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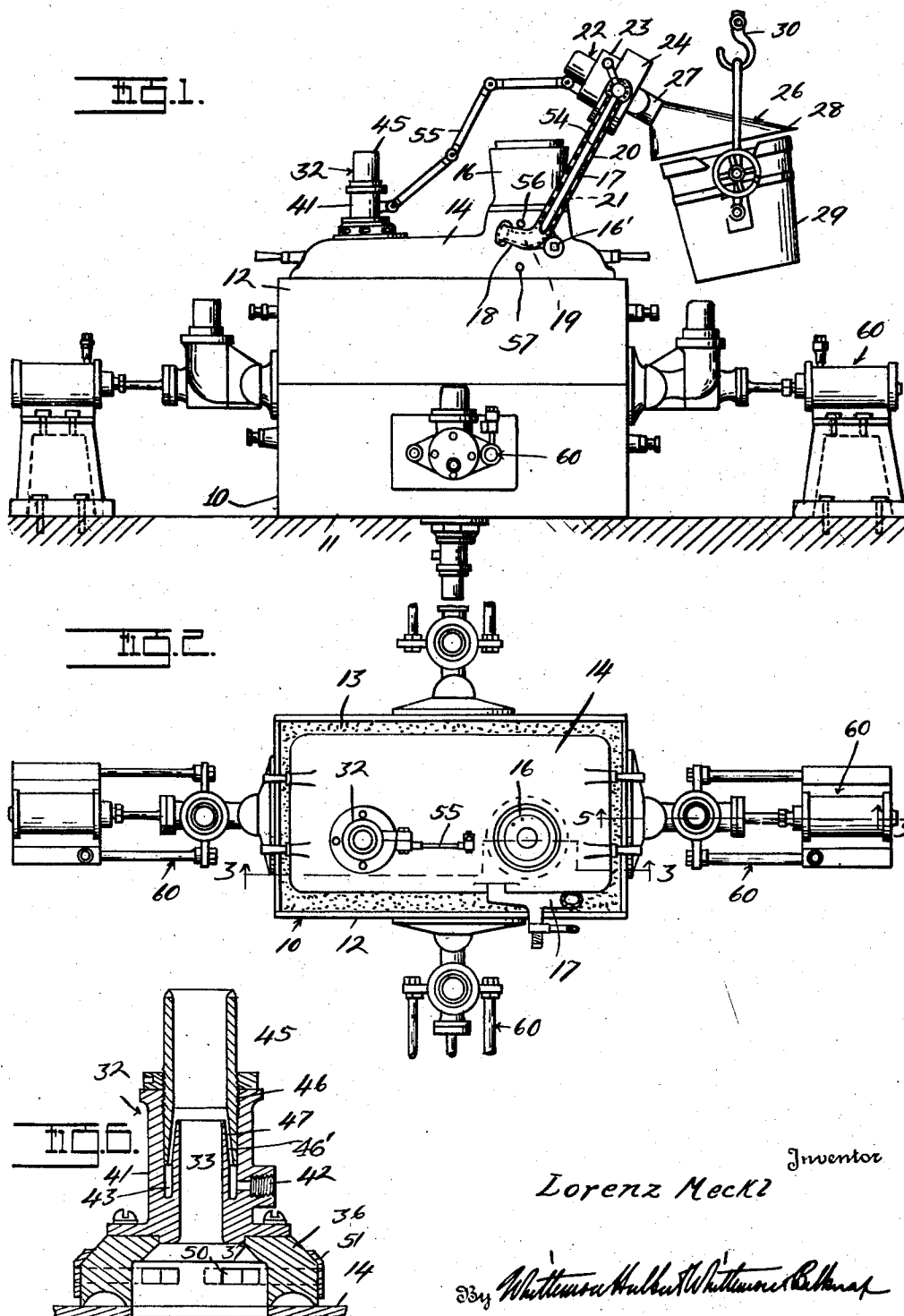
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CASTING APPARATUS

Filed Nov. 7, 1932

3 Sheets-Sheet 1



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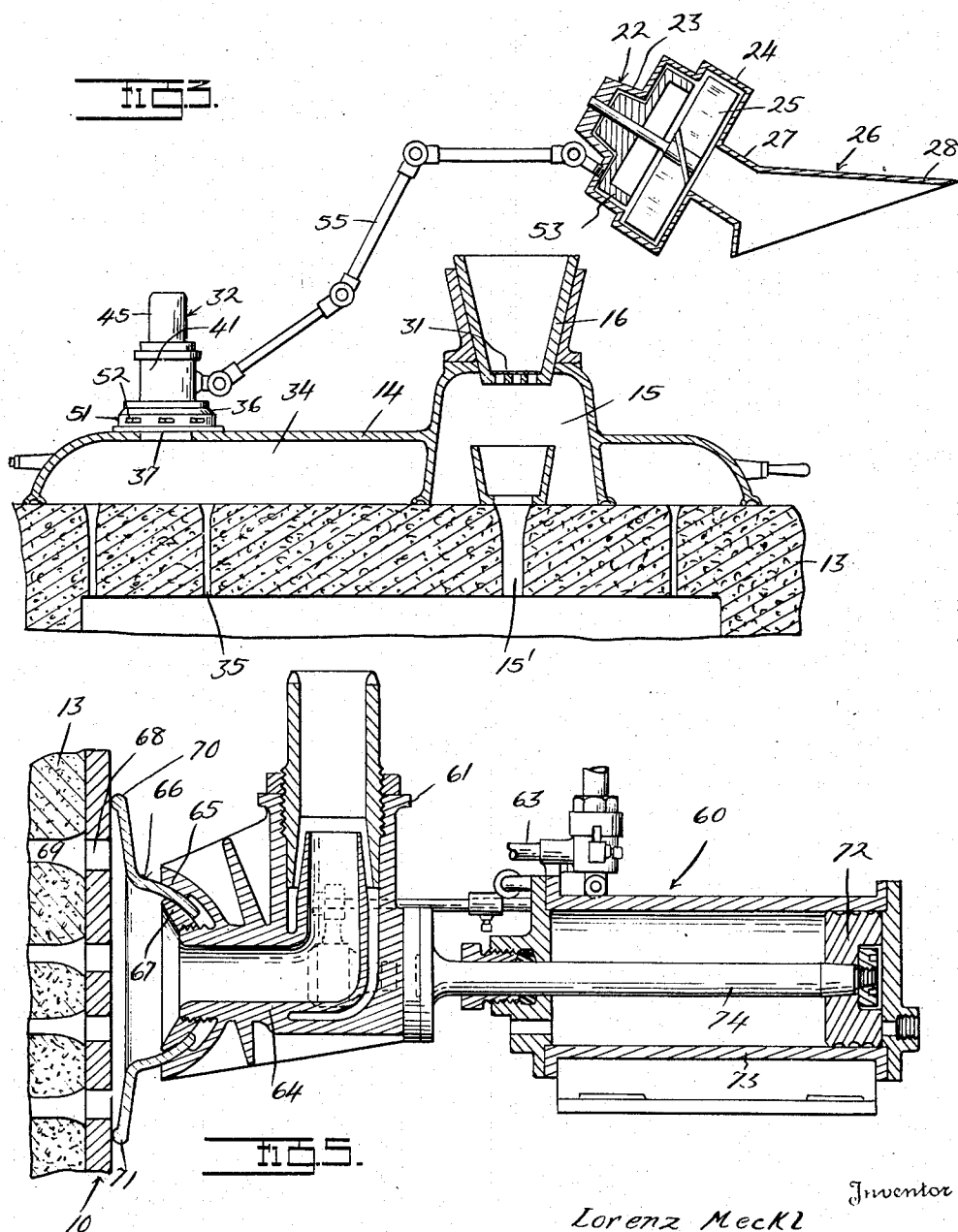
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3 Sheets-Sheet 2



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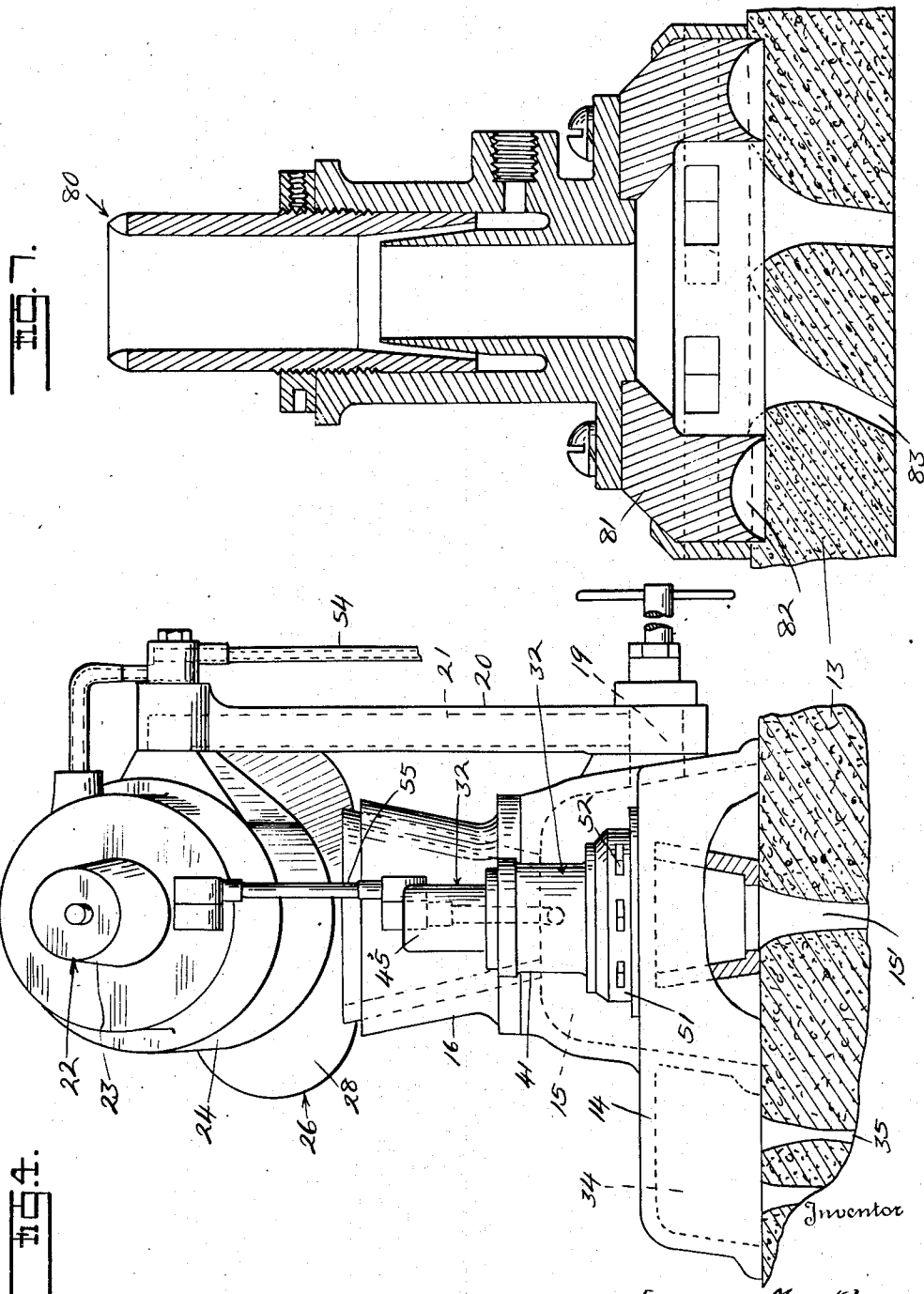
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CASTING APPARATUS

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3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE

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CASTING APPARATUS

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7 Claims. (Cl. 22-57)

This invention relates generally to the art of molding and refers more particularly to improvements in apparatus for forming castings.

It is well established that metals having relatively low pouring temperatures freeze or solidify at a comparatively high rate necessitating complete and rapid exhausting of the vapor or gases occluded in the molten metal in order to produce a casting free from porosity. The rapid rate of solidification of some metals not only tends to create blowholes in the casting by trapping the gases or vapors in the mold, but also tends to produce shrinkage cracks in the casting which are also objectionable, and in many cases necessitate scrapping the entire casting.

The present invention contemplates the provision of molding apparatus capable of forming castings from metal having extremely low pouring temperatures free from porosity, shrinkage cracks and draws. In accordance with this invention, the tendency for the casting to shrink to such an extent as to cause cracks therein is eliminated by retarding the rate of solidification of the molten metal, and this is accomplished herein by passing a heated fluid through the mold prior to the pouring operation. In addition, the gases or vapors occluded in the molten metal are actually withdrawn from the mold during the pouring operation, and this feature, together with the fact that the rate of solidification is somewhat retarded by preheating the mold, eliminates porosity of the casting.

With the foregoing as well as other objects in view, the invention resides in the peculiar construction of the molding apparatus which provides for obtaining the foregoing results and which will be made more apparent as this description proceeds, especially when considered in connection with the accompanying drawings, wherein:

Figure 1 is a side elevational view of a molding apparatus constructed in accordance with this invention;

Figure 2 is a plan view of the construction shown in Figure 1;

Figure 3 is a fragmentary sectional view taken substantially on the line 3-3 of Figure 2;

Figure 4 is a fragmentary end elevational view of the construction shown in Figure 1;

Figure 5 is a sectional view taken substantially on the line 5-5 of Figure 2;

Figure 6 is a longitudinal sectional view through the suction device illustrated in Figure 1;

Figure 7 is a longitudinal sectional view through a slightly modified form of construction.

For the purpose of illustration, I have shown my improved molding apparatus as designed to form sand molds, and for this purpose, comprises a flask 10 having a lower part 11 and an upper part 12 cooperating in the positions thereof shown in Figure 1 to form a sand mold 13. The apparatus as well as the method utilized for ramming the sand in the flask to fashion the mold forms no part of the present invention and may be accomplished by employing any one of the numerous commercially acceptable methods.

As previously stated, the present invention concerns itself more particularly with the novel means employed herein for preheating the mold and the means provided for actually withdrawing the gases or vapors from the mold. The foregoing results are accomplished herein by providing a manifold 14 adapted to seat upon the top of the sand mold to form in effect a cover therefor. The manifold 14 is formed with a preheating chamber 15 therein communicating at the upper end with a suitable funnel 16 fashioned for receiving the molten metal from the ladle and communicating at the lower end with the interior of the mold cavity through the medium of the usual mold gate 15' formed in the sand mold. Pivotally mounted as at 16' upon the side wall of the manifold is a bell crank lever 17 having a relatively short arm 18 formed with a passage 19 therethrough communicating in one extreme position of the bell crank lever shown in Figure 1 with the interior of the chamber 15. The other arm 20 of the bell crank lever extends upwardly from the arm 18 and is provided with a passage 21 therethrough communicating with the passage 19 formed in the arm 18. The upper end of the arm 20 forms a support for a combined turbine and fan assembly designated generally herein by the reference character 22. The latter assembly comprises a casing 23 having a portion 24 communicating at one side thereof with the upper end of the passage 21 in the bell crank arm 17 and fashioned to house a suitable suction fan 25. The portion 24 of the housing 23 is also provided with an opening in the front wall thereof adjacent the fan 25 through which heated fluid may be withdrawn into the housing by the fan. In the present instance, the heated fluid is supplied to the housing by means of a funnel-shaped hood 26 having the stem portion 27 communicating with the interior of the housing through the front wall of the portion 24 and having the outwardly flared portion 28 thereof fashioned to assume a position in juxtaposition to the ladle 29 prior to the pouring opera-

tion. The ladle 29 is usually transported from the retort to the mold by means of a traveling conveyor, a portion of which is designated herein by the reference character 30, and the molding apparatus is so positioned with respect to the conveyor that when the bell crank lever 17 is in the position thereof shown in Figure 1, the flared portion 28 of the hood registers with the top of the ladle 29. The fan 25 is so designed as to withdraw the heated air radiating from the molten metal in the ladle into the portion 24 of the housing and to discharge this fluid through the passages in the bell crank lever 17 into the chamber 15. During this latter operation of the apparatus, a relatively thin plate 31 is positioned across the lower end of the funnel 16 so as to compel the heated fluid discharged into the chamber 15 to flow through the gating means of the mold into the mold cavity.

The heated fluid discharged into the mold cavity by the blower or fan 25 is withdrawn from the cavity by a suction device 32 removably secured to the top surface of the manifold 14 and establishing communication between a suction chamber 34 in the manifold and the atmosphere. The suction chamber 34 surrounds the chamber 15 hereinbefore described and communicates with the latter through the mold cavity by means of the vents 35. With this construction, it will be apparent that a suction created in the device 32 will not only effect a withdrawal of the heated fluid discharged into the mold cavity by the blower prior to the pouring operation, but will also effect a withdrawal of the gases or vapors occluded in the molten metal during the pouring operation.

Referring now more in detail to the particular construction of the device 32 for creating a suction on the mold and with special reference to Figure 6, it will be noted that this device comprises a base 36 detachably secured to the top of the manifold and having a central opening 37 therethrough communicating with the suction chamber 34 through an aperture in the adjacent wall of the manifold. Extending upwardly from and removably secured to the base 36 in a casting 41 having a central passage 33 therethrough registering with the opening 37 in the base. The casting is further formed with an annular recess 43 surrounding the passage 33 and communicating therewith at the upper end thereof. The lower end of the recess 43 communicates with a source of fluid under pressure through the medium of an intake port 42 formed in the casting, and the arrangement is such that as fluid under pressure is discharged from the upper end of the annular recess, the same flows past the mouth of the passage 33 at a high rate of velocity causing a suction in the passage 33. In order to secure the desired degree of suction at the discharge end of the passage 33, I provide means for varying the effective area of the recess 43 adjacent the aforesaid end of the passage. In the present instance, the above results are secured by a sleeve 45 threadably mounted as at 46 within the upper end of the casting 41 and having the lower end thereof fashioned to project into the discharge end of the recess 43 so as to restrict the effective area of the latter end of this passage. In detail, it will be noted that the inner surface of the sleeve at the lower end of the same is tapered outwardly as at 46', and the adjacent annular wall 47 of the recess 43 is correspondingly tapered inwardly. In other words, the upper end of the annular passage 43 tapers inwardly

with respect to the axis of the passage 33 so as to correspondingly deflect the fluid under pressure and thereby insure creating a suction in the passage 33. Moreover, by reason of the above construction, axial adjustment of the sleeve 45 relative to the casting 41 varies the effective area of the discharge end of the annular recess 43 which in turn varies the velocity of the fluid discharged from the annular recess, and, as a consequence, provides for controlling the suction. While the sleeve 45 provides for varying the suction within certain limits, nevertheless, in forming certain types of molds, considerable care must be taken that the suction is not sufficient to rupture the mold, and in order to eliminate this objection, I provide additional means for controlling the suction. In detail, the base 36 of the device 32 is formed with a plurality of transversely extending passages 50 establishing communication between the opening 37 therethrough and the atmosphere. The flow of air through these passages is accurately controlled by means of a valve member 51 rotatably mounted upon the base and having openings 52 therethrough accurately located with respect to the passages. The arrangement is such that if it is desired to reduce the suction on the mold to the minimum, the valve member 51 is rotated to register the openings therethrough with the passages 50 through the device, with the result that a considerable amount of the suction force is utilized in withdrawing air into the device instead of acting upon the mold. On the other hand, if greater suction is desired, the valve member 51 is merely rotated to a position wherein the openings therethrough are either partially or completely out of registration with the passages in the base.

While fluid under pressure from any suitable source may be discharged into the annular recess 43 through the intake port 42 to effect the desired suction, nevertheless, in the specific embodiment of the invention, the driving means for the blower or fan 25 is employed for supplying fluid under pressure to the suction device. In detail, the blower or fan 25 is actuated by a turbine 53 rotatably mounted within the casing 23 in rear of the blower and adapted to be driven by a source of compressed air designated generally herein by the reference character 54. The discharge side of the turbine communicates with the intake port 42 of the suction device 32 through the means of an articulated conduit 55. The conduit 55 is articulated in order to provide for moving the bell crank arm 17 to its various positions of adjustment without interfering with communication between the suction device 32 and the casing 23 carried by the aforesaid arm. It will be observed from the above that the turbine 53 not only serves to drive the blower or fan 25, but also functions to supply compressed air to the device 32 for creating a suction therein.

Operation

Assuming that the ladle 29 has been moved to the position thereof shown in Figure 1 and that it is desired to pour the mold, the operator merely swings the bell crank lever 17 downwardly until the arm 18 thereof strikes the stop 56. In this position of the lever 17, the flared portion 28 of the hood assumes a position adjacent the open upper end of the ladle 29 and the passage 19 in the arm 18 of the bell crank lever registers with the intake opening formed in the side of the chamber 15. When the parts are in the above

position, the blower 25 serves to withdraw the heated air radiating from the molten metal into the casing 23 and to force this heated medium into the chamber 15 through the passages in the bell crank arm 17 provided for this purpose. Inasmuch as the chamber 15 communicates with the mold cavity through the medium of the usual gate construction and in view of the fact that the thin plate 31 prevents escape of the heated medium out of the chamber 15, it necessarily follows that this medium is discharged into the mold cavity. As the blower or fan 25 is forcing the heated fluid into the mold cavity, the turbine 53 is discharging fluid under pressure into the device 32 for creating a suction in the latter in the manner clearly defined above. The device 32 also communicates with the mold cavity with the result that the same serves to withdraw from the mold cavity the heating fluid previously discharged therein by the blower or fan 25. In actual practice, the pressure by which the heated fluid is discharged into the mold cavity exceeds the suction at the device 32 so as to insure uniform preheating at all portions of the mold cavity.

After the mold cavity has been preheated in the manner stated above, the bell crank lever is swung rearwardly until the arm 18 thereof strikes the stop 57 whereupon the passage 19 is out of communication with the chamber 15 and the flared portion 28 of the hood 26 is positioned to one side of the funnel 16 permitting the molten metal in the ladle to be poured into the funnel. As the molten metal strikes the extremely thin plate previously positioned across the mouth of the funnel to prevent the escape of the preheating fluid, this plate is automatically destroyed and the molten metal permitted to flow through the chamber 15 into the mold. While it has been previously stated that the turbine and blower assembly has been swung to one side of the funnel in order to permit the pouring of the mold, nevertheless, the operation of this unit is continued, or, in other words, the turbine 53 still functions to discharge fluid under pressure into the device 32. As a consequence, during the pouring operation, a suction is applied to the mold cavity by the device 32, with the result that the gases occluded in the molten metal are forcibly withdrawn from the mold.

In forming relatively large castings, it may be desirable to apply suction to the mold cavity at various points in order to insure complete withdrawal from the mold of the vapors occluded in the molten metal prior to solidification of the latter. For the above purpose, I provide a plurality of independent suction units designated generally herein by the reference character 60, and as shown in Figure 1, one unit may be applied to each side of the flask if desired. Each of the units 60 shown in Figure 1 is identical in construction, and as will be observed from Figure 5, is clamped to the flask by means of fluid-operated pistons. In detail, each of the units 60 is provided with a suction valve or device 61 identical in construction to the device 32 hereinbefore described and supplied with compressed air to produce the desired suction through the medium of a valve-controlled conduit 63. The lower end of the device 61 is provided with a lateral extension 64 having a semi-spherical enlargement 65 adjacent the outer end thereof for slidably engaging a spherical cup-shaped member 66 and having a correspondingly shaped nut 67 threaded upon the extreme outer end thereof for maintaining the cup-shaped member in as-

sembled relation therewith. The nut 67 provides for relatively free universal movement of the cup-shaped member relative to the device 61 so as to permit the aforesaid member to automatically adjust itself to the adjacent side of the flask. In this connection, it is to be noted that the side wall aforesaid of the flask is provided with a series of openings 68 therethrough communicating with the mold cavity through the vents 69 and the cup-shaped member is formed with an outwardly projecting annular flange 70 terminating in a circumferentially extending bead 71 for engaging the side wall of the flask beyond the openings 68. The cup-shaped member 66 is clamped to the flask by means of a piston 72 reciprocally mounted in a cylinder 73 and rigidly secured to the device 61 by means of a rod 74. The piston 72 is of the double-acting type and in the present instance, is moved in opposite directions relative to the cylinder by compressed air to clamp the cup-shaped member to and release the same from the flask. The fluid connections with the cylinder 73 for accomplishing the desired reciprocation of the piston 72 are not shown herein and any suitable system may be employed.

When several units 60 are utilized in association with the preheating device hereinbefore described, the valves controlling the flow of fluid under pressure to the suction devices 61 for creating a suction in the latter are not operated until the preheating function has been completed so that there will be no danger of the suction on the mold exceeding the pressure at which the heating fluid is discharged into the mold. In other words, when the units 60 are employed in the combination shown in Figure 1, the same operate only to withdraw from the mold the gases occluded in the molten metal during the pouring operation. It will, of course, be understood that if the suction device 32 in Figure 1 is omitted, then one of the units 60 may be operated in unison with the preheating mechanism for the purpose previously set forth in connection with the device 32.

In forming certain types of castings or in forming castings from different types of metals, it is not essential to preheat the mold, and in such cases, the suction device 80 shown in Figure 7 may be employed. This suction device is identical to the suction device 32 with the exception that the base 81 of the device 80 is adapted to seat directly upon the sand, and the lower surface thereof is provided with a plurality of cup-shaped recesses 82 in order to insure the necessary seal around the central opening through the base. When the device 80 is employed, the central opening through the base is arranged in communication with the mold through the medium of vents 83 formed in the molding material.

From the foregoing description, it will be apparent that I have provided means for utilizing the heat radiated from the molten metal prior to pouring the mold for preheating the latter so as to retard the rate of solidification of the molten metal in the mold and thereby eliminate shrinkage cracks and blowholes in the casting. It will further be observed that I have provided in conjunction with the preheating means a device for creating a suction on the mold so as to not only draw the heating fluid therethrough, but to forcibly exhaust the gases occluded in the molten metal during the pouring operation. It will also be apparent from the previous description that the several features of this invention may be realized by various types of constructions, and, accordingly, reservation is made to make such

changes in the specific embodiments illustrated herein as may come within the purview of the accompanying claims.

What I claim as my invention is:

5 1. A casting apparatus comprising a manifold having chambers communicating with each other through a mold cavity, means for discharging a heating medium into one of said chambers including a blower having an intake opening
10 communicating with a source of heated fluid and an exhaust opening communicating with said chamber, and means for creating a suction in the other of said chambers.

2. A casting apparatus comprising, a blower
15 having an intake opening communicating with a source of heated fluid and having an exhaust opening communicating with a mold cavity for discharging the heated fluid into the latter, a suction device also communicating with the mold
20 cavity for withdrawing the heating fluid therefrom, and a turbine for driving the blower having the exhaust side thereof communicating with said device for creating a suction in the latter.

3. A casting apparatus of the class set forth,
25 comprising a mold forming member having a side wall portion formed with an opening there-through communicating with the mold cavity, a suction device for withdrawing gases from the mold cavity through said opening, and means
30 for clamping said device to the side wall portion aforesaid of the mold forming member including a cup-shaped element engageable with the exterior surface of said side wall with the perimeter thereof surrounding the opening through the
35 latter and connected to said device for universal movement relative thereto.

4. A casting apparatus of the class set forth, comprising a mold forming member having a side
40 wall portion formed with an opening there-through communicating with the mold cavity, a suction device for withdrawing gases from the mold cavity through said opening, means for clamping said device to the side wall portion
aforesaid of the mold forming member including
45 a cup-shaped element engageable with the exterior surface of said side wall with the perimeter thereof surrounding the opening through the

latter, and a connection between the element and said device permitting the former to automatically adjust itself relative to the portion of the side wall with which it is engaged.

5. A casting apparatus of the class set forth,
5 comprising a mold forming member having a side wall portion formed with an opening there-through communicating with the mold cavity, a suction device for withdrawing gases from the mold cavity through said opening, means for
10 clamping said device to the side wall portion aforesaid of the mold forming member including a cup-shaped element engageable with the exterior surface of said side wall with the perimeter thereof surrounding the opening through the
15 latter, and fluid pressure means for urging said element into clamping engagement with the member.

6. A casting apparatus, comprising a casing having an intake opening therein and having an
20 exhaust opening communicating with a mold, a source of molten metal, a hood at the intake opening of the casing for collecting the heated air radiating from the molten metal prior to pouring the mold, and a fan rotatably mounted
25 within said casing for withdrawing the heated air radiating from the molten metal and collected by said hood and discharging the same into the mold.

7. A casting apparatus, comprising a manifold
30 having chambers communicating with each other through the mold cavity, a casing having an intake opening therein and having an exhaust opening communicating with one of the chambers, a source of molten metal, a hood at the
35 intake opening of the casing for collecting the heated air radiating from the molten metal prior to pouring the mold, a fan rotatably mounted within said casing for withdrawing the heated air
40 radiating from the molten metal into the hood and discharging the same into the said chamber, and suction means communicating with the other chamber for withdrawing the heated air in the
45 first mentioned chamber into the mold cavity for heating the latter.

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