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(54) Mill for grinding loose material

(57) The mill for grinding loose material comprises a base frame, a grinding chamber which has at least an inlet mouth and an outlet mouth for the material to be ground and the ground material respectively and which is associated with the base frame by interposition of rotation means around a longitudinal axis, first and second closing means of the inlet mouth and outlet mouth respectively, and loading means of the material to be ground through the inlet mouth, which are associated with the base frame and comprise spreading means for spreading the material to be ground inside the grinding chamber, which can be associated with the base frame and can be positioned near the inlet mouth.

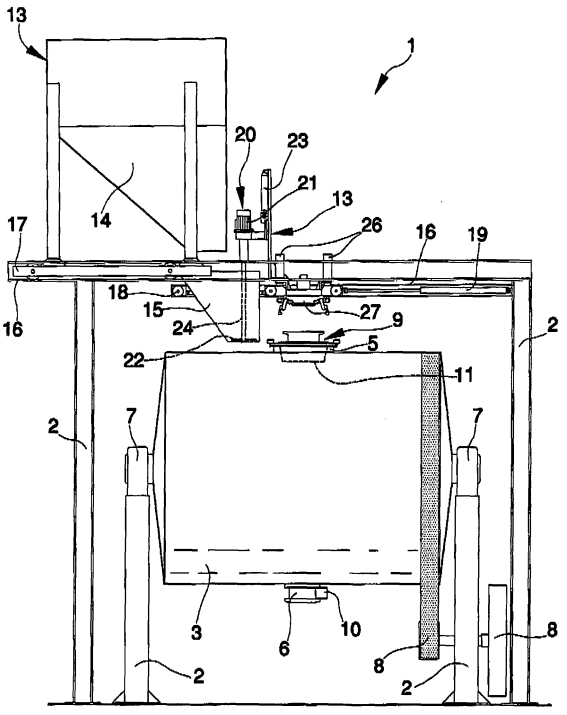

Fig. 1

EP 1 842 593 A1

Description

[0001] This invention relates to a mill for grinding loose material.

[0002] With particular, but not exclusive, reference to the ceramic industry sector, mills are known for the wet or dry grinding of loose materials for the preparation of e.g. ceramic mixes, glazes, silk-screen printing pastes or the like.

[0003] The known mills essentially comprise a base frame on which is mounted a grinding chamber having an inlet mouth and an outlet mouth for the materials to be ground and the ground materials respectively.

[0004] Inside the grinding chamber are grinding bodies, such as, for example, metal balls or spheres of different diameter.

[0005] The grinding chamber is mounted on the base frame by interposition of rotation means that permit its movement around a longitudinal rotation axis.

[0006] Following the rotary movement of the grinding chamber, the material to be ground inside the chamber is crushed between the grinding bodies and between the grinding bodies and the inner walls of the grinding chamber.

[0007] In a particular type of mill, the grinding chamber has cylindrical shape with circular section and is driven in rotation around its own axis of symmetry, arranged horizontally.

[0008] The inlet mouth and the outlet mouth of the material are usually arranged at diametrically opposite ends of the cylindrical side wall of the grinding chamber and openable/closable by means of a cap removable by hand.

[0009] When the outlet mouth is positioned low down, the inlet mouth is located high up and, without further movements of the grinding chamber, it is possible to introduce the material to be ground and extract the ground material by gravity alone, once the corresponding closing caps of the outlet and inlet mouths have been removed.

[0010] The filling of the grinding chamber is usually made by means of a loading hopper arranged above the chamber, from which the material to be ground is allowed to fall through the inlet mouth, previously positioned underneath the hopper.

[0011] These mills of known type do however have a series of drawbacks including the fact that they take a disadvantageously long time to load the materials to be ground and to grind these, which negatively affects production.

[0012] In this respect in fact, it should be remembered that the gravity filling of the material to be ground from the hopper and its transit through the inlet mouth results in its not being regularly and uniformly arranged inside the grinding chamber, over all the area available inside the grinding chamber, but in its being concentrated in the area below the inlet mouth, with the risk, in case of incomplete filling, of the mill's production capacity being considerably reduced.

[0013] To efficiently fill the grinding chamber, in point of fact, it is necessary to introduce a limited quantity of material to be ground, to close the inlet mouth, to make at least one rotation of the grinding chamber to allow the introduced material to be distributed more or less uniformly inside the chamber and to repeat this operation several times until filling has been completed.

[0014] This loading procedure, besides being very slow and laborious and slowing down the entire production process, requires ongoing intervention on the part of the personnel charged with opening and closing the inlet mouth, thus increasing the safety risks.

[0015] The opening and closing operations of the inlet mouth in fact are not easy and quick jobs to perform and, in some cases, can cause accidents and/or injuries; the same considerations can be made for the opening and closing operations of the outlet mouth.

[0016] The primary aim of this invention is to overcome the drawbacks complained of above of the known types of mills providing a mill for grinding loose material that permits reducing the time required to perform the loading operations of the materials to be ground and the grinding operations, thus increasing the overall productivity.

[0017] Another object of this invention consists in providing a mill for grinding loose material that is able to operate in conditions of utmost efficiency and safety for the personnel charged with operating the machine.

[0018] The above objects are all achieved by this mill for grinding loose material, comprising a base frame, at least one grinding chamber which has at least an inlet mouth and an outlet mouth for the material to be ground and the ground material respectively and which is associated with said base frame by interposition of rotation means around a longitudinal axis, first and second closing means of said inlet mouth and outlet mouth respectively, and loading means of the material to be ground through said inlet mouth associated with said base frame, wherein said loading means comprise spreading means for spreading the material to be ground inside said grinding chamber, which can be associated with said base frame and can be positioned near said inlet mouth.

[0019] Further characteristics and advantages of this invention will appear even more evident from the detailed description of a preferred, but not exclusive, embodiment of a mill for grinding loose material, illustrated indicatively by way of non limiting example, in the attached drawings wherein:

figure 1 is a front view of the mill according to the invention during the grinding phase;
figure 2 is a front view of the mill, in enlarged scale, according to the invention during the filling phase;
figure 3 is a front view of the mill, in partial transparency, according to the invention, at the end of filling;
figure 4 is a side view, in partial transparency, of the mill according to the invention;
figure 5 is a front view of a detail of the mill according to the invention, which shows in detail the stop

means for stopping the rotation of the grinding chamber;

figure 6 is a front view of a detail of the mill according to the invention that shows in detail the supply means for supplying the fluid under pressure for operating the first and second closing means.

[0020] With special reference to such figures, a mill for grinding loose material has been globally designated by reference number 1.

[0021] The mill 1 comprises a base frame 2 that supports a grinding chamber 3 containing a plurality of grinding spheres 4 and has an inlet mouth 5 and an outlet mouth 6 for the material to be ground and the ground material respectively.

[0022] The grinding chamber 3 has a substantially straight cylindrical shape and is associated with the base frame 2 by interposition of rotation means 7 for rotating around its longitudinal axis, which is arranged horizontally.

[0023] The rotating operation of the grinding chamber 3 is made by means of a traditional motorised belt drive system 8.

[0024] The inlet mouth 5 and the outlet mouth 6 are arranged at diametrically opposite parts of the side surface of the grinding chamber 3 and are openable/closable through first closing means 9 and through second closing means 10 respectively.

[0025] The first closing means 9, in detail, are composed of a removable shutter body 11, positionable so as to completely close the inlet mouth 5, and which can be blocked in this position by a series of retaining hooks 12 mounted on the grinding chamber 3 near the mouth itself.

[0026] The second closing means 10, on the other hand, consist of a dispenser valve connected to the outlet mouth 6.

[0027] Usefully, the mill 1 has loading means 13 for loading the material to be ground through the inlet mouth 5, which are associated with the base frame 2 above the grinding chamber 3.

[0028] Such loading means are of the gravity type and comprise a first hopper 14 for collecting the material to be ground and a second hopper 15 of smaller size, arranged underneath the first hopper 14 and intended to convey the material to be ground near the inlet mouth 5.

[0029] The hoppers 14 and 15 are mounted on straight guiding means along a horizontal direction, composed of a guide casing 16 associated with the base frame 2 above the grinding chamber 3, and of a first trolley 17 and a second trolley 18 sliding inside the guide casing 16 and supporting the first hopper 14 and the second hopper 15 respectively.

[0030] The second trolley 18 is pushed along the guide casing 16 by means of a hydraulic jack 19 interposed between the base frame 2 and the trolley itself.

[0031] Usefully, the second hopper 15 is suitable for cooperating with spreading means 20 for spreading the material to be ground falling inside the grinding chamber 3, which are positionable near the inlet mouth 5 and associated with the base frame 2 by interposition of the second trolley 18.

[0032] These spreading means comprise rotary driving means 21 for driving an impeller element 22 around an axis parallel to the direction of introduction of the material to be ground inside the grinding chamber 3, and introduction and removal means 23 for introducing and removing the impeller element 22 through the inlet mouth 5.

[0033] In the particular embodiment of the invention shown in the figures, the filling of the grinding chamber 3 is by gravity and the direction of introduction of the material to be ground and the direction of introduction and removal of the impeller element 22 through the inlet mouth 5 are both vertical; alternative embodiments of the mill 1 cannot however be ruled out in which such directions are oriented differently.

[0034] Advantageously, the rotary driving means 21 are composed of a rotary motor having a vertical motor shaft 24 fitted inside the second hopper 15 and at the lower end of which the impeller element 22 is keyed.

[0035] The rotary motor 21 is associated with the introduction and removal means 23 which, in turn, are composed of a linear actuator, of the hydraulic cylinder type or the like, arranged vertically and having a first end supporting the rotary motor 21 and a second end mounted on a support bracket 25 associated with the second trolley 18.

[0036] The loading means 13 also comprise automated removal means for removing the removable shutter body 11, which are associated with the base frame 2 by interposition of the second trolley 18.

[0037] Such automated removal means are composed of lifting means 26 for lifting a vice device 27 for gripping the removable shutter body 11.

[0038] The lifting means 26 consist of a pair of vertical hydraulic cylinders mounted on the second trolley 18, the length of which defines the lifting and lowering stroke of the vice device 27.

[0039] The vice device 27 has a plurality of moving hooks 27a for gripping the removable shutter body 11 which, during use, are operated by means of a series of actuators not shown in the figures.

[0040] The mill also features stop means 28 for stopping the rotation of the grinding chamber 3 in a predefined locking position in which the inlet mouth 5 is turned upwards and the outlet mouth 6 is positioned facing downwards.

[0041] Such stop means comprise a locking insert 29, which is associated with the base frame 2, and a stop element 30, which is associated with one of the bases of the grinding chamber 3 and which, in the predefined locking position, can be coupled with the locking insert 29.

[0042] The locking insert 29 is positioned facing the stop element 30 and is associated with the base frame 2 by interposition of reciprocal approaching and moving

away means 31 for moving closer and away with the respect to the stop element 30.

[0043] The reciprocal approaching and moving away means 31 are composed of e.g. a horizontal linear actuator having a fixed end associated with the base frame 2 and a moving end supporting the locking insert 29.

[0044] Advantageously, the retaining hooks 12 for locking the removable shutter body 11 and the dispenser valve 10 for closing the outlet mouth 6 are both of the fluid-operation type (pneumatic or hydraulic) and can be connected to supply means 32 for supplying a fluid under pressure.

[0045] The supply means 32 comprise e.g. a pump 33 for pumping the fluid under pressure, which is mounted on the base frame 2, a first fluid flow circuit 34, which is associated with the pump 33 and mounted on the base frame 2, a second fluid flow circuit 35, associated with the first and second closing means 9 and 10 and mounted on the grinding chamber 3, and reciprocal connection means 36 of the first and second circuits 34 and 35 in the predefined locking position.

[0046] In detail, the reciprocal connection means 36 comprise a series of first end couplings 37, associated with the first circuit 34, and a series of second end couplings 38, associated with the second circuit 35 and which can be coupled, in the predefined locking position, with the first couplings 37.

[0047] In detail, the second couplings 38 are associated with a base of the grinding chamber 3 and the first couplings 37 are substantially positioned facing these.

[0048] To complete the reciprocal connection means 36, moving means 39 are provided for moving the first couplings 37 with respect to the second couplings 38, which are interposed between the base frame 2 and the first couplings 37 and permit connecting the circuits 34 and 35 in the predefined locking position.

[0049] Such moving means are defined by a linear actuator having a fixed end associated with the base frame 2 and a moving end on which a supporting plate 40 is mounted that supports the first couplings 37.

[0050] The operation of this invention is as follows.

[0051] In the grinding phase (figure 1) the grinding chamber 3 is closed and is made to turn around its axis by means of a motorised belt drive system 8; in these circumstances, the trolleys 17 and 18 are positioned so the vice device 27 is arranged on the vertical lying plane of the inlet mouth 5.

[0052] Once the grinding cycle has been completed, the grinding chamber 3 is made to turn as far as the predefined locking position in which the stop means 28 and the reciprocal connection means 36 are fitted.

[0053] In this configuration, the supply means 32 are able to control the opening of the outlet mouth 6, allowing the exit of the ground material, and the operation of the retaining hooks 12 and, consequently, the release of the removable shutter body 11.

[0054] In automated way the loading means 13 are therefore able to: lower the vice device 27 as far as it is close to the inlet mouth 5, grip the removable shutter body 11 by means of the moving hooks 27a of the vice device 27, lift the shutter body 11, move sideways along the guide casing 16 by means of the sliding of the trolleys 17 and 18 as far as the positioning of the second hopper 15 above the inlet mouth 5, and then lower the impeller element 22 as far as this is introduced into the grinding chamber 3 (figure 2).

[0055] In this position, the filling of the grinding chamber is made by allowing the material to be ground to drop from the hoppers 14 and 15 and at the same time driving in rotation the impeller element 22.

[0056] The rotary movement of the impeller element 22 is such as to divert the fall of the loose material coming from the second hopper 15 and push this close to the walls of the grinding chamber 3 avoiding the formation of an accumulation of material only beneath the inlet mouth 5 (figure 3).

[0057] The filling of the grinding chamber 3 can be completed by continuing to introduce the material to be ground through the inlet mouth 5 without driving in rotation the impeller element 22.

[0058] It has in fact been found how the described invention achieves the set objects.

[0059] In this respect, it should be noted that the special solution of using spreading means for spreading the material to be ground at the entrance of the grinding chamber makes it considerably easier to load the material to be ground, making this operation faster than is the case with traditional mills.

[0060] Furthermore, the use of automated removal means for opening and closing the grinding chamber makes the operation easier and safer and this operation can in fact be performed without an operator necessarily moving close to the inlet mouth of the material.

[0061] It is easy to appreciate therefore, how the mill for grinding loose material according to the invention ensures a bigger output compared to the machines of known type.

[0062] The invention thus conceived is susceptible of numerous modifications and variations, all of which falling within the scope of the inventive concept.

[0063] Furthermore all the details may be replaced by other elements which are technically equivalent.

[0064] In practice, all the materials used, as well as the contingent shapes and dimensions, may be any according to requirements without because of this moving outside the protection scope of the following claims.

Claims

1. Mill for grinding loose material, comprising a base frame, at least one grinding chamber which has at least an inlet mouth and an outlet mouth for the material to be ground and the ground material respectively and which is associated with said base frame by interposition of rotation means around a longitu-

dinal axis, first and second closing means of said inlet mouth and outlet mouth respectively, and loading means of the material to be ground through said inlet mouth associated with said base frame, wherein said loading means comprise spreading means for spreading the material to be ground inside said grinding chamber, which can be associated with said base frame and can be positioned near said inlet mouth.

2. Mill according to claim 1, **characterized in that** said spreading means comprise rotary driving means for driving an impeller element around an axis substantially parallel to the direction of introduction of the material to be ground inside said grinding chamber.

3. Mill according to one or more of the preceding claims, **characterized in that** said spreading means comprise introduction and removal means for introducing and removing said impeller element through said inlet mouth.

4. Mill according to one or more of the preceding claims, **characterized in that** said rotary driving means comprise at least a rotary motor which is associated with said introduction and removal means and has a motor shaft supporting said impeller element.

5. Mill according to one or more of the preceding claims, **characterized in that** said introduction and removal means comprise at least a linear actuator having a first end which can be associated with said rotary driving means and a second end which can be associated with said base frame.

6. Mill according to one or more of the preceding claims, **characterized in that** said loading means are of the gravity type.

7. Mill according to one or more of the preceding claims, **characterized in that** said loading means comprise at least a hopper which can be associated with said base frame above said grinding chamber and suitable for cooperating with said spreading means.

8. Mill according to one or more of the preceding claims, **characterized in that** said motor shaft can be fitted inside said hopper.

9. Mill according to one or more of the preceding claims, **characterized in that** said first closing means comprise at least a removable shutter body.

10. Mill according to one or more of the preceding claims, **characterized in that** said loading means comprise automated removal means for removing said removable shutter body, which can be associated with said base frame.

11. Mill according to one or more of the preceding claims, **characterized in that** said automated removal means comprise lifting means for lifting a vice device for gripping said shutter body, which are mounted on said frame above said grinding chamber.

12. Mill according to one or more of the preceding claims, **characterized in that** said loading means comprise straight guiding means along a substantially horizontal direction of at least one between said spreading means, said hopper and said automated removal means.

13. Mill according to one or more of the preceding claims, **characterized in that** said straight guiding means comprise at least a guide casing associated with said base frame above said grinding chamber, and at least a trolley sliding inside said guide casing and supporting at least one between said spreading means, said hopper and said automated removal means.

14. Mill according to one or more of the preceding claims, **characterized in that** it comprises stop means for stopping the rotation of said grinding chamber in a predefined locking position.

15. Mill according to one or more of the preceding claims, **characterized in that** said stop means comprise at least a locking insert, which is associated with at least one between said base frame and said grinding chamber, and a stop element, which is associated with the other between said base frame and said grinding chamber and which, in said predefined locking position, can be coupled with said locking insert.

16. Mill according to one or more of the preceding claims, **characterized in that** said locking insert is associated with said base frame.

17. Mill according to one or more of the preceding claims, **characterized in that** said stop element is associated with a base of said grinding chamber, said grinding chamber having a substantially straight cylindrical shape.

18. Mill according to one or more of the preceding claims, **characterized in that** said stop means comprise reciprocal approaching and moving away means of said locking insert and of said stop element which are associated with at least one between said base frame and said grinding chamber.

19. Mill according to one or more of the preceding claims, **characterized in that** said reciprocal approaching and moving away means comprise at least a linear actuator having a fixed end which can be associated with said base frame and a moving end which can

be associated with said locking insert.

20. Mill according to one or more of the preceding claims, **characterized in that** at least one between said first and second closing means is of the fluid-operation type.

21. Mill according to one or more of the preceding claims, **characterized in that** it comprises supply means for supplying a fluid under pressure for operating at least one between said first and second closing means.

22. Mill according to one or more of the preceding claims, **characterized in that** said supply means comprise a first fluid circuit, which is associated with said base frame, a second fluid circuit, associated with said grinding chamber, and reciprocal connection means of said first and second circuits in said predefined locking position.

23. Mill according to one or more of the preceding claims, **characterized in that** said reciprocal connection means comprise at least a first end coupling associated with said first circuit and at least a second end coupling associated with said second circuit and which can be coupled, in said predefined locking position, with said first coupling.

24. Mill according to one or more of the preceding claims, **characterized in that** said second coupling is associated with a base of said grinding chamber, said grinding chamber having a substantially straight cylindrical shape.

25. Mill according to one or more of the preceding claims, **characterized in that** said reciprocal connection means comprise moving means for moving said first coupling with respect to said second coupling, which are interposed between said base frame and said first coupling.

26. Mill according to one or more of the preceding claims, **characterized in that** said moving means comprise at least a linear actuator having a fixed end which can be associated with said base frame and a moving end which can be associated with said first coupling.

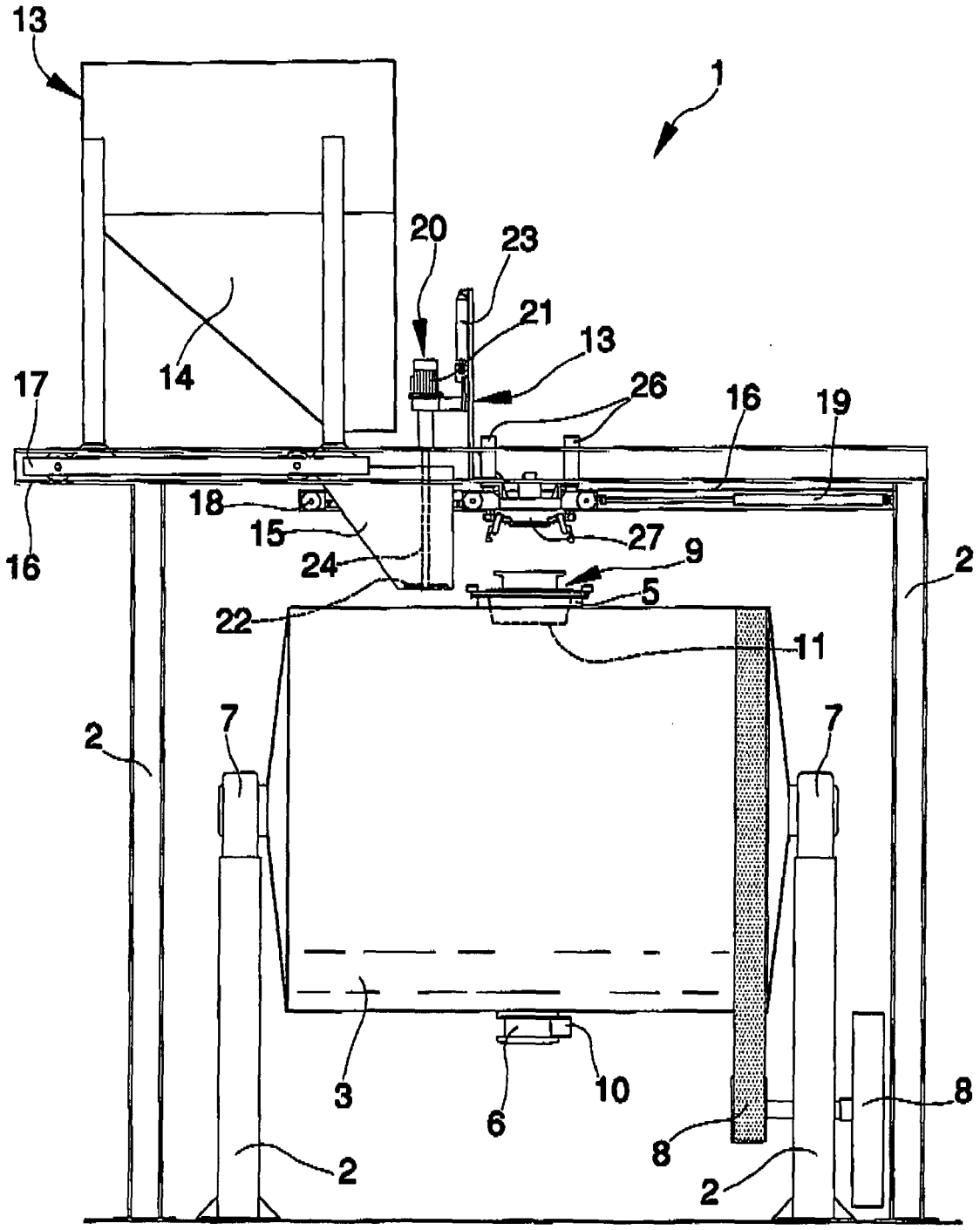

Fig. 1

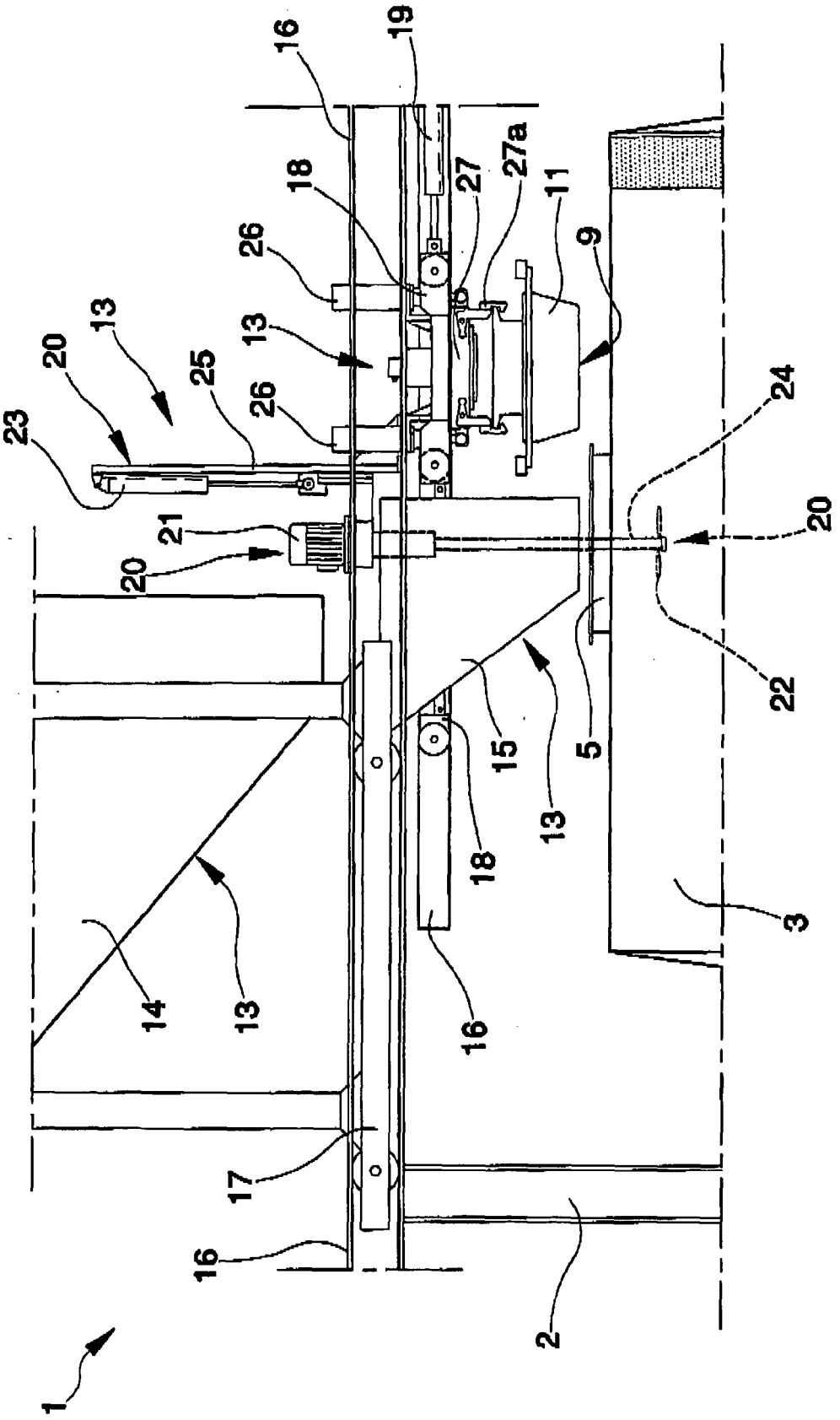

Fig. 2

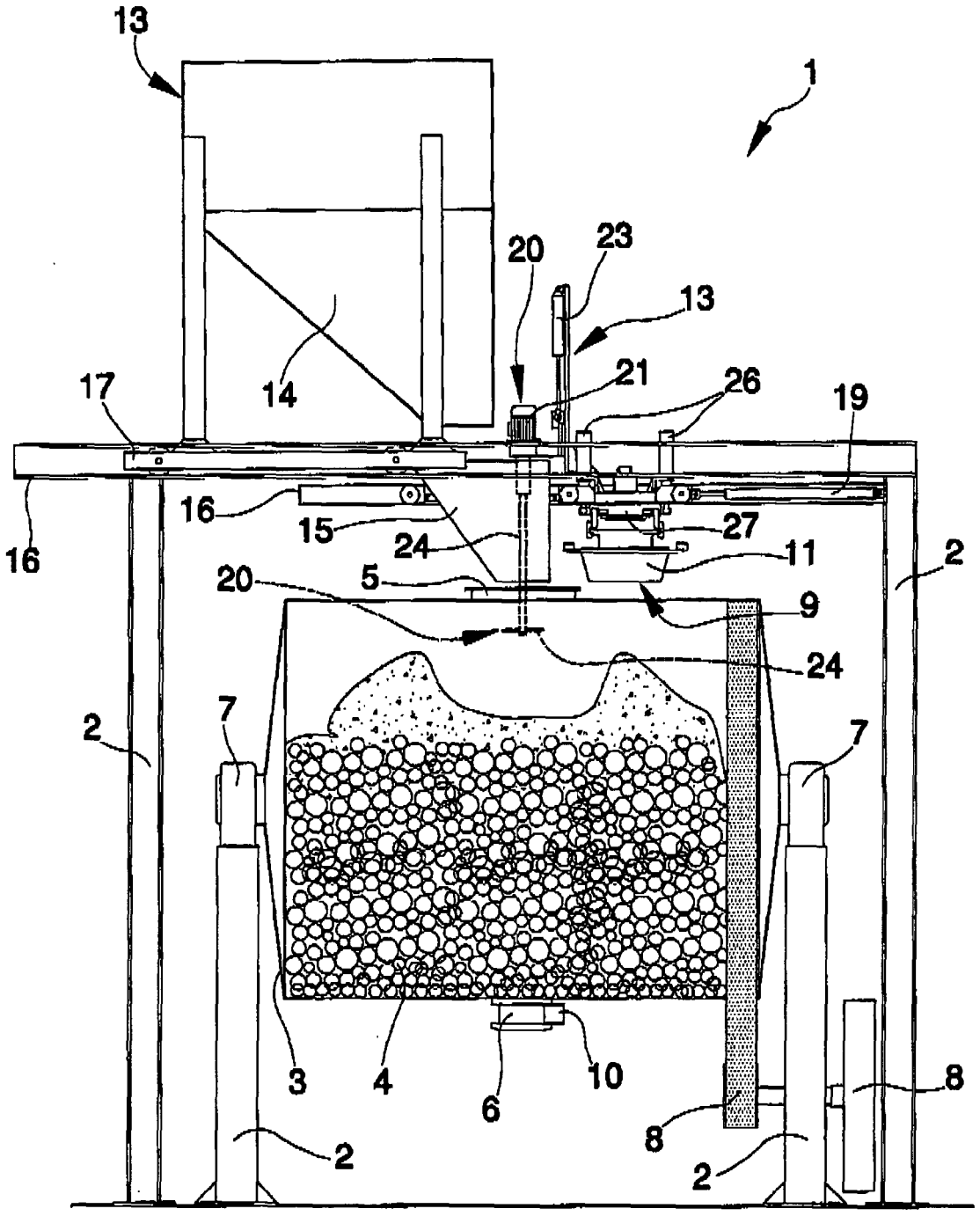
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Fig. 3

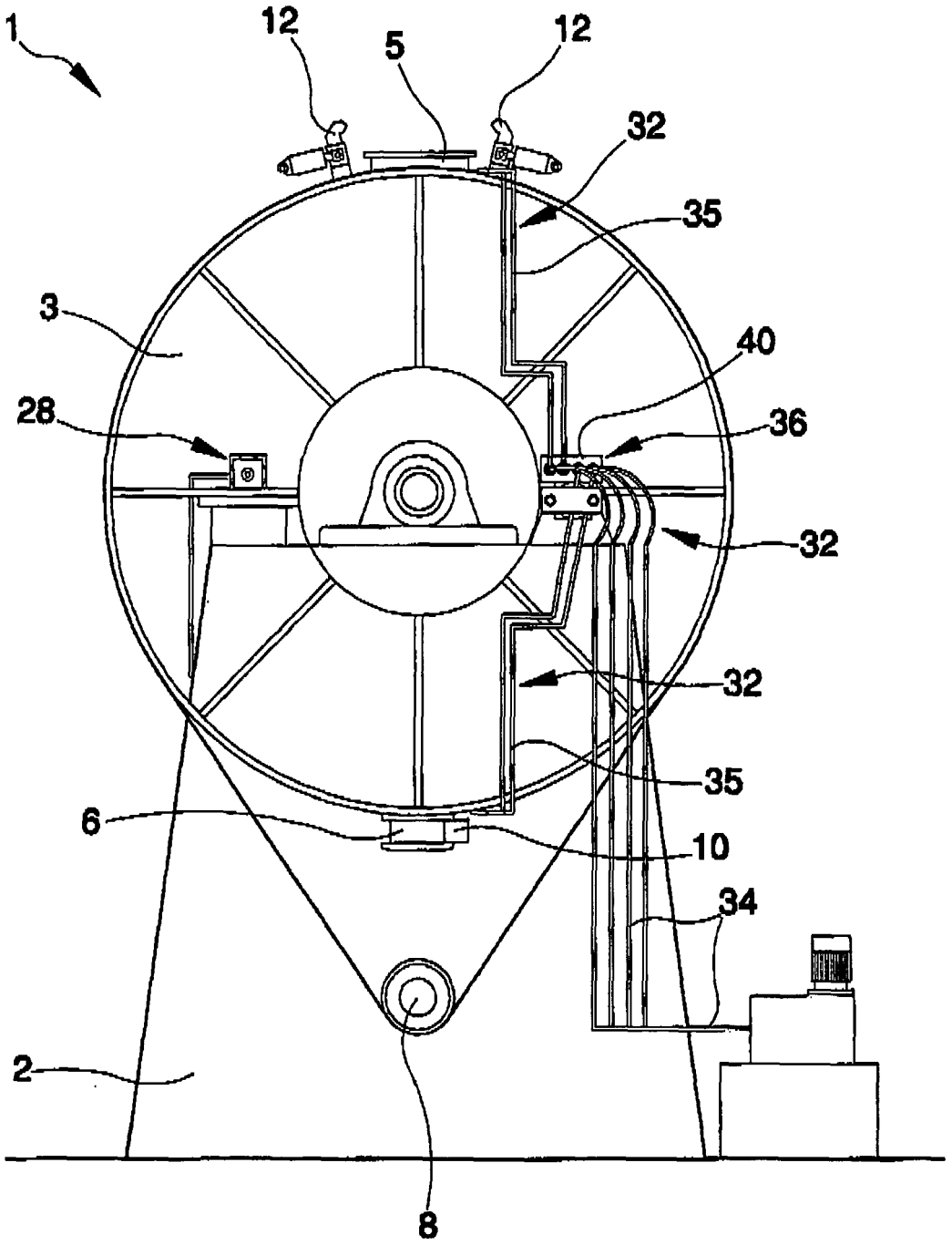
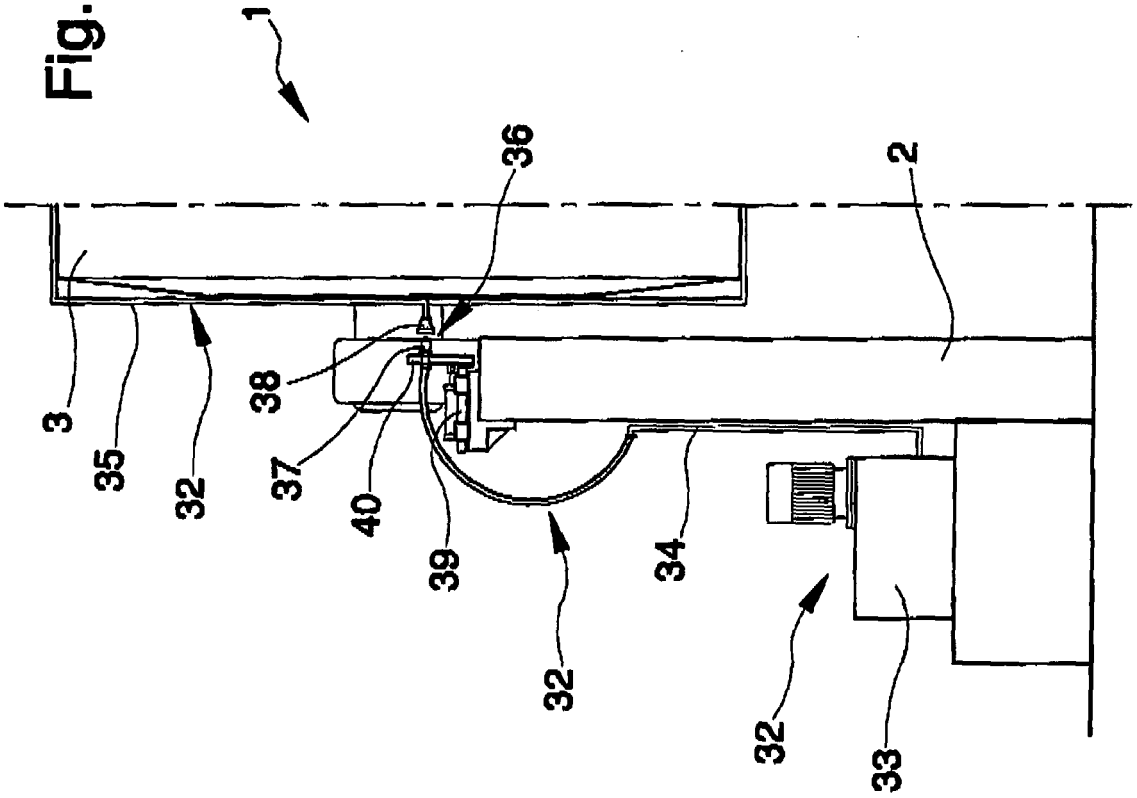


Fig. 4

Fig. 6



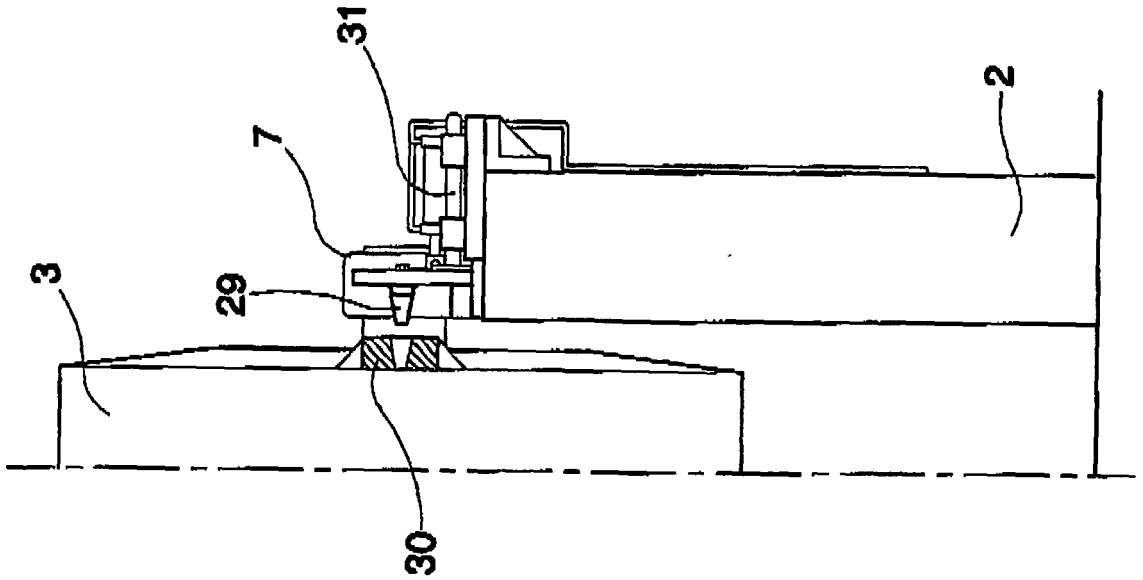


Fig. 5

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European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 07 00 6893

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	US 3 001 730 A (DAMAN ARTHUR C) 26 September 1961 (1961-09-26) * the whole document * -----	1-26	INV. B02C17/10 B02C17/18
A	US 4 679 736 A (ORLANDO JOHN J [US]) 14 July 1987 (1987-07-14) * the whole document * -----	1-26	
A	US 3 401 893 A (REYNOLDS JAMES A) 17 September 1968 (1968-09-17) * the whole document * -----	1-26	

TECHNICAL FIELDS SEARCHED (IPC)

B02C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	22 June 2007	Kopacz, Ireneusz

CATEGORY OF CITED DOCUMENTS

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22-06-2007

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 3001730 A	26-09-1961	NONE	
US 4679736 A	14-07-1987	NONE	
US 3401893 A	17-09-1968	NONE	

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82