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(54) Process and apparatus for manufacturing a counterweight for washing machines and counterweight resulting therefrom.

(57) Process and apparatus for manufacturing counterweights for washing machines, as well as counterweight resulting from said process and apparatus, said process making use of such high specific-gravity materials as ferrous by-products and similar waste materials from steel mills and the like. It comprises a first phase in which said recycled material is ground to a coarse grain size and moistened with water in view of obtaining a substantially dry or partially moistened powder; a second phase in which said powder is dried and subsequently cooled down; a third phase in which said powder is sieved in view of separating the grains of the desired size from the grains having a different size, the latter ones being sent again to grinding and then recovered and stored with the first ones; a fourth phase in which said powder is pressed and brushed on its surface; a fifth phase in which a protective shell (28) is overinjected onto said pressed powder blocks (27) to the same size and shape of the final counterweight, which is then attached to the wash tub, or outer drum, of the washing machine, said counterweight being therefore capable of being mass-produced to a large scale with low-cost, scrap or waste material that is available in large supply.

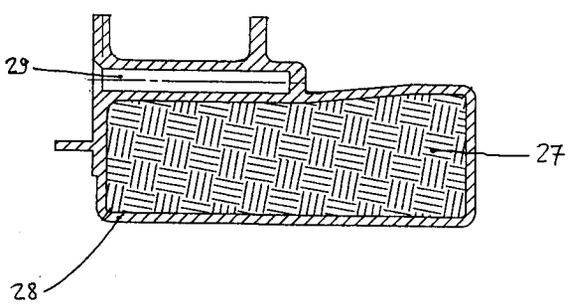

FIG. 4

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The present invention relates to both a process and related apparatus for manufacturing counterweights to be used in conjunction with washing machines, in particular clothes washing machines and combined clothes washing and drying machines. in order to balance the rotating drum-tub assembly of these machines when the drum is being rotatably driven at its washing and spin-extracting speeds, and to a counterweight manufactured according to such a process with such an apparatus.

Counterweights for washing machines of the above cited kind are known, which are formed by either one or several concrete blocks, or by masses of high specific-gravity materials of some kind, that are appropriately prepared to shape in advance separately and subsequently fixed on to the front wall of the wash tub of the respective washing machine by means of removable fastening means such as screws, bolts, nuts, washers and the like.

However, counterweights of this kind have a major drawback in that they require a relatively long time for preparing and allowing the concrete to appropriately set. Furthermore, they are associated with a possibility for the concrete blocks to become loosened and undesiredly come off the seats in which they are fastened to the wash tub, owing to vibrations that are typically generated during the operation of the washing machines to such an extent as to sometimes cause the same blocks to even break or crumble off.

Further *per sè* known counterweights for washing machines are once again constituted by concrete blocks that are prepared in advance separately, on which some plastic material is then over-injected in view of forming an appropriately shaped, closed shell which is capable of preventing such blocks from undesirably becoming displaced or breaking off, and which is further adapted to be applied against the wash tub of the washing machines.

Even in this case, however, there is a main drawback in the relatively long time required by the preparation and the setting of the concrete blocks, to such an extent that the corresponding manufacturing process brings about quite high cost burdens and is not much befitting from an industrial point of view.

It is the purpose of the present invention to eliminate such drawbacks by providing a counterweight for washing machines under the use of the high specific-gravity material as described hereinafter, appropriately enclosed in a protective shell of plastic material, by means of the process and the related manufacturing apparatus according to the invention.

These process and manufacturing apparatus according to the present invention, as well as the so obtained counterweight have the features as essentially described with particular reference to the appended claims. The invention will anyway be further described by way of non-limiting example with reference to the accompanying drawings in which:

- Figures 1 and 2 are schematic views of two basic component parts of the construction of the manufacturing apparatus according to the invention;
- Figure 3 is a front view of a counterweight according to the invention;
- Figure 4 is a lateral view of the counterweight of Figure 3, as sectioned along the A-A line.

The process according to the present invention provides for the manufacture of a counterweight for washing machines, in particular clothes washing machines and/or combined clothes washing and drying machines, which is applied against the outer surface of the wash tub containing the rotating drum, in view of damping the vibrations of the tub-drum assembly when the clothes washing cycles are being performed, so as to cause said assembly to be dynamically balanced in a satisfactory way (said wash tub and rotating drum are not shown in the Figures).

Such a counterweight is as usual constituted by one or several blocks of a high specific-gravity material, which are wrapped in a protectice shell of plastic material of a traditional kind, said plastic material being overinjected on to said block material. According to the invention, material constituted by ferrous by-products and scrap materials from steel mills (ferrous oxides) in the form of flakes, chips, dry powder, pellets (in a solid state such as the one of expanded clay) or moist powder (in a shovelable form or as a casting slip) is used to manufacture such counterweight blocks. Such ferrous by-products are a material with a high specific gravity and, in a preferred way have an average density situated anywhere between 4.0 and 6.0 kg/dm^3, so that they, for an equal volume, are actually able to provide a much heavier counterweight for a more effective result in balancing the tab-drum assembly of the washing machine.

The above cited manufacturing process according to the invention is carried out in the way as described hereinafter, under utilization of the apparatus according to the present invention as shown in the accompanying Figures 1 and 2.

In the first phase of the afore cited process according to the invention, all scrap materials and by-products as indicated above, which will have been duly collected at the various steel mills and transported to the utilization site where they are stored in appropriate silos or adequately sized storage pits, are treated according to the criteria as

described hereinafter so as to thereby obtain a dry powder, or a powder with just a pre-determined moisture content, preferably situated at about 5 or 6 percent, said powder having a pre-determined grain size as well, preferably not exceeding 40 μm.

As shown in Figure 1, the apparatus used to carry out this first phase of the manufacturing process according to the invention essentially comprises a hopper 5 or similar feedbox having an adequate capacity, in which the afore cited ferrous by-products are introduced, and a granulator 6 or similar grinding facility of a traditional type, which is connected to the hopper 5 in a downstream position with respect to said hopper, and in which said ferrous by-products being released from said hopper in precisely metered, unvarying amounts are ground to the desired grain size.

In particular, said granulator 6 comprises a first portion 7 provided with a cylindrical inner chamber 8 situated below said hopper 5 and communicating with the lower side thereof, and further comprises a second portion 9 having a zigzag-like outer contour and being provided with a descending portion 10 and an ascending portion 11 defining cylindrical inner chambers 12 and 13, respectively.

Furthermore, an Archimedean screw that can be rotatably driven by a related motor (neither of these component parts is shown in the Figure), as well as a set of spray nozzles (not shown, either) that are connected to a water supply source and disposed radially inside the chamber to form a circular crown-like ring, are provided in said cylindrical inner chamber 8. In this way, the ferrous by-products being introduced in said cylindrical inner chamber 8 are set to spinning and driven toward the periphery of said chamber by the rotary motion of said Archimedean screw. They are then moistened by means of atomized water jets from said spray nozzles to such an extent that an agglomerate having a moisture content of preferably 10 to 11 percent is in this way obtained.

Subsequently, the by-products that have been in this way moistened to a desired extent, are fed in sequence into the cylindrical inner chambers 12 and 13 of the respective descending portion 10 and ascending portion 11 of said granulator 6, each one of said chambers containing corresponding Archimedean screws or similar grinding and feeding provisions (not shown) capable of performing both a preliminary grinding of said by-products to a coarse grain size as well as a homogeneous, progressive mixing of said by-products, while at the same time feeding them toward the outlet end portion of said granulator 6, where they will be ready for being transferred into the next portion of this manufacturing apparatus as described hereinafter.

Accordingly, in this first phase of said manufacturing process according to the invention all ferrous by-products are preliminarily ground in said granulator 6 so as to obtain a corresponding powder with a grain size which is fairly coarser than the ultimate grain size required for the process, said powder being further mixed in a homogeneous way.

In the next, second phase of this manufacturing process according to the invention, the powder that has in such a way been obtained from the ferrous by-products, and that has a moisture contents which is in excess of the one actually required for the following phases of the process itself, is allowed to undergo a drying treatment at a temperature of preferably approx. 150 ° C for a given period of time, in such a way as to bring about a reduction in the moisture content of said powder down to a level of preferably 2 to 4 percent.

As it can further be seen in Figure 1, the apparatus used to carry out this second phase of the manufacturing process according to the invention substantially comprises a fluidized-bed drier 14 or similar heating equipment, into which the powder so obtained from the afore cited mill by-products is transferred from the outlet end portion of said granulator equipment 6, and in which the drying of said powder is performed by blowing in hot air at a temperature of approx. 150 ° C thereth-rough. This drier equipment is furthermore provided with an appropriate cooling system 15 of a traditional type (eg. a fan-assisted cooling system) adapted to bring about an adequate reduction in the temperature of the dried powder of mill by-products, until it is brought down to a temperature which is close to the ambient one, so as to prevent condensate build-ups from undesirably occurring in the subsequent phases of this manufacturing process according to the invention.

Finally, said drier equipment 14 can be seen to communicate with at least a filter means 16 of a *per sè* known type, which is associated with at least an aspirator means 17 adapted to extract the hot air from the drier equipment and exhaust it outside after due separation of all solid particles of said mill by-product powder being in suspension in the same air, in such a way that said particles can be appropriately collected and recovered in view of their possible re-utilization in the subsequent phases of this manufacturing process according to the invention.

In the next, third phase of this manufacturing process according to the invention, said powder of mill by-products as prepared in the afore described way is now available with an appropriate moisture content as required for the continuation of the process. It is however provided with variously sized grains so that a screening is performed at this point in order to obtain a final powder product with just

properly sized grains for further processing as described hereinafter.

To this purpose, said mill by-product powder material flowing in from the afore described drier equipment 14 and filter means 16 is conveyed toward at least a screen means 18 of a *per sè* known type (see Figure 1) adapted to separate grains of the required size from grains of a different size, said screen means being in communication with one or more collection silos 19 adapted to store all in-flowing powder with properly sized grains in view of further processing.

On the other hand, the mill by-product powder with differently sized grains being separated in the afore described screening operation is sent to at least a further grinding apparatus, which in a preferred way consists in a dry grinding mill 20 of a *per sè* known type communicating with both said screen means 18 and the granulator means 6, so as to further grind said mill by-product powder down to the required grain size, and to recirculate the so re-ground powder material toward said granulator means 6, in view of effectively recovering in this way the whole bulk of ground mill by-product powder and storing it in the silos 19 together with the powder material that had been stored there previously.

In order to enable the afore cited powder material to be transferred between the different parts forming the manufacturing apparatus according to the present invention, the manufacturing apparatus itself is equipped with traditional-type materials handling means (eg. conveyor belts, conduits, pumps, valves and the like) communicating with said parts, which therefore will not be described any further in the following.

The mill by-product powder material that has been processed and stored in the afore described way is then available with the required moisture content and grain size for the next, fourth phase of the manufacturing process according to the present invention, where it then undergoes a pressing operation in the way that will be described in the following, in order to obtain one or more solid, compact blocks having the shape and the size as required by the particular counterweight design.

In a preferred way, the so pressed powder material shall have a density of approx. 4 to 5 kg/dm^3 in order to obtain blocks having an adequate weight in view of performing satisfactorily in balancing the tub-drum assembly of washing machines.

Referring now to Figure 2, it can be seen that the latter is a schematic view showing that part of the manufacturing apparatus according to the invention, which is provided to carry out said fourth phase of the manufacturing process considered.

As illustrated in said Figure, at least a press 21 of the type traditionally used to form ceramic and refractory materials in general can be advantageously employed to perform said pressing operation, which should be carried out at such high forming pressures as to give rise to compact blocks of pressed powder which are adapted to perform satisfactorily in their intended use.

As usual, said press is provided with at least a forming tool 22 communicating with a hopper 22', in which the powder is introduced from its storage silo(s) 19 located in the preceding part of the manufacturing apparatus after having been processed in the afore described way.

In particular, Figures 2a through to 2c are schematical views showing the various operations that are carried out during this pressing phase of the manufacturing process according to the invention.

From the illustration in Figure 2a it can be noticed that the press 21 is open, with its plunger 23 moved away from said forming tool 22, this being therefore a condition in which the inner cavity 24 of said forming tool 22 can be filled with a pre-determined, metered amount of duly pre-processed mill by-product powder material flowing in from the hopper 22' located thereabove.

From the illustration in Figure 2b it can be noticed that said hopper 22' is moved away from said forming tool 22, so that the powder material filled into said inner cavity 24 of said forming tool 22 can be shaved on its surface under utilization of the special tools usually provided for performing this kind of operation, thereby obtaining a smooth surface of the powder in the forming cavity before its being pressed to a compact block.

From the illustration in Figure 2c it can be noticed that the plunger 23 of said press 21 is driven toward said forming tool 22, thereby causing the powder in the inner cavity 24 of said forming tool to be pressed and compacted in such a way as to obtain one or more blocks of said compacted powder having the required final density, said blocks being then allowed to undergo a treatment as described hereinafter so that they will be able to be used as counterweight masses.

At the end of this pressing operation, ie. when the plunger 23 of said press 21 is returned to its initial position, the resulting blocks of compacted powder are knocked out from said forming tool 22 and transferred, by means of *per sè* known handling means (eg. by means of a lifting sucker or similar implement), to a traditional-type brushing station (not shown), in which they are brushed on their surface so as to clean them and remove any possible processing defect from the same blocks, before they are jacketed in a protective shell in the way as described hereinafter.

Finally, in the next, fifth phase of the manufac-

turing process according to the invention, a protective shell of plastic material is overinjected onto said blocks of pressed powder to the same shape as and a slightly bigger size than the blocks themselves, so as to keep them together and safely in position, thereby preventing them from undesirably displacing or breaking off due to the vibratory movements of the tub-drum assembly as the machine is going through a washing programme.

Figure 2d is a schematical view of a mould 25 for a plastic processing machine and, particularly, an injection moulding machine (not shown), said mould being provided with an inner cavity 26 in which said blocks of pressed powder are first of all inserted. Plastics is then overinjected onto the whole outer surface of said blocks in said mould in such a way that said plastics will tightly adhere to said outer surface of said blocks and will take such a shape as to be able to be adaptively fitted onto the corresponding outer surface of the wash tub of the washing machines, to which it is then fastened by means of screws, bolts or other *per sè* known fastening means (not shown).

The counterweight that is in this way obtained does therefore away with the typical drawbacks associated with the use of conventional blocks of concrete. It further is actually more expedient and advantageous due to both its requiring less demanding, more simple manufacturing processes, which enable it to be mass-produced on an industrial scale, and the lower costs made possible by the use of scrap mill by-products for manufacturing the ballast masses of the counterweight.

Referring now to Figures 3 and 4, it can be finally noticed that they are schematical views of a counterweight obtained in the afore described way for application in washing machines, said counterweight essentially consisting of one or more semi-circular blocks 27 of pressed powder of scrap mill by-products of the afore cited kind, said blocks having a variously shaped cross-sectional profile, being entirely jacketed inside the protective shell 28 of plastic material that is provided all along its peripheral portion with a plurality of receptacles 29 for letting through the screws, bolts and the like used to fasten the counterweight in position onto the back wall (not shown) of the wash tub of the respective washing machine.

Claims

1. Process for manufacturing a counterweight for washing machines, particularly clothes washing machines or combined clothes washing and drying machines, said counterweight consisting of one or more blocks of a material with a high specific gravity that are jacketed with at least one protective shell of a plastic material of a traditional type which is overinjected onto said blocks, said process being **characterized in that** ferrous scrap by-products (ferrous oxides, etc.) from metallurgical processes with a preferred average density situated anywhere between 4 and 6 kg/dm^3 are used as such a high specific-gravity material, and **characterized further in that** it comprises a first processing phase in which the whole bulk of the earlier collected material is ground and moistened with water so as to obtain a powder mixture being either dry or having a pre-determined moisture content, preferably 5 to 6 percent, as well as having a pre-determined maximum allowable size of its grains, such as preferably 40 μm; a second processing phase in which said powder mixture is dried at a temperature which is preferably situated at approx. 150 °C so as to reduce the moisture content of said powder mixture down to a value of preferably approx. 2 to 4 percent, under subsequent cooling of the temperature of said powder mixture down to a value which is close to the value of the ambient temperature; a third processing phase in which said powder mixture is screened so as to separate the powder with the required grain size, which is then directly stored for further processing, from the powder with differently sized grains, which is further ground to the required grain size; a fourth processing phase in which said powder mixture is pressed to the required final density and is then preferably brushed on its surface so as to clean it and remove any processing defect; and a fifth processing phase in which said protective shell of plastic material is overinjected onto said compacted powder mixture to essentially the same shape and size as the counterweight.

2. Apparatus used to carry out the process for manufacturing a counterweight according to claim 1, **characterized in that** it uses the combined action of grinding means (6) for said high specific-gravity material, which are capable of grinding and mixing with water said high specific-gravity material so as to obtain a powder mixture being either dry or having a pre-determined moisture content, such as preferably 5 to 6 percent, as well as having a predetermined maximum allowable size of its grains, such as preferably 40 μm; drying means (14) adapted to heat up said powder mixture to a temperature of preferably approx. 150 °C so as to reduce its moisture content down to approx. 2 to 4 percent; screening means (18) adapted to separate the powder having the required grain size from the powder

with differently sized grains, which is ground again by further grinding means (20) until the required grain size is obtained; pressing means (21) adapted to compact said ground powder mixture down to the required final density; brushing means adapted to brush said compacted powder mixture on its surface so as to clean it and remove any possible processing defect; and moulding means (25) in which said compacted powder is inserted for the subsequent overinjection of plastic material so as to obtain said protective shell having essentialy the final shape and size of the envisaged counterweight.

3. Apparatus according to claim 2, **characterized in that** said grinding means comprise at least a granulator (6) or similar grinding apparatus of a traditional type, adapted to receive the material filled into at least a hopper (5) or similar appropriately sized container, and comprising a first portion (7) provided with a cylindrical inner chamber (8) communicating with said hopper (5) and in which are delivered metered amounts of said material that are moistened with water through spraying means being associated with said chamber (8), as well as a second portion (9) having a zigzag-like outer contour and being provided with at least a descending portion (10) and an ascending portion (11) that define respective cylindrical inner chambers (12, 13), said cylindrical inner chambers (8, 12, 13) being each provided with a respective Archimedean screw or similar conveying means adapted to cause the material to be conveyed through the chambers themselves so as to be both preliminarily ground to a coarse grain size and homogeneously mixed.

4. Apparatus according to claim 2, **characterized in that** said drying means comprise at least a fluidized-bed drier (14) or similar apparatus, adapted to dry said powder mixture through in-blowing of hot air at a temperature of preferably approx. 150 °C, said drier (14) being provided with a cooling facility (15) of a traditional type adapted to reduce the temperature of the dried powder mixture down to a value which is close to the value of the ambient temperature, and being further provided with at least a filter means (16) associated with at least an aspirator means (17) adapted to extract the hot air from said drier and exhaust it outside after due separation of all solid particles being in suspension in the same air, in such a way that said particles can be appropriately collected and recovered for further use in the process.

5. Apparatus according to claim 2, **characterized in that** said screening means comprise at least a *per sè* known type of screen (18) being in communication with one or more storage silos (19) or similar equipment provided for collecting and storing the powder having a proper grain size.

6. Apparatus according to claim 5, **characterized in that** said further grinding means comprise at least a *per sè* known type of dry grinding mill (20) being in communication with said screen (18) and said granulator (6).

7. Apparatus according to claim 5, **characterized in that** said pressing means comprise at least a press (21) of a traditional type for moulding ceramic and refractory materials, said press being provided with a forming tool (22) communicating with said storage silos (19) so as to receive the powder stored therein and moulding the same powder under high pressure to final densities preferably situated anywhere between 4 and 5 kg/dm^3, in such a way as to obtain one or more blocks of said compacted powder therefrom.

8. Apparatus according to claim 7, **characterized in that** said moulding means comprise at least a mould (25) for a plastic processing machine, in particular an injection moulding machine, said mould being adapted to accomodate said blocks of compacted powder, onto the outer surface of which plastic material is then overinjected to the final shape and size of said counterweight.

9. Counterweight made with the process according to claim 1 using the manufacturing apparatus according to claims 2 through to 8, **characterized in that** it comprises one or more blocks (27) of compacted powder of said waste mill by-products, said blocks being enclosed in at least a protective shell (28) of plastic material having a preferably semi-circular shape and a variously contoured cross-section, said shell (28) being provided with seats (29) for applying and fastening the counterweight in position against the wash tub of the respective washing machine by means of *per sè* known fastening means.

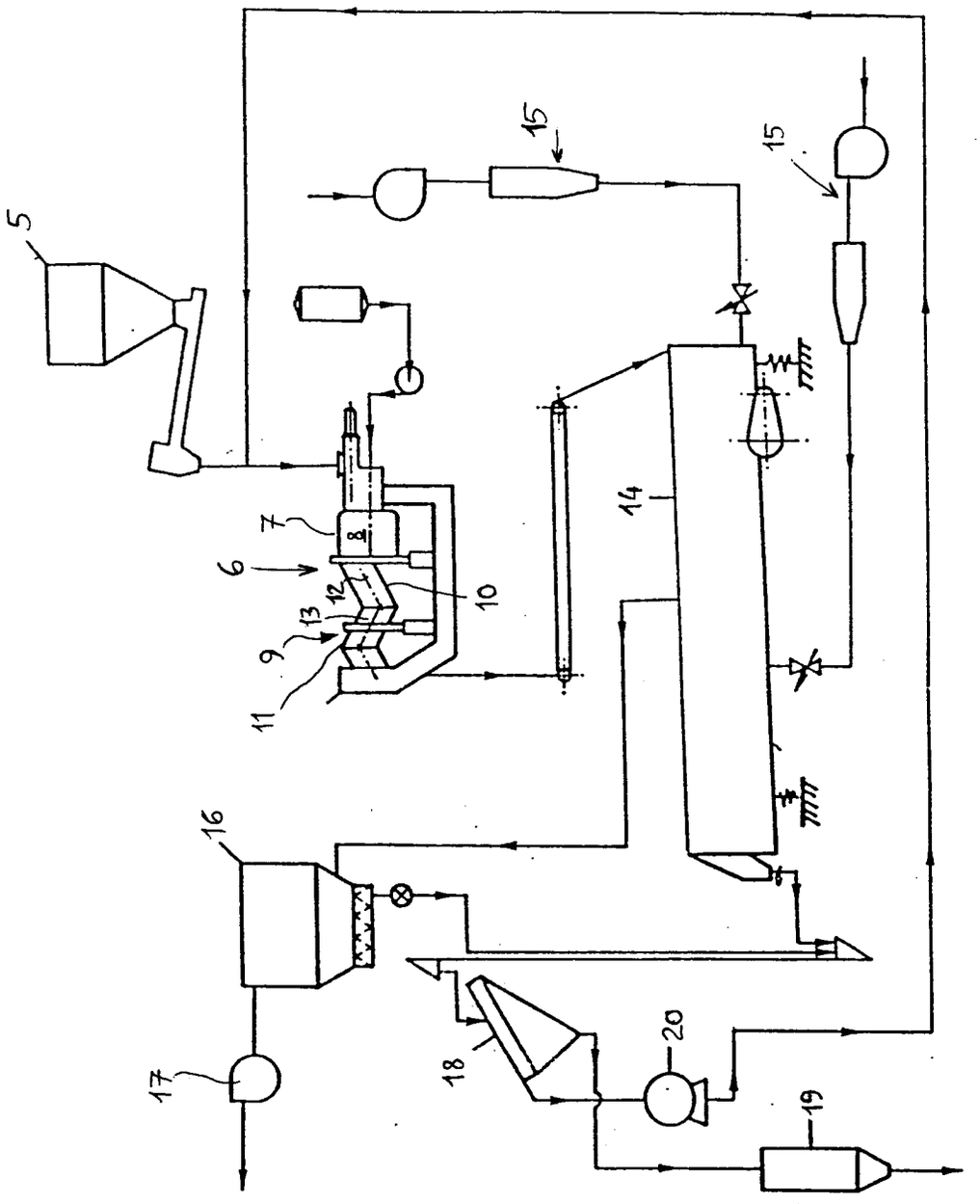

FIG. 1

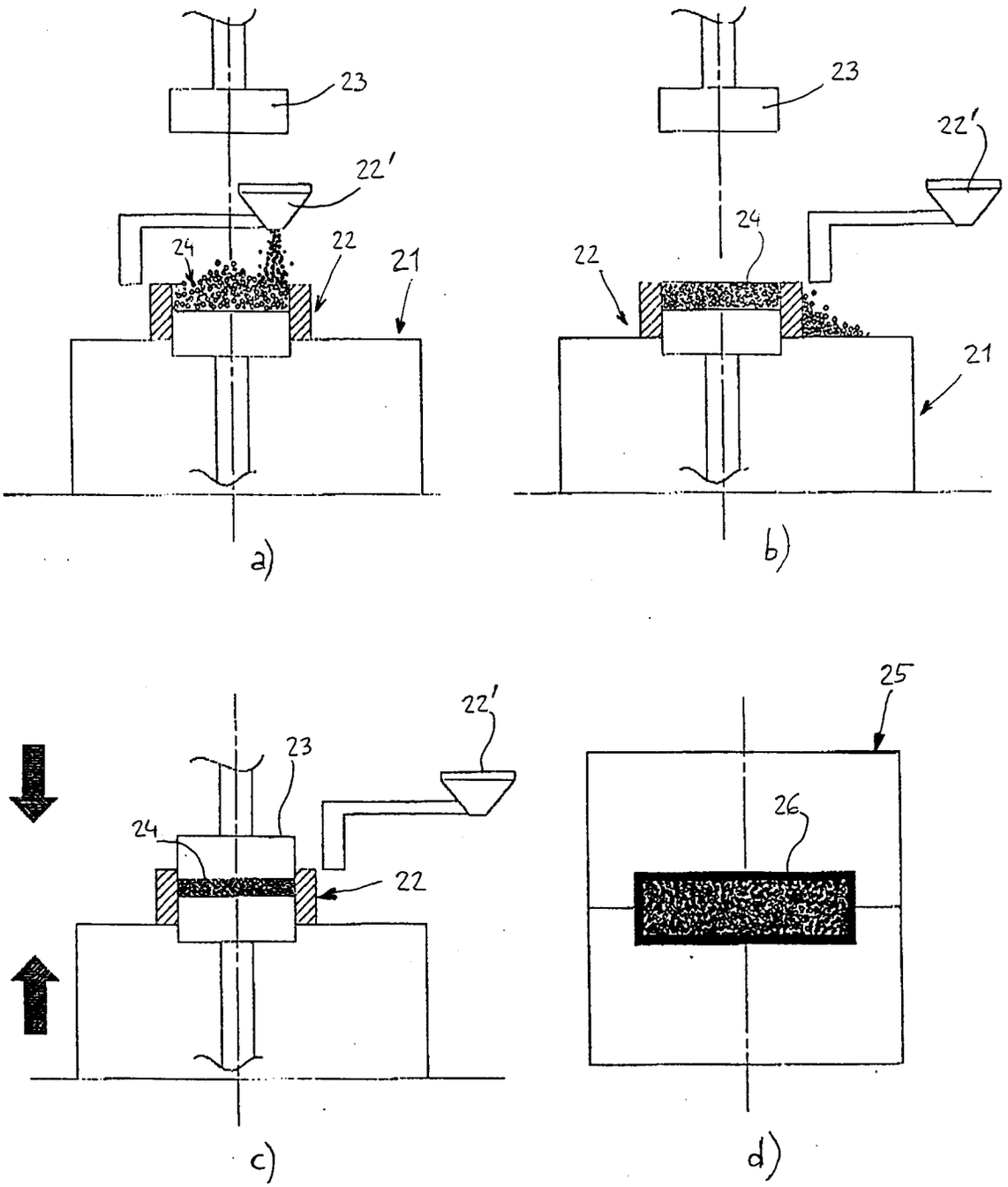

FIG. 2

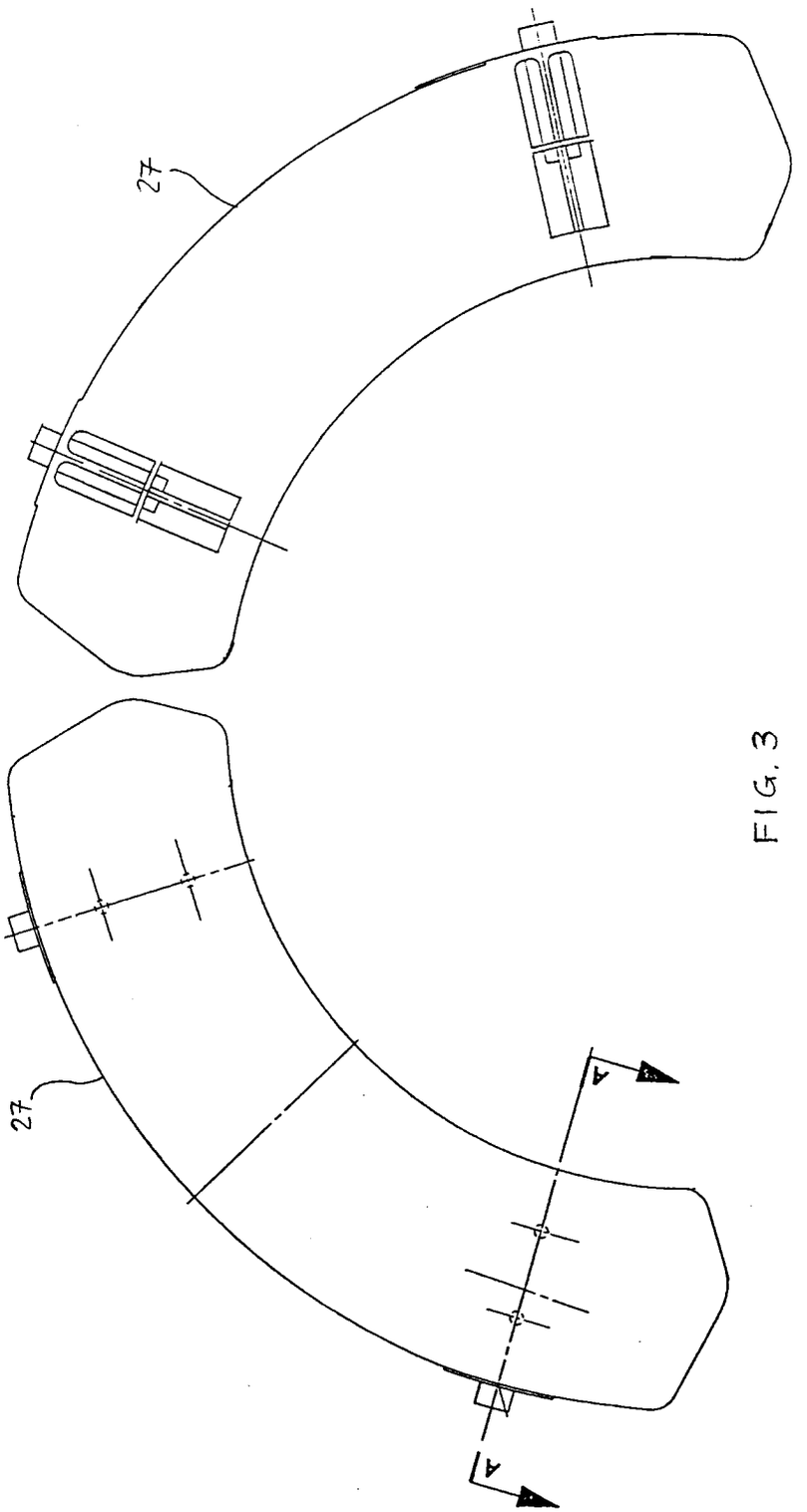

FIG. 3

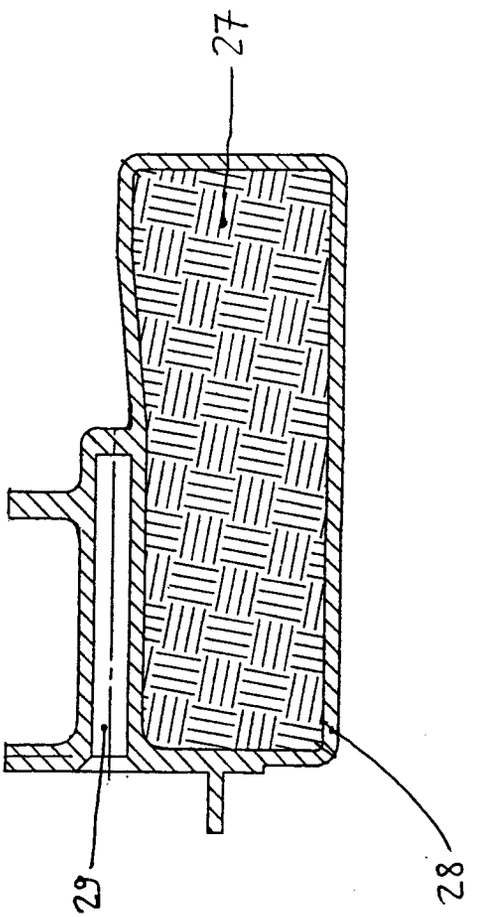

FIG. 4

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EUROPEAN SEARCH REPORT

Application Number

EP 92 10 7603

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.5)
A	FR-A-2 654 443 (INDUSTRIE ZANUSSI S.P.A.) * page 4, line 31 - page 5, line 11 * * page 6, line 11 - line 19; figures 2,3 * ---	1,8,9	D06F37/26
A	US-A-4 502 303 (WHITE CONSOLIDATED INDUSTRIES INC.) * column 5, line 1 - line 10 * * column 5, line 64 - column 6, line 19; figures 2,6 * ---	1,9	
A	DE-A-3 834 112 (LICENTIA PATENT-VERWALTUNGS-GMBH) * column 2, line 9 - column 3, line 10; figures * -----	1,9	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

D06F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	18 SEPTEMBER 1992	COURRIER G.L.A.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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