(12) PATENT **(11)** Application No. **AU 199941632 B2**
(19) AUSTRALIAN PATENT OFFICE **(10)** Patent No. **747258**

(54) Title
Method and apparatus for producing olive oil without pressing the stones

(51)[7] International Patent Classification(s)
C11B 001/06 **C11B 001/04**

(21) Application No: **199941632** (22) Application Date: **1999.05.21**

(87) WIPO No: **WO99/61568**

(30) Priority Data

(31) Number	(32) Date	(33) Country
TO98A000444	**1998.05.22**	**IT**

(43) Publication Date : **1999.12.13**
(43) Publication Journal Date : **2000.02.24**
(44) Accepted Journal Date : **2002.05.09**

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(56) Related Art
EP 616024
EP 581748

41632/99

PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 :
C11B 1/06, 1/04

A1

(11) International Publication Number: **WO 99/61568**

(43) International Publication Date: 2 December 1999 (02.12.99)

(21) International Application Number: PCT/IT99/00143

(22) International Filing Date: 21 May 1999 (21.05.99)

(30) Priority Data:
TO98A000444 22 May 1998 (22.05.98) IT

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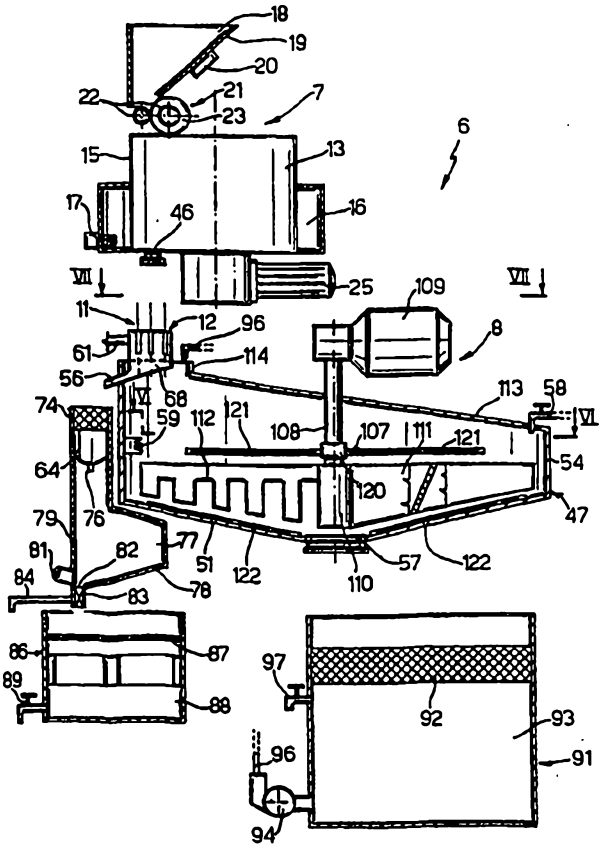
(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, GM, HR, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: METHOD AND APPARATUS FOR PRODUCING OLIVE OIL WITHOUT PRESSING THE STONES

(57) Abstract

The method includes a pulp removal and kneading step to remove the pulp from and knead the olives; and a separating and extracting step to separate and extract the oil from a mixture of paste and water. The pulp removing and kneading step is performed substantially with no added water and at a controlled temperature below 35 °C; and the separating and extracting step is performed by mixing the paste with water substantially at the controlled temperature, and by immersing an extracting member (11) into the paste and moving the extracting member continually with respect to a scraping member (12). The apparatus has a pulp removing and kneading device (7) for removing the pulp from and kneading the olives in a first vessel (13); and a separating and extracting device (8) for separating the oil from the mixture and extracting the oil in a second vessel (47). The pulp removing and kneading device (7) has two rollers (22) for initiating breakage of the epicarp of the olives; and the paste is transferred directly from the first vessel (13) to the separating and extracting device (8), which has at least one pair of members (111, 112) for mixing the paste with water.



METHOD AND APPARATUS FOR PRODUCING OLIVE OIL WITHOUT PRESSING THE STONES

TECHNICAL FIELD

The present invention relates to a method and apparatus for producing olive oil without pressing the stones.

BACKGROUND ART

Various methods are known of extracting oil from olive paste, e.g. by means of pressure or centrifugation; electrophoretically, by feeding electric current into the paste diluted with water; or chemically by diluting the paste with water to which alkalis are added. The olive paste itself is generally obtained by removing the pulp of the olives from the stones by means of mechanical presses, followed by mixing or so-called kneading to produce merging or coalescence of the oil particles.

In another proposed method, oil is extracted on the basis of the different surface tension of the oil as compared with the olive water in the paste, which causes

greater adhesion of the oil particles to a smooth metal surface. Extraction in this way is normally effected by immersing steel blades back and forth into the paste so that a film of oil adheres to the blades, and then scraping the blades to remove the oil film.

Pressing the stones normally calls for extremely powerful presses and invariably produces an increase in the acidity of the oil due to the presence of seed oil particles. Moreover, the skin or epicarp of the olives contains bitter-tasting polyphénol substances, which, as mechanical pulp removal also results in fine shredding of the epicarp, are released into the paste, thus giving the oil a bitter taste.

All the above methods normally involve adding water at a temperature of over 35°C to simplify both kneading and separation of the oil and olive water from the solid residue or husks, and have the drawback of increasing the peroxide content and so negatively affecting the organoleptic characteristics of the oil.

It has also been proposed to remove the pulp in an apparatus known from document EP-A-581 748, without pressing the stones, for which purpose, the olives are placed inside a pulp removing and kneading vessel in which a set of mixing tools produces a peripheral upward movement and a central downward movement of the mass of olives. The tools comprise cutting blades which cooperate with pairs of fixed converging countermembers to cut the pulp; and kneading

is performed by the combined action of mechanical stirring and the heat produced by adding water at 40-45°C.

After a given kneading time, further water at the above temperature is fed into an oil separating vessel, is circulated from the separating vessel into the pulp removing and kneading vessel, mixes with the olive water, the oil particles and the epicarp or skin of the olives, overflows from the pulp removing and kneading vessel into the separating vessel through a mechanical system of filters and subfilters, and eventually decants; the oil is removed manually from the top of the separating vessel; the solid residue is removed through an opening in the pulp removing and kneading vessel; and the water in the separating vessel is drained off through a tap.

This known method involves several drawbacks. In particular, the cutting blades for removing the pulp of the olives also shred the epicarp, so that the oil still contains a high percentage of polyphenols; the high temperature of the water added both during kneading and so that the liquids overflow into the separating vessel results in a considerable increase in the peroxide content of the oil; circulating water between the two vessels greatly increases kneading, paste transfer and oil separation time; and additional time is also taken to extract the oil from the top of the separating

vessel, thus increasing processing cost.

Moreover, the filtration of the above known method is subject to frequent clogging and therefore calls for continual, high-cost servicing on the part of the operator; the kneading vessel is also occupied during separation and extraction, thus halving the output of the machine; and manual removal of the oil is also unsatisfactory by the oil being separated in a surface film from the mass of paste in which part of oil is invariably retained.

It is also known, from document US-A-4 522 119, a method for processing olives to recover olive oil, wherein an inert additive is mixed to the pitless olive paste to increase the yield of the product olive oil. The relevant apparatus includes a first vessel housing a pulper to remove the olive pulp from the stones, and a second vessel wherein oil and water are separated from the dry pulp by a mechanical progressive press formed of a positive displacement pump. The oil is extracted in two steps by a pair of centrifuge devices.

It is also known, from document EP-A-616 024, another method for recovering olive oil by extracting and separating it from olive drupes with stones removed, wherein the olive paste is added with enzymes such as cellusate and protease. The enzymes react while the olive past is stirred to destroy the cellular membrane of the olive to facilitate oil extraction.

DISCLOSURE OF THE INVENTION

It is an object of the invention to provide a method and apparatus for producing olive oil, which provide for

obtaining oil of superior organoleptic quality, and for reducing both processing time and cost by eliminating the aforementioned drawbacks typically associated with known technology.

According to the present invention, there is provided a method of producing olive oil without pressing the stones, and which comprises a pulp removing and kneading step to remove the pulp from and knead the olives; and a separating and extracting step to separate the oil from a mixture of paste and water, and to extract the oil from the mixture; characterized in that said pulp removing and kneading step is performed with no added water and at a controlled temperature below 35°C; and in that said separating and

extracting step is performed by mixing said paste with water ~~substantially~~ at said controlled temperature.

Extraction may be performed by immersing into the paste an extracting member having smooth surfaces of material to which the oil, as opposed to the water, adheres, so as to withdraw, by adhesion, a film of oil directly from the mixture of paste and water; and by moving the extracting member with respect to a scraping member to detach the film of oil from the smooth surfaces.

The pulp removing and kneading step is performed in a first vessel; the separating step is performed in a second vessel; and the paste is transferred from the first vessel into the second vessel at a transfer step, so that the separating and extracting step relative to one batch of olives is performed simultaneously with the pulp removing and kneading step relative to another batch of olives.

The apparatus for producing olive oil without pressing the stones comprises a pulp removing and kneading device having a kneading assembly for removing the pulp from and kneading the olives in a first vessel; and a separating and extracting device for separating the oil from a mixture of paste and water and extracting the oil from said mixture in a second vessel; characterized in that said pulp removing and kneading device provides for thoroughly removing the pulp from and kneading the olive

paste in said first vessel with no added water and at controlled temperature of below 35°C; said separating and extracting device comprising means for adding water in said second vessel, a rotating tool for mixing said water and said paste and recirculating the mixture by drawing the mixture from a bottom portion of said second vessel and feeding the mixture upwards, temperature controlling means for keeping said mixture at said controlled temperature, and an oil extracting member adapted to be immersed into said mixture to directly extract oil from said mixture.

The extracting member comprises smooth surfaces of material to which the oil, as opposed to the water, adheres; the extracting member being so activated that said surfaces are immersed alternately into the mixture of paste and water in the second vessel to directly withdraw a film of oil by adhesion, and cooperate with a fixed scraping member to detach the film of oil from said surfaces.

BRIEF DESCRIPTION OF DRAWINGS

A number of preferred non-limiting embodiments of the invention will be described by way of example with reference to the accompanying drawings, in which:

Figure 1 shows a schematic, partially sectioned view of a first embodiment of an apparatus for producing olive oil in accordance with the invention;

Figure 2 shows a schematic vertical section of part

of the Figure 1 apparatus;

Figure 3 shows an exploded view in perspective of a detail in Figure 2;

Figure 4 shows a top plan view of a further detail of the Figure 1 apparatus;

Figure 5 shows a top plan view of a variation of the Figure 4 detail;

Figure 6 shows a partial section along line VI-VI in Figure 1;

Figure 7 shows a partial view along line VII-VII in Figure 1;

Figure 8 shows a vertical section of a variation of a device in Figure 1;

Figures 9 and 10 show a vertical section and a partial plan view of a further embodiment of the Figure 1 apparatus.

BEST MODE FOR CARRYING OUT THE INVENTION

General description

Number 6 in Figure 1 indicates as a whole an apparatus for producing olive oil, and which comprises a pulp removing and kneading device 7 for removing the pulp from and kneading the olives, and a separating and extracting device 8 for separating and extracting the oil from a mixture of olive paste and water.

According to the invention, device 7 provides for thoroughly removing the pulp from and kneading the olives at a controlled temperature of below 35°C.

Similarly, separating and extracting device 8 mixes the paste with water at said controlled, i.e. thermoregulated, temperature to separate the oil droplets from the paste. Advantageously, said controlled temperature is between 25°C and 28°C, and the paste is mixed with water to a ratio by weight of 1:3.

Separating and extracting device 8 extracts the oil by immersing into the mixture an extracting member 11 having a smooth surface of a material to which the oil, as opposed to the water, adheres. Extracting member 11 is rotary, and is scraped by a fixed scraping member 12. As such, kneading is performed substantially with no added water; kneading and separation are performed practically at ambient temperature; and the oil is extracted by continually withdrawing a film of oil from the mixture.

Pulp removal and kneading

Pulp removing and kneading device 7 comprises a first cylindrical vessel 13 made of stainless steel and housing a kneading assembly 14 (Figure 2). The kneading vessel 13 has a lateral wall 15 surrounded by a gap or hollow space 16 (Figure 1) which is filled with water heated to the selected temperature, for example, by an electric resistor 17 controlled by a thermostat (not shown).

A trapezoidal-section hopper 18, into which the olives are loaded, is located over vessel 13 and has a sloping wall 19 fitted to an electric vibrator 20. At

the narrowest part of hopper 18, an assembly 21 is provided comprising two rubber rollers 22, which are rotated in opposite directions about two horizontal axes by a motor reducer 23, and are spaced apart so as to commence breaking the skin or epicarp of the olives, but not the stones.

Kneading assembly 14 (Figures 2 and 3) comprises a set of tools fitted to a shaft 24, which is coaxial with vessel 13, may be vertical, as in Figures 2 and 3, or horizontal, and is rotated by a further motor reducer 25. In particular, the tool set comprises a mixer 26 in turn comprising two pairs of mixing elements or arms 27, 28; the arms in each pair 27, 28 are diametrically opposite, and the two pairs 27 and 28 are offset 90°; each arm 27 has a blade 29 curved with respect to the vertical plane and which provides for pushing the olive paste radially; and each arm 28 has a blade 31 inclined with respect to the horizontal plane and which provides for pushing the paste axially upwards.

Over arms 27 and 28, shaft 24 is fitted with a radial valve defined by a disk 32 having four flat segments or radial blades 33. At radial blades 33, lateral wall 15 of vessel 13 is fitted with a metal ring 34 supporting four flat radial blades 36 spaced 90° apart and beneath which radial blades 33 slide. And radial blades 33 correspond angularly with curved blades 29 so as to retain the paste alongside the passage of

curved blades 29 of arms 27, and to open a passage for the paste alongside the passage of inclined blades 31.

Over disk 32, shaft 24 is fitted with a hub 37 supporting a horizontal pressure and lump-breaking arm 38 having two vertical projecting wings 39 for breaking up the lumps formed in the olive paste. Hub 37 also supports a blade 41 diametrically opposite arm 38 and inclined so as to press and force the paste down into the kneading region, and is so positioned angularly that blade 41 corresponds with a gap between blades 33 of disk 32 and so acts on the paste at an open through opening of the radial valve.

The tool set of assembly 14 is fitted axially to shaft 24 by a threaded hub 42 having a lever 43 by which to screw hub 42 to a threaded end 40 of shaft 24. Finally, kneading vessel 13 has a bottom wall 44 having at least one opening 46 closed by a gate, which is opened to transfer the olive paste from kneading vessel 13 into a second vessel 47 housing device 8.

Pulp removal and kneading are performed as follows.

The olives - washed, with the stalks removed, and loaded into hopper 18 (Figures 1 and 2) - are squeezed lightly by rubber rollers 22 to break the skin or epicarp, but not the stones, of the olives, and are fed into vessel 13 in which the gate over opening 46 is closed, and a temperature of between 25°C and 28°C is maintained constantly by the water in gap 16. Motor

reducer 25 is activated to rotate shaft 24 of assembly 14, so that tools 26, 32, 38 fitted to shaft 24 begin stirring the mass of olives to remove the skin and the pulp from the stones.

Once the olives to be kneaded have been loaded into vessel 13, loading of hopper 18 is discontinued, and motor reducer 25 continues operating for a predetermined time to knead the olive paste thoroughly and substantially with no added water. Radial valve 32 alternately retains and permits recirculation of the paste and water mixture in vessel 13 to improve crushing and sliding of the mixture between blades 33 and 36. At the start of the kneading operation, tools 26, 32, 38 mainly provide for removing the skin and pulp of the olives, and thorough pulp removal and kneading are assisted by the increase in the number of free stones.

Advantageously, kneading is performed with only slight breakage of the olive skin to reduce both the percentage of polyphenols, which give the oil a bitter taste, and the chlorophyll percentage to obtain a yellower, as opposed to greenish, colour of the oil. Moreover, kneading as described above, on account of the limited amount of mechanical action involved, produces a limited increase in the temperature of the paste, which is easily maintained by regulating the temperature of the water in gap 16, thus reducing the formation of peroxides in the oil, and eliminating the relative

organoleptic characteristics which develop enormously above 35°C.

Kneading in vessel 13 may last from 40 to 80 minutes, and may advantageously be set to about 60 minutes. Upon completion of the kneading operation, the gate over opening 46 is opened to transfer the kneaded paste rapidly into vessel 47, thus leaving vessel 13 free to knead another batch of olives.

Oil separation and extraction

Vessel 47 of oil separating and extracting device 8 comprises a lateral wall 54; and a bottom wall 51 having an outlet opening 57 closed by a gate which is opened to release the water, stones and other processing residue. Vessel 47 is provided with a tap 58 for supplying water to mix with the kneaded paste; and an electric resistor 59, located in use beneath the level of the water and paste mixture, is controlled by a thermostat (not shown) to keep the water and paste mixture at a controlled temperature, preferably equal to that of the water in gap 16.

Vessel 47 houses a device or tool 107 fitted to a shaft 108, which is powered by a motor reducer 109 located over vessel 47; and tool 107 has a hub 110 fitted with at least one pair of members 111, 112 (see also Figure 6). Each pair of members may comprise a lift member 111; and a lump-breaking member 112 diametrically opposite lift member 111, which is defined by a plate

appropriately angled to push the water and paste mixture upwards to assist extraction of the oil.

Lump-breaking member 112 is comb-shaped, and provides for breaking up any lumps in the paste before they are engaged by lift member 111. If hub 110 is fitted with more than one pair of members 111, 112, the various pairs are offset so that the lift members 111 alternate with the lump-breaking members 112. Alternatively, each pair of members 111, 112 on hub 110 may comprise a pair of similar lift members, one of which acts as a lump breaker.

Bottom wall 51 of vessel 47 is fitted with contrasting elements defined by substantially radial bars 122. In particular, bars 122 may be straight or curved with the back of the curve in the rotation direction of shaft 108, as shown in Figure 6. In which case, the curved back imparts a centrifugal thrust to the paste and interrupts rotation of the paste-water mass.

Lateral wall 54 of vessel 47 is fitted, over tool 107, with spokes 121, which are located over the tool 107 and extend radially with respect to vessel 47, converge centrally at a bush 120 in which shaft 108 rotates freely, and provide for interrupting rotation, and ensuring thorough mixing, of the paste and water.

Vessel 47 may be fitted with a subhorizontal top wall 113 (Figures 1 and 7) for retaining the paste and

water mixture; in which case, spokes 121 may be fitted directly to subhorizontal wall 113, as opposed to a hub. The subhorizontal position of wall 113 provides for conveying the lighter oil to a region 114 having a smaller free surface than vessel 47; and the paste is transferred from vessel 13 to vessel 47 through the free surface of region 114.

Member 11 for extracting the oil from the paste and water mixture is located at region 114. More specifically, member 11 is fitted to a shaft 61 rotating on two supports, which are so positioned that at least 1/10 and no more than 1/2 of the radius of member 11 is immersed in the mixture; and shaft 61 is rotated by a respective motor reducer 62. Scraping member 12 is inclined, is complementary in shape to the section of member 11, is located substantially diametrically opposite the point at which member 11 emerges from the mixture, and has a channel 56 sloping towards a manifold 64.

In the Figure 4 variation, extracting member 11 is defined by a number of disks 66 made of chromium-plated steel with polished surfaces, or of plastic material such as polyethylene, Teflon (registered trademark) or similar, and which are packed onto shaft 61 and spaced apart by spacers 67; and member 12 is defined by a comb-shaped plate 68 also made of chromium-plated steel or plastic material, and having a number of slots 65, in

each of which slides a peripheral portion of a respective disk 66.

In the Figure 5 variation, extracting member 11 is defined by a cylinder 69 made of chromium-plated steel or plastic material, and which is fitted onto shaft 61 and has two polished flat surfaces 70 and a polished lateral surface 71; and member 12 is defined by a C-shaped plate 72 also made of chromium-plated steel or plastic material, and in the cavity of which slide peripheral portions of surfaces 70 and 71 of cylinder 69.

The oil is separated and extracted as follows.

After closing the gate over opening 57 of vessel 47 (Figure 1), the gate over opening 46 of kneading vessel 13 is opened to unload the kneaded paste directly and substantially instantaneously into separating vessel 47 underneath. The kneaded paste comprises oil, olive water, stones and husks, and, by means of tap 58, is diluted by adding processing water, and the mixture maintained at a controlled temperature of 25°C-28°C. The total quantity of water is advantageously selected to obtain a ratio by weight of three parts water to one part olive paste.

Tool 107 is then rotated continuously by motor reducer 109, so that member 112 breaks up any lumps in the paste, while lift member 111 forces the water and paste mixture upwards. The different specific weights

and viscosities of the water, oil, skin, organic pulp material and olive stones cause separation of the oil droplets, which merge or coalesce with one another and rise to the surface so as to also separate slowly from the water; while the stones and other solid residue settle at the bottom of vessel 47.

During separation, the oil is also extracted directly from vessel 47 as the oil surfaces. For which purpose, extracting member 11 (see also Figures 4 and 5) gradually immerses the surfaces of disks 66 or surfaces 70, 71 into the liquid part of the mixture, below the dividing line between the water and oil.

A film of oil therefore adheres more readily than the water to the surfaces of disks 66 or to surfaces 70, 71 of member 11, and is scraped off by member 12 into manifold 64. Shaft 61 is rotated slowly by motor reducer 62 so that the surface speed of member 11 ranges between 1.5 and 1.6 m/sec and each disk 66 pumps about 0.8-0.9 liters an hour of mixture comprising one part water and dregs and three parts oil.

Once all the oil has been extracted from the mixture in vessel 47, the gate over opening 57 is opened to unload the water together with the stones and remaining paste; at which point, vessel 47 is free to receive another batch of paste from vessel 13. Oil separation and extraction take about 60 minutes, i.e. substantially the same time as for pulp removal and

kneading, so that, by unloading the whole batch of kneaded paste directly into vessel 47, a new batch of olives can be kneaded in vessel 13 as oil is being separated and extracted from the previous batch in vessel 47.

In the Figure 8 variation, vessel 47 has no inclined top wall; member 11 (not shown) is located at any point along the periphery of vessel 47; and tool 107, contrasting members 122 and spokes 121 are the same as in Figures 1 and 6.

In the Figure 9 and 10 embodiment, oil separating and extracting device 8 comprises a net 116 fitted to wall 54, over members 111, 112 and perpendicular to shaft 108, and which has a 1-5 mm mesh for preventing the passage upwards through net 116 of the stones and any other waste floating on the paste.

Members 111, 112 have two respective straight, horizontal top edges 117, 118; net 116 is fitted at a height of 0 to 20 mm over edges 117 and 118, so that edges 117 and 118 continually clean the bottom face of net 116; net 116 has an opening 119, e.g. in the form of a circular portion, normally closed by a hatch 123, e.g. defined by a frame 126 fitted with a net 127 and hinged with respect to net 116; and vessel 47 comprises a valve 124 for supplying processing water, and a channel 125 for draining off the oil.

To separate and extract the oil, hatch 123 is first

opened and the paste in vessel 13 (Figure 1) unloaded beneath net 116; and processing water is then fed continually into vessel 47, by means of valve 124, to keep the water on a level with channel 125 so that net 116 and hatch 123 are immersed at all times. During separation, the oil rises to the surface of the water over net 116, while the stones and other waste are retained by nets 116 and 127. The floating oil is therefore substantially clear and is drained off by channel 125.

Separation and extraction as described in both the above embodiments afford enormous advantages as compared with conventional press or centrifuge techniques. The basket filters of known presses, in fact, are used repeatedly, thus causing the oil to degrade and become rancid; while centrifuges deprive the oil of so-called "yield", which represents an important olfactory and organoleptic element of the oil. Finally, separating and extracting the oil by draining, as in the known whole-stone technique, involves a considerable length of time, during which kneading of a new batch of olives cannot be commenced.

Oil settling and filtration and water recirculation

Manifold 64 (Figure 1) is fitted with a 0.5-1 mm wide-mesh net filter 74 for retaining any dregs or skin entrained by extracting member 11 or passing through channel 125 (Figure 9), and is inclined longitudinally

with a drain opening 76 into a removable settling tank 77. Tank 77 has a bottom wall 78 sloping so that the section of the tank decreases downwards; and a vertical wall 79 of tank 77 is fitted at the bottom with a transparent sight 81 for sighting the level at which the oil separates from the olive water.

At the bottom, settling tank 77 has a drain conduit 82 housing a three-way valve 83 designed to assume three different positions : a first (off) position in which conduit 82 is closed; a second (drain) position in which valve 83 permits drainoff of the olive water to the outside along a conduit 84; and a third (oil) position in which valve 83 permits drainoff of the oil to a clarification station 86. Station 86 comprises a cotton clarification filter 87; and a clarified-oil tank 88 underneath, in turn comprising a tap 89 by which to draw off the oil.

The water, stones and other processing waste are unloaded through opening 57 in vessel 47 into a recirculating station 91 comprising a percolation filter 92 for retaining the skin, stones and other solid residue, and a tank 93 underneath for the water for recirculation. Tank 93 comprises a pump 94 housed inside a conduit 96 to pump the water from tank 93 back into vessel 47; and an overflow valve 97 for draining off surplus water from tank 93.

The oil is settled and filtered as follows.

The liquid mixture extracted by extracting member 11 or from channel 125 is filtered by net filter 74, which retains any dregs and/or skin. The filtered mixture collects in manifold 64 and flows through opening 76 into settling tank 77 where the mixture is kept for several hours to allow the oil to separate from the water, and any minute waste suspended in the liquid mixture to settle on the bottom. Settling tank 77 may therefore contain the product of several separation and extraction cycles, and, when full, may be replaced by a new tank 77 emptied by means of valve 83.

In the latter case, three-way valve 83 is first set to the drain position to drain off the water and decanted solid residue to the outside; which operation is controlled using transparent sight 81, so as to arrest drainoff as soon as the oil separation level reaches valve 83. Valve 83 is then set to the oil position to drain the decanted oil onto cotton clarification filter 87.

The water is recirculated as follows.

The water and any other waste remaining after the separation process are fed onto percolation filter 92, which retains the stones, skin and other solid processing waste. The olive water and the processing water added in vessel 47, on the other hand, are collected in tank 93, are still substantially at the processing temperature, and may be recycled by pump 94

and conduit 96 back into vessel 47 for the next separating and extracting cycle, thus considerably reducing cost.

The stones and organic material retained by filter 92 may also be recycled as fertilizer or fuel, and, in particular, may be burned in a boiler to heat the water in gap 16 and/or the mixture in vessel 47, as opposed to electric resistors 17 and 59.

As compared with the known whole-stone oil producing method, the advantages of the method and apparatus according to the invention will be clear from the foregoing description. In particular, kneading the olive paste and separating the oil substantially at ambient temperature improve the organoleptic quality of the oil; kneading with no added water accelerates pulp removal; removing the pulp by the sliding and compressive action of blades 29 and 31 and radial valve 32 prevents shredding the skin, unlike the known method in which the cutting blades are moved between two fixed and converging countermembers.

Separating and extracting the oil simultaneously with the kneading of a new batch increases the output of the apparatus; extracting the oil continuously and directly from separating vessel 47 simplifies the processing cycle; and the running cost of the apparatus is further reduced by recycling the processing and olive water.

Clearly, changes may be made to the method and apparatus as described herein without, however, departing from the scope of the accompanying Claims. For example, the various steps in the method may be controlled by a microprocessor control unit; and oil extracting member 11 and scraping member 12 may be made of stainless steel, or of plastic-coated metal.

Shaft 108 may even be coaxial with shaft 24 and rotated by the same motor reducer 25. In the Figure 9 and 10 embodiment, hatch 123 may be defined by a plate, possibly a slide-open plate; and vessel 47 may be fitted with a subhorizontal top retaining wall similar to wall 113 in Figure 1. And finally, rollers 22 of hopper 18 may be replaced by other means of breaking the olive skin without breaking the stones.

CLAIMS

1) A method of producing olive oil without pressing the stones, and which comprises a pulp removing and kneading step to remove the pulp from and knead the olives; and a separating and extracting step to separate the oil from a mixture of paste and water, and to extract the oil from said mixture; characterized in that said pulp removing and kneading step is performed ~~substantially~~ with no added water and at a controlled temperature below 35°C; and in that said separating and extracting step is performed by mixing said paste with water ~~substantially~~ at said controlled temperature.

2) A method as claimed in Claim 1, wherein said pulp removing and kneading step is performed in a first vessel (13), and said separating and extracting step is performed in a second vessel (47); characterized by a transfer step in which said paste is transferred from said first vessel (13) into said second vessel (47), so that said separating and extracting step relative to one batch of olives may be performed simultaneously with said pulp removing and kneading step relative to another batch of olives.

3) A method as claimed in Claim 1 or 2, characterized in that said controlled temperature ranges between 25°C and 28°C; each of said steps lasting approximately 60 minutes.

4) A method as claimed in one of the foregoing Claims, characterized in that the mixture temperature in said first vessel (13) is controlled by water at a predetermined temperature and contained inside a gap (16) of said first vessel (13).

5) A method as claimed in one of the foregoing Claims, wherein a quantity of said water equal in weight to approximately three times said paste is added in said second vessel (47); characterized in that, in said second vessel (47), said water and said paste are mixed by drawing the water and paste upwards to effect recirculation of the mixture.

6) A method as claimed in Claim 5, characterized in that the extent of such recirculation is so selected that said mixture is recirculated completely at least three times in the course of said separating and extracting step.

7) A method as claimed in Claim 6, characterized in that said extraction is performed by immersing into said paste an extracting member (11) having smooth surfaces (66, 70, 71) for withdrawing, by adhesion, a film of oil directly from said mixture of paste and water; and by moving said extracting member (11) with respect to a scraping member (12) to detach said film of oil from said surfaces (66, 70, 71); the oil so extracted then being filtered and decanted.

8) A method as claimed in Claim 6 or 7,

characterized in that, at the end of said separating and extracting step, the leftover water is drained off and the solid residue of the paste in said second vessel)47) is filtered; said leftover water being recycled into said second vessel (47).

9) A method as claimed in Claims 4 and 8, characterized in that the temperature of the water in said gap (16) and of the mixture in said second vessel is controlled by burning the stones and/or other solid residue unloaded form said second vessel (47).

10) An apparatus for producing oil without pressing the stones, and comprising a pulp removing and kneading device (7) having a kneading assembly (14) for removing the pulp from and kneading the olives in a first vessel (13); and a separating and extracting device (8) for separating the oil from a mixture of paste and water and extracting the oil from said mixture in a second vessel (47); characterized in that said pulp removing and kneading device (7) provides for thoroughly removing the pulp from and kneading the olive paste in said first vessel (13) with no added water and at controlled temperature of below 35°C; said separating and extracting device (8) comprising means (58, 94) for adding water in said second vessel (47), a rotating tool (107) for mixing said water and said paste and recirculating the mixture by drawing the mixture from a bottom portion of said second vessel (47) and feeding the mixture upwards, temperature controlling means (59) for keeping said mixture at said controlled temperature, and an oil extracting member (11) adapted to be immersed into said mixture to directly extract

oil from said mixture.

11) An apparatus as claimed in Claim 10, characterized in that said rotating tool (107) comprises at least one lift member (111), and at least one lump-breaking member (112).

12) An apparatus as claimed in Claim 11, characterized in that said rotating tool (107) is operated by a motor reducer (25, 109) so designed that, in use, said mixture is recirculated at least three times in the course of operation of said separation and extracting device (8).

13) An apparatus as claimed in Claim 12, characterized in that said lift member is defined by an inclinde plate (111), which is fitted to a shaft (108) operated by said motor reducer (109), and is so inclined as to push said past upwards; said lump-breaking member being defined by a comb-shaped plate (112) fitted to said shaft (108) diametrically opposite to said inclined plate (111).

14) An apparatus as claimed Claims 13, characterized by a number of fixed first contrasting elements (121) located over said tool (107), and a number of fixed second contrasting elements (122) located beneath said tool (107), said first and second contrasting elements (121, 122) being adapted to ensure thorough mixing of said paste and water to interrupt rotation of the mixture.

15) An apparatus as claimed in Claim 14, characterized in that said first contrasting elements are formed of spokes (121) fitted centrally to an idle bush (120) fitted through with said shaft (108), said spokes (121) being also fitted peripherally to a lateral wall (54) of said second vessel (47).

16) An apparatus as claimed Claim 14 or 15, characterized in that said second contrasting elements (122) are curved with the back of the curve oriented in the rotation direction of said shaft (108) so as to impart a centrifugal thrust to said mixture.

17) An apparatus as claimed in one of Claims 10 to 16, characterized in that said temperature controlling means comprise an electric resistor (59) for controlling the temperature of said mixture; said resistor (59) being activated by a thermostat.

18) An apparatus as claimed in one of Claims 10 to 17, characterized in that said second vessel (47) has a bottom wall (51) provided with at least one opening (57) closed by a gate adapted to be opened to unload water and solid processing residue from said second vessel (47).

19) An apparatus as claimed in one of Claims 10 to 18, characterized in that said first vessel (13) is located over said second vessel (47); said first vessel (13) having a bottom wall (24) provided with an opening (46) closed by a gate adapted to be opened to unload the olive paste directly into said vessel (47), whereby said separating and extracting device (8) is enabled to process one batch of olives simultaneously with the processing of another batch of olives by said pulp removing and kneading device (7).

20) An apparatus as claimed in Claim 19, characterized in that said first vessel (13) is substantially cylindrical and includes a lateral wall (15) surrounded by a hollow space (16) adapted to be filled with thermoregulated water to maintain the paste in said first vessel (13) at said

controlled temperature.

21) An apparatus as claimed in Claim 20, characterized in that said hollow space (16) is provided with an electric resistor (17) adapted to be activated by a thermostat.

22) An apparatus as claimed in Claim 20 or 21, wherein said kneading assembly (14) is defined by a set of tools (26, 32, 38) fitted to a relevant shaft (24), which is rotated by an electric motor reducer (25), said relevant shaft (24) being coaxial with said first vessel (13), a first tool (32) of said set of tools (26, 32, 38) being formed of coplanar rotatable flat radial blades (33) cooperating with a series of fixed elements (36); characterized in that said fixed elements are in form of other flat radial blades (36) parallel to said rotatable blades (33) and secured to said lateral wall (35), said rotatable flat radial blades (33) sliding on said other flat radial blades (36).

23) An apparatus as claimed in Claim 22, wherein said set of tools (26, 32, 38) also comprises a first pair of diametrically opposite mixing arms (27) each one provided with a curved blade (29) to provide for pushing the olive past radially, and a second pair of diametrically opposite arms (28) offset 90° with respect to the arms (27) of said first pair, each arm (28) of said second set being provided with a blade (31) inclined as to push the paste axially upwards, characterized in that said first tool (32) comprises four flat radial blades (33) located angularly so as to retain the paste alongside the passage of said curved blades (29) and to open a passage for the paste along side said inclined blades (31).

24) An apparatus as claimed in Claim 22 or 23, characterized in that the rotatable tool (107) of said separating and extracting device (8) and the set of tools (26, 32, 38) of said kneading assembly (14) are operated by a common motor reducer (25).

25) An apparatus as claimed in any Claim 22 to 24, wherein said pulp removing and kneading device (7) comprises a hopper (18) located over said first vessel (13), characterized in that said hopper (18) is provided with a pair of rubber rollers (22) adapted to rotate in opposite directions about two horizontal axes and so spaced as to commence breaking the olive skin but not the olive stones.

26) An apparatus as claimed in one of Claims 10 to 25, characterized in that said oil extracting member (11) includes smooth surfaces (66, 70, 71) and is so activated that said surfaces (66, 70, 71) are immersed alternately into said mixture to directly withdraw a film of oil by adhesion, said surfaces (66, 70, 71) cooperating with a scraping member (12) to detach said film of oil therefrom.

27) An apparatus as claimed in Claim 26, characterized in that said scraping member (12) and the surfaces (66, 70, 71) of said extracting member (11) are made of stainless steel or chromium-plated steel.

28) An apparatus as claimed in Claim 26, characterized in that said scraping member (12) and the

surfaces (66, 70, 71) of said extracting member (11) are made of plastic material to which the oil, as opposed to the water, adheres, or of metal material coated with said plastic material.

29 27 28
~~30~~) An apparatus as claimed in Claim ~~28~~ or ~~29~~, characterized in that said extracting member (11) rotates about a horizontal axis so located that said extracting member (11) is partially immersed in said mixture; said scraping member (12) being fixed and so located as to direct the detached oil droplets into an oil manifold (64) located outside said second vessel (47) and below the axis of rotation of said extracting member (11).

30 10
~~31~~) An apparatus as claimed in one of Claims ~~17~~ to 29
~~30~~, characterized in that said second vessel (47) has a subhorizontal wall (113) for conveying the oil to a region (114) having a small free surface.

31 29 30
~~32~~) An apparatus as claimed in Claim ~~30~~ or ~~31~~, characterized in that said scraping member (12) is inclined between said manifold (64) and a portion of said extracting member (11) not immersed in said mixture.

32 26
~~33~~) An apparatus as claimed in one of Claims ~~27~~ to 31
~~32~~, characterized in that said extracting member (11) is defined by a number of disks (66) fitted to a common shaft (61); said surfaces being defined by the two faces of each of said disks (66); and said scraping member

(12) being defined by a comb-shaped plate (68) having a number of slots (65) cooperating with said faces.

33 34) An apparatus as claimed in one of Claims 26 27 to 31 32, characterized in that said extracting member (11) is in the form of a cylinder (69); said surfaces (70, 71) comprising a lateral surface (71) and two flat surfaces (70) of said cylinder (69); and said scraping member (12) being defined by a C-shaped plate (72) having an edge cooperating with said surfaces (70, 71).

34 35) An apparatus as claimed in Claim 32 33 or 33 34, characterized in that said extracting member (11) is so located that 1/10 to 1/2 of the radius of the extracting member is immersed in the mixture in said second vessel (47).

35 36) An apparatus as claimed in one of Claims 14 17 to 34 26, characterized in that said separating and extracting device (8) comprises a net (116) fitted over said pair of members (111, 112) to prevent the upward passage through the net (116) of the stones and other waste floating on the paste; an oil manifold (125) being located at a predetermined height over said net (116).

36 37) An apparatus as claimed in Claim 35 36, characterized in that said net (116) has a mesh ranging between 1 and 5 mm, and is fitted over respective top edges (117, 118) of said pair of members (111, 112) and at such a height as to enable said pair of members (111, 112) to continually clean said net (116).

37 13 36
~~38~~) An apparatus as claimed in Claims ~~21~~ and ~~37~~, characterized in that said net (116) is perpendicular to said shaft (108), and has an opening (119) normally closed by a hatch (123), which is opened to load said paste beneath said net (116); said water in said second vessel (47) being maintained, in use, at such a height as to keep said net (116) immersed.

38 29
~~39~~) An apparatus as claimed in one of Claims ~~30~~ to 37
~~38~~, characterized in that said manifold (64) has a net filter (74), and is inclined so as to feed the extracted oil into a settling tank (77).

39 38
~~40~~) An apparatus as claimed in Claim ~~41~~, characterized in that said settling tank (77) has a transparent sight (81); and a three-way valve (83) for separately draining off the decanted oil and the olive water.

40 39
~~41~~) An apparatus as claimed in Claim ~~40~~, characterized in that said three-way valve (83) drains off said oil into a clarification station (86) comprising a cotton filter (87) and an oil tank (88).

41 18 in
~~42~~) An apparatus as claimed in Claims ~~26~~ and one of 26 40
Claims ~~27~~ to ~~41~~, characterized in that said opening (57) in said second vessel (47) unloads said water and said solid residue into a tank (93) having a filter (92) for retaining said solid residue; said tank (93) being connected to said second vessel (47) by a pump (94) and a conduit (96) for recirculating said water.

42 ~~43~~) An apparatus as claimed in Claim 41 ~~42~~, characterized by comprising a boiler for heating the water of said gap (16) and/or of said second vessel (47); said boiler being fueled with said solid residue retained by said filter (92).

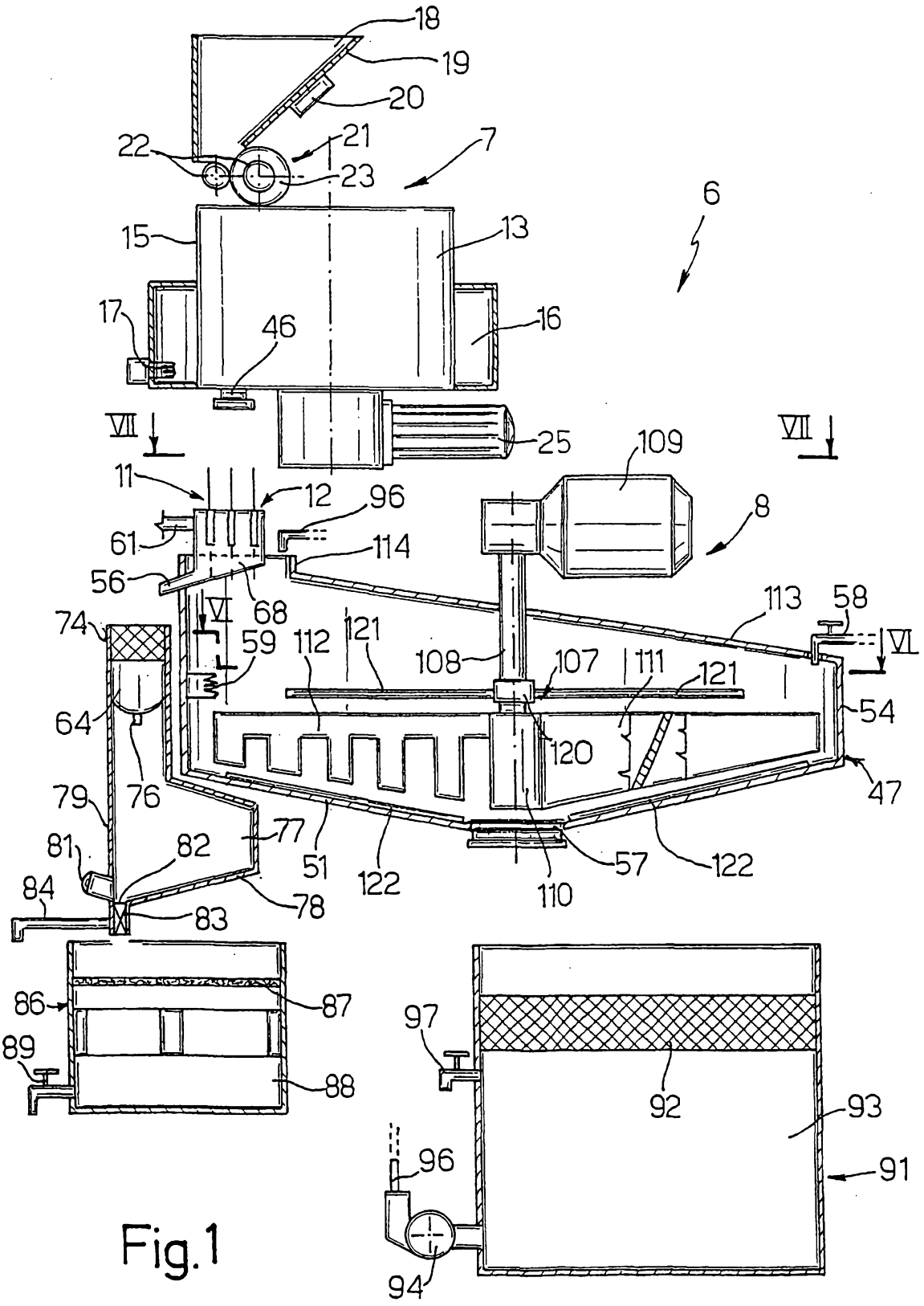

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Fig.1

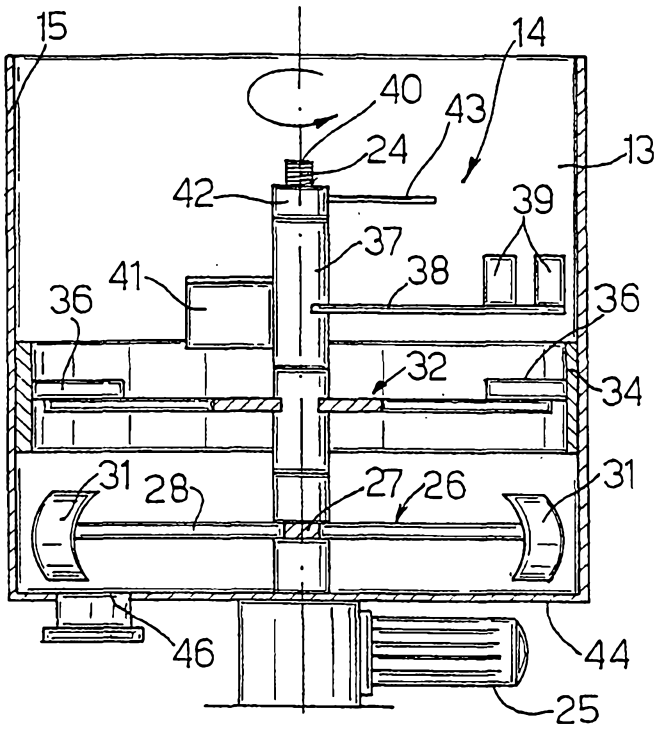


Fig.2

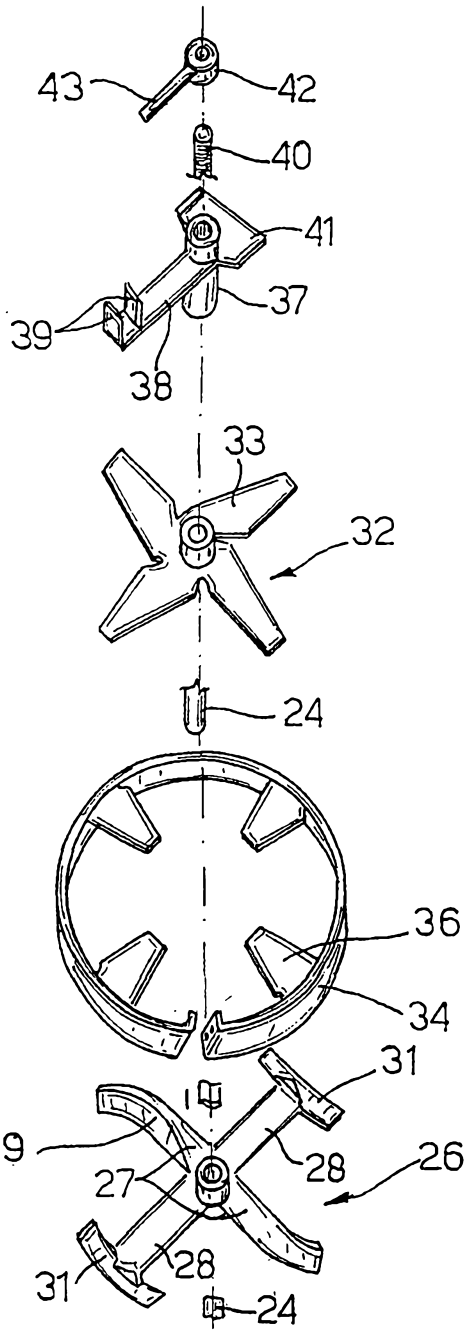
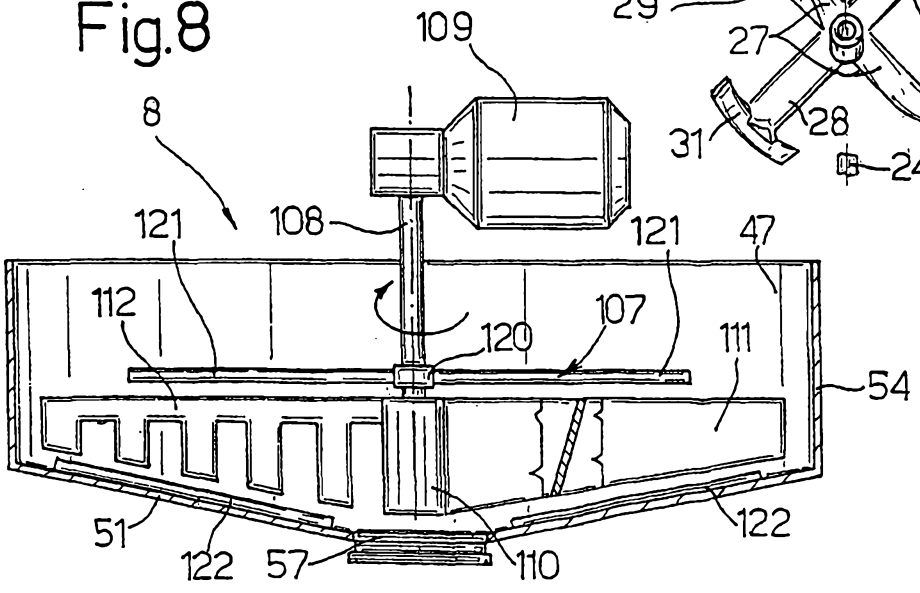


Fig.3

Fig.8



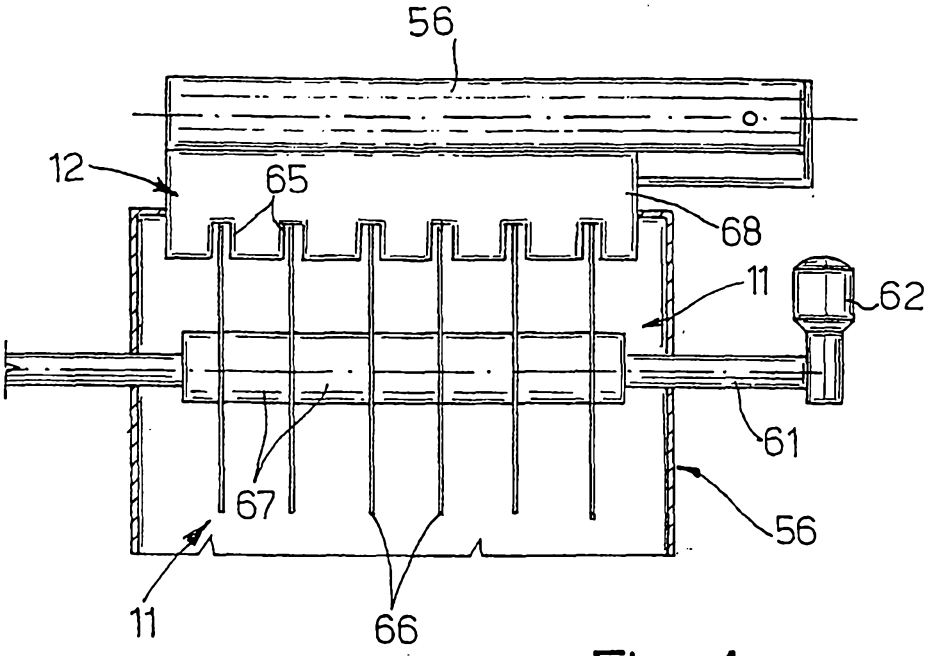


Fig. 4

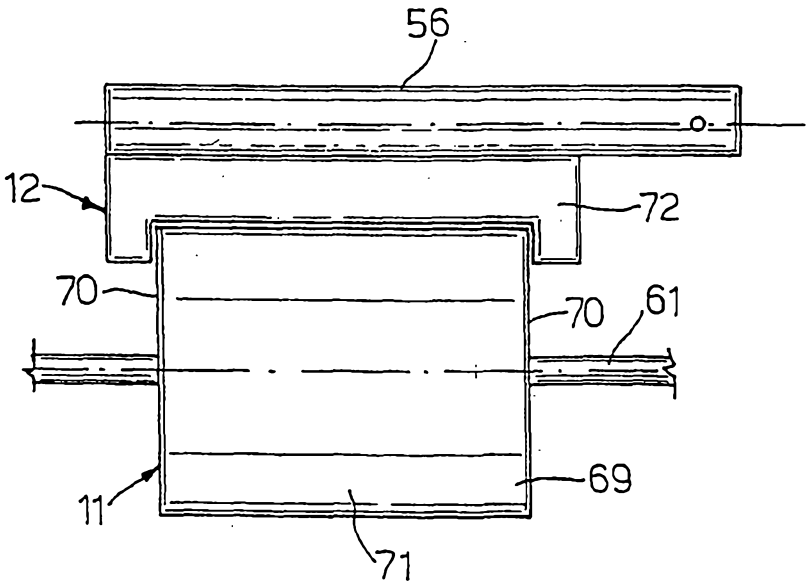


Fig. 5

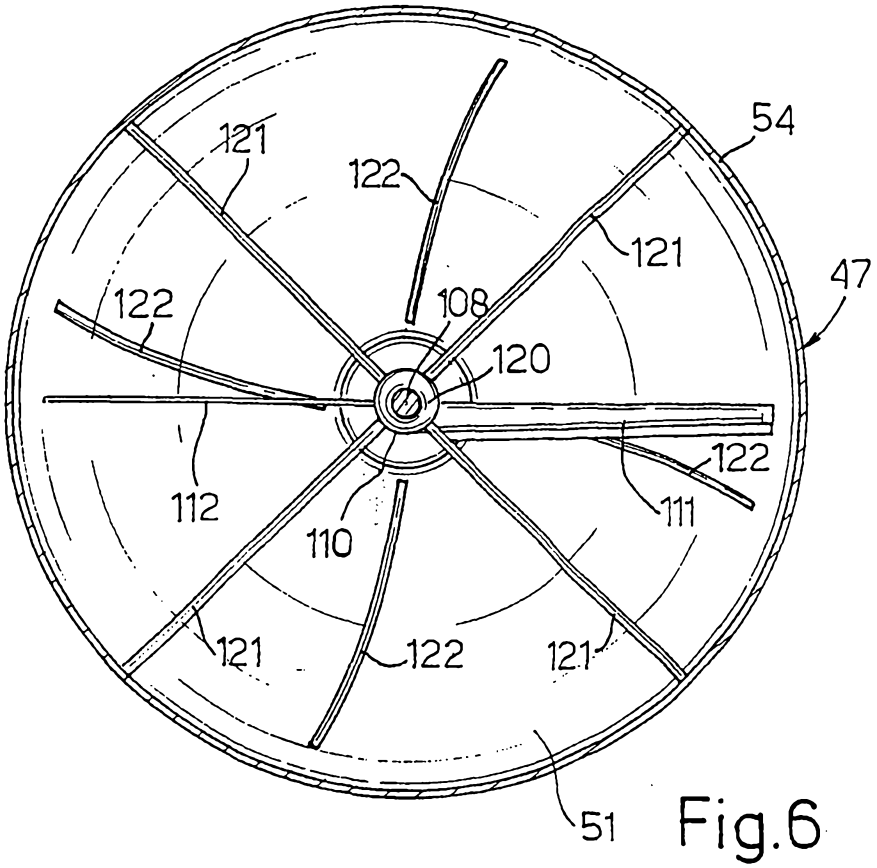

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Fig.6

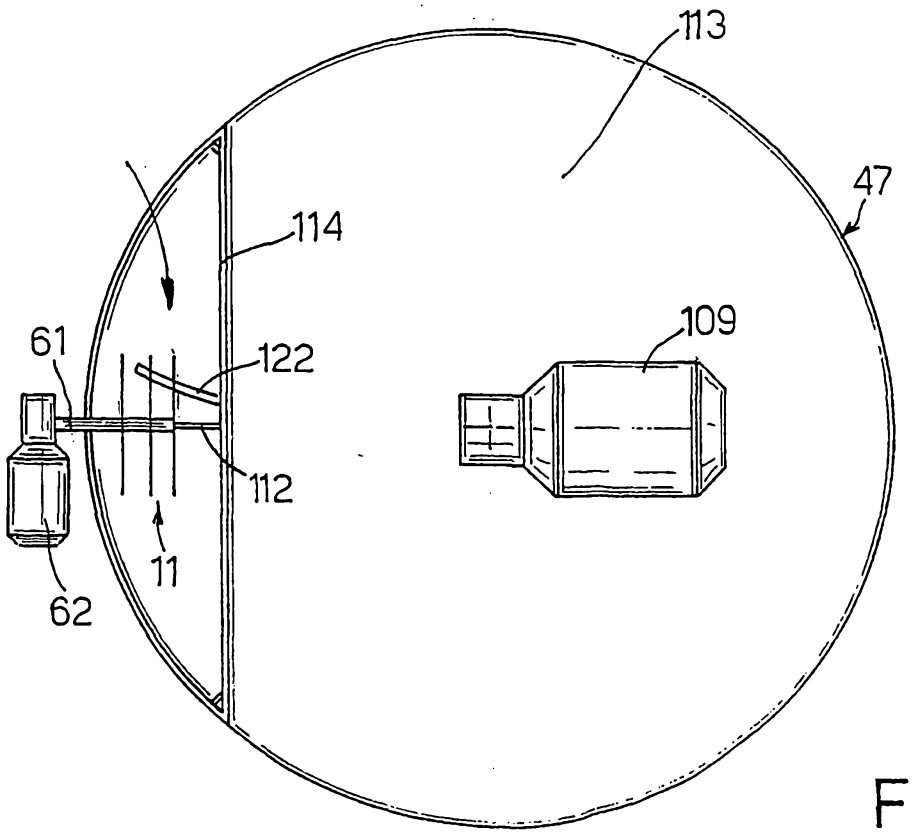
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Fig.7

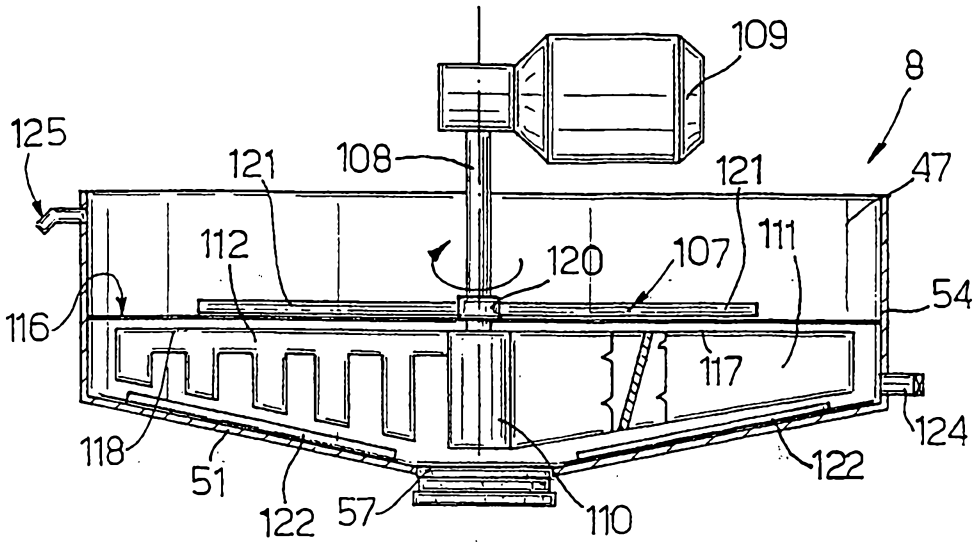
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Fig.9

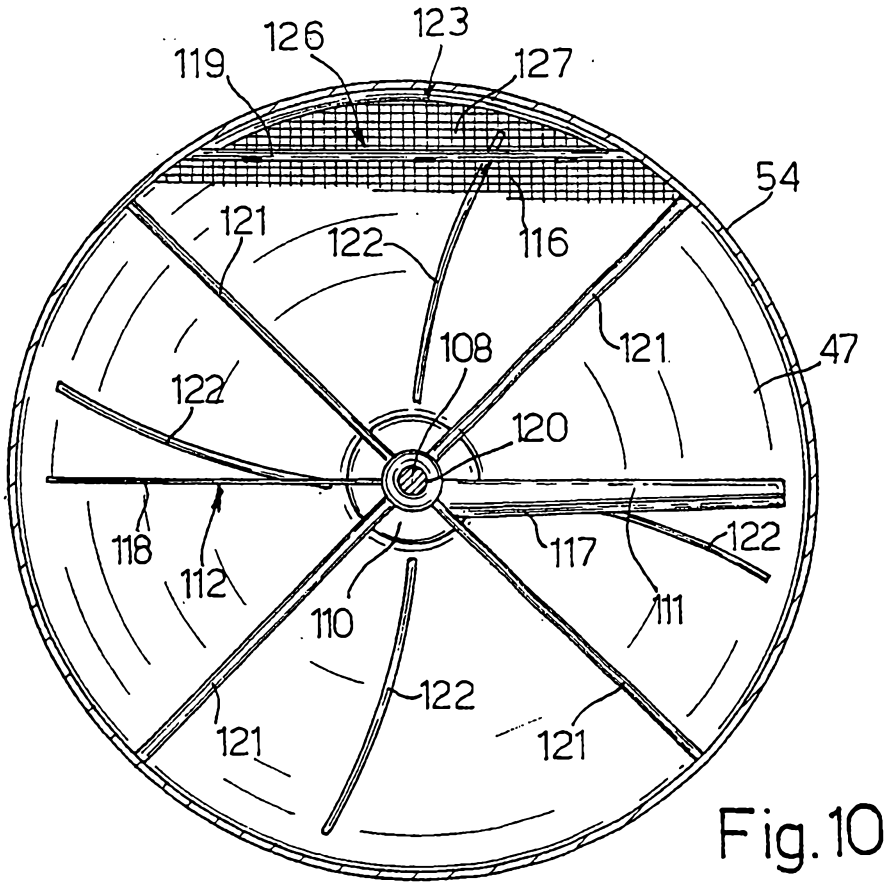
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Fig.10