

(19) World Intellectual Property
Organization
International Bureau



(43) International Publication Date
5 February 2004 (05.02.2004)

PCT

(10) International Publication Number
WO 2004/011580 A1

(51) International Patent Classification⁷: **C11B 1/10**,
A23N 1/00

(21) International Application Number:
PCT/IT2003/000470

(22) International Filing Date: 29 July 2003 (29.07.2003)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
RM2002A000406 31 July 2002 (31.07.2002) IT

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(81) Designated States (national): AE, AG, AL, AM, AT, AU,
AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU,
CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH,
GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC,
LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW,
MX, MZ, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC,
SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA,
UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

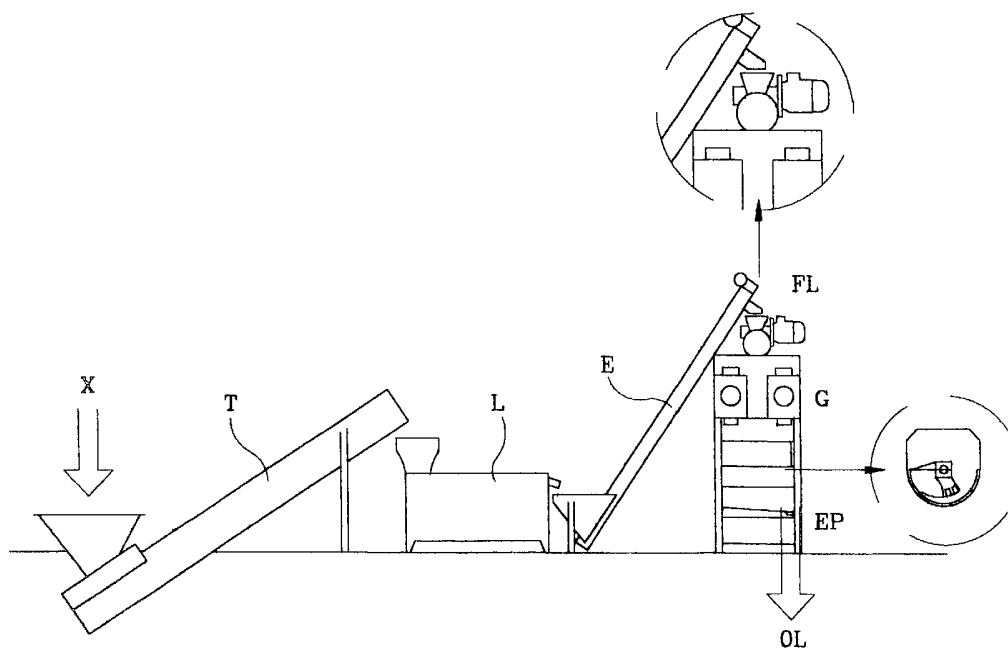
(84) Designated States (regional): ARIPO patent (GH, GM,
KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW),
Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM),
European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE,
ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO,
SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM,
GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

— as to applicant's entitlement to apply for and be granted
a patent (Rule 4.17(ii)) for the following designations AE,
AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA,
CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES,
FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE,
KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD,

[Continued on next page]

(54) Title: OLIVE OIL EXTRACTION PLANT OPERATING AT LOW TEMPERATURES



(57) Abstract: An olive oil extraction plant, including olive washing and transport means (T, L, E), a slow breaker (FL), scutching machines (G), and a percolation extractor (EP). The breaker comprises a substantially cylindrical housing (1) inside which is mounted coaxially a breaking screw (9), and the temperature increase produced during the breaking process performed by this breaker is very low. In order to increase the extraction yield of the extractor (EP), there is provided a blade (41) pushing the olive paste or slurry, with a controlled pressure, towards the lower perforated wall of the extraction chamber.



- MG, MK, MN, MW, MX, MZ, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, VC, VN, YU, ZA, ZM, ZW, ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG)
- as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii)) for the following designation US
- of inventorship (Rule 4.17(iv)) for US only
- Published:**
- with international search report
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments
- For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

Description

Olive oil extraction plant operating at low temperatures

Technical Field

The present invention relates to a plant, or processing line, for processing olives, which allows to extract olive oil at normal room temperature of conventional crushers (15-18 Celsius degrees) and without addition of processing water in the

5 breaker.

The invention allows to obtain extra vergine olive oil of the highest quality, since it does not modify the equilibrium of all chemical bonds of the substances contained in the olives, due to the extremely low breaking temperature and the delicate operation of percolation performed by the oil extraction device.

- 10 A consequence of the present invention is that oils obtained in this way preserve all their organoleptic characteristics unmodified, in the same way as olives in their natural state before grinding.

Background Art

- 15 During olive processing, the latter are first milled, in order to obtain an olive paste or slurry. This olive paste or slurry, is subsequently collected in appropriate basins (scutching machines) where the scutching operation (homogenisation) is carried out, and from the latter it reaches the oil extraction device that extracts oil from the slurry.

- 20 It is therefore easy to recognise that the two essential parts (components) of the process are formed by the breaker and the oil extraction device.

If said two components are made in an appropriate manner, it is possible to avoid alteration of the organoleptic properties of the oil obtained from this process.

Olive breakers, apt to obtain an oily paste from an olive batch of entire (that is not yet processed) olives, are already known in the art. These known breakers employ radially and rotatably mounted hammers, arranged around a motorised shaft. A grid is mounted coaxially to the hammer set. By virtue of the rapid rotation of the hammers around the shaft, and with respect to the inner surface of the grid (which has suitably sized holes), it is possible to break the olives and to obtain an oily paste with the desired properties. This oily paste or slurry is used in the successive process steps, in the so-called decanters (horizontal centrifuges).

However, said conventional breakers provided with hammers or knives have the drawback that the rotation of the hammers occurs at high speed (about 40-50 m/s), required to obtain the final sizing (calibration) of the paste by virtue of the friction of the olives between the grid and the hammers (knives). The heat produced by this rubbing action can cause – in some kinds of known breakers - a partial alteration of the organoleptic properties of the oil subsequently extracted from the slurry.

Therefore, an object of the present invention is to realise a plant, employing an olive breaker for breaking olives or other oily fruits, said breaker having a totally different structure with respect to breakers of the above described kind, and operating at a lower speed (e.g. 0.2-0.5 m/s on the outer radius of the knife), and according to a different principle.

For what concerns the extraction devices, so-called decanters (horizontal centrifuges) are known since long time. These extraction devices generate a temperature increase which is incompatible with the purposes of the present invention, due to the high speeds of the periphery of the screw and of the drum.

On the other hand, an oil extraction machine extracting oil from oily fruits, particularly olives, is already well known and has been described in the Italian patent No. 1.191.971 (granted to the same applicant of the present application and having the title “Estrattore perfezionato dell’olio da paste di semi e frutti oleosi o simili”). In the following description we will expressly refer to the above mentioned patent for

what concerns all technical details which are considered well-known and which do not directly relate to the innovation forming the subject matter of the present invention.

The machine disclosed in the patent No. 1.191.971 is formed by a basin (or
5 container) having a rectangular cross-section in the upper part thereof, and by two straight circular cylinder sections, in its lower part, wherein, along the vertical longitudinal symmetry plane between the two cylinder sections there is provided a longitudinal channel receiving a screw (auger) that allows to perform the discharge operation at the end of the oil extraction cycle with respect to a batch of oily slurry.

10 The walls of the straight circular cylinder sectors are provided with many slits, for the insertion – at suitable times - of lamellae (small blades) inside the extractor.

There are provided suitable means, – described in the above mentioned patent – , for carrying out the periodic insertion and extraction of the small blades, in the radial direction, at predefined times.

15 The lamellae, by periodically entering in the extractor and exiting therefrom, carry with them - by adhesion – a certain quantity of oil to the outside of the extractor chamber, and this quantity of oil drops under gravity and is collected in appropriate containers.

Moreover, the known extraction device (extractor) is provided with a pair of shafts,
20 rotating in opposite directions, mounted horizontally along the axis of each of said cylindrical sectors corresponding to the two longitudinal halves of the extractor chamber. Helicoidal blades are rigidly mounted on these shafts, that serve to homogenise the olive paste (slurry) during the extraction cycle, within the whole chamber of the extraction device. Furthermore, said one or more counter-rotating
25 shafts support respective “combs” made of elastomeric material suited for use with foodstuffs; said “combs” have radial teeth that are spaced apart in such a way that during the rotation of a respective shaft, the above mentioned lamellae penetrate between the corresponding teeth of the “comb” and are periodically cleaned , so that

oil can better adhere to the lamellae and be carried out to the outside, and the mud may be more effectively removed from the surface of the lamellae.

All the above matter has been extensively described in the cited patent, and reference is made to it for technical details. This cited patent has disclosed for the first time an
5 extraction device which allows a “cold” extraction of oil.

However, a disadvantage of this known extractor, is that the means used to restir the oily slurry, do not at the same time permit to increase the oil amount that can be extracted with this percolation process.

Therefore, although the percolation process has the advantage – as compared with
10 the centrifugation process – to prevent a temperature increase of the oily paste, it would be advantageous to further increase the effectiveness (yield) of the extractor for this kind of extraction process.

Consequently, a further object of the present invention is to apply this already known technology of the extractor of the Italian patent No.1.191.971, to the present oil
15 extraction plant (processing line), but radically changing at the same time the structure of the “equipped” shafts used for restirring, which form the core of the extraction device, so that these shafts will no more perform the sole function of re-mixing, but also that of speeding up the extraction process, thereby considerably increasing the yield of the extractor.

20 Summing up, the invention suggests to realise a plant (processing line) for the extraction of olive oil, in which a specific breaker and a specific percolation extractor are used in combination, these devices being suited to preserve the organoleptic properties of olive oil extracted during the processing cycle, due to the fact that the temperature is maintained at low levels in the course of the processing cycle (“cold
25 process“ extraction and natural percolation at ambient temperature of conventional crushers).

Disclosure of Invention

The main object of the present invention is obtained by means of a plant for the extraction of oil, from olives or other oily fruits, which has the features disclosed in the characterising portion of claim 1.

In practice, the plant is provided with a breaker of a specific kind, also called “slow
5 breaker”, which operates - in the plant – upstream of the percolation extractor, and which, during the crushing of the olives, produces a negligible temperature increase. The breaker comprises a cylindrical housing with internal ribs, that are preferably continuous and have a helicoidal form, and which cooperate with breaking screw, mounted coaxially to the cylindrical housing. The slurry exit end of said cylindrical
10 housing, is closed by a perforated calibration grid.

Preferably, a knife - integral with the breaking screw - has inclined portions that squeeze the paste (slurry) against the calibration grid.

According to claim 3, in the most advantageous solution, the plant includes a percolation extractor (extraction device) whose re-mixing blades also have the
15 function of increasing the effectiveness of the oil extraction process. This means that the blades are not rigid, but yield elastically according to the viscosity and consistency of the slurry.

Further advantages of the present invention will be appreciated when reading its detailed description.

20

Brief Description of Drawings

The present invention will now be explained in more detail, referring to the annexed drawings which show a non-limitative and non-binding preferred embodiment thereof, wherein:

25

Fig. 1 is a lateral and schematic general view of the innovative olive oil extraction plant, operating at low temperatures, according to the present invention;

Fig. 2 is a lateral view, in partial longitudinal section, of the slow breaker according to the present invention;

Fig. 3a is a plan view of a knife, or final breaking member, which is mounted at the
5 leftmost end of the breaking screw, in Fig. 2;

Fig. 3b is a view in the direction of "arrow B" of Fig. 3a;

Fig. 3c is a cross-sectional view in the plane A-A of Fig. 3a;

10

Fig. 4a is a plan view of a perforated calibration (sizing) grid;

Fig. 4b is a sectional view along the line A-A of Fig. 4a;

15 Fig. 5a is a view of a longitudinal vertical cross-section (plane A-A of Fig. 5c) of the cylindrical housing, defining the breaking chamber of the breaker according to the present invention;

Fig. 5b is an end view of the cylindrical housing, in the direction of "arrow B" of
20 Fig. 5a;

Fig. 5c is an end view of the cylindrical housing, in the direction of "arrow C" of Fig. 5a;

25 Fig. 5d is a vertical cross-sectional view along the line D-D of Fig. 5a;

Fig. 6a shows, in enlarged scale, a bushing or bearing brass, allowing the rotation of the breaking screw, in cross-sectional and plan view respectively;

Fig. 6b is a cross-sectional view, in enlarged scale with regard to Fig. 2, of a flange or plate used to mount the gearmotor;

- 5 Fig. 6c is a sectional view, in enlarged scale, of a closure flange or plate;

Fig. 7 is a partial axonometric view of the interior of the extraction chamber of the extraction device (extractor), and more specifically it shows a longitudinal half of the extraction chamber of an extractor according to the present invention;

10

Fig. 8 is a partial, schematic view, corresponding to a cross-section of the extraction chamber taken perpendicularly to the axes of the pair of equipped rotating shafts, and showing also part of the second cylindrical sector of the extraction device;

- 15 Fig. 9 is an axonometric view of an equipped shaft of the extractor, according to a direction of observation opposite to that of Fig. 7.

Best Mode of Carrying out The Invention

- Fig. 1 schematically shows the whole line or plant for the extraction of olive oil,
20 operating at low temperatures.

The olives are loaded, as indicated by the arrow X, on a transport device (T) which transports them to a washing machine (L). The cleaned olives are loaded, using lifting means (E), into the low rotational speed olive breaker, or simply "slow breaker" (FL), in which they are crushed (as explained in detail below), in order to
25 obtain the olive paste (slurry). The olive paste is immediately collected inside apposite basins or scutching machines (G), where the scutching operation (homogenisation) is performed. At the end of this step, the olive paste is introduced in the controlled-pressure percolation extractor (EP), which extracts the oil (see

arrow OL). The plant (or line) shown in Fig. 1 insures that the temperature is not increased beyond a certain limit "of danger", which would impair the final product (extraction oil), this being due to the following:

- (i) the slow breaker (FL), which is described later, does not heat the olive paste during their breaking (the temperature increase in the tests was equal to 1°C);
- (ii) the extractor (EP) extracts oil from the olive paste obtained by means of the slow breaker (FL), without increasing the temperature of the olive paste, simply extracting the oil by percolation.

Before describing in detail the structure of the slow breaker (FL), and separately from it, the structure of the percolation extractor (EP), it should be noted from now on, that the preservation (that is, the protection) of the organoleptic properties of the final product (extracted oil), could in the same way be obtained from a plant in which the percolation extractor (EP) corresponds to a percolation extractor as already known from the cited Italian Patent No. 1.191.971. Only by means of an improved percolation extractor, like that shown in Figs. 7-9 of the present patent application, it is possible – however – to attain the further object of the present invention, consisting in increasing the extraction yield, by making use of blades made from sheet metal, which push the paste with a controlled pressure towards the perforated wall of the extraction chamber. Thus, claim 1 is formulated in a more general way, by defining only the features of the slow breaker in its characterising portion, and considering the further aspect of the improved extraction yield of the extractor (EP), only in a subordinate claim (claim 3).

With reference to Figs. 2 - 6, we will first describe a preferred embodiment of the slow breaker (FL), which is only schematically shown in Fig. 1.

The slow breaker (FL) according to the present invention is generally shown in Fig. 2. Its constitutive parts are made – for instance – of stainless steel, although this choice of the material should not be interpreted as a limitation by those skilled in the art.

The low rotational speed breaker comprises a cylindrical housing 1 that defines the breaking chamber, a perforated grid 2 mounted in a removable manner to a first end of the housing 1, - e.g. by screws 3 - , a body 4 for lodging conical bearings, mounted in a removable manner by means of screws 5 to the second end of the cylindrical housing 1, a plate or flange 6 for mounting a gearmotor 8 by means of mounting screws 7, and a breaking screw (auger) 9 driven by the gearmotor 8 through its output shaft 10 (which is integral with the screw 9).

The whole olives are introduced into the breaking chamber 11, through a hopper (not shown in Fig. 2), which is inserted on the upper feeding aperture 12 of the cylindrical housing 1. This hopper is visible in Fig. 1 at the upper end of the lifting means (E).

The shaft 10 rotates on the conical (roller) bearings 13a, 13b received inside the body 4 for lodging the bearings.

The opposite end of the screw 9, with respect to the position occupied by the body 4, presents a hub 14 that crosses the perforated grid 2 at the location of a central hole 32 of the grid. Between the walls of this central hole 32 of the perforated grid 2, and the hub 14, there is provided a flanged bearing brass 15, or bushing, fixed by screws 16 to the outer face of the perforated grid 2. The flanged bearing brass 15 allows rotation of the breaking screw (auger) 9, and supports at the same time the hub 14.

A plug 17, inserted on the body 4 for lodging the conical bearings 13a and 13b, is used to introduce a lubricating grease (of a kind not harmful to foodstuffs) into the body 4. On the diametrically opposite side of body 4 with respect to said plug 17, there is provided a grease discharge and periodical replacement plug. The numbers 18a, 18b denote gaskets used to prevent lubricating grease leakage. A closure plate or flange 19 is removably mounted - by means of screws - to the body 4 for lodging the conical bearings 13a, 13b.

Fig. 2 further shows that on the leftmost end of the screw 9, there is mounted (on the breaking screw 9), by means of screws 20, a final breaking member 21, or knife, which preferably is not located in direct contact with the inner wall of the perforated

grid 2, but is spaced from the same grid 2 by an adjustable distance, depending on the type of olives.

The word “adjustable” means – for instance – the possibility of adding shims between the knife 21 and the screw 9.

- 5 The knife 21 will be described later in greater detail with reference to Figs. 3a–3c. Referring first to Figs. 5a-5d, which show various views of the cylindrical housing 1, it can be noted that the inner cylindrical wall of the cylindrical housing 1 presents ribs 22 (e.g. of rectangular cross-section, as shown in the drawings). These ribs 22 are welded or integrally formed on the cylindrical housing 1 during melting of the
- 10 metal. The ribs 22 have a helicoidal form and the same sense as that of the turns of the screw 9, so that when the screw 9 rotates around the axis X-X of Fig. 2, thereby feeding the olives towards the perforated grid 2, the olives “hit” on the helical ribs 22 and are turned upside down and rotated around their own axis, so as to increase the breaking efficiency.

- 15 Once the olives have reached the perforated grid 2, the knife 21 – shown in Fig. 3a – chops them up definitively and pushes them at the same time towards the perforated grid 2, letting them pass through the calibration (sizing) holes.

Referring to Figs. 3a – 3c, it may be seen that the knife 21 has a cross-like configuration and has holes 23 for the introduction of the mounting screws 20 shown

20 in Fig. 2. The mounting screws 20 are screwed into corresponding threaded holes obtained on the breaking screw 9 used to break the olives.

The central hole 24 of the (cross-like) knife serves for the passage of the hub 14 of the screw 9, said hub rotating on the bearing brass or bushing 15.

- As shown in Figs. 3a and 3b, a particular feature of the knife 21 is that each of its
- 25 “arms” presents an inclined surface 25 on the leading (advancement) side of each arm, with respect to the rotation direction (arrow R, Fig. 3a) of the knife 21. In this manner the rotation of the knife 21 also produces a squeezing of the material against the perforated grid 2, besides the final crushing (it should be noted that the side of the

knife 21 denoted by 26 in Fig. 3b, faces the inner wall of the perforated grid 2).

Moreover, it is obvious that the angle of 15° , for the inclination of the surface 25 of each arm of the knife 21, only represents an example and is not limitative. The knife 21 could have, for instance, a thickness of about 14.5 mm.

- 5 The screw 9 is preferably provided on its turns with added material, in the form of a hard metal, to increase wear resistance. Alternatively, the screw is wholly made of a material which is very resistant to wear.

Figs. 4a and 4b show (in an enlarged scale) the perforated grid 2, in plan view and cross-section respectively.

- 10 The perforated grid 2 presents eight peripheral holes 27, for the passage of mounting screws 3 of the perforated grid 2, used for mounting the latter on a first end of the cylindrical housing 1 (see Fig. 2). Moreover, the perforated grid 2 has a plurality of concentric rows of calibration (sizing) holes 28 for sizing the olive paste particles. In this embodiment, for instance, the holes 28 are 120 in total, and have a diameter of 7
15 mm each. The holes are also provided on radial rows, each including 3 holes, angularly shifted from each other so as to enclose an angle of 9° between one row and the following row. In the present realisation the perforated grid has a diameter equal to 168 mm, corresponding also to the diameter of the cylindrical housing 1. Obviously, all these parameters should not be construed as a limitation but only as an
20 example.

The perforated grid 2 is also provided with four threaded holes 29, used to mount the bushing 15 by means of screws 16. The cross-section of Fig. 4b also shows the seat 30 of the flanged bushing illustrated in Fig. 6a.

- Fig. 6a shows the bushing 15, in cross-section and in plan view respectively. The
25 flange 31 of this bushing, has holes 31 for the introduction of the screws 16, these latter holes being aligned to the four threaded holes 29 of the perforated grid 2.

Fig. 6b shows (in an enlarged cross-sectional view) the plate or flange 6 used to assemble the gearmotor 8 by means of the screws 7, while the closure flange 19 is

also shown in an enlarged scale and in cross section, in Fig. 6c.

For merely illustrative purposes, we mention two different versions of the slow breaker according to the present embodiment, which substantially differ from each other only as regards their dimensions.

- 5 According to the first version, which has a smaller size and which has been described above, the diameter of the cylindrical housing 1 is about 170 mm; this model allows to reach a production of 4 quintals per hour (4 x 220.46 pounds/hr).

In the second version, corresponding to a larger size, with a cylindrical housing of 450 mm (diameter), it is possible to obtain a productivity of 15-20 quintals per hour.

- 10 Obviously, the dimensions could be varied according to circumstances, and for this reason the above mentioned values are merely illustrative and non-limitative.

The present invention provides an olive breaker used to break olives or other oily fruits, characterised by a totally different structure in comparison with the structure of breakers having rotating hammers and a cylindrical grid, and in which the

- 15 principal breaking member is formed by slow-rotational-speed breaking screw 9, that cooperates with the inner ribs 22 of the cylindrical housing 1 during the olive breaking process. The paste is consequently pushed towards the perforated calibration grid 2, which has a plurality of holes 28 arranged in an appropriate manner and having appropriate diameters, suited to the kind of slurry to be obtained and/or to the kind of olives to be processed. In front of the grid 2, there is provided a knife 21 which rotates together with the screw 9 and which has various arms with slanted surfaces 25, which further contribute to chop up the olive paste and to push the latter towards the perforated grid 2, thanks to the particular orientation of said slanted surfaces 25, which are preferably inclined towards the perforated grid 2.

- 25 Between the knife 21, having several arms, and a cross-like configuration in the preferred embodiment (four arms), and said perforated grid 2, there is preferably a gap, so that the knife is not – preferably – in direct contact with the grid.

The slow breaker (FL) according to the present invention has been described herein

for merely illustrative purposes with reference to a preferred embodiment thereof, shown in Figs. 2 – 6, but it is self-evident that various modifications could be made by those skilled in the art, without thereby eluding the scope of protection conferred. Now, a detailed description will be given of the preferred embodiment of the

5 percolation extractor (EP) used in the olive oil extraction plant according to the present invention, by referring to Figs. 7, 8 and 9. This extractor, or extraction device, allows – in contrast to the known percolation extractor mentioned in the introductory part of the description – to attain the second object of the invention, amounting to a better yield in the oil extraction process.

10 Fig. 7 shows half of the extraction chamber (or tank) of an oil extraction machine that works according to a percolation principle, said machine belonging to a typology already described in the cited Italian patent, although it has been modified according to the present inventive concept.

For what concerns all constructive details that are not directly involved in the present
15 improvement, reference is made to the description of the Italian patent No.1.191.971. In short, the extraction machine comprises two straight cylinder sectors 33, 33' that partially penetrate each other, each formed of a plurality of longitudinal segments S, wherein each of these segments presents two rows of transversal slots arranged side by side (perpendicularly to the generating lines of the two straight cylinder sectors).

20 Note that Fig 7 only shows (completely) one of these two straight cylinder sectors (the one indicated by 33), whereas the second straight cylinder sector 33', forming the other longitudinal half of the lower part of the extraction chamber, is only partially sketched in Fig. 8. Therefore, the complete cross-section of the extraction machine (extractor) also comprises a second sector 33', symmetrically to the
25 longitudinal vertical plane X-X of Fig. 8.

The upper part of the extraction machine comprises vertical longitudinal walls 34 (Figs. 7 and 8) disposed on opposite sides of the straight cylinder sectors 33, 33' (only one of them being shown), and two head (closure) walls (not shown), arranged

perpendicularly to the longitudinal walls 34.

The transversal slots of said longitudinal segments S are traversed by a plurality of respective lamellae 35, that are present in a very large number (as illustrated in the drawings), and which periodically come in and out of the extraction chamber (in the radial direction), thereby carrying with them – outside the chamber – the oil of the oily paste that has been loaded in this chamber delimited by the walls 34, the sectors 33 and 33', and the transversal head walls (not shown).

The oil adheres to the surface of the rectangular lamellae (small blades) 35, when the latter are inside the extraction chamber or tank (see the position of the lamellae shown in Figs. 7 and 8), and due to the very large number of lamellae 35, a noticeable amount of oil is carried outside and drops into apposite containers located externally of the extraction tank. When the lamellae re-enter in the tank, they are cleaned by the comb 36 - which has also been disclosed in the cited Italian patent -, in order to increase the percentage of extracted oil.

The comb 36 is formed of an elastomeric material, not harmful to foodstuffs, and has teeth that are spaced apart from each other. During the rotation of the respective longitudinal horizontal shaft 37, which is rotatably mounted on the head walls of the extraction chamber, this comb 36 – which is sustained by arms 38 – cleans the lamellae 35 (by moving in the direction indicated by the arrow F in Fig. 8); note that the lamellae 35 are at this time inside the extraction chamber. In fact, the respective comb 36 comes in contact with the corresponding cylindrical wall of the straight cylinder sector 33 (or 33'), and the lamellae 35 are thereby cleaned between the teeth of the comb 36 spaced apart from each other.

Therefore, as a whole, the extraction machine according to this embodiment comprises two straight cylinder sectors 33 and 33', with respective rotatable shafts 37, each of which is mounted along the longitudinal axis of the corresponding straight cylinder sector; moreover, a respective comb 36, used for cleaning the lamellae 35 associated with a corresponding sector, is provided on each of the two

shafts 37.

The advancement and retraction mechanisms 40, to cause advancement and retraction of the lamellae 35 associated with the sectors 33 and 33' respectively, have already been described in the cited Italian patent.

- 5 Since said one or more equipped shafts 37 realised according to the present invention, mounted on the head walls, symmetrically with respect to the vertical longitudinal symmetry plane X-X of Fig. 8, have the same configuration, in the following we will concentrate on the description of the equipped shaft 37 that is actually shown in the drawings.
- 10 It should be noted that the channel that lodges the controlled-discharge screw (auger) actuated at the end of an extraction cycle, is not shown in the drawings, but this channel is nevertheless provided at the position indicated by reference numeral 39 in Fig. 7 and in Fig. 8, that is, in the lowermost region of the extraction chamber, between two straight cylinder sections 33 and 33'. In this region the set of perforated
- 15 segments S that serve for the passage of the lamellae 35 is obviously interrupted. According to the present invention, besides the comb 36, the equipped shaft 37 also comprises (instead of the known helical mixing means of the cited Italian patent) a squeezing system of the olive paste that pushes the latter towards the inner wall of the straight cylinder sectors, in order to speed up the oil extraction process. In other
- 20 words, by accelerating the adhesion process of the oil on the surface of the lamellae 35, it is possible to speed up the extraction process itself, as has been proved also in practical tests.
- The squeezing system of the olive paste, used for pushing the latter towards the walls of the sectors 33, 33', and which radically changes the configuration - and replaces
- 25 the function - of the known homogenisation means (helical blade mixing means), has been specifically designed to optimise oil extraction and to reduce the adhesion of the mud onto the surfaces of the lamellae 35. In other words, it is essential to create an equilibrium between the oil amount, on the one hand, and the amount of mud and

water, on the other hand, which adhere on to the lamellae 35 between the single cleaning operations performed by the comb 36, in such a manner that the extraction yield is thereby increased. The reduced percentage of mud and water adhering to the lamellae, which is due to the balancing of the value of the pressure exerted by the squeezing system, facilitates the separation of the oil inside a separator which is utilised subsequently in order to process the liquid that has been extracted by this percolation process. Thus, the separator is able to work more effectively, with such a reduced percentage of mud and water contained in the liquid (principally oil) extracted by the extractor of the present invention, and denoted by (OL) in Fig. 1.

10 This equilibrium between the various components of the percolation liquid should be insured independently of the characteristics of the olive paste, which could be more or less viscous, and whose flowability could therefore be more or less high. It is therefore necessary to realise a squeezing system of the olive paste against the walls of the extraction tank, which is apt to automatically modulate the compression force of the olive paste on the walls of the tank, as a function of the consistency and viscosity of the paste itself.

A squeezing system suited to overcome the above problems, is shown in the drawings, and is mounted on the counter-rotating equipped shafts 37; it includes:

- a blade 41, forming a curved sheet metal, indirectly connected to the shaft 37 itself, using screws (not shown) introduced into threaded holes obtained in the three arms 43, wherein said arms 43 are connected in turn, by means of bolts 44, to the shaft 37 and to the arms 38 which support the comb 36;
- six leaf springs, made of stainless steel of a kind not harmful to foodstuffs, located between the three arms 43 and the blade 41, said leaf springs being indicated by

25 numerals 42 and 42' and being fixed to the arms 43 by the same screws employed for fixing the blade 41 to the arms 43.

The three leaf springs 42 are each associated to a respective arm 43, and are arranged between the latter and a respective leaf spring 42'.

The six leaf springs 42 and 42' follow the profile – that is, the curvature – of the blade 41. In the region of the leaf springs 42, having a smaller length than the leaf springs 42', the leaf springs have a double thickness and consequently a higher elastic compression force with respect to the compression force that may be exerted by the outermost portion of the leaf springs 42', which is located more far away from the support arms 43.

Now, with reference to Fig. 8 – showing the rotation direction F of an equipped shaft 37 - , it can be seen that the olive paste is pushed by the blade 41 towards the wall of the straight cylinder sector 33, and towards the lamellae 35, when the latter are inside the extraction tank (position of the lamellae 35 shown in Fig. 8). If the flowability of the olive paste is relatively low, the leaf springs 42 are bent to a greater extent, that is they yield, thereby reducing the value of the pressure exerted on the paste in the region P between the blade 41 and the tank wall. Specifically, the outer ends of the leaf springs 42' (where the thickness is halved), will yield to a greater extent, limiting in this way the value of the pressure in case of pastes of greater consistency and viscosity. In other words, due to the high modulus of elasticity of the leaf springs 42 and 42', the latter can bend to a great extent (high modulus of elasticity of stainless steel used for foodstuffs) and can successively resume their initial shape when the pressure relaxes, that is, when the shaft 37 has rotated by an angle (with respect to Fig. 8) such that the blade 41 no more faces the wall of the straight cylindrical sector 33.

Thus, it may be seen that the effect has been obtained of modulating the pressure exerted on the olive paste as a function of the consistency and degree of flowability of the same, which depends on the olive quality and on the water content of the paste.

The regulation (or limitation) of the pressure value allows to maintain an equilibrated (minimum) value of mud percentage in the liquid extracted by the lamellae 35; in fact, an excessive pressure would increase too much the mud leakage. Moreover, the

shaft 37 has an adjustable angular velocity, for instance between 5 and 10 rpm, and the adjustment of this parameter also contributes to the reduction of mud percentage in the extracted liquid. As compared with the background art, yields between 30 and 70% of oil have been obtained in the extracted liquid (in contrast with values of 15-40% of the background art), and moreover the present process is a "cold process" which avoids centrifugation, and which improves the quality of the extraction oil by subjecting the olive paste inside the extraction chamber to a slight adjustable pressure (in addition to the setting of the rounds per minute of the shaft 37).

Another important factor that must be taken into account in order to obtain an optimum oil percentage value in the extraction liquid, is the dimension of the gap formed between a single lamella and the edge of the respective transversal slot or slit formed in the perforated wall of the straight cylinder sector (33 or 33'). This dimension is of some importance, since if the gap is too large, an excessive mud leakage occurs, whereas, if it is too small, the amount of oil extracted per unit of time becomes too low.

Some tests have shown that preferably the size of this gap is between 0.1 and 0.3 mm. Nevertheless, it goes without saying that these values are non-limitative and are only given here to signify the importance of this parameter in the practical realisation of the invention.

We finally note that the present invention has been described with reference to one embodiment of the percolation extractor, in which there are two counter-rotating equipped shafts 37, each of which is associated with a respective straight cylinder section, and each of which has a comb 36, and a paste squeezing system formed by the above described components 41, 42, 42', 43.

In this case it is clear that the "phases", that is, the instantaneous angles of rotation of the two shafts 37, are such that no mutual interference occurs - during operation - between the blades 41 and the combs 36 of the two mutually parallel shafts 37.

The present invention is also applicable to the situation of an extraction machine

including a single equipped shaft 37, and in this case the extraction chamber will comprise, in its lower part, a single straight semicylindrical sector, with a channel for lodging the controlled-discharge auger located in the lowermost region of the chamber.

- 5 In Fig. 8, it may be seen that the blade 41 (in the form of a curved sheet metal), has its end - opposite to the arm 43 - slightly spaced apart from the lamellae 35.

This distance is preferably comprised in the interval 10 – 40mm.

- All components of the equipped shaft 37 are made of materials complying with the regulations on this matter; for instance, the leaf springs are made of steel of a kind
10 normally used when dealing with foodstuffs or of any other similar material having a high modulus of elasticity, the blade may be made of stainless steel, also of a kind compatible with the handling of foodstuffs, the comb is made of an elastomeric material compatible with foodstuffs, etc.

- The present invention is obviously not limited to the above described embodiments,
15 and a skilled person would not encounter any difficulties in looking for other solutions corresponding to the same inventive concept.

For example, the surface of the blade 41 could form corners instead of a continuously curved profile; moreover, the leaf springs could be replaced by other elastic means mounted on the arm 43.

- 20 To conclude, the invention insures an optimum quality of extracted oil, by using an extraction plant provided with a slow breaker of the above described kind, in combination with a percolation extractor.

The second aspect of the invention concerns the yield increase and the improved “oil to water-mud ratio” of the oil (OL) extracted at the cycle end.

- 25 Finally, note that the invention is also applicable to other oily fruits having features similar to those of the olives.

Claims

1. A plant for the extraction of oil from olives or from other oily fruits, comprising:
 - olive loading and transport means (T);
 - olive washing means (L), receiving the olives from said olive loading and transport means (T);
 - 5 - lifting means (E), for loading the already washed olives and for feeding them into a breaker (FL), so as to obtain an olive paste;
 - homogenisation means of said olive paste, formed by scutching machines (G);
 - a percolation extractor (EP);characterised in that:
 - 10 said breaker (FL) forms a low-rotational-speed breaker, including:
 - a substantially cylindrical housing (1), having first and second ends, and ribs (22) on its inner walls;
 - a perforated grid (2) on said first end of the housing (1);
 - a breaking screw (9), with several turns, coaxially mounted inside said housing
 - 15 (1), and whose turns do not directly interfere with said ribs (22);
 - mounting and closure means (4, 6, 19), for closing said second end of the housing (1), and for mounting drive means (8) of the breaking screw (9), used for driving a shaft (10) forming an extension of said breaking screw (9);
 - means (13a, 13b, 15) for supporting and allowing the rotation of the screw (9);
 - 20 - a lateral aperture (12), realised on the wall of the housing (1), for permitting the introduction of olives or similar fruits;
 - a knife (21), mounted on the breaking screw (9), between the latter and the perforated grid (2), and comprising at least one arm extending radially with respect to the geometric axis of the breaking screw (9).
 - 25
 2. A plant for the extraction of oil from olives, according to claim 1, wherein the

peripheral velocity of the arms of the knife (21) is preferably comprised in the interval 0.2 – 0.5 m/s.

3. A plant for the extraction of oil from olives, according to claims 1 or 2, wherein
- 5 the percolation extractor (EP) comprises:
- a frame, into which said olive paste is loaded, having a lower perforated wall (33;33') presenting a plurality of slots that are periodically traversed, at predetermined times, by oil extraction lamellae (35);
 - means (40) for driving the lamellae (35);
- 10 - at least one discharge auger for discharging the oily paste at the extraction cycle end;
- at least one equipped shaft (37), rotatably mounted at its two ends on two head walls of the frame, and sustaining a respective comb (36) used for cleaning the lamellae (35) at the end of each of their periodic excursions, when the lamellae are
- 15 inside the oil extraction chamber enclosed by said frame;
- said equipped shaft (37) also having an olive paste squeezing system, with a blade (41), for pushing the olive paste towards the lower perforated wall (33; 33'), thereby increasing the oil extraction yield by percolation through the perforated lower wall (33; 33') of the frame.
- 20
4. A plant for the extraction of oil from olives, according to claim 3, wherein the angular velocity of the equipped shaft (37) is adjustable.
5. A plant for the extraction of oil from olives, according to claim 3 or 4, wherein
- 25 said squeezing system includes elastic means (42, 42') for automatically adjusting, according to the viscosity and consistency of the oily paste, the pressure exerted on the oily paste which is pushed towards said lower perforated wall (33; 33').

6. A plant for the extraction of oil from olives, according to claim 5, wherein said elastic means are formed by leaf springs (42; 42') arranged between the squeezing and re-mixing blade (41) and a connection member (43) for the connection to the shaft (37).

5

7. A plant for the extraction of oil from olives, according to claim 6, wherein said leaf springs (42; 42') follow the profile of the blade (41) and have different lengths in the direction towards the free end of the blade (41).

10 8. A plant for the extraction of oil from olives, according to anyone of the preceding claims, wherein the extractor comprises two perforated cylindrical wall sectors (33; 33') forming the lower part of said frame, a channel for lodging the discharge auger, located between said two sectors (33 and 33'), in the lowest part of the extraction chamber, and two equipped counter-rotating shafts (37, 37) whose blades (41, 41)
15 and whose combs (36, 36) push the paste against the wall (33 or 33') and respectively clean the corresponding lamellae (35) which come in and out of their relative sector (33 or 33').

9. A plant for the extraction of oil from olives, according to any of the claims 3-7,
20 wherein, in the extractor, there is provided a single equipped shaft (37), and the lower part of the frame containing the oily paste, is formed by a single perforated cylindrical sector with respective oil extraction lamellae (35), said sector being interrupted only in its lowermost part occupied by the channel which lodges the discharge auger effecting the discharge at the cycle end.

25

10. A plant for the extraction of oil from olives, according to claim 1, wherein said knife (21) of the breaker (FL) is not in contact with the perforated grid (2).

11. A plant for the extraction of oil from olives, according to claim 1 or claim 10, wherein there are provided means for adjusting the distance between the knife (21) and the perforated grid (2), dependent on the type of olives.
- 5 12. A plant for the extraction of oil from olives, according to claim 1, 10 or 11, wherein the arms of the knife of the breaker (FL), each have an inclined surface (25) facing the perforated grid (2), and which, during the rotation (R), push the paste towards the perforated grid (2).
- 10 13. A plant for the extraction of oil from olives, according to anyone of the claims 1 or 10 –12, wherein said ribs (22) of the housing (1) defining the breaking chamber, are continuous or discontinuous, and in the former case they are interrupted only by the aperture (12).
- 15 14. A plant for the extraction of oil from olives, according to claim 13, wherein said ribs (22) have a helicoidal configuration and have the same sense, right-hand or left-hand, as the turns of the breaking screw (9).
15. A plant for the extraction of oil from olives, according to claim 14, wherein said
20 helical ribs (22) of the breaker (FL) have a rectangular cross-section, and their pitch is of the same order of magnitude as the pitch of the turns of the breaking screw (9).
16. A plant for the extraction of oil from olives, according to claim 15, wherein said ribs (22) are welded or realised integrally with the housing (1).
- 25 17. A plant for the extraction of oil from olives, according to claim 1, wherein said breaking screw (9) and/or said knife (21) may include a wear resistant material, at least on their parts more subject to stress, or may be made wholly of said wear

resistant material.

18. A plant according to claim 1, wherein paste calibration holes (28) of the perforated grid (2) are arranged on concentric circles of holes (28), in shifted
5 positions, so as to optimise the number of holes (28) for given diameters of the grid (2) and holes (28), said diameter of the holes (28) being chosen in an appropriate manner so as to obtain a desired processing and consequently a desired product (olive paste).
- 10 19. A plant according to claim 1, wherein said means for supporting and allowing the rotation of the screw (9), are formed by bushings (15) and/or bearings (13a, 13b).
20. A plant according to claim 19, wherein a flanged bushing (15) is removably mounted inside a central hole (32) and in a central seat (30) of the perforated grid (2),
15 between the wall of the hole (32) and a hub (14) of the breaking screw (9).
21. A plant according to claim 20, wherein conical roller bearings (13a, 13b) are located inside a body (4) for lodging said bearings, said body forming part of said closure and mounting means (4,6,19); said bearings being used for reducing friction
20 during rotation of said shaft (10) arranged on the opposite side of the breaking screw (9) with respect to the hub (14).
22. A plant according to claim 21, wherein the body (4) for lodging the bearings, is closed, on its side opposite said second end of the housing (1), by a closure plate or
25 flange (19) crossed by said shaft (10); gaskets (18a, 18b) being also provided at the two opposite ends of said body (4) for lodging the bearings, so as to give rise to a lubrication region for the bearings within the whole interior of the body (4), said region being preferably filled with a lubricating grease compatible with foodstuffs.

23. A plant according to claims 1, 10 or 12, wherein said knife (21) of the breaker (FL) includes four arms arranged at equal angles from each other, in a cross-like configuration.

5

24. A plant according to claim 1, wherein the drive means of the breaking screw (9) of the breaker (FL) constitute an electric gearmotor (8).

25. A plant according to claim 1, 10, 12 or 23, wherein the thickness of the knife (21)
10 is comprised in an interval of about 1cm - 4cm.

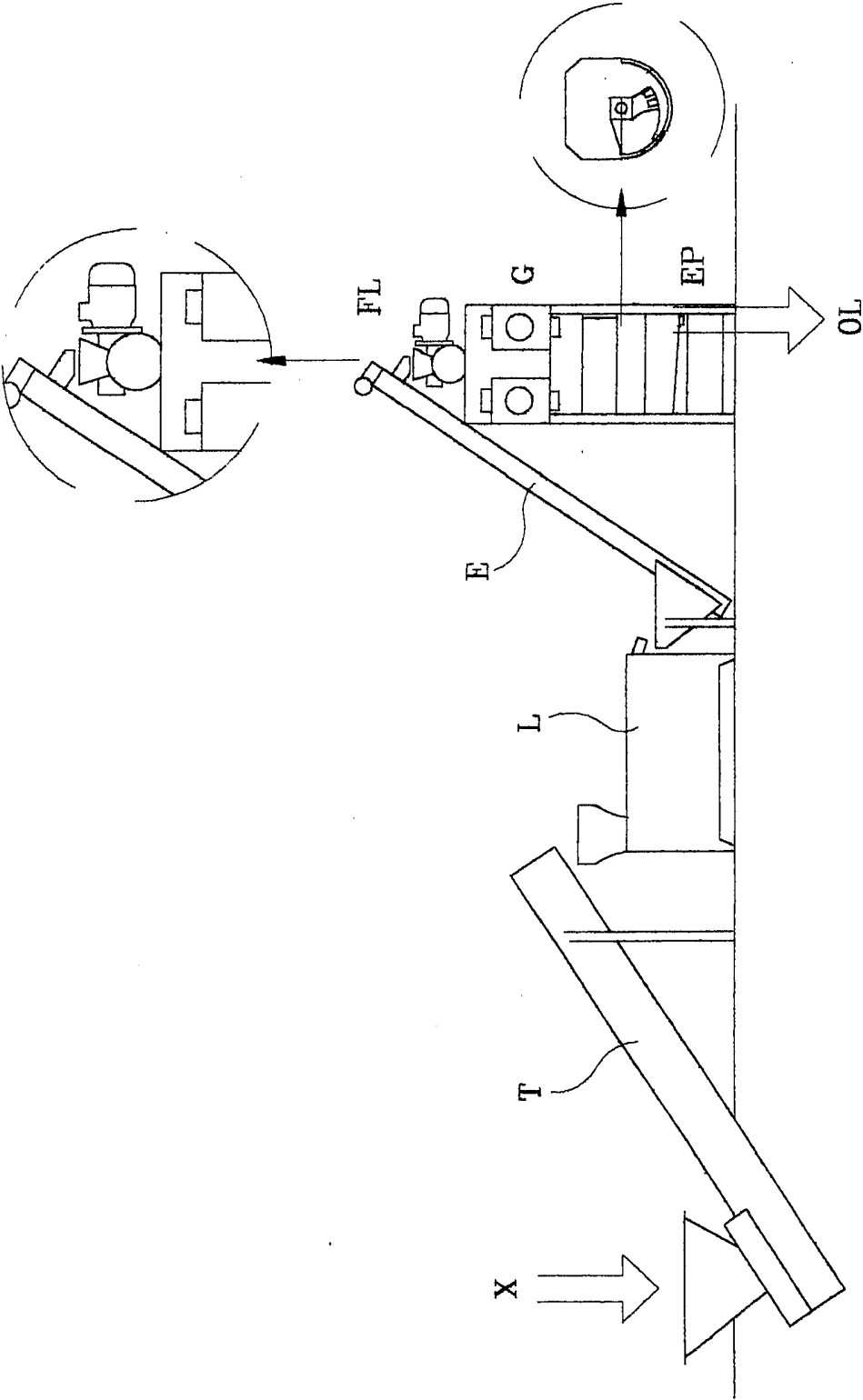


FIG. 1

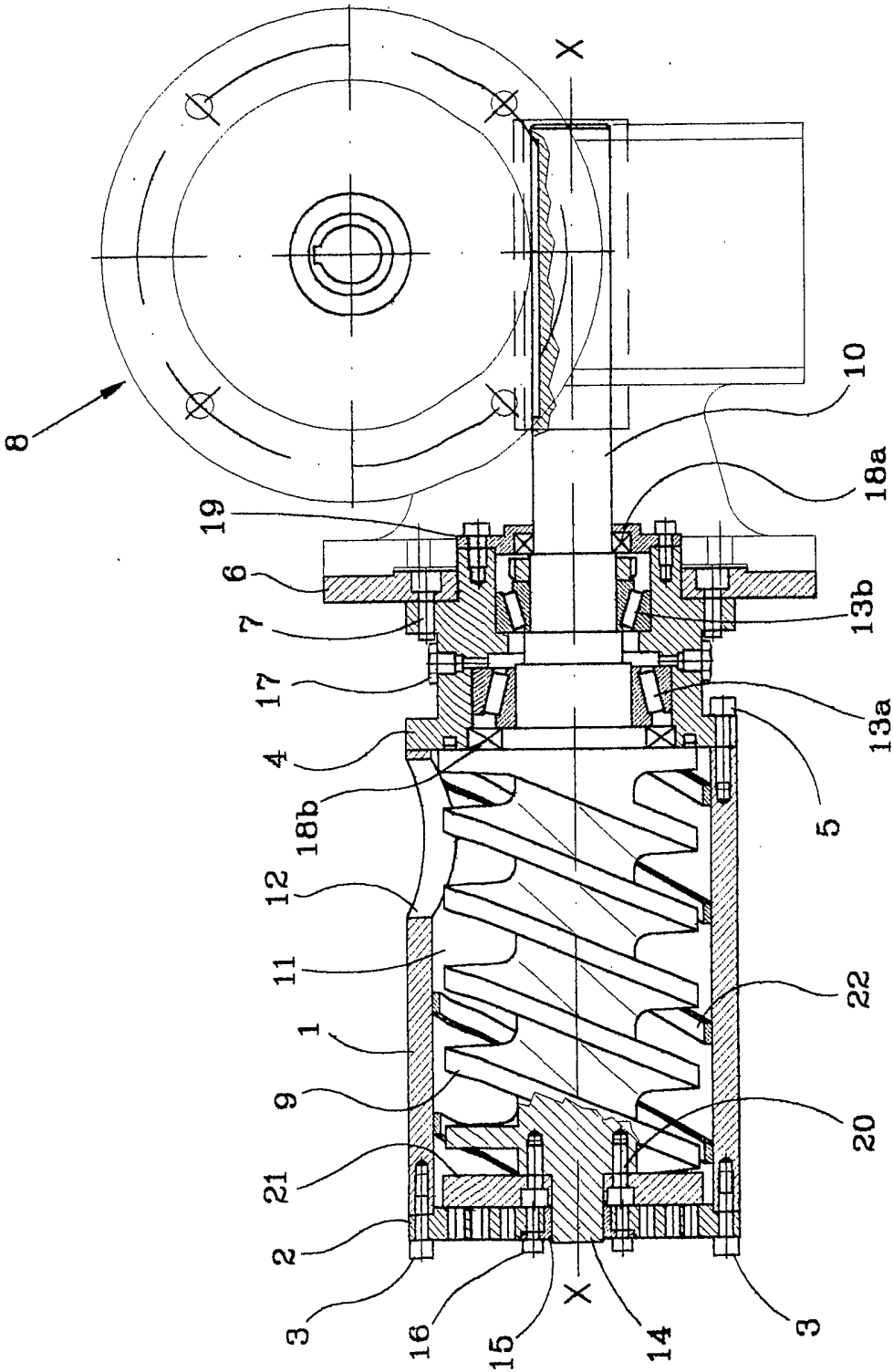
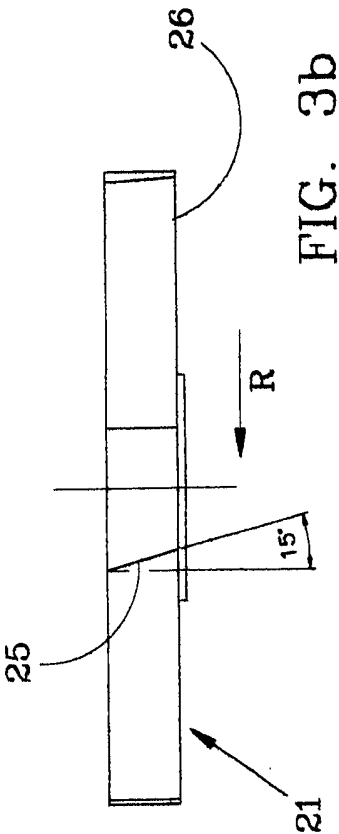
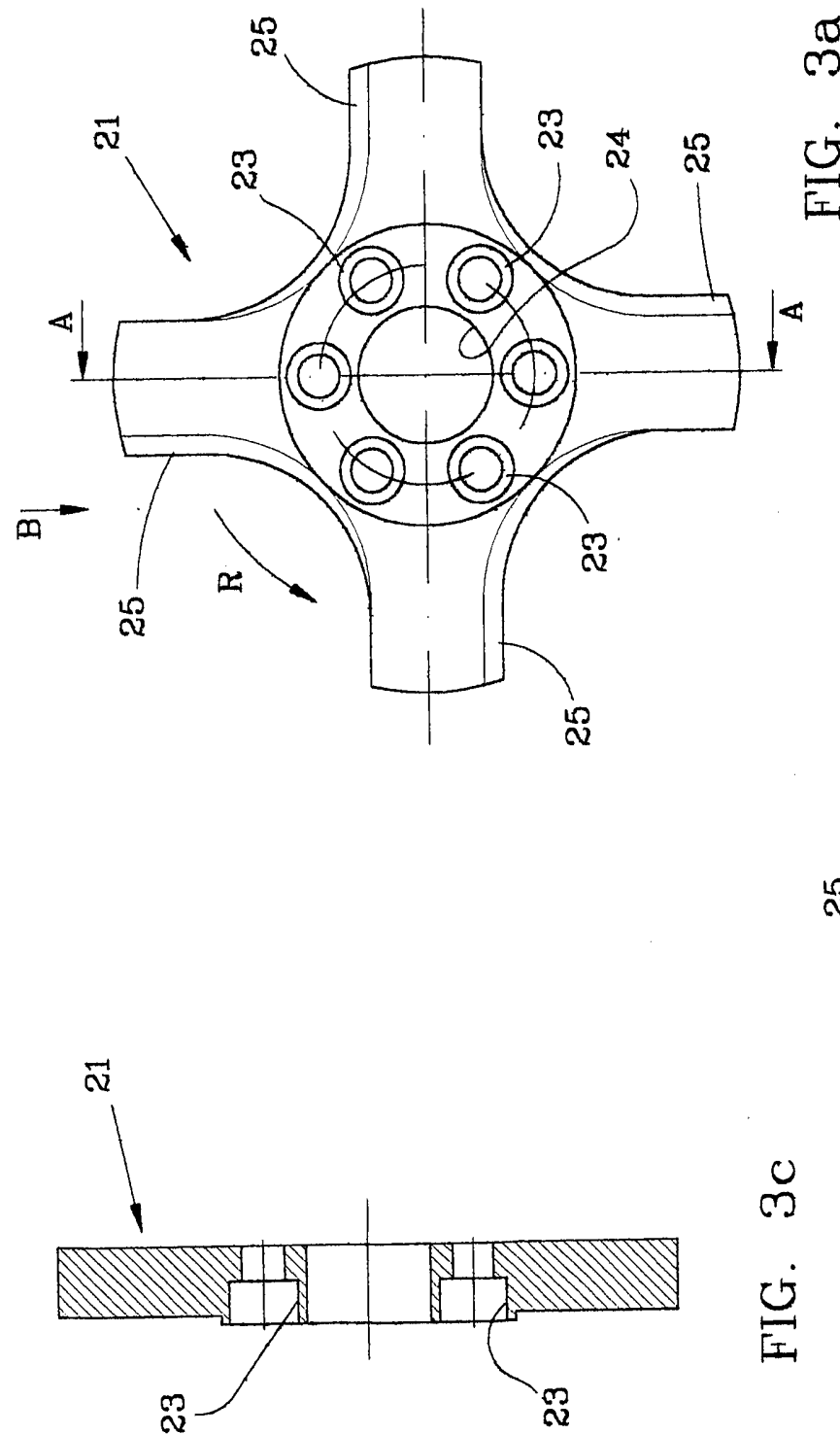


FIG. 2



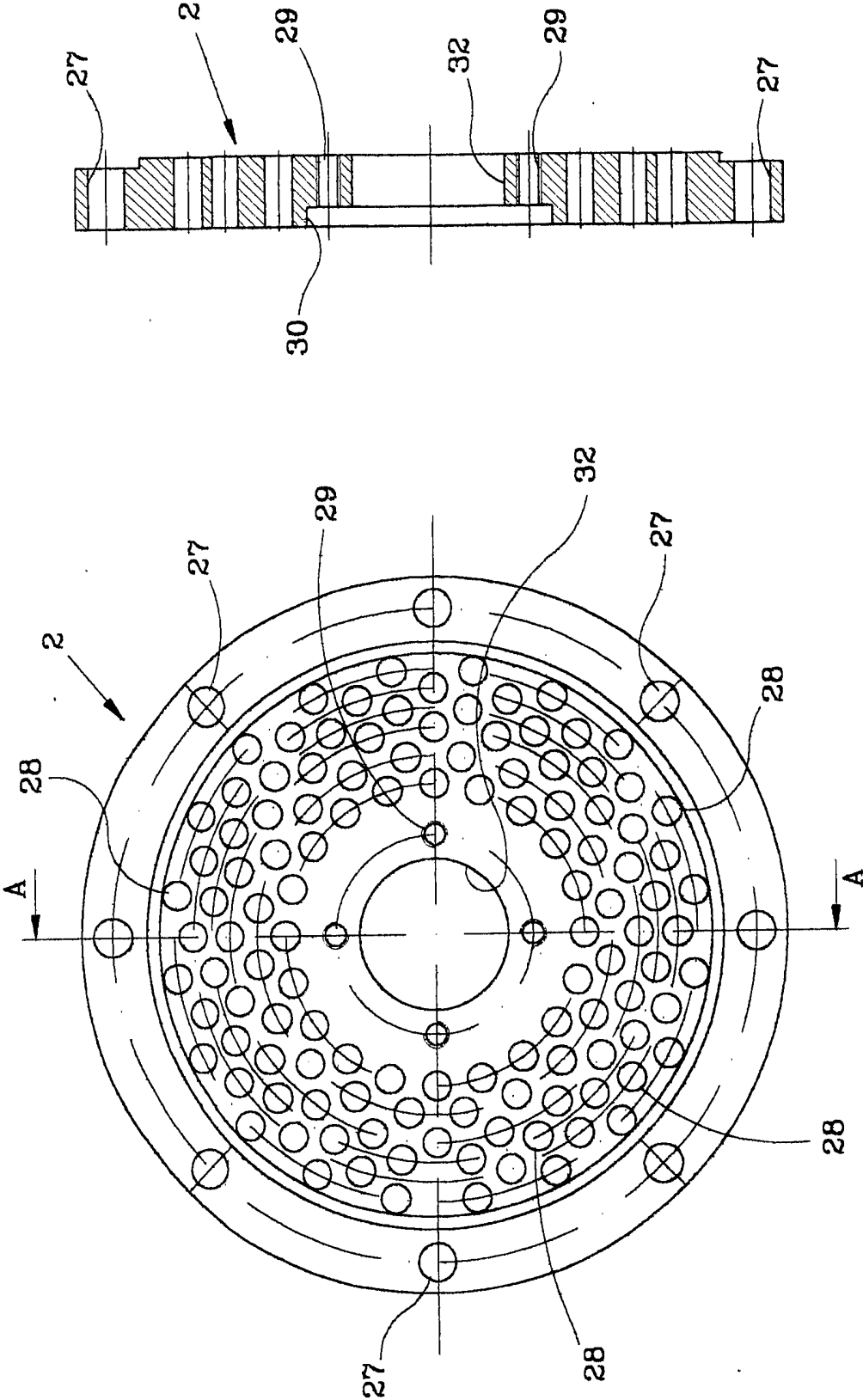


FIG. 4b

FIG. 4a

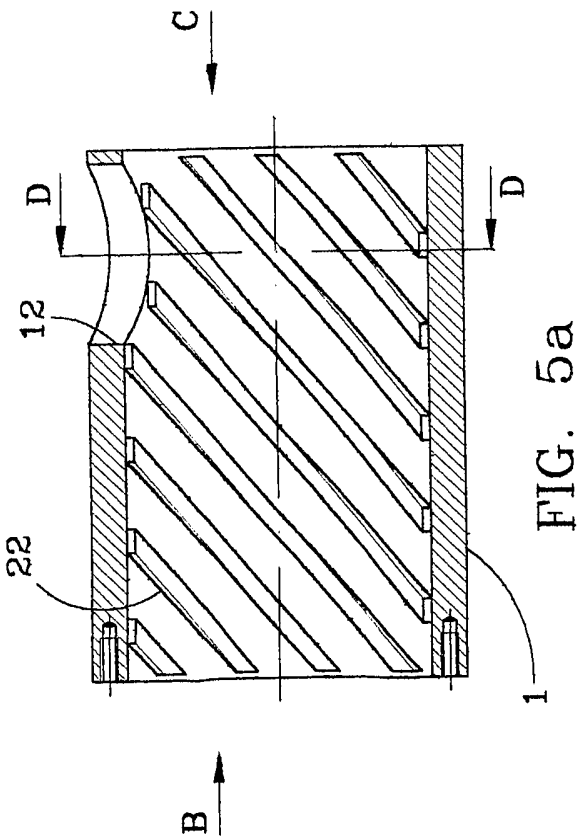


FIG. 5a

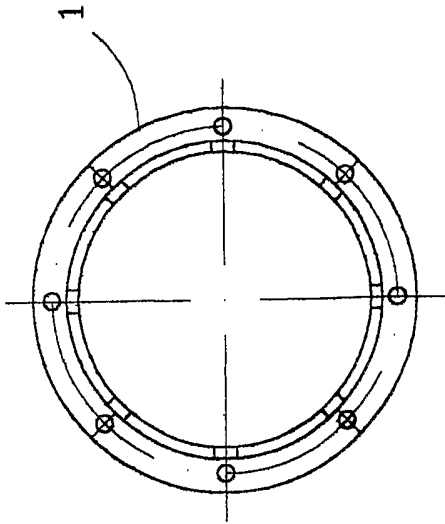


FIG. 5b

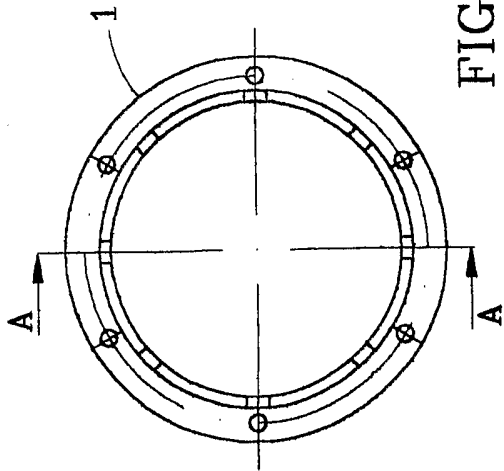


FIG. 5c

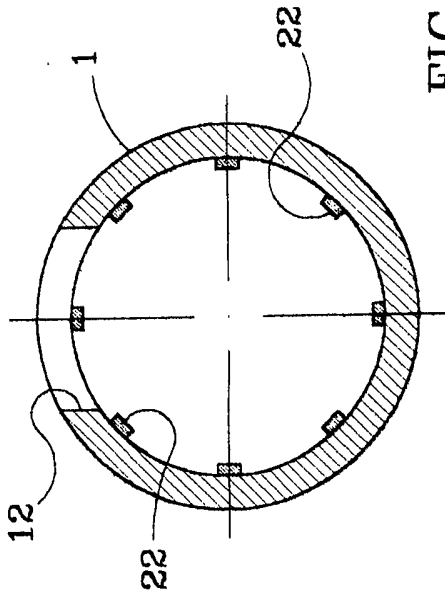


FIG. 5d

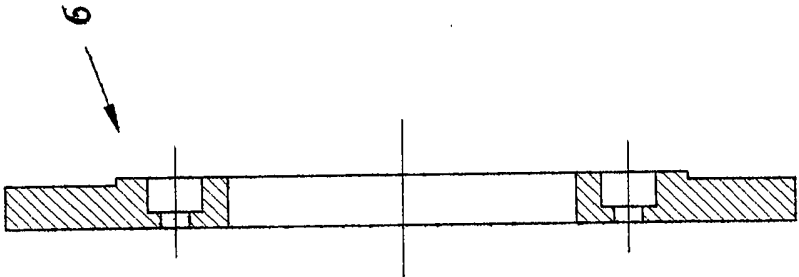


FIG. 6b

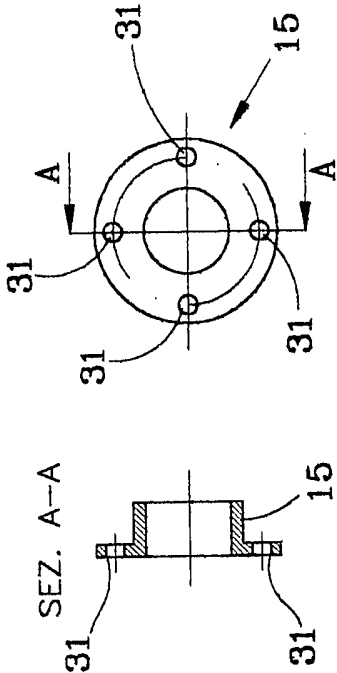


FIG. 6a

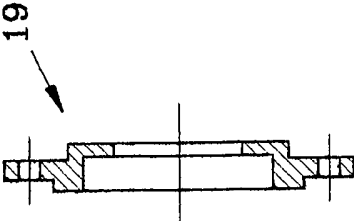


FIG. 6c

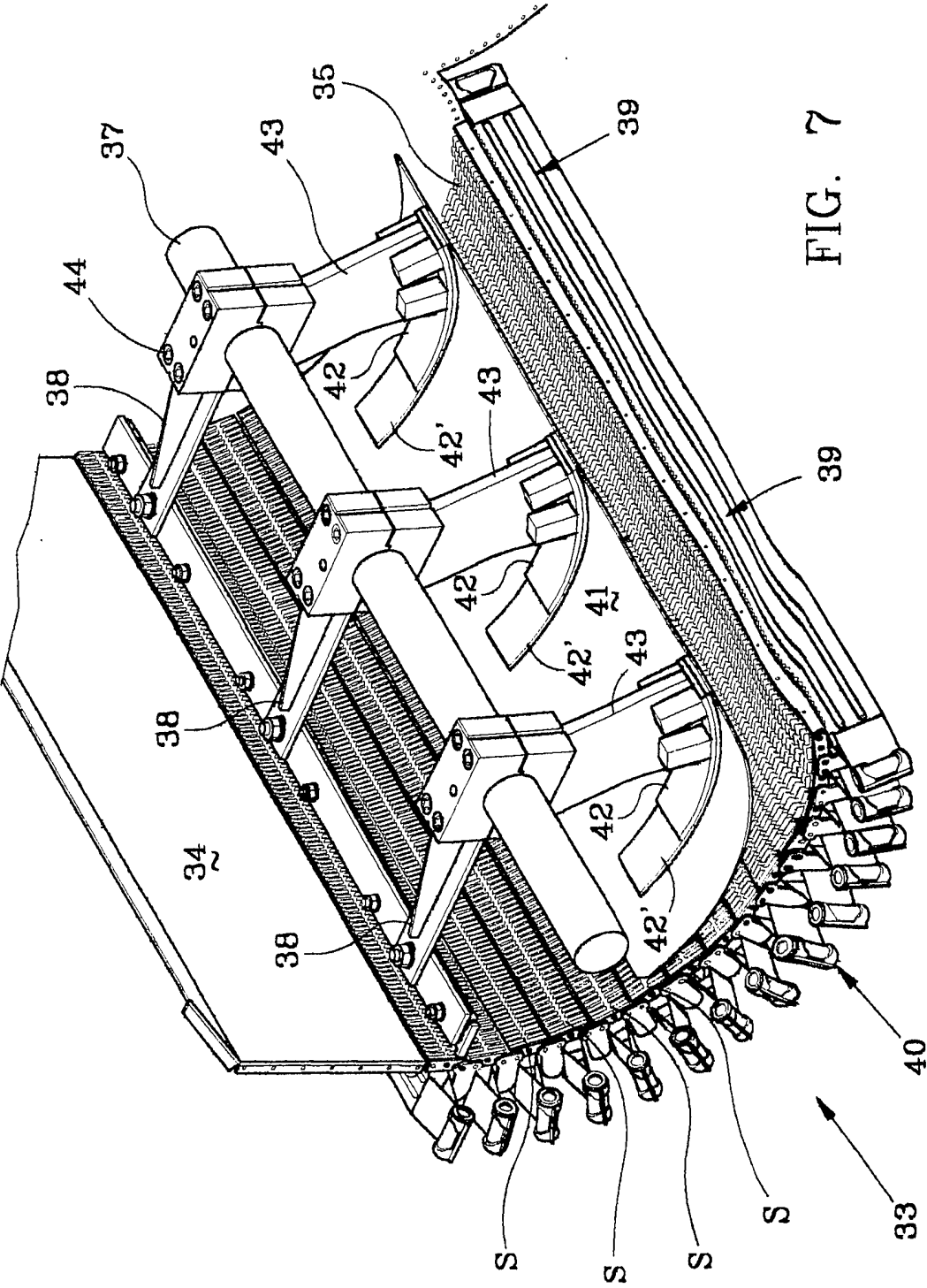


FIG. 7

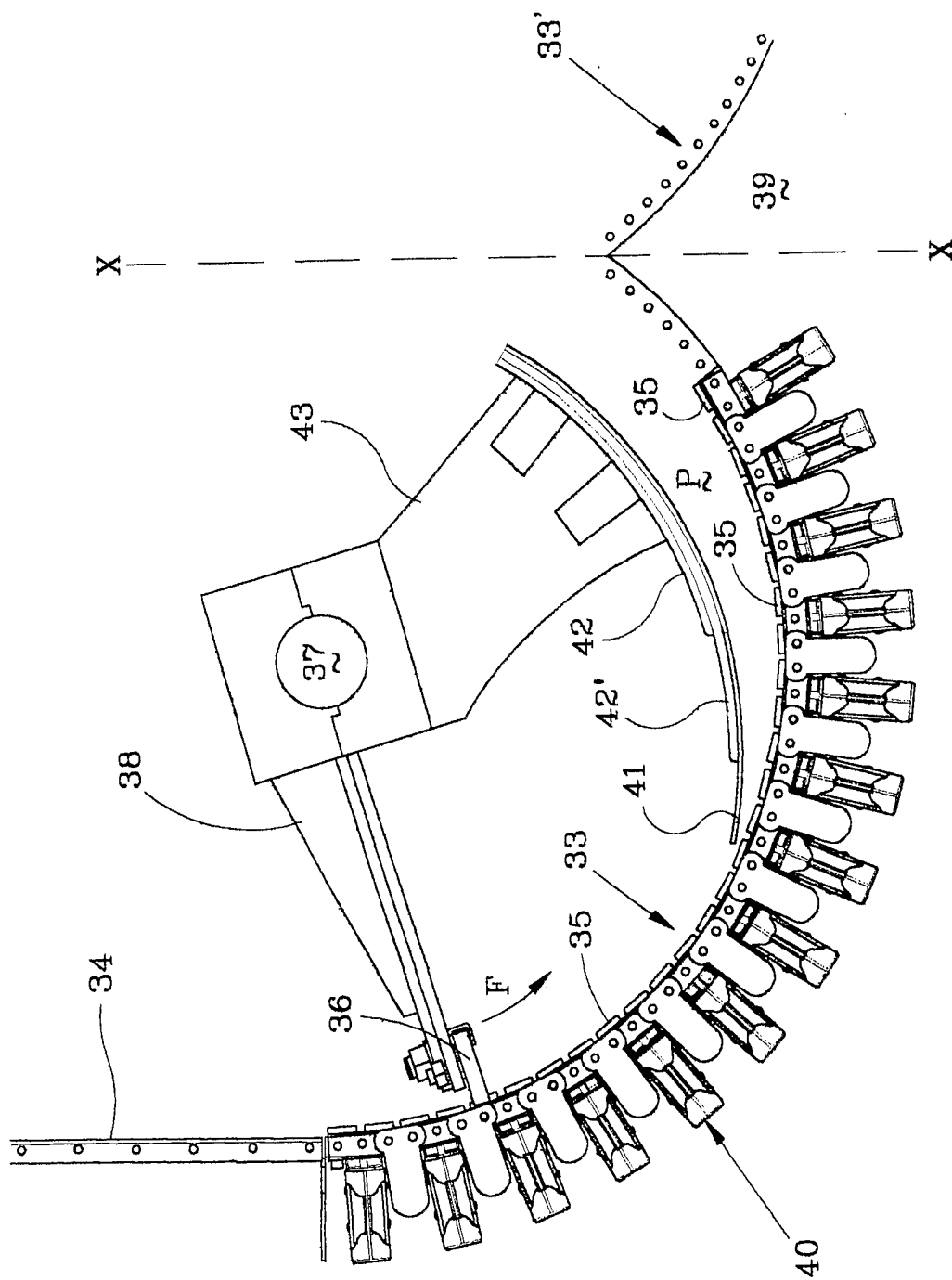


FIG. 8

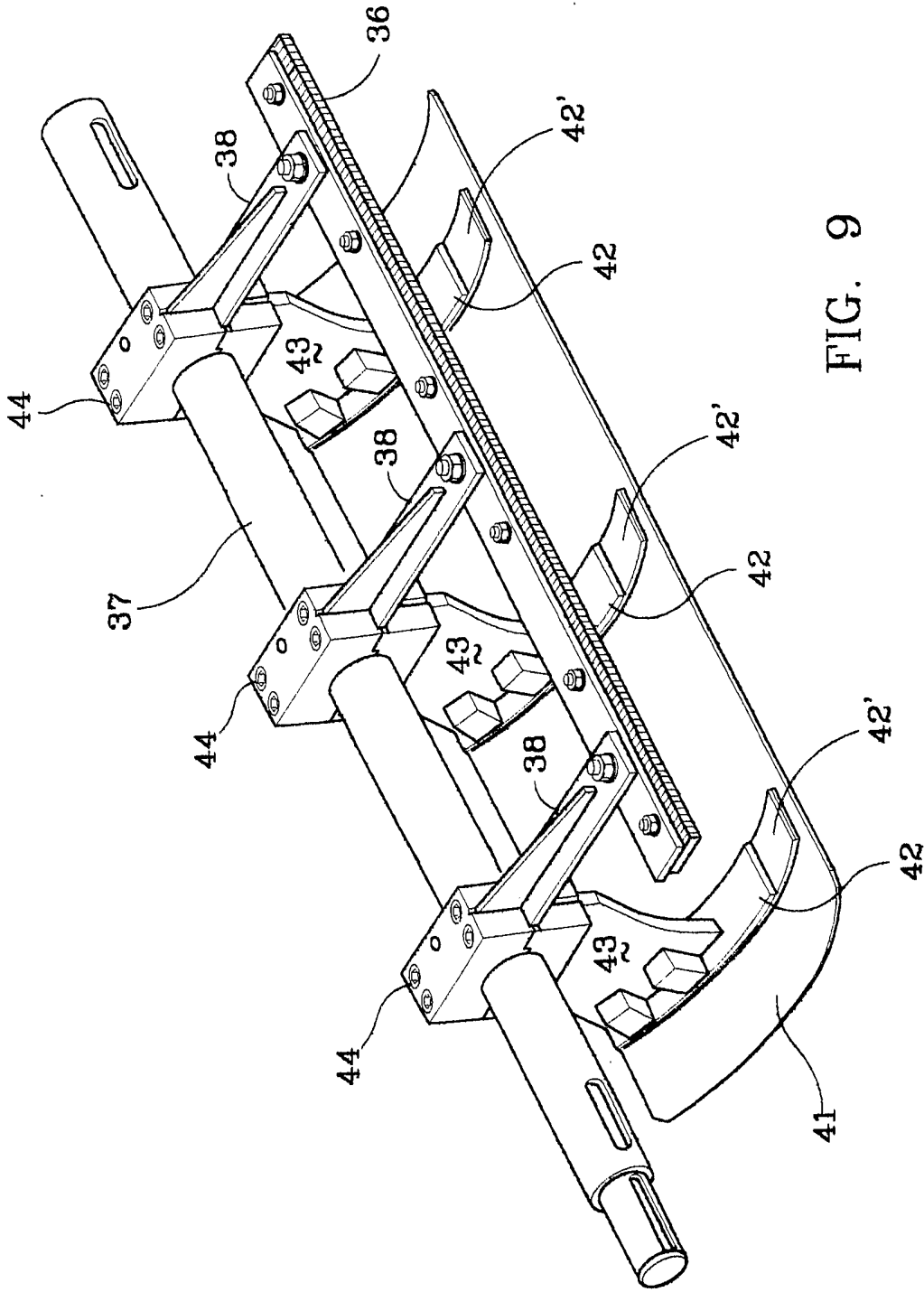


FIG. 9

INTERNATIONAL SEARCH REPORT

International Application No
PCT/IT 03/00470

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 C11B1/10 A23N1/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 C11B A23N B30B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 197 06 803 A (BUTTCHEREIT KLAUS DIPL ING) 3 September 1998 (1998-09-03) column 4, line 20 -column 6, line 68; figures 4-6 ---	1,2,10, 13,16, 17,19, 24,25
A	EP 0 252 025 A (RAPANELLI FIORAVANTE SPA) 7 January 1988 (1988-01-07) cited in the application claims 1-3; figures 1-3 ---	1,3,5,8
A	EP 0 557 758 A (WESTFALIA SEPARATOR AG) 1 September 1993 (1993-09-01) column 4, line 29 - line 40; figure 2 --- -/--	



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

° Special categories of cited documents :

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Date of the actual completion of the international search

2 December 2003

Date of mailing of the international search report

10/12/2003

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INTERNATIONAL SEARCH REPORT

International Application No
PCT/IT 03/00470

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Information on patent family members

Intel International Application No

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