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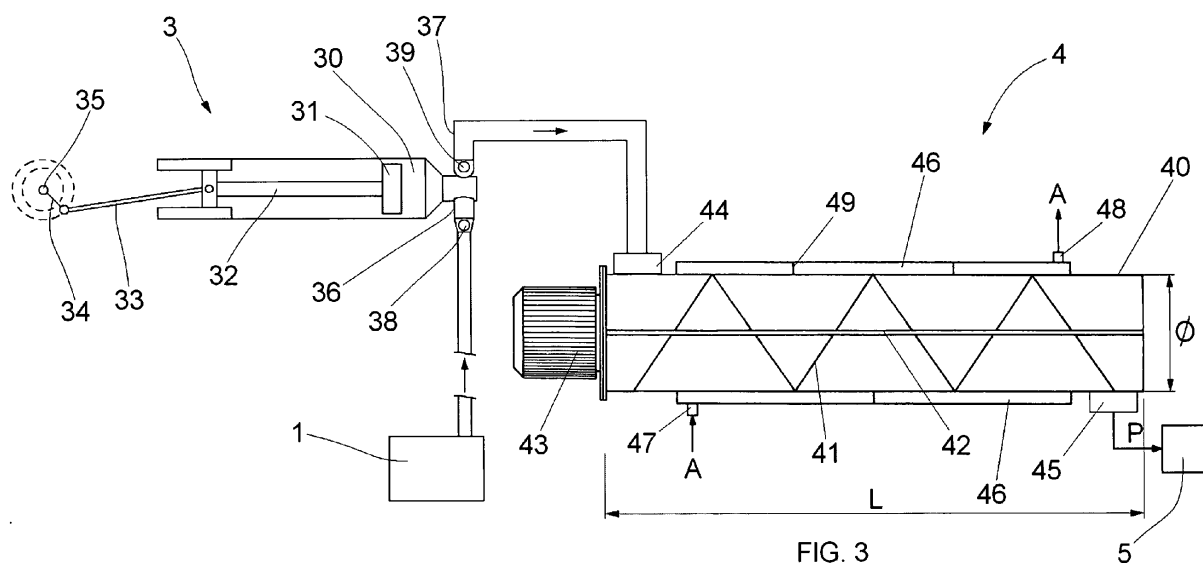
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(54) **Installation for extraction of oil from olive paste**

(57) The present invention relates to a high-efficiency olive kneading installation according to which the olive paste coming from a crushing station (1) is heated in a

heater-conveyor (4) adapted to transfer it to the kneading station (5). The olive paste is fed in a pulsating way to the heater-conveyor by a piston pump (3).



Description

[0001] The present patent application for industrial invention relates to an installation 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 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 claim 1.

[0009] Advantageous embodiments appear from the dependent claims.

5 **[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 olive pit,
- 10 - a kneading station comprising at least one basically cylindrical tank with rotating blades supported by a shaft disposed in axial position in the tank to knead the paste,
- a centrifuge wherein oil is extracted from olive paste,
- 15 - a heater-conveyor disposed between the crushing station and the kneading station, said heater-conveyor comprising a cylindrical tubular structure with air space with circulation of hot water and 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 heater-conveyor to generate a pulsating effect on feeding of olive paste into said heater-conveyor.

25 **[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.

30 **[0012]** 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.

35 **[0013]** The various actions that occur during kneading are:

- 40 • Thermal action. The temperature increase reduces the viscosity of the oil, thus favouring the coming out of the oil from the vacuole.
- 45 • 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 centrifuge).
- 50 • 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 sep-
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arable. 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 heater-conveyor before kneading.

[0015] With the installation of the pulsating pump (for instance, sinusoidally) upstream the heater-conveyor, alternate pressure stress of the vacuole is obtained, with additional breakage effect of the membrane corresponds to higher efficacy and efficiency of the process (increase of productivity of the device in terms of process acceleration, volume reduction of kneading station in downstream position, oil output).

[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 heater-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 the heater-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 heater-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 heater-conveyor. Therefore, the synergetic effect of the ultrasound treatment and the piston pump favors the passage of the olive paste in the heater-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 heater 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 olive pit,
- a kneading station (5) to knead the paste (P), and
- a centrifuge (6) to extract oil from olive paste.

[0022] A heater-auger conveyor (4) is disposed between the crushing station (1) and the kneading station (5). A piston pump (3) is connected to the heater-conveyor (4) to feed the olive paste in the heater-conveyor (4) in a pulsating way.

[0023] 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 centrifuge (6). Advantageously, an ultrasound application device is disposed upstream the heater-conveyor (4). Actually, the devices installed between the crushing station and the centrifuge, 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. The crushing station (1) is of traditional type and may comprise a hammer crusher.

[0024] 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 semicylindrical 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.

[0025] 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 centrifuge station. To allow for correct kneading, the tank (50) generally has external diameter of about 60 cm and length of about 2-3 m.

[0026] The heater-conveyor (4) is adapted to convey the olive paste (P) and heat it uniformly to guarantee rapid kneading.

[0027] 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.

[0028] 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).

[0029] 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).

[0030] 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).

[0031] 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).

[0032] 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.

[0033] 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.

[0034] Therefore, the function of the kneading station

is reduced because its effect is compensated by the effects of other devices installed between the crushing station and the centrifuge. Certainly, with the same general effect, the useful volume of the kneading station is reduced.

[0035] 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).

[0036] 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).

[0037] 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.

[0038] Advantageously, the delivery of the piston pump (3) is higher than the delivery of the auger conveyor (41).

[0039] Preferably, the pulsating action of the piston pump is of sinusoidal type because of its constructive configuration.

[0040] Referring to Fig. 5, the ultrasound treatment device (2) comprises at least one ultrasound generator (20).

[0041] 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 piezo-electrical 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).

[0042] 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 the crushing station (1) to the centrifuge (6).

[0043] 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.

[0044] 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.

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 olive pit,
 - a kneading station (5) comprising at least one basically cylindrical tank (50) with rotating blades (51) supported by a shaft (52) disposed in axial position in the tank to cause kneading of paste (P),
 - a centrifuge (6) wherein oil is extracted from olive paste
 - a heater-conveyor (4) disposed between the crushing station (1) and the kneading station (5), said heater-conveyor comprising a cylindrical tubular structure (40) with air space (46) with circulation of hot water (A) and a worm conveyor (42) axially disposed inside said cylindrical tubular structure in such a way to generate an auger conveyor 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 heater-conveyor to generate a pulsating effect on feeding of olive paste into said heater-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 sinusoidal type.
4. 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 upstream said centrifuge (6), provided with ultrasound generator (22) in direct contact with olive paste (P) to break the cells of olive paste and favour the coming out of oil from vacuoles.
5. Installation as claimed in claim 4, **characterized in that** the power of said ultrasounds and the transit time of olive paste in contact with said ultrasound generator (22) are chosen in such a way to heat olive paste by means of ultrasounds at a temperature lower than 5°C.
6. Installation as claimed in claim 4 or 5, **characterized in that** said ultrasound generator (22) is disposed upstream said piston pump (3).

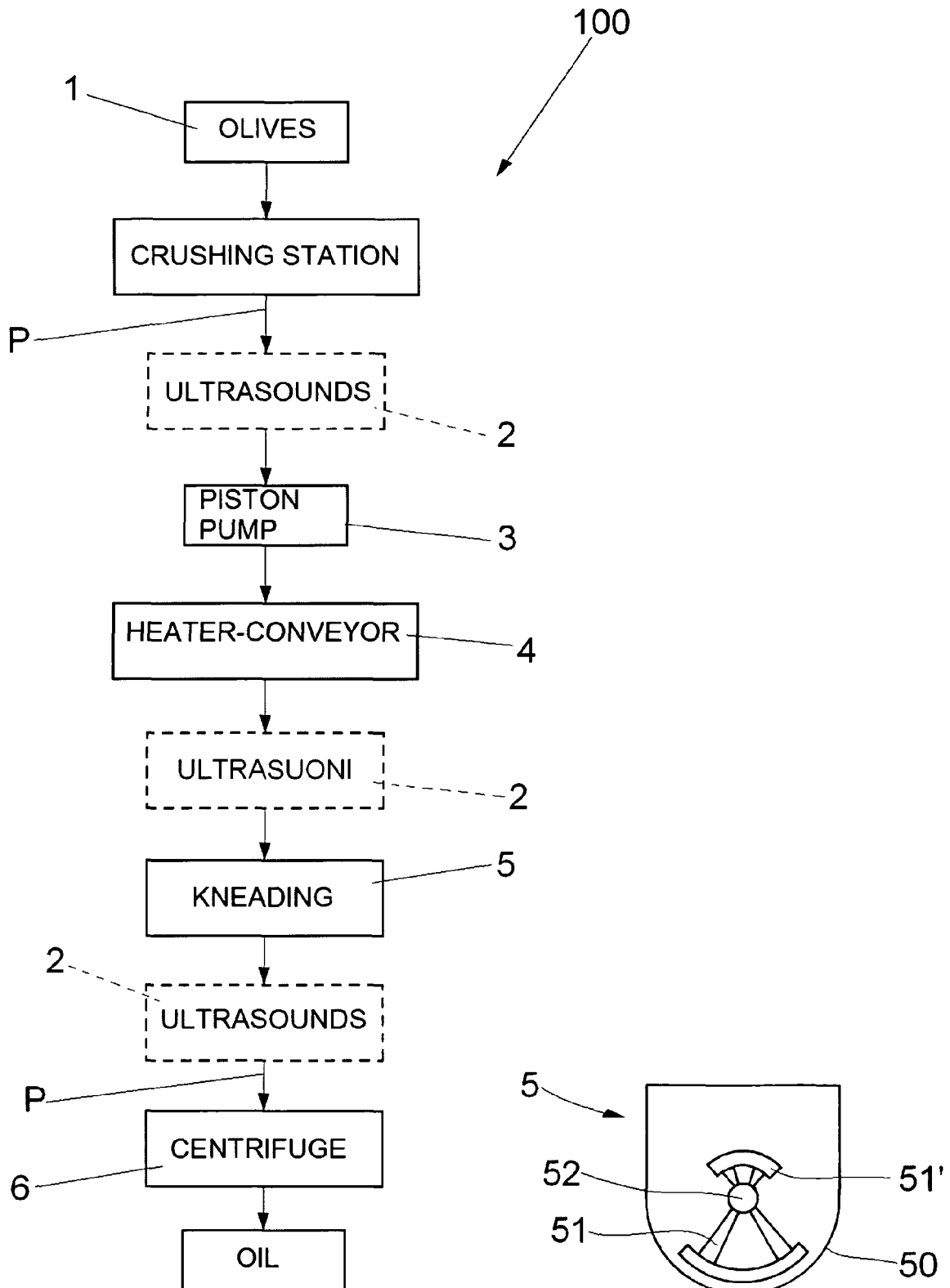
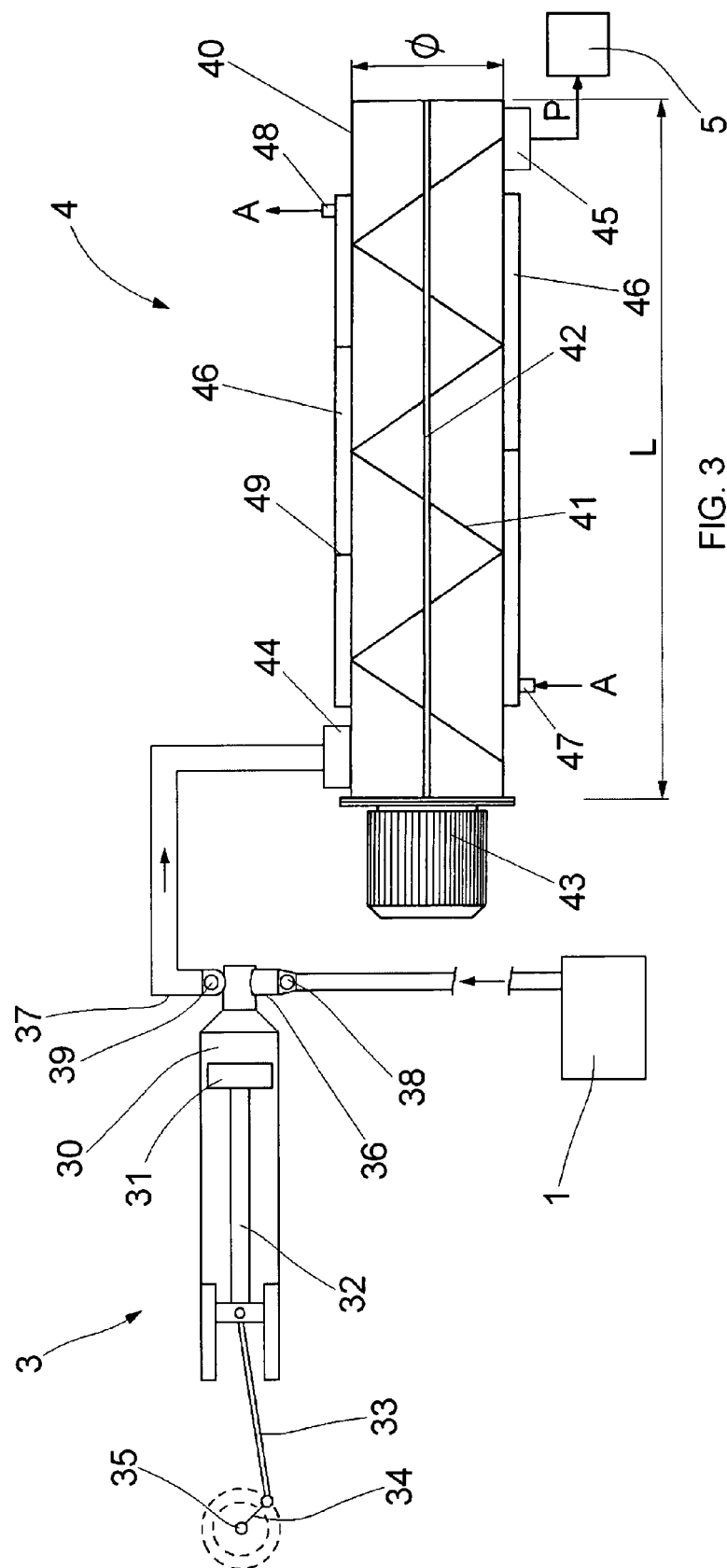


FIG. 1

FIG. 2



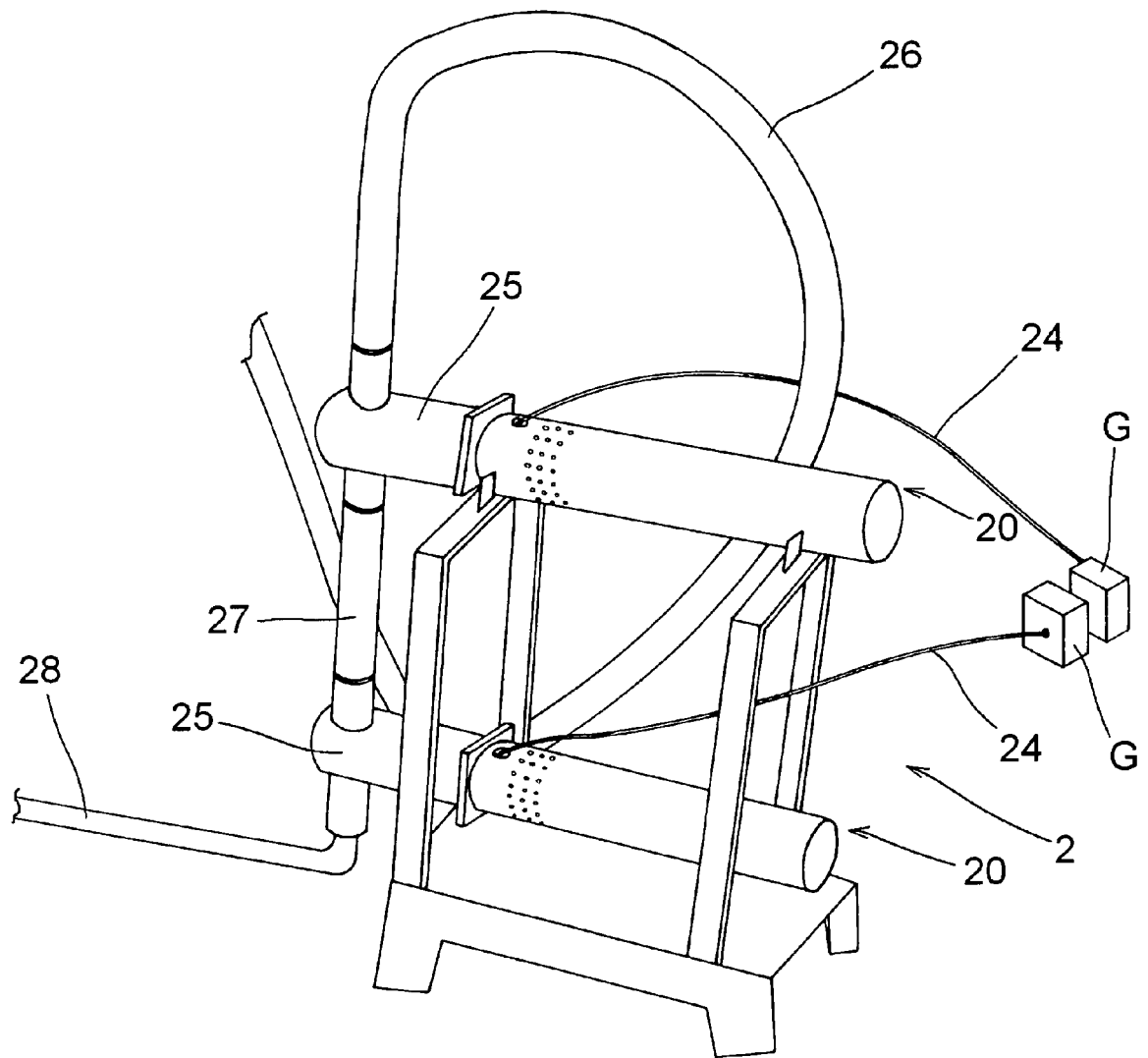
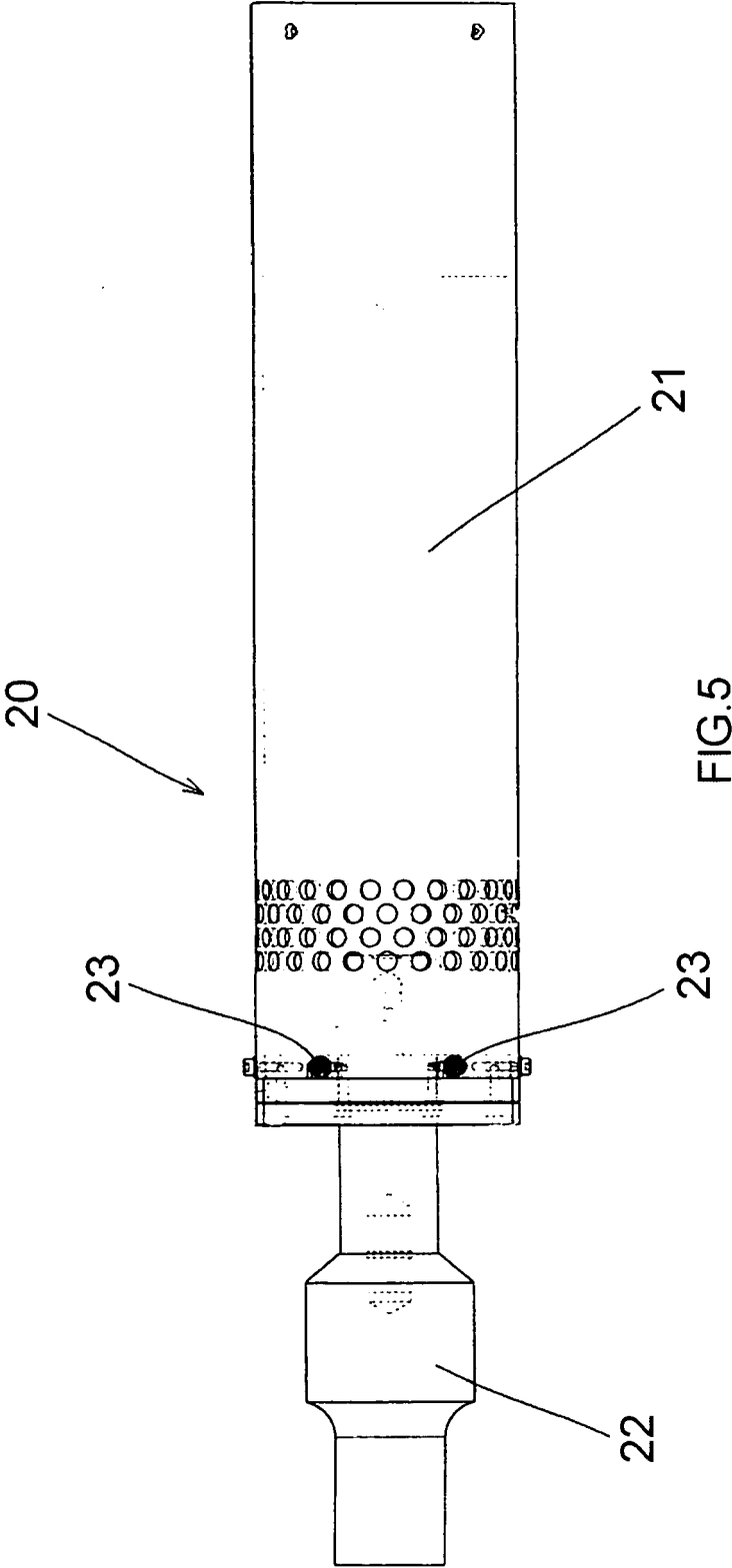


FIG. 4





EUROPEAN SEARCH REPORT

Application Number
EP 11 42 5159

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC)
			C11B
Place of search		Date of completion of the search	Examiner
Munich		27 October 2011	Adechy, Miriam
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 11 42 5159

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The members are as contained in the European Patent Office EDP file on
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27-10-2011

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EP 2248880	A1	10-11-2010	NONE
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REFERENCES CITED IN THE DESCRIPTION

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