raising of the casting far enough to loosen the beads or ribs formed externally of the roll-body-forming portion of the casting relative to the sloping seats 19 upon turning the nuts O in the direction required to shift the rods P and connected head F upwardly, whereupon the said head F can be supported in its elevated position by blocks placed under it preparatory to the removal of the nuts O to accommodate the hoisting of the jacket D from the drag-casing E. Of course the filling-forming sand or material 34 is drained from the space between the jacket and the chill through the apertures 35 upon removing the plugs 36 preparatory to the removal of the jacket. The washers O', plates 55 and blocks *y* are of course hoisted from the chill with the jacket or removed preparatory to the hoisting of the jacket. Upon the removal of the jacket the compressible members 56 and the top chill-ring *t* are removed whereupon the remaining chill-rings can be successively removed. The space formed between the roll-body-forming portion of the casting and the seats 19 of the sectional rings R by the raising of the casting and the beveled surrounding walls of the recesses 18 in the said rings accommodate and facilitate the raising and lateral separation of the sections of the said rings R which are lifted, divided and removed one at a time after the removal of the top ring *t*. Obviously the casting is rendered free to be hoisted or removed from the bottom chill-ring and drag upon the removal of the intermediate chill-rings R. Should the chill-rings be made so shallow in depth or the sloping seats so nearly straight as to cause the chill-rings or chill to be self-clearing after the final cooling or contraction of the casting then the hereinbefore described manipulation to liberate the casting would not be necessary as the chill-rings or chill could be hoisted independently of any first raising of the casting.

What I claim is:—

1. In a mold for casting chilled rolls, a vertically arranged annular chill composed of superimposed rings arranged in line vertically, with the lower end of the upper of adjacent rings snugly engaging a recess formed in and extending circumferentially of the lower of the said rings, and the opening which extends vertically through each ring below the uppermost or top ring flaring upwardly and having its surrounding wall forming an upwardly and outwardly sloping seat extending circumferentially of the chill and from the lower end of the respective ring to the recess in the upper end of the ring.

2. In a roll-casting mold, a vertically arranged annular chill composed of superimposed rings arranged in line vertically, and the opening which extends vertically through each ring below the uppermost or top ring flaring upwardly so that the surrounding wall of the said opening forms an upwardly and outwardly sloping seat extending circumferentially of the chill and from the lower end of the respective ring to the lower end of the next upper ring.

3. In a roll-casting mold, a vertically arranged annular chill comprising intermediate superimposed rings arranged in line vertically with and interposed between a top ring and a suitably supported bottom ring and provided interiorly with upwardly and outwardly sloping seats extending circumferentially of the chill, and the upper of adjacent intermediate rings overlapping the sloping seat formed internally of the lower of the said rings, and the slopes of the seats in the intermediate rings increasing toward the upper end of the chill.

4. In a roll-casting mold, a vertically arranged annular chill comprising superimposed rings arranged in line vertically and

provided each interiorly with an upwardly and outwardly sloping seat extending circumferentially of the chill, and the upper of adjacent rings below the uppermost or top ring overhanging the seat formed internally of the lower of the said adjacent rings.

5. In a roll-casting mold, a vertically arranged annular chill comprising superimposed intermediate rings arranged in line vertically between a suitably supported bottom ring and a top ring, with the lower portion of each intermediate ring snugly embraced by the upper portion of the next lower ring, said intermediate rings being divided vertically into sections, with the joints formed between the sections of each intermediate ring alternating with the joints formed between the sections of the next adjacent intermediate ring or rings so that the upper of adjacent intermediate rings is overlapped exteriorly at each joint thereof by a section of the lower of the said adjacent rings.

6. In a roll-casting mold, a vertically arranged annular chill comprising superimposed rings arranged and held in line vertically with and interposed between a top ring and a suitably supported bottom ring, said rings being each provided internally with an upwardly and outwardly sloping seat extending circumferentially of the chill and having outlets for air and gas at the top of the said seat, which outlets are spaced circumferentially of the chill.

7. In a roll-casting mold, a vertically arranged annular chill comprising superimposed rings arranged in line vertically, and the opening which extends vertically through each ring below the uppermost or top ring flaring upwardly so that the surrounding wall of the said opening forms an upwardly and outwardly sloping seat extending circumferentially of the chill and from the lower end of the respective ring to the lower end of the next upper ring, and the chill being provided at the joint between adjacent rings with outlets for air and gases, which outlets are spaced circumferentially of the chill.

8. In a roll-casting mold, a vertically arranged annular chill comprising superimposed rings arranged in line vertically, said rings being provided internally with upwardly and outwardly sloping seats extending circumferentially of the chill, and one of the opposing joint-forming surfaces of adjacent rings being grooved or recessed transversely from the interior to the exterior of the chill at suitable intervals circumferentially of the chill.

9. In a roll-casting mold, the combination, with an upright annular chill provided with a lateral hole which extends from the interior to the exterior of the chill and tapers toward its outer end, of a correspondingly tapering plug engaging the said hole and shiftable inwardly, and means for limiting the inward shifting of the plug.

10. In a roll-casting mold, the combination, with an annular vertically arranged chill comprising superimposed rings and one of the rings being provided with a lateral hole extending from the interior to the exterior of the chill, a jacket surrounding the chill-rings and provided opposite and in registry with the aforesaid hole with a lateral hole extending from the interior to the exterior of the jacket, and a plug or member occupying and movable endwise of the said hole and into the interior chamber of the chill.

11. In a roll-casting mold, a vertically arranged annular chill comprising superimposed intermediate rings arranged in line vertically between a suitably supported bottom ring and a top ring, with the adjacent portions of adjacent intermediate rings overlapping each other circumferentially, said intermediate rings being divided vertically into sections whose joint-forming ends have registering holes which extend through the said sections, and pins or members engaging the said holes.

12. In a roll-casting mold, a vertically arranged chill comprising superimposed rings divided into sections vertically, with the upper of adjacent rings resting on the lower of the said rings, and members spaced circumferentially of the said sections and arranged to brace the aforesaid sections externally and adjustable to center the upper of adjacent rings relative to the lower of the said rings.

13. In a roll-casting mold, a vertically arranged chill comprising superimposed rings divided into sections vertically, with the upper of adjacent rings resting on the lower of the said rings; a jacket surrounding and formed independent of the said rings and enough larger in internal diameter than the rings to form a space extending circumferentially of the chill between the chill and the jacket; a removable filling occupying the said space, and members spaced circumferentially of the chill and supported from the jacket and arranged to brace the aforesaid sections externally and adjustable to center the upper of adjacent rings relative to the lower of the said rings.

14. In a roll-casting mold, the combination, with an annular vertically arranged chill comprising superimposed intermediate rings interposed between a suitably supported bottom ring and a top ring, said intermediate rings being divided into sections vertically, of a jacket surrounding the chill-rings, and set-screws spaced circumferentially of the chill, which set-screws are supported from the jacket and arranged to brace the sectional chill-rings.

15. In a roll-casting mold, a suitably supported upright chill provided interiorly with

vertically spaced casting-centering sloping surfaces; a suitably supported vertically movable upper mold-part or cope arranged to move within the upper end of the chill, and a lower mold-part or drag having a suitably supported depressible body which is provided with a cavity arranged centrally of the lower end of and in communication with the chill, said drag also comprising the following:—a stationary casing extending circumferentially of the said depressible body; a metal-feeding passageway extending through the said casing and through the said depressible body and communicating at its discharging end with the aforesaid cavity, and means for interrupting continuity in the said passageway at the junction of the said casing and the said depressible body.

16. In a roll-casting mold, a stationary upright chill provided interiorly with vertically spaced casting-centering sloping surfaces; a suitably supported vertically movable upper mold-part or cope arranged to move within the upper end of the chill, and a lower mold-part or drag having a depressible body provided with a cavity arranged centrally of the lower end of and in communication with the chill, said drag also comprising the following:—a stationary casing for the said depressible body; a metal-feeding passageway extending through the said casing and through the said depressible body and communicating at its discharging end with the aforesaid cavity; means for interrupting continuity in the said passageway at the junction of the said casing and the said depressible body, and a suitably supported vertically movable head arranged under the said depressible body.

17. In a roll-casting mold, a stationary vertically arranged chill provided interiorly with vertically spaced casting-centering sloping surfaces; a suitably supported vertically movable upper mold-part or cope arranged to move within the upper end of the chill, and a lower mold-part or drag having a cavity arranged centrally of the lower end of and in communication with the chill, which cavity has its surrounding wall or walls and bottom formed by a body of suitable sand, said drag also comprising the following:—a stationary casing surrounding the said body of sand; a metal-feeding passage-way extending through the said casing and through the said body of sand and communicating at its discharging end with the aforesaid cavity; a cut-off for interrupting continuity in the said passage-way at the junction of the said casing and body of sand, and a suitably supported vertically movable head arranged under said body of sand.

18. In a roll-casting mold, an upright chill; an upper mold-part or cope communicating with the upper end of the chill, and a lower mold-part or drag having a cavity arranged at the lower end of and in communication with the chill, said drag also comprising the following:—a metal feeding passageway communicating at its discharging end with the said cavity, and a cut-off for interrupting continuity in the said passage-way.

19. In a roll-casting mold, a suitably supported upright chill provided interiorly with a chamber which is formed by superimposed rings and extending from end to end of the chill, said rings being provided interiorly with upwardly and outwardly sloping seats extending circumferentially of the chill; an upper mold-part or cope arranged and supported as required to render it capable of being lowered within the upper end of the chill; a lower mold-part or drag having a suitably supported depressible body extending into the lowermost or bottom chill-ring and provided with a cavity which communicates with the chill at the lower end of the chill, said drag also comprising a stationary casing for the said depressible body; a metal-feeding passageway extending through the said casing and through the said depressible body and communicating at its discharging end with the aforesaid cavity, and means for interrupting continuity in the said passageway at the junction of the said casing and the said depressible body.

20. In a roll-casting mold, a stationary upright chill provided interiorly with a chamber which is formed by superimposed rings and extends from end to end of the chill, said rings being provided interiorly with upwardly and outwardly sloping seats extending circumferentially of the chill; an upper mold-part or cope arranged and supported as required to render it capable of being lowered within the upper end of the chill; a lower mold-part or drag having a cavity which communicates with the chill at the lower end of the chill, which cavity has its surrounding wall or walls and bottom formed by a body of suitable sand which extends into the lowermost or bottom chill-ring, said drag also comprising a stationary casing surrounding the said body of sand; a metal-feeding passage-way extending through the said casing and through the said body of sand and communicating at its discharging end with the aforesaid cavity; a cut-off for interrupting continuity in the said passage-way at the junction of the said casing and body of sand, and a head arranged under and instrumental in supporting the said body of sand, which head is supported as required to render it capable of being lowered.

21. In a roll-casting mold, a stationary vertically arranged chill; a suitably supported vertically movable upper mold-part or cope depending into the chill-chamber, and a lower mold-part or drag having a cavity arranged centrally of the lower end of and in communication with the chill, which

cavity has its surrounding wall or walls and bottom formed by a body of suitable sand, said drag also comprising a stationary casing surrounding the said body of sand; a metal-feeding passage-way extending through the said casing and through the said body of sand and communicating at its discharging end with the aforesaid cavity; a cut-off for interrupting continuity in the said passage-way at the junction of the said casing and body of sand, and a vertically movable head arranged under said body of sand and operatively connected with the cope.

22. In a roll-casting mold, a stationary vertically arranged chill; an upper mold-part or cope arranged and adapted to be lowered; a lower mold-part or drag comprising a depressible body having a cavity arranged centrally of the lower end of and in communication with the chill, said drag also comprising a head which bears said depressible body and is adapted to be lowered to accommodate the depression of the said depressible body.

23. In a roll-casting mold, a stationary upright chill; an upper mold-part or cope arranged and adapted to be lowered within the upper end of the chill; a lower mold-part or drag having a cavity which is arranged at the lower end of and in communication with the chill and formed in a body of suitable sand, which drag has a stationary casing surrounding the said body and is provided with a metal-feeding passageway which extends through the said casing and through the said body of sand and communicates at its discharging end with the aforesaid cavity; a head arranged under the said body and adapted to be lowered, and means whereby the said head and body of sand and the cope may be lowered while the chill remains stationary.

24. In a roll-casting mold, the combination, with a stationary upright chill; an upper mold-part or cope arranged and adapted to be lowered within the upper end of the chill; a lower mold-part or drag having a cavity which is arranged at the lower end of and in communication with the chill and has its surrounding wall or walls and bottom formed by a body of suitable sand, which drag has a stationary casing surrounding the said body of sand and is provided with a metal-feeding passage-way which extends through the said casing and through the said body of sand and communicates at its discharging end with the aforesaid cavity, said drag also comprising means for interrupting continuity in the said passage-way at the junction of the said casing and body of sand, and a head arranged under said body of sand and adapted to be lowered, of means whereby said head and body of sand and the cope may be simultaneously lowered while the chill remains stationary.

25. In a roll-casting mold, a stationary vertically arranged chill; suitably supported blocks spaced circumferentially of the upper end of the chill; an upper mold-part or cope arranged and adapted to be lowered within the chill and comprising a casing which has portions thereof overhanging but spaced from the blocks, said casing being provided above the said blocks with upright screw-threaded holes and correspondingly threaded screws engaging the said holes and resting upon the blocks, and a lower mold-part or drag having a cavity arranged at the lower end of and in communication with the chill, which cavity has its surrounding wall or walls and bottom formed by a body of suitable sand, said drag also comprising the following:—A stationary casing surrounding the said body of sand; a metal-feeding passage-way extending through the last-mentioned casing and through the said body of sand and communicating at its discharging end with the aforesaid cavity; means for interrupting continuity in the said passage-way at the junction of the said casing and body of sand, and a suitably supported head arranged under the said body of sand and adapted to be lowered.

26. In a roll-casting mold, a stationary vertically arranged annular chill; an upper mold-part or cope arranged and adapted to be lowered within the upper end of the chill, said cope comprising a casing which has portions thereof provided with upright screw-threaded holes and correspondingly threaded screws engaging the said holes; a bottom bearing for the said screws; a lower mold-part or drag having a cavity arranged centrally of the lower end of and in communication with the chill, which cavity has its surrounding wall or walls and bottom formed by a body of suitable sand, said drag also comprising a stationary casing surrounding the said body of sand; a metal-feeding passage-way extending through the said casing and through the said body of sand and communicating at its discharging end with the aforesaid cavity; a cut-off for interrupting continuity in the said passage-way at the junction of the said casing and body of sand, and a head arranged under said body of sand and adapted to be lowered, which head is operatively connected with the aforesaid cope-casing.

27. In a roll-casting mold, the combination, with a stationary vertically arranged annular chill; an upper mold-part or cope arranged and adapted to be lowered within the chill, said cope comprising a casing which has portions projecting laterally and outwardly beyond the exterior of the chill and spaced circumferentially of the cope, said casing also having portions provided with upright screw-threaded holes and correspondingly threaded screws engaging the said holes; a bottom bearing for the screws, and

a lower mold-part or drag having a cavity which communicates with the chill and has its surrounding wall or walls and bottom formed by a body composed of suitable sand and adapted to be depressed, said drag comprising a stationary casing surrounding the said body of sand; a metal-feeding passage-way which extends through the said drag-casing and through the said body of sand and communicates at its discharging end with the aforesaid cavity; a cut-off for interrupting continuity in the said passage-way at the junction of the said drag-casing and body of sand, and a head arranged under said body of sand and adapted to be lowered, which head has portions arranged below the said drag-casing and projecting laterally and outwardly, of upright rods arranged externally and spaced circumferentially of the chill, which rods have screw-threaded ends and extend loosely through the said projecting portions of the said head and aforesaid cope-casing; nuts mounted on the rods under the projecting portions of the said head, and nuts mounted on the rods above the projecting portions of the cope-casing.

28. In a roll-casting mold, the combination, with a stationary vertically arranged annular chill; an upper mold-part or cope supported as required to render it capable of being lowered within the upper end of the chill; and a lower mold-part or drag having a cavity which communicates with the chill and has its surrounding wall or walls and bottom formed by a body of suitable sand, said drag comprising a stationary casing surrounding the said body of sand; a metal-feeding passage-way extending through the said casing and through the said body of sand and communicating at its discharging end with the aforesaid cavity; a cut-off for interrupting continuity in the said passage-way at the junction of the said casing and body of sand, and a vertically movable head arranged under said body of sand, of vertically shiftable upright rods operatively connected with and supporting the said head, which rods are arranged externally and spaced circumferentially of the chill and have screw-threaded portions a suitable distance above the said head, and suitably supported nuts engaging the said screw-threaded portions of the rods.

29. In a roll-casting mold, a lower mold-part or drag having a cavity extending a suitable distance downwardly from the upper end of the drag and formed in a body composed of suitable sand and supported as required to render it capable of being depressed, said cavity having an inlet; a suitably supported vertically arranged annular chill communicating at its lower end and centrally with the aforesaid cavity, and a suitably supported upper mold-part or cope provided with a chamber which is arranged centrally of the upper end of and in communication with the chill, said cope being arranged and adapted to be lowered within the upper end of the chill.

30. In a roll-casting mold, a lower mold-part or drag having a cavity extending a suitable distance downwardly from the upper end of the drag and formed in a body composed of suitable sand and supported as required to render it capable of being lowered, said drag comprising a stationary casing which surrounds the said body of sand and has a metal-feeding passage-way extending through the said casing and communicating at its discharging end with the aforesaid cavity; a vertically arranged annular chill communicating at its lower end and centrally with the aforesaid cavity and mounted on the drag-casing; a suitably supported upper mold-part or cope provided with a chamber arranged centrally of the upper end of and in communication with the chill, said cope being supported as required to render it capable of being lowered.

31. In a roll-casting mold, a lower mold-part or drag having its cavity extending a suitable distance downwardly from the upper end of the drag and having its surrounding wall or walls and bottom formed by a body of suitable sand, said drag comprising a stationary casing which surrounds the said body of sand and having a metal-feeding passage-way extending through the said casing and communicating at its discharging end with the aforesaid cavity, said casing being provided at its upper end and internally with an annular recess extending around the said body of sand and having its surrounding wall beveled, which recess is arranged concentrically relative to the aforesaid cavity; a suitably supported vertically shiftable head arranged under the said body of sand; a vertically arranged annular chill communicating at its lower end and centrally with the aforesaid cavity, and an upper mold-part or cope having a chamber arranged centrally of the upper end of and communicating with the chill, said cope being supported as required to render it capable of being lowered.

32. In a roll-casting mold, a lower mold-part or drag provided with a cavity having an inlet and extending a suitable distance downwardly from the upper end of the drag and having its surrounding wall or walls and bottom formed by a body of suitable sand, said drag comprising a suitably supported casing which surrounds the said body of sand; a vertically arranged annular chill communicating at its lower end and centrally with the aforesaid cavity and comprising superimposed intermediate rings arranged in line vertically between a top ring and a bottom ring which is mounted on the drag-casing;

means for preventing upward displacement of the top ring, and an upper mold-part or cope supported independently of the chill and having a chamber arranged centrally of the upper end of and in communication with the chill.

33. In a roll-casting mold, a lower mold-part or drag having a cavity which extends downwardly from the upper end of the drag and is provided with an inlet, said drag comprising a suitably supported casing; an upright chill communicating at its lower end and centrally with the aforesaid cavity and comprising a solid top ring, a solid bottom ring supported from the drag-casing, and superimposed intermediate sectional rings between the bottom ring and top ring; vertically compressible members mounted on the top ring; means for preventing upward displacement of the said compressible members, and a suitably supported upper mold-part or cope having a chamber arranged centrally of the upper end of and in communication with the chill.

34. In a roll-casting mold, a lower mold-part or drag having a cavity extending a suitable distance downwardly from the upper end of the drag, which cavity is provided with an inlet, said drag comprising a suitably supported casing; a vertically arranged annular chill communicating at its lower end and centrally with the aforesaid cavity and comprising superimposed rings arranged over and supported from the drag-casing; means arranged to prevent upward displacement of the top ring and yieldable to accommodate upward calorical expansion of the rings, and an upper mold-part or cope supported independently of the chill and having a chamber arranged centrally of the upper end of and in communication with the chill-chamber.

35. In a roll-casting mold, a lower mold-part or drag having a suitably supported depressible body provided with a cavity which extends downwardly from the upper end of the drag and is provided with an inlet, said drag comprising a stationary casing which extends circumferentially of the said depressible body and is provided internally of its upper end with an upwardly and outwardly sloping seat extending circumferentially of the casing; an upright chill communicating at its lower end and centrally with the aforesaid cavity and comprising superimposed rings which are arranged in line vertically over and supported from the drag-casing and provided interiorly with upwardly and outwardly sloping seats extending circumferentially of the chill, and the sloping seat of the bottom ring being flush at its lower end with the upper end of the aforesaid sloping seat on the drag-casing, and a suitably supported upper mold-part or cope having a chamber arranged centrally of the upper end of and in communication with the chill.

36. In a roll-casting mold, a lower mold-part or drag having a cavity which extends downwardly from the upper end of the drag and is formed by suitable sand, said drag comprising a suitably supported casing for the said sand and having a metal-feeding passageway extending through the casing and communicating at its discharging end with the aforesaid cavity, said casing being provided internally of its upper end with an upwardly and outwardly sloping seat extending circumferentially of the casing; a suitably supported head arranged under the said sand and adapted to be lowered; an upright chill communicating at its lower end and centrally with the aforesaid cavity and provided interiorly with upwardly and outwardly sloping seats extending circumferentially of the chill, and the lowermost sloping seat of the chill being flush at its upper end with the aforesaid sloping seat on the drag-casing, and a suitably supported upper mold-part or cope having a chamber arranged centrally of the upper end of and in communication with the chill.

37. In a roll-casting mold, a lower mold-part or drag provided with a cavity having an inlet and extending a suitable distance downwardly from the upper end of the drag; a vertically arranged annular chill communicating at its lower end and centrally with the aforesaid cavity and comprising superimposed intermediate rings arranged in line vertically between a suitably supported bottom ring and a top ring which is provided externally with upwardly facing shoulders spaced circumferentially of the chill; means for preventing upward displacement of the top ring and comprising compressible members engaging the said shoulders, and a suitably supported upper mold-part or cope having a chamber arranged centrally of the upper end of and in communication with the chill.

38. In a roll-casting mold, a lower mold-part or drag provided with a cavity having an inlet and extending a suitable distance downwardly from the upper end of the drag; a vertically arranged annular chill communicating at its lower end and centrally with the aforesaid cavity and comprising superimposed intermediate rings arranged in line vertically between a suitably supported bottom ring and a top ring which is provided externally with upwardly facing shoulders spaced circumferentially of the chill, said top ring having outwardly facing flat external surfaces adjacent the said shoulders; a suitably supported jacket surrounding the chill; plates mounted on the jacket and extending into close proximity and conforming

to the aforesaid flat surfaces; compressible members interposed between the said plates and the aforesaid shoulders; means for holding the plates down upon the jacket, and a suitably supported upper mold-part or cope having a chamber arranged centrally of the upper end of and in communication with the chill-chamber.

39. In a roll-casting mold, a lower mold-part or drag provided with a cavity having an inlet and extending a suitable distance downwardly from the upper end of the drag; a vertically arranged annular chill communicating at its lower end and centrally with the aforesaid cavity and comprising superimposed intermediate rings arranged in line vertically between a suitably supported bottom ring and a top ring which is provided externally with upwardly facing shoulders spaced circumferentially of the chill; a suitably supported jacket surrounding the chill and provided at its upper end with laterally and outwardly projecting lugs spaced circumferentially of the jacket; plates resting on the said lugs and overlapping the aforesaid shoulders; compressible members interposed between the said plates and the shoulders; means for preventing upward displacement of the said plates, and a suitably supported upper mold-part or cope having a chamber arranged centrally of the upper end of and in communication with the chill-chamber.

40. In a roll-casting mold, a lower mold-part or drag provided with a cavity having an inlet; a vertically arranged annular chill communicating at its lower end with the said drag-cavity; an upper mold-part or cope provided with a chamber which extends from end to end of the cope and communicates with the chill, said cope consisting of an upper part and a lower part and comprising the following:—a body of suitable sand forming the surrounding wall or walls of the inner end-portion of the cope-chamber and shaped to form the inner end-portion of the upper neck of the roll and instrumental in the formation of the lower cope-part; a casing surrounding the said body of sand and comprising an inner section which supports and extends around the said body of sand and a suitably supported outer section extending around the said inner section, said inner casing-section being supported from the outer casing-section as required to render the former capable of being lowered independently of the latter; a body of suitable sand forming the surrounding wall or walls of the remainder of the cope-chamber and shaped to form the wabble-forming outer end-portion of the aforesaid roll-neck and a feeding head above the said wabble-forming portion and instrumental in the formation of the upper cope-part, and a casing surrounding and supporting the last-mentioned body of sand and resting and removable from the inner casing-section of the lower cope-part.

41. In a roll-casting mold, a lower mold-part or drag provided with a cavity having an inlet; a vertically arranged annular chill communicating at its lower end with the said drag-cavity; an upper mold-part or cope provided with a chamber which extends from end to end of the cope and communicates with the chill, said cope consisting of an upper part and a lower part and comprising the following:—a body of suitable sand forming the surrounding wall or walls of the inner end-portion of the cope-chamber and shaped to form the inner end-portion of the upper neck of the roll and instrumental in the formation of the lower cope-part; a casing surrounding the said body of sand and comprising an inner section which supports and extends around the said body of sand and an outer section extending around the said inner section and supported independently of the chill, said inner casing-section being supported from the outer casing-section as required to render the former capable of being lowered independently of the latter; a body of suitable sand forming the surrounding wall or walls of the remainder of the cope-chamber and shaped to form the wabble-forming outer end-portion of the aforesaid roll-neck and a feeding-head above the said wabble-forming portion and instrumental in the formation of the upper cope-part, and a casing surrounding and supporting the last-mentioned body of sand and resting on the inner casing-section of the lower cope-part.

42. In a roll-casting mold, a lower mold-part or drag provided with a cavity having an inlet; a vertically arranged annular chill communicating at its lower end with the said drag-cavity; an upper mold-part or cope provided with a chamber which extends from end to end of the cope and communicates with the chill, said cope comprising the following:—a body of suitable sand forming the surrounding wall or walls of the inner end-portion of the cope-chamber; a casing surrounding the said body of sand and comprising an inner section which supports and extends around the said body of sand and a suitably supported outer section extending around the said inner section, said outer casing-section being provided at its upper end and externally with a laterally and outwardly projecting annular flange, and said inner casing-section provided at its upper end and externally with a laterally and outwardly projecting annular flange overhanging but suitably spaced from the first-mentioned flange; bolts arranged with their heads countersunk in the under side of the flange of the outer casing-section and with their shanks extending upwardly through the flange of the inner casing-section; nuts on

the said shanks at the top of the last-mentioned flange; screws screwed into and extending through the last-mentioned flange into engagement with the upper end of the outer casing-section; a body of suitable sand forming the surrounding wall or walls of the remainder of the cope-chamber, and a casing surrounding and supporting the last-mentioned body of sand and resting on the first-mentioned cope-casing-section.

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

RALPH HENRY WEST.

Witnesses:
C. H. DORER,
B. C. BROWN.