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(71) Applicant: **S.I.T.I. S.p.A. Società Impianti Termoelettrici Industriali**
28040 Marano Ticino (Novara) (IT)

(72) Inventors:
- **Caverio, Cleo**
  20159 Milano (IT)
- **Bossetti, Renato**
  28100 Novara (IT)

(74) Representative: **Forattini, Amelia et al**
c/o Internazionale Brevetti
Ingg. ZINI, MARANESI & C. S.r.l.
Piazza Castello 1
20121 Milano (IT)

(54) Device for grinding ceramic materials and apparatus comprising the device

(57) The invention relates to a device for grinding ceramic materials which includes a cylindrical body, which is loaded with grinding media and is supported by two pairs of rollers which engage the external surface of the cylindrical body. The rotation of the cylindrical body is entrusted to two sets of belts arranged at the ends of the cylindrical body. The apparatus includes the device, a press and a kiln. The invention allows to drive large rotating cylindrical bodies with a system which is simple, cheap and reliable.

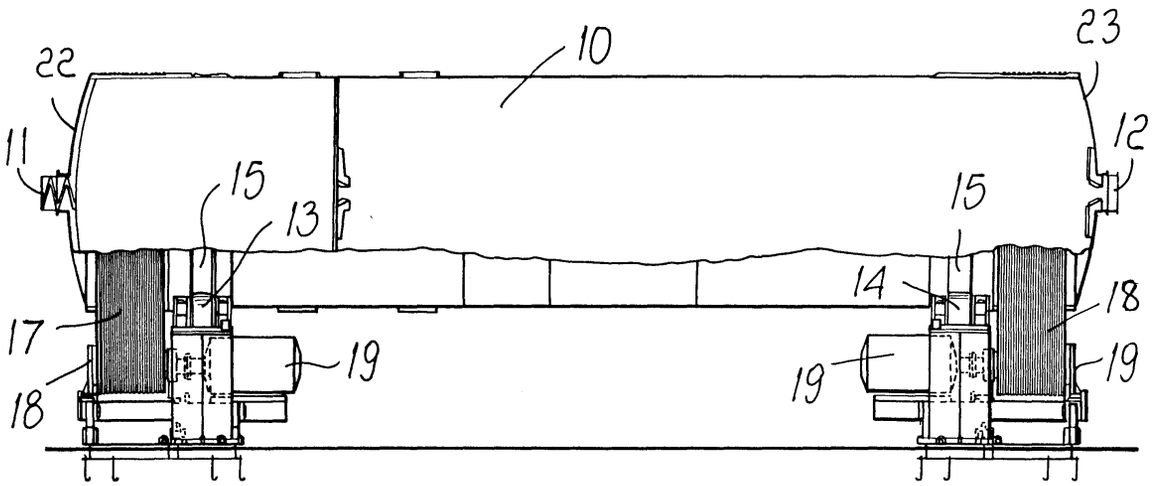

Fig. 1

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Description

[0001] The invention relates to a device for grinding ceramic materials and to an apparatus that includes the device. In general, these devices are formed by a cylindrical body which is arranged substantially horizontally and is internally lined with rubber or with a nonferrous material which does not contaminate the ceramic product. The rubber lining is meant to avoid the separation and abrasion of metallic particles which might contaminate the ground product. The inside of the cylindrical body is loaded, to approximately half of its volume, with grinding media made of nonferrous material. By turning the cylindrical body, the grinding media are moved and, by rolling, grind the product to be ground, which is fed into the cylindrical body. The grinding media can be, for example, silica marbles. The cylindrical body has two openings at its two opposite ends, so that the product to be ground can be fed from one of the two openings and removed from the other opening. It is also possible to provide dividing partitions along the cylinder, so as to adjust the movement of the product to be ground along the length of the cylindrical body.

[0002] The ceramic material can so be ground to powder. This powder is dry pressed to obtain a preformed article, such as a tile, a plate, a slate, or a refractory brick. Then the preformed article is fired in a kiln to obtain the final product.

[0003] The above is the field of industrial application of the invention but is not a limitation of the invention because the invention is limited exclusively by the accompanying claims.

[0004] Devices as described above are known in which the rotating cylinder is supported by two rolling bearings which are arranged at the ends of the cylindrical body and are axially aligned with the rotating cylinder. One of the two bearings must be able to perform a longitudinal translatory motion, so as to absorb the expansion of the cylindrical body that occurs due to the increase in temperature caused by the grinding process. The supporting pivots, which rest on the bearings, are formed monolithically with the members that constitute the heads of the cylinder. These members, formed by casting or welding, must be made of a material with a high static and fatigue strength, since they are subjected to significant flexural stresses in the region connecting the pivot and the vertical wall.

[0005] Accordingly they require accurate design and manufacture; they must also be checked with nondestructive tests (ultrasound, radiographs) and machined with suitable processes so as to limit the risk of triggering fatigue failures. Furthermore, inside the pivots there are passage holes for loading the material to be ground and water, and on the opposite side there is the hole for discharging the ground material.

[0006] These solutions entail many disadvantages: in particular, the large bearings are very expensive, have lubrication problems and problems in terms of possible contamination by the ceramic material to be ground or already ground. Furthermore, the delivery times for such bearings are very long and it is therefore necessary to keep expensive spares in store. Finally, it is necessary to have very expensive bases for the rotating cylinder, with long procurement times, and with the possibility of having casting rejects, accordingly entailing a supply risk and requiring expensive testing and manufacturing.

[0007] Another type of mill, used in the above defined field of the invention, is known which uses a cylindrical rotating body which is rested on rubber-covered motorized rollers. The rubber provided on the rollers allows to increase the friction coefficient in the coupling between the rollers and the rotating body, so as to allow to transmit the other forces required to turn the cylindrical body. However, even this solution has various drawbacks. First of all, the driving and supporting rollers must have an elongated shape, in order to increase the surface of contact with the cylindrical rotating body and therefore allow to transmit the forces required to turn the cylindrical rotating body. However, this entails an extremely difficult coupling between the supporting and driving rollers and the structure of the mill, since even small imperfections can compromise the possibility of transmitting the necessary forces. Furthermore, even if the length of the rubber-covered rollers is increased, the pressure on the rubber is extremely high. Consider in fact that the weight of the rotating cylinder alone can exceed 58 tons and is increased by the weight of the grinding media, which can exceed 76 tons, by the weight of the rubber covering of the rotating body, which can exceed 35 tons, and also of course by the considerable weight of the material to be ground and of the corresponding mixture water. The rubber of the rollers is therefore subjected to extremely high pressures which tend to damage it and therefore to compromise its operation. To reduce these pressures, it is necessary to further increase the length of the rubber-covered support rollers, consequently increasing the geometric difficulties in operation. On the other hand, it has been found that it is impossible to use materials harder than rubber, since the motion to be transmitted has a very high torque from the very start and indeed it has starting torques which are approximately twice as high as the steady-state torques, consequently requiring a high friction coefficient.

[0008] It should also be noted that after any breakage of the support rollers, their replacement is a rather complicated operation, since the mill must be stopped, entailing the need to also stop the entire system upstream and downstream of the mill, that is to say, the weighing and pregranulation system, the atomizer for granulating the ground product, the presses for pressing the material ground with the mill and the kilns for firing the pressed material.

[0009] Other industrial fields, different from the ceramic sector, to which the present invention belongs, such as cement production plants, use large mills in which the rotating body is motorized by virtue of gears.

However, even this solution has drawbacks, since the gear transmission is expensive to manufacture and to maintain. It should in fact be noted that the gears must be lubricated and protected from the abrasive dust that occurs in the ceramic industry.

[0010] US 5,586,925 and JP 55054171 A-53123799 disclose an apparatus for artificially weathering marble and stones with a drum. So it relates to a completely different aim. Furthermore it is supported laterally along its rotating with the above remarked drawbacks. Finally it can be loaded and discharged only by a lateral opening and therefore can allow only a batch working and not a continuous working as required in the field of the present application.

[0011] US 5, 029, 415 discloses an apparatus for centrifugal hydromechanical cleaning and polishing of billets. So, also in this case the field is completely different. Fuerthermore it can be loaded and discharged by openings arranged near the lateral wall of the cylinder and cannot work continuously as required in the field of the present invention.

[0012] US 2 210 584 discloses a drum for removing flash from molded plastic articles and polishing them. So the field of the invention is even more remote. Also, the drum is perforated so it cannot keep water inside, as required in the filed of the present invention. Finally no grinding body is provided.

[0013] US 2,875,894 discloses a drum for separating whiskers from nails. So the field of completely different from the present invention. Also one side of the drum is open so that it is impossible to keep water and the grinding media inside. In fact no grinding media whatsoever is provided.

[0014] EP 0 714 703 discloses only the inner lining of a drum.

[0015] The aim of the present invention is therefore to overcome the above drawbacks with a device for grinding ceramic materials, according to claim 1.

[0016] The rollers are preferably made of a material with a Brinell hardness BH of no less than 150, preferably no less than 350.

[0017] The rollers are preferably made of metallic material.

[0018] Preferably, the cylindrical body has a length of no less than 8000 mm, more preferably no less than 10000 mm.

[0019] The invention furthermore relates to an apparatus for manufacturing ceramic products which includes a device as described, a press for pressing the product ground in the device, and a kiln for firing the ground product. For the description of a press suitable to operate in this apparatus, reference is made for example to European patent no. 594217 in the name of the same Applicant. For the description of a kiln suitable to operate in the apparatus, reference is made for example to European patent No. 750169 and to European patent no. 866296.

[0020] The present invention will be better understood with reference to the accompanying figures, which are provided as nonlimitative examples of the present invention and wherein:

Figure 1 is a partially sectional side view of the device according to the invention;

Figure 2 is a partially sectional plan view of the device of Figure 1;

Figure 3 is a front view of the device of Figure 1;

Figure 4 is a schematic side view of a second embodiment of the device according to the invention;

Figure 5 is a front view of the device of figure 4; and

Figure 6 is a front enlarged view of a third embodiment of the device according to the invention.

[0021] With reference to Figures 1 to 6, the device according to the invention includes a cylindrical body 10 which is arranged substantially horizontally. The cylindrical body 10 is loaded with grinding media, not shown in the figures, which occupy approximately half of its volume. The cylindrical body 10 has two openings 11 and 12, arranged at its ends, for feeding the product to be ground and for removing the ground product.

[0022] The cylindrical body is supported by two pairs of rollers 13 and 14. The two pairs of rollers 13 and 14 engage an external surface 15 of the cylindrical body 10.

[0023] The rotation of the cylindrical body 10 is entrusted to a belt drive 16 which engages the outer surface 15 of the cylindrical body 10. The belt drive 16 is arranged externally with respect to the pairs of rollers 13 and 14. In this manner it is possible to easily replace the belts 17 without having to lift the cylindrical body 10.

[0024] The belt drive 16 includes, in the embodiment shown in the figures, two transmission assemblies 18 arranged on the opposite sides of the cylindrical body 10 and externally with respect to the pairs of rollers 13 and 14. Each transmission assembly includes a motor 19 and a series of belts 17. In particular, the series of belts 17 is formed by a plurality of V-belts.

[0025] In the illustrated embodiment, each transmission assembly 18 and 19 is mounted so that it can oscillate on the pivot 20, so as to allow to adjust the tension of the belts by virtue of the fixing member 21.

[0026] The invention allows to achieve the intended aim, and in particular it is possible to eliminate the large and expensive bearings, to eliminate the rubber-covered motorized rollers and to eliminate the gears, with a system which is particularly simple and effective even in the field of the present invention, in which abrasive ceramic materials are present. The rubber belts in fact are not penalized in this work environment. On the contrary, it has been found that the belts 17 allow to transmit, in the claimed embodiment, all the forces required for

the rotation of the cylindrical body 10, even in the initial step, when the torques are very high.

[0027] Furthermore, the couplings are very simple, since the pairs of rollers 13 and 14 need no particular adjustments because the coupling is a metal-to-metal coupling with limited contact surfaces and is therefore very simple and reliable without requiring difficult alignments between the rollers and the cylindrical body 10.

[0028] The system is very cheap both to manufacture and to maintain, and even any replacement of worn belts is a very quick operation which does not require stopping the system arranged downstream of the mill.

[0029] It has furthermore been found that it is possible to drive in this way even very large mills, even when weights and thermal expansions are very important factors.

[0030] The bases of the cylindrical body 10, 22 and 23 are no longer affected by mechanical stresses, since they do not have to support bearings, and therefore they can be manufactured much more simply and cheaply.

[0031] Likewise, the inlet 11 and the outlet 12 can be provided much more simply, since there are no mechanical stresses in these regions. Furthermore, the operations for feeding the granular material to be ground and for removing the ground material are simplified; also the feeding of the grinding media to the cylindrical body can be arranged automatically. An improved reliability is achieved since there is no more risk to contaminate the bearing with ceramic material and water.
because in the region there are no delicate bearings which might be contaminated by the ceramic material or by water.

[0032] Furthermore, the pairs of rollers 13 and 14 are supported by very small bearings which as such entail simple procurement and a much lower cost.

[0033] It is furthermore possible to open the bases 22 and 23 whilst the mill is assembled in order to inspect the inside if required.

[0034] It is possible to replace the belts without having to lift the mill or remove the bearings from the pivot.

[0035] It is possible to work continuously, as required, feeding the material to be grinded at the inlet 11 and delivering the grinded finished material at the outlet 12.

[0036] Finally, it is possible to optimize the thickness of the side wall of the cylindrical body 10, reducing weights and costs because the distance between the supports is no longer the total length of the mill but can be optimized by placing the support rollers 13 and 14 at such a mutual distance as to minimize the flexural stresses of the cylindrical body 10.

[0037] The invention is susceptible of numerous modifications and variations; accordingly, the belts 17 can be provided with various different configurations and the motorization and tensioning means of the belts can be modified, according to what is known to the technician expert in the field. The pairs of support rollers 13 and 14 can also be provided with various configurations, all of which are within the scope of the same inventive concept.

[0038] So, for example the outer surface 15 can be obtained directly on the body of the cylindrical body 10, as particularly represented in figures 1 to 3, or can be obtained by two rings that are assembled on the cylindrical body 10, with particular reference to figures 4 to 6. In this last case the two rings 15 can be substituted. In this case, the axial displacement of the cylindrical body 10 can be controlled for examples by the rollers 30 that act on the ring 15. According to another embodiment, the axial displacement of the cylindrical body 10 can be controlled by the ribs 31 that engage the side walls 32 of the ring 15.

Claims

1. A device for grinding ceramic materials, comprising a cylindrical body (10) which is arranged substantially horizontally, is loadable with grinding media an water and has two openings (11, 12) at its ends for feeding the product to be ground and for removing the ground product, said openings being axial and substantially smaller than the diameter of the cylindrical body (10) and characterized in that: said cylindrical body (10) is supported by at least two pairs of rollers (13, 14) which engage an external surface of said cylindrical body (10); and in that a rotation of said cylindrical body is entrusted to a belt drive (16) which engages an external surface (15) of said cylindrical body (10).

2. A device according to claim 1, wherein said belt drive (16) is arranged externally with respect to said pairs of rollers (13, 14).

3. A device according to at least one of the preceding claims, characterized in that said belt drive (16) comprises two transmission assemblies (18) arranged at the opposite sides of said cylindrical body (10) and externally with respect to said pairs of rollers (13, 14).

4. A device according to at least one of the preceding claims, wherein said rollers (13, 14) are made of a material having a Brinell hardness BH of no less than 150, preferably no less than 350.

5. A device according to claim 4, wherein said rollers (13, 14) are made of metallic material.

6. A device according to at least one of the preceding claims, wherein said grinding media are made of nonferrous material.

7. A device according to at least one of the preceding claims, wherein said cylindrical body (10) has a length of no less than 8000 mm, preferably no less

than 10000 mm.

8. A device according to at least one of the preceding claims, wherein said cylindrical body (10) is internally lined with rubber.

9. An apparatus for producing ceramic products, comprising a device according to at least one of the preceding claims, a press for pressing the product ground in said device and a kiln for firing the pressed product.

10. Any new characteristic or new combination of characteristics described or illustrated herein.

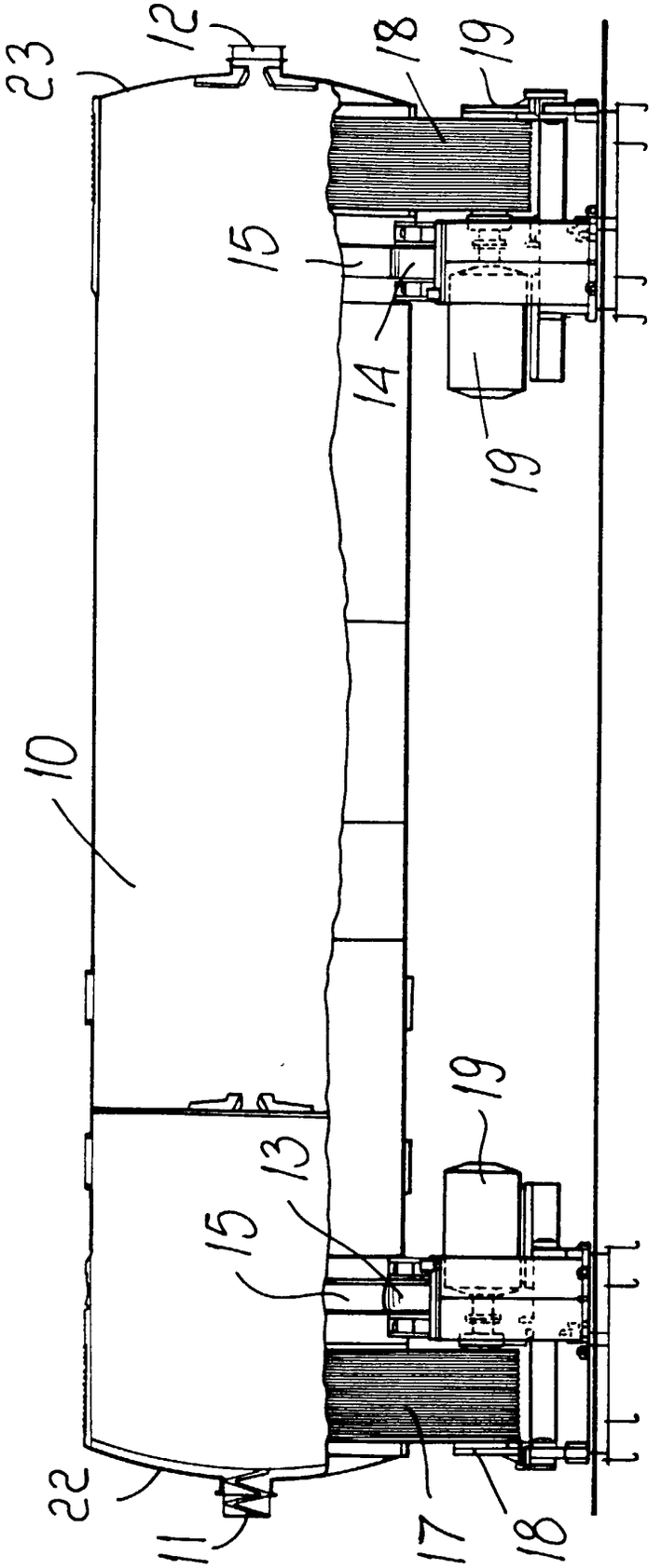

Fig. 1

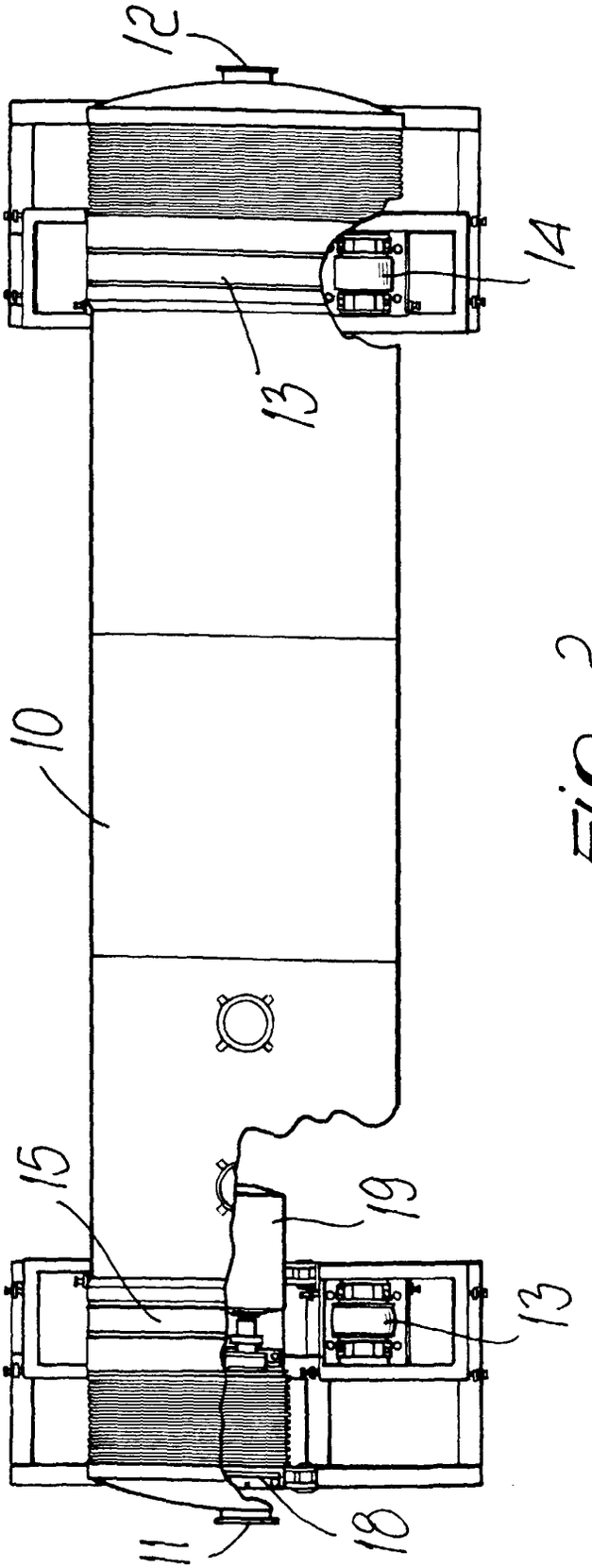

Fig. 2

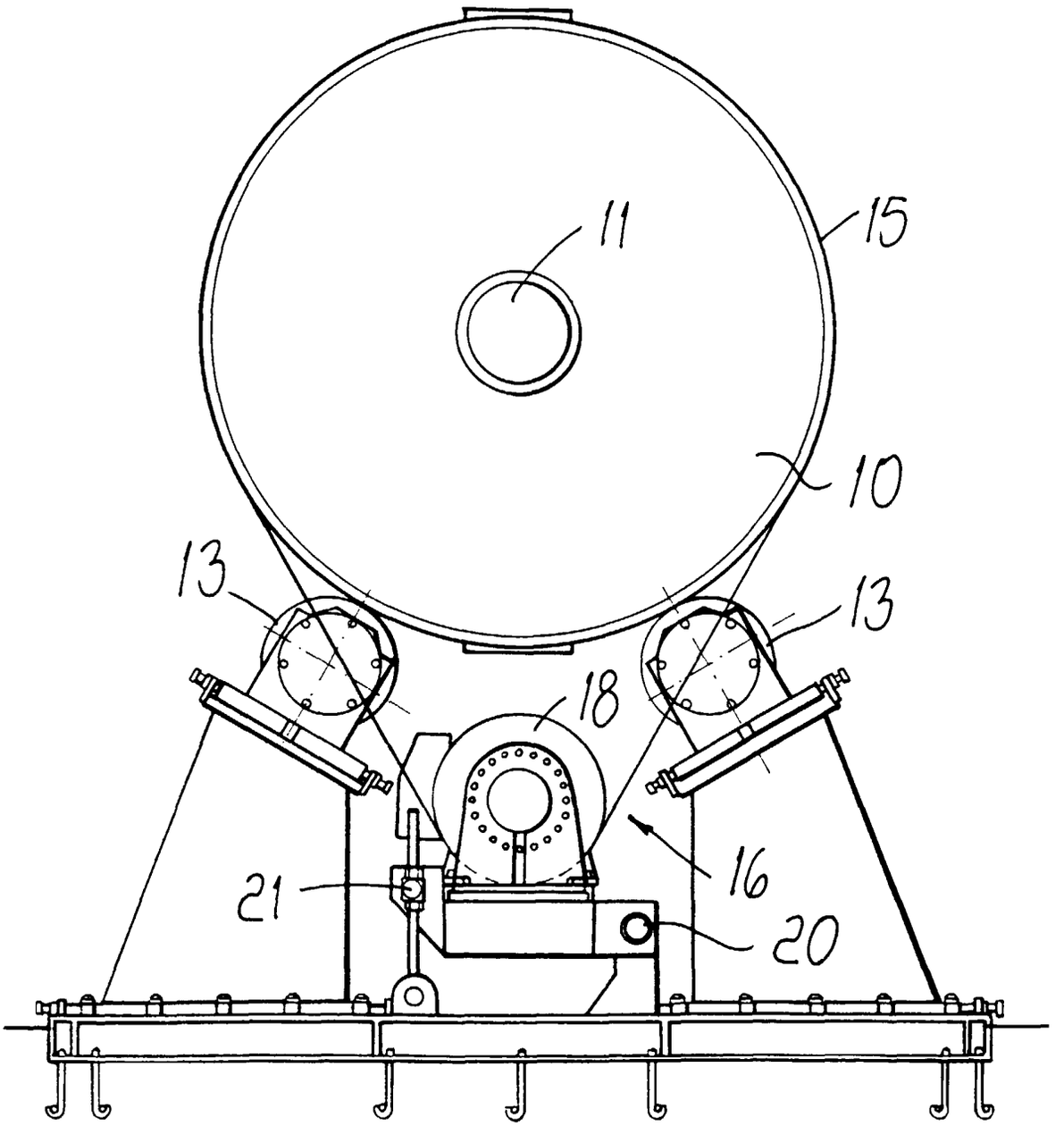

Fig. 3

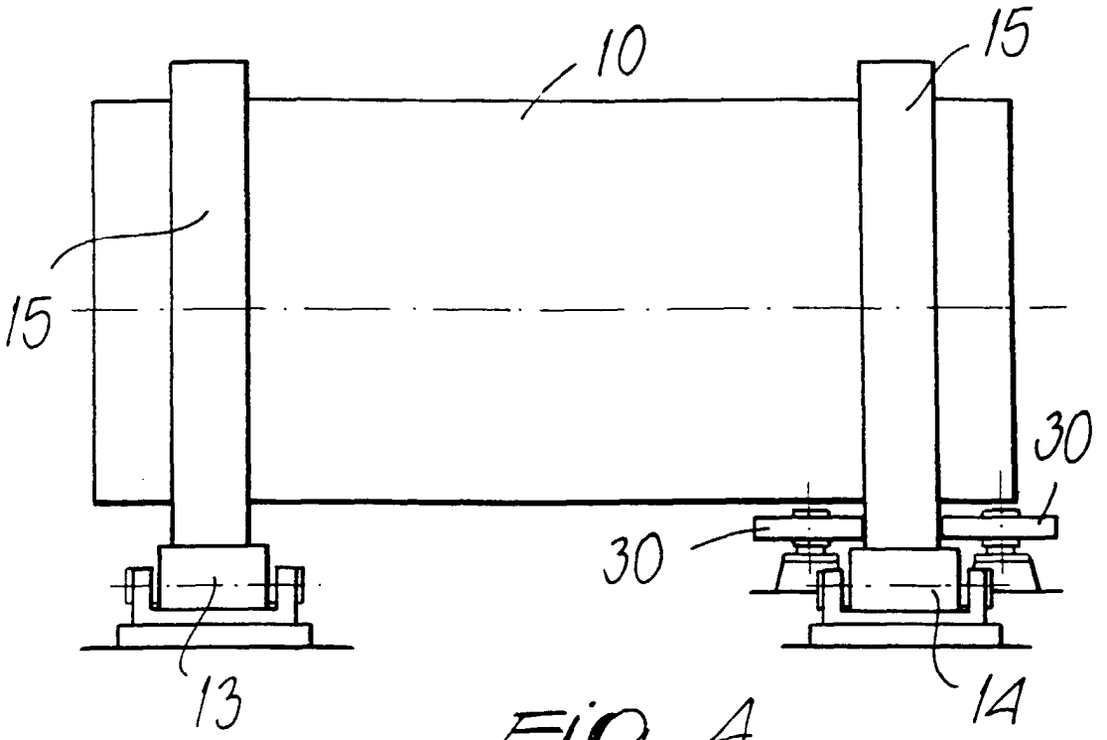

Fig. 4

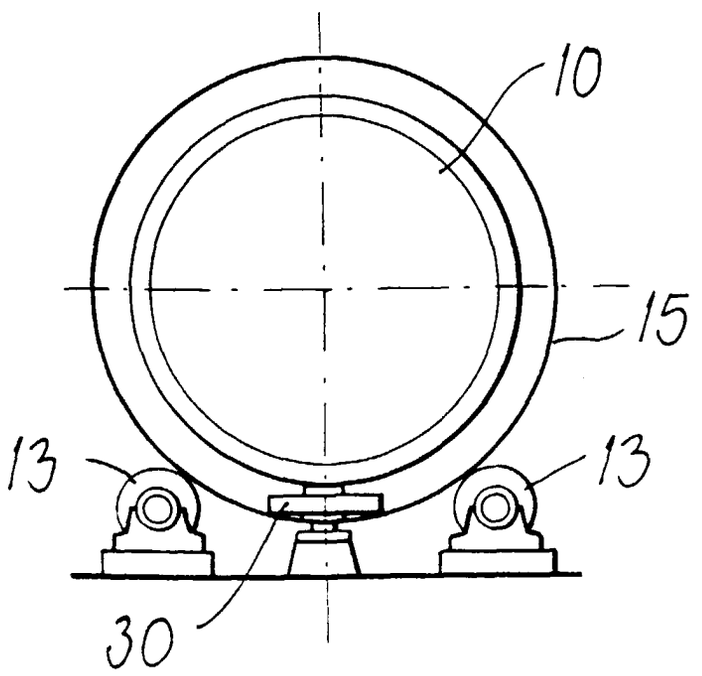

Fig. 5

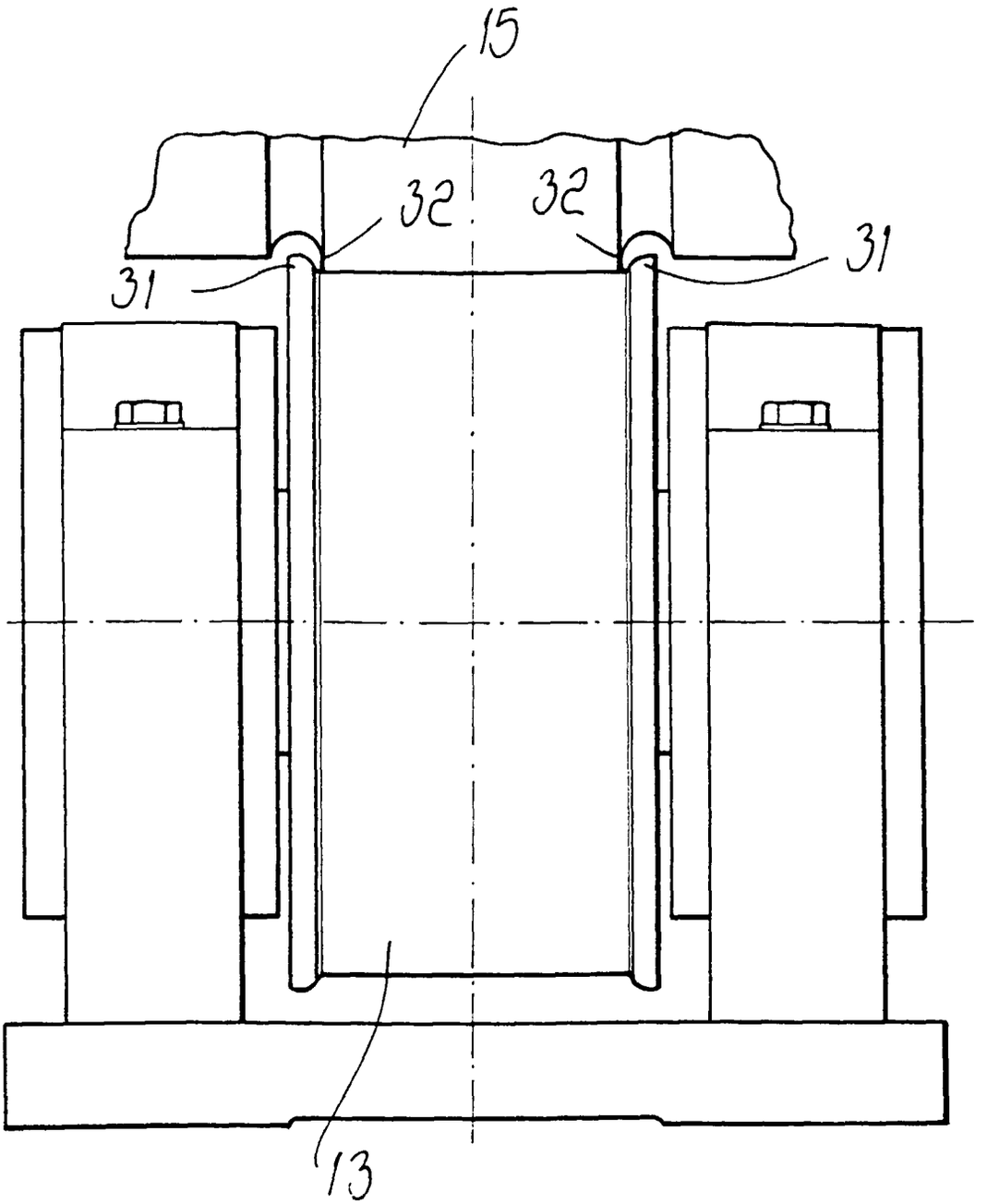

FIG. 6

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 99 12 5366

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D,A	US 2 875 894 A (J.F. NELSON) 3 March 1959 (1959-03-03) * column 1, line 45 - line 64; figure 1 *	1	
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	20 April 2000	Eschbach, D

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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