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(54) **INSTALLATION AND METHOD FOR EXTRACTION OF OIL FROM OLIVE PASTE**

INSTALLATION UND VERFAHREN ZUR GEWINNUNG VON ÖL AUS OLIVENPASTE

INSTALLATION ET METHODE POUR L'EXTRACTION D'HUILE À PARTIR DE PÂTE D'OLIVES

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Description

[0001] The present patent application for industrial invention relates to an installation and method for extraction of oil from olive paste.

[0002] As it is known, olive processing for oil production is traditionally composed of three operations, defined as crushing, kneading and oil extraction. Within the prior art numerous attempts have been made to heat olive paste before oil extraction in order to improve the efficiency of the installation.

[0003] GB 917 638 discloses a system for oil and fat extraction from animal or vegetal products that provides for alternate crushing and heating of the product, which is then pressed to extract oil. Heating is obtained with a tubular heat exchanger provided with air space wherein steam flows. The product is fed into the heat exchanger by means of a worm conveyor. In order to favor the transfer of product inside the exchanger, water is added to the product to make it more fluid. It appears evident that the addition of water considerably degrades the quality of the oil and produces emulsion during the following operations (especially during crushing in the disintegrator), impairing the extraction output.

[0004] The above drawbacks are partially remedied in EP2248880 in the name of the same applicant, which discloses a conveyor device composed of a heat exchanger with air space with circulation of hot water and worm conveyor. A pressure rotary pump is used to maintain the conveyor device under pressure, so that the conveyor device is filled with olive paste during the passage of the olive paste. The above guarantees a contact between the olive paste and the entire heating wall of the exchanger, in order to optimize the heat exchange efficiency. As a matter of fact, the heat exchange efficiency improves for the continuous scraping of the internal surface of the heat exchanger caused by the olive paste moved by the worm conveyor.

[0005] Although such a system avoids the use of water to transport the olive paste, it does not consider the variable nature of different types of olive paste. In fact, some of them, being especially dehydrated, are difficult to be moved and tend to stagnate and deposit along the walls of the heat exchanger, thus impairing the quality of the oil.

[0006] ES 2 327 308 discloses a system that uses ultrasounds to achieve quicker and more uniform heating of a mass of olives during the extraction process of olive oil. Such a process uses the heating effect of ultrasounds on olive paste until it reaches a temperature of approximately 28-35°C. However, experimental tests have shown that the heating effect of ultrasounds does not achieve a significant temperature increase.

[0007] The purpose of the present invention is to eliminate the drawbacks of the prior art by disclosing an installation and method for extraction of olive oil that considerably reduces kneading time, while improving the quality of the oil without impairing the extraction output.

[0008] These purposes are achieved according to the invention with the characteristics disclosed in the attached independent claims.

[0009] Advantageous embodiments appear from the dependent claims.

[0010] The installation for extraction of olive from olives according to the invention comprises:

- a crushing station to crush olives in such a way to obtain a paste composed of pulp and crushed olive pit,
- a centrifugation station wherein oil is extracted from olive paste,
- a conveyor disposed between crushing station and centrifugation station, said conveyor comprising a cylindrical tubular structure with a worm conveyor axially disposed inside said cylindrical tubular structure in such a way to generate an auger conveyor with product inlet and outlet,
- a piston pump disposed in said inlet of the conveyor to generate a pulsating effect on feeding of olive paste into said conveyor.

[0011] The piston pump, of pulsating type, creates a pressure wave (a sequence of implosions and explosions of cellular membranes that favors the liberation of oil) that propagates in time and space to all the paste contained inside the worm conveyor. It can be defined as "milking" of olive paste, an alternate pressing of sinusoidal type as transmitted by a piston pump. The linear motion of the piston is sinusoidal, in terms of space, speed and acceleration.

[0012] The installation of the invention may be optionally provided with a kneading station. It must be considered that preparation processes of the paste to oil separation occur during kneading. Oil is contained in olives in small cellular bags (vacuoles) with wall consisting in a cellular membrane. Crushing is not effective in terms of oil separation, because it breaks olives, but only a very few cellular membranes.

[0013] The various actions that occur during kneading are:

- Thermal action. The temperature increase reduces the viscosity of the oil, thus favoring the coming out of the oil from the vacuole.

- Mechanical action. The kneading movement creates friction between olive pulp and crushed pit. The sharp corners of the pit scratch the membrane. Consequently, the membrane is broken and the oil comes out. However, oil comes

out as microdrops that are strongly dispersed in the mass and therefore in emulsion form (not in "separable phase" not even by means of centrifugation).

- Coalescence. Obviously, oil would not be separable and would remain in emulsion without the effect of coalescence. Coalescence is the coming together of microdrops to form large drops that become separable. It is caused by the slow mixing of the mass in kneading. Therefore, coalescence is a physical effect (due to the slow movement of the paste that favors coalescence, not emulsion, of the oil).

- Enzymatic action. Because of pulp breakage, diffuse distribution and prolonged dynamic contact with the membrane, the enzymes contained in the pulp - but not in the vacuoles - cause an enzymatic attack of the membrane, also favored by temperature, with consequent enzymatic breakage of the membrane.

[0014] "Milking" of the paste is an additional effect that cannot take place in the kneading phase, but in the conveyor before kneading.

[0015] With the introduction of the pulsating pump (for instance, sinusoidally) upstream the conveyor, alternate pressure stress of the vacuole is obtained, with additional breakage effect of the membrane. Such additional breakage effect of the membrane corresponds to higher efficacy and efficiency of the process (productivity of the device is increased in terms of process speed, volumes of the kneading station in downstream position, if any, are reduced, and output of oil is increased).

[0016] Advantageously, the delivery of the pump is higher than the delivery of the auger conveyor (pump and auger push the olive paste in series, one after the other). Therefore, a forced pushing action on the paste is generated in the air space between the revolving auger and the thermal exchange surface, thus keeping the surface of the conveyor clean, meaning that the product (olive paste) does not stagnate on the surface, favoring thermal exchange and avoiding local overheating of the olive paste. The above improves the extraction output without impairing the quality of the oil.

[0017] In order to additionally accelerate the oil extraction process, ultrasounds can be applied in direct contact with the olive paste. The synergetic effect of the ultrasound treatment that causes the breakage of the membranes and favors the coming out of oil, and of the conveyor allows for a considerable reduction of kneading time, thus guaranteeing high extraction output without impairing the quality of the oil.

[0018] Advantageously, the ultrasound treatment device can be installed upstream the conveyor. In such a case, the application of ultrasounds to the olive paste favors the breakage of the pulp cells, thus favoring the coming out of oil from the vacuoles. The above makes the paste more oily and slicker, thus reducing friction on the internal walls of the conveyor. Therefore, the synergetic effect of the ultrasound treatment and the piston pump favors the passage of the olive paste in the conveyor, avoiding possible deposits of paste on the internal walls that may overheat and damage the quality of the extracted oil.

[0019] Further characteristics of the invention will become clearer from the detailed description below, which refers to a merely illustrative, not limiting, embodiment, wherein:

Fig. 1 is a block diagram of the installation for extraction of oil according to the invention;
Fig. 2 is a cross-sectional view of a kneading tank of the installation of Fig. 1;
Fig. 3 is a side view, partially in axial section, that shows the conveyor and piston pump of the installation of Fig. 1;
Fig. 4 is a diagrammatic perspective view of an ultrasound device of the installation of Fig. 1;
Fig. 5 is a side view of a ultrasound generator of the device of Fig. 4.

[0020] Referring to Fig. 1, the installation of the invention is disclosed, generally indicated with numeral (100).

[0021] Said installation (100) comprises:

- a crushing station (1) to crush olives in such a way to obtain a paste (P) composed of pulp and crushed olive pit,
- a centrifugation station (6) to extract oil from olive paste.

[0022] An auger conveyor (4) is disposed between crushing station (1) and centrifugation station to transport the olive paste (P). A piston pump (3) is connected to the conveyor (4) to feed the olive paste in the conveyor (4) in a pulsating way.

[0023] A first collection tank (7) is disposed upstream the piston pump. A second collection tank (7') is disposed upstream the centrifugation station (6). A volumetric pump (8), for example a single screw pump, is disposed between second collection tank (7') and centrifugation station (6) to feed olive paste to the centrifugation station (6).

[0024] The conveyor (4) can be optionally heated and, in such a case, it is defined as heater-conveyor (4).

[0025] A kneading station (5) can be optionally provided downstream the conveyor (4) to knead the paste (P). In such a case, the kneading station (5) is generally provided with a tank and a volumetric pump; therefore the second tank (7') and the volumetric pump (8) shown in Fig. 1 can be omitted.

[0026] The first tank (7) used to collect and transfer the paste, disposed upstream the piston pump (3) may comprise a bottom screw to feed the piston pump (3). The first tank (7) may also be provided with kneading blades.

[0027] Optionally, the installation (100) comprises at least one ultrasound generator device (2) to apply ultrasounds to the olive paste (P). The ultrasound device or devices (2) may be disposed in any position of the installation, downstream the crushing station (1) and upstream the centrifugation station (6). Advantageously, an ultrasound application device is disposed upstream the heater-conveyor (4). Actually, the devices installed between crushing station and centrifugation station, in addition to the kneading station, are designed to reduce the thermal and oxidative stress of the olive paste, while exalting the quality of the extracted oil and improving the extraction output. It is known that, if too long, kneading tends to cause the development of aliphatic alcohols, in addition to other compounds, which degrade the quality of the oil.

[0028] The crushing station (1) is of traditional type and may comprise a hammer crusher.

[0029] The kneading station (5) is of traditional type and, as shown in Fig. 2, comprises at least one basically cylindrical tank (50) with rotating blades (51, 51') supported by a shaft (52) disposed in axial position in the tank. The blades (51, 51') have a different radial length. The longest blade (51) brushes the semi-cylindrical internal profile concentric to the shaft of the kneading tank, whereas the shortest blade (51') does not. Although not shown in Fig. 2, the shortest blade (51') has helicoidal direction opposite to the longest blade (51') in order to give the fundamental relative motion between adjacent parts of the paste contained in the tank. The peripheral speed of the blades has a higher limit that depends on the variety of olives, being the limit beyond which emulsion is developed.

[0030] The blades create a relative motion between adjacent parts of the paste (P) that remains inside the tank (50) to allow for mechanical scratching-breaking action of the cellular membranes. Of course, the movement of the paste also favors the thermal exchange with the heating surface and the enzyme action at a temperature of approximately 27 - 35°C. The speed of the blades must not be excessive not to impair the natural aggregation action of the oil (coalescence), which is crucial for the following centrifugation station. To allow for correct kneading, the tank (50) generally has external diameter of about 60 cm and length of about 2-3 m.

[0031] The heater-conveyor (4) is adapted to convey the olive paste (P) and heat it uniformly to guarantee rapid kneading.

[0032] Referring to Fig. 3, the heater-conveyor (4) comprises a cylindrical tubular structure (40) internally housing an auger (41) with bearing shaft (42), actuated by a suitable gear motor (43) to generate an auger conveyor.

[0033] The heater-conveyor (4) comprises an inlet (44) to load the olive paste (P) coming from the crushing station (1) and an outlet (45) to unload the olive paste (P) towards the kneading station (5).

[0034] The lateral walls of the cylindrical tubular structure (40) of the heater-conveyor are provided with air space (46) to allow for hot water circulation (A) by means of an inlet conduit (47) and an outlet conduit (48) provided at the ends of the air space (46). The hot water circulation (A) guarantees a hot water temperature of about 35-40°C. In fact, a higher temperature would cause an excessive thermal shock of the olive paste (P).

[0035] Such a continuous circulation of hot water inside the air space (46) of the heater-conveyor (4) guarantees the desired heating of the olive paste that moves inside it. Advantageously, the air space (46) is provided with helicoidal partitions (49).

[0036] Advantageously, the shaft (42) of the auger has an internally empty tubular structure and is crossed by hot water in order to heat also the central part of the flow of paste (P) moved by the heater-conveyor (4).

[0037] Advantageously, the internal diameter (Φ) of the tubular structure (40) of the heater is lower than half of the internal diameter of the kneading tank (50), preferably being one third of the diameter of the kneading tank.

[0038] The length (L) of the tubular structure (40) of the heater is higher than four meters, preferably six meters, to provide for suitable heating of the paste (P) inside the heater, with a temperature difference of about 10°C from the inlet to the outlet of the heater, in a very short transit time, such as 1-2 minutes. So, the paste (P) reaches the kneading station (5) at a temperature of about 20-30°C and kneading has a reduced length of 10-20 minutes, thus saving on time and energy.

[0039] Therefore, the function of the kneading station is reduced because its effect is compensated by the effects of other devices installed between crushing station and centrifugation station. Certainly, with the same general effect, the useful volume of the kneading station is reduced.

[0040] The installation (100) provides for a piston pump (3) disposed upstream the heater-conveyor (4) to generate a pulsating effect on feeding of olive paste into the heater (4).

[0041] The piston pump (3) comprises a cylindrical chamber (30) where a piston (31) slides. The piston (31) is connected to a connecting rod (33). The connecting rod (33) is connected to a crank (34) that is driven into rotation by a drive shaft (35).

[0042] The pumping chamber (30) is connected to an inlet conduit (36) and an outlet conduit (37). The outlet conduit (37) is directly connected to the inlet conduit (44) of the heater. One-way valves (38, 39) are disposed in the inlet (36) and outlet (37) conduits of the piston pump to allow for correct direction of the flow of olive paste (P) towards the heater-conveyor.

[0043] Advantageously, the delivery of the piston pump (3) is higher than the delivery of the auger conveyor (41).

[0044] Preferably, the pulsating action of the piston pump is of sinusoidal type because of its constructive configuration.

[0045] Referring to Fig. 5, the ultrasound treatment device (2) comprises at least one ultrasound generator (20).

[0046] Referring to Fig. 5, each ultrasound generator (20) comprises a transducer (21) to transform electricity into mechanical vibration at ultrasound frequency. The transducer (21) comprises an enclosure that contains piezoelectrical crystals. The transducer (21) is connected to an ultrasound emitter (22) that protrudes axially from the transducer. The transducer (21) is provided with electrical contacts (23) connected to electrical wires (24) (Fig. 4). As shown in Fig. 4, the electrical wires (24) are connected to electricity generators (G).

[0047] So, when the piezo-electric crystals of the transducer (21) are powered with electricity, they determine a high-frequency mechanical vibration that expands radially from the ultrasound emitter (22). The ultrasound emitter (22) is inserted in a conduit (25) inserted in pipes (26, 27, 28) that transfer the olive paste from crushing station (1) to centrifugation station (6).

[0048] The olive paste passing through the conduits (26, 27, 28) comes in direct contact with the ultrasound emitter (22). Low frequency ultrasounds are used, from 20 KHz to 100KHz, preferably at 20 KHz frequency. The ultrasound treatment can be made for a variable time from 5 to 60 seconds. To that end, the transfer speed of the olive paste is suitably adjusted.

[0049] The power of the ultrasounds and the transit speed of the olive paste are chosen in order to prevent ultrasounds from heating the olive paste excessively, thus causing oil deterioration. Such an ultrasound treatment causes heating of olive paste lower than 5 °C.

[0050] Experimental tests were carried out in an installation (100) similar to the one of Fig. 1, but not provided with ultrasound generators (2).

[0051] Processing in the experimental installation was carried out with two varieties of olives, with constant olive delivery to the installation, changing the temperature of processed paste (by means of the heater-conveyor (4)) and the kneading time in kneading station (5).

[0052] The experimental installation (100) was compared with two processing lines of an industrial oil mill, which were equivalent and alternative for comparison with the experimental installation, operating with fixed parameters:

- the delivery of the experimental installation (100) is basically the same as each line of the industrial installation,
- the kneading time and temperature used in the industrial installation are the typical kneading time and temperature of the oil mill.

[0053] Each of the industrial lines used as reference is characterized by three kneading tanks in series (in overflow configuration) of 6,000 l/each, with single shaft and two-phase decanter (SPI 99 model), i.e. with only one subproduct. The crusher and piston pump used in the lines of the industrial installation are identical to the experimental installation. The parameters that were changed with experimental methodicalness (in the experimental installation) were kneading time and temperature (measured in the inlet of the decanter or horizontal centrifugation station).

[0054] The results obtained with the experimental installation (with variable kneading time and temperature) were compared with the results of the lines of the industrial installation used as reference, which operated throughout the oil campaign with kneading time of 90-100 min and temperature of 27-35°C of the paste at the end of kneading.

[0055] The following tests were carried out:

	Paste delivery	Kneading time	Kneading temperature
Experimental installation	5,000kg/h	90 to 0 min	50°C to 15°C
Industrial installation	5,000kg/h	90-100 min	27 - 35°C

[0056] The quality of the oil (obtained in the two installations) was tested with a sensorial analysis of the finished product (outlet of centrifugation separator).

[0057] It was observed that extraction yield increased when kneading time was reduced from 90 min to 60, 30, 15 min, down to 0 and when temperature was reduced from 50 °C to 30 °C, 20 °C, and 15 °C. Therefore, yield is significantly higher with lower kneading time and temperature.

[0058] A practically null kneading time was obtained by making the paste pass rapidly (without stopping) in the kneading tank (5).

[0059] This result demonstrates that the presence of kneading tanks (5) and the heating of the conveyor (4) can be reduced or avoided, because of the presence of the piston pump (3) in association with the worm screw (4).

[0060] The worm screw (4) was not heated for the temperature values with the best results. Therefore the effect can be entirely ascribed to the "milking" effect obtained by the piston pump (3) in the presence of the worm screw (4) that carries out a braking (contrast) action during passage of the paste pumped by the piston pump (3).

[0061] This occurs because the worm screw acts as a pump with lower delivery than the piston pump. For its entire

length the worm screw is a conveyor that guarantees the sealing (outwards) of the paste, because during its travel the paste is subject to a certain pressure basically due to the pumping effect of the piston pump.

[0062] Between the periphery of the screw of the worm screw and the tubular channel, the radial "clearance" that is necessary for the relative motion between the two parts must be minimized to avoid the formation of a "static" layer of paste in such space, which causes difficulties in the cleaning of tubular walls and in the heat exchange, if necessary, from the heating water to the paste to be heated. Evidently, in order for the contrast action to occur, the delivery transmitted by the screw of the worm screw must be lower than the delivery of the piston pump.

[0063] The installation and method of the present invention have the following advantages:

- Energy (heat) is saved in the kneading station (5) and/or the heater conveyor (4). In any case, it must be noted that the kneading station is a heat exchanger with low heat output because of the large size of the tank (large distances between heating surface and center of heated mass). In addition to the heat used to heat the paste, a great amount of heat is dissipated by the kneading station because of the large surfaces involved, contrary to the conveyor (4) when used as heater. This is evidently caused by the different ratio between heating surface and heated mass.
- The operating system is more continuous. In fact, the large volumes of the kneading tanks contribute to high operating discontinuity. Transit time of the processed product through the installation is reduced, with lower possibility of oil oxidation (higher quality). Processing time is reduced (permanence in the kneading station is reduced or eliminated). The equipment of the installation is exploited in a more efficient way (optimization).
- Operating costs are reduced (faster amortization) because of the reduction or elimination of the kneading stations.
- The space necessary in the oil mill is reduced (the kneading section is the bulkiest section of the installation). The organization of the installation is improved.
- The quality of the oil is improved and increased (as clearly, yet unexpectedly, demonstrated). This method has the advantages of cold processing (without oil oxidation caused by temperature and long kneading time), and enhances the quality of oil, which is normally associated with low temperature, without the contraindication of low extraction output of oil, as it normally occurs with traditional cold processing methods.

Claims

1. Installation (100) for extraction of oil from olives comprising:

- a crushing station (1) to crush olives in such a way to obtain a paste (P) composed of pulp and crushed olive pit,
- a centrifugation station (6) wherein oil is extracted from olive paste
- a conveyor (4) disposed between crushing station (1) and centrifugation station (6), said conveyor comprising a cylindrical tubular structure (40) with a worm conveyor (41) axially disposed inside said cylindrical tubular structure, in such a way to generate an auger conveyor (40,41) with inlet (44) and outlet (45) of product,

characterized in that it also comprises
a piston pump (3) disposed in said inlet (44) of the conveyor to generate a pulsating effect on feeding of olive paste into said conveyor (4).

2. Installation as claimed in claim 1, **characterized in that** the delivery of said piston pump (3) is higher than the delivery of said auger conveyor (40, 41).

3. Installation as claimed in claim 1 or 2, **characterized in that** the pulsating action of said piston pump (3) is of alternate type related to the sinusoidal motion of the piston.

4. Installation as claimed in any one of the preceding claims, **characterized in that** it comprises a kneading station (5) comprising at least one tank (50) with basically cylindrical shape, where blades (51) rotate, being supported by a shaft (52) arranged axially in the tank to knead the paste (P).

5. Installation as claimed in any one of the previous claims, **characterized in that** said conveyor (4) comprises a space (46) with circulation of hot water to heat the olive paste passing in the conveyor (4).

6. Installation as claimed in any one of the preceding claims, **characterized in that** it also comprises at least one ultrasound generator device (2) disposed downstream said crushing station (1) and/or upstream said centrifugation station (6), provided with ultrasound generator (22) in direct contact with olive paste (P) to break the cells of olive paste and favor the coming out of oil from vacuoles.

7. Installation as claimed in claim 6, **characterized in that** the power of said ultrasounds and transit time of olive paste in contact with said ultrasound generator (22) are chosen in such a way to cause heating of olive paste by ultrasounds lower than 5°C.

8. Installation as claimed in claim 6 or 7, **characterized in that** said ultrasound generator (22) is disposed upstream said piston pump (3).

9. Installation as claimed in any one of the preceding claims, **characterized in that** it comprises a tank (7') disposed upstream said centrifugation station and a volumetric pump (8) disposed between said tank (7') and centrifugation station.

10. Method for extraction of oil from olives comprising the following steps:

- crushing to crush olives in order to obtain a paste (P) composed of pulp and crushed olive pits,
- centrifugation of olive paste to extract oil,
- transportation of olive paste to centrifugation station by means of a conveyor (4) with tubular cylindrical structure (40) with a worm screw (41) disposed axially inside said tubular cylindrical structure, in such manner to generate a worm screw (40, 41) with product inlet (44) and outlet (45),

characterized in that it comprises the generation of a pulsing effect on the delivery of olive paste inside said conveyor (4) by means of a piston pump (3) disposed in said inlet (44) of the conveyor.

11. Method as claimed in claim 10, **characterized in that** the delivery of said piston pump (3) is higher than the delivery of said screw conveyor (40, 41).

12. Method as claimed in claim 10 or 11, **characterized in that** the pulsing action of said piston pump (3) is of alternate type related with the sinusoidal motion of the piston.

13. Method as claimed in any one of claims 10 to 12, **characterized in that** it comprises kneading of olive paste before centrifugation.

14. Method as claimed in any one of claims 10 to 13, **characterized in that** it comprises heating of olive paste before centrifugation.

15. Method as claimed in any one of claims 10 to 14, **characterized in that** it comprises the application of ultrasounds to olive paste (P) to break the cells of olive paste and favor the coming out of oil from vacuoles.

16. Method as claimed in claim 15, **characterized in that** the power of said ultrasounds and transit time of olive paste in contact with ultrasounds are selected in order to cause heating of olive paste by ultrasounds lower than 5 °C.

Patentansprüche

1. Anlage (100) zur Extraktion von Öl aus Oliven, umfassend:

- eine Mahlstation (1) zum Zerkleinern der Oliven, um einen Brei (P), bestehend aus dem Fruchtfleisch und den zerkleinerten Kernen der Oliven zu erhalten,
- eine Zentrifugierstation (6), in der das Öl aus dem Olivenbrei extrahiert wird,
- ein Förderer (4), der zwischen der Mahlstation (1) und der Zentrifugierstation (6) angeordnet ist, wobei der Förderer eine zylinderförmige Rohrstruktur (40) mit einer Schnecke (41) umfasst, die axial in der zylinderförmigen Rohrstruktur so angeordnet ist, dass ein Schneckenförderer (40, 41) mit einem Eingang (44) und einem Ausgang (45) für das Material entsteht,

dadurch gekennzeichnet, dass sie ferner Folgendes umfasst:

eine Kolbenpumpe (3), die am Eingang (44) des Förderers angeordnet ist, um eine Stoßwirkung beim Einspeisen des Olivenbreis in den Förderer (4) zu erzeugen.

2. Anlage nach Anspruch 1, **dadurch gekennzeichnet, dass** der Durchsatz der Kolbenpumpe (3) größer als der Durchsatz des Schneckenförderers (40,41) ist.

3. Anlage nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** die Stoßwirkung der Kolbenpumpe (3) alternierend und mit der sinusförmigen Bewegung des Kolbens verbunden ist.

4. Anlage nach einem beliebigen der vorstehenden Ansprüche, **dadurch gekennzeichnet, dass** sie eine Knetstation (5), umfasst, umfassend mindestens einen im Wesentlichen zylinderförmigen Tank (50), in dem von einer axial im Tank angeordneten Welle (52) getragene Schaufeln (51) rotieren, um ein Durchkneten des Breis (P) zu bewirken.

5. Anlage nach einem beliebigen der vorstehenden Ansprüche, **dadurch gekennzeichnet, dass** der Förderer (4) einen Zwischenraum (46) umfasst, in dem heißes Wasser zirkuliert, um den durch den Förderer (4) laufenden Olivenbrei zu erwärmen.

6. Anlage nach einem beliebigen der vorstehenden Ansprüche, **dadurch gekennzeichnet, dass** sie mindestens eine Vorrichtung zur Erzeugung von Ultraschallwellen (2) umfasst, die der Mahlstation (1) nachgelagert und/oder der Zentrifugierstation (6) vorgelagert ist und mit einem in direktem Kontakt mit dem Olivenbrei (P) befindlichen Ultraschallerzeuger (22) versehen ist, um ein Aufbrechen der Zellen des Olivenbreis zu bewirken und das Austreten des Öls aus den Vakuolen zu begünstigen.

7. Anlage nach Anspruch 6, **dadurch gekennzeichnet, dass** die Stärke des Ultraschalls und die Durchlaufzeit des im Kontakt mit dem Ultraschallerzeuger (22) befindlichen Olivenbreis so eingestellt sind, dass eine Erwärmung des Olivenbreis durch den Ultraschall um weniger als 5 °C bewirkt wird.

8. Anlage nach Anspruch 6 oder 7, **dadurch gekennzeichnet, dass** der Ultraschallerzeuger (22) der Kolbenpumpe (3) vorgelagert ist.

9. Anlage nach einem beliebigen der vorstehenden Ansprüche, **dadurch gekennzeichnet, dass** sie einen der Zentrifugierstation vorgelagerten Tank (7') und eine volumetrische Pumpe (8) umfasst, die zwischen dem Tank (7') und der Zentrifugierstation angeordnet ist.

10. Verfahren zur Extraktion von Öl aus Oliven, umfassend folgende Schritte:

    - Mahlen zum Zerkleinern der Oliven, um einen Brei (P), bestehend aus dem Fruchtfleisch und den zerkleinerten Kernen der Oliven zu erhalten,
    - Zentrifugieren des Olivenbreis zur Extraktion des Öls,
    - Fördern der Olivenpaste zur Zentrifugierstation mittels eines Förderers (4), der eine zylinderförmige Rohrstruktur (40) mit einer Schnecke (41) besitzt, die axial in der zylinderförmigen Rohrstruktur so angeordnet ist, dass ein Schneckenförderer (40, 41) mit einem Eingang (44) und einem Ausgang (45) für das Material entsteht,

    dadurch gekennzeichnet, dass es die Erzeugung einer Stoßwirkung auf die Einspeisung des Olivenbreis in den Förderer (4) mittels einer Kolbenpumpe (3) umfasst, die am Eingang (44) des Förderers angeordnet ist.

11. Verfahren nach Anspruch 10, **dadurch gekennzeichnet, dass** der Durchsatz der Kolbenpumpe (3) größer als der Durchsatz des Schneckenförderers (40,41) ist.

12. Verfahren nach Anspruch 10 oder 11, **dadurch gekennzeichnet, dass** die Stoßwirkung der Kolbenpumpe (3) alternierend und mit der sinusförmigen Bewegung des Kolbens verbunden ist.

13. Verfahren nach einem der Ansprüche 10 bis 12, **dadurch gekennzeichnet, dass** es das Durchrühren des Olivenbreis vor dem Zentrifugieren umfasst.

14. Verfahren nach einem der Ansprüche 10 bis 13, **dadurch gekennzeichnet, dass** es das Erhitzen des Olivenbreis vor dem Zentrifugieren umfasst.

15. Verfahren nach einem der Ansprüche 10 bis 14, **dadurch gekennzeichnet, dass** es die Ultrabeschallung des Olivenbreis (P) umfasst, um ein Aufbrechen der Zellen des Olivenbreis zu bewirken und das Austreten des Öls aus den Vakuolen zu begünstigen.

16. Verfahren nach Anspruch 15, **dadurch gekennzeichnet, dass** die Stärke des Ultraschalls und die Durchlaufzeit des im Kontakt mit den Ultraschallwellen befindlichen Olivenbreis so eingestellt sind, dass eine Erwärmung des Olivenbreis durch den Ultraschall um weniger als 5 °C bewirkt wird.

Revendications

1. Installation (100) pour l'extraction de l'huile des olives comprenant :

- un poste de pressage (1) pour broyer les olives, de manière à obtenir une pâte (P) composée de pulpe et de noyau d'olive broyé,
- un poste de centrifugation (6) dans lequel on obtient l'extraction de l'huile à partir de la pâte d'olives,
- un convoyeur (4) disposé entre le poste de pressage (1) et le poste de centrifugation (6), ledit convoyeur comprenant une structure tubulaire cylindrique (40) avec une vis sans fin (41) disposée axialement à l'intérieur de ladite structure tubulaire cylindrique, de manière à générer un transporteur d'alimentation (40, 41) ayant une entrée (44) et une sortie (45) du produit

caractérisée en ce qu'elle comprend en outre
une pompe à piston (3) agencée au niveau de ladite entrée (44) du convoyeur afin de générer un effet de pulsation sur l'alimentation de la pâte d'olives à l'intérieur dudit convoyeur (4).

2. Installation selon la revendication 1, **caractérisée en ce que** le débit de ladite pompe à piston (3) est supérieur au débit de celui dudit transporteur d'alimentation (40, 41).

3. Installation selon la revendication 1 ou 2, **caractérisée en ce que** l'action de pulsation de ladite pompe à piston (3) est du type alterné, associé au mouvement sinusoïdal du piston.

4. Installation selon l'une quelconque des revendications précédentes, **caractérisée en ce qu'**elle comprend un poste de malaxage (5) comprenant au moins un réservoir (50), sensiblement cylindrique, à l'intérieur duquel tournent des lames rotatives (51) supportées par un arbre (52) disposé axialement dans le réservoir pour provoquer le malaxage de la pâte (P).

5. Installation selon l'une quelconque des revendications précédentes, **caractérisée en ce que** ledit convoyeur (4) comprend une cloison (46) dans laquelle circule de l'eau chaude pour chauffer la pâte d'olives qui passe dans le convoyeur (4).

6. Installation selon l'une quelconque des revendications précédentes, **caractérisée en ce qu'**elle comprend en outre au moins un dispositif générateur d'ultrasons (2), disposé en aval dudit poste de pressage (1) et/ou en amont dudit poste de centrifugation (6), muni d'un générateur d'ultrasons (22) en contact direct avec la pâte d'olives (P) pour provoquer la rupture des cellules de la pâte d'olives et faciliter la sortie de l'huile depuis les vacuoles.

7. Installation selon la revendication 6, **caractérisée en ce que** la puissance des dits ultrasons et le temps de passage de la pâte d'olives en contact avec ledit générateur d'ultrasons (22) sont choisis de manière à provoquer un échauffement de la pâte d'olives, sous l'action des ultrasons, inférieur à 5°C.

8. Installation selon la revendication 6 ou 7, **caractérisée en ce que** ledit générateur d'ultrasons (22) est disposé en amont de ladite pompe à piston (3).

9. Installation selon l'une quelconque des revendications précédentes, **caractérisée en ce qu'**elle comprend un réservoir (7') disposé en amont dudit poste de centrifugation et une pompe volumétrique (8) disposée entre ledit réservoir (7') et ledit poste de centrifugation.

10. Procédé pour l'extraction de l'huile des olives, comprenant les étapes suivantes:

- broyage pour briser les olives de manière à obtenir une pâte (P) composée de pulpe et de noyau d'olives broyé,
- centrifugation de la pâte d'olives pour l'extraction de l'huile,
- transport de la pâte d'olives vers le poste de centrifugation moyennant un convoyeur (4) ayant une structure tubulaire cylindrique (40) avec une vis sans fin (41) disposée axialement à l'intérieur de ladite structure tubulaire

cylindrique, de manière à générer un transporteur d'alimentation (40, 41) ayant une entrée (44) et une sortie (45) du produit,

caractérisé en ce qu'il comprend l'étape consistant à générer un effet de pulsation sur l'alimentation de la pâte d'olives à l'intérieur dudit convoyeur (4), au moyen d'une pompe à piston (3) agencée au niveau de ladite entrée (44) du convoyeur.

11. Procédé selon la revendication 10, **caractérisé en ce que** le débit de ladite pompe à piston (3) est supérieur au débit dudit transporteur d'alimentation (40, 41).

12. Procédé selon la revendication 10 ou 11, **caractérisé en ce que** l'action de pulsation de ladite pompe à piston (3) est du type alterné, associée au mouvement sinusoïdal du piston.

13. Procédé selon l'une quelconque des revendications de 10 à 12, **caractérisé en ce qu'**il comprend le malaxage de la pâte d'olives, avant centrifugation.

14. Procédé selon l'une quelconque des revendications de 10 à 13, **caractérisé en ce qu'**il comprend l'échauffement de la pâte d'olives, avant centrifugation.

15. Procédé selon l'une quelconque des revendications de 10 à 14, **caractérisé en ce qu'**il comprend l'application d'ultrasons à la pâte d'olives (P) afin de provoquer la rupture des cellules de la pâte d'olives et de faciliter la sortie de l'huile depuis le vacuoles.

16. Procédé selon la revendication 15, **caractérisé en ce que** la puissance des dits ultrasons et le temps de passage de la pâte d'olives en contact des ultrasons sont choisis de manière à provoquer un échauffement de la pâte d'olives, sous l'action des ultrasons, inférieur à 5°C.

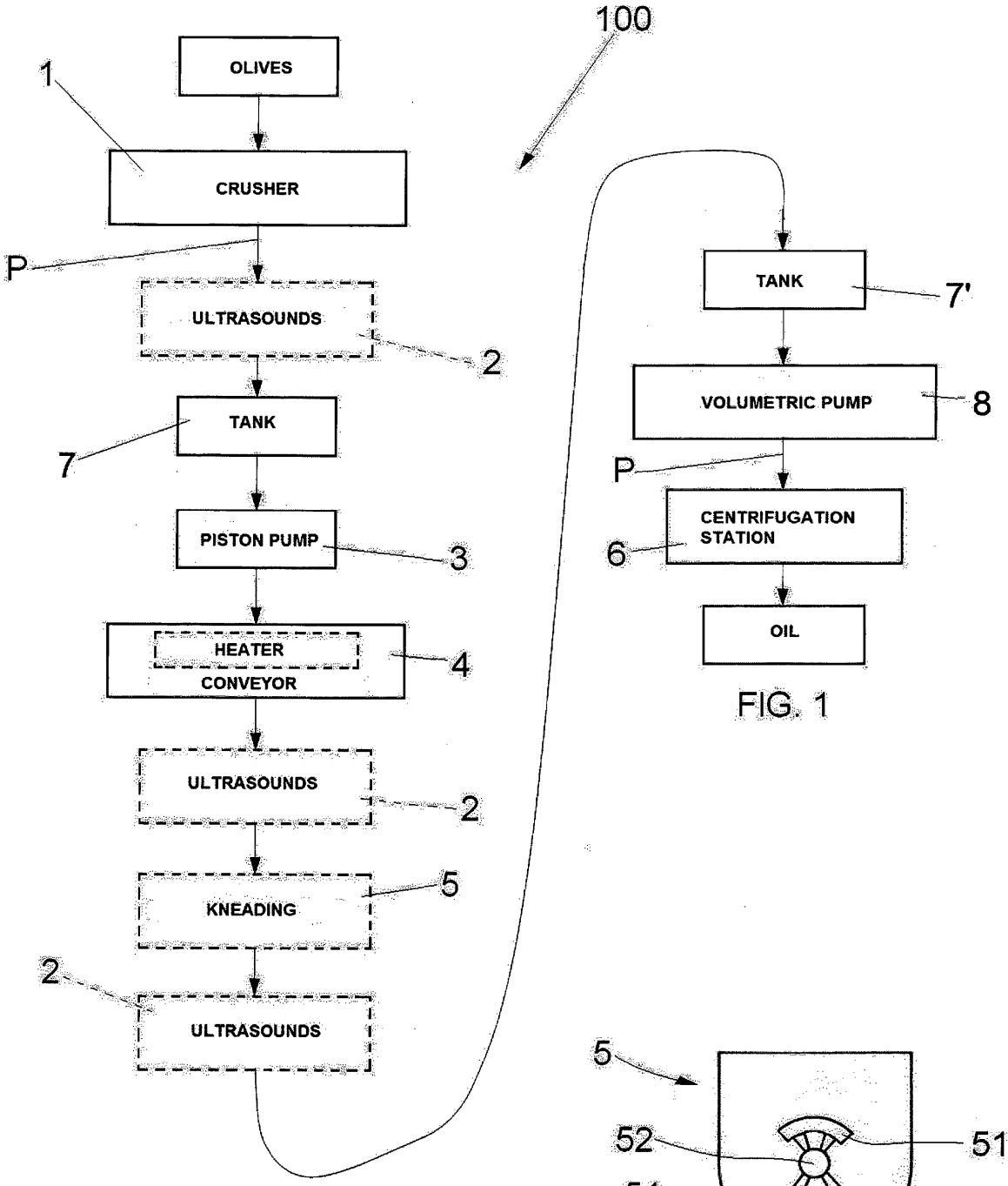

100
OLIVES
1
CRUSHER
P
ULTRASOUNDS
2
TANK
7
PISTON PUMP
3
HEATER
CONVEYOR
4
ULTRASOUNDS
2
KNEADING
5
2
ULTRASOUNDS
TANK
7'
VOLUMETRIC PUMP
8
P
CENTRIFUGATION STATION
6
OIL

FIG. 1

5
52
51'
51
50

FIG. 2

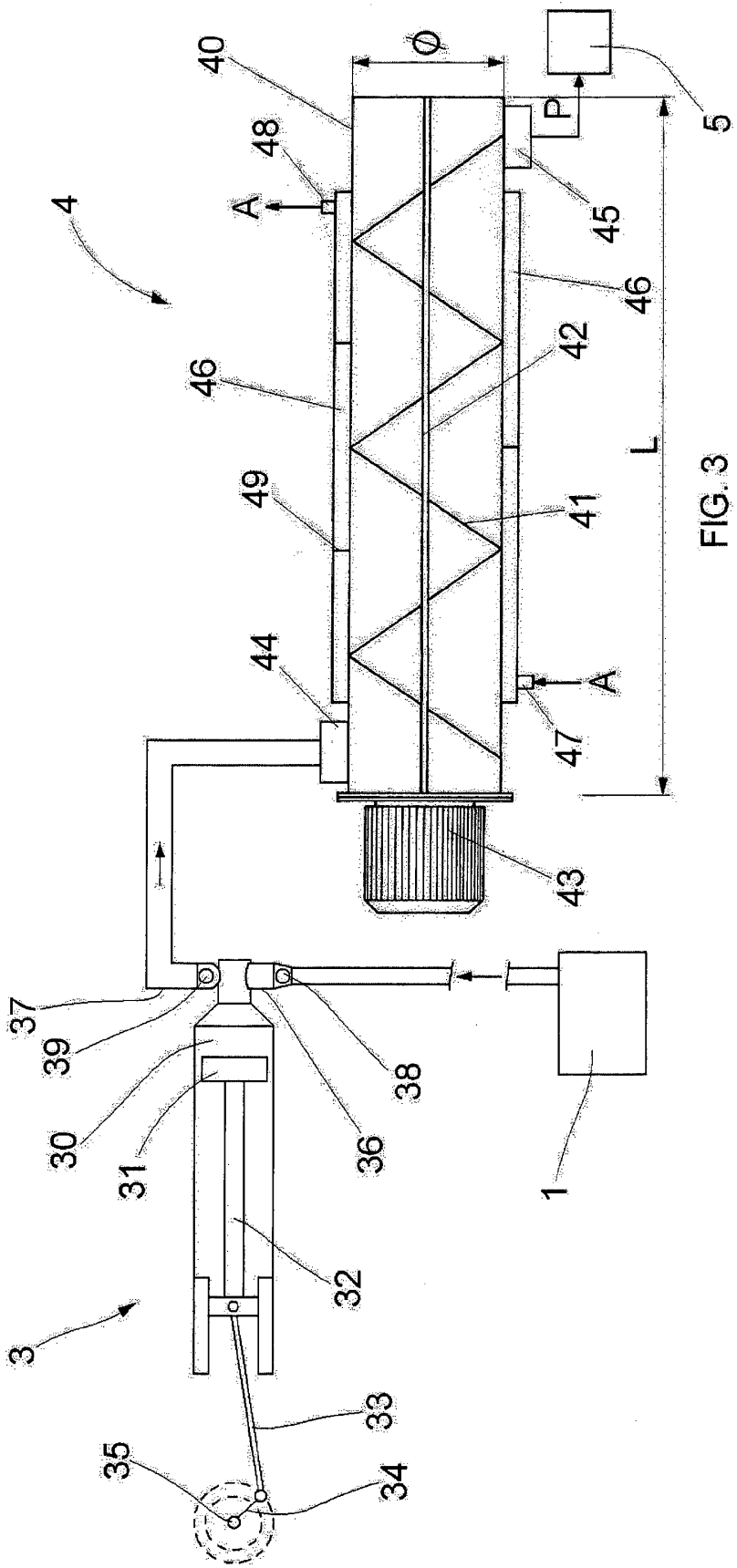

40
Ø
5
P
48
A
45
4
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42
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30
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35
34

FIG. 3

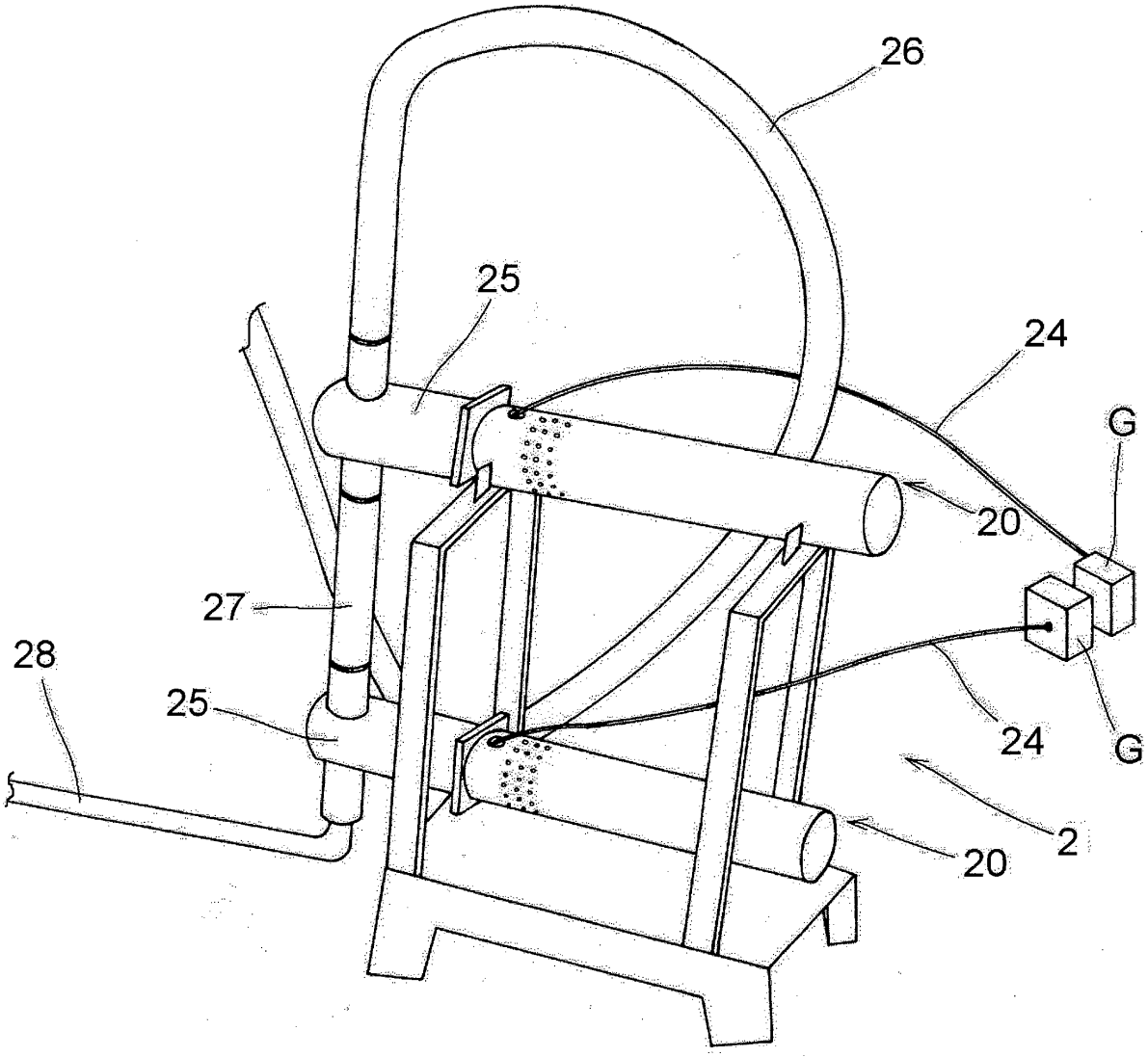


FIG. 4

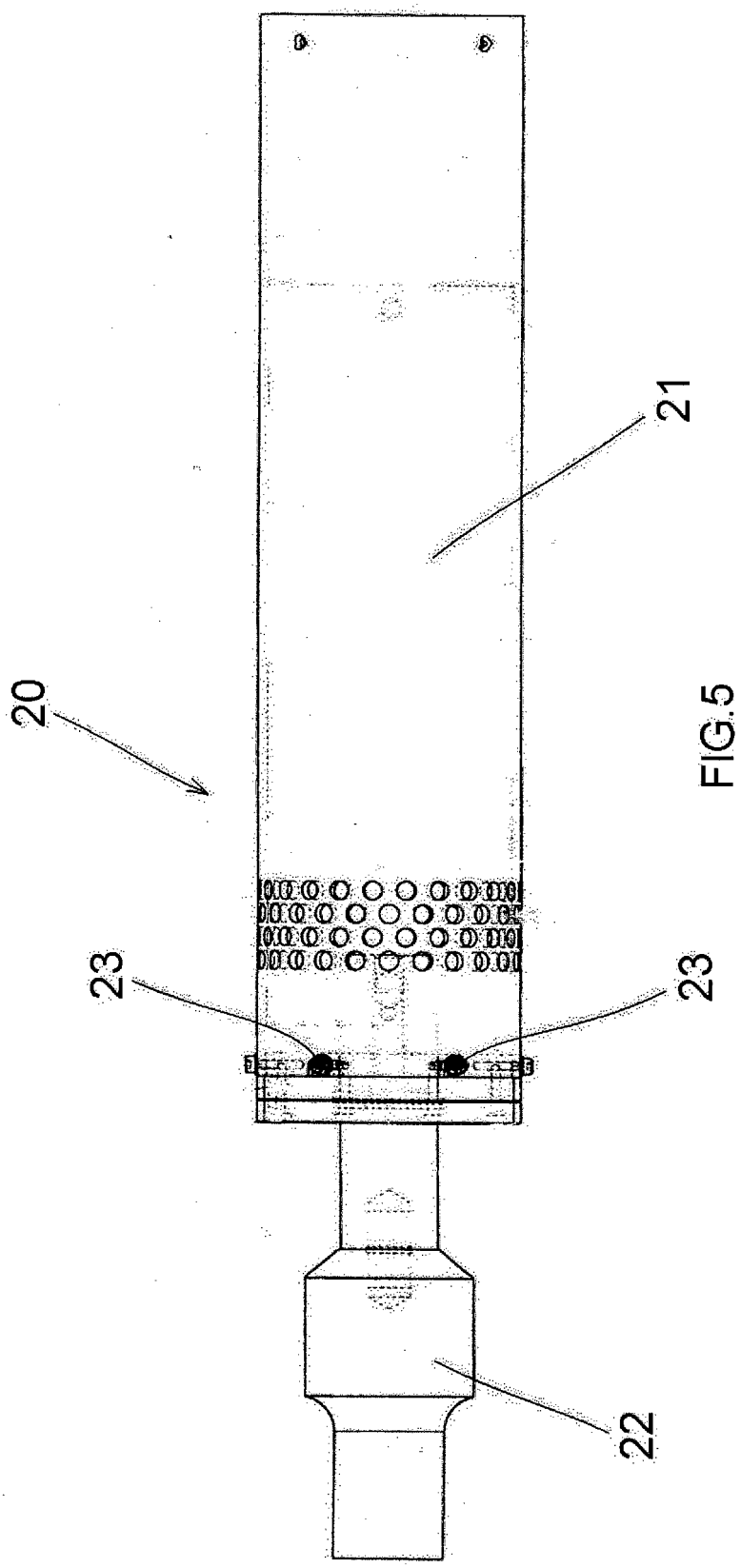


FIG.5

REFERENCES CITED IN THE DESCRIPTION

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