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(54) **COMPRESSOR AND HOUSEHOLD APPLIANCE**

(57) A compressor (10) for a household appliance (1), comprising a rotating roller (23) for compressing a gaseous phase (GR) of a refrigerant, wherein the roller (23) is lubricated by means of a mixture (M) of oil and

the refrigerant being dissolved in the oil, an oil sump (25) for receiving the mixture (M), and a rotating agitation element (24) which is at least partly submerged in the mixture (M) for agitating it.

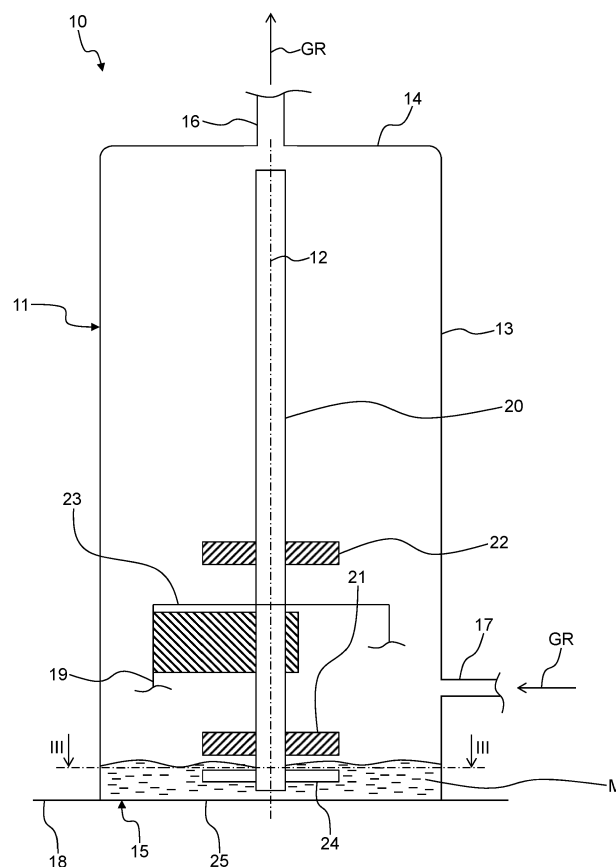


Fig. 2

Description

[0001] The present invention relates to a compressor for a household appliance and to a household appliance with such a compressor.

[0002] Household appliances like refrigerators, heat pump dryers, heat pump washers, heat pump washer-dryers or heat pump dishwashers comprise a compressor for compressing a gaseous phase of a refrigerant. The compressor can be a rotary compressor with a piston or roller inside a compression chamber that is driven by means of a drive shaft of an electro motor. The roller is arranged inside the compression chamber of the compressor. The roller and other internal parts of the compressor in movement or in possible friction have to be lubricated during compressing the gaseous phase of the refrigerant. For this purpose, oil is used. However, the refrigerant is soluble in the oil thereby reducing the amount of refrigerant that is available for a heat transfer process.

[0003] It is one object of the present invention to provide an improved compressor.

[0004] Accordingly, a compressor for a household appliance is provided. The compressor comprises a rotating roller for compressing a gaseous phase of a refrigerant, wherein the roller is lubricated by means of a mixture of oil and the refrigerant being dissolved in the oil, an oil sump for receiving the mixture, and a rotating agitation element which is at least partly submerged in the mixture for agitating it.

[0005] Agitating or stirring the mixture could reduce the needed time to achieve the stable solubility of the refrigerant according to the operating conditions in whatever moment in the oil. Consequently, there is in a shorter time more refrigerant available for doing energy interchange in a heat exchanger, in the case the refrigerant is egressing from the oil which happens during startup of the compressor. This improves the efficiency of the household appliance. A further advantage being related to the homogeneous blend of oil and refrigerant in the mixture is that the lubrication function is improved because of the extra forced agitation. This can in particular be very beneficial in oil mixtures which are provided with additives in the form of nanoparticles or nanofluids.

[0006] The compressor preferably is a rotary compressor or can be named rotary compressor. A "refrigerant" is a substance or mixture, usually a fluid, used in a heat pump and refrigeration cycle. In most cycles it undergoes phase transitions from a liquid to a gas and back again. The gaseous phase can be transferred into the liquid phase and vice versa. The gaseous phase can be named gaseous refrigerant. The liquid phase can be named liquid refrigerant.

[0007] "Agitating" the mixture means circulating or stirring it. In particular, the gaseous phase of the refrigerant is at least so some extend soluble in the oil. Agitating the mixture reduces the time for achieving the stable solubility that corresponds to particular operating conditions

of the compressor. Since the oil sump does not only contain oil, it can be named sump or mixture sump. The mixture can be part of the compressor. The roller is a piston or can be named piston or rotating piston. Apart from the roller there are other internal parts of the compressor in movement or friction. These internal parts can include a vane, bearings or the like.

[0008] According to an embodiment, the compressor further comprises a drive shaft for driving the roller, wherein the agitation element is attached to the drive shaft.

[0009] In particular, the agitation element is attached to the drive shaft at the bottom thereof. Preferably, the drive shaft is arranged vertically. In particular, the agitation element is attached to an end of the drive shaft that protrudes into the oil sump. The drive shaft is rotatably supported in a compressor housing. The shaft can be part of an electric motor of the compressor. The electric motor can comprise a rotor that is fixed to the drive shaft and a stator that is fixed to the compressor housing. The drive shaft preferably has a cam which is received in the roller. The roller preferably has a ring-shape. Due to the cam, the roller fulfills an eccentric movement when the shaft rotates. The shaft can have a central intake bore that runs along a longitudinal direction of the shaft. The intake bore can have a helical intake element which is used to take in the mixture of oil and the refrigerant when rotating the shaft. The intake element can have the form of a thread. The cam has an outlet for the mixture. The outlet can be a bore that is arranged perpendicular to the intake bore. In this way, the outlet provides the mixture into a gap that is provided in between the cam and the roller. In this way the roller and the cam are lubricated when the shaft rotates. The outlet constitutes a lubrication point for lubricating the cam and the roller. According to a further embodiment, the compressor further comprises a bottom bearing and a top bearing for supporting the drive shaft, wherein the drive shaft extends beyond the bottom bearing, and wherein the bottom bearing is arranged between the agitation element and the top bearing.

[0010] The bearings can be part of the aforementioned electric motor. The bearings can be friction bearings or rolling bearings. In particular, the drive shaft extends beyond the bottom bearing into the oil sump. The bottom bearing can be at least partly submerged into the mixture of oil and refrigerant. The shaft can have two further outlets for delivering the mixture from the intake bore to the bearings. In this way, the bearings can be lubricated when the shaft rotates. These outlets constitute further lubrication points for lubricating the bearings.

[0011] According to a further embodiment, the compressor further comprises a compressor housing, wherein the oil sump is part of the compressor housing.

[0012] The compressor housing preferably has a cylindric shape with an outer wall, a bottom cap and a top cap. The caps hermetically close the outer wall at its ends. The compressor housing can be made of steel.

The outer wall can be rotation-symmetric to a centerline. The centerline is preferably arranged vertically so that also the compressor housing is arranged vertically.

[0013] According to a further embodiment, the compressor further comprises a compression chamber which receives the roller, wherein the compression chamber is arranged inside the compressor housing.

[0014] For pressurizing the gaseous phase of the refrigerant, the roller rotates inside the compression chamber. The roller comes into contact with a wall of the compression chamber when the shaft rotates. The compression chamber can be part of the compressor housing.

[0015] According to a further embodiment, the oil sump is fluidly connected to a lubrication point for lubricating the roller.

[0016] The number of lubricating points is arbitrarily. In particular, the oil sump is fluidly connected to a number of different lubrication points that have the function of distributing the oil or the mixture for proper lubrication. These lubrication points can be - as mentioned before - between the cam and the roller as well as between the drive shaft and the bearings. "Fluidly connected" means that the mixture of the oil and the refrigerant can flow from the oil sump to the lubrication points. After the lubrication is done, the oil comes back to the oil sump. This is repeated cyclically.

[0017] According to a further embodiment, the agitation element is bar-shaped.

[0018] The agitation element can have a circular, a rectangular, a triangular or any other desired cross section. The agitation element can be made of one piece and can be pushed into a bore that is provided in the drive shaft. In this case, the two ends of the agitation element protrude radially outwards from the drive shaft. Alternatively, the agitation element can comprise two bars that are screwed into two threaded holes being provided at the end of the drive shaft that submerges in the mixture being received in the oil sump.

[0019] According to a further embodiment, the agitation element is a propeller.

[0020] The propeller can have an annular basic section that receives one end of the drive shaft. The propeller has blades that are attached to the basic section. The basic section is optional. That means that the blades can also be directly attached to the drive shaft. The propeller has at least one blade. Preferably, the propeller has at least two blades.

[0021] According to a further embodiment, the agitation element has two, three or more than three blades.

[0022] The number of blades is arbitrary. There can for example be four or five blades. The design of the blades can be modified as needed. Parameters for modifying the agitation element are for example a diameter of the agitation element, the geometric design of the blades, an angle of the blades or the like. The blades can be named propeller blades.

[0023] Further, a household appliance comprising such a compressor is provided.

[0024] The household appliance can be a laundry dryer, a dishwasher, a refrigerator, a deep freezer or the like. In the case that the household appliance is a laundry dryer or a dishwasher, the compressor can be part of a heat pump. In particular, the household appliance can be a heat pump dryer, a heat pump washer, a heat pump washer-dryer or a heat pump dishwasher.

[0025] Further possible implementations or alternative solutions of the invention also encompass combinations - that are not explicitly mentioned herein - of features described above or below with regard to the embodiments. The person skilled in the art may also add individual or isolated aspects and features to the most basic form of the invention.

[0026] Further embodiments, features and advantages of the present invention will become apparent from the subsequent description and dependent claims, taken in conjunction with the accompanying drawings, in which:

Fig. 1 shows a schematic perspective view of one embodiment of a household appliance;

Fig. 2 shows a schematic cross-sectional view of one embodiment of a compressor for the household appliance according to Fig. 1;

Fig. 3 shows a schematic cross-sectional view of the compressor according to the intersection line III-III of Fig. 2;

Fig. 4 shows a schematic view of one embodiment of an agitation element for the compressor according to Fig. 2; and

Fig. 5 shows a schematic view of one further embodiment of an agitation element for the compressor according to Fig. 2.

[0027] In the Figures, like reference numerals designate like or functionally equivalent elements, unless otherwise indicated.

[0028] Fig. 1 shows a schematic perspective view of one embodiment of a household appliance 1. The household appliance 1 can be a laundry dryer, a dishwasher, a refrigerator, a deep freezer or the like. The household appliance 1 has a housing 2 comprising a bottom 3, a ceiling 4 which is arranged opposite the bottom 3, two opposing side walls 5, 6 and a back wall 7. The housing 2 is cuboid-shaped. The housing 2 has a front wall 8 which opposes the back wall 7. A door 9 is provided at the front wall 8 which can be opened to put laundry or other items into the household appliance 1. In this case, the household appliance 1 is a front loader. The door 9 can also be provided at the ceiling 4. In this case, the household appliance 1 is a top loader.

[0029] Fig. 2 shows a schematic cross-sectional view of one embodiment of a compressor 10 for the household appliance 1. The compressor 10 is capable of compress-

ing a gaseous phase GR of a refrigerant. A "refrigerant" is a substance or mixture, usually a fluid, used in a heat pump and refrigeration cycle. In most cooling or heat pump cycles it undergoes phase transitions from a liquid to a gas and back again. The refrigerant also has a liquid phase. The gaseous phase GR can be transferred into the liquid phase and vice versa. The compressor 10 transfers the gaseous phase GR from low pressure to high pressure. The liquid phase is transferred into the gaseous phase GR by means of an evaporator (not shown). The gaseous phase GR can be named gaseous refrigerant. The liquid phase can be named liquid refrigerant.

[0030] The compressor 10 is a rotary compressor 10. The compressor 10 comprises a compressor housing 11. The compressor housing 11 can be made of steel. The compressor housing 11 is cylindrical. The compressor housing 11 is constructed rotation-symmetrical towards a centerline 12. The centerline 12 is arranged vertically. The compressor housing 11 comprises a cylindrical outer wall 13, a top cap 14 and a bottom cap 15. The caps 14, 15 hermetically close the outer wall 13 at its ends.

[0031] The top cap 14 can be provided with a discharge pipe 16 to discharge the gaseous phase GR with high pressure. The discharge pipe 16 can be pipe that is arranged vertically. The outer wall 13 can comprise a suction port 17 for intaking the gaseous phase GR at low pressure. The suction port 17 can be a pipe that is arranged horizontally. Upstream the suction port 17 can be provided an accumulator (not shown) for separating the liquid phase from the gaseous phase GR and for storing the liquid phase until it evaporates. In this way, the accumulator prevents the liquid phase from entering the compressor 10.

[0032] The bottom cap 15 can be provided with a flange 18. The flange 18 can have a triangular shape with three openings (not shown) in the corners of the triangle. The openings can be used to attach the compressor 10 to the household appliance 1. Alternatively, the flange 18 can have a circular shape.

[0033] The compressor 10 is provided with a compression chamber 19 which is enclosed in the compressor housing 11 or which is part of the compressor housing 11. In the compression chamber 19, the gaseous phase GR of the refrigerant is compressed to obtain the gaseous phase GR with high pressure. The compression chamber 19 takes in the gaseous phase GR at low pressure through the suction port 17 and discharges the gaseous phase GR at a higher pressure through a discharge valve (not shown).

[0034] The compressor has a drive shaft 20. The drive shaft 20 is rotatably supported in the compressor housing 11. A bottom bearing 21 and a top bearing 22 are provided to support the drive shaft 20. The drive shaft 20 is supported in the compressor housing 11 by means of the bearings 21, 22. The bearings 21, 22 can be friction bearings or rolling bearings. The drive shaft 20 can be part of an electric motor (not shown). The electric motor can

comprise a rotor that is fixed to the drive shaft 20 and a stator that is fixed to the compressor housing 11.

[0035] The drive shaft 20 is used to drive a roller 23 to compress the gaseous phase GR. The roller 23 can be named piston or rotating piston. The roller 23 is suspended on the drive shaft 20 which runs through the compression chamber 19. The drive shaft 20 has a cam which is received in the roller 23. The roller 23 can be ring-shaped. When the drive shaft 20 rotates, the roller 23 fulfills an eccentric movement by means of the cam. The roller 23 is arranged inside the compression chamber 19. The compressor 10 further has at least one valve, electric cables, springs and further elements that are not shown in Fig. 2. Attached to the drive shaft is an agitation element 24. The agitation element 24 can be bar-shaped. The agitation element 24 can comprise two bars that are screwed into blind holes being provided in an end of the drive shaft 20 that extends over the bottom bearing 21. That means, the drive shaft overpasses the bottom bearing 21 at least slightly.

[0036] The compressor 10 comprises an oil sump 25. The oil sump 25 is at the bottom of the compressor housing 11. The oil sump 25 can be constituted by a part of the outer wall 13 and the bottom cap 15. That means, the oil sump 25 is part of the compressor housing 11. At least, the oil sump 25 is fluidly connected to lubrication points. The oil sump 25 is at least partly filled with a mixture M of oil and the refrigerant. The agitation element 24 is submerged in this mixture M. The bottom bearing 21 can also be at least partly submerged in the mixture M. The mixture M is used to lubricate internal parts of the compressor 10 in movement or in friction. The internal parts can comprise the roller 23 and/or the bearings 21, 22. There can be provided a system of bores in the drive shaft 20 to provide proper lubrication with the mixture M.

[0037] Fig. 3 shows a schematic cross-sectional view of the compressor 10, wherein in Fig. 3 only the drive shaft 20 and the agitation element 24 are shown. The agitation element 24 can be bar-shaped. The agitation element 24 can have a circular, a rectangular, a triangular or any other desired cross section. The agitation element 24 can be made of one piece and can be pushed into a bore that is provided in the drive shaft 20. In this case, the two ends of the agitation element 24 protrude radially outwards from the drive shaft 20. Alternatively, the agitation element 24 can comprise two bars 26, 27 that are screwed into two threaded holes being provided at the end of the drive shaft 20 that submerges into the mixture M.

[0038] Fig. 4 shows a schematic view of a further embodiment of an agitation element 24 for the compressor. The agitation element 24 has the form of a propeller or can be named propeller. The agitation element 24 has an annular basic section 28 that receives the drive shaft 20. The basic section 28 can be fixed to the drive shaft 20. Two blades 29, 30 are attached to the basic section 28. The basic section 28 is optional. This means that the two blades 29, 30 can be directly attached to the drive

shaft 20.

[0039] Fig. 5 shows a schematic view of a further embodiment of an agitation element 24 for the compressor. This agitation element 24 also has the form of a propeller or can be named propeller. The agitation element 24 according to Fig. 5 differs from the agitation element 24 according to Fig. 4 only in that it has three blades 29 to 31 instead of two blades 29, 30. The number of blades 29 to 31 is arbitrary. There can be more than three blades 29 to 31.

[0040] The design of the blades 29 to 31 can be modified as needed. Parameters for modifying the agitation element 24 are for example a diameter of the agitation element 24, the geometric design of the blades 29 to 31, an angle of the blades 29 to 31 or the like.

[0041] The function of the agitation element 24 is to agitate the mixture M in the oil sump 25 during compression of the gaseous phase GR of the refrigerant. This decreases the time for achieving the stable solubility that corresponds to particular operating conditions of the compressor 10. Consequently, there is more refrigerant available for doing energy interchange in a heat exchanger (not shown). This improves the efficiency and cycle time of the household appliance 1. A further advantage being related to the homogeneous mixture of oil and refrigerant in the mixture M is that the lubrication function is improved because of the extra forced agitation. Without such an agitation element 24, there could be different heterogeneous phases doing the lubrication. The homogeneous mixing of the oil and the refrigerant can in particular be very beneficial in oil mixtures which are provided with additives in the form of nanoparticles or nanofluids.

[0042] Although the present invention has been described in accordance with preferred embodiments, it is obvious for the person skilled in the art that modifications are possible in all embodiments.

Reference Numerals:

[0043]

- 1 household appliance
- 2 housing
- 3 bottom
- 4 ceiling
- 5 side wall
- 6 side wall
- 7 back wall
- 8 front wall
- 9 door
- 10 compressor
- 11 compressor housing
- 12 centerline
- 13 outer wall
- 14 top cap
- 15 bottom cap
- 16 discharge pipe

- 17 suction port
- 18 flange
- 19 compression chamber
- 20 drive shaft
- 5 21 bottom bearing
- 22 top bearing
- 23 roller
- 24 agitation element
- 25 oil sump
- 10 26 bar
- 27 bar
- 28 basic section
- 29 blade
- 30 blade
- 15 31 blade
- GR gaseous phase
- M mixture

20 Claims

1. A compressor (10) for a household appliance (1), comprising a rotating roller (23) for compressing a gaseous phase (GR) of a refrigerant, wherein the roller (23) is lubricated by means of a mixture (M) of oil and the refrigerant being dissolved in the oil, an oil sump (25) for receiving the mixture (M), and a rotating agitation element (24) which is at least partly submerged in the mixture (M) for agitating it.
2. The compressor according to claim 1, further comprising a drive shaft (20) for driving the roller (23), wherein the agitation element (24) is attached to the drive shaft (20).
3. The compressor according to claim 2, further comprising a bottom bearing (21) and a top bearing (22) for supporting the drive shaft (20), wherein the drive shaft (20) extends beyond the bottom bearing (21), and wherein the bottom bearing (21) is arranged between the agitation element (24) and the top bearing (22).
4. The compressor according to one of claims 1 - 3, further comprising a compressor housing (11), wherein the oil sump (25) is part of the compressor housing (11).
5. The compressor according to claim 4, further comprising a compression chamber (19) which receives the roller (23), wherein the compression chamber (19) is arranged inside the compressor housing (11).
6. The compressor according to claim 5, wherein the oil sump (25) is fluidly connected to a lubrication point for lubricating the roller (3).
7. The compressor according to one of claims 1 - 6,

wherein the agitation element (24) is bar-shaped.

8. The compressor according to one of claims 1 - 6,
wherein the agitation element (24) is a propeller. 5
9. The compressor according to claim 8, wherein the
agitation element (24) has two, three or more than
three blades (29 - 31).
10. A household appliance (1) comprising a compressor 10
(10) according to one of claims 1 - 9.

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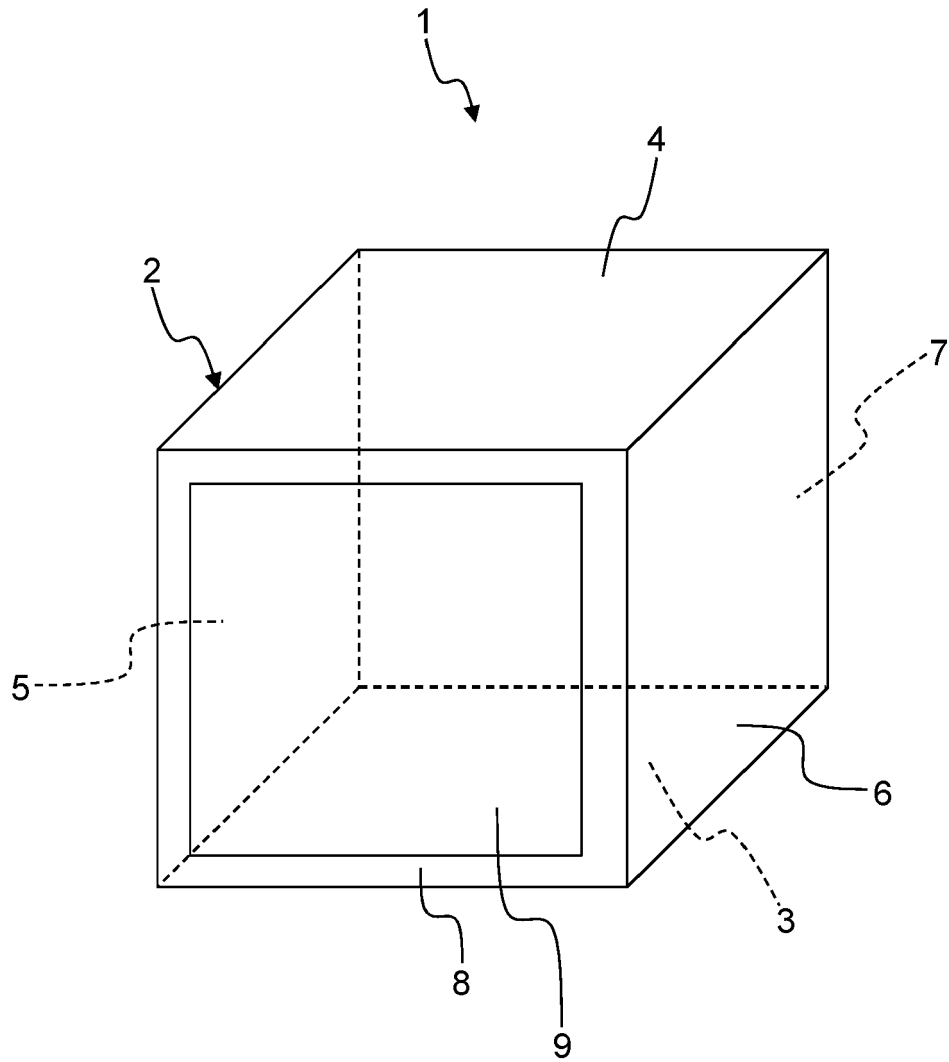


Fig. 1

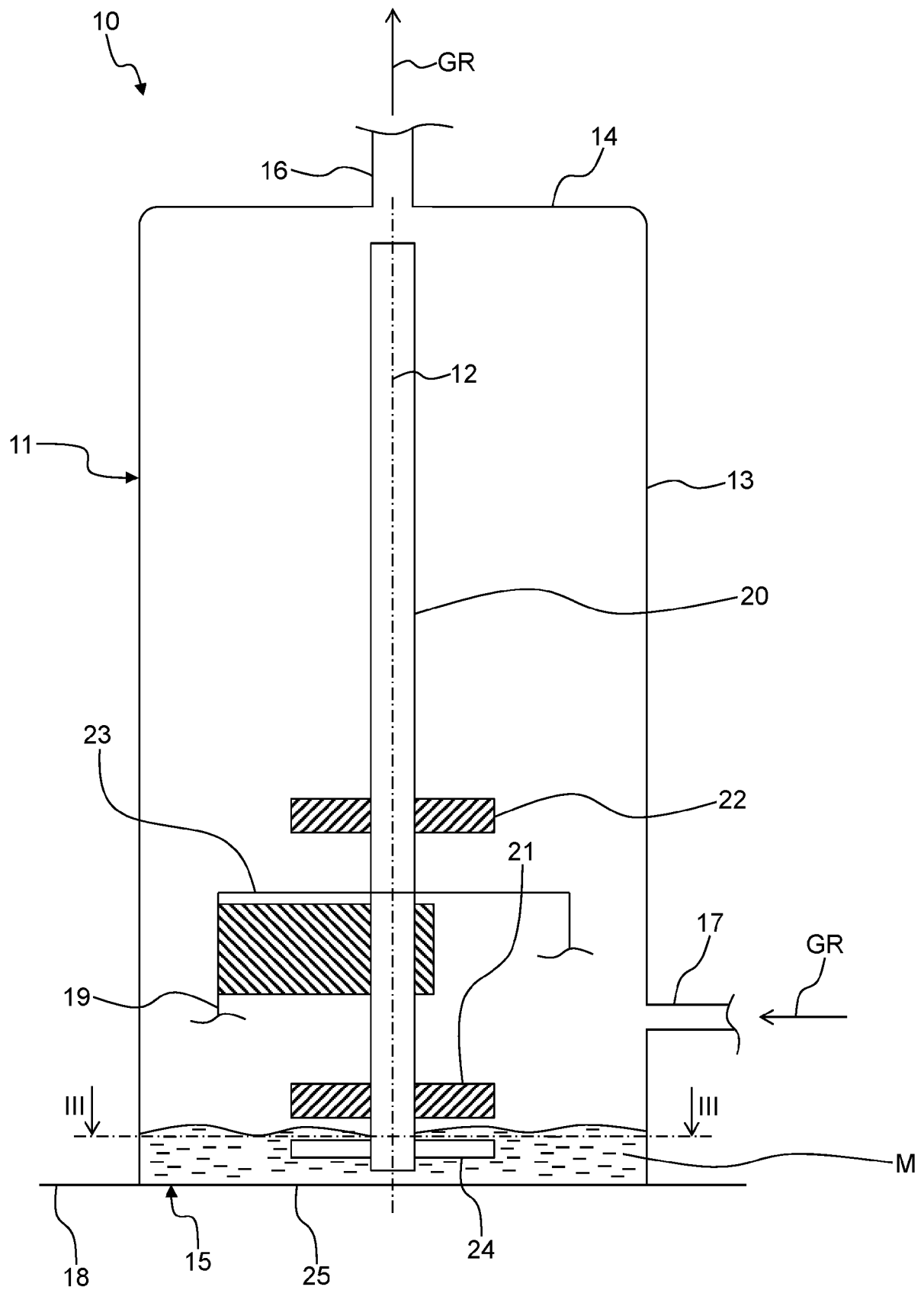


Fig. 2

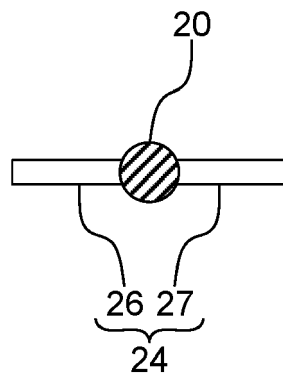


Fig. 3

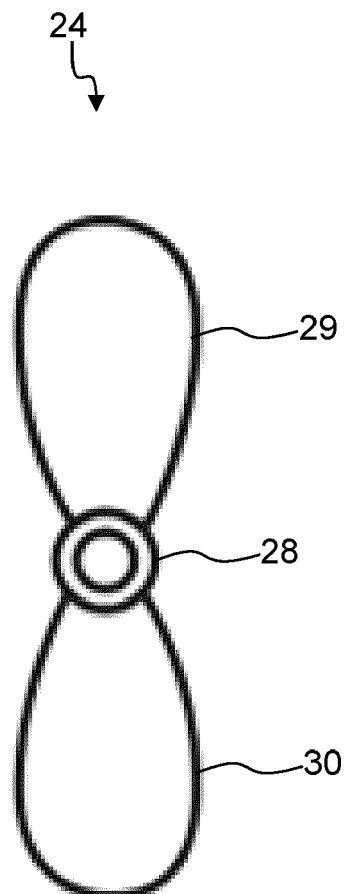


Fig. 4

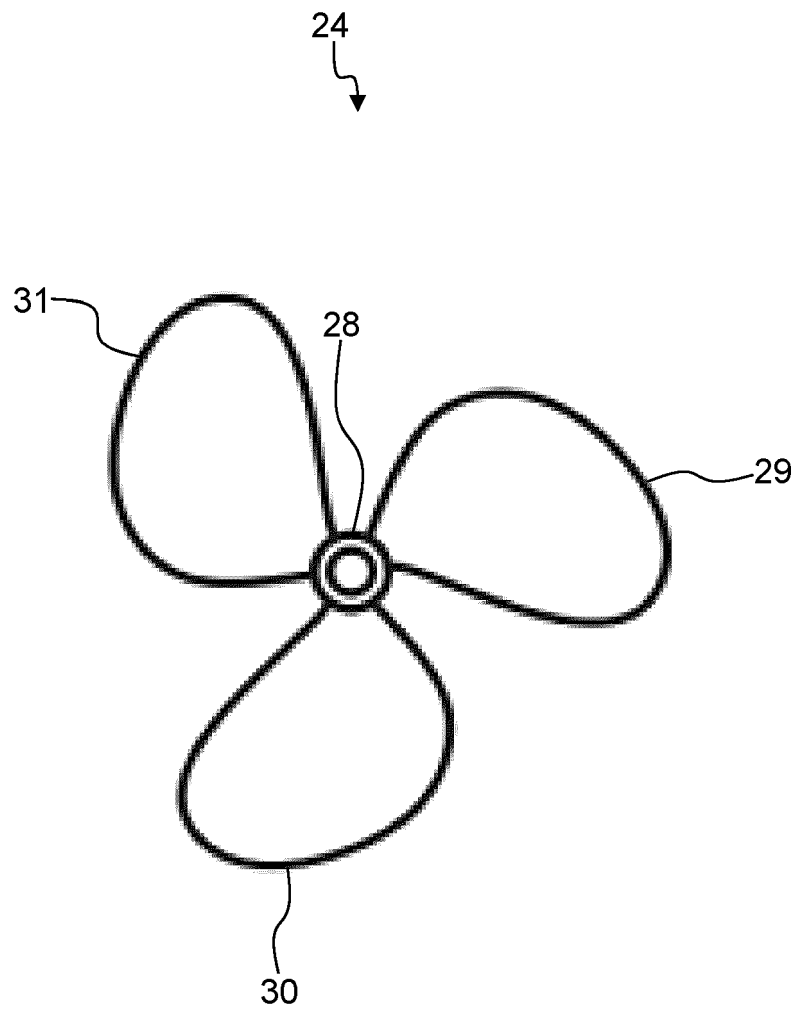


Fig. 5



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 Application Number
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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 5 November 2020	Examiner Alquezar Getan, M
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