No. 698,434. Patented Apr. 29, 1902.

H. L. BOCK.

CASTING MACHINE.

(Application filed Apr. 23, 1900.)

(No Model.) 8 Sheets—Sheet 1.

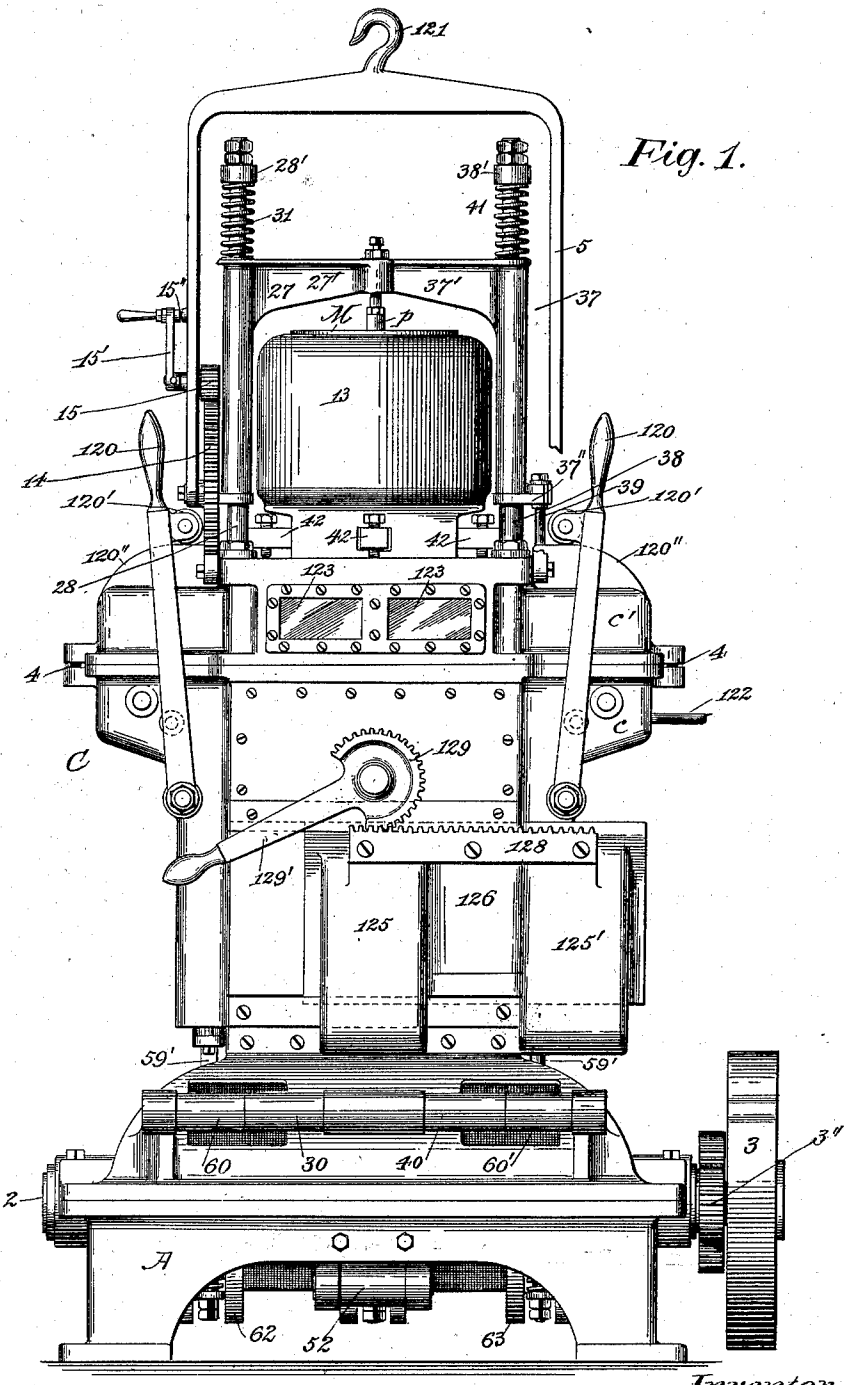


Fig. 1.

Witnesses:
Chas. F. Schmidt
C. C. Thompson.

Inventor:
H. L. Bock,
By his Attorney
F. H. Richards.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

No. 698,434. Patented Apr. 29, 1902.

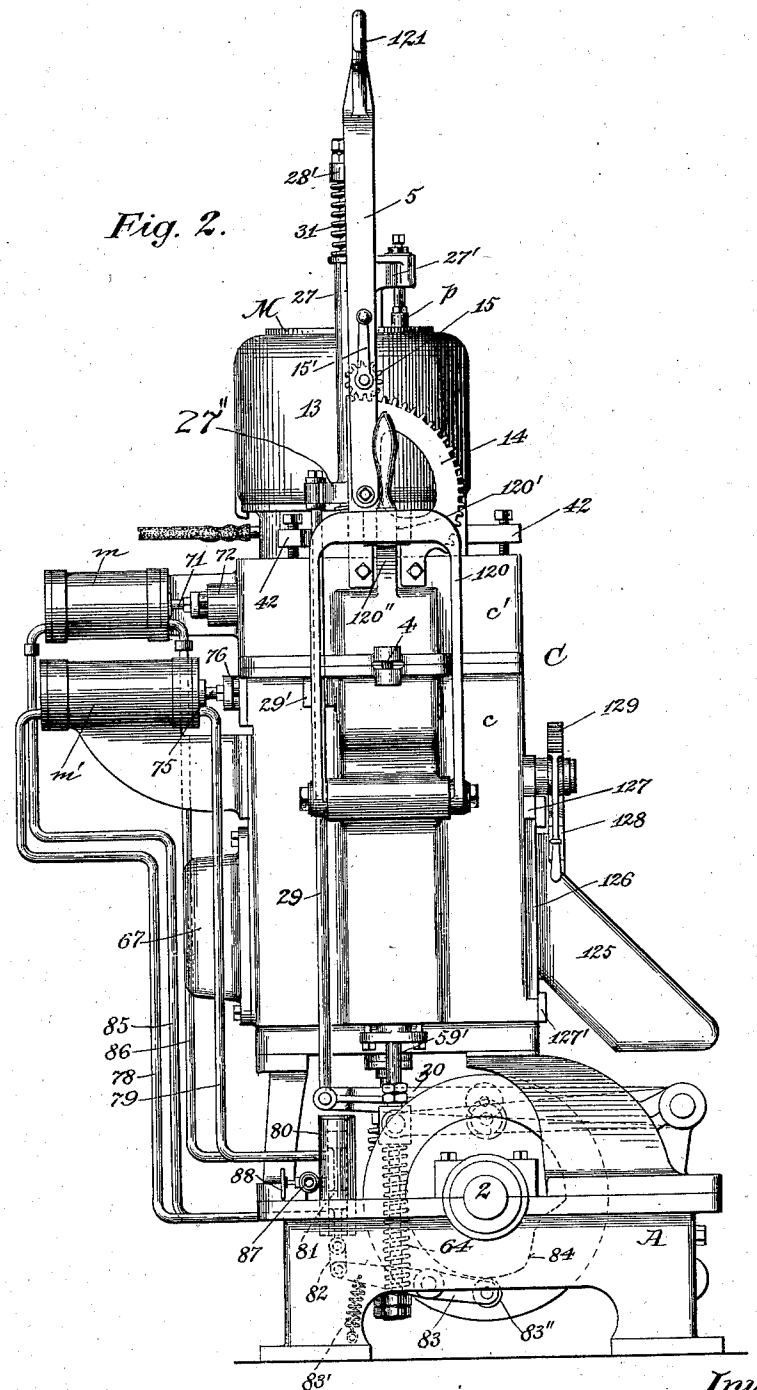
H. L. BOCK.

CASTING MACHINE.

(Application filed Apr. 23, 1900.)

(No Model.) 8 Sheets—Sheet 2.

Fig. 2.



Witnesses:
Chas. F. Schuel
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No. 698,434. Patented Apr. 29, 1902.

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(No Model.) 8 Sheets—Sheet 3.

Fig. 3.

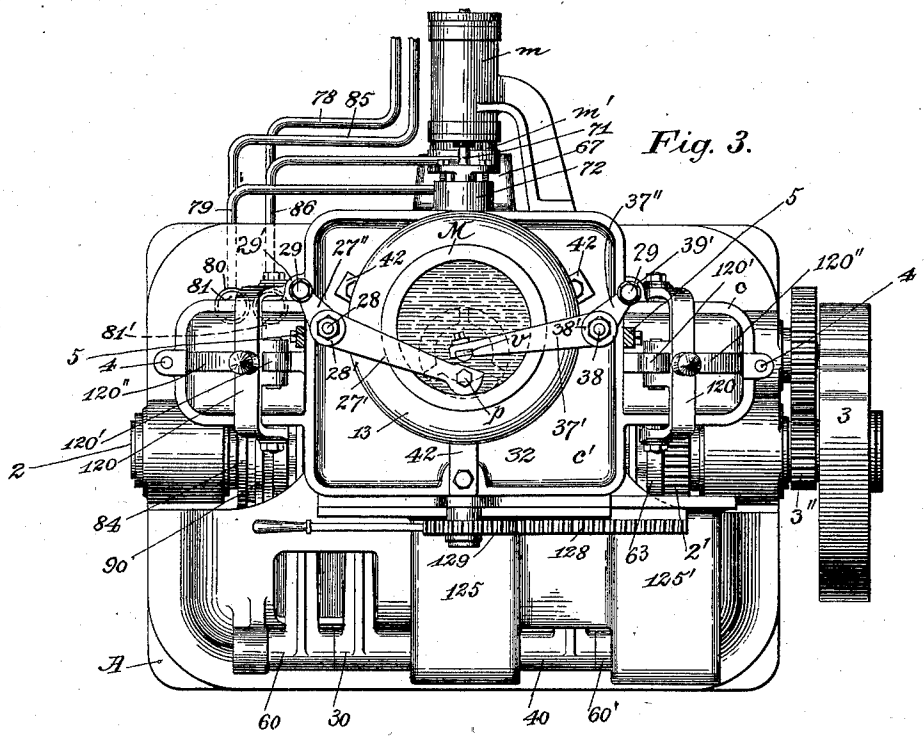
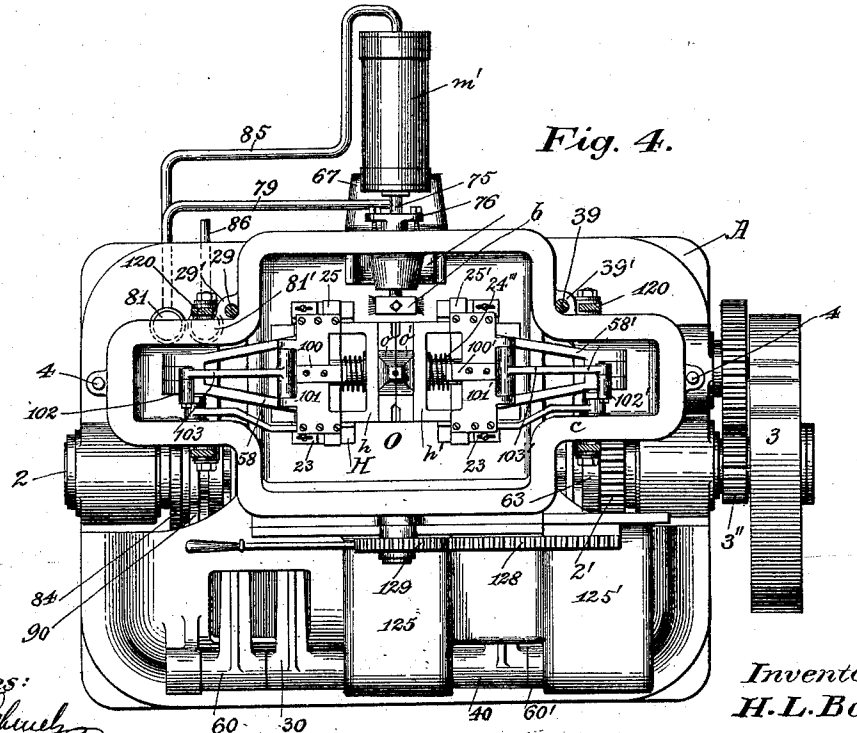


Fig. 4.



Witnesses:
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C. C. Champion.

Inventor:
H. L. Bock,
By his Attorney
F. H. Richards.

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No. 698,434. Patented Apr. 29, 1902.

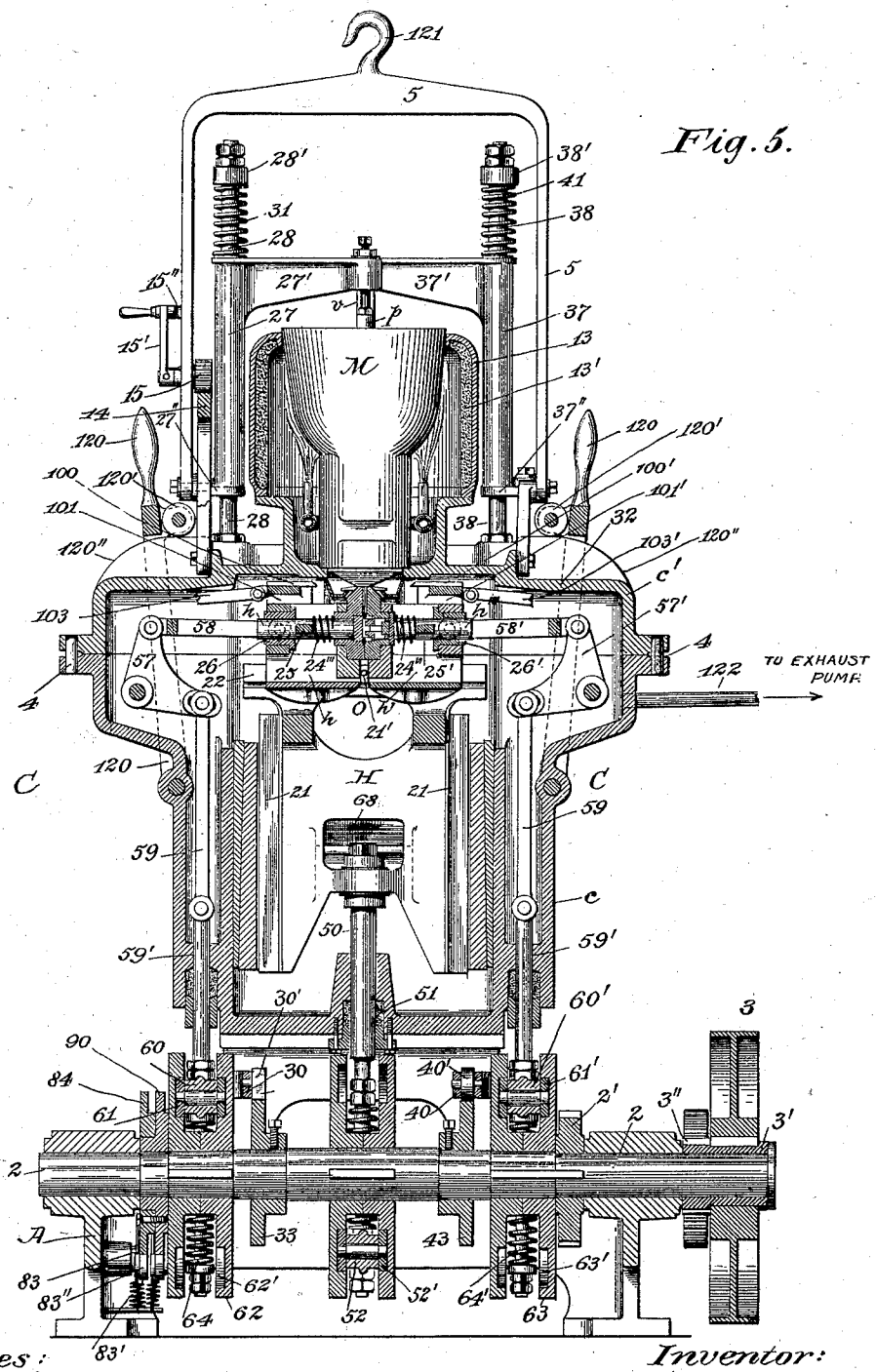
H. L. BOCK.

CASTING MACHINE.

(Application filed Apr. 23, 1900.)

(No Model.) 8 Sheets—Sheet 4.

Fig. 5.



Witnesses:
Chas. F. Schuelp
E. E. Thompson.

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By his Attorney
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THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

No. 698,434. Patented Apr. 29, 1902.

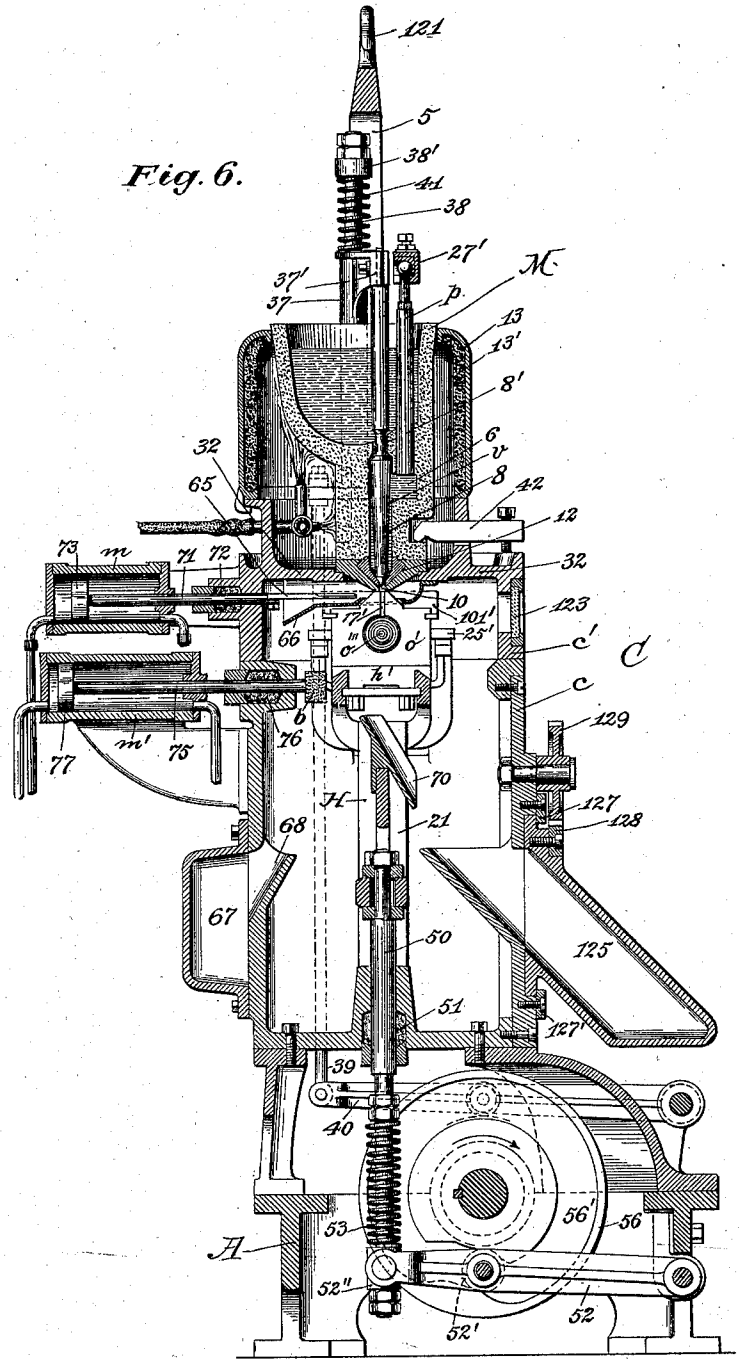
H. L. BOCK.

CASTING MACHINE.

(Application filed Apr. 23, 1900.)

(No Model.) 8 Sheets—Sheet 5.

Fig. 6.



Witnesses:
Chas. D. Schmeel
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THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

No. 698,434. Patented Apr. 29, 1902.

H. L. BOCK.

CASTING MACHINE.

(Application filed Apr. 23, 1900.)

(No Model.) 8 Sheets—Sheet 6.

Fig. 7.

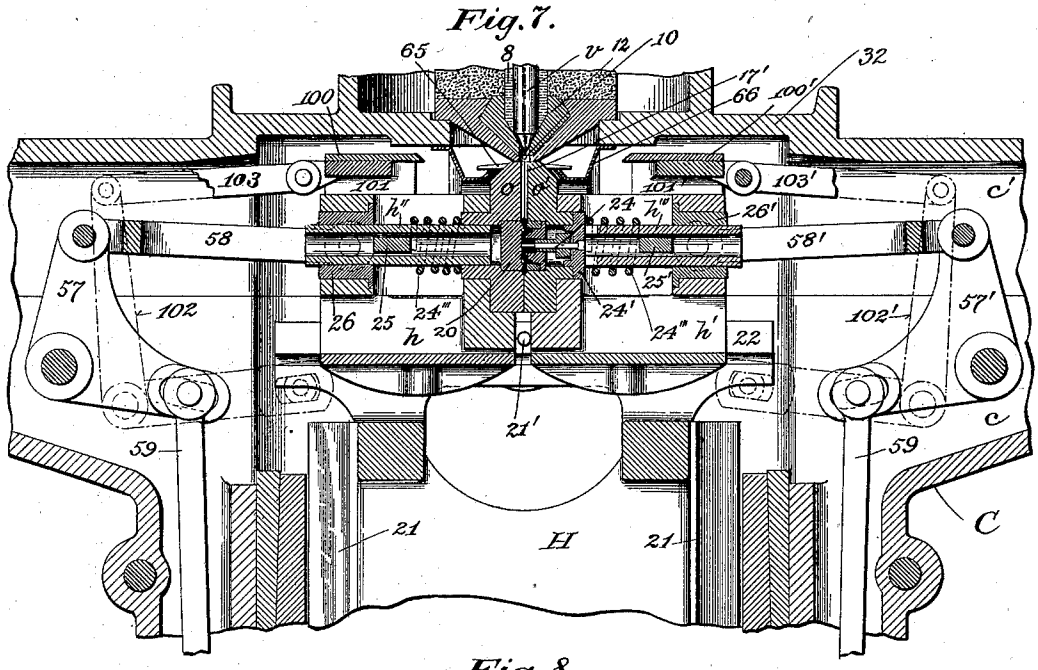
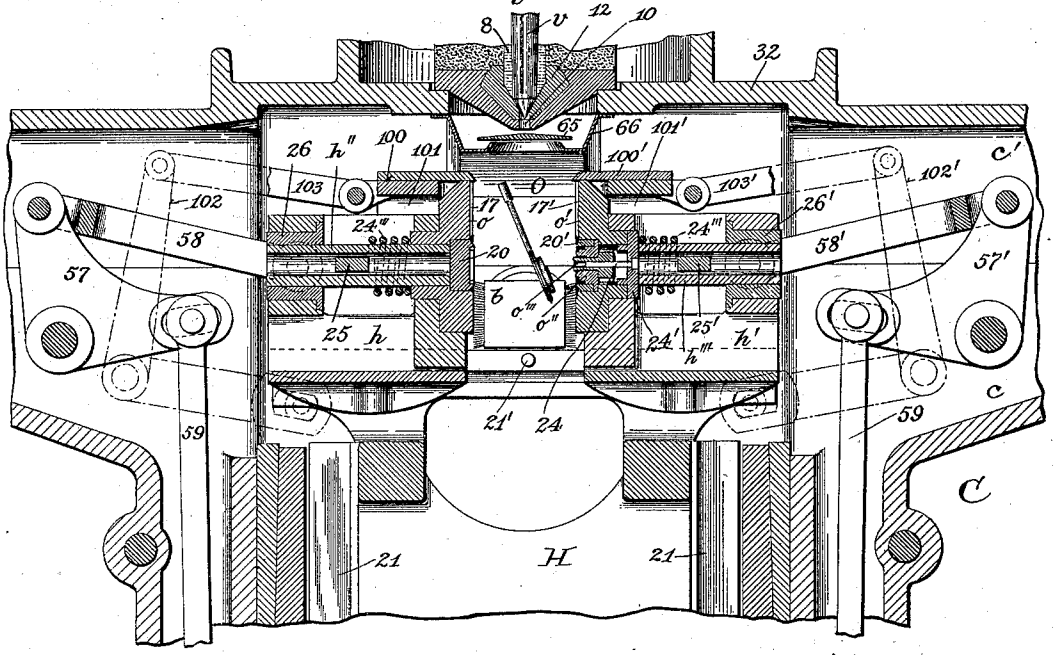


Fig. 8.



Witnesses:
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No. 698,434. Patented Apr. 29, 1902.

H. L. BOCK.

CASTING MACHINE.

(Application filed Apr. 23, 1900.)

(No Model.) 8 Sheets—Sheet 7.

Fig. 9.

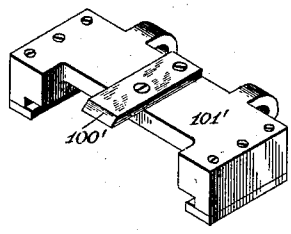


Fig. 10.

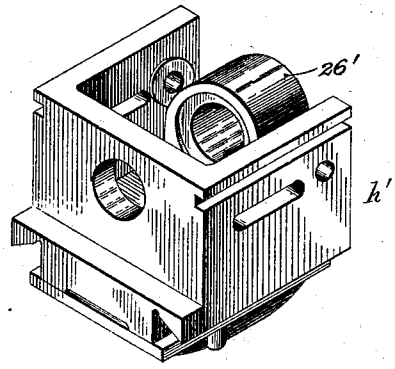


Fig. 11.

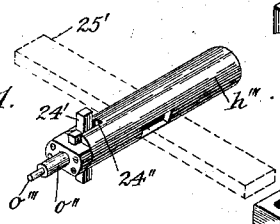
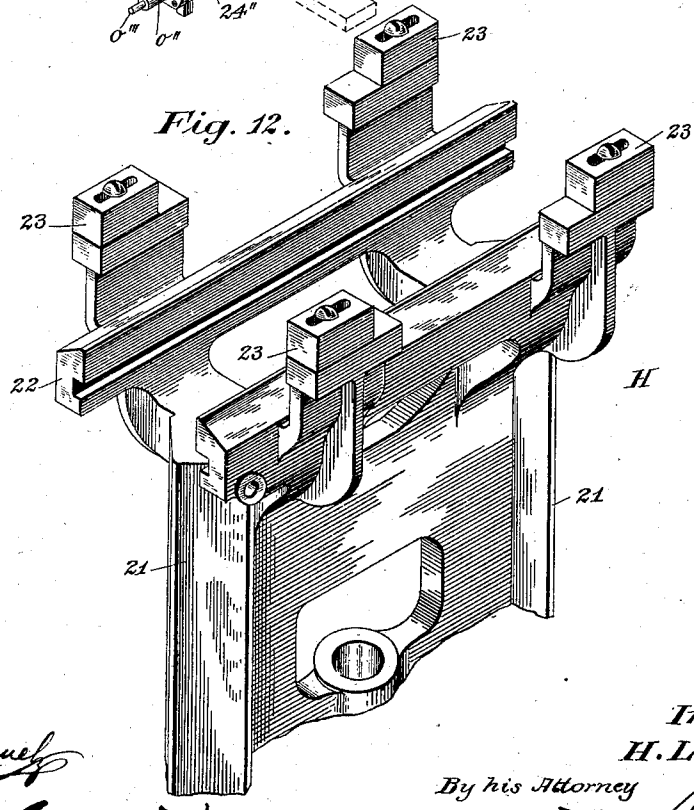


Fig. 12.



Witnesses:
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No. 698,434. Patented Apr. 29, 1902.

H. L. BOCK.

CASTING MACHINE.

(Application filed Apr. 23, 1900.)

(No Model.) 8 Sheets—Sheet 8.

Fig. 13.

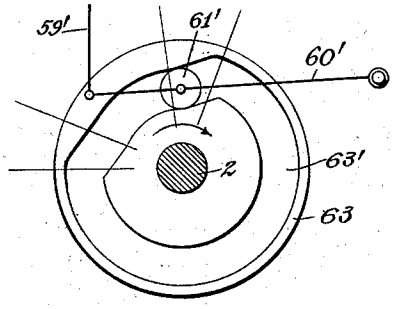


Fig. 14.

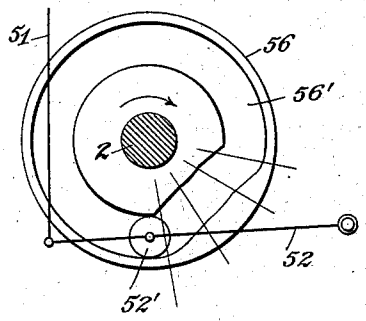


Fig. 15.

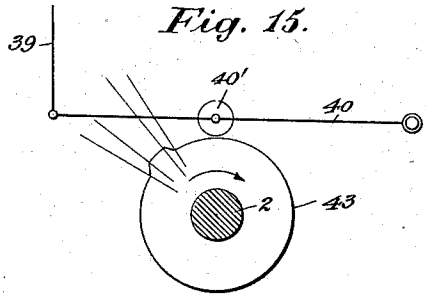


Fig. 16.

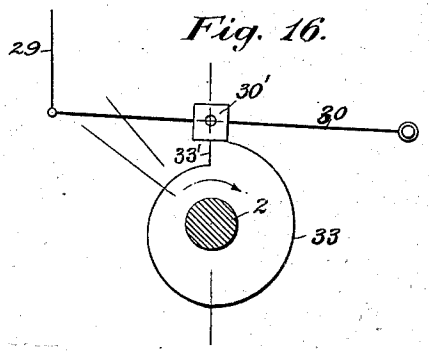


Fig. 17.

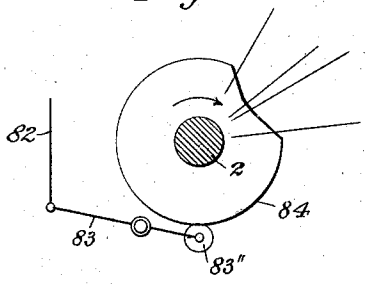
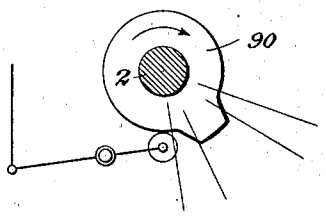


Fig. 18.



Witnesses:
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W. Champion

Inventor:
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F. A. Richards.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

HENRY L. BOCK, OF HARTFORD, CONNECTICUT, ASSIGNOR TO THE VEEDER MANUFACTURING COMPANY, OF HARTFORD, CONNECTICUT, A CORPORATION OF CONNECTICUT.

CASTING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 698,434, dated April 29, 1902.

Application filed April 23, 1900. Serial No. 13,977. (No model.)

To all whom it may concern:

Be it known that I, HENRY L. BOCK, a citizen of the United States, residing in Hartford, in the county of Hartford and State of Connecticut, have invented certain new and useful Improvements in Casting-Machines, of which the following is a specification.

This invention relates to casting-machines, and has for its main object the provision of a machine for forming dense castings having faces of such smoothness that the castings will not need to be subjected to the usual operations of planing, turning, &c., but can be used and assembled with other parts with the bearing-surfaces in the condition in which they come from the molds and under conditions where exceptionally wel lfinished bearing-surfaces are required in order to permit the proper movement of parts upon one another. This result I attain by employing a casting-machine so constructed and capable of operating in such a manner as to condense the molten metal most perfectly during the making of the casting and before the completion thereof. I have found that the best results can be secured by producing a vacuum in the mold into which the metal is to be poured and then forcing molten metal under pressure into the exhausted mold until the mold is completely filled. When castings are formed in this way, all of the spaces and corners of the mold, no matter how small they may be, are completely filled by the molten metal forced thereinto, and the casting corresponds exactly in contour to the mold, every minute projection or indentation in which is reproduced perfectly as an indentation or projection in the finished casting no matter how complex the pattern to be reproduced may be. Moreover, in every case castings formed in this manner are of a dense, homogeneous, and exceedingly fine crystalline structure throughout.

The present invention is in the nature of an improvement upon the inventions shown, described, and claimed in the applications of Curtis H. Veeder, Serial No. 738,269, filed November 27, 1899, Serial No. 2,435, filed January 23, 1900, Serial No. 5,296, filed February 15, 1900, and Serial No. 17,219, filed May 19, 1900, to which I have permission to refer.

The present invention embodies many important features of novelty relating to various mechanisms and devices which may be included in a complete casting-machine.

The molten metal may be delivered to the mold in many ways; but I prefer to inject it into the same under high pressure, so that the stream will be forced violently into every portion of the mold. In the present case I have employed for this purpose mold-filling means in which a melting-tank is located above a substantially vertical valve-chamber in such a manner that the pressure of substantially the whole body of metal in the main portion of the tank will be effective to force the valve to and hold it in its closed position, and, moreover, when the valve is opened the force with which the column is injected into the mold will be increased by the force of gravity exerted thereon as the metal descends in the valve-chamber.

In said application of Curtis H. Veeder, Serial No. 5,296, filed February 15, 1900, there is shown a mold mounted in a vacuum-chamber in such a manner as to be movable therein in different directions, and in the present case I have retained this feature in an improved form, certain of the parts shown herein being mounted in the vacuum-chamber and operated by fluid-motors, such as air-motors, in such a manner as not to interfere with the vacuum produced in the chamber in which the mold and other operating parts are contained.

Many other features of importance not hereinbefore mentioned will be set forth hereinafter in detail and are clearly illustrated in the drawings accompanying this specification, in which—

Figure 1 is a front elevation of the machine. Fig. 2 is an end elevation of the same looking from the left in Fig. 1. Fig. 3 is a plan of the same with the bail and certain other parts broken away. Fig. 4 is a plan of the same with the cover of the vacuum-chamber and the parts carried thereby removed. Fig. 5 is a substantially central vertical longitudinal

section of the machine. Fig. 6 is a substantially central transverse section of the same. Figs. 7 and 8 are enlarged sectional details of the mold and its operating mechanism, showing the mold in its closed and open positions, respectively. Figs. 9 to 12, inclusive, are perspective views of a scraper and its carrier, a main mold-carrier, an auxiliary mold-carrier, a core-carrier and a core carried thereby, and the mold-carriage; and Figs. 13 to 18, inclusive, are details of the cams for operating the various parts.

Similar characters designate like parts in all the figures of the drawings.

As in most of the prior applications hereinbefore referred to, I have shown herein a complete automatic machine by means of which castings may be formed and ejected from a mold regularly and at a high rate of speed without requiring any considerable amount of attention from an operator.

The several operative parts of my improved machine may be mounted on a suitable framework or bed, such as A, supported on legs in the usual manner and having a main shaft 2, which may be driven by a band-wheel 3 from any suitable source of power, the band-wheel being in this case keyed to a bushing 3′, which also has secured thereto a pinion 3″, which through suitable back gearing (only one member of which is shown) will drive the gear-wheel 2′, fixed to the shaft 2, and from this shaft the movements of all of the automatically-operating parts of the machine may be derived.

Any suitable means may be employed for melting and holding the metal from which castings are to be formed, and in the present case I have shown at the upper side of the machine a melting-pot, which is designated in a general way by M. The contents of this pot may be kept hot in any suitable manner, ordinarily by gas-jets. In the construction shown this melting-pot is so constructed and so positioned as to be vertically removable from the machine, and the main portion or body of the melting-pot may open directly at its under side into a valve-chamber 8, preferably vertically disposed, the inlet-opening of this valve-chamber being designated by 8′ and it also having an outlet-opening at 10. It will be evident that when the valve is opened in a valve-chamber positioned as illustrated herein the force of the stream which may be ejected from the opening 10 will be increased, owing to the action of gravity in accelerating the downward movement of the column in the chamber 8. Of course in order to obtain a high pressure within the valve-chamber I will make use of a plunger, such as *p*, operating in a well, such as 6, which may open directly into the valve-chamber near the upper end thereof. The chamber 8 in the present instance is formed partly within and partly without the main portion of the melting-pot, the body of the pot being of refractory material, while at the lower end thereof there is in this case a metallic discharge-nozzle 12, in which the opening 10 is formed.

It will be apparent that when the melting-pot is so constructed as to have its valve-chamber, the well, and the body portion positioned relatively to one another in substantially the manner herein stated any air and thermochemically-generated gases and vapors in the valve-chamber and in the well will rise freely and passing through the inlet-opening 8′ into the upper part of the melting-pot will escape into the open air, thus assuring the delivery to the mold of metal free from gases and vapors.

The valve-chamber is preferably heated directly by one or more gas-jets, which serve to keep the body of molten metal in such chamber in a state of most perfect fluidity. In order to apply the heat to the valve-chamber and the body of the melting-pot to the best advantage, I may employ in connection therewith a casing, which may comprise an annular member or shell 13, surrounding the melting-pot and preferably having a refractory lining 13′. This casing is vertically disposed, and through it the melting-pot, with its nozzle, is vertically removable from the machine.

The mold-filling means is intended to lie partly within and partly without a vacuum-chamber, in which the mold will be mounted for movement, and the refractory material of which the valve-chamber and the body of the melting-pot are constructed will prevent excessive conduction of heat to the metallic nozzle 12, and hence to that wall of the vacuum-chamber with which the nozzle is in contact.

For the purpose of controlling the flow of molten metal to the mold I prefer to mount within the valve-chamber 8 and the openings 8′ and 10 a valve, such as *v*, so constructed as to close the opening 10 when a casting is not being made. This valve in the present case also serves to open communication through the passage 8′ with the main body of metal in the melting-pot, and hence constitutes a double-action valve.

For the purpose of supplying a charge of metal to the mold I prefer to make use of mold-filling means embodying a member which will act upon the metal in such a manner as to force the molten charge under high pressure into the mold, and thus assure the filling of all corners thereof. Ordinarily a plunger, such as *p*, mounted in parallelism with the valve *v*, will work in the well 6 and when depressed will cause the metal to be injected in a small column or stream into the mold. These two operated members—viz., the valve *v* and the plunger *p*—are intended in this case to be so connected with their operating members as to be readily detachable therefrom to permit the melting-tank, with the valve and the plunger, to be lifted bodily out of the casing 13, and substantially similar

connections may be employed for operating said valve and plunger. In this case the plunger is joined to one arm 27′ of a connector 27, which may be in the form of a slide having a long journal or sleeve supported on a vertical rod 28, so as to turn thereon, and at its other end the slide may have an arm 27″, detachably connected in a similar manner to an operating member or rod, such as 29, which is disposed in parallelism with the sleeve of the slide 27 and with the operated member or plunger *p*, said rod 29 being pivoted at its lower end to a lever, such as 30, pivoted at a suitable point on the framework and having a block 30′, which works in contact with the face of a cam 33, secured to the main shaft 2.

The rod 28, on which the connector 27 is adapted to turn, is fixedly secured at its lower end at some suitable point and has thereon in this instance a spring 31, which works between the upper end of the slide 27 and a stop, such as 28′, on said rod. This stop may be an adjustable one, and its position may be determined by suitable adjusting and check nuts in the usual manner. It will be evident that this spring 31 normally tends to force the slide 27 down, and hence force the plunger *p* into the well 6, and will become effective to accomplish this result when the block 30′ rides down the let-off face 33′ of the cam 33.

As before stated, the connector 27 is intended to be detachably secured to its operating and operated members—that is, with the rod 29 and with the plunger *p*—and preferably this connector will be detachable from said parts by a simple swinging movement in the plane of its oscillation. In order to effect this, the connector will be so constructed at its opposite ends as to be detachable by loosening a clamping nut or screw—as shown, for example, in Fig. 6—and the details of this connection may be varied so long as they operate in this manner. Of course in order that said connector may be detached by a simple swinging movement the parts to which it is joined must be located at opposite sides thereof, as will be clear by referring to Fig. 3, from which it will be seen that when the long arm 27′ is swung downward, as seen in said figure, it will be lowered relatively to the plunger, while the short arm 27″ will be raised and moved to the right relatively to the connecting-rod 29 as it disengages from the latter.

The valve *v* is intended to reciprocate in the chamber 8 and in the openings 8′ and 10, and during a portion of a complete cycle of operations will be controlled in its movements preferably by a spring, and during another portion of such cycle of operations it will be operated, preferably, from a cam on the main shaft 2. The operating connections should be so constructed and organized as to actuate the valve to close the opening 8′ shortly after the plunger *p* has begun to descend and should open the passage 10 at such time to permit the molten metal to enter the mold, whereupon the valve should be shifted immediately to close such passage and shut off the flow of metal therefrom. For the purpose of operating this valve *v* I may make use of any suitable valve-operating mechanism; but I prefer to employ connections similar to those previously described for operating the plunger. Here the valve has a long stem, the upper end of which is detachably connected to one arm 37′ of a connector or slide 37, having a long sleeve through which a rod 38 passes and is secured to some suitable fixed point in substantially the same manner as the rod 28. The other arm 37″ of this connector is detachably secured to a rod, such as 39, which is pivoted at its lower end to a lever 40, having an antifriction-roll 40′, adapted to travel on the face of a cam, such as 43, secured to the shaft 2. A spring 41 is also interposed in this case between the slide 37 and a stop, such as 38′, on the rod 38, the position of which stop may be controlled by suitable adjusting and check nuts. The opposite ends of the connector 37 are also connected to the respective operating and operated members—viz., the rod 39 and the valve *v*—in substantially the same manner that the connector 27 is secured to the rod 29 and the plunger *p*—that is to say, the connections with the ends of the member 37 are such that by simply loosening the connections and turning the member 37 about its pivot the ends of the connector will withdraw from the connecting-rod and from the valve, and hence the connector may be swung out of the way to permit the melting-pot, with the valve and the plunger, to be removed bodily from the machine. The spring 41 of course normally tends to force the valve down to close the opening 10, and as the slide 37 is shiftable on the rod 38 in the same manner that the slide 27 is shiftable on the rod 28 at the proper time during the descent of the plunger this slide 37, and hence the valve, will be raised quickly by the cam 43 in opposition to the force of the spring 38, and the passage 8′ will be closed and that at 10 opened to permit the injection of a charge into the mold.

One of the most important features of my improved machine is the employment of a vacuum-chamber in which the mold and certain other coöperating parts are located and work. This vacuum-chamber may be of any suitable construction and of any proper size, provided that it is large enough to receive the various operating parts which are intended to be contained therein, and it should be so constructed as to prevent leakage of air thereinto. Usually this vacuum-chamber will be a large one, occupying substantially the whole central portion of the machine, and it may, as in the present case, constitute a portion of the framework, support other parts of the mechanism, and connect other portions of the framework. The vacuum-chamber employed herein is designated in a general

way by C and may be a two-part casing embodying a lower main chamber *c* and an upper portion or cover *c'*.

The upper and lower portions of the vacuum-chamber may be properly located with respect to each other in any suitable manner—as, for example, by means of dowel-pins, such as 4, carried by one of the members and adapted to be received by corresponding dowel-openings in the other member.

The two parts of the vacuum-chamber should of course be so connected as to form an air-tight joint between them, and in order to assure this result I deem it desirable to employ clamping devices of some suitable construction for holding the parts together. In the present case I have shown an improved clamping device, which connects the two parts of the vacuum-chamber and embodies a cam for wedging said members together. Each clamping device embodies a clamping-frame, such as 120, pivoted to one member of the vacuum-chamber and carrying, preferably, an antifriction-roll, such as 120', and this clamping device also embodies a cam-face, such as 120'', on the other member of the vacuum-chamber and coacting with the roll 120' to wedge the parts firmly together. Each clamping-frame has a handle for operating it readily, and each is so positioned as to be swung out of the way when it is desired to remove the cover *c'* from the lower portion of the vacuum-chamber. When the parts are to be clamped together, the handles will be forced inward and the rolls will ride up the cam-faces 120'' until said rolls are in the positions shown in Fig. 5, when the two parts of the chamber will be clamped and secured in position to maintain an air-tight joint between them.

As the cover *c'* is quite heavy in a full-size machine, it will be found desirable to provide some means for lifting it—such, for example, as the hook 121.

It should be understood, of course, that the vacuum-chamber should be exhausted as completely as possible before the machine begins to operate, the chamber being exhausted ordinarily through a pipe, such as 122, by means of an exhaust-pump. (Not shown.)

In order to observe the operation of the mechanism within the vacuum-chamber, large sight-openings may be formed in the walls thereof, preferably in the cover *c'*, and these openings will have transparent air-tight closures, such as 123.

In connection with the mold-filling means I have also illustrated in the present case mechanism for tipping the same for the purpose of pouring out the contents of the melting-pot, especially when it is desired to clean the latter by removing lumps, &c., therefrom. Here this mold-filling means is intended to be carried by an auxiliary frame supported on the main framework, so as to be movable relatively thereto and preferably removable therefrom. In this case the main portion *c* of the vacuum-chamber C constitutes a portion of the main frame, and the upper portion or cover *c'* of said vacuum-chamber is included in the auxiliary frame. Moreover, the mold-filling means is secured directly to and mounted on the auxiliary frame, and hence is movable with the latter from the main frame. This auxiliary frame also constitutes a means for counterpoising the melting-tank and other parts of the mold-filling means when the latter is to be tipped. In the present construction said mold-filling means is pivotally connected to a bail 5 in such a manner that when the bail, to which in this case the hook 121 is secured, is lifted to raise the mold-filling means and the cover *c'* from the main portion of the vacuum-chamber the melting-pot and its connected parts, including, of course, the cover *c'*, may be turned or tipped relatively to the bail.

In order to accomplish the tipping of the mold-filling means, I prefer to make use of gearing connecting the bail and the auxiliary frame for turning the latter and the mold-filling mechanism in said bail. In this case a gear-segment, such as 14, is fixed to the cover *c'*, and a pinion 15, which meshes with such gear-segment, is mounted on one of the arms of the bail, so as to turn thereon, suitable means, such as a crank 15', having a stop-pin, such as 15'', being employed for turning the pinion 15 in either direction to permit the tipping of the gear-segment, the mold-filling means and the cover, the return of the same to their normal positions, and the locking of the parts in such positions. Hence not only is the upper portion of the machine removable bodily from the lower portion thereof and from the mold and its operating mechanism, but the melting-pot, with its accessories, is mounted directly on the cover of the vacuum-chamber and projects therethrough into said chamber and turns with such cover to permit the discharge of the contents of the pot when desired.

The melting-pot is supported directly on the top 32 of the cover, which top has an opening thereof, through which the lower portion or nozzle projects to coöperate with the mold located within the vacuum-chamber. Owing to the fact that this melting-pot is disposed with its discharge-nozzle in a vertical position, the weight of the melting-pot tends to form an air-tight joint between the nozzle 12 and the top 32 of the cover. I prefer to make use of a plurality of clamps, such as are shown at 42, for pressing the melting-pot down firmly against the top 32. The manner in which these clamps operate will be apparent.

As the connecting-rods 29 and 39 should be properly supported when the upper portion of the machine is removed, I have shown on the outside of the main portion *c* of the casing a pair of bored lugs 29' and 39', through which said rods pass and by which they will be positively guided.

Many different styles of molds may be employed in connection with my improved machine for forming castings of various shapes so long as the molds differ only in the shapes of the mold-spaces; but in the present case I have illustrated a mold embodying four mold-sections adapted to be separated to the proper extent and in a predetermined order to permit the stripping of the completed casting therefrom. The mold shown is designated in a general way by O, and the main sections thereof are designated, respectively, by *o* and *o'*. These main sections are combined sprue-forming and casting-forming sections and may be in two or more parts, the main portion of each mold section or die containing in this case the sprue-forming channels, such as 17 or 17', while the mold-space proper for the body of the casting is formed in a separate mold section or die, such as 20 or 20'. In this case two other mold-sections or side sections are employed, one of which is an auxiliary mold-section *o''*, while the other is a core-section *o'''*.

All of the sections of the mold may be supported by mold-carriers, each mold-section in this case having a separate carrier on which it is supported and by means of which its movements are controlled. Preferably the entire mold will be mounted on a mold-carriage which will be movable toward and from the discharge-nozzle 12, and hence in this case said mold-carriage will move in a vertical direction. This mold-carriage is designated in a general way by H and has parallel guides, such as 21, mounted in suitable guideways in the inner sides of the opposite vertical end walls of the lower portion *c* of the vacuum-chamber, said carriage also having a pair of parallel horizontal guides, such as 22, on which the main mold-carriers may be supported for movement toward and from each other. Two main mold-carriers are mounted in this case on the mold-carriage H, these carriers being designated, respectively, by *h* and *h'*, said mold-carriers being positively guided on the ways of the carriage, as will be evident by referring particularly to Figs. 8 and 12. In order to determine with precision the limits of the movements of the two mold-carriers *h* and *h'*, I deem it desirable to make use of adjustable stops, such as 23, on the mold-carriage, (see Fig. 12,) and the manner in which these are adjusted and held in position will be apparent.

Either or both of the main mold-carriers may support one or more auxiliary mold-carriers, which may be cylindrical or tubular carriers, as shown at *h''* and *h'''*. Each main carrier will also preferably carry a stop member, which may be in the form of a bar or key, such as 25 or 25', passed therethrough and adapted to abut against the stops 23 to limit the movements of the main mold-carriers and of said auxiliary mold-carriers. In this case the auxiliary mold-carriers *h''* and *h'''* work at their outer ends in bushings, such as 26 and 26', in the mold-carriers *h* and *h'* and at their inner ends in corresponding journal-openings in the mold-sections *o* and *o'*. The mold-carrier *h''* does not in this case carry a mold-section, but is so constructed as to be capable of carrying such a mold-section and stripping the latter from the casting, as will be evident by referring to Figs. 7 and 8. The mold-carrier *h'''*, however, is intended to carry a mold-section, and in this case the auxiliary mold-section *o''* is bored throughout its length for the reception of the core *o'''*, and the core-carrier is intended to be guided partly by said mold-section *o''* and partly by the mold-carrier *h'''*. Here the core-carrier is made in two parts, one of which is designated by 24 and is the core-carrier proper, while the other is designated by 24' and is in the form of a stop arm or key passed through a key-slot 24'' in the mold-carrier *h'''* and secured to an adjacent portion of the mold-carrier *h'*, as by means of screws. A coiled spring, such as 24''', may be employed to shift the key 25' and the carrier *h'''* back to the position shown in Fig. 7 after the mold has been fully opened.

In order that the two sides of the mold may be properly centered beneath the discharge-opening 10, I may employ a suitable fixed stop, such as 21', on the mold-carriage H, this stop being of such size that it will not quite fill the space between the adjacent faces of the main mold-carriers *h* and *h'* when the latter come together, and hence said stop while assuring the centering of the parts will not prevent the proper closing of the mold-sections.

The mold-carriers and hence the mold-sections operated thereby may be actuated in any suitable manner, and so also may the other operated parts coacting with the mold; but as all of these elements of the machine are contained in the present case within a vacuum-chamber and go through their movements in such chamber while the latter is exhausted I have employed herein operating means controlling the movements of certain portions of the mechanism within the vacuum-chamber and preferably controlled in turn from a point without such chamber. The operating members for actuating the mold-carriage and the main mold-sections in the present construction pass through openings in the vacuum-chamber, suitable air-tight packings being interposed between the walls of such openings and said operating members. Certain other parts of the mechanism within said vacuum-chamber may be controlled by the piston of a fluid-motor located either within or without the vacuum-chamber and receiving fluid from suitable fluid-supplying means controlled by a piston-valve, governed in turn by a suitable driving member, which in this case may be the main shaft 2. Here, however, the mold-sections are not so operated, but are moved by direct mechanical connections to said shaft.

In the construction shown the mold-car-

riage H has secured thereto a rod 50, which passes through an opening in the bottom wall of the vacuum-chamber, a suitable air-tight packing, such as 51, being interposed between said rod and the walls of such opening to prevent admission of air into said chamber. Said rod is connected in this case to a lever 52, which is pivoted at a suitable point on the framework and carries an antifriction-roll 52′, working in a cam-groove 56′ of a cam 56, secured to the shaft 2. The connection between the rod 51 and the lever 52 is a yielding one, and in this case the end of the lever is forked and carries a swiveled sleeve 52″, through which the rod 51 passes, a spring 53 being interposed between the upper end of said sleeve 52″ and a suitable stop on the rod, said stop being formed in this case by an adjusting-nut and a check-nut for maintaining a determined tension of the spring. Corresponding adjusting and check nuts may be placed at the lower end of said rod to form a stop for the sleeve 52″.

The mold-carriers *h* and *h′* may be operated by substantially similar connections from the shaft 2. Here angle-levers, such as 57 and 57′, are pivoted at suitable fixed points and connected to said respective mold-carriers by means of links, such as 58 and 58′, the other arms of the angle-levers being loosely pivoted to links, such as 59, attached at their lower ends to connecting-rods 59′, these connecting-rods passing through openings in the vacuum-chamber and having air-tight packings interposed between them and the walls of such openings. At their lower ends these rods are connected to levers, such as 60 and 60′, pivoted at fixed points on the framework and carrying antifriction-rolls, such as 61 and 61′, working in cam-grooves, such as 62′ and 63′ of cams 62 and 63, secured to the main shaft 2. These rods 59′ are yieldingly connected to the levers 60 and 60′ in substantially the manner just described with respect to the connections for operating the mold-carriage, the springs on the rods 59′ being designated herein by 64 and 64.′ (See Fig. 5.)

All of the springs just described for obtaining a yielding connection between the operating-rods and the levers controlled by the cams on the shaft 2 are employed for the purpose of forcing the mold-carriers, and hence the mold-sections carried thereby, firmly together and maintaining a continuous pressure upon each of the mold-sections while the mold is closed.

In the construction shown in the present case the mold mechanism and the operating devices therefor are intended to coöperate with certain other elements, and one of these is a scraper or scrapers for cleaning one or more cheeks of the mold. Other devices which I have shown herein and which coöperate with the mold mechanism are drip-receiving means for directing surplus metal away from the mold and a mold-cleaning brush for cleaning the mold-sections after the mold has been opened.

Some means for scraping off the metal which adheres to the mold is an important element of a casting-machine of this type, especially for scraping those cheeks which come in contact with the discharge-nozzle of the mold-filling means, as metal sometimes adheres very firmly to these faces of the mold. In order to remove this metal and assure a tight joint and prevent clogging on the mechanism, I may employ one or more scrapers movable relatively to the mold or the mold-filling means for scraping a cheek or cheeks of such parts. Usually I will employ a scraper or scrapers movable with and relatively to the mold, and in the present case I have shown a pair of scrapers, such as 100 and 100′, each secured to a scraper-carrier 101 or 101′, which may be mounted on the mold-carrier *h* or *h′* and suitably held in place thereon for sliding movement, as by coacting guides and guideways. These scraper-carriers are operated in the present case by means of angle-levers 102 and 102′, pivoted at fixed points on the inside of the casing, said angle-levers being connected at their upper sides to the scraper-carriers by means of links, such as 103 and 103′, while the opposite ends of such angle-levers are loosely pivoted to the mold-carriage H. By means of these connections each mold-scraper is moved inward toward the line of separation of the mold-sections, while the corresponding mold-section with which the scraper coacts is moved away from such line of separation to open the mold, and hence as the sprue-forming mold-sections separate the scrapers move toward each other and across the cheeks of such mold-sections.

When the mold-filling means and the mold are positioned in the manner shown herein, there is sometimes a small amonnt of drip material to be disposed of, and in order to remove this I have shown herein a drip-receiver, which is movable between the mold and the mold-filling means after these parts have separated, this drip-receiver serving either to receive the drip material and convey it to some other point or merely as a drip-deflector for directing the drip material toward a suitable receiver. Here I prefer to employ a drip-deflector in the form of an inverted-V-shaped drip-shedder movable under the opening 10, the oppositely-inclined faces of this drip-shedder serving to direct the drip material into a second drip-receiver or combined drip-receiver and drip-deflector located below said drip-shedder and in which the latter may move back and forth. Here the upper drip-deflector or drip-shedder is designated by 65 and has a pair of oppositely-inclined drip-deflecting faces which direct the drip material toward the one side or the other into a second drip-receiver or drip-deflector located just below the drip-shedder 65 and pref-

erably so constructed as to receive drip material at its opposite sides and then direct it down inclined faces into some suitable receiver. This second drip-receiver, which is indicated herein by 66, may be both a drip-receiver and a drip-deflector—that is to say, it is a drip-receiving deflector—and serves to direct the drip material into a suitable receiver, such as 67, which in this case is formed as a separate member secured to the outside wall of the main portion *c* of the vacuum-chamber in such a manner as to seal an opening in the wall of such chamber and maintain the latter air-tight. Here a fixed drip-deflector, such as 68, forms one wall of this opening in the vacuum-chamber and is so positioned as to lie below and substantially in alinement with the discharge end of the second drip-deflector 66. The deflector 65, it should be noted, is movable in the meeting-line of the mold and the mold-filling means, while the drip-deflecting receiver 66, in which the shiftable deflector 65 works, has an opening therein through which the upper portion of the mold is movable, as will be evident by reference to Figs. 6, 7, and 8.

In connection with the mold and the mold-filling means I prefer to employ deflecting means for directing in different paths, preferably into receivers located at opposite sides of the casting-receivers, finished castings and such drip material as may escape from the opening 10. Here I have shown a casting-deflector which is located below the mold and has a deflecting-face inclined in a different direction from that of the drip-deflecting receiver 66, the deflecting-faces of the two members being preferably inclined oppositely to each other. The casting-deflector is designated herein by 70 and is disposed substantially in the meeting-line of the mold-sections in order that it may be in position to direct the casting into a suitable receiver as soon as such casting is stripped from and falls between the mold-sections. This casting-deflector in this case is supported on the mold-carriage H, and hence is movable therewith, it being also preferably removable therefrom. It is of course located above the casting-receiver, no matter what the position of the mold-carriage may be; but the lowering of the casting-deflector will shorten the distance which the casting will have to travel from the casting-deflector 70 to the receiver, which will usually be located opposite the drip-receiver 67.

As the drip-deflector 65 is intended to be movable under the discharge-nozzle 10, some suitable means should be employed for moving it back and forth in its proper path. The means employed may be any suitable for the purpose; but of course the member which operates the same will have to move either wholly or partly within the vacuum-chamber C. In the present construction this member moves through an opening in one of the walls of such chamber, and an air-tight packing is interposed between such member and the walls of such opening. Here the deflector 65 is secured to a piston-rod 71, which works through a stuffing-box 72, and is operated by a piston 73 of a motor, such as *m*, preferably an air-motor, to either end of which air may be admitted through suitable fluid-supplying means, the supply being governed in this case by a piston-valve, the movements of which are controlled by the main shaft 2.

In this machine there is more than one operated member located wholly within the vacuum-chamber C and controlled in its movements by the piston of a fluid-motor, the supply to which is regulated by a valve operated by some suitable driving member, such as the shaft 2, a second member which is operated in this manner being a mold-cleaning brush, such as *b*, which is operated in substantially the same manner as the deflector 65, said brush being secured in this case to the end of a piston-rod 75, projecting into the chamber C after passing through a stuffing-box, such as 76, the other end of said piston-rod being connected to a piston 77, working in the cylinder of another fluid-motor, such as *m'*, a pair of pipes, such as 78 and 79, leading to a valve-chamber 80, in which a piston-valve 81 works, this valve being connected by means of a short link, such as 82, to a lever 83, pivoted on the framework and normally held by means of a spring, such as 83', in contact with the face of a cam 84, secured to the main shaft 2, said lever carrying an antifriction-roll 83''. This piston-valve is so operated by means of these connections as to permit the motive fluid or air to flow alternately through the pipes 78 and 79 to admit air to opposite sides of the piston 77, and thus actuate the brush in opposite directions alternately. By means of connections similar to those just described a second piston-valve 81', shown in Figs. 3 and 4 of the drawings, and which may be similar in every respect to that shown in Fig. 2, may control the flow of air through pipes 85 and 86 to opposite ends of the cylinder of the motor *m* for operating the drip-deflector 65 in the same manner. The air-supply for operating both of these motors may be obtained from a common supply-pipe, such as 87, leading to the valve-chambers of the two piston-valves, and the supply may be turned on or shut off by means of a valve 88.

Of course it should be understood that the cam 84, which controls the piston-valve 81, and the cam 90, which controls the piston-valve 81', will have their cam-faces so shaped as to operate said valves differentially in order to permit the actuation of the brush and the drip-deflector, as may be required, and hence these parts are differentially operated. (See Figs. 17 and 18.)

In the prior application of Curtis H. Veeder, Serial No. 5,296, filed February 15, 1900, there is shown, described, and claimed in connection with the mold-filling means, the mold,

and the vacuum-chamber in which the mold is located, a casting-receiver constructed to seal an opening in a wall of the vacuum-chamber and yet be shiftable into position to permit the removal of castings therefrom substantially without impairing the vacuum in such chamber. This feature I have retained in the present application in a modified form, the vacuum-maintaining casting-receiver which I prefer to employ being in this case a slidable one mounted on suitable ways in order to facilitate the shifting thereof. The vacuum-maintaining means illustrated embodies not only a casting-receiver but also a valve reciprocally effective with said receiver for sealing the opening—in other words, when the opening is not sealed by the receiver it is sealed by the valve, and vice versa—the two parts being preferably movable in unison, and the slide-valve in this case being connected directly to the casting-receiver.

In order to save time and permit the emptying of a filled casting-receiver without materially delaying the operation of the machine, I deem it desirable to make use of a plurality of such receivers separately effective for sealing an opening in the vacuum-chamber, and in this case I have shown two such receivers which are effective alternately, one of them being in position to receive castings and seal such opening while the other is being emptied. Here the two receivers alone are not sufficient for effecting the perfect sealing of the opening in the vacuum-chamber, and hence I have employed additional means effective reciprocally with said receivers, respectively, for sealing such opening, the slide-valve 126 being the means employed herein for effecting this result. In this construction two casting-receivers, such as 125 and 125′, are connected by the slide-valve 126, so that all three parts move together, and it will be evident that said valve will always be effective reciprocally with one or the other of such receivers. This slide-valve 126 is in the form of a cut-off plate and preferably forms a continuation of the upper and lower edges of the casting-receivers (see Fig. 6) in order that all of these connected parts may fit closely against the outer wall of the vacuum-chamber and be suitably guided in their movements thereon, said connected parts being held and guided in place in this case by means of a pair of guide-strips, such as 127 and 127′, it being evident that when the receivers are slid in the one direction or the other one of the receivers should be shifted to a point beyond the corresponding end wall of the vacuum-chamber (see Fig. 1) in order to permit access to the interior of the receiving-chamber.

Any suitable means may be employed for shifting the receivers and the cut-off valve back and forth; but I have illustrated herein a rack-and-pinion movement consisting of a rack 128, secured to the receivers, and a segmental gear or pinion 129, having an operating-handle 129′.

The operation of a machine constructed in accordance with my present invention, as herein shown and described, is as follows: It being understood that all of the parts are in condition for operation, that the vacuum-chamber C has been exhausted, that one of the casting-receivers is in position to seal the large opening in the side of the vacuum-chamber, and that the cover of the vacuum-chamber is firmly clamped in place, the machine will be started and the band-wheel 3 will be turned in the direction of the arrow shown in Fig. 6. The mold being closed at this time, the cam 33 will first become effective to release the lever 30 and permit the spring 31 to force down the plunger p and set the molten metal in the well and in the valve-chamber in circulation. After the plunger has accomplished a portion of its working stroke the cam 43 will become effective to actuate the lever 40 and shift the valve v quickly to open the passage 10 and close the passage 8′, whereupon the continued descent of the plunger p will result in forcing a stream of molten metal under high pressure into the mold, and this metal will fill every corner of the mold-space. As soon as a full charge has been injected in this manner the wiper on the cam 43 will release the lever 40, and the spring 41 will quickly force the valve v down again to close the opening 10 and cut off the supply and at the same time open the passage 8′ to permit the refilling of the valve-chamber and the well. After reaching the limit of its downward stroke the plunger p will begin to rise again, it being positively actuated in this direction by the cam 33. After the casting has been formed the cam 56 will become effective to depress the lever 52, and the latter will carry with it the rod 50 and the mold-carriage H, which will descend to the limit of its downward movement and will be held there until the parts are in positions for forming another casting. Immediately after the mold-carriage begins to descend the piston-valve 81′, which controls the operation of the motor m, will be lowered by the cam 90 on the shaft 2, the piston 73 will be forced to the right, as seen in Fig. 6, the drip-receiving deflector 65 will be shifted under the opening 10, and any drip material which may flow out will be directed into the deflector 66, and thence into the drip-receiver 67. This drip-deflector 65 will, of course, be shifted back to its normal position before the mold-carriage reaches its highest position, this movement being accomplished by means of said cam 90, which actuates the piston-valve 81′ in the opposite direction—that is, upward—to permit the operating fluid to flow into the other end of the motor-cylinder through the pipe 86. On the descent of the mold-carriage H the two cams 60 and 60′ operate simultaneously to raise the connecting-rods 59′, and thereby separate the main mold-carriers h and h'. As these mold-carriers move away from each other they carry with

them the auxiliary mold-carriers h'' and h''' and also the core-carrier until the keys 25 and 25′ strike the stops 23 on the mold-carriage H, when the auxiliary carriers h'' and h''' will be at the limits of their separating movements. The carriers h and h' will continue on for a short distance until they are also stopped in their movements by the inner edges of the keys 25 and 25′, when the parts will be in the positions shown in Fig. 8. During this last part of the movement of the carrier h' the core which moves therewith is drawn back, and as the auxiliary mold-carrier h''' and the core-carrier stand still at this time the result is that the casting is stripped practically completely from the right-hand side of the mold, the small portion of the face of the casting which may adhere to the end of the mold-section o'' being stripped by the scraper 100′ when the latter becomes effective. During the opening movements of the mold-sections and before the mold-carriage H reaches the limit of its downward movement the mold-scrapers 100 and 100′, together with their carriers, are advanced toward each other across the cheeks of the sprue-forming mold-sections and thoroughly clean the latter, the scraper 100′ also striking the sprue of the casting and completing the stripping of the latter from the mold if the casting adheres to the mold-section o''. On the opening of the mold-sections the cam 84 on the shaft 2 becomes effective to permit the spring 83′ to lower the piston-valve 81, whereupon air will be admitted to the outer end of the motor-cylinder m' and the brush b will be advanced toward the mold-sections and moving between the same, as shown in Fig. 8, will thoroughly clean the faces of the main sections of the mold, after which the valve 81 will be raised by said cam and the air entering the other end of the cylinder of the motor m' will cause the brush to be withdrawn to its original position. After the mold has been cleaned in this manner and the brush withdrawn the cam 56 will operate to raise the mold-carriage H again until the parts are in the positions shown in Fig. 6, with the mold in contact with the face of the discharge-nozzle 12 ready to receive a charge for forming another casting. During the rising of the mold-carriage the mold-scrapers 100 and 100′ will be withdrawn and the main sections h and h' of the mold will be advanced toward each other. As these carriers h and h' move inward the mold-carriers h'' and h''' at first stand still until their springs 24‴ have shifted the auxiliary mold-carriers to their original positions (shown in Fig. 7) with the outer edges of the keys 25 and 25′ in contact with the outer ends of the slots in the mold-carriers h and h', (see Figs. 7 and 10,) whereupon said last-named carriers will shift said auxiliary mold-carriers positively until the parts reach their closed positions, when a new cycle of operations may be begun.

Having described my invention, I claim—

1. In a casting-machine, the combination with a melting-tank, of a valve-chamber having an inlet-opening from the tank and terminating in a vertically-disposed outlet-opening at its extreme lowest point, whereby the head of molten metal rendered effective to augment the velocity with which the metal issues downward from said chamber is equated to the total height of the chamber; a well located at one side of the valve-chamber and communicating therewith below the plane of the inlet-opening from the tank; a plunger in the well; and mechanism for controlling the inlet and outlet openings of the valve-chamber.

2. In a casting-machine, the combination with a melting-tank, of a valve-chamber whose side walls converge upwardly on all sides toward a centrally-disposed inlet-opening at its highest point communicating through an upwardly-extending passage-way with the lower portion of the tank, whereby gases and vapors escaping from the molten metal in the chamber may find free vent to the atmosphere; a well located at one side of the valve-chamber and communicating therewith below the plane of the inlet-opening from the tank; a plunger in the well; and mechanism for controlling the inlet and outlet openings of the valve-chamber.

3. In a casting-machine, the combination with a melting-tank, of a valve-chamber whose side walls converge upwardly on all sides toward a centrally-disposed inlet-opening at its highest point communicating through an upwardly-extending passage-way with the lower portion of the tank, whereby gases and vapors escaping from the molten metal in the chamber may find free vent to the atmosphere; said valve-chamber also terminating in a vertically-disposed outlet-opening at its extreme lowest point, whereby the head of molten metal rendered effective to augment the velocity with which the metal issues downward from such chamber is equated to the total height of the chamber; a well located at one side of the valve-chamber and communicating therewith below the plane of the inlet-opening from the tank; a plunger in the well; and mechanism for controlling the inlet and outlet openings of the valve-chamber.

4. In a casting-machine, the combination with a melting-tank, of a vertically-disposed valve-chamber having a centrally-located inlet-opening at its highest point communicating through an upwardly-extending passage-way with the tank, whereby gases and vapors escaping from the molten metal may find free vent to the atmosphere, said valve-chamber also terminating in a vertically-disposed outlet-opening at its extreme lowest point toward which the side walls of the chamber converge, whereby the vertical downflow of metal from the chamber is facilitated and the head of molten metal, rendered effective to augment the velocity with which the metal is-

sues downward from said chamber, is equated to the total height of the chamber; and means for effecting the ejection of molten metal in the valve-chamber through the outlet thereof under a pressure additional to that of its own weight.

5. In a casting-machine, the combination with a melting-tank, of a valve-chamber having an inlet-opening from the tank and terminating in a vertically-disposed outlet-opening at its extreme lowest point, whereby the head of molten metal rendered effective to augment the velocity with which the metal issues downward from said chamber is equated to the total height of the chamber; a well located at one side of the valve-chamber and communicating therewith below the plane of the inlet-opening from the tank; a plunger in the well; and a vertically-disposed valve device in said chamber.

6. In a casting-machine, the combination with a melting-tank, of a valve-chamber having an inlet-opening from the tank and terminating in a vertically-disposed outlet-opening at its extreme lowest point, whereby the head of molten metal rendered effective to augment the velocity with which the metal issues downward from said chamber is equated to the total height of the chamber; a well located at one side of the valve-chamber and communicating therewith below the plane of the inlet-opening from the tank; a plunger in the well; and valves connected to move in unison with each other for controlling the inlet and outlet openings of the chamber.

7. In a casting-machine, the combination with a melting-tank, of a valve-chamber having a centrally-disposed inlet-opening at its highest point communicating through an upwardly-extending passage-way with the tank and also terminating in an outlet-opening at its extreme lowest point having a substantially vertical axis; a well located at one side of the valve-chamber and communicating through a passage-way therewith; a plunger in the well; and mechanism for depressing said plunger below the plane of the upper surface of the passage-way by which it communicates with the valve-chamber and for controlling the inlet and outlet openings of said chamber.

8. In a casting-machine, the combination with a vacuum-chamber, of a mold located therein; a melting-tank on top of the vacuum-chamber; a valve-chamber whose side walls converge upwardly on all sides toward a centrally-disposed inlet-opening which communicates through an upwardly-extending passage-way with the lower portion of the tank, whereby gases and vapors escaping from the molten metal in the chamber may find free vent to the atmosphere; valves for controlling the inflow of molten metal to the chamber and its outflow therefrom; a well located at one side of the valve-chamber and communicating therewith below the plane of the inlet-opening from the tank; a plunger in the well; a power-driven device in the machine; and mechanism operatively connected with such device for actuating the valves and the plunger in proper sequence.

9. In a casting-machine, the combination with a vacuum-chamber, of a mold located therein; a melting-tank on top of the vacuum-chamber; a valve-chamber terminating in a vertically-disposed outlet-opening at its extreme lowest point, whereby the head of molten metal rendered effective to augment the velocity with which the metal issues downward from said chamber is equated to the total height of the chamber; a well located at one side of the valve-chamber and communicating therewith below the plane of the inlet-opening from the tank; a plunger in the well; a power-driven device in the machine; and mechanism operatively connected with such device for actuating the valves and the plunger in proper sequence.

10. In a casting-machine, the combination with a mold, of a vacuum-chamber located therein; a melting-tank on top of the vacuum-chamber; a valve-chamber whose side walls converge upwardly on all sides toward a centrally-disposed inlet-opening communicating through an upwardly-extending passage-way with the lower portion of the tank, whereby gases and vapors escaping from the molten metal in the chamber may find free vent to the atmosphere; said valve-chamber also terminating in a vertically-disposed outlet-opening at its extreme lowest point, whereby the head of metal rendered effective to augment the velocity with which the metal issues downward from said chamber is equated to the total height of the chamber; a well located at one side of the valve-chamber and communicating therewith below the plane of the inlet-opening from the tank; a plunger in the well; valves for controlling the inlet and outlet openings of the valve-chamber; a power-driven device in the machine; and mechanism operatively connected with such device for actuating the valves and the plunger in proper sequence.

11. In a casting-machine, the combination with a separable mold, of a vacuum-chamber located therein; a melting-tank on top of the vacuum-chamber; a valve-chamber whose side walls converge upwardly on all sides toward a centrally-disposed inlet-opening communicating through an upwardly-extending passage-way with the lower portion of the tank, whereby gases and vapors escaping from the molten metal in the chamber may find free vent to the atmosphere, said valve-chamber also terminating in a vertically-disposed outlet-opening at its extreme lowest point whereby the head of metal rendered effective to augment the velocity with which the metal issues downward from said chamber is equated to the total height of the chamber; a well located at one side of the valve-chamber and communicating therewith below the plane of the inlet-opening from the

tank; a plunger in the well; valves for controlling the inlet and outlet openings of the valve-chamber; a power-driven device in the machine; and mechanism operatively connected with such device for actuating the valves and the plunger in proper sequence.

12. In a casting-machine, the combination with a vacuum-chamber, of a separable mold located therein; a melting-tank on top of the vacuum-chamber; a valve-chamber having an inlet-opening at its highest point communicating through an upwardly-extending passage-way with the lower portion of the tank, and also terminating in an outlet-opening at its lowest point; valves for controlling the inlet and outlet openings; a well located at one side of the valve-chamber and communicating therewith; a plunger in the well; a spring for closing the outlet-valve; and means for opening the same.

13. In a casting-machine, the combination with a mold, of a melting-tank; a well communicating with the tank; a plunger in the well for injecting molten metal into the mold; and means for tipping and thereby emptying the tank.

14. In a casting-machine, the combination with a frame, of a removable auxiliary frame supported on the main frame; a mold; a melting-tank supported by the auxiliary frame; a valve-chamber communicating with the interior of the melting-tank and provided with an outlet-opening at its lowest point; a plunger at the side of the valve-chamber for injecting metal therein into the mold; and means for tipping and thereby emptying the tank.

15. In a casting-machine, the combination with a separable vacuum-chamber, of a mold located therein; a bail for removing the movable member of the chamber; mold-filling means supported on the movable member; a melting-tank also located on said movable member; and means for tipping said movable member to empty the tank carried thereon.

16. In a casting-machine, the combination, with a main frame, of a mold carried thereby; mold-filling means removable from the main frame and operative for forcing molten metal under high pressure into the mold; a bail pivoted to the mold-filling means; and mechanism for tipping the mold-filling means relatively to said bail.

17. In a casting-machine, the combination, with a main frame, of a mold carried thereby; mold-filling means removable from the main frame and operative for forcing molten metal under high pressure into the mold; a bail pivoted to the mold-filling means; and gearing mechanism for tipping the mold-filling means relatively to said bail.

18. In a casting-machine, the combination, with a main frame, of a mold carried thereby; mold-filling means removable from the main frame and operative for forcing molten metal under high pressure into the mold; a bail pivoted to the mold-filling means; a gear-segment movable in unison with the mold-filling means; a rotatable gear carried by said bail and in mesh with said gear-segment; and means for turning and for locking said gear.

19. In a casting-machine, the combination with a vacuum-chamber, a mold located therein; a melting-tank adapted to be tilted from its normal position; means for injecting metal into the mold; and means for tipping and thereby emptying the tank.

20. The combination with a separable vacuum-chamber, of a mold located therein; means for clamping the sections of the vacuum-chamber together; a melting-tank; means for injecting metal into the mold located on the movable section of the vacuum-chamber; and means for tipping and thereby emptying the tank.

21. In a casting-machine, the combination, with a mold, of a bail; a vacuum-chamber having a removable cover pivoted to said bail; mold-filling means mounted on said cover; and means for tipping said mold-filling means.

22. In a casting-machine, the combination with a vacuum-chamber and a mold located therein, of mold-filling means; movable and stationary deflectors for directing castings and drip material into different paths, one at least of the drip-deflectors being mounted independently of the mold; and means for actuating said independently-mounted deflector.

23. In a casting-machine, the combination with a vacuum-chamber and a mold located therein, of a mold-filling means; means for shifting the mold and mold-filling means with relation to each other; a combined drip-receiver and drip-deflector mounted independently of the mold; and means for shifting said drip-deflector between the mold and the mold-filling means upon the withdrawal of the mold from the mold-filling means.

24. In a casting-machine, the combination with a vacuum-chamber and a mold located therein, of mold-filling means; means for shifting the mold and mold-filling means with relation to each other, a drip-deflector, and a combined drip-receiver and drip-deflector movable between the mold and the mold-filling means.

25. In a casting-machine, the combination with a vacuum-chamber and a mold located therein, of mold-filling means; means for shifting the mold and mold-filling means with relation to each other, and an inverted-V-shaped combined drip-receiver and drip-deflector movable between the mold and the mold-filling means.

26. In a casting-machine, the combination with a vacuum-chamber and a mold located therein, of mold-filling means; means for shifting the mold and mold-filling means with relation to each other; a drip-deflector movable between the mold and the mold-filling means; and a removable drip-receiver attached to and removable from the vacuum-chamber.

27. In a casting-machine, the combination,

with a mold and with mold-filling means, of means for shifting one of said elements toward and from the other; a drip-deflector movable between the mold and the mold-filling means; a second drip-deflector below said first drip-deflector; and a drip-receiver below said second drip-deflector.

28. In a casting-machine, the combination with a vacuum-chamber and a mold located therein, of mold-filling means; means operatively connected to the machine for shifting the mold and mold-filling means with relation to each other; a drip-deflector mounted independently of the mold; means for shifting said deflector between the mold and the mold-filling means upon the separation of the two; and a casting-receiver located below the mold.

29. In a casting-machine, the combination with a vacuum-chamber and a mold located therein, of mold-filling means; means operatively connected to the machine for shifting the mold and mold-filling means with relation to each other; a drip-deflector mounted independently of the mold and having a deflecting-face inclined in one direction; means for shifting said deflector between the mold and the mold-filling means upon the separation of the two; and a casting-deflector located below the mold and having a deflecting-face inclined in a different direction.

30. In a casting-machine, the combination with a vacuum-chamber and a separable mold located therein embodying a plurality of mold-sections, of mold-filling means; means operatively connected with the machine for shifting the mold and mold-filling means with relation to each other; mold-separating means for parting the mold-sections; a drip-deflector mounted independently of the mold; means for shifting the deflector between the mold and mold-filling means upon the separation of the two; and a casting-deflector disposed substantially below the mold-filling means.

31. In a casting-machine, the combination with a vacuum-chamber and with a mold located therein, of mold-filling means; means for shifting the mold and mold-filling means with relation to each other; a drip-receiver located at one side of the mold; a casting-receiver located at the other side of the mold; drip-deflecting means mounted independently of the mold; means for shifting the drip-deflecting means between the mold and the mold-filling means upon the separation of the two; and casting-deflecting means located above the casting-receiver.

32. In a casting-machine, the combination with a vacuum-chamber and a mold located therein, of mold-filling means; means operative from the machine for shifting the mold and mold-filling means with relation to each other; a drip-receiver located at one side of the mold; a casting-receiver located at the other side of the mold; drip-deflecting means movable between the mold and the mold-filling means and located above the drip-receiver; a mold-carrier; and casting-deflecting means supported on the mold-carrier.

33. In a casting-machine, the combination with a vacuum-chamber and a mold located therein, of superposed mold-filling means having a discharge-nozzle; means operatively connected to the machine for raising and lowering the mold; a reciprocatory drip-deflector mounted independently of the mold; and means for shifting the drip-deflector into a position under the discharge-nozzle.

34. In a casting-machine, the combination, with a mold and with superposed mold-filling means having a discharge-nozzle, of a mold-carrier movable toward and from said discharge-nozzle; a drip-receiver movable into position under said discharge-nozzle; and casting-deflecting means supported on the mold-carrier and movable therewith.

35. In a casting-machine, the combination with a vacuum-chamber and a mold located therein, of superposed mold-filling means having a discharge-nozzle; means operatively connected to the machine for raising and lowering the mold into and out of contact with the nozzle; a drip-deflector mounted independently of the mold; and power-operated means for shifting the drip-deflector into position under the discharge-nozzle on the lowering of the mold, and for withdrawing the same from between the mold and the nozzle to permit the mold to be raised.

36. In a casting-machine, the combination, with a vacuum-chamber having an opening therein, of a mold within said chamber; superposed mold-filling means having a discharge-nozzle; means for raising and lowering the mold; an operating member working in said opening; an air-tight packing between the operating member and the walls of said opening; and a drip-receiver controlled by said operating member and movable into position under said discharge-nozzle on the lowering of the mold.

37. In a casting-machine, the combination, with a mold and with superposed mold-filling means having a discharge-nozzle, of means for raising and lowering the mold, and a drip-receiver below said discharge-nozzle and having an opening through which the upper portion of the mold is movable.

38. In a casting-machine, the combination, with a mold and with superposed mold-filling means having a discharge-nozzle, of means for raising and lowering the mold; a drip-receiver below said discharge-nozzle and having an opening through which the upper portion of the mold is movable; and a drip-deflector movable in said drip-receiver into position under said discharge-nozzle.

39. In a casting-machine, the combination, with a mold and with superposed mold-filling means having a discharge-nozzle, of means for raising and lowering the mold; a drip-receiver below said discharge-nozzle and having an opening through which the upper portion of the mold is movable; and an inverted-

V-shaped drip-deflector movable in said drip-receiver into position under said discharge-nozzle and having its faces inclined toward the sides of said drip-receiver.

40. In a casting-machine, the combination, with a mold and with superposed mold-filling means having a discharge-nozzle, of means for raising and lowering the mold; a drip-deflector movable into position under said discharge-nozzle; a second drip-deflector located below the first drip-deflector and having an opening through which the upper portion of the mold is movable; and a drip-receiver located below the second drip-deflector.

41. In a casting-machine, the combination, with a vacuum-chamber having an opening therein, of a separable mold located within said chamber and having a pair of mold-sections; mold-filling means; mold-separating mechanism; an operating member working in said opening; an air-tight packing between the operating member and the walls of said opening; and a mold-cleaning brush controlled by said operating member and movable between the opened mold-sections.

42. In a casting-machine, the combination with a vacuum-chamber, of mechanism including a mold located therein; mold-filling means; a driving member; a valve controlled in its movements by said driving member; a motor having a piston operatively connected with a member of the mechanism within said vacuum-chamber; and means controlled by said valve for supplying the motor with a motive fluid.

43. In a casting-machine, the combination with a vacuum-chamber, of mechanism including a mold located therein; mold-filling means; a driving member located outside the vacuum-chamber; a piston-valve controlled in its movements by said driving member; a motor having a piston operatively connected with a member of the mechanism within said vacuum-chamber; and means controlled by said valve for supplying the motor with a motive fluid.

44. In a casting-machine, the combination with a vacuum-chamber, of mechanism including a mold located therein; a driving member located outside the vacuum-chamber; a piston-valve controlled in its movements by said driving member; a motor also located outside the vacuum-chamber and having a piston operatively connected with a member of the mechanism within the vacuum-chamber, said member working through an opening therein; means controlled by said valve for supplying the motor with a motive fluid; and an air-tight packing between said member and the wall of said opening.

45. In a casting-machine, the combination, with a vacuum-chamber having an opening therein, of a mold within said chamber; superposed mold-filling means having a discharge-nozzle; means for raising and lowering the mold; a driving member located outside the vacuum-chamber; a fluid-controlling piston-valve controlled in its movements by said driving member; a fluid-motor also located outside the vacuum-chamber and having a piston; fluid-supplying means connected and communicating with the motor and with the piston-valve; a piston-rod working in said opening in the chamber; an air-tight packing between the piston-rod and the walls of said opening; and a drip-receiver located wholly within said chamber and movable into position under said discharge-nozzle and controlled by said piston-rod.

46. In a casting-machine, the combination, with a vacuum-chamber having an opening therein, of a mold within said chamber; superposed mold-filling means having a discharge-nozzle; means for raising and lowering the mold; a driving member located outside the vacuum-chamber; a fluid-controlling piston-valve controlled in its movements by said driving member; a fluid-motor also located outside the vacuum-chamber and having a piston, and also having a piston-rod working in said opening in the chamber; fluid-supplying means connected and communicating with the motor and with the piston-valve; an air-tight packing between the piston-rod and the walls of said opening; and a drip-receiver located wholly within said chamber and movable into position under said discharge-nozzle and connected with said piston-rod.

47. In a casting-machine, the combination with a vacuum-chamber and a mold located therein, of mold scraping and cleansing mechanism; mold-filling means; driving means; a pair of differentially-operative valves controlled in their movements by the driving means; a pair of fluid-motors having pistons; fluid-supplying means connected and communicating with each motor and with the valve corresponding to such motor; and means connecting the said pistons with the mold scraping and cleansing mechanism for effecting the operation thereof.

48. In a casting-machine, the combination, with a mold embodying a pair of mold-sections, of mold-filling means; mold-separating means for shifting said mold-sections in different directions; and a pair of mold-scrapers mounted respectively on said mold-sections and movable relatively thereto across the cheeks thereof.

49. In a machine of the class specified, the combination, with a vacuum-chamber having an opening, of a mold located within said chamber; mold-filling means; and slidable vacuum-maintaining casting-receiving means for sealing said opening.

50. In a machine of the class specified, the combination, with a vacuum-chamber having an opening, of a mold located within said chamber; mold-filling means; and vacuum-maintaining means embodying a casting-receiver and a valve reciprocally effective for sealing said opening.

51. In a machine of the class specified, the

combination, with a vacuum-chamber having an opening, of a mold located within said chamber; mold-filling means; and vacuum-maintaining means embodying a casting-receiver and a valve movable in unison and reciprocally effective for sealing said opening.

52. In a machine of the class specified, the combination, with a vacuum-chamber having an opening, of a mold located within said chamber; mold-filling means; and vacuum-maintaining means embodying a casting-receiver and a slidable valve reciprocally effective for sealing said opening.

53. In a machine of the class specified, the combination with a vacuum-chamber having an opening, of a mold located within said chamber; mold-filling means; and vacuum-maintaining means embodying a slidable casting-receiver and a valve reciprocally effective for sealing said opening.

54. In a machine of the class specified, the combination, with a vacuum-chamber having an opening, of a mold located within said chamber; mold-filling means; and vacuum-maintaining means embodying a casting-receiver and a slide-valve secured thereto and effective reciprocally therewith for sealing said opening.

55. In a machine of the class specified, the combination, with a vacuum-chamber having an opening, of a mold located within said chamber; mold-filling means; and a plurality of shiftable vacuum-maintaining casting-receivers separately effective for sealing said opening.

56. In a machine of the class specified, the combination, with a vacuum-chamber having an opening, of a mold located within said chamber; mold-filling means; and a pair of shiftable vacuum-maintaining casting-receivers alternately effective for sealing said opening.

57. In a machine of the class specified, the combination, with a vacuum-chamber having an opening, of a mold located within said chamber; mold-filling means; and a plurality of slidable vacuum-maintaining casting-receivers separately effective for sealing said opening.

58. In a machine of the class specified, the combination, with a vacuum-chamber having an opening, of a mold located within said chamber; mold-filling means; and a plurality of shiftable vacuum-maintaining casting-receivers movable in unison and separately effective for sealing said opening.

59. In a machine of the class specified, the combination, with a vacuum-chamber having an opening, of a mold located within said chamber; mold-filling means; a pair of shiftable vacuum-maintaining casting-receivers alternately effective for sealing said opening; and means effective reciprocally with said casting-receivers respectively for also sealing said opening.

60. In a machine of the class specified, the combination, with a vacuum-chamber having an opening, of a mold located within said opening; mold-filling means; a pair of shiftable vacuum-maintaining casting-receivers alternately effective for sealing said opening; and a cut-off plate connecting said casting-receivers and effective reciprocally with said receivers respectively for also sealing said opening.

61. In a machine of the class specified, the combination, with a vacuum-chamber having an opening, of a mold located within said chamber; mold-filling means; a pair of connected slidable vacuum-maintaining casting-receivers separately effective for sealing said opening; and a rack-and-pinion movement for shifting said receivers.

62. In a casting-machine, the combination, with a support, of a melting-tank; an operated member mounted in the melting-tank and adapted to govern the flow of molten metal; an operating member disposed in parallelism with said operated member; and a pivoted connector detachably secured to said operating and operated members respectively and detachable therefrom by a movement in the plane of its oscillation.

63. In a casting-machine, the combination, with a support, of a melting-tank mounted thereon and vertically removable therefrom; a vertically-disposed valve mounted in the melting-tank; a valve-operating member disposed in parallelism with said valve; and a horizontally-disposed pivoted connector detachably secured to the valve and the valve-operating member respectively, and detachable therefrom by swinging it in the plane of its oscillation.

64. In a casting-machine, the combination, with a support, of a melting-tank mounted thereon and vertically removable therefrom; a vertically-disposed valve mounted in the melting-tank; a plunger also mounted in the melting-tank and parallel with said valve; valve-operating and plunger-operating members disposed in parallelism with said valve and plunger; and a pair of horizontally-disposed pivoted connectors detachably connected, the one to the valve and the valve-operating member respectively, and the other to the plunger and the plunger-operating member respectively, and detachable by swinging them in their respective planes of oscillation.

HENRY L. BOCK.

Witnesses:
C. A. WEED,
S. NELSON LYONS.