(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 149 876**
A1

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **84300369.0**

(22) Date of filing: **20.01.84**

(51) Int. Cl.[4]: **B 22 C 5/00**
B 22 C 5/06, B 22 C 5/08
B 22 C 5/18

(43) Date of publication of application:
31.07.85 Bulletin 85/31

(84) Designated Contracting States:
BE CH DE GB LI NL

(71) Applicant: **WHEELABRATOR-FRYE INC.**
Liberty Lane
Hampton New Hampshire(US)

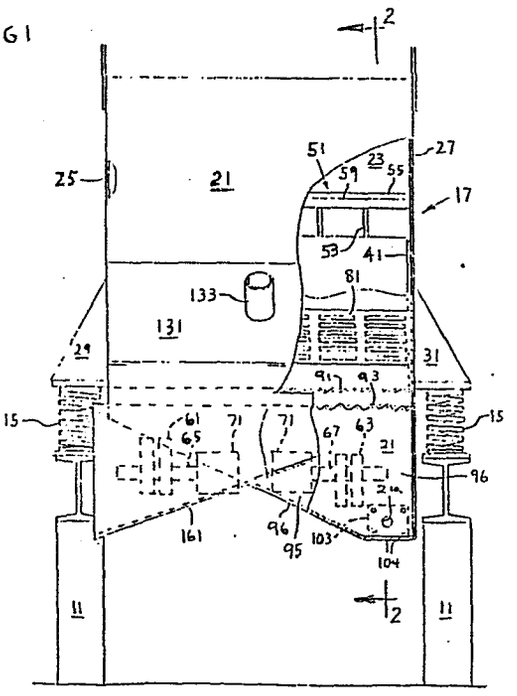
(72) Inventor: **Furness, James Clinton, Jr.**
1901 North College
Newberg Oregon 97132(US)

(74) Representative: **Fisher, Bernard et al,**
Raworth, Moss & Cook 36 Sydenham Road
Croydon Surrey CR0 2EF(GB)

(54) Method of and apparatus for reclaiming casting sand.

(57) A sand reclamation apparatus having an air nozzle jetting a blast of air into a reclamation tube (101), and in its passage to pick up resin coated sand grains to spin them and project them into the tube to cause such a scrubbing and abrading multi-collision action of the grains between the interior of the tube and themselves as to remove the coating. The abraded material leaving the tube contacts a target to knock off resin particles which electrostatically cling to the sand grains.

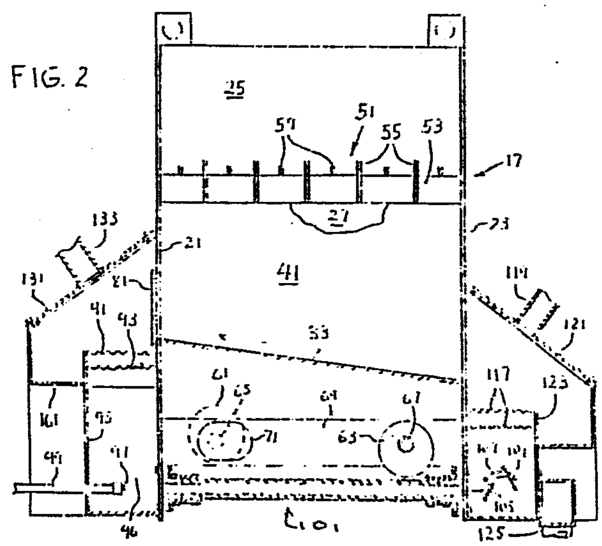
FIG 1



./...

EP 0 149 876 A1

FIG. 2



Method of and apparatus for reclaiming casting sand

This invention relates to a method of and apparatus for the reclamation of casting sand.

One popular modern form of metal casting makes use of mold and core parts (hereinafter mold parts) made up of sand particles bonded together by a binder, such as a phenolic urethane resin. One disadvantage of this casting practice is that there has been practically no way of effectively reclaiming the sand after use, in an inexpensive manner.

Casting sand is of a special make up, and thus to the extent that it cannot be reclaimed, two expenses are involved, one, in obtaining replacement sand, and two, disposing of the resin bonded chunks.

A prior sand reclaiming machine operates on a multiple-cell - multiple-pass principle in which, in each cell, sand is blown by low pressure air, around 0.211 kg/cm^2 (3 pounds per square inch), against a target, in sandblast fashion, attempting to knock off the binder coating from the grains. A typical cell of such a machine has a blower tube of approximately 5.08 cm (two inches) in diameter blowing sand through a 10.16 cm (four inch) pipe onto a target.

The effect of blowing the sand through a single cell is not at all effective in cleansing the sand grains, so that a series of cells are provided, in some instances up to

eight, in which sand from a first cell is conducted to the second cell, and then through the remaining cells in serial fashion. Even this is not enough, so that the sand must be rerouted through the series of cells in multiple-pass fashion. While the machine works to an extent, it is expensive and slow acting, and the sand recovery is sometimes considered unsatisfactory.

Since, in the multiple-pass machine, described above, there is considerable fracture of the sand grains, it has been thought impractical to go to a higher air pressure, because it has been assumed that with higher pressures, the fracture of the sand grains would be so substantial as to make the machine unworkable.

However, it has now been discovered that the binder coating can be effectively removed from sand in a one pass system having a single cell and utilizing what would be considered high pressure, in the range of 3.51 - 4.22 kg/cm^2 (50 - 60 pounds per square inch). Instead of simply blowing the air through a relatively large diameter tube into a pipe, a nozzle is used and is so spaced from the nozzle a relatively long tube that the sand, because of the coriolis effect, or otherwise, tends to swirl within the tube setting up such a repetitive collision environment that when the operation is over the single pass through the single cell removes the coating as effectively or better than the sand produced by the multiple-pass multiple-cell prior machine.

A main object of the present invention is to provide a method and apparatus for effectively reclaiming casting resin coated sand in a single pass.

A more specific object of the invention is to provide such a method and apparatus wherein a reclamation tube is so dimensioned relative to an associated air jet nozzle, all

relative to the pressure of the air passing through the nozzle as to effect multiple collisions of the coated particles of a magnitude so much higher than the units of the serial system as to effectively remove the resin coating from a substantial portion of the sand particles.

The subject matter of the invention is particularly pointed out and distinctly claimed in the concluding portion of this specification. The invention, however, both as to organization and method of operation, together with further advantages and objects thereof, may be best understood by reference to the following description, taken in connection with the following drawings, wherein like reference characters refer to like elements.

Fig. 1 is an elevational view of an apparatus embodying the concepts of the present invention with parts broken away, with the dimensions of the sand reclamation tube assembly being distorted, at least in part, for clarity in illustration;

Fig. 2 is a vertical sectional view taken along line 2-2 of Fig. 1;

Fig. 3 is an isolated view of the tube assembly with the dimensions more nearly in proper proportion than in Fig.1.

The apparatus shown can be considered as having two major functions, one of breaking up mold chunks into resin coated sand particles or small agglomerates, and a second of knocking off the resin coating from the sand particles. It is to the second function that the present invention is primarily directed.

Referring to Fig. 1, the apparatus shown has a base 11 supporting a box assembly by springs 15, four, two to a side, preferably being used. The box assembly includes a

box generally entitled 17 which is rectangular in horizontal section and is defined by a first pair of opposed plate-like walls 21 and 23 (Fig. 2), and a second pair, 25 and 27. For convenience, walls 21 and 23 will be designated the front and rear walls, respectively, while walls 25 and 27 will be considered as the side walls.

The above walls define an open topped box to receive resin bonded chunks to be broken up, such chunks being fed into the box in any suitable manner, such as by a belt conveyor (not shown). Walls 25 and 27 have brackets 29 and 31 resting on springs 15.

The box is closed at its lower portion by a floor 33 (Fig. 2) which is inclined from the front wall 21 downwardly toward the rear wall 23, for a purpose presently to be described.

Preferably, each of the interior faces of the side walls has a protective plate 41 of abrasion resistant material secured thereto. Similar plates may be provided on the interior faces of the front and rear walls (but they are not so shown).

Just above the wear resistant plates is mounted a heavy grid generally entitled 51 made up of a series of equally spaced longitudinally extending plates 53, and a series of equally spaced transversely extending plates 55, the plates being secured together such as by welding.

The plates 55 are taller than the plates 53, as is evident by comparing Figs. 1 and 2. The lower edges of the plates are coplanar so that the plates 55 have portions projecting upwardly beyond the top edges of the plate 53. This construction gives more effective breaking up of the resin bonded chunks than would otherwise be the case.

It is preferred to provide a series of transverse strips 59 located as shown, which coact with the plates in breaking up the bonded chunks.

Beneath the floor 33 are two pairs of eccentric weights 61 and 63 mounted respectively on shafts 65 and 67, which in turn are rotatably carried by cross members 69 which extend between and are secured to the front and rear walls 21 and 23. Each eccentric pair of weights is driven by its own hydraulic motor 71 (Fig. 1) which is supplied with hydraulic fluid under pressure by a suitable pump (not shown) through hoses (not shown). Preferably the motors are driven at substantially the same speed but the phase relationship may change.

Rotation of the eccentric weights effects vibration and shaking of the box 17 to break up the resin bonded chunks to provide individual resin coated particles and also agglomerates, i.e., smaller sized resin bonded sand clusters. The sand particles and those agglomerates small enough to pass through the openings in the grid fall down onto the floor 33 where the material is subject to continued vibration and shaking to further break up the agglomerates. The sand particles tend to stratify at a lower level next to the floor 33 beneath the agglomerates and clusters.

As is evident from Fig. 2, the eccentrics are so oriented as to cause material on the floor 33 to advance uphill to the left and crawl up the inclined floor piece 33 and exit through the slots in a grate 81 provided in the front wall 21. The grate will reject those clusters or agglomerates and foreign objects (metal chunks, wood particles, etc. that are found when breaking up resin bonded chunks) which are of a size larger than the grate slots. These rejected objects will continue to be shaken and vibrated and have a

continuing breaking up action on the sand clusters and agglomerates to produce additional individual resin coated sand grains. These will join the other sand grains on the floor and eventually pass through the grate 81. Clean out doors (not shown) are provided in the side walls to enable periodic removal of foreign objects, and agglomerates that prove unbreakable.

The sand grains and small clusters or agglomerates that pass through the grate 81, fall down onto an upper screen 91, which by way of example and not by way of limitation, could be an 8 mesh screen. The particles falling through the upper screen will fall onto a lower screen 93, which by way of example and not by way of limitation, could be a 20 mesh screen. This means that substantially all the material falling through the lower screen 93 will be resin coated sand particles.

The screens are supported by an outboard wall 95 and the front wall 21, the wall 95 having a floor 96 inclined downwardly so that material falling on the floor will gravitate into a small pocket near an air blast nozzle 97. The nozzle is carried by an air pressure pipe 99 which leads to a source of air under pressure.

The air under pressure contacts the falling grains, causing them to be propelled while being rapidly rotated into a reclamation tube 101 mounted at its front and rear ends in the space between the walls 21 and 23, by an arrangement which includes a pair of flanged fittings 103 mounted against the walls 21 and 23 by bolts 104. The sand passing through the tube 101 will, as it leaves, be deflected by deflector means in the form of deflector plates 105, 107 and 109 (about which more will be presently said). It is evident from Fig. 3 that the

deflector means provides non-reentrant serially arranged deflector surfaces, each of which has a forward component of deflection. The arrangement for supporting the tube 101 further includes a pair of plastic sleeves 111, which secure the tube 101 in place in abutting relationship to the ends of the tubular portions of the fittings 103 by means of hose clamps 113, as shown.

The tube 101 preferably has a metal (preferably steel) exterior shell 101a, which is filled with a wear plastic, such as urethane, which may be poured into the shell as a casting. Preferably the sleeves 111 are also made of a wear plastic, such as urethane.

The walls 21 and 23 have openings in them aligned with the scrubbing passageway P provided by the fittings 103 and the tube 101, the opening for wall 21 being designated in Fig. 3 by the reference numeral 21a.

With an air pressure of 3.51 or 4.22 kg/cm^2 (50 or 60 pounds per square inch) being supplied to the nozzle 97 by an air pump (not shown), the nozzle outlet needs to be accurately aligned with the axis of the scrubbing passageway, because if it is misaligned, sand being propelled by such a high pressure would quickly wear out the walls of the passageway. In any event, even with the nozzle axis aligned accurately with the axis of the passageway, and despite the fact that the swirling sand within the passageway tends to shield it somewhat from the abrading effect of the sand passing through the passageway, wear does occur. However, even though the inner wall of the tube 101 wears through, the urethane filler 101b also wears quite well, so that the tube 101 lasts a reasonable amount of time. When it is necessary to replace the tube 101, the sleeves 111 are removed and a replacement tube moved into place, and the sleeves 111 replaced.

The reference above to the possible shielding effect of the swirling sand, does not mean that the sand grains do not bounce against the passageway walls. They do, and repetitively. What is meant is that the swirling sand would tend to deflect a concentrated stream of sand away from the passageway walls.

Note that it is possible for the tube 101 to be worn through, particularly near the forward end thereof. Even so, the associated wear plastic sleeve 111 would function as a substitute wall, until the tube was replaced.

Those operators wanting to get maximum life from my machine, will switch the tube 101 end for end, after the forward end wears through. And those who find they can continue the effective use of the machine, even with the forward sleeve 111 acting as a part of the passageway wall, could switch the sleeves to get additional life.

It has been found that the tube works better after it has worn somewhat, so the operator might experience a break-in period for a tube, where performance is less than later experienced.

The pressure of the air, the spacing of the nozzle 97 from the front end of the reclamation tube 101 and the size of the tube and its length are so chosen that the resin coated sand grains rather than merely passing through the tube undergo multiple collisions with the walls of the tube, ricocheting back and forth in contact with the walls and with one another in a multi-collision process to effectively knock off the resin particles by the time that the grains exit from the rear end of the reclamation tube.

It is believed that the resin particles are either free of the sand grains or lightly attached to the sand grains when they exit the tube 101. I have found that such

lightly attached resin particles can be flicked off the sand grains, if the sand/air mixture issuing from the cleansing passageway engages a deflector plate, such as deflector plate 105. Additional deflector plates 107 and 109 are provided because the sand deflected from plate 105 will engage the lower face of the deflector plate 107 as the parts are shown in Fig. 3, and then the lower face of the deflector plate 109, so that the material being treated goes into a swirling action, tending to better separate the plastic flakes from the sand grains.

It is to be distinctly understood, however, that the plate 105 does not function as a sandblasting target, as does the target plate in the previously described multiple-pass - multiple-cell unit because the blasting of coated sand particles against a target is not an effective way of separating the coating from the sand grains. If the binder coating is not substantially effectively loosened from the grains by the time that they issue from the cleansing passageway, the contact of the sand with the deflector plates 105, 107, 109 is certainly not going to perform that function.

The deflector plates 105, 107 and 109 can be mounted in any particular fashion, such as, for instance, in guide-ways or wall slots.

The resin particles, which are now separated from the sand grains, in the form of dust, pass upwardly, preferably through one or more screens 117 and out a dust exit tube 119. Attached to the exit tube is an air blower drawing a negative pressure to positively pull the dust particles through the outlet 119. The outlet 119 and the screen 117 are mounted on a housing 121 secured to the rear wall 23.

A somewhat similar housing 131 is provided on the front wall 21 and is equipped with a duct outlet 133 leading to a blower creating a negative pressure to pull out any resin dust created within the housing 131. The negative pressure is not sufficient to remove the sand grains, or at least only a very limited number of such grains.

The screens 117 are mounted in a compartment 123 of the housing 121. The reclaimed sand grains in the lower portion of the compartment 123 are withdrawn through a discharge outlet 125 connected to a withdraw blower so that the sand does not accumulate within the compartment 123.

The agglomerates not passing through the screen 91 drop over the upper edge of the wall 95 onto an inclined floor 161 (Figs. 1 and 2) and gravitate along the floor and are discharged into a bin (not shown). This material may be reintroduced into the box 17 or discarded, as desired.

Fig. 3 shows the parts of the reclamation tube assembly in proprotions more nearly those which have proven effective in equipment produced under my direction.

As an example of what has proved effective, in one unit I utilize a nozzle of substantially 6.35 mm ($\frac{1}{4}$ inch), although I have found that a nozzle size of between 3.81 and 7 mm (0.150 and 0.275 inches) will provide acceptable results. The air supplied to the nozzles 97 is under a pressure of between 3.51 and 4.22 kg/cm^2 (50 and 60 pounds per square inch) i.e. at such a pressure as to be considered as a high pressure, as compared to the low 0.211 kg/cm^2 (3 pounds per square inch), pressure utilized in the multiple-cell - multiple-pass prior machine. The nozzle was located about 7.62 cm (three inches) from the inlet end 113 of the reclamation tube, although it has been found that a spacing of between 5.08 and 7.62 cm (2

and 3 inches) will produce acceptable results. The reclamation tube had an internal diameter of 3.81 cm (1.5 inches) and was 152.4 cm (five feet) long. The spacing between the output end of the reclamation tube and the deflector plate 105 was about 10.16 cm (four inches). It is believed that unless the sand particles reach the deflector plate 105 within about 0.01 seconds after leaving the tube, the resin flakes will re-attach themselves by electorstatic action to the sand grains.

While there can be some variations in the above dimensions, one thing is clear. The present system contemplates the use of high pressure air, and contemplates a system in which the resin coatings are not knocked off the sand grains by impacting on a target in a multiple-cell - multiple-pass arrangement, but to the contrary because of collisions with themselves and with the interior of the tube 101 as the grains whirl along said tube. In addition, a true nozzle is required for the air and not simply a large interior diameter air tube, such as is used in one of the cells of the prior machine. In fact if the nozzle size is increased to 12.7 mm ($\frac{1}{2}$ inch) it will simply not produce the desired results.

It is pointed out that if the air pressure in the prior machine were increased to 3.51-4.22 kg/cm^2 (50 - 60 pounds per square inch) the sand stream would quickly wear a hole through the target plate. This is proof that in my machine, what happens in the scrubbing passageway is the cause of the sand-coating separation, not the contact of such sand with the wear plates.

It has been found that the apparatus of the present invention is effective in removing dust from mined sand at as low as 1.4 kg/cm^2 (20 pounds per square inch) reducing the need to wash and dry in both foundry and glass manufacturing applications.

Claims:

1. In a sand reclamation apparatus comprising a reclamation tube having a front end and a rear end,

high pressure air nozzle means spaced from the front end of said tube and oriented to direct air under pressure through sand to be reclaimed and entrain grains of the same and direct them into said tube,

the spacing of the nozzle from the front end of the tube being greater than the internal diameter of the tube,

the ratio of the internal diameter of the tube to the internal diameter of the nozzle being no less than four to one,

and means for supplying air to said tube under pressure of not less than 3.51 kg/cm^2 (50 pounds per square inch).

2. In a sand reclamation apparatus comprising a reclamation tube having a front end and a rear end,

an air nozzle spaced from the front end of said tube and oriented to direct air under pressure into and through said tube,

deflector means adjacent the outlet end of the tube located a distance from the tube exceeding the internal diameter of the tube,

said deflector means having non-reentrant serially arranged deflecting surfaces each of which has a forward component of deflection so as to establish deflecting rather than impact contact with particles striking said deflection surfaces.

3. An apparatus as recited in claim 2, wherein the spacing of the nozzle from the front end of the tube is greater than the internal diameter of the tube,

said tube having a length at least thirty times its interior diameter,

the ratio of the internal diameter of the tube to the internal diameter of the nozzle being no less than four to one,

and means for supplying air to said tube under pressure of not less than 3.51 kg/cm^2 (50 pounds per square inch).

4. An apparatus as described in claim 2 wherein said deflector means comprises multiple separated deflector plates adjacent the outlet of the tube and spaced from said outlet end,

said deflector plates being arranged in a serial non-reentrant pattern such that granular material deflected from the first plate contacts and is deflected by the second and is similarly deflected by each subsequent plate.

5. In a sand reclamation apparatus comprising a reclamation tube having a front end and a rear end,

an air nozzle spaced from the front end of said tube and oriented to direct air under pressure into and through said tube,

said nozzle having an internal diameter of approximately 6.35 mm ($\frac{1}{4}$ of an inch),

the tube having an internal diameter of approximately 3.81 cm ($1\frac{1}{2}$ inches) and a length of approximately 152.4 cm (five feet),

and means for supplying air to said tube at a pressure of not less than 3.51 kg/cm^2 (50 pounds per square inch).

6. An apparatus as described in claim 5 wherein there are multiple wear plates adjacent the outlet of the tube and spaced from said outlet end by approximately 10.2 cm (four inches).

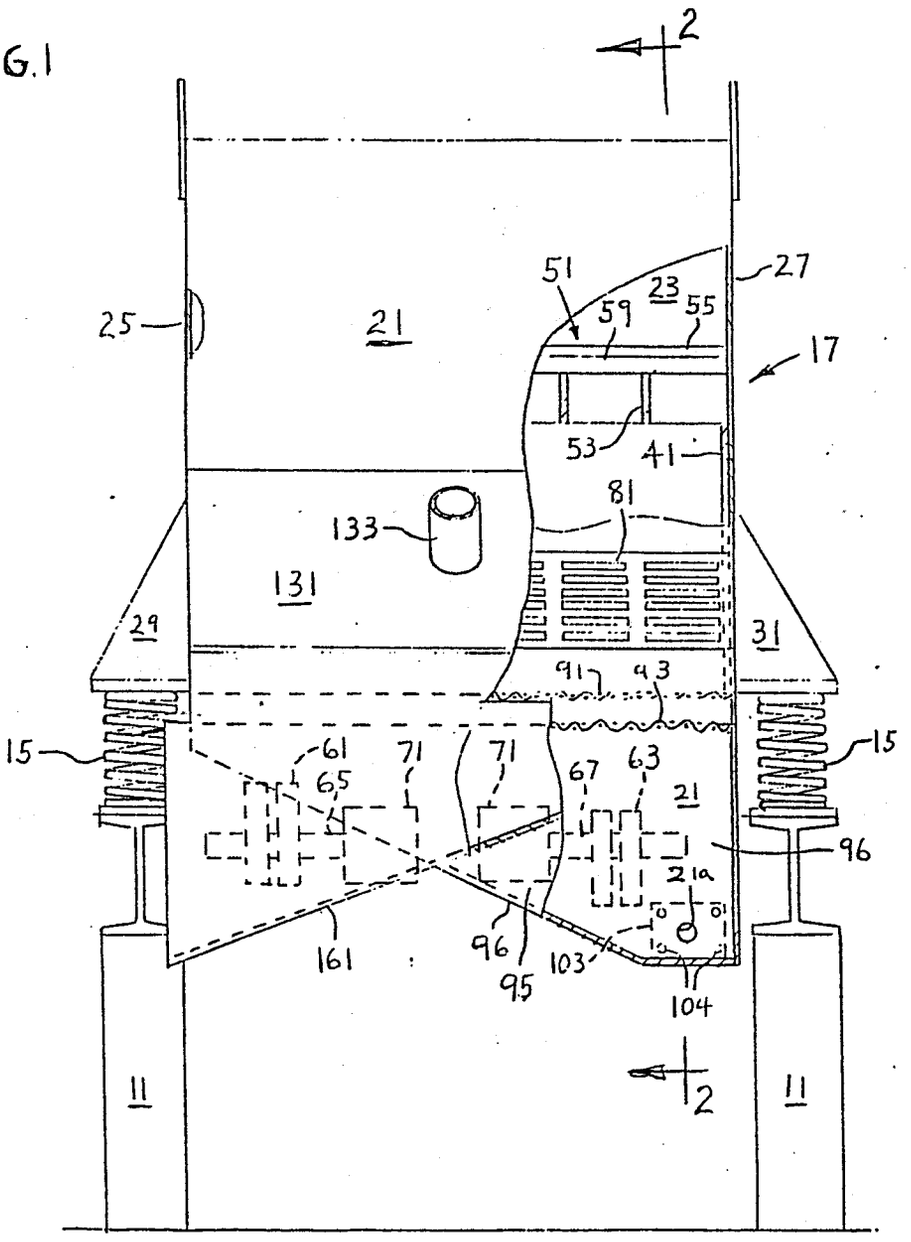
7. A method of cleaning resin coated sand particles comprising creating a jet of air supplying coated grains of sand to the jet in a transverse direction so that a rapid spin is imparted to the particles and such particles are directed in a predertermined direction,

ricocheting the particles back and forth against confining walls to effect an abrading and scrubbing action on the particles, and

directing the grains, after they leave the zone of ricocheting, against one or more non-reentrant deflecting surfaces such that the grains have forward deflection components thereby to knock-off electrostatically clinging resin particles.

0149876

FIG.1



0149876

FIG. 3

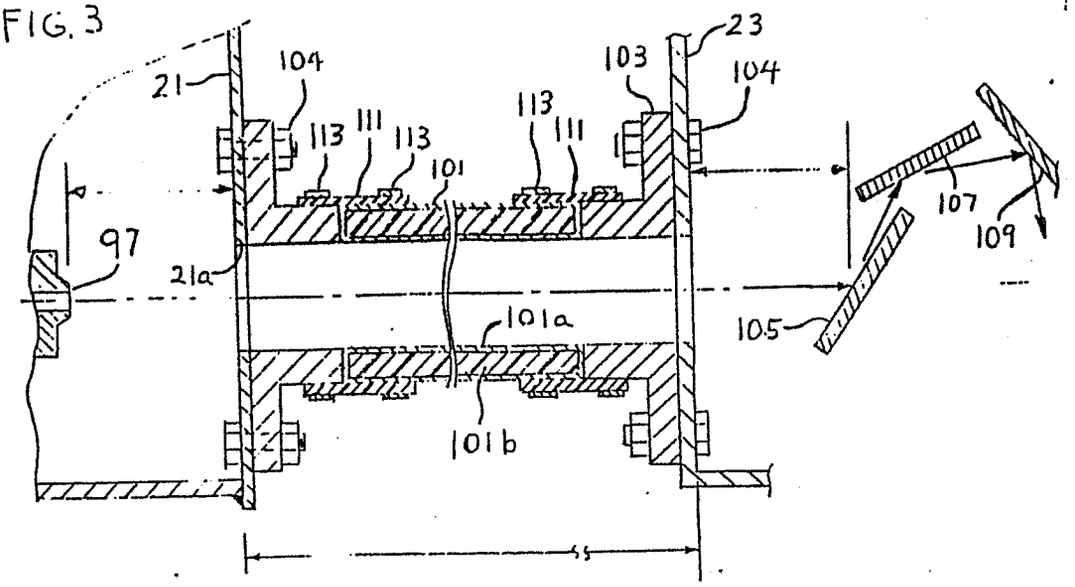
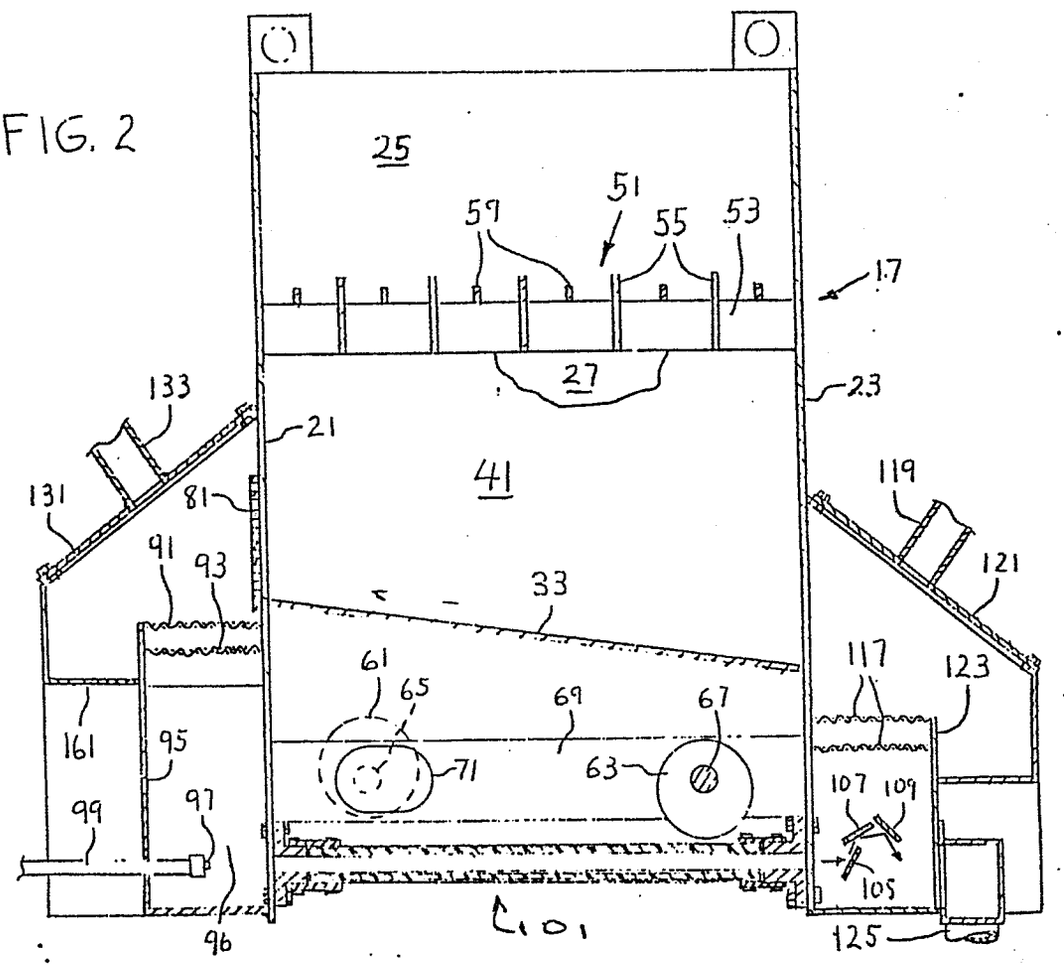


FIG. 2



European Patent Office

EUROPEAN SEARCH REPORT

0149876
Application number

EP 84 30 0369

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)
A	DE-B-2 406 834 (SIMPSON MASCHINEN AG) * Claim 1 *	1	B 22 C 5/00 B 22 C 5/06 B 22 C 5/08 B 22 C 5/18
A	CH-A- 590 700 (SIMPSON MASCHINEN AG) * Claim 1; figure 1 *	1	
A	CH-A- 575 262 (ESCHER WYSS AG) * Claim 1; figure 1 *	1	
A	DE-A-2 921 197 (H.J. LINDER)		

TECHNICAL FIELDS SEARCHED (Int. Cl. ³)

B 22 C 5/00

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
BERLIN	06-09-1984	GOLDSCHMIDT G

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO Form 1503. 03.82