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(54) **MAGNETIC PUMP INSTALLATION**

MAGNETISCHE PUMPENANLAGE

INSTALLATION DE POMPE MAGNÉTIQUE

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Description

RELATED APPLICATION

FIELD OF THE INVENTION

[0001] The present invention relates to pumps used to circulate material in non-ferrous molten metal furnaces and, more specifically, to the location and operation of electromagnetic or permanent magnet-based molten metal pumps.

BACKGROUND

[0002] It is desirable for a number of reasons to cause material to flow in non-ferrous molten metal furnaces. Magnetic pumps are sometimes used to induce eddy currents in the metal in order to induce such flow or agitation. Electromagnetic devices are used in some known pumps, and permanent magnets are used in other such pumps. Such pumps are typically attached to the outside of a side wall of a furnace, and the molten metal may be piped into and around the pump structure (as in published U.S. patent application publication numbers 2011/0248432 and 2010/0244338, which are both incorporated herein by reference). This means that molten metal is moved outside the furnace, elevating the likelihood of an uncontained leak from such pumps and associated structures.

[0003] Moreover, some existing devices project magnetic flux through furnace external walls, which need to be thick for safety reasons.

[0004] Furthermore, US patent application 2008/0106830 shows an apparatus for a circulating molten metal in a vessel containing the molten metal, the apparatus comprising a well located entirely in the vessel and a magnet positioned within the well.

[0005] Each of these approaches can be inefficient in agitating molten metal and create a significant risk of leakage of molten metal through the side wall of the furnace or within the structures outside the furnace and through which the metal flows. Such a leak or breach may result in significant risk of leakage outside the pump structure, not to mention the risk of damage to the pump structure.

SUMMARY

[0006] The terms "invention," "the invention," "this invention" and "the present invention" used in this patent are intended to refer broadly to all of the subject matter of this patent and the patent claims below. Statements containing these terms should be understood not to limit the subject matter described herein or to limit the meaning or scope of the patent claims below. Embodiments of the invention covered by this patent are defined by the claims below, not this summary. This summary is a high-level overview of various aspects of the invention and

introduces some of the concepts that are further described in the Detailed Description section below. This summary is not intended to identify key or essential features of the claimed subject matter, nor is it intended to be used in isolation to determine the scope of the claimed subject matter. The subject matter should be understood by reference to appropriate portions of the entire specification of this patent, any or all drawings and each claim.

[0007] The present invention solves the problems described above by an apparatus according to claim 1. In some embodiments, the invention provides other benefits by positioning a magnetic pump, which may be an electromagnetic or permanent magnet based pump, at the entrance to a side well of the furnace and in a pump well with a long, relatively thin side wall that wraps around a significant fraction of the circumference of the pump. The long, thin side wall of the pump well and significant wrap angle around the pump well facilitates creation of a strong eddy current based flow field in the molten material with better magnetic coupling, thereby enhancing the effectiveness of the pump. The risk of breach of the relatively thin pump well wall is

acceptable because breach of the well wall and flow of molten metal into the well will not result in spillage of metal outside the furnace. Moreover, the well can be monitored for any such breach so that the pump can be lifted out of the well to protect it from contact with the molten metal in the event of such a breach.

BRIEF DESCRIPTION OF THE FIGURES

[0008]

Figure 1 is a perspective view of a pump of this invention in a well in a metal furnace.

Figure 2 is an elevation view, in section of the installed pump shown in figure 1.

Figure 3 is a schematic plan view of a furnace and pump of this invention.

Figure 4 is a schematicized side view, partially in section, of another embodiment of the pump of this invention in a well in a metal furnace.

Figure 5 is a schematic plan view of a furnace and pump according to another embodiment.

Figures 6-7 are isometric views of a lift system according to an embodiment.

Figure 8 is a schematic plan view of a furnace and pump according to another embodiment.

DETAILED DESCRIPTION

[0009] The subject matter of embodiments of the

present invention is described here with specificity to meet statutory requirements, but this description is not necessarily intended to limit the scope of the claims. The claimed subject matter may be embodied in other ways, may include different elements or steps, and may be used in conjunction with other existing or future technologies. This description should not be interpreted as implying any particular order or arrangement among or between various steps or elements except when the order of individual steps or arrangement of elements is explicitly described.

[0010] The present invention solves the problems described above by positioning a magnetic pump 10, which may be an electromagnetic or permanent magnet based pump, in a well 12 located entirely inside the exterior wall 14 of a metal melting furnace 16 and near the entrance 22 to a side well 18 of furnace 16. Certain kinds of scrap may be added in the side well 18, and the extra turbulence in the molten metal generated by the pump 10 quickly submerges and melts the scrap. Agitation in side well 18 also agitates the metal in the main hearth area 20 of furnace 16.

[0011] While other pump configurations may be used, the pump 10 illustrated in figures 1-2 is a permanent pump that is driven by a motor 24 coupled to a gear box 26. The motor 24 may be electrically powered with alternating current or direct current, hydraulically powered or otherwise operated to provide rotational force. The gear box 26, which may be interposed between the motor 24 and a vertical shaft (not visible in figures 1-3), reduces the relatively high rotational speed of the motor 24. This provides a lower rotational speed for rotating an arrangement of one or more permanent magnets (also not visible in figures 1-2) that rotate just inside the inner wall 28 of the cooling jacket 30 through which air, nitrogen or other suitable cooling medium is circulated through inlet 34.

[0012] Cooling jacket 30 is adjacent to a relatively thin refractory wall 32 of the furnace 16 well 12. This cooling maintains a thermal freeze plane. This reduces the likelihood that the aluminum or other molten metal will dissolve holes in the wall 32 of the well 12. If such holes nevertheless form, because the metal is still retained within the furnace, the consequences typically will be less severe than those potentially associated with breach of an exterior wall of a furnace.

[0013] As mentioned, other pump arrangements, such as an electromagnetic pump, may be used instead of a permanent rotatable pump. For example, an induction motor such as the one described in U.S. Pat. No. 3,824,414, which issued Jul. 16, 1974 and is incorporated herein by reference, may be incorporated into a side well of a furnace. Figure 8 illustrates a linear induction motor 200 that may be positioned in a well 212 located entirely inside a metal melting furnace 216 and near a side well 218 of furnace 216. In some embodiments, the surface that is normally flat in a linear induction motor is convex as illustrated in Figure 8. Agitation in side well 212 also agitates the metal in other

areas of the furnace and circulates the metal between the main hearth area 220 and the side well 218 of the furnace 216 in the direction of arrows 215. In some embodiments, submerged ports 222 allow metal to flow between side well 218 and hearth area 220. A submerging pump 224 may be used to submerge and melt any scrap (such as, without limitation, light gauge, clips, chips, or post-consumer based bale scrap) added to the side well 218.

[0014] The pump arrangement of this invention provides an open channel flow system to move molten metal due to the eddy current based flow field created by the magnetic pump, thereby agitating the metal and contributing to maintenance of homogeneous temperatures within the metal. The arrangement of the pump within a relatively thin wall of a well within the furnace minimizes the distance between the moving metal and the magnet, thus facilitating creation of strong eddy currents in the molten material, thereby enhancing the effectiveness of the pump.

[0015] In some cases, the magnetic pump is positioned within the furnace such that significant linear vortexes are created within the metal. For instance, the magnet may be positioned and configured to generate eddy current based flow field for the molten metal positioned within approximately half the thickness of the thin wall of the well (closest to the pump) and force a linear flow along this portion of the metal closest to the magnet. The other approximately half of the molten metal within the thin wall flows in a sympathetic, tortuous path that in turn generates a strong linear vortex throughout the depth of the well.

[0016] Figure 4 depicts another embodiment of a magnetic pump in a well of this invention. Pump 40 is a permanent magnetic based pump and includes a motor/gearbox 42 that drives a shaft 44 that rotates permanent magnets 46 within a well 48 positioned in a molten metal furnace 50 having a main hearth area 52 and a side well 54. Cooling medium indicated by arrows 56 is blown into the well 48 by a blower 58 and exits through port 60. A controller 70 controls motor/gearbox 42 and blower 58. In the event of a breach of well 48 a signal from detector 62 can activate a lift system to lift the pump out of the well. As shown in Figure 4, the lift system includes a hoist (not shown) attached to chain 64 or cable attached to motor/gearbox 42 and capable of lifting pump 40 out of the well 48 to protect it from damage.

[0017] Figures 6-7 illustrate another non-limiting embodiment of a lift system 300 configured to hoist a pump (such as pump 400) out the well in the event of a breach. The lift system 300 illustrated in Figures 6-7 includes a cart 301 having a plurality of wheels 303. The cart 301 is configured to traverse along a set of rails 302 to move the pump 400 away from the furnace.

[0018] Detector 62 can be a thermocouple or other temperature detector for detecting the temperature within the well at the location of the detector. In some cases, detector 62 is a duplex type K thermocouple with an open-

ended protection tube and ceramic bead insulators, although any suitable thermocouple or other temperature detector may be used.

[0019] Detector 62 could, alternatively, be a detector capable of detecting the presence of molten metal in the well by other means. It can also be any other detector adapted to directly or indirectly detect a condition, such as elevated temperature, cessation of air flow, conductivity which indicates the presence of molten metal, change in moisture content of the air or any other parameter or condition capable of being monitored.

[0020] In some embodiments, more than one detector 62 is used and in some cases, more than one type of detector is used. In one non-limiting embodiment, a thermocouple or other temperature detector is used, as well as a detector capable of detecting the presence of molten metal by another means, such as by measuring conductivity with a conduction probe. In one non-limiting embodiment, one of the detectors may be part of a Warrick® conductivity system circuit that has liquid level sensing capabilities such as, but not limited to, Warrick® Series 16M controls.

[0021] If used, a thermocouple element may detect temperature from any suitable location, for example but not limited to, approximately ½" from the bottom of the well 48. If used, a conductivity system, such as but not limited to a Warrick relay reference probe, may be connected directly to the well wall to detect a breach by sensing conductivity associated with any metal infiltration.

[0022] A programmable logic controller or suitable processor can receive and interpret the signal from detector 62 and initiate any suitable action. For example, the PLC can sound or display an alarm so that a furnace operator can determine whether to lift pump 40 out of the well 48, or take any other appropriate action. Alternatively, the PLC can activate a lift apparatus to lift pump 40 out of well 48. Signals from detector 62 and/or the PLC could also be used to automatically or through operator action otherwise control the furnace by, for instance, stopping rotation of the magnets 46 or adjusting the speed of rotation by adjusting operation of motor/gearbox 42, adjust cooling airflow 56 by adjusting operation of blower 58, or changing heat input to the main hearth 52 or some other portion of the furnace 50.

[0023] Figure 5 is another plan view depicting an embodiment of a permanent magnet pump in a well. As shown, a magnetic pump 100 is positioned in a well 112 that is located entirely inside a metal melting furnace 116 and near a side well 118 of furnace 116. Certain kinds of scrap (such as, without limitation, light gauge, clips, chips, or post-consumer based bale scrap) may be added in the side well 118 and/or side well 122 and the extra turbulence in the molten metal generated by the pump 100 quickly submerges and melts the scrap. Agitation in side well 112 also agitates the metal in other areas of the furnace and circulates the metal between the main hearth area 120, the side well 118, and the side well 112 of the furnace 116. In some embodiments, submerged ports

allow metal to flow between side well 112 and hearth area 120 and between side well 112 and side well 118.

[0024] All patents, publications and abstracts cited above are incorporated herein by reference in their entirety.

[0025] Different arrangements of the components depicted in the drawings or described above, as well as components and steps not shown or described are possible. Similarly, some features and subcombinations are useful and may be employed without reference to other features and subcombinations. Embodiments of the invention have been described for illustrative and not restrictive purposes, and alternative embodiments will become apparent to readers of this patent. Accordingly, the present invention is not limited to the embodiments described above or depicted in the drawings, and various embodiments and modifications can be made without departing from the scope of the claims below.

Claims

1. An apparatus for circulating molten metal in a vessel containing the molten metal, the apparatus comprising:
 - a well (12, 48, 112, 212) located entirely within the vessel;
 - a magnet positioned within the well (12, 48, 112, 212);
 - a detector (62) for detecting breach of the well; and
 - a lift adapted to be actuatable in response to a signal from the detector (62) to lift the magnet out of the well (12, 48, 112, 212).
2. The apparatus of claim 1, wherein the magnet is either a permanent magnet (46) rotatable by a motor (24, 42) or an electromagnet.
3. A molten metal furnace (16, 50, 116, 216) comprising:
 - a. a main hearth (20, 52, 120, 220),
 - b. a side well (18, 54, 118, 218),
 - c. a furnace wall surrounding at least the main hearth (20, 52, 120, 220) and the side well (18, 54, 118, 218), and
 - d. an apparatus according to claim 1 for agitating molten metal within the furnace (16, 50, 116, 216), wherein the well of said apparatus is a pump well (12, 48, 112, 212) comprising a generally cylindrical refractory wall (32) positioned entirely within the furnace (16, 50, 116, 216), adjacent to the side well (18, 54, 118, 218) and not contacting the furnace wall, and wherein the apparatus comprises an eddy current pump (10, 40, 100) at least partially within the pump well

(12, 48, 112, 212), the pump (10, 40, 100) comprising a magnet assembly.

4. The furnace (16, 50, 116, 216) of claim 3, wherein the magnet assembly is a rotatable permanent magnet assembly and wherein the pump (10, 40, 100) further comprises a motor (24, 42) for rotating the rotatable permanent magnet assembly. 5
5. The furnace (16, 50, 116, 216) of claim 3, wherein the magnet assembly is a stationary electromagnetic assembly. 10
6. The furnace (16, 50, 116, 216) of claim 3, wherein the pump well (12, 48, 112, 212) is adjacent to the side well (18, 54, 118, 218). 15
7. The furnace (16, 50, 116, 216) of claim 3, further comprising a means for cooling the pump (10, 40, 100). 20
8. The furnace (16, 50, 116, 216) of claim 7, wherein the cooling means is a blower (58) for injecting cooling medium (56) into the well (12, 48, 112, 212). 25
9. The furnace (16, 50, 116, 216) of claim 8, further comprising a jacket (30) adapted for passing cooling medium (56) around the at least one magnet.
10. The furnace (16, 50, 116, 216) of any of claims 3 to 9, further comprising a lift actuatable in response to a signal from the detector (62) to lift the pump (10, 40, 100) out of the well (12, 48, 112, 212). 30
11. The furnace (16, 50, 116, 216) of claim 10, further comprising a lift actuatable in response to furnace operator control to lift the pump (10, 40, 100) out of the well (12, 48, 112, 212). 35

Patentansprüche

1. Vorrichtung zum Zirkulieren geschmolzenen Metalls in einem Behälter, welcher das geschmolzene Metall enthält, wobei die Vorrichtung umfasst:
 - eine Wanne (12, 48, 112, 212), welche vollständig innerhalb des Behälters angeordnet ist;
 - einen Magnet, welcher innerhalb der Wanne (12, 48, 112, 212) positioniert ist;
 - einen Detektor (62) zum Detektieren eines Bruchs der Wanne; und
 - einen Lift, welcher dafür eingerichtet ist, als Reaktion auf ein Signal von dem Detektor (62) betätigbar zu sein, den Magnet aus der Wanne (12, 48, 112, 212) herauszuheben. 50
2. Vorrichtung nach Anspruch 1, wobei der Magnet ent-

weder ein durch einen Motor (24, 42) rotierbarer Permanentmagnet (46) oder ein Elektromagnet ist.

3. Ofen für geschmolzenes Metall (16, 50, 116, 216), umfassend:
 - a. einen Hauptofenraum (20, 52, 120, 220),
 - b. eine Seitenwanne (18, 54, 118, 218),
 - c. eine Ofenwand, welche wenigstens den Hauptofenraum (20, 52, 120, 220) und die Seitenwanne (18, 54, 118, 218) umgibt, und
 - d. eine Vorrichtung nach Anspruch 1 zum Agitieren geschmolzenen Metalls innerhalb des Ofens (16, 50, 116, 216), wobei die Wanne der Vorrichtung eine Pumpenwanne (12, 48, 112, 212) ist, welche eine grundsätzlich zylindrische feuerfeste Wand (32) umfasst, welche vollständig innerhalb des Ofens (16, 50, 116, 216), benachbart der Seitenwanne (18, 54, 118, 218) und die Ofenwand nicht berührend, positioniert ist, und wobei die Vorrichtung wenigstens teilweise innerhalb der Pumpenwanne (12, 48, 112, 212) eine Wirbelstrompumpe (10, 40, 100) umfasst, wobei die Pumpe (10, 40, 100) eine Magnetanordnung umfasst.
4. Ofen (16, 50, 116, 216) nach Anspruch 3, wobei die Magnetanordnung eine rotierbare Permanentmagnetanordnung ist und wobei die Pumpe (10, 40, 100) ferner einen Motor (24, 42) zum Rotieren der rotierbaren Permanentmagnetanordnung umfasst.
5. Ofen (16, 50, 116, 216) nach Anspruch 3, wobei die Magnetanordnung eine stationäre elektromagnetische Anordnung ist.
6. Ofen (16, 50, 116, 216) nach Anspruch 3, wobei die Pumpenwanne (12, 48, 112, 212) der Seitenwanne (18, 54, 118, 218) benachbart ist. 40
7. Ofen (16, 50, 116, 216) nach Anspruch 3, ferner umfassend ein Mittel zum Kühlen der Pumpe (10, 40, 100).
8. Ofen (16, 50, 116, 216) nach Anspruch 7, wobei das Kühlmittel ein Gebläse (58) zum Einbringen von Kühlmittel (56) in die Wanne (12, 48, 112, 212) ist. 45
9. Ofen (16, 50, 116, 216) nach Anspruch 8, ferner umfassend eine Hülle (30), welche dafür eingerichtet ist, Kühlmittel (56) um den wenigstens einen Magneten zu verbreiten. 50
10. Ofen (16, 50, 116, 216) nach einem der Ansprüche 3 bis 9, ferner umfassend einen Lift, welcher als Reaktion auf ein Signal von dem Detektor (62) betätigbar ist, die Pumpe (10, 40, 100) aus der Wanne (12, 48, 112, 212) herauszuheben. 55

11. Ofen (16, 50, 116, 216) nach Anspruch 10, ferner umfassend einen Lift, welcher als Reaktion auf eine Ofenbetriebssteuerung/-regelung betätigbar ist, die Pumpe (10, 40, 100) aus der Wanne (12, 48, 112, 212) herauszuheben.

Revendications

1. Appareil pour la circulation de métal fondu dans un récipient contenant le métal fondu, l'appareil comprenant :
- un puits (12, 48, 112, 212) situé entièrement à l'intérieur du récipient ;
 - un aimant positionné à l'intérieur du puits (12, 48, 112, 212) ;
 - un détecteur (62) pour détecter une brèche du puits ; et
 - un dispositif de soulèvement adapté pour être actionnable en réponse à un signal du détecteur (62) pour soulever l'aimant hors du puits (12, 48, 112, 212).
2. Appareil selon la revendication 1, dans lequel l'aimant est soit un aimant permanent (46) pouvant être entraîné en rotation par un moteur (24, 42) soit un électroaimant.
3. Four à métal fondu (16, 50, 116, 216) comprenant :
- a. une sole principale (20, 52, 120, 220),
 - b. un puits latéral (18, 54, 118, 218),
 - c. une paroi de four entourant au moins la sole principale (20, 52, 120, 220) et le puits latéral (18, 54, 118, 218), et
 - d. un appareil selon la revendication 1 pour agiter le métal fondu à l'intérieur du four (16, 50, 116, 216), dans lequel le puits dudit appareil est un puits à pompe (12, 48, 112, 212) comprenant une paroi réfractaire généralement cylindrique (32) positionnée entièrement à l'intérieur du four (16, 50, 116, 216), adjacente au puits latéral (18, 54, 118, 218) et sans contact avec la paroi du four, et dans lequel l'appareil comprend une pompe à courant de Foucault (10, 40, 100) au moins partiellement à l'intérieur du puits à pompe (12, 48, 112, 212), la pompe (10, 40, 100) comprenant un ensemble d'aimant.
4. Four (16, 50, 116, 216) selon la revendication 3, dans lequel l'ensemble d'aimant est un ensemble d'aimant permanent rotatif et dans lequel la pompe (10, 40, 100) comprend en outre un moteur (24, 42) pour faire tourner l'ensemble d'aimant permanent rotatif.
5. Four (16, 50, 116, 216) selon la revendication 3, dans

lequel l'ensemble d'aimant est un ensemble électromagnétique stationnaire.

6. Four (16, 50, 116, 216) selon la revendication 3, dans lequel le puits à pompe (12, 48, 112, 212) est adjacent au puits latéral (18, 54, 118, 218).
7. Four (16, 50, 116, 216) selon la revendication 3, comprenant en outre un moyen pour refroidir la pompe (10, 40, 100).
8. Four (16, 50, 116, 216) selon la revendication 7, dans lequel le moyen de refroidissement est une soufflante (58) pour injecter un agent de refroidissement (56) dans le puits (12, 48, 112, 212).
9. Four (16, 50, 116, 216) selon la revendication 8, comprenant en outre une chemise (30) adaptée pour faire passer un agent de refroidissement (56) autour de l'au moins un aimant.
10. Four (16, 50, 116, 216) selon l'une quelconque des revendications 3 à 9, comprenant en outre un dispositif de soulèvement actionnable en réponse à un signal du détecteur (62) pour soulever la pompe (10, 40, 100) hors du puits (12, 48, 112, 212).
11. Four (16, 50, 116, 216) selon la revendication 10, comprenant en outre un dispositif de soulèvement actionnable en réponse à une commande de l'opérateur du four pour soulever la pompe (10, 40, 100) hors du puits (12, 48, 112, 212).

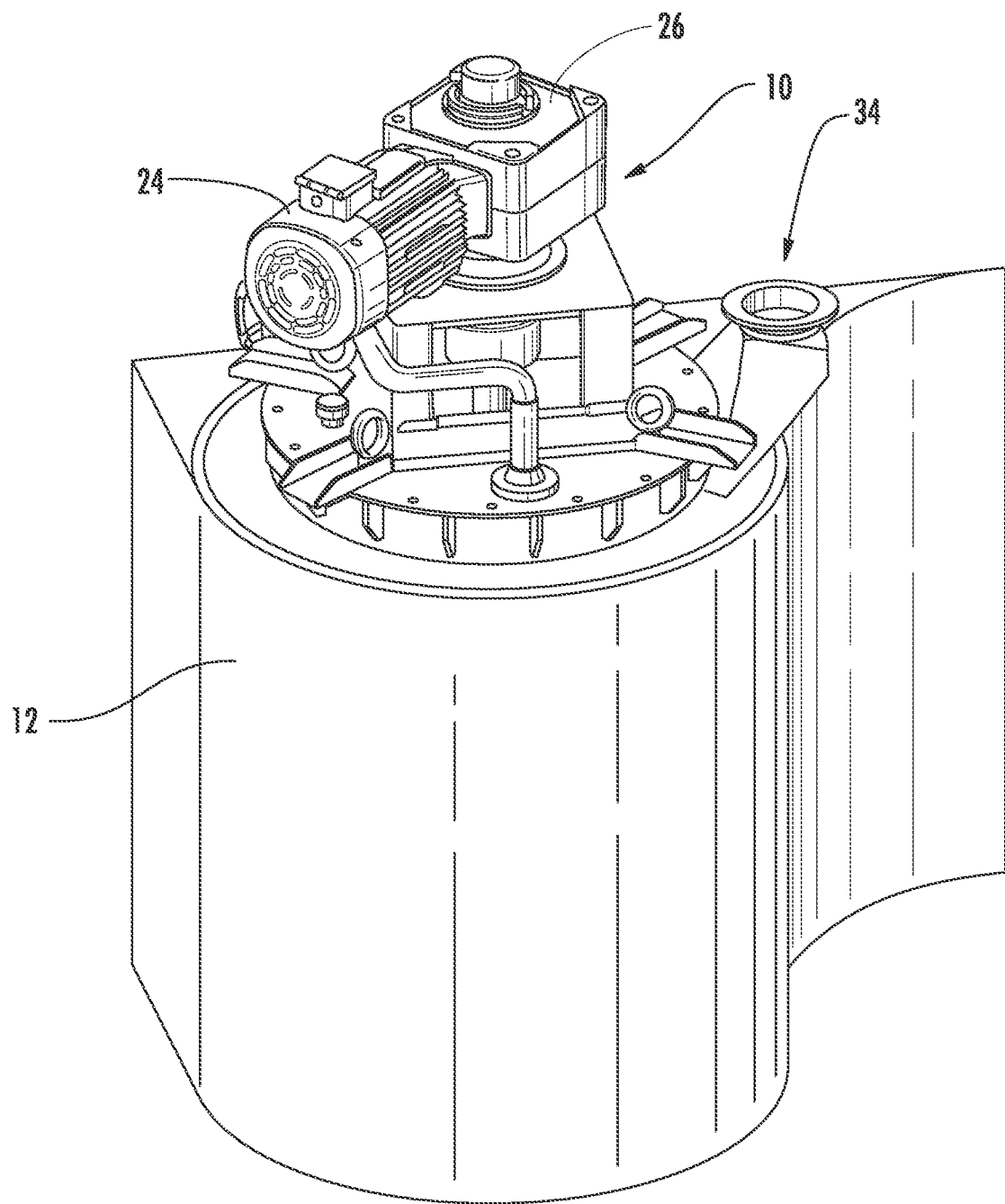


FIG. 1

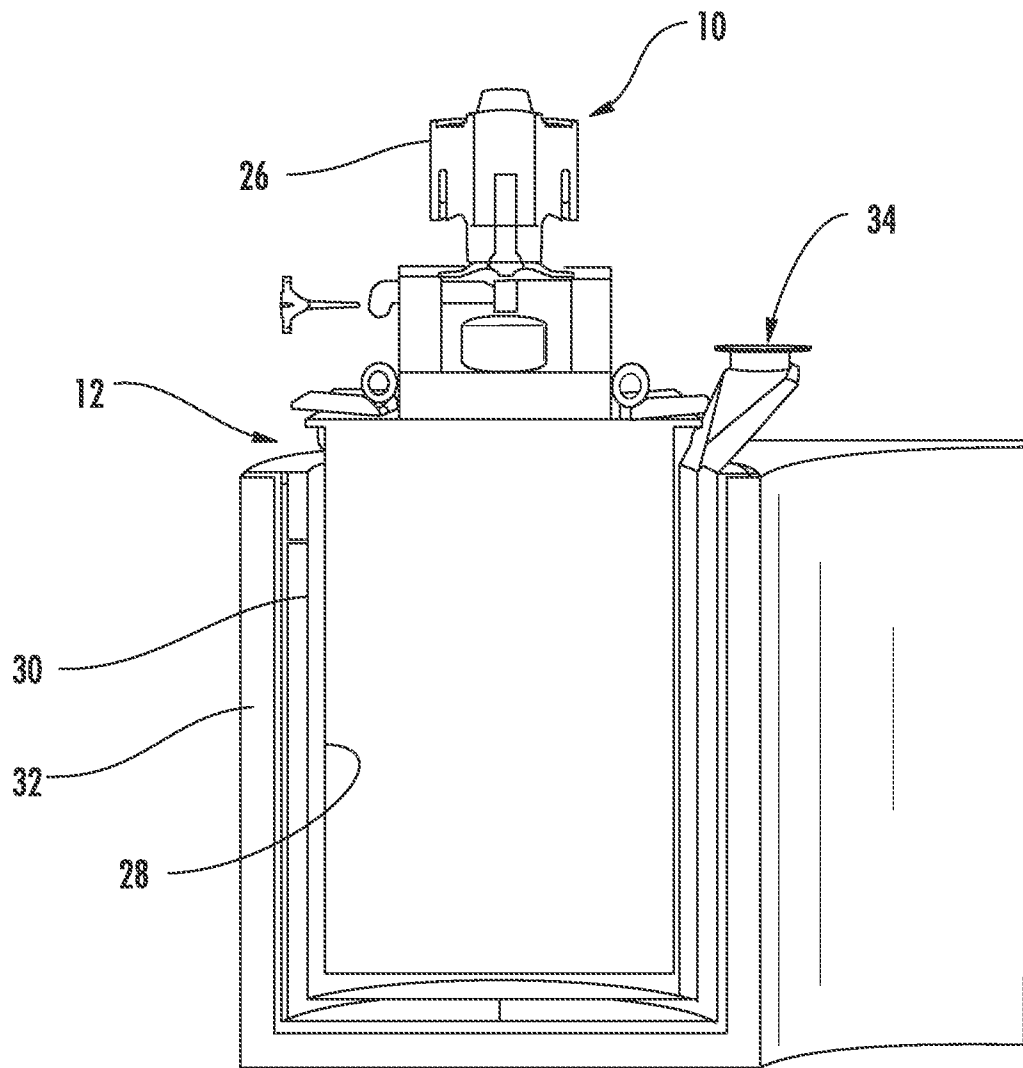


FIG. 2

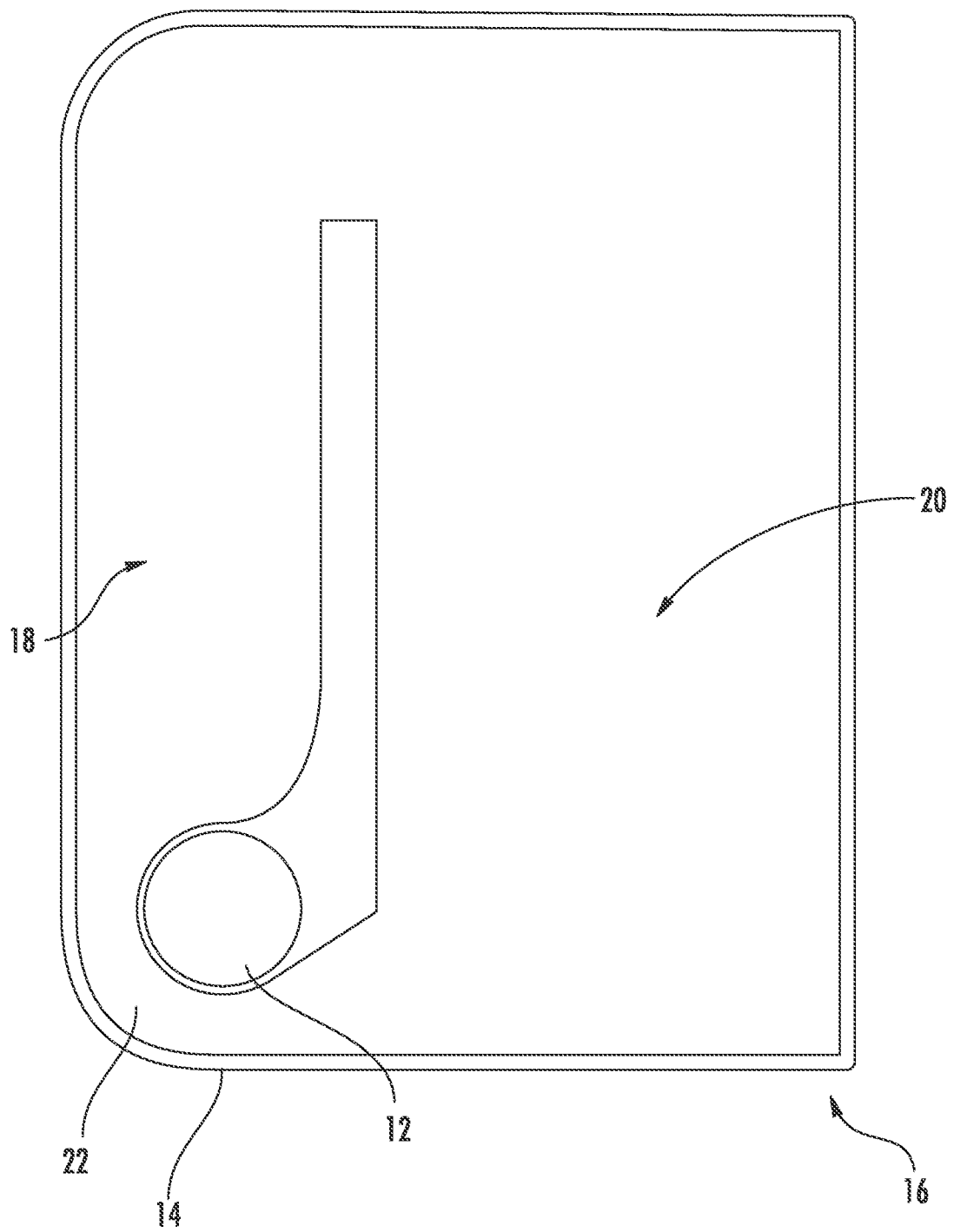


FIG. 3

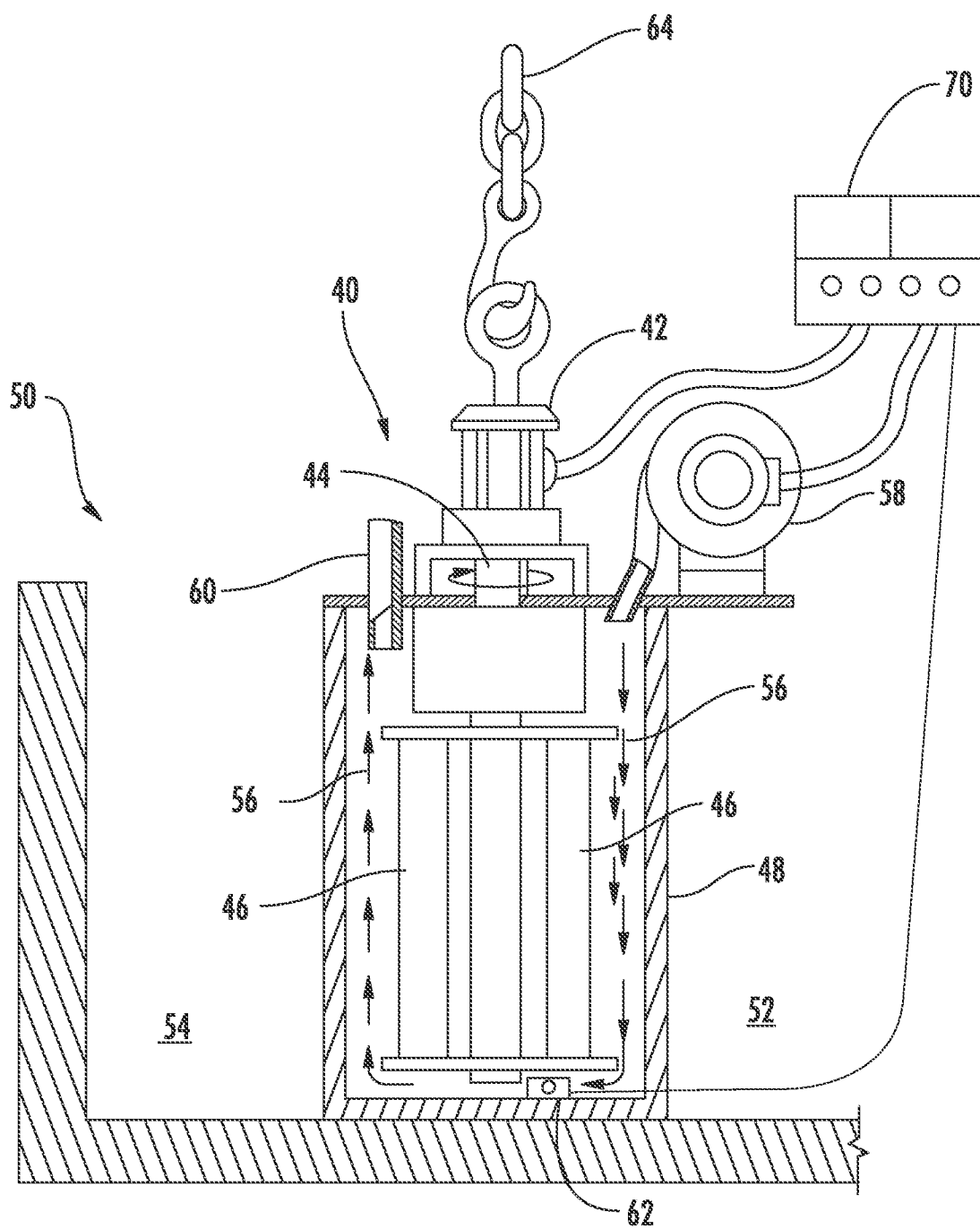


FIG. 4

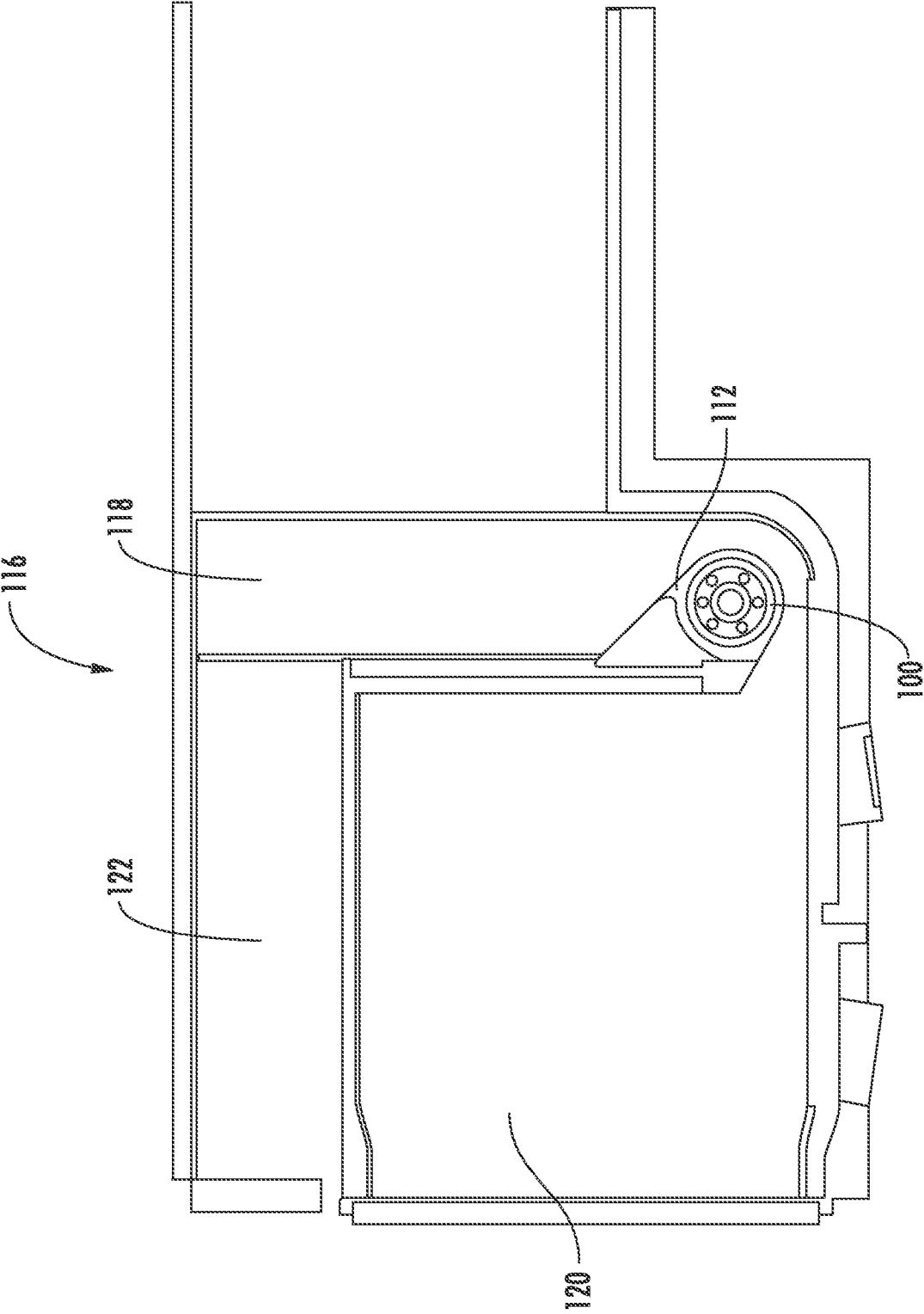


FIG. 5

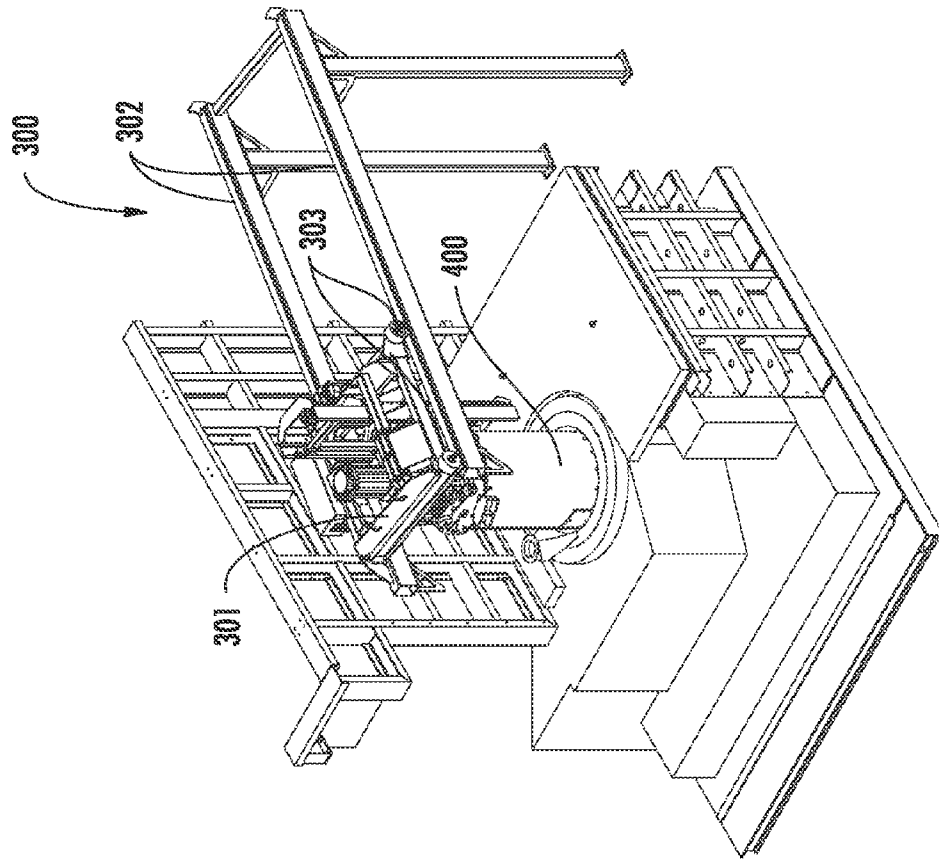


FIG. 7

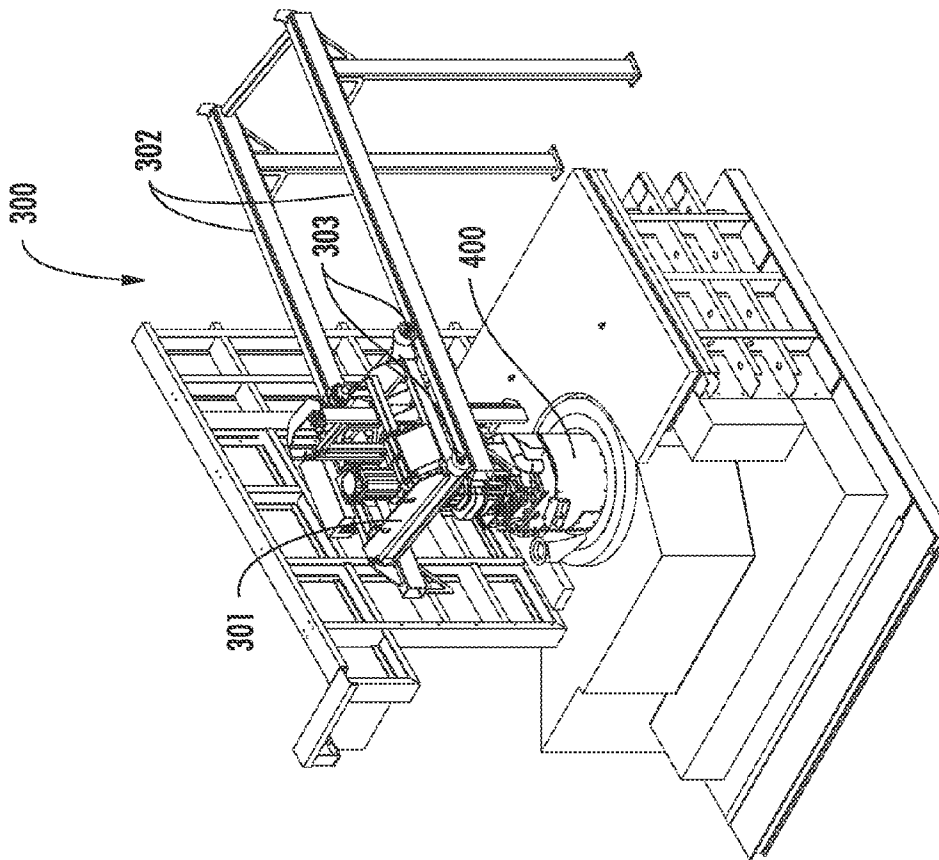


FIG. 6

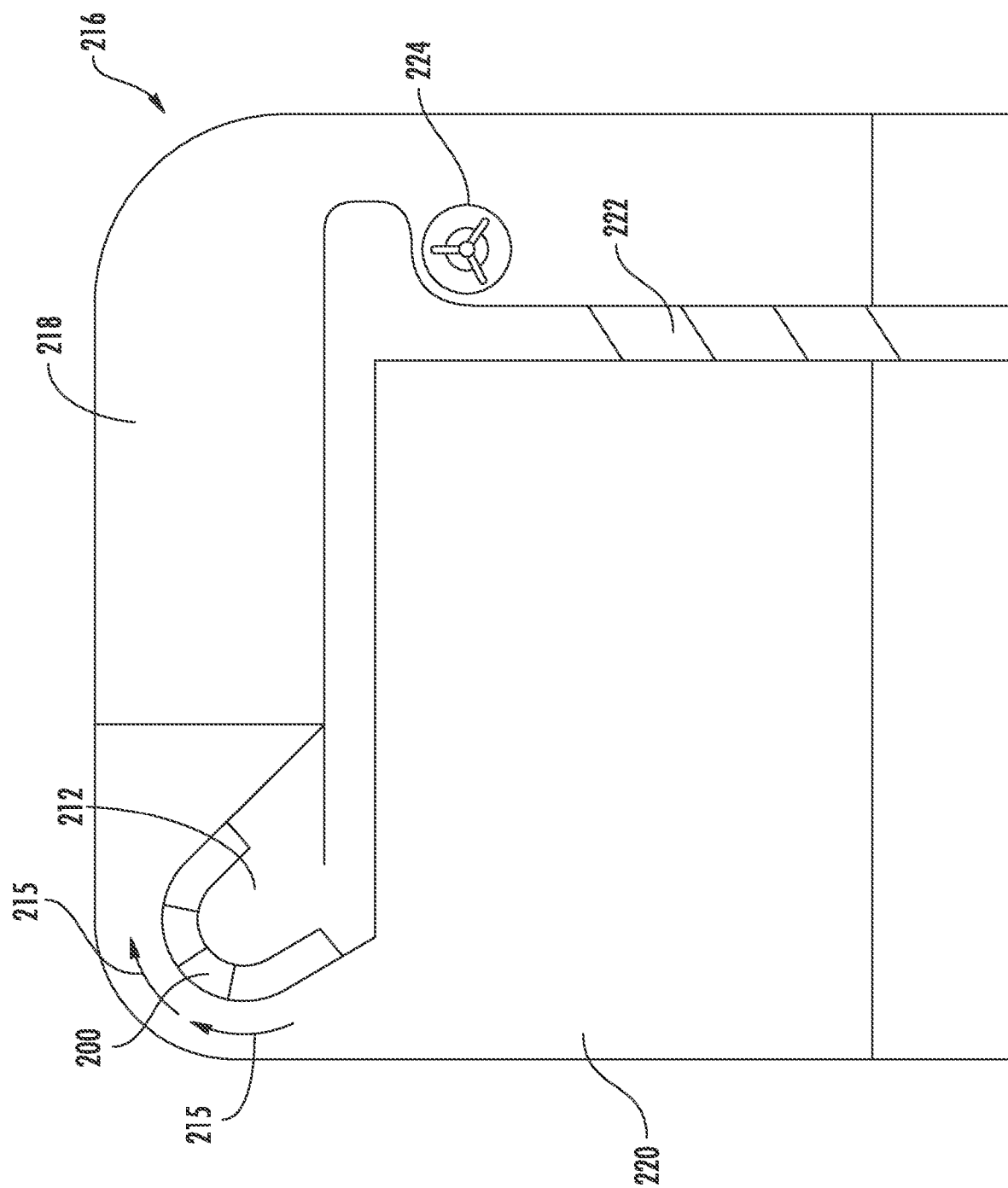


FIG. 8

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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- US 20100244338 A [0002]
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- US 3824414 A [0013]

MÁGNESES SZIVATTYÚÁLLOMÁS*Szabadalmi igénypontok*

1. Berendezés olvadt fémeket tartalmazó edényben az olvadt fém keringtetésére, a berendezés tartalmaz

5 aknát (12, 48, 112, 212), mely teljes egészében az edényben van;
mágneset, mely az aknában (12, 48, 112, 212) van elhelyezve;
detektort (62) az akna repedésének detektálására; továbbá
emelőeszközt, amely a mágnes aknából (12, 48, 112, 212) való kiemeléséhez a detektortól (62) származó jelre válaszul működtethetőn van kiképezve.

10 2. Az 1. igénypont szerinti berendezés, ahol a mágnes elektromágnes vagy motorral (24, 42) forgatható állandómágnes (46).

3. Olvadtfémes kemence (16, 50, 116, 216), **azzal jellemezve**, hogy tartalmaz

a) fő munkateret (20, 52, 120, 220),

b) oldalsó aknát (18, 54, 118, 218),

15 c) legalább a fő munkateret (20, 52, 120, 220) és az oldalsó aknát (18, 54, 118, 218) körülvevő kemencefalat, valamint

d) a kemencében (16, 50, 116, 216) lévő olvadt fém keveréséhez 1. igénypont szerinti berendezést, ahol a berendezés aknája szivattyúakna (12, 48, 112, 212), melynek egy általában hengeres, az oldalsó aknával (18, 54, 118, 218) szomszédosan és a kemencefallal nem érintkezőn teljes egészében a kemencében (16, 50, 116, 216) elhelyezett tűzálló fala (32) van,
20 továbbá ahol a berendezés örvényáram-szivattyút (10, 40, 100) tartalmaz legalább részben a szivattyúaknában (12, 48, 112, 212), ahol a szivattyú (10, 40, 100) mágnesegységet tartalmaz.

4. A 3. igénypont szerinti kemence (16, 50, 116, 216), ahol a mágnesegység forgatható állandómágnes-egység, továbbá ahol a szivattyú (10, 40, 100) tartalmaz továbbá motort (24, 42) a forgatható állandómágnes-egység forgatásához.

5. A 3. igénypont szerinti kemence (16, 50, 116, 216), ahol a mágnesegységet stacionárius elektromágneses egység képezi.

6. A 3. igénypont szerinti kemence (16, 50, 116, 216), ahol a szivattyúakna (12, 48,
30 112, 212) az oldalsó aknával (18, 54, 118, 218) szomszédos.

7. A 3. igénypont szerinti kemence (16, 50, 116, 216), amely tartalmaz továbbá eszközt a szivattyú (10, 40, 100) hűtéséhez.

8. A 7. igénypont szerinti kemence (16, 50, 116, 216), ahol a hűtőeszköz fűvógép (58) hűtőközeg (56) aknába (12, 48, 112, 212) injektálására.

5 9. A 8. igénypont szerinti kemence (16, 50, 116, 216), amely tartalmaz továbbá köpenyt (30), amely hűtőközegnek (56) a legalább egy mágnesen való körülvezetésére alkalmasan van kiképezve.

10 10. A 3-9. igénypontok bármelyike szerinti kemence (16, 50, 116, 216), amely tartalmaz továbbá emelőeszközt, amely a szivattyú (10, 40, 100) aknából (12, 48, 112, 212) való
10 kiemeléséhez a detektortól (62) származó jelre válaszul működtethetően van kialakítva.

11. A 10. igénypont szerinti kemence (16, 50, 116, 216), amely tartalmaz továbbá emelőeszközt, amely a szivattyú (10, 40, 100) aknából (12, 48, 112, 212) való kiemeléséhez a kemencekezelő vezérlésre válaszul működtethetően van kialakítva.