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(54) **Method and apparatus for reclaiming casting sand**

(57) A method of reclaiming casting sand comprises the steps of throwing casting sand into a processing tank and reclaiming the casting sand while air pressure in the processing tank is kept lower than air pressure outside the processing tank, and discharging the reclaimed casting sand from the processing tank while the internal air pressure is kept higher than the external air pressure.

An apparatus for reclaiming and cooling casting sand, comprising means for fluidizing casting sand, means disposed above the fluidizing means for cooling the fluidized casting sand, means disposed above the cooling means for scaling bonds from particles of the casting sand by friction, and means disposed above the cooling means for having relatively large dust particles sedimented is characterized by the bond-scaling means, being configured such that the reclaimed casting sand can be discharged into the fluidizing means therethrough.

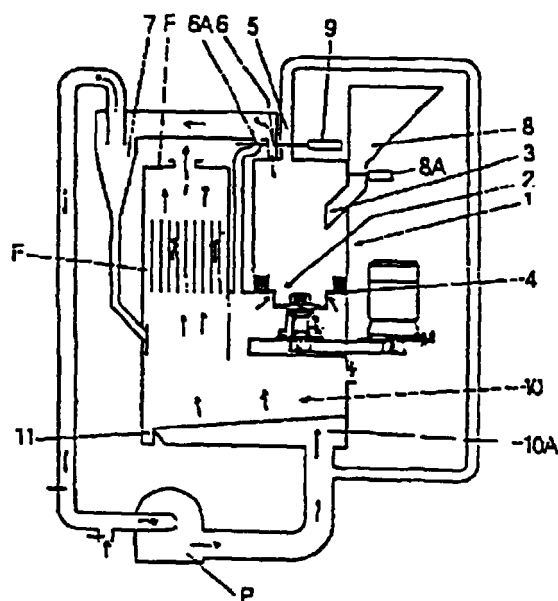


Fig. 1

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Description

[0001] This invention relates to an apparatus and method for reclaiming casting sand. It particularly relates to a method and apparatus for reclaiming casting sand by scaling adhesives on the surfaces of the casting sand. It also relates to an apparatus for effectively reclaiming and cooling the reclaimed casting sand.

[0002] The surfaces of some casting sand particles are coated with adhesives. Such casting sand is repeatedly used by having it coated with new adhesives after its old adhesives have scaled off.

[0003] In a well-known conventional means for reclaiming casting sand (Japanese Patent Early-publication No. 7-314082), used casting sand is put into a drum, sealed with a vertically-movable lid, and then the particles of the sand are rubbed together using centrifugal friction.

[0004] There is a conventional apparatus for reclaiming self-hardening casting sand, wherein adhesives are taken off from particles of sand by having self-hardening casting sand particles rub one another. On the other hand, in reclaiming self-hardening casting sand, which uses alkaline phenol, phenol urethane, or the like as an adhesive, it has recently been required that as little as possible of the residual adhesives be kept in the casting sand. Thus, casting sand particles need rubbing for a long time in reclaiming self-hardening casting sand.

[0005] Further, as to self-hardening casting sand, the temperature of usable sand is generally limited in view of the speed of its chemical reaction. Thus, as mentioned above, when the temperature of casting sand rises after the sand particles have been rubbed together for a long time the reclaimed sand cannot be used as self-hardening casting sand immediately after it has been processed. For this reason the reclaimed sand needs cooling when it is to be used immediately after being reclaimed. Hitherto, reclaimed sand has been cooled in a separate cooler after the reclaiming. As a result of this, there have been problems in that the reclaiming apparatus, comprising means for both reclaiming casting sand and cooling the reclaimed sand, becomes large and expensive.

[0006] However, according to the method disclosed in that publication there were problems in that the reclaiming apparatus needs movable members such as a vertically-movable lid so that it becomes complex and requires extra maintenance. Further, there was no simply-structured processing tank which can reclaim casting sand regardless of its quantity and degree of processing.

[0007] This invention was made to avoid the above-mentioned problems. Its purpose is to provide a simply-constituted method and apparatus for reclaiming casting sand without using movable members such as a vertically-movable lid. Another object of this invention is to

provide a single simply-structured apparatus which can easily control the quantity and degree of processing regardless of the quantity and degree of reclaiming of the casting sand to be processed. A further object of this invention is to provide a compact apparatus comprising the functions of both reclaiming casting sand and cooling the reclaimed casting sand.

[0008] To achieve the above-mentioned objects the method of reclaiming casting sand of this invention is characterized in that it comprises the steps of throwing casting sand into a processing tank and reclaiming the casting sand while air pressure in the processing tank is kept lower than air pressure outside the processing tank, and discharging the reclaimed casting sand from the processing tank while the internal air pressure is kept higher than the external air pressure.

[0009] In one aspect of this invention, an apparatus for reclaiming casting sand having means disposed in a processing tank for scaling a portion of contaminants adhered to surfaces of particles of the casting sand comprises an absorbing tube for absorbing air from the processing tank, a tube for blowing air into the processing tank, and changeover means for alternately opening and closing the absorbing and blowing tube, and is characterized in that air can be caused to flow into and out through a gap provided in the scaling means in cooperation with the absorbing and blowing tube.

[0010] According to this aspect of the invention, casting sand can be reclaimed through a simply-structured apparatus by controlling the retention and discharge of the casting sand in a processing tank by the use of an air stream. Even when a small quantity of or high degree of reclaiming casting sand is needed just one processing tank can easily control the degree of processing by a timer adjusting the reclaiming time.

[0011] In another aspect of this invention, an apparatus for reclaiming and cooling casting sand comprises means for fluidizing casting sand, means disposed above the fluidizing means for cooling the fluidized casting sand, means disposed above the cooling means for scaling bonds from particles of the casting sand by friction, and means disposed above the cooling means for having relatively large dust particles sedimented. It is characterized by the bond-scaling means being configured such that the reclaimed casting sand can be discharged into the fluidizing means therethrough.

[0012] In the thus-constituted apparatus, when recovered casting sand is put into the means for scaling bonds, the casting sand particles are rubbed together so that the bonds scale off. After the casting sand particles have been rubbed for a predetermined time, the processed sand is discharged onto fluidizing means. The discharged casting sand is fluidized and cooled by the cooling means. On the other hand, relatively large powdery dust particles are discharged outward together with the reclaimed sand after the sand has been sedimented by the sedimentation means.

Brief Description of the Drawings

[0013]

- Fig. 1 is a schematic cross section showing the state of the first embodiment of this invention, wherein casting sand is being reclaimed.
- Fig. 2 is a schematic cross section showing the state of the first embodiment of this invention, wherein the reclaimed casting sand is being discharged.
- Fig. 3 is an enlarged schematic cross section showing sedimentation means used in the first embodiment.
- Fig. 4 is a schematic cross section showing the second embodiment of this invention.
- Fig. 5 is a schematic cross section showing the third embodiment of this invention.
- Fig. 6 is a front view showing the fourth embodiment of this invention.

[0014] Generally casting sand used herein is casting sand such as silica, silicone sand or mullite sand. It also comprises globular mullite sand having a high hardness, which was spray/dry-granulated and kilned.

[0015] A processing tank herein is a tank wherein casting sand is processed. The processing is carried out by rubbing sand particles together or by generating a shearing force so as to scale adhesives adhered to the surface layer of sand particles of casting sand whose surface layer has been coated with adhesives.

[0016] In this invention various kinds of well-known scaling means can be used. For example, in one type, casting sand is put into a cylindrical body with a bottom. The cylindrical body is rotated at a high speed to scale contaminants adhered to the surfaces of sand particles of the casting sand by having the sand particles rub one another.

[0017] Another system may also be used wherein, for example, casting sand particles that have accumulated on a ring by being projected outward from the rotating drum through centrifugal force rubbed one another to scale contaminants adhered to the surfaces of the casting sand.

[0018] A further system may be used as scaling means, wherein rotary rollers are disposed in a saucer-shaped rotary drum to scale contaminants adhered to the surfaces of the sand particles of the casting sand, and wherein the scaling process is carried out by pressing the casting sand with both the inside wall of the rotary drum and the rotary rollers, and by generating a shearing force.

[0019] As mentioned above, any well-known scaling means can be used. Further, this invention may be combined with a burning-type reclaiming apparatus as a post-reclaiming unit.

[0020] In this invention air pressure in the processing tank may be reduced to be lower than that outside the tank by, for example, 20 mm Aq (0,2 Pa). When the air pressure in the processing tank is further reduced, the amount of air flowing into the processing tank increases, but the casting sand is kept retained within the tank. On the other hand, since as the pressure in the processing tank nears atmospheric pressure the sand tends to leak outside the processing tank, a differential pressure of about 20mm Aq (0,2 Pa) is required. The amount of air flowing into the processing tank from the fluid layer changes according to the change in the dimension of the gap in the scaling means. Preferably, the gap is about 3 to 15 mm, and more preferably, about 5 to 10 mm.

[0021] Especially, in the scaling means of this invention, casting sand is put into the cylindrical body rotating at a high speed; contaminants adhered to the surfaces of the sand particles of the casting sand are scaled off by having the sand particles rub one another; further, the casting sand is also projected outward by the centrifugal force exerted by the rotary drum; and contaminants adhered to the sand are further scaled off by having the projected sand particles and the sand particles accumulated on the ring rub one another. Thus, when the scaling means of this invention is used, air pressure in the processing tank can be kept lower than that outside the processing tank by adjusting the amount of air that is caused to flow into and discharged through the gap provided between the rotary cylinder and ring. When air pressure inside the processing tank is reduced to be lower than that outside the processing tank, the casting sand will not fall through the gap. Further, the dimension of the gap can be changed relative to the air pressure.

[0022] In this invention, any type of means for absorbing air, as, for example, and preferably, the absorbing side of a blower or dust collector, may be used for it. In this invention, the air-generating means herein is an apparatus for generating low-pressure compressed air such as a blower. An apparatus formed by integrating an air-absorbing means and air-generating means may also be used.

[0023] In this invention, a blowing tube refers to a tube for blowing air into the processing tank and an absorbing tube refers to a tube for absorbing air from the processing tank. In this invention, for example, a changeover valve can be used as a changeover means. However, any means having a function to alternately change the blowing and absorbing tubes through an electric signal can be used.

[0024] In this invention, casting sand is weighed to keep the processing ability and the quality of the reclaimed sand constant in view of the processing time.

[0025] In this invention, contaminants adhered to the surfaces of sand particles of casting sand actually include a self-hardening resin such as alkaline phenol, phenol urethane or furan, and adhesives for raw sand such as bentonite, starch or sea coal.

[0026] In this invention, powdery dust-sedimentation means refer to any means for removing contaminants adhered to the surfaces of the reclaimed casting sand particles to keep the quality of the processed casting sand constant. For example, means for removing powdery dust include a method of separating contaminants from sand by having the speed of an air stream in a dust hood correspond to that of falling sand through the combination of the fluid layer and dust hood or a method for separating contaminants from sand through the difference in the force of inertia by blowing the sand up through a blast pipe to have it collide with a target.

[0027] In this invention, when a cylindrical processing tank is used, scaling means having a cylindrical side is preferable. This selection enables a path for circulating air to be easily formed by providing a gap between the rotor and ring plate of the processing tank and scaling means so as to blow or absorb air through the gap. When two scaling means are used, annular means may be stacked.

First Embodiment

[0028] Below this invention will be described based on a first embodiment. Figs. 1 and 2 show the cross sections of the apparatus of this invention for reclaiming casting sand using a cyclone. Fig. 1 shows the apparatus in a processing state. Fig. 2 shows it in a discharging state. In Fig. 2, the processing tank has means 2 for scaling adhesives at its bottom, and an inlet 3 for putting casting sand thereinto at its upper part, and an outlet 4 for discharging casting sand at its lower part. The outlet 4 also serves as an entrance and exit for air.

[0029] The processing tank 1 communicates with a blower P as air-generating means via a blowing tube 5 at its upper part. The tank 1 also communicates, at its upper part, with the blower P serving as air-absorbing means at its absorbing side via an absorbing tube 6 and a cyclone 7. A casting sand shoot 8 is disposed at the upper part of the tank 1. The shoot 8 has a weighing gate 8A communicating with a sand-shooting inlet 3.

[0030] Further, a changeover valve is provided as changeover means 9 for changing over from the blowing tube 5 to the absorbing tube 6.

[0031] Below the outlet 4 for the processed casting sand, a fluid layer 10 or tank, serving as means for removing impalpable powder, and an entrance to a dust hood F, communicate with the lower part of the processing tank 1. The upper part of the fluid layer 10 communicates with air-absorbing means (not shown) via dust-collecting means 12. The upper part of the fluid layer 10 communicates with an absorbing tube 6A via the changeover means 9, which can be opened and closed

at need.

[0032] Fig. 3 is a cross section detailing the scaling means used in the first embodiment. In it the scaling means 2 comprises a rotary drum 16, which is rotated at a high speed and driven by a motor 15 via a belt pulley 14 and a pillow 13. When the drum is rotated after casting sand S has been thrown into it, contaminants adhered to the surfaces of sand particles of the casting sand S are scaled through friction generated by the sand particles rubbing one another. A gap is formed between the rotary drum 16 and a fixed ring 17, through which gap G air can flow into and out of the processing tank 1.

[0033] Next is described the operation of this reclaiming apparatus. Fig. 1 shows the apparatus wherein casting sand is being reclaimed: the blower P is operating; the rotary drum 16 is driven by the motor 15 via the pillow and the belt pulley 14; a flange on the upper part of the dust hood F communicates with a dust collector duct (not shown), from which duct a needed amount of wind is always being sent out; and the changeover means 9 is set to blow air into the processing tank 1.

[0034] During this state the absorbing tube 6 and the blowing tube 5, both communicating with the processing tank 1, are opened and closed, respectively, and the absorbing tube 6A, communicating with the fluid layer 10, is closed. At this time the absorbing tube 6 serves to separate dust from the sand through the different rates of sedimentation in the processing tank 1. In other words, air in the processing tank 1 is drawn toward the absorbing side of the air-generating means via the absorbing tube 6 and cyclone 7. The air generated from the blower P flows into the processing tank 1 through the gap G between the rotary drum 16 and fixed ring 17.

[0035] Casting sand S in the chute or shoot 8 is weighed through a timer in a weighing gate 8A and shot into the processing tank 1. The casting sand that has fallen into the tank is projected onto the fixed ring 17 by centrifugal force exerted by the rotating drum 16, and collides with the casting sand accumulated in the fixed ring 17 so that some parts of contaminants adhered to the surfaces of sand particles are scaled (see Fig. 3). While air flows into the processing tank 1 through the gap G between the rotary drum 16 and the fixed ring 17, no casting sand can go out of the gap. Thus, the sand particles are repeatedly projected, and collide with one another while being retained in the processing tank 1. In other words, the surfaces of the casting sand particles are ground commensurate with the processing time during which the casting sand is retained in the processing tank 1. Thus, a retention time is set to obtain a needed degree of grinding.

[0036] It is now described how the completely reclaimed casting sand is discharged, in reference to Fig. 2. At this time the absorbing tube 6 and blowing tube 5, both communicating with the processing tank 1, are closed and opened, respectively, and the absorbing

tube 6A, communicating with the fluid tank 10, is opened. That is, air in the wind chest 10A of the fluid layer 10 is absorbed into the processing tank 1 via the blowing tube 5 and changeover means 9. The air blown into the processing tank 1 presses the completely reclaimed casting sand S into the fluid layer 10 through the gap G between the rotary drum 16 and fixed ring 17.

[0037] Since at this point the powdery dust which has been scaled is still adhered thereto, it must be removed. The processed sand that has fallen into the fluid tank 10 is blown upward by the air shot out through a split plate 10B, and is caused to flow toward the dust hood F. Since the inside of the dust hood F has been adjusted such that the speed of the wind is matched to the sedimentation speed of the casting sand, only the powdery dust is carried by the air stream and collected in a dust collector (not shown). Finally, the reclaimed sand, which has been ground and which is free from powdery dust particles, is discharged from the sand outlet 11.

[0038] Although in this embodiment the blowing tube 5 and absorbing tubes 6 and 6A are separately provided, a single tube may achieve the two functions. The powdery dust is collected through a cyclone 7.

[0039] As described above, this embodiment can easily control the degree to which casting sand is reclaimed by controlling the retention and discharge of the casting sand in the processing tank through the adjustment of the air pressure therein. Further, in this invention only a simply-structured apparatus is needed to reclaim casting sand.

Second Embodiment

[0040] The invention is now described based on a second embodiment. Fig. 4 is a cross section of the reclaiming apparatus of this invention, wherein a dust collector 41 is used instead of the cyclone 7. In Fig. 4, solid lines show the state of an air stream within the apparatus containing casting sand being reclaimed, and dotted lines show the state of an air stream in the apparatus containing completely reclaimed casting sand being discharged.

[0041] In Fig. 4, the apparatus has the same constitution as that of the first embodiment, except for the dust collector 41. The second embodiment functions similarly to the first embodiment. However, since the absorbing tube 6 communicates with the dust collector 41 for collecting dust, the blower P is prevented from being worn away by dust particles. As stated above, by the use of a dust collector the second embodiment has an effect of preventing the blower from being worn away.

Third Embodiment

[0042] This embodiment of the invention is described by reference to Fig. 5 which is a cross section of the reclaiming apparatus of this invention, wherein

only the dust hood F is used, instead of the cyclone and dust collector 41. In Fig. 5, solid lines show the state of an air stream within the apparatus containing casting sand being reclaimed, and dotted lines show the state of an air stream in the apparatus containing completely reclaimed casting sand being discharged.

[0043] In Fig. 5, the apparatus has the same constitution as that of Fig. 1, except that air is not circulated within the apparatus, and that no cyclone or dust collector in the air-circulating path is used.

[0044] It is now described how the above structured apparatus functions. In Fig. 5, casting sand S is reclaimed in a state wherein the absorbing tube 6 is opened, and the blowing tube 5 communicating with the processing tank 1 is closed. The reclaimed sand is discharged in a state wherein the absorbing tube is closed, and the blowing tube 5 communicating with the processing tank 1 is opened. In the apparatus of Fig. 5, air flows as follows: during reclaiming, a gate G1 is opened so that air flows from it, and into the opened absorbing tube 6 after passing through the gap 4. Since the blowing tube is closed, the amount of wind in the dust hood F is the same as that produced by the blower. As at this time a damper D2 is closed, the amount of dust-collecting wind is the sum of that of the blower wind and that of the wind passing through the gate G1.

[0045] Next, while discharging the reclaimed sand, the gate G1 is dosed, the blowing tube 5 is opened, the absorbing tube 6 is closed, and the damper D2 is opened. A part of air from the blower flows via the fluid layer, and another part flows from the absorbing tube 6 into the dust hood F. Since at this time the total amount of dust-collecting wind decreases, this deficient wind is supplemented from the damper D2. As stated above, since the third embodiment can omit the cyclone and dust collector, it can be further simplified.

[0046] The fourth embodiment is a variation of the third embodiment of this invention and is described by reference to Fig. 6. As shown in it, the apparatus has substantially the same constitution and operating conditions as those of the third embodiment, except that it has a cooling means 20, disposed midway between the processing tank 1 and fluid layer 10, for cooling the fluidized casting sand.

[0047] The inside of the dust hood F communicates with the dust collector duct via a communication tube 25, which functions similarly to the absorbing tube 6A of the first and second embodiments. The combination of the air gate G1 and the damper D2 of the third embodiment, operating as means for adjusting the amount of dust-collecting wind, is simplified by using the absorbing tube 25, which just replaces that combination. Three opening and closing mechanisms 26, 27, and 28 are used instead of the changeover means 9 of the third embodiment. The mechanisms function separately and also similarly to the changeover means.

[0048] The cooling means 20 comprises horizontal piping, wherein a number of pipes are arranged verti-

cally above the air-storing tank 10A, and through which water passes.

[0049] The casting sand S, which is passed into the air-storing tank, and which has a temperature of, for example, about 100°C, is cooled by the cooling means 20 while it is being fluidized and agitated by the fluidizing means 10. The temperature of the coded casting sand fell to, for example, about 30°C.

[0050] When the temperature of the casting sand S discharged from the sand-discharge outlet is to be controlled, the temperature is measured by a temperature sensor disposed around the outlet 9. It is controlled such that when the temperature of the sand exceeds a predetermined value, the amount of sand to be processed is reduced and the predetermined cycle is extended or the process is temporarily stopped to recover the predetermined value.

[0051] Thus, the finished casting sand can be used immediately after it has been reclaimed and cooled.

[0052] As is clear from the above description, by using air pressure casting sand can be reclaimed with a simply-structured apparatus by controlling the retention and discharge of casting sand being reclaimed in the processing tank. Even when the amount of casting sand to be processed is small, and even when a high degree of reclaiming is needed, the degree of reclaiming can be easily controlled using only one processing tank by controlling the retention and discharge through air pressure, using a timer for adjusting the processing time.

[0053] The apparatus of this invention has also excellent practical effects in that it enables casting sand to be both reclaimed and cooled, and in that it can be formed as a compact unit. Thus, this invention has these effects, and so greatly contributes to the industry.

Claims

1. A method of reclaiming casting sand, comprising the steps of throwing casting sand into a processing tank and reclaiming the casting sand while air pressure in the processing tank is kept lower than air pressure outside the processing tank, and discharging the reclaimed casting sand from the processing tank while the internal air pressure is kept higher than the external air pressure.
2. The method of claim 1, wherein the step of keeping the internal air pressure lower than the external air pressure is carried out by an air stream circulating through air-generating means and the processing tank.
3. The method of claim 1, wherein the step of keeping the internal air pressure lower than the external air pressure is carried out by an air stream circulating through air-generating means, the processing tank, and air-absorbing means.
4. The method of any one of claims 1 to 3, wherein the step of discharging the reclaimed casting sand from the processing tank while the internal air pressure is kept higher than the external air pressure is carried out by supplying an air stream from the air-generating means downward from the upper part of the processing tank.
5. A method of reclaiming casting sand, comprising the steps of having the casting sand fall into a processing tank, scaling a portion of contaminants adhered to surfaces of particles of the fallen sand, and discharging the processed casting sand, characterized in that at least in the scaling step, air flows from air-generating means into the processing tank through a gap formed between a rotary drum and a fixed ring of scaling means disposed in the processing tank, and in that air in the processing tank is absorbed through an absorbing tube.
6. A method of reclaiming casting sand, comprising the steps of having the casting sand fall into a processing tank, scaling a portion of contaminants adhered to surfaces of particles of the fallen sand, and discharging the processed casting sand, characterized in that at least in the step of discharging the processed casting sand, air is blown from air-generating means into the processing tank through a blowing tube, and the air blown into the processing tank causes the processed casting sand to be discharged into powdery dust-sedimentation means from a gap formed between a rotary drum and a fixed ring of contaminants-scaling means.
7. An apparatus for reclaiming casting sand having means for scaling (2) disposed in a processing tank (1) for scaling a portion of contaminants adhered to surfaces of particles of the casting sand, comprising a tube (5) for blowing air into the processing tank, an absorbing tube (6) for absorbing air from the processing tank, and changeover means (9) for alternately opening and closing the blowing and absorbing tube, characterized in that air can be caused to flow into and out through a gap provided in the scaling means (2) in cooperation with the absorbing and blowing tubes.
8. An apparatus for reclaiming casting sand, comprising a processing tank (1) having an inlet (3), through which the casting sand is thrown thereinto, means for scaling (2) surfaces of casting sand particles, and an outlet (4) through which the processed casting sand is discharged, at

an upper bottom and a lower part thereof,
respectively,

a blowing tube (5), one end of which communi-
cates with the processing tank (1), and the
other end of which communicates with air-gen- 5
erating means,

an absorbing tube (6), one end of which com-
municates with the processing tank (1), and the
other end of which communicates with the air-
absorbing means, 10

changeover means (9) to change communica-
tion between the blowing and absorbing tubes
(5, 6) and the processing tank (1), and

sedimentation means to separating powdery
dust particles of the processed casting sand 15
discharged from the outlet (4) of the processing
tank (1).

9. The apparatus of claim 8, wherein the sedimenta-
tion means comprises a fluid layer (10) communi- 20
cating with the discharge outlet (4) of the
processing tank (1), an outlet for the finished
reclaimed sand at a lower part of the fluid layer, and
means (12) for collecting dust at the upper part of
the fluid layer. 25

10. An apparatus for reclaiming and cooling casting
sand, comprising

means for fluidizing casting sand, 30
means disposed above the fluidizing means for
cooling the fluidized casting sand,
means (20) disposed above the cooling means
for scaling bonds from particles of the casting
sand by friction, and 35
means disposed above the cooling means for
having relatively large dust particles sedi-
mented,
characterized by
the bond-scaling means being configured such 40
that the reclaimed casting sand can be dis-
charged into the fluidizing means therethrough.

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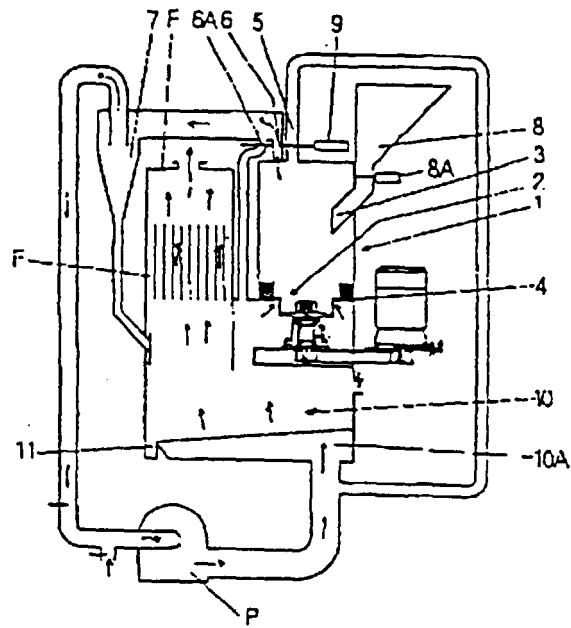


Fig. 1

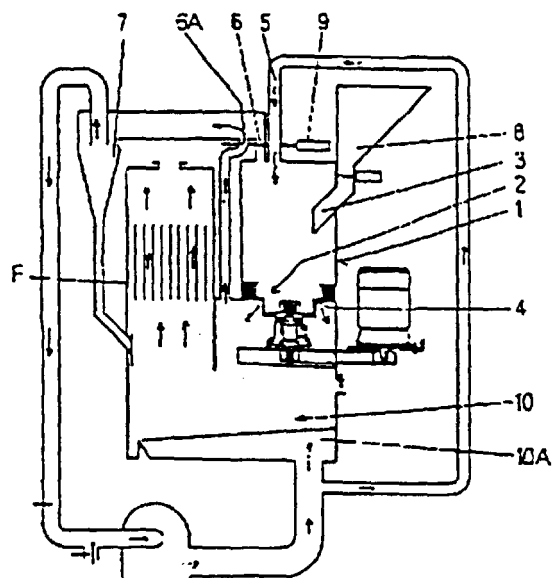


Fig. 2

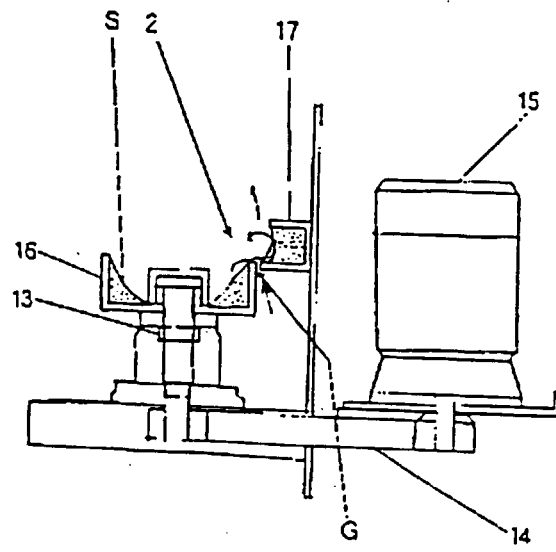


Fig. 3

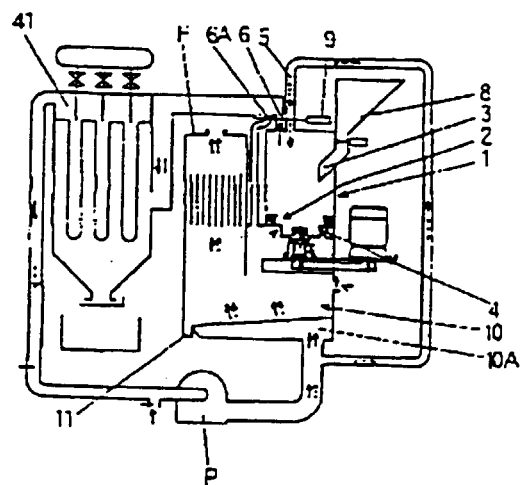


Fig. 4

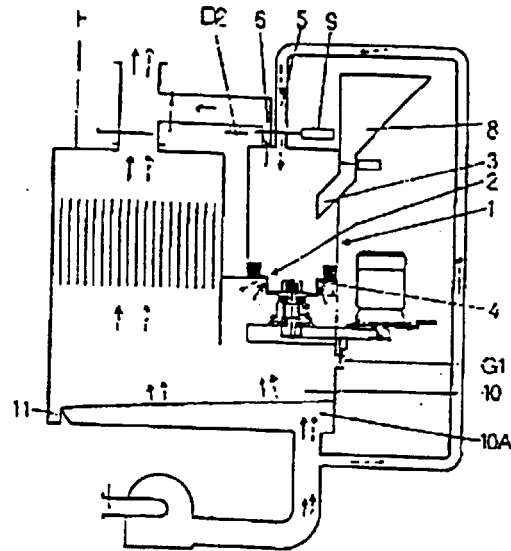


Fig. 5

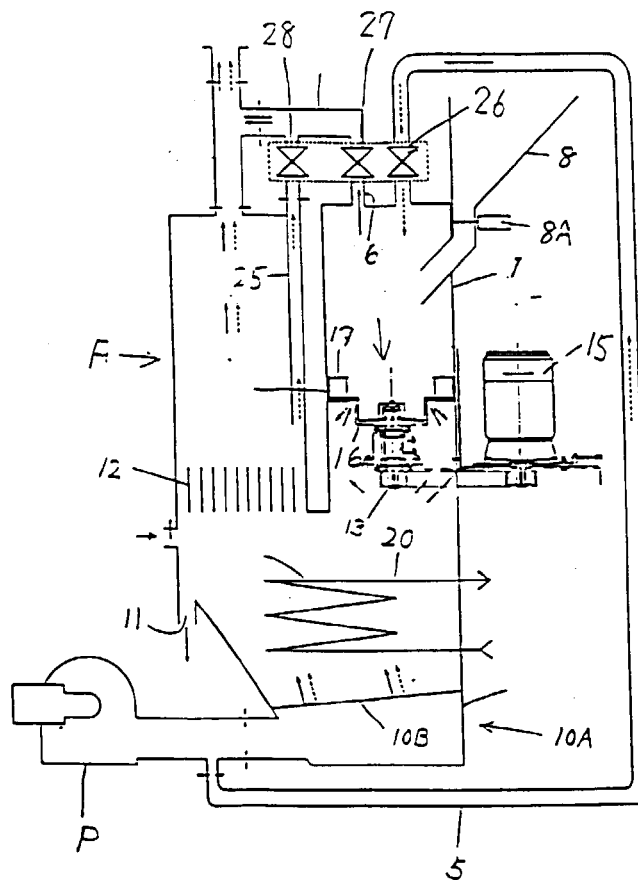


Fig. 6