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(54) PROCESSING UNIT FOR FOOD OR PHARMACEUTICAL PRODUCTS

(57) A processing unit is described for food or pharmaceutical products, in particular centrifugation, grinding and homogenization of food or pharmaceutical products, comprising: a casing (10) defining a chamber (7) for containing the products inside which first processing devices (9) are housed; a shaft (11) revolving around an axis (A) and provided with second processing devices (13) interacting with the first processing devices (9); a sealing member (15) positioned to prevent outflow of the products from the chamber (7) towards the shaft (11); and a cooling circuit configured to convey a cooling fluid (6) towards the sealing member (15); the cooling circuit comprises an impeller (35) operatively connected to the shaft (11) and configured to move the cooling fluid (6) towards a heat exchange area between the sealing member (15) and the cooling fluid (6).

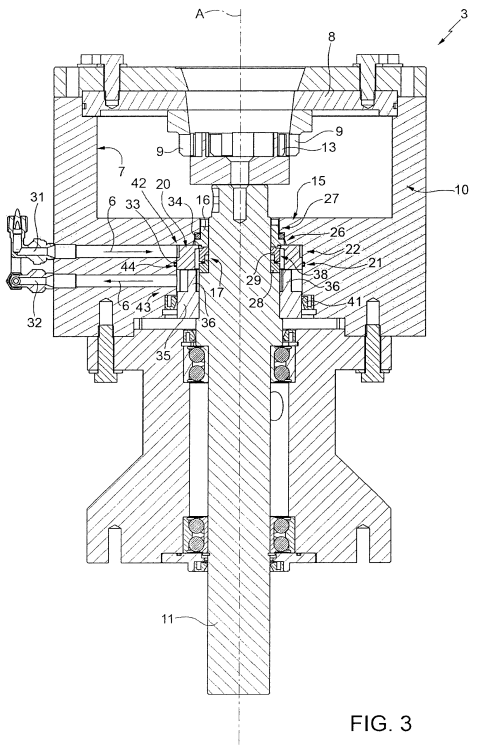

FIG. 3

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Description

[0001] The present invention concerns a processing unit for food or pharmaceutical products, in particular a centrifugation, grinding and homogenization unit for food or pharmaceutical products.

[0002] In the food and/or pharmaceutical industry, it is common practice to process products by using centrifugation, grinding and homogenization units or similar.

[0003] Generally, the processing units of known type have a vertical axis and a common base. The base acts as a supporting structure for a processing machine configured to centrifuge, grind and homogenize food or pharmaceutical products, and a motor that delivers a torque used by the processing machine.

[0004] In particular, the processing machine comprises:

- a casing defining a chamber for containing the food or pharmaceutical products to be processed, provided with a cover and equipped with statoric blades organized in arrays; and
- a shaft rotatable around a vertical axis and driven in rotation by the motor by means of a belt or gear drive, for example; the shaft is provided with rotoric blades organized in arrays; the rotoric blades are housed in the chamber, facing the statoric blades and interacting with the latter to centrifuge, grind and homogenize the food or pharmaceutical products.

[0005] Generally, the processing machine further comprises a mechanical seal coaxial to the vertical axis, interposed between the chamber and the shaft and adapted, in use, to prevent outflow of the products from the chamber towards the shaft itself.

[0006] In particular, the mechanical seal is coupled with the shaft and comprises a fixed sleeve and a mobile sleeve arranged axially in series and mounted so as to contact with each other at respective annular surfaces; the mobile sleeve is angularly integral with the shaft and is driven in rotation around the vertical axis by the latter.

[0007] Therefore, the mobile sleeve of the mechanical seal slides, in use, against the fixed sleeve in correspondence with the annular contact surfaces; this causes overheating by friction of the mechanical seal, with consequent deterioration and wear thereof.

[0008] To solve this problem, processing units are known provided with a cooling circuit which conveys a fluid (usually water) into the area adjoining the mobile sleeve of the mechanical seal, in order to cool down the latter.

[0009] In some known solutions, the fluid is conveyed so as to lap a shell which encloses the mechanical seal, through appropriate delivery and intake channels, by means of a recirculation pump, external to the processing machine.

[0010] Other known solutions for cooling the mechanical seal involve a pressurized tank, which use the pressure applied inside it by a second fluid, for example nitrogen, to recirculate the cooling fluid inside a circuit of the type mentioned above. This arrangement requires a continuous supply of nitrogen under pressure and, therefore, a dedicated circuit.

[0011] The Applicant has observed that the known solutions are not able to ensure reliability of the mechanical seal for a sufficient number of hours. This means that the seal has to be replaced, which is particularly costly. The need is therefore felt to prolong the lifespan of the seal.

[0012] In addition, the need is felt in the sector to simplify the architecture of the processing units of known type, and at the same time increase the reliability thereof.

[0013] The need is further felt in the sector to correlate, in a simple inexpensive manner, the quantity of heat removed from the mechanical seal with the rotation speed of the shaft; in fact, the more viscous the product, the higher the shaft rotation speed must be and therefore the greater the overheating of the mechanical seal.

[0014] The need is further felt to improve the heat exchange of the cooling fluid with the mechanical seal.

[0015] The object of the present invention is to produce a processing unit for food or pharmaceutical products, which offers high reliability and has a limited cost and meets, in a simple inexpensive manner, at least one of the needs illustrated above and related to the processing units for food or pharmaceutical products of known type.

[0016] According to the invention, this object is achieved by a processing unit for food or pharmaceutical products, as defined in claim 1.

[0017] For a better understanding of the present invention, a preferred non-limiting embodiment thereof is described, purely by way of example and with the help of the accompanying drawings, in which:

Figure 1 is a perspective view, with parts removed for clarity, of a processing unit for food or pharmaceutical products according to the present invention;
Figure 2 is a partially exploded perspective view, on an enlarged scale and with parts removed for clarity of some details of the processing unit of figure 1;
Figure 3 is an axial section view, on an enlarged scale and with parts removed for clarity, of a detail of the processing unit of figure 1; and
Figure 4 is a view on an enlarged scale and with parts removed for clarity of some details of the section of figure 3.

[0018] With reference to the attached figures, number 1 indicates as a whole a processing unit for products, preferably food or pharmaceutical products. In particular, according to the non-limiting embodiment illustrated here, number 1 indicates as a whole a processing unit for food products.

[0019] Unit 1 is configured to process food products characterized by a different viscosity, for example cheese, fruit juices, or similar and comprises:

- a supporting base 2;
- a processing machine 3 having a vertical axis A and configured to process (preferably centrifuge, grind and homogenize) food products;
- a motor 4 configured to deliver a torque used, at least partly, by the machine 3 itself; and
- a cooling circuit 23 configured to convey a cooling fluid 6 into the machine 3, the function of which will be clarified below.

[0020] Motor 4 and machine 3 are carried by base 2. With particular reference to figures 1 and 3, machine 3 comprises:

- an outer casing 10;
- a chamber 7 for containing the products to be processed defined by casing 10, provided with a cover 8 and equipped with statoric blades 9, organized in arrays; and
- a shaft 11 rotatable around axis A, coaxial to the latter and housed in a seat of machine 3.

In particular, statoric blades 9 are mounted (or obtained in the same piece) on cover 8 of chamber 7.

[0021] Shaft 11 is driven in rotation by motor 4, preferably by means of a belt or gear drive (in a known manner not shown), and is provided, at its own end projecting inside chamber 7, with blades 13 rotating around axis A and organized in arrays. Blades 13 are housed in chamber 7, facing blades 9 and interact with the latter to centrifuge, grind and homogenize the food products housed in the chamber 7 itself.

[0022] Machine 3 further comprises a mechanical seal 15 coaxial to axis A, interposed between chamber 7 and shaft 11 and adapted to prevent the outflow of the food products from chamber 7 towards shaft 11, on the side axially opposite with respect to cover 8.

[0023] In particular, as can be seen in detail in figures 3 and 4, mechanical seal 15 comprises a fixed sleeve 16 and a mobile sleeve 17 arranged axially in series and mounted so as to contact with each other at respective annular friction surfaces 18, 19.

[0024] Mobile sleeve 17 is carried in rotation around axis A by shaft 11, whilst fixed sleeve 16 does not rotate.

[0025] In particular, fixed sleeve 16 defines two portions 26, 27 having a substantially tubular shape, arranged axially on opposite sides to each other and angularly connected to form one single piece; portion 26 is arranged on the opposite side with respect to chamber 7, i.e. in the axially lower part of fixed sleeve 16 and has an inner diameter greater than the outer diameter of portion 27; furthermore, fixed sleeve 16 has a sealing ring 34, preferably an o-ring, around portion 27.

[0026] In particular, sealing ring 34 is radially interposed between portion 27 and a shoulder 14 of casing 10 and axially interposed between shoulder 14 and portion 26.

[0027] Machine 3 further comprises a spacer 20 mounted coaxially on shaft 11 around mobile sleeve 17 of mechanical seal 15. Preferably, spacer 20 is mounted with a certain radial clearance around mobile sleeve 17.

[0028] In particular, spacer 20 defines portions 21, 22 arranged axially on mutual opposite sides and angularly connected to form the spacer 20 itself in one single piece. Portion 21 has a substantially cylindrical shape and is arranged on the axially opposite part with respect to chamber 7, i.e. in the axially lower part of spacer 20; portion 22 is arranged on the same side of chamber 7 and defines a plurality, four in the case shown, of arc-shaped sectors 24 (figure 2), projecting from portion 21 in an axial direction towards chamber 7 and angularly equispaced on the portion 21 itself around axis A. Sectors 24 further define between them respective seats 25 for passage of cooling fluid 6, consequently angularly equispaced on portion 21 around axis A.

[0029] Spacer 20 further comprises a sealing ring 33, preferably an o-ring, positioned around portion 21, housed in a groove 44 of casing 10; spacer 20 is configured to axially adjust fixed sleeve 16, in particular by means of axial abutment of portion 26 of fixed sleeve 16 on each one of the sectors 24 of portion 22.

[0030] Mobile sleeve 17 of mechanical seal 15 angularly revolves around axis A integrally with shaft 11.

[0031] In particular, mobile sleeve 17 comprises a bushing 28, which is splined on shaft 11, and a bushing 29 connected to the bushing 28 itself by means of elastic elements 30, preferably helical springs. Bushing 29 is axially slidable on shaft 11 with respect to bushing 28, so as to axially abut with fixed sleeve 16, at the respective friction surfaces 18, 19. In this way, bushing 29 applies an axial pre-load to fixed sleeve 16 of mechanical seal 15 by means of the return force of elastic elements 30.

[0032] In other words, bushing 28 rotates integrally with shaft 11, and bushing 29 is carried in rotation by bushing 28 and is axially mobile with respect to the bushing 28 itself.

[0033] Friction surface 19 of mobile sleeve 17 is therefore subject to sliding against friction surface 18 of fixed sleeve 16; this would cause overheating of mechanical seal 15 by friction, with consequent deterioration and wear thereof.

[0034] Cooling circuit 23 is configured to convey cooling fluid 6 into machine 3, in order to cool mechanical seal 15, which overheats due to friction between fixed sleeve 16 and mobile sleeve 17, as described above.

[0035] In particular cooling circuit 23 comprises:

- a tank 5 housing cooling fluid 6 and arranged externally to machine 3, onto base 2;
- an intake channel 31 configured to convey cooling fluid 6 from tank 5 towards machine 3; and
- a delivery channel 32 configured to convey cooling fluid 6 from machine 3 towards tank 5.

[0036] According to an important aspect of the present invention, cooling circuit 23 further comprises an impeller

35 coaxial to axis A, operatively connected to shaft 11, and configured to convey cooling fluid 6 to an area 37 of heat exchange between mechanical seal 15 and the cooling fluid 6 itself.

In particular, impeller 35 is splined on shaft 11, carried in rotation by the latter and arranged downstream of mechanical seal 15 and spacer 20, according to the flow direction of cooling fluid 6 in circuit 23, from intake channel 31 towards delivery channel 32.

[0037] More specifically, impeller 35 comprises a blading 36, which creates a pressure drop in cooling fluid 6, sucking the latter from tank 5 through intake channel 31 towards the heat exchange area 37. In the heat exchange area 37, cooling fluid 6 directly laps an outer cylindrical surface 38 of mechanical seal 15, absorbing the heat produced by the friction between friction surfaces 18 and 19. In this preferred and non-limiting embodiment, cooling fluid 6 laps, in particular, mobile sleeve 17 of mechanical seal 15.

[0038] In other words, cylindrical surface 38 of mobile sleeve 17 defines, in the embodiment illustrated, the heat exchange area 37.

[0039] Subsequently, cooling fluid 6 is conveyed into delivery channel 32 and, from the latter, towards tank 5. Lastly, the process is repeated cyclically during the operation of processing unit 1, so as to guarantee a continuous cooling of mechanical seal 15.

[0040] Impeller 35 further comprises a sealing ring 41 interposed between the impeller 35 itself and seat 12 of machine 3 housing shaft 11, and configured to prevent the outflow of cooling fluid 6 from circuit 23.

[0041] With reference to figure 4, cooling circuit 23 further comprises two chambers 39, 40 fluidly connected to each other and crossed in sequence by cooling fluid 6 in movement along circuit 23.

[0042] More specifically, chamber 39 is axially delimited by sealing ring 34 of fixed sleeve 16 and by sealing ring 33 of spacer 20; chamber 40 is axially delimited by sealing ring 33 of spacer 20 and by sealing ring 41 of impeller 35.

[0043] Chamber 39 is furthermore radially delimited between casing 10 and mechanical seal 15.

[0044] Chamber 40 is furthermore radially delimited between casing 10 and by the portions axially cooperating with each other, and rotatable around axis A, of shaft 11 and bushing 28.

[0045] In the case shown, chamber 39 houses an upper portion of spacer 20 and an upper portion of mobile sleeve 17. Chamber 40 houses impeller 35, a lower portion of spacer 20 and a lower portion of mobile sleeve 17.

[0046] The two chambers 39 and 40 communicate respectively with intake channel 31 and delivery channel 32, and define, together with the latter, an intake environment 42 and a delivery environment 43 within cooling circuit 23.

[0047] In other words, circuit 23 operates like a pump, the impeller 35 of which is coupled to shaft 11, is carried in rotation by the latter, and creates a pressure drop within the circuit 23 itself, sucking cooling fluid 6 contained in tank 5 from intake environment 42 to delivery environment 43.

[0048] In use, motor 4 of unit 1 drives in rotation shaft 11 around axis A, by means of the belt or gear drive (not illustrated) and, consequently, blades 13 housed in chamber 7. Due to the interaction of blades 13 with blades 9, the food or pharmaceutical products are centrifuged, ground and homogenized, according to the function of machine 3.

[0049] The outflow of the products from chamber 7 towards seat 12 in which shaft 11 is housed is prevented by mechanical seal 15. Mechanical seal 15 would tend to overheat due to the sliding between friction surfaces 18, 19 of fixed sleeve 16 and mobile sleeve 17, respectively.

[0050] In order to cool down mechanical seal 15, cooling fluid 6 is conveyed by means of impeller 35 from tank 5, through intake channel 31 and through seats 25 of spacer 20, into chamber 39, in the area of outer cylindrical surface 38 of mechanical seal 15, i.e. in the heat exchange area 37 between cooling fluid 6 and mechanical seal 15.

[0051] Subsequently, cooling fluid 6 is sucked axially towards the blading 36 of impeller 35 and pushed by the latter into delivery channel 32 and, therefore, towards tank 5.

[0052] Lastly, the process is repeated cyclically so as to guarantee a continuous cooling of mechanical seal 15.

[0053] The advantages of machine 1 according to the present invention will be clear from the foregoing description.

[0054] In particular, the fact that impeller 35 is angularly integral with shaft 11 results in self-adapting cooling of mechanical seal 15, since the higher the rotation speed of shaft 11 necessary for processing the viscous fluid, the higher the rotation speed of impeller 35 and, consequently, the faster the recirculation of cooling fluid 6 inside circuit 23.

[0055] Furthermore, the heat exchange between cooling fluid 6 and mechanical seal 15 is particularly effective, since cooling fluid 6 directly laps mechanical seal 15, in correspondence with cylindrical surface 38.

[0056] This also reduces the wear of mechanical seal 15 and, complementarily, prolongs the lifespan thereof.

[0057] In addition, the architecture of unit 1 is simplified, since external components are eliminated, such as a recirculation pump with external impeller or a pressurized tank, whilst increasing the reliability of unit 1.

[0058] It is clear that modifications and variations can be made to processing unit 1 described and illustrated hereby without departing from the scope of protection defined by the claims.

[0059] In particular, according to an alternative not shown, impeller 35 could be arranged upstream of mechanical seal 15, according to the flow direction of cooling fluid 6 in circuit 23, from intake channel 31 towards delivery channel 32.

[0060] Furthermore, the heat exchange area 37 could be defined by a heat conducting shell surrounding mechanical seal 15.

Claims

1. A processing unit (1) for food or pharmaceutical products, in particular for centrifugation, grinding and homogenization of food or pharmaceutical products, comprising:

   - a casing (10) defining a chamber (7) for containing said food or pharmaceutical products inside which first processing devices (9) are housed;
   - a shaft (11) rotatable around an axis (A) and provided with second processing devices (13) interacting, in use, with said first processing devices (9);
   - a sealing member (15) positioned to prevent outflow of said products from said chamber (7) towards said shaft (11); and
   - a cooling circuit (23) configured to convey a cooling fluid (6) towards said sealing member (15);

   characterized in that said cooling circuit (23) comprises an impeller (35) operatively connected to said shaft (11) and configured to move said cooling fluid (6) towards a heat exchange area (37) between said sealing member (15) and said cooling fluid (6).

2. The unit according to claim 1, **characterized in that** said sealing member (15) is positioned in said cooling circuit (23) so as to be directly lapped, in use, by said cooling fluid (6).

3. The unit according to claims 1 or 2, **characterized in that** said cooling circuit (23) comprises an intake environment (42) and a delivery environment (43) fluidly connected to a tank (5) which can be filled with said cooling fluid (6); said impeller (35) being fluidly interposed between said intake environment (42) and said delivery environment (43) to create a circulation of said cooling fluid (6) from said tank (5) to said heat exchange area (37) and vice-versa.

4. The unit according to any one of the preceding claims, **characterized in that** said impeller (35) is arranged in said cooling circuit (23) in a position axially downstream of said sealing member (15), according to the flow direction of said cooling fluid (6) inside the circuit (23).

5. The unit according to claims 3 or 4, **characterized in that** said sealing member (15) comprises a fixed part (16) and a mobile part (17) mounted so as to contact with each other at respective annular friction surfaces (18, 19); said mobile part (17) being angularly rotatable around said axis (A) integrally with said shaft (11); said mobile part (17) being housed into said circuit (23).

6. The unit according to claim 5, **characterized in that** said mobile part (17) is housed inside said intake environment (42); said mobile part (17) comprising a first bushing (28) mounted angularly integral with said shaft (11), and a second bushing (29) connected to said first bushing (28) by means of elastic elements (30), and being configured to apply an axial pre-load to said fixed part (16) of said sealing member (15).

7. The unit according to any one of the claims from 3 to 6, **characterized in that** said intake environment (42) comprises an intake channel (31) and a first chamber (39); said delivery environment (43) comprising a delivery channel (32) and a second chamber (40), which is fluidly connected to said first chamber (39).

8. The unit according to claim 7, **characterized in that** said first chamber (39) is axially delimited by a first sealing element (34) and by a second sealing element (33); said first chamber (39) being radially delimited by said casing (10) and by said sealing member (15).

9. The unit according to claim 8, **characterized in that** said second chamber (40) is axially delimited by said second sealing element (33) and by a third sealing element (41); said second chamber (40) being radially delimited by said casing (10) and at least by said shaft (11).

10. The unit according to any one of the claims from 7 to 9, **characterized in that** said impeller (35) is housed at least partly inside said second chamber (40).

11. The unit according to any one of the claims from 7 to 10, **characterized in that** said mobile part (17) is housed, at least partly, in the area of said first chamber (39).

12. The unit according to any one of the claims from 7 to 11, **characterized in that** it comprises a spacer (20) mounted coaxially to said shaft (11) around said mobile part (17) with a certain radial clearance; said spacer (20) having a plurality of sectors (24) angularly distributed around said axis (A) and defining between them respective seats (25) for the passage of said cooling fluid (6) coming from said intake channel (31).

13. The unit according to claim 12, **characterized in that** said second sealing element (33) is fitted on said spacer (20).

Amended claims in accordance with Rule 137(2) EPC.

1. A processing unit (1) for food or pharmaceutical products, in particular for centrifugation, grinding and homogenization of food or pharmaceutical products, comprising:

- a casing (10) defining a chamber (7) for containing said food or pharmaceutical products inside which statoric blades (9) are housed;
- a shaft (11) rotatable around an axis (A) and provided, at its own end projecting inside said chamber (7), with rotating blades (13) interacting, in use, with said statoric blades (9), so as to centrifuge, grind and homogenize said food or pharmaceutical products contained in said chamber (7);
- a sealing member (15) positioned to prevent outflow of said products from said chamber (7) towards said shaft (11); and
- a cooling circuit (23) configured to convey a cooling fluid (6) towards said sealing member (15);

characterized in that said cooling circuit (23) comprises an impeller (35) operatively connected to said shaft (11) and configured to move said cooling fluid (6) towards a heat exchange area (37) between said sealing member (15) and said cooling fluid (6).

2. The unit according to claim 1, **characterized in that** said sealing member (15) is positioned in said cooling circuit (23) so as to be directly lapped, in use, by said cooling fluid (6) .

3. The unit according to claims 1 or 2, **characterized in that** said cooling circuit (23) comprises an intake environment (42) and a delivery environment (43) fluidly connected to a tank (5) which can be filled with said cooling fluid (6); said impeller (35) being fluidly interposed between said intake environment (42) and said delivery environment (43) to create a circulation of said cooling fluid (6) from said tank (5) to said heat exchange area (37) and vice-versa.

4. The unit according to any one of the preceding claims, **characterized in that** said impeller (35) is arranged in said cooling circuit (23) in a position axially downstream of said sealing member (15), according to the flow direction of said cooling fluid (6) inside the circuit (23).

5. The unit according to claims 3 or 4, **characterized in that** said sealing member (15) comprises a fixed part (16) and a mobile part (17) mounted so as to contact with each other at respective annular friction surfaces (18, 19); said mobile part (17) being angularly rotatable around said axis (A) integrally with said shaft (11); said mobile part (17) being housed into said circuit (23).

6. The unit according to claim 5, **characterized in that** said mobile part (17) is housed inside said intake environment (42); said mobile part (17) comprising a first bushing (28) mounted angularly integral with said shaft (11), and a second bushing (29) connected to said first bushing (28) by means of elastic elements (30), and being configured to apply an axial pre-load to said fixed part (16) of said sealing member (15).

7. The unit according to any one of the claims from 3 to 6, **characterized in that** said intake environment (42) comprises an intake channel (31) and a first chamber (39); said delivery environment (43) comprising a delivery channel (32) and a second chamber (40), which is fluidly connected to said first chamber (39).

8. The unit according to claim 7, **characterized in that** said first chamber (39) is axially delimited by a first sealing element (34) and by a second sealing element (33); said first chamber (39) being radially delimited by said casing (10) and by said sealing member (15).

9. The unit according to claim 8, **characterized in that** said second chamber (40) is axially delimited by said second sealing element (33) and by a third sealing element (41); said second chamber (40) being radially delimited by said casing (10) and at least by said shaft (11).

10. The unit according to any one of the claims from 7 to 9, **characterized in that** said impeller (35) is housed at least partly inside said second chamber (40).

11. The unit according to any one of the claims from 7 to 10, **characterized in that** said mobile part (17) is housed, at least partly, in the area of said first chamber (39).

12. The unit according to any one of the claims from 7 to 11, **characterized in that** it comprises a spacer (20) mounted coaxially to said shaft (11) around said mobile part (17) with a certain radial clearance; said spacer (20) having a plurality of sectors (24) angularly distributed around said axis (A) and defining between them respective seats (25) for the passage

of said cooling fluid (6) coming from said intake channel (31).

13. The unit according to claim 12, **characterized in that** said second sealing element (33) is fitted on said spacer (20) .

1. A processing unit (1) for food or pharmaceutical products, in particular for centrifugation, grinding and homogenization of food or pharmaceutical products, comprising:

- a casing (10) defining a chamber (7) for containing said food or pharmaceutical products inside which statoric blades (9) are housed;
- a shaft (11) rotatable around an axis (A) and provided, at its own end projecting inside said chamber (7), with rotating blades (13) interacting, in use, with said statoric blades (9), so as to centrifuge, grind and homogenize said food or pharmaceutical products contained in said chamber (7);
- a sealing member (15) positioned to prevent outflow of said products from said chamber (7) towards said shaft (11); and
- a cooling circuit (23) configured to convey a cooling fluid (6) towards said sealing member (15);

said cooling circuit (23) comprising an intake environment (42) and a delivery environment (43) fluidly connected to a tank (5) which can be filled with said cooling fluid (6); **characterized in that** said cooling circuit (23) comprises an impeller (35) operatively connected to said shaft (11) and configured to move said cooling fluid (6) towards a heat exchange area (37) between said sealing member (15) and said cooling fluid (6);
said impeller (35) being fluidly interposed between said intake environment (42) and said delivery environment (43) to create a circulation of said cooling fluid (6) from said tank (5) to said heat exchange area (37) and vice-versa;
said impeller (35) comprising a blading (36), which creates, in use, a pressure drop in said cooling fluid (6), sucking said cooling fluid (6) from said tank (5) through an intake channel (31) of said intake environment (42) towards said heat exchange area (37) and vice-versa.

2. The unit according to claim 1, **characterized in that** said sealing member (15) is positioned in said cooling circuit (23) so as to be directly lapped, in use, by said cooling fluid (6) .

3. The unit according to any one of the preceding claims, **characterized in that** said impeller (35) is arranged in said cooling circuit (23) in a position axially downstream of said sealing member (15), according to the flow direction of said cooling fluid (6) inside the circuit (23).

4. The unit according to claims 2 or 3, **characterized in that** said sealing member (15) comprises a fixed part (16) and a mobile part (17) mounted so as to contact with each other at respective annular friction surfaces (18, 19); said mobile part (17) being angularly rotatable around said axis (A) integrally with said shaft (11); said mobile part (17) being housed into said circuit (23).

5. The unit according to claim 4, **characterized in that** said mobile part (17) is housed inside said intake environment (42); said mobile part (17) comprising a first bushing (28) mounted angularly integral with said shaft (11), and a second bushing (29) connected to said first bushing (28) by means of elastic elements (30), and being configured to apply an axial pre-load to said fixed part (16) of said sealing member (15).

6. The unit according to any one of the claims from 2 to 5, **characterized in that** said intake environment (42) comprises an intake channel (31) and a first chamber (39); said delivery environment (43) comprising a delivery channel (32) and a second chamber (40), which is fluidly connected to said first chamber (39).

7. The unit according to claim 6, **characterized in that** said first chamber (39) is axially delimited by a first sealing element (34) and by a second sealing element (33); said first chamber (39) being radially delimited by said casing (10) and by said sealing member (15).

8. The unit according to claim 7, **characterized in that** said second chamber (40) is axially delimited by said second sealing element (33) and by a third sealing element (41); said second chamber (40) being radially delimited by said casing (10) and at least by said shaft (11).

9. The unit according to any one of the claims from 6 to 8, **characterized in that** said impeller (35) is housed at least partly inside said second chamber (40).

10. The unit according to any one of the claims from 6 to 9, **characterized in that** said mobile part (17) is housed, at least partly, in the area of said first chamber (39).

11. The unit according to any one of the claims from 6 to 10, **characterized in that** it comprises a spacer (20) mounted coaxially to said shaft (11) around said

mobile part (17) with a certain radial clearance; said spacer (20) having a plurality of sectors (24) angularly distributed around said axis (A) and defining between them respective seats (25) for the passage of said cooling fluid (6) coming from said intake channel (31).

12. The unit according to claim 11, **characterized in that** said second sealing element (33) is fitted on said spacer (20) .

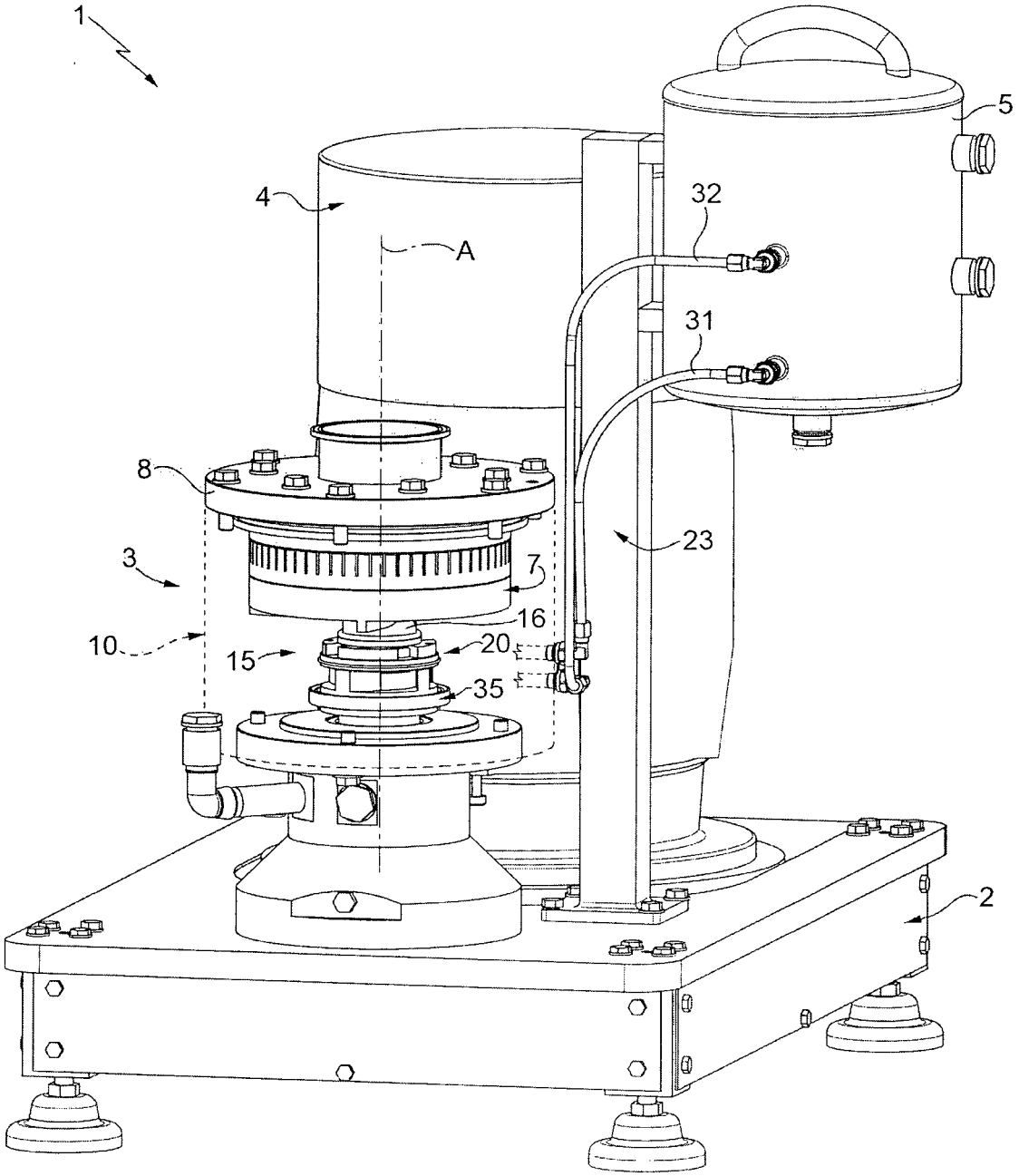

FIG. 1

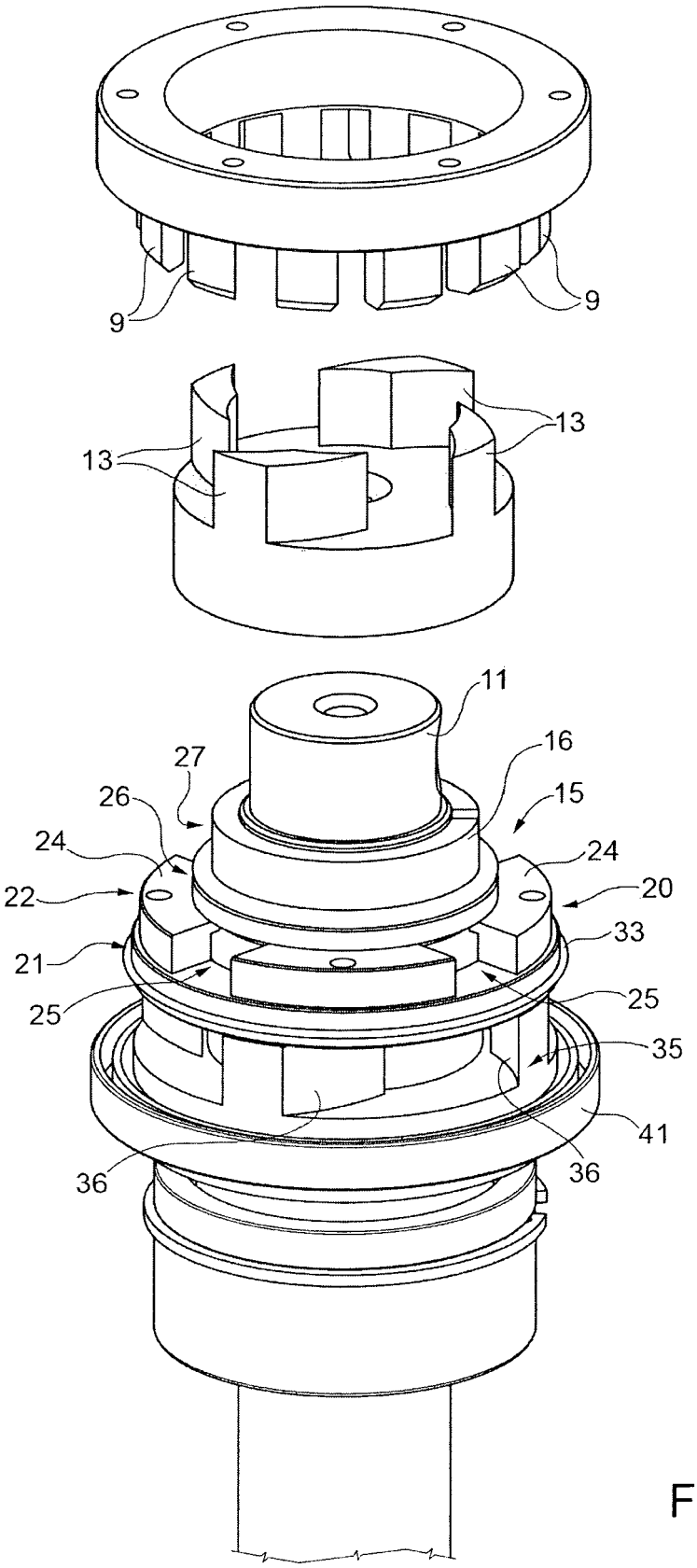

FIG. 2

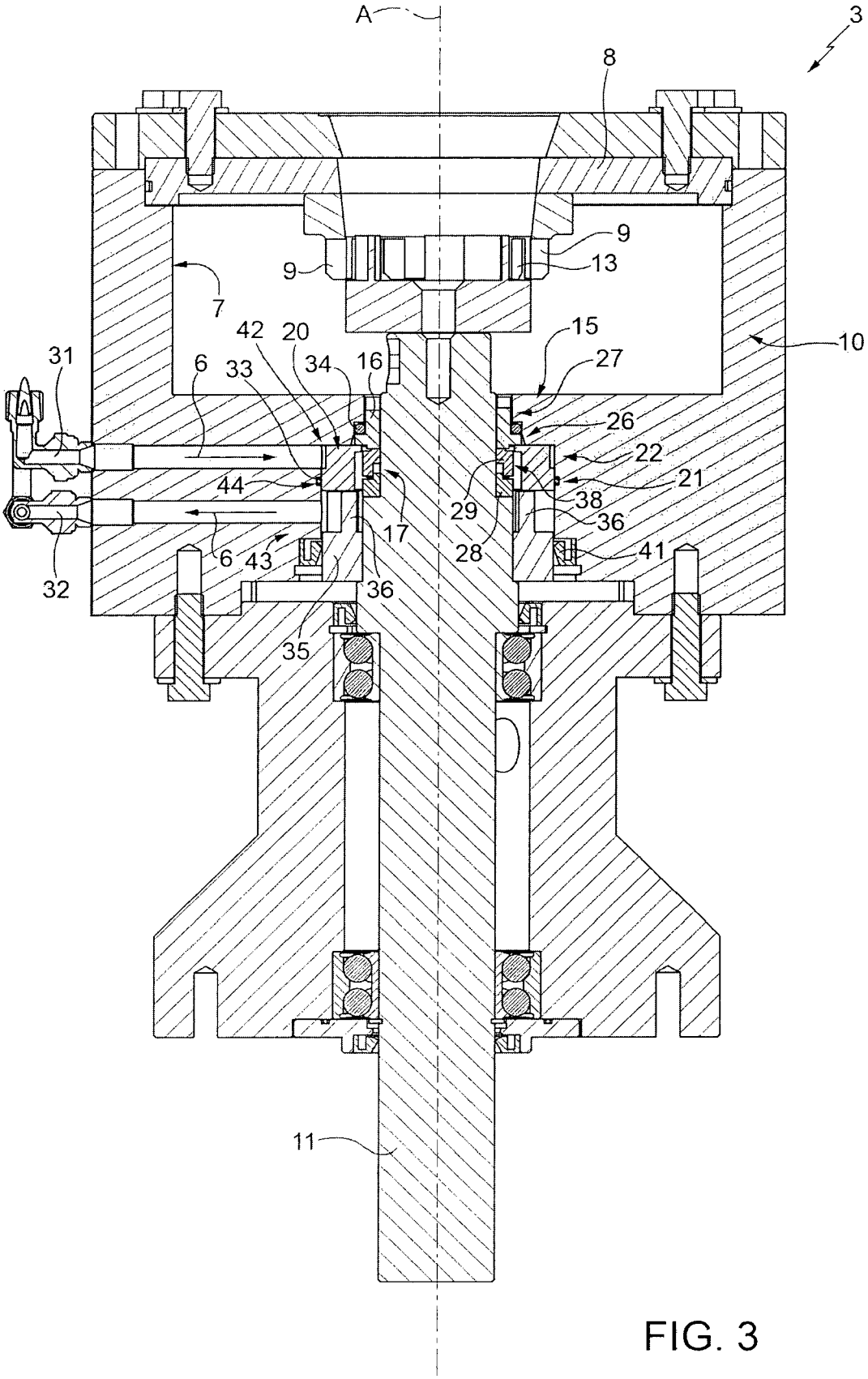
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FIG. 3

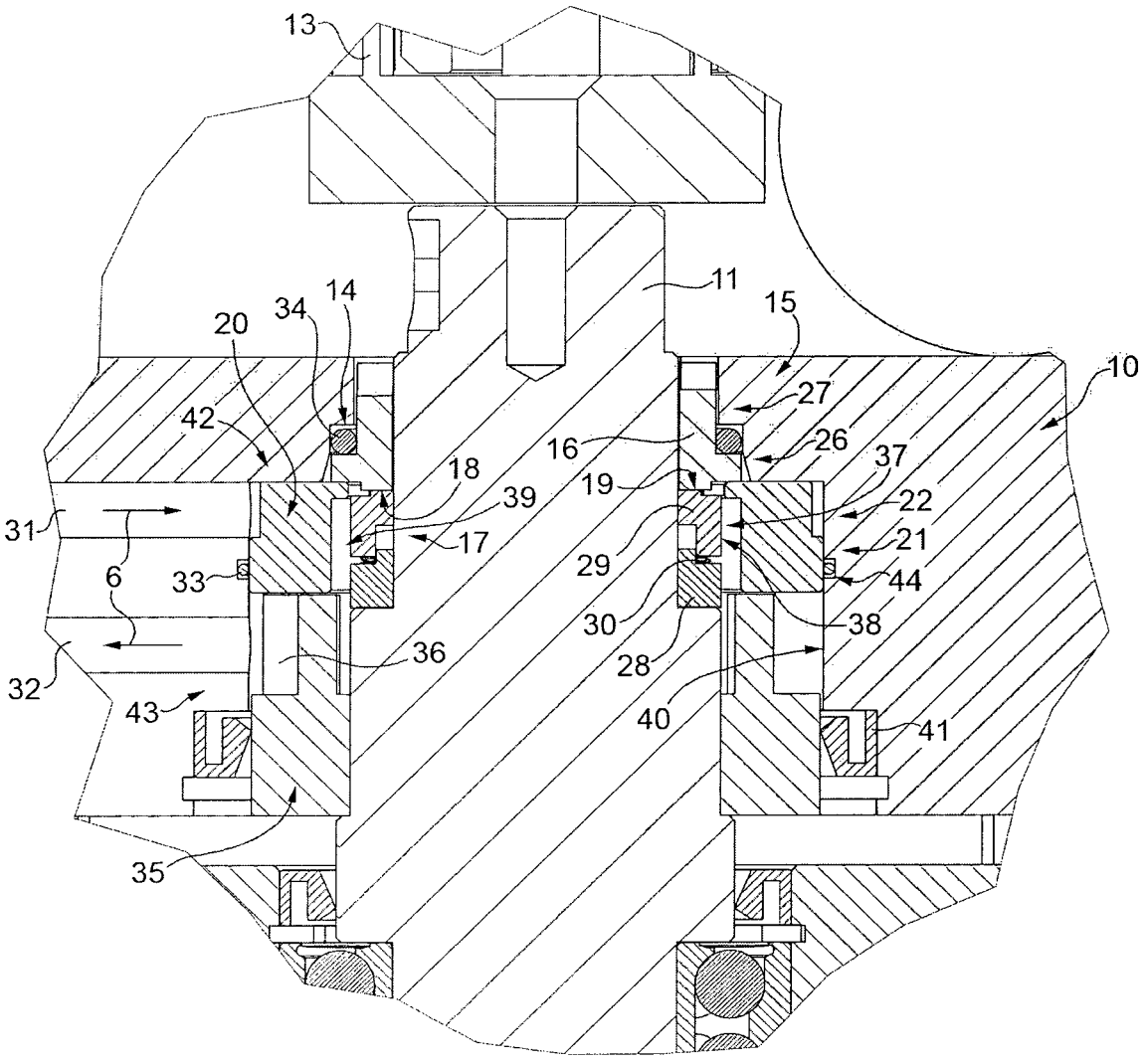
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FIG. 4

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EUROPEAN SEARCH REPORT

Application Number
EP 17 42 5067

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	22 January 2018	Finzel, Jana

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