(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 4 170 166 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
26.04.2023 Bulletin 2023/17

(21) Application number: **22203368.0**

(22) Date of filing: **24.10.2022**

(51) International Patent Classification (IPC):
F04B 39/00 *(2006.01)* ***F04B 39/12*** *(2006.01)*
F04B 39/02 *(2006.01)*

(52) Cooperative Patent Classification (CPC):
F04B 39/0027; F04B 39/0044; F04B 39/023; F04B 39/0284; F04B 39/121

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA
Designated Validation States:
KH MA MD TN

(30) Priority: **25.10.2021 EP 21204539**

(71) Applicant: **Secop GmbH**
24941 Flensburg (DE)

(72) Inventors:
- **Da Silva Castro, Mattias**
  8042 Graz (AT)
- **Ribeiro Martins, Paulo Victor**
  8010 Graz (AT)

(74) Representative: **KLIMENT & HENHAPEL**
Patentanwälte OG
Gonzagagasse 15/2
1010 Wien (AT)

(54) COMPRESSOR SHELL FOR A REFRIGERANT COMPRESSOR

(57) The invention relates to a compressor shell for a refrigerant compressor;
wherein the compressor shell encloses an inner containing space (130) for housing a pump unit of the refrigerant compressor;
wherein four mounting pins (140) are extending from the bottom wall (111) into the containing space (130), wherein each mounting pin (140) is configured to mount a support spring assembly for supporting the pump unit,
wherein the four mounting pins (140) are arranged in a rectangular shape.

In order to improve the compressor shell (100) design with regard to the formation of an oil pocket (104) in which an oil sump forms during operation so as to reduce the probability of malfunction of the lubricant conveying system it is provided according to the invention that a first centre point (C_1) of the four mounting pins (140) is offset in the length direction (x) with regard to a second centre point (C_2) of an outline of the compressor shell (100) and that a curved section (111a) of a bottom wall (111) of a lower shell part (110) is convexly curved in order to form an oil pocket (104), wherein a lowest point of the oil pocket (104), seen in the height direction (z), is aligned with the first centre point (C_1).

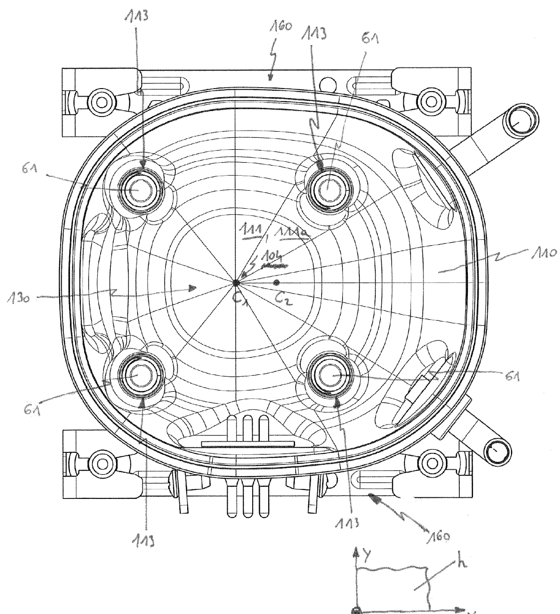


Fig. 9

EP 4 170 166 A1

Description

FIELD OF THE INVENTION

[0001] The invention relates to compressor shell for a refrigerant compressor comprising a lower shell part and an upper shell part;

> wherein the compressor shell encloses an inner containing space for housing a pump unit of the refrigerant compressor; wherein the compressor shell extends along a length direction, a width direction and a height direction, wherein the length direction and the width direction define a horizontal plane; wherein the lower shell part comprises a bottom wall and a lower circumferential wall;
> wherein the upper shell part comprises a top wall and an upper circumferential wall;
> wherein four mounting pins are extending from the bottom wall into the containing space, wherein each mounting pin is configured to mount a support spring assembly for supporting the pump unit,
> wherein the four mounting pins are arranged in a rectangular shape being aligned with the length direction and the width direction.

[0002] Reference to elements being aligned in the horizontal plane is synonymous to elements (or points) being congruent when viewed in the height direction, so that all elements are projected into the horizontal plane.

PRIOR ART

[0003] Encapsulated, especially hermetically sealed, refrigerant compressors have been known for a long time and are mainly used in refrigeration cabinets, such as refrigerators or refrigerated shelves, but can also be used in mobile appliances. The refrigerant process as such has also been known for a long time. Refrigerant is thereby heated by energy absorption from the space to be cooled in an evaporator and finally superheated and pumped to a higher pressure level using the refrigerant compressor having a cylinder and a reciprocating piston. At this higher pressure level the refrigerant is cooled via a condenser and is conveyed back into the evaporator via a throttle, via which throttle the pressure is reduced and the refrigerant is further cooled down, before the cycle starts anew.

[0004] The path of the (usually gaseous) refrigerant through the compressor can be described as follows:
The refrigerant enters a compressor shell of the refrigerant compressor, which compressor shell encapsulates a pump unit of the refrigerant compressor, through a suction pipe, which is in the operating state connected to the evaporator of the refrigerant appliance. During a suction cycle, the refrigerant is sucked through a suction muffler, a suction opening of a valve plate, which suction opening is released by a suction valve spring, into a cylinder of the pump unit of the refrigerant compressor. The suction is caused by linear movement of a piston inside the cylinder. During a compression part of a compression and discharge cycle, the refrigerant is compressed within the cylinder by the linear movement of the piston until a discharge valve spring releases a discharge opening of the valve plate. During a discharge part of the compression and discharge cycle, the so compressed refrigerant then flows through the discharge opening of the valve plate into a discharge muffler and leaves the compressor shell through a discharge pipe, which is connected to the discharge muffler by a discharge connection tube. The discharge tube is in the operating state connected to the condenser of the refrigerant appliance.

[0005] The pump unit comprises a cranktrain, which includes the piston and is causing the linear movement of the piston inside the cylinder, a crankcase, in which a crankshaft of the cranktrain is mounted, the crankcase also having a cylinder housing, an electric drive unit, which comprises a rotor and a stator, and a cylinder head assembly. The cylinder head assembly includes the valve plate, the suction valve spring, the discharge valve spring, the suction muffler and the discharge muffler. The pump unit is supported within the compressor shell on a plurality of support spring assemblies, preferably on four support spring assemblies.

[0006] The shell usually comprises a lower shell part and an upper shell part, which are welded together. The discharge pipe and the suction pipe as well as a maintenance pipe (also known as service pipe) are hermetically connected to the shell. As the refrigerant compressor is a stand-alone product, which is integrated into a refrigerant appliance at some stage of the assembly process, the discharge pipe, the suction pipe and the maintenance pipe are also called discharge connector, suction connector and maintenance connector as they are configured to be connected with respective elements with the refrigerant appliance during assembly and/or in the operation state.

[0007] The movement of the piston is caused by rotation of the crankshaft, wherein the piston is connected to a crank-pin of the crankshaft via a connecting rod. The electric drive unit is required to facilitate the rotation of the crankshaft, wherein the rotor is fixed to the crankshaft.

[0008] Usually an electronic control unit is mounted to an outside surface of the compressor shell, wherein the stator is connected to an electric pass through element (also known as "fusite") via an inner harness and the electronic control unit is connected to the electric pass through element via an outer harness. The electronic control unit powers the stator and thereby controls the rotational speed of the pump unit of the refrigerant compressor.

[0009] In order to lubricate the piston moving within the cylinder and the cranktrain, in particular the crankshaft, during operation, the refrigerant compressor has a lubricant conveying system, by means of which lubricant is transported from a lubricant sump building up in the lower housing part of the compressor housing during operation towards the piston and along the crankshaft. The lubricant conveying system includes an oil pick up mounted to a lower side of the crankshaft, preferably directly on the rotor. In order to convey lubricant, the oil pick up has to immerge into the lubricant sump, so that lubricant can enter the oil pickup in order to be conveyed by the rotation of the crankshaft.

[0010] As it cannot be guaranteed that the compressor shell is mounted to a completely horizontal plane, in refrigerant compressors according to the prior art there is a certain risk that the oil pickup does not immerge into the lubricant sump, when the compressor shell is mounted on an inclined surface, which leads to malfunction and increased wear, as the lubrication is interrupted for a certain period of time, generally until enough lubricant has drained from the pump unit back into the lubricant sump. Mostly oil is used as a lubricant in refrigerant compressors; therefore the lubricant sump is often also referred to simply as oil sump.

OBJECT OF THE INVENTION

[0011] It is therefore an object of the invention to provide a compressor shell which overcomes the disadvantages of the prior art and provides an improved design with regard to the formation of an oil pocket in which the oil sump forms during operation, in order to reduce the probability of malfunction of the lubricant conveying system. A further object of the invention is to reduce the overall size of the compressor shell in order to reduce the required space within the refrigerant appliance, while at the same time providing enough space to avoid collisions between the pump unit and the inner surface of the compressor shell.

SUMMARY OF THE INVENTION

[0012] In order to achieve at least one of the objects set out above in a compressor shell as initially defined, it is provided according to the invention that a first centre point of the four mounting pins in the horizontal plane is offset in the length direction with regard to a second centre point of an outline of the compressor shell in the horizontal plane and that a curved section of the bottom wall is convexly curved in order to form an oil pocket, wherein a lowest point of the oil pocket, seen in the height direction, is aligned with the first centre point in the horizontal plane. Preferably the mounting pins are arranged in a square shape.

[0013] The position of the pump unit within the compressor shell is defined by the support spring assemblies. I.e. the position of the mounting pins, on which the support spring assemblies are mounted, can be used to adjust the position of the pump unit with regard to the compressor shell. Due to the offset of the mounting pins, defined by the first centre point, with regard to the second centre point, which is defined by the outline or contour of the compressor shell, the distance between the pump unit and the compressor shell can be reduced in the offset direction. Thereby the overall size of the refrigerant compressor can be reduced.

[0014] In order to secure the functioning of the lubricant conveying system, the curved section of the bottom wall forming the oil pocket, in which oil pocket the oil sump forms during operation, is aligned with the first centre point of the mounting points in such a way that the lowest point of the curved section is aligned with the first centre point when viewed in the height direction. This design ensures that the oil pick up mounted on the crankshaft, which crankshaft is preferably also aligned with the first centre point, is always positioned adjacent to the section of the lower shell part in which the most oil is accumulated in the oil pocket, also when the compressor shell is in an inclined position.

[0015] In a further embodiment variant of the invention it is provided that the curved section of the bottom wall extends from the lower circumferential walls inward, wherein the curved section of the bottom wall is interrupted by four support areas, wherein each mounting pin is located in one of the support areas. An essentially continuously curved shape of the curved section further improves the function of the oil pocket as the oil always accumulates at the lowest point of the curved section even if the compressor shell is mounted on an inclined surface. As the mounting pins require a flat surface for being fixed, preferably welded, to the bottom wall, the support areas for the mounting pins are exempt from the continuously curved section of the bottom wall, but the support areas are accordingly designed to be integrated into the oil pocket.

[0016] According to a further embodiment variant of the invention it is provided that the curved section of the bottom wall is shaped, preferably essentially or at least in sections, spherically. The spherical shape is particularly suitable for forming the oil pocket.

[0017] To allow easy integration of the refrigerant compressor into a refrigerant appliance on the one hand and to allow an optimal positioning of the pump unit, especially of the cylinder head assembly, within the compressor shell a further embodiment variant of the invention provides that a discharge pipe and a maintenance pipe are located in the lower circumferential wall and a suction pipe is located in the upper circumferential wall. While the discharge pipe is in connectable to a highpressure side of the refrigerant appliance, the suction pipe is connectable to a low-pressure side of the refrigerant appliance. The maintenance pipe is used to insert the refrigerant and oil into the compressor shell during an initial assembly.

[0018] In order to allow an electric connection between an electronic control unit mounted to the outside of the compressor shell and the electric drive unit, especially with the stator, a further embodiment variant of the invention provides that an electric pass through element is located in the lower circumferential wall. The electric pass through element has, preferably three, pins which are protruding from the side of the compressor shell to the outside of the compressor shell and are connectable to respective sockets of an inner harness and an outer harness. The pins are insulated against a carrier element of the electric pass through element, usually using ceramic insulators. The carrier element can be connected to the lower circumferential wall of the lower shell part by welding.

[0019] For allowing an easy mounting of the electronic control unit to the compressor shell a further embodiment variant of the invention provides that a connection shield for supporting an electronic control unit of the refrigerant compressor is welded to an outer surface of the lower circumferential wall, wherein the connection shield has a shield base plate with an opening and two support arms extending from the base plate, wherein the opening of the base plate surrounds the electric pass through element. The alignment of the electric pass through element and the connection shield secures an easy way of establishing the electric connection between the electronic control unit and the electric pass through element, when the electronic control unit is slid onto the support arms. Further, the base plate can be welded to the lower circumferential wall of the lower shell part.

[0020] In a further embodiment variant of the invention it is provided that the upper shell part has two sets of contacting regions for limiting the movement of inner dampening elements mounted on the pump unit, preferably on a crankcase of the pump unit, wherein each set contains two contacting regions, wherein each contacting region has a first contact area being essentially aligned to the horizontal plane, a second contact area being essentially aligned with a first vertical plane and a third contact area being essentially aligned with a second vertical plane, wherein the first vertical plane is defined by the length direction and the height direction and the second vertical plane is defined by the width direction and the height direction. Because every contacting region of the upper shell part is able to absorb the movement of the pump unit in one specific direction, namely in or against the length direction, in or against the width direction and in or against the height direction, by making contact with a inner dampening element of the pump unit, nearly every possible relative movement of pump unit and compressor shell can be dampened accordingly. It goes without saying that the upper shell part is formed by deep drawing or respective alternative forming operations, so that the contacting areas are partly curved, especially in transition sections, and no sharp edges are possible. Further the functioning of the contact areas can also be achieved when the contact areas are not perfectly aligned with the respective defining planes.

[0021] For mounting and supporting the refrigerant compressor, e.g. within the refrigerant appliance, a further embodiment variant of the invention provides that two supporting base plates are welded to an outer surface of the bottom wall, wherein each support base plate has a fixing section and a mounting section, wherein the fixing section is welded to the bottom wall and the mounting section has two openings for receiving outer dampening elements, which are preferably part of a support damper assembly, wherein the openings are spaced apart in the length direction. The supporting base plates together with the spaced apart openings for the outer dampening elements provide an increased area of contact for the outer dampening elements, which are preferably made of a rubber material in order to dampen vibrations of the compressor shell so that the adjacent parts of the refrigerant appliance are excited as little as possible. Further the steadiness of the refrigerant compressor is increased.

[0022] In order to be able to further adjust the overall height of the refrigerant compressor a further embodiment variant of the invention provides that the mounting section and the fixing section of the supporting base plates are offset in the height direction by an inclined connection section. Due to the inclination of the inclined section the overall height can be reduced, when the offset is in the positive height direction, i.e. that the mounting section is positioned above the fixing section in a front view. Accordingly the overall height can be increase, when the offset is in the negative height direction, i.e. that the mounting section is positioned below he fixing section in a front view.

[0023] The assembly and the installation can be further simplified in a further embodiment variant of the invention when the mounting section and the fixing section are aligned in parallel to the horizontal plane.

[0024] As discussed above, the mounting pins are preferably positioned in support areas, which have an essentially flat surface. As for the welding-on of the fixing section of the supporting base plates also a flat surface is preferable, a further embodiment variant of the invention provides that welding areas of the fixing section are aligned with support areas for the mounting pins in the horizontal plane.

[0025] The invention further relates to an encapsulated refrigerant compressor having

- a compressor shell, wherein a discharge pipe, a suction pipe and a maintenance pipe enter the compressor shell, wherein an electric pass through element is inserted into the compressor shell;
- a pump unit comprising:

    -- a cranktrain having a crankshaft, a crank pin, a connecting rod and a piston;
    -- an electric drive unit having an inner harness, a stator and a rotor, the rotor being fixed to the crankshaft, wherein the inner harness is connecting the electric pass through element and the stator;

    -- a crankcase with a cylinder housing,

    wherein a cylinder for reciprocating move-

ment of the piston is located in the cylinder housing, wherein the crankshaft is rotatably mounted in the crankcase,
wherein the stator is attached to the cylinder crankcase;

-- a cylinder head assembly mounted to the cylinder housing of the crankcase, the cylinder head assembly comprising a valve plate, a suction valve spring, a discharge valve spring, a suction muffler and a discharge muffler, wherein the discharge muffler has a discharge connection tube being connected to the discharge pipe;

- a plurality of support spring assemblies for supporting the compressor body in the compressor shell,

wherein the compressor shell is configured according to the invention described above.

BRIEF DESCRIPTION OF THE DRAWINGS

[0026] The invention will now be explained in more detail below with reference to a exemplary embodiment. The drawings are provided by way of example and are intended to explain the concept of the invention, but shall in no way restrict it or even render it conclusively, wherein:

Fig. 1 shows a three dimensional view of a refrigerant compressor from the outside;
Fig. 2 shows an exploded view of the refrigerant compressor;
Fig. 3 shows a three dimensional view of an assembled pump unit of the refrigerant compressor;
Fig. 4 shows a three dimensional view of the refrigerant compressor from the outside from a viewing direction offset by 90° compared to Fig. 1;
Fig. 5 shows a side view of the refrigerant compressor from the outside;
Fig. 6 shows a three dimensional view of supporting base plates of the refrigerant compressor;
Fig. 7 shows a three dimensional view of the refrigerant compressor from the outside from diagonal below;
Fig. 8 shows a top view of the interior of an upper shell part of a compressor shell of the refrigerant compressor;
Fig. 9 shows a top view of the interior of a lower shell part of the compressor shell of the refrigerant compressor;
Fig. 10 shows a sectional view of the refrigerant compressor according to the sectional line C-C indicated in Fig. 5;
Fig. 11 shows a sectional view of the refrigerant compressor according to the sectional line A-A indicated in Fig. 5;
Fig. 12 shows a sectional view of the refrigerant compressor according to the sectional line B-B indicated in Fig. 11.

DETAILED DESCRIPTION

[0027] Fig. 1 shows an outside view of an, in particular hermetically, encapsulated refrigerant compressor 1 which extends along a length direction x, a width direction y and a height direction z. Length direction x, width direction y and height direction z form an orthogonal reference system. In general the length dimension of the refrigerant compressor measured along the length direction x is greater than the width dimension measured along the width direction y.

[0028] In the following reference will occasionally be made to a(usually gaseous) refrigerant, which flows through the refrigerant compressor 1. It is self evident that these remarks refer to an operating state of the refrigerant compressor 1, but that usually no refrigerant is present in the refrigerant compressor 1 when the refrigerant compressor 1 is produced or sold as a stand-alone product.

[0029] The refrigerant compressor 1 comprises a compressor shell 100, which in this embodiment consists of a lower shell part 110 and an upper shell part 120. The upper shell part 120 and the lower shell part 110 are welded together. On both sides of the lower shell part 110, which extend mainly in the length direction x, a supporting base plate 160 is fixed to the compressor shell 100. Each supporting base plate 160 has two openings 164 for mounting support damper assemblies 90 (see Fig. 2).

[0030] A suction pipe 30, which is connectable to a low pressure side of a refrigerant appliance, enters the upper shell part 120 on a lateral side of the refrigerant compressor 1. During operation refrigerant is sucked into the refrigerant compressor 1 through the suction pipe 30, mainly during a suction cycle of a pump unit 10 (see Fig. 3) of the refrigerant compressor 1. Therefore, in an operating state, the suction pipe 30 is connected directly or indirectly, e.g. through piping of the low pressure side of the refrigerant appliance, to an evaporator of the refrigerant appliance. With regard to the compressor shell 100, the suction pipe 30 enters the upper shell part 110 through a second connector element 80, which second connector element 80 is hermetically connected to the upper shell part 120 on the one hand and to the suction pipe 30 on the other hand, for example by welding and/or soldering.

[0031] A discharge pipe 20 as well as a maintenance pipe 40 enters the lower shell part 110 on a front side of the refrigerant compressor 1. The discharge pipe 20 enters the lower shell part 110 through a first connector element 70, which first connector element 70 is hermetically connected to the lower shell part 110 on the one hand and to the discharge pipe 20 or maintenance pipe 40 respectively on the other hand, for example by welding and/or soldering. During operation, refrigerant compressed by the pump unit 10 can escape the refrigerant compressor 1 through the discharge pipe 20, mainly during a compression and discharge cycle of the pump unit 10. Therefore, the discharge pipe 20 is connectable to a high pressure side of the refrigerant appliance to allow compressed refrigerant to be fed to a high pressure side of the refrigerant appliance. In the operation state the discharge pipe 20 is connected directly or indirectly, e.g. through piping of the high pressure side of the refrigerant appliance, to a condenser of the refrigerant appliance.

[0032] The maintenance pipe 40 can be used to insert lubrication oil and/or refrigerant into the refrigerant compressor 1 during assembly of the refrigerant application or during maintenance operations. The maintenance pipe 40 is, similar to the suction pipe 30, connected to the lower shell part 110 by a second connector element 80, which is hermetically connected to the lower shell part 110 on the one hand and to the maintenance pipe 40 on the other hand, for example by welding and/or soldering.

[0033] With regard to Fig. 2 all main components of the refrigerant compressor 1 as well as their functions will be briefly described. The refrigerant compressor 1 comprises the shell 100, an electronic control unit 800, which is detachably mounted to the compressor shell 100, and the pump unit 10 (see Fig. 3), which is located inside the compressor shell 100 and supported by four support spring assemblies 60. The refrigerant compressor 1 is mounted on four support damper assemblies 90, which are connected to the respective openings of the two supporting base plates 160. Each support damper assembly 90 includes a damper pin 92, an outer dampening element 91, a lining disk 93 and a securing element 94.

[0034] As can be seen in Fig. 2, the suction pipe 30 enters the upper shell part 120 through a second connection opening 102, whereas the maintenance pipe 20 enters the lower shell part 110 through a third connection opening 103. Even though not visible in Fig. 2, the discharge pipe 20 enters the lower shell part 110 through a first connection opening 101.

[0035] The pump unit 10 comprises an electric drive unit 400, a cranktrain 200, a crankcase 300 and a cylinder head assembly 500, which includes a suction muffler 600 and a discharge muffler 700.

[0036] Each support spring assembly 60 comprises a mounting pin 140, which is fixed, preferably welded, to the lower shell part 110, a lower spring pin 61, which is mounted on the respective mounting pin 140, and a support spring 62, which is supported on the lower spring pin 61.

[0037] The electric drive unit 400 comprises a stator 420, a rotor 410 and an inner harness 430. The stator 420 has a lower end element 421 made of plastic, which lower end element 421 comprises four upper spring holders 63 for the respective support springs 62. The stator 420 is fixed to the crankcase 300 via two stator mounting screws 340. The inner harness 430 connects the stator 420 with an electric pass through element 50, which is located in the compressor shell 100. On the outside of the compressor 1 the electronic control unit 800 is connected to the electric pass through element 50 via an outer harness 801, in order to control the rotation speed of the pump unit 10.

[0038] The cranktrain 200 comprises a piston 240 and a crankshaft 210, which is rotatably mounted inside a main bearing section 302 of the crankcase 300 on the one hand and axially supported on the crankcase 300 by a ball bearing 201. The crankshaft 210 has a crank pin 220 on which a connecting rod 230 is mounted, which connecting rod 230 connects the crank pin 220 with a piston pin 243 of the piston 240. The piston pin 243 is fixed to the piston 240 via a clamping sleeve 244 that is inserted into a matching axial opening in the piston 240 and the piston pin 243. On a lower end of the crankshaft 210, opposite the end with the crankpin 220, the rotor 410 is mounted to the crankshaft 210, preferably via press fitting. Further an oil pickup 250 for conveying lubricant from a lubricant sump formed in the lower shell part 110 during operation into a lubricant conveying system of the cranktrain 200 is mounted to the rotor 410 via three mounting rivets 251.

[0039] The crankcase 300 includes a cylinder housing 310, in which a cylinder 320 is formed. The piston 240 reciprocates within the cylinder 320 during operation of the refrigerant compressor 1 in order to suck refrigerant into the cylinder 320 during a suction cycle and to compress and discharge the compressed refrigerant during a compression and discharge cycle. On the crankcase 300 a set of two first protrusions 301 is located on the side opposite of the cylinder housing 310 and a set of two second protrusions 311 is located on the cylinder housing 310 itself. Inner dampening elements 330 are attached to each of the first protrusions 301 and second protrusions 311, which inner dampening elements 330 interact with respective regions of an inner surface of the upper housing part 120 in order to dampen vibrations of the pump unit 10 during operation and to prevent damages during transport.

[0040] In order to establish a suction path and a discharge path for the refrigerant from the suction pipe 30 via the cylinder 320 to the discharge pipe 20, the cylinder head assembly 500 is mounted onto a cylinder head section of the cylinder housing 310. The cylinder head assembly 500 comprises a cylinder gasket 510, a suction valve spring 520, a valve plate 530 and a discharge valve spring 540, wherein the valve plate 530 has a suction opening and a discharge opening. The cylinder gasket 510 and the suction valve spring 520 are located on a suction side of the valve plate 530, which suction side faces towards the piston 240. The discharge valve spring 540 is located on a discharge side of the valve plate 530, which faces in the opposite direction of the piston 240. When assembled, the valve plate 530, the suction valve spring 520 and the cylinder gasket 510 are pressed into a valve plate seat 312 of the cylinder housing 310, as will be described below in detail.

[0041] A suction connector head 640 of the suction muffler 600 and a discharge connector head 730 of the discharge muffler 700 are pressed onto the discharge side of the valve plate 530, wherein a first sealing element 550 is placed between the valve plate 530 and the suction connector head 640 as well as the discharge connector head 730 respectively.

[0042] During the suction cycle of the pump unit 10, the piston 240 inside the cylinder 320 moves away from the valve plate 530, so that a negative pressure builds up in the cylinder 320, because the suction valve spring 520 keeps the suction opening of the valve plate 530 closed due to its spring force, while the discharge valve spring 540 closes the discharge opening 532 of the valve plate 530. When the negative pressure exceeds a certain threshold, the suction valve spring 520, which at least has a section configured as a reed valve, opens the suction opening to allow refrigerant to flow from the suction pipe 30 through the suction muffler 600 into the cylinder 320.

[0043] During the compression cycle of the pump unit 10, the piston 240 inside the cylinder 320 moves in the direction of the valve plate 530, so that the refrigerant in the cylinder 320 is compressed, because the discharge valve spring 540 keeps the discharge opening of the valve plate 530 closed due to its spring force, while the suction valve spring 520 keeps the suction opening of the valve plate 530 closed. Once the pressure of the compressed refrigerant exceeds a predefined threshold, the discharge valve spring 540, which is configured as a reed valve, opens the discharge opening of the valve plate 530 to allow refrigerant to flow from the cylinder 320 through the discharge muffler 700 to the discharge tube 20.

[0044] The suction muffler 600 includes a lower housing part 610, an upper housing part 620 and an inner housing element 630, which is inserted into a suction muffler volume defined by the lower housing part 610 and the upper housing part 620 of the suction muffler 600. Refrigerant is sucked into the suction muffler 600 via an inlet opening 621 located in the upper housing part 620 mainly during the suction cycle of the pump unit 10. The suction muffler 600 dampens sound based on the well-known Helmholtz principle when refrigerant flows through it, i.e. by chambers formed within the suction muffler 600 which act as resonators that absorb sound. The refrigerant escapes the suction muffler 600 through the suction connector head 640, which is placed above the suction opening of the valve plate 530 and is located on the upper housing part 620 of the suction muffler 600.

[0045] The discharge muffler 700 includes a lower housing part 710, an upper housing part 720 and the discharge connector head 730, which is connected to the upper housing part 720 of the discharge muffler 700. During the discharge cycle of the pump unit 10, compressed refrigerant coming from the discharge opening of the valve plate 530 enters the discharge muffler 700 though the discharge connector head 730. The discharge muffler 700 dampens sound based on the well-known Helmholtz principle when refrigerant flows through it, i.e. by chambers formed within the discharge muffler 700 which chambers act as resonators that absorb sound and or by pulsation filtering. The compressed refrigerant escapes the discharge muffler 700 through a discharge connection tube 750, which is connected to the discharge tube 20 via connection sleeve 760 and an O-ring seal 762.

[0046] The mounting of the cylinder head assembly 500 to the cylinder housing 310 is facilitated by a mounting assembly 580 (see Fig. 3), which comprises a clamping element 560 for clamping the valve plate 530 to the valve plate seat 312 and a fixing element 570, which presses the suction connector head 640 and the discharge connector head 730 onto the valve plate 530. The fixing element 570 is latched onto the clamping element 560. The clamping element 560 further comprises two positioning pins 565 (see Fig. 2), which are used for aligning the discharge connector head 730 with the discharge opening and the suction connector head 640 with the suction opening respectively.

[0047] Fig. 3 shows the pump unit 10 of the refrigerant compressor 1 in an assembled state. The suction muffler 600 and the discharge muffler 700 are fixed to the cylinder housing 310 via the clamping element 560 and the fixing element 570 of the mounting assembly 580, while the crankshaft 210 is inserted into the crankcase 300 and the stator 420 is surrounding the rotor 410.

[0048] Fig. 4 shows a three dimensional view of the refrigerant compressor 1 from the outside from a viewing direction offset by 90° compared to Fig. 1. Both the lower shell part 110 and the upper shell part 120 of the compressor shell 100 as well as the two supporting base plates 160 are visible.

[0049] The lower shell part 110 comprises a bottom wall 111 and a lower circumferential wall 112, while the upper shell part 120 comprises a top wall 121 and an upper circumferential wall 122 (see Fig. 5). The top wall 121 forms a top surface of the upper shell part 120 and the upper circumferential wall 122 is acting as a lateral surface of the upper shell part 120. Analogously the bottom wall 111 forms a bottom surface of the lower shell part 110 and the lower circumferential wall 112 is acting as a lateral surface of the lower shell part 110.

[0050] The two supporting base plates 160 are welded to an outer surface 111b of a bottom wall 111 of the lower shell part 110 (compare Fig. 5 and Fig. 7). Each supporting base plate 160 has a fixing section 161 and a mounting section 162, wherein the fixing section 161 comprises welding areas 165, in which the fixing section 161 is welded to the bottom wall 111 - see also Fig. 5, which shows a side view of the refrigerant compressor 1 from the outside - and the mounting section 162 has two openings 164 for receiving outer dampening elements 91, wherein the openings 164 are spaced apart in the length direction x. In other words the support damper assemblies 90 are connected to the supporting base plates 160 via the openings 164. The mounting section 162 and the fixing section 161 are offset in the height direction z by an inclined connection section 163. A three dimensional view of the supporting base plates 160 without the compressor shell 100 is visible in Fig. 6, while in Fig. 7, which shows a three dimensional view of the refrigerant compressor 1 from the outside from diagonally below, the mounting of the supporting base plates 160 on the lower shell part 110 of the compressor shell 100 is visible.

[0051] Fig. 8 shows a top view of the interior of the upper shell part 120 of the compressor shell 100 of the refrigerant compressor 1 and Fig. 9 shows a top view of the interior of the corresponding lower shell part 110 of the compressor shell 100 of the refrigerant compressor 1. In both Figures the pump unit 10 is not shown, but it is clearly perceptible that the compressor shell 100 consisting of upper shell part 120 and lower shell part 110 encloses an inner containing space 130 for housing the pump unit 10.

[0052] Four mounting pins 140 are extending from the bottom wall 111 into the containing space 130 (see Fig. 2), wherein the pins 140 are arranged in a rectangular shape, which is aligned with the length direction x and with the width direction y. A first centre point C_1 of the pins 140 in a horizontal plane h is offset in the direction x with regard to a second centre point C_2 of an outline of the compressor shell 100 in the horizontal plane h. A curved section 111a of the bottom wall 111 is spherically curved in order to form an oil pocket 104, which lowest point, seen in the height direction z, is aligned with the first centre point C_1 in the horizontal plane h (see Fig. 9). On each mounting pin 140 a lower spring pin 61 is mounted (compare Fig. 2), which lower spring pin 61 is a part of one of the four support spring assemblies 60, on which the pump unit 10 is mounted within the compressor shell 100. In Figs. 9 and 10 the lower spring pins 61 and the support springs 62 are already mounted on the mounting pins 140, therefore the mounting pins 140 are invisible. However as the mounting pins 140 and the lower spring pins 61 are aligned, the positioning of the mounting pins 140 can easily be derived from the shown positioning of the lower spring pins 61.

[0053] The curved section 111a extends from the lower circumferential wall 112 inward, wherein the curved section 111a of the bottom wall 111 is interrupted by four support areas 113. Each of the four mounting pins 140 is located on one of the support areas 113 (see Fig. 9), wherein the support areas 113 are designed as plateaus within the curved section 111a of the bottom wall 111. The mounting pins 140 are welded to the respective support areas 113 in order to define the position of the support spring assemblies 60 and thereby fix the lower spring pins 61 of the support spring assemblies 60 relative to the compressor shell 100 during operation and transportation. As can be seen in Figs. 11 and 12, an oil sump forms within the oil pocket 104 during operation of the refrigerant compressor 1, which oil sump is also bounded by a lower end of the lower circumferential wall 112 which forms the transition between lower circumferential wall 112 and bottom wall 111.

[0054] A connection shield 150 is welded to an outer surface 112a of the lower circumferential wall 112, wherein the connection shield 150 has a shield base plate 151 with an opening 152 for the electric pass through element 50 of the compressor 1, and wherein two support arms 153 extend from the shield base plate 151 and the opening 152 of the base plate 151 (see Fig. 4). The connection shield 150 is usually formed as an integral metal part so that the support arms 153 can be produced by bending two opposite ends of the connection shield 150. The support arms 153 are slightly bent inwards towards each other, which makes it easier to slide clips 806,807 of the electronic control unit 800 onto the support arms 153, so that the support arms 153 are situated between the clips 806,807 in the mounted state of the refrigerant compressor 1. This can be seen in Fig. 9 as well as in Fig. 10, wherein Fig. 10 shows a sectional view of the refrigerant compressor 1 without the pump unit 10 according to the sectional line C-C indicated in Fig. 5. I.e. the sectional line in Fig. 10 runs through the lower circumferential wall 112 of the lower shell part 110 as well as through the electric pass through element 50, the connection shield 150 and the electronic control unit 800, wherein the electronic control unit 800 is not visible in Fig. 5.

[0055] The upper shell part 120 comprises two sets of contacting regions 123 for limiting the movement of inner dampening elements 330 mounted on the pump unit 10. These regions 123 and/or corresponding dampening elements 330 are visible in Figs. 8, 11 and 12, wherein Fig. 11 shows a sectional view of the refrigerant compressor 1 according to the sectional line A-A indicated in Fig. 5 and Fig. 12 shows a sectional view of the refrigerant compressor 1 according to the sectional line B-B indicated in Fig. 11. Each set of contacting regions 123 contains two contacting regions 123, wherein each contacting region 123 has

- a first contact area being essentially aligned to the horizontal plane h,
- a second contact area being essentially aligned with a first vertical plane v_1 and
- a third contact area being essentially aligned with a second vertical plane v_2.

[0056] The first vertical plane v_1 is defined by the length direction x as well as the height direction z and the second vertical plane v_2 is defined by the width direction y and the height direction z (compare Fig. 4).

[0057] It is self evident that even though each contact area is essentially aligned with one of the planes, the contact areas do not have to be mathematically precise. In fact each contact area may be slightly curved in order to facilitate easy production and there are curved transition areas connecting the contact areas of one contact region 123.

[0058] The inner dampening elements 330 prevent the pump unit 10 from making contact with the top wall 121 of the upper shell part 120, since every movement or deflection of the pump unit 10 brings about a corresponding deflection of the inner dampening elements 330.

[0059] Referring to Fig. 8, the interaction of the inner dampening element 330, which is located in the upper left contacting region 123 and the respective contacting region 123 is intended to limit the movement of the pump unit 10 along the positive height direction z, along the negative length direction x as well as along the negative width direction y.

[0060] The interaction of the inner dampening element 330, which is located in the lower left contacting region 123 (see Fig. 8), and the respective contacting region 123 is intended to limit the movement of the pump unit 10 along the positive height direction z, along the negative length direction x as well as along the positive width direction y.

[0061] The interaction of the inner dampening element 330, which is located in the upper right contacting region 123 (see Fig. 8), and the respective contacting region 123 is intended to limit the movement of the pump unit 10 along the positive height direction z, along the positive length direction x as well as along the positive width direction y.

[0062] The interaction of the inner dampening element 330, which is located in the lower right contacting region 123 (see Fig. 8), and the respective contacting region 123 is intended to limit the movement of the pump unit 10 along the positive height direction z, along the positive length direction x as well as along the negative width direction y.

[0063] All four inner dampening elements 330 together with their respective contact areas 123 limit the movement of the pump unit 10 in the positive height direction z, in positive and negative length direction x as well as in in positive and negative width direction y.

[0064] Figs. 11 and 12 show the refrigerant compressor 1 in an operating condition, where the pump unit 10 is located inside the compressor shell 100 and mounted on the support spring assemblies 60, wherein each support spring assembly 60 is mounted on one of the mounting pins 140. In detail for each support spring assembly 60 the lower spring pin 61 is mounted onto the respective mounting pin 140 and the support spring 61 connects the lower spring pin 61 with the upper spring holder 63 of the pump unit 10. Further oil is in the oil pocket 104 and the support damper assembly 90 is mounted on the supporting base plates 160. The oil pocket 104 is essentially formed by the lower curved section 111a of the bottom wall 111 and the bottom wall 111. The advantage of this design is that - even if the refrigerant compressor 1 is inclined, as shown in Fig. 11 - the oil pick-up 250 mounted to the lower end of the crankshaft 210 is still submerged in the oil sump thanks to the curvature of the curved section 111a of the bottom wall 111.

Reference Numerals

[0065]

1	Refrigerant Compressor
10	Pump Unit
20	Discharge Pipe
30	Suction Pipe
40	Maintenance Pipe
50	Electric Pass Through Element
60	Support Spring Assembly
61	Lower Spring Pin
62	Support Spring
63	Upper Spring Holder
70	First Connector Element
80	Second Connector Element
90	Support Damper Assembly
91	Outer Dampening Element
92	Damper Pin
93	Lining Disk
94	Securing Element
100	Compressor Shell
101	First Connection Opening
102	Second Connection Opening
103	Third Connection Opening
104	Oil Pocket
110	Lower Shell Part
111	Bottom Wall
111a	Curved Section of the Bottom Wall
111b	Outer Surface of the Bottom Wall
112	Lower Circumferential Wall
112a	Outer Surface of the Lower Circumferential Wall
113	Support Area
120	Upper Shell Part
121	Top Wall
122	Upper Circumferential Wall
123	Contacting Region
130	Inner Containing Space
140	Mounting Pin
150	Connection Shield
151	Shield Base Plate
152	Opening of the Connection Shield
153	Support Arm
160	Supporting Base Plate
161	Fixing Section of the Supporting Base Plate
162	Mounting Section of the Supporting Base Plate
163	Connection Section of the Supporting Base Plate
164	Opening of the Supporting Base Plate
165	Welding area of the fixing section
200	Cranktrain
201	Ball Bearing
210	Crankshaft
220	Crankpin
230	Connecting Rod
240	Piston
243	Piston Pin
244	Clamping Sleeve

250	Oil Pickup
251	Mounting Rivet
300	Crankcase
301	First Protrusion
302	Main Bearing
310	Cylinder Housing
311	Second Protrusion
312	Valve Plate Seat
320	Cylinder
330	Inner Dampening Elements
340	Stator Mounting Screw
400	Electric Drive Unit
410	Rotor
420	Stator
421	Lower End Element
430	Inner Harness
500	Cylinder Head Assembly
510	Cylinder Gasket
520	Suction Valve Spring
530	Valve Plate
540	Discharge Valve Spring
550	First Sealing Element
560	Clamping Element
565	Positioning Pins
570	Fixing Element
580	Mounting Assembly
600	Suction Muffler
610	Lower Housing Part of the Suction Muffler
620	Upper Housing Part of the Suction Muffler
621	Inlet Opening
630	Inner Housing Element
640	Suction Connector Head
700	Discharge Muffler
710	Lower Housing Part of the Discharge Muffler
720	Upper Housing Part of the Discharge Muffler
730	Discharge Connector Head
750	Discharge Connection Tube
760	Connection Sleeve
800	Electronic Control Unit
x	Length Direction
y	Width Direction
z	Height Direction
h	Horizontal Plane
v_1	First Vertical Plane
v_2	Second Vertical Plane
C_1	First Centre Point
C_2	Second Centre Point

Claims

1. A compressor shell (100) for a refrigerant compressor (1) comprising a lower shell part (110) and an upper shell part (120);

   wherein the compressor shell (100) encloses an inner containing space (130) for housing a pump unit (10) of the refrigerant compressor (1);
   wherein the compressor shell (100) extends along a length direction (x), a width direction (y) and a height direction (z), wherein the length direction (x) and the width direction (y) define a horizontal plane (h);
   wherein the lower shell part (110) comprises a bottom wall (111) and a lower circumferential wall (112);
   wherein the upper shell part (120) comprises a top wall (121) and an upper circumferential wall (122);
   wherein four mounting pins (140) are extending from the bottom wall (111) into the containing space (130),
   wherein each mounting pin (140) is configured to mount a support spring assembly (60) for supporting the pump unit (10),
   wherein the four mounting pins (140) are arranged in a rectangular shape being aligned with the length direction (x) and the width direction (y),
   characterized in that
   a first centre point (C_1) of the four mounting pins (140) in the horizontal plane (h) is offset in the length direction (x) with regard to a second centre point (C_2) of an outline of the compressor shell (100) in the horizontal plane (h)
   and that
   a curved section (111a) of the bottom wall (111) is convexly curved in order to form an oil pocket (104), wherein a lowest point of the oil pocket (104), seen in the height direction (z), is aligned with the first centre point (C_1) in the horizontal plane (h).

2. The compressor shell (100) according to claim 1, **characterized in that** the curved section (111a) of the bottom wall (111) extends from the lower circumferential walls (112) inward, wherein the curved section (111a) of the bottom wall (111) is interrupted by four support areas (113), wherein each mounting pin (140) is located in one of the support areas (103).

3. The compressor shell (100) according to claim 2, **characterized in that** the curved section (111a) of the bottom wall (111) is shaped spherically.

4. The compressor shell (100) according to any one of claims 1 to 3, **characterized in that** a discharge pipe (20) and a maintenance pipe (40) are located in the lower circumferential wall (112) and a suction pipe (30) is located in the upper circumferential wall (122).

5. The compressor shell (100) according to any one of claims 1 to 4, **characterized in that** an electric pass through element (50) is located in the lower circumferential wall (112) .

6. The compressor shell (100) according to claim 5, **characterized in that** a connection shield (150) for supporting an electronic control unit (800) of the refrigerant compressor (1) is welded to an outer surface (112a) of the lower circumferential wall (112), wherein the connection shield (150) has a shield base plate (151) with an opening (152) and two support arms (153) extending from the base plate (151), wherein the opening (152) of the base plate (151) surrounds the electric pass through element (50).

7. The compressor shell (100) according to any one of claims 1 to 6, **characterized in that** the upper shell part (120) has two sets of contacting regions (123) for limiting the movement of inner dampening elements (330) mounted on the pump unit (10),

   wherein each set contains two contacting regions (123), wherein each contacting region (123) has a first contact area being essentially aligned to the horizontal plane (h), a second contact area being essentially aligned with a first vertical plane (v_1) and a third contact area being essentially aligned with a second vertical plane (v_2),
   wherein the first vertical plane (v_1) is defined by the length direction (x) and the height direction (z) and the second vertical plane (v_2) is defined by the width direction (y) and the height direction (z).

8. The compressor shell (100) according to any one of claims 1 to 7, **characterized in that** two supporting base plates (160) are welded to an outer surface (111b) of the bottom wall (111), wherein each support base plate (160) has a fixing section (161) and a mounting section (162), wherein the fixing section (161) is welded to the bottom wall (111) and the mounting section (162) has two openings (164) for receiving outer dampening elements (91), wherein the openings (164) are spaced apart in the length direction (x).

9. The compressor shell (100) according to claim 8, **characterized in that** the mounting section (162) and the fixing section (161) of the supporting base plates (160) are offset in the height direction (z) by an inclined connection section (163).

10. The compressor shell (100) according to claim 8 or 9, **characterized in that** the mounting section (162) and the fixing section (161) are aligned in parallel to the horizontal plane (h).

11. The compressor shell (100) according to any one of claims 8 to 10, **characterized in that** welding areas (165) of the fixing section (161) are aligned with support areas (113) for the mounting pins (140) in the horizontal plane (h).

12. An encapsulated refrigerant compressor (1) having

   - a compressor shell (100), wherein a discharge pipe (20), a suction pipe (30) and a maintenance pipe (40) enter the compressor shell (100),

   wherein an electric pass through element (50) is inserted into the compressor shell (100);

   - a pump unit (10) comprising:

     -- a cranktrain (200) having a crankshaft (210), a crank pin (220), a connecting rod (230) and a piston (240);
     -- an electric drive unit (400) having an inner harness (430), a stator (420) and a rotor (410), the rotor (410) being fixed to the crankshaft (210), wherein the inner harness (430) is connecting the electric pass through element (50) and the stator (420);
     -- a crankcase (300) with a cylinder housing (310),

       wherein a cylinder (320) for reciprocating movement of the piston (240) is located in the cylinder housing (310), wherein the crankshaft (210) is rotatably mounted in the crankcase (300), wherein the stator (420) is attached to the cylinder crankcase (300);

     -- a cylinder head assembly (500) mounted to the cylinder housing (310) of the crankcase (300), the cylinder head assembly (500) comprising a valve plate (530), a suction valve spring (520), a discharge valve spring (540), a suction muffler (600) and a discharge muffler (700), wherein the discharge muffler (700) has a discharge connection tube (750) being connected to the discharge pipe (20);

   - a plurality of support spring assemblies (60) for supporting the compressor body (10) in the compressor shell (100),

   wherein the compressor shell (100) is configured according to any one of claims 1 to 11.

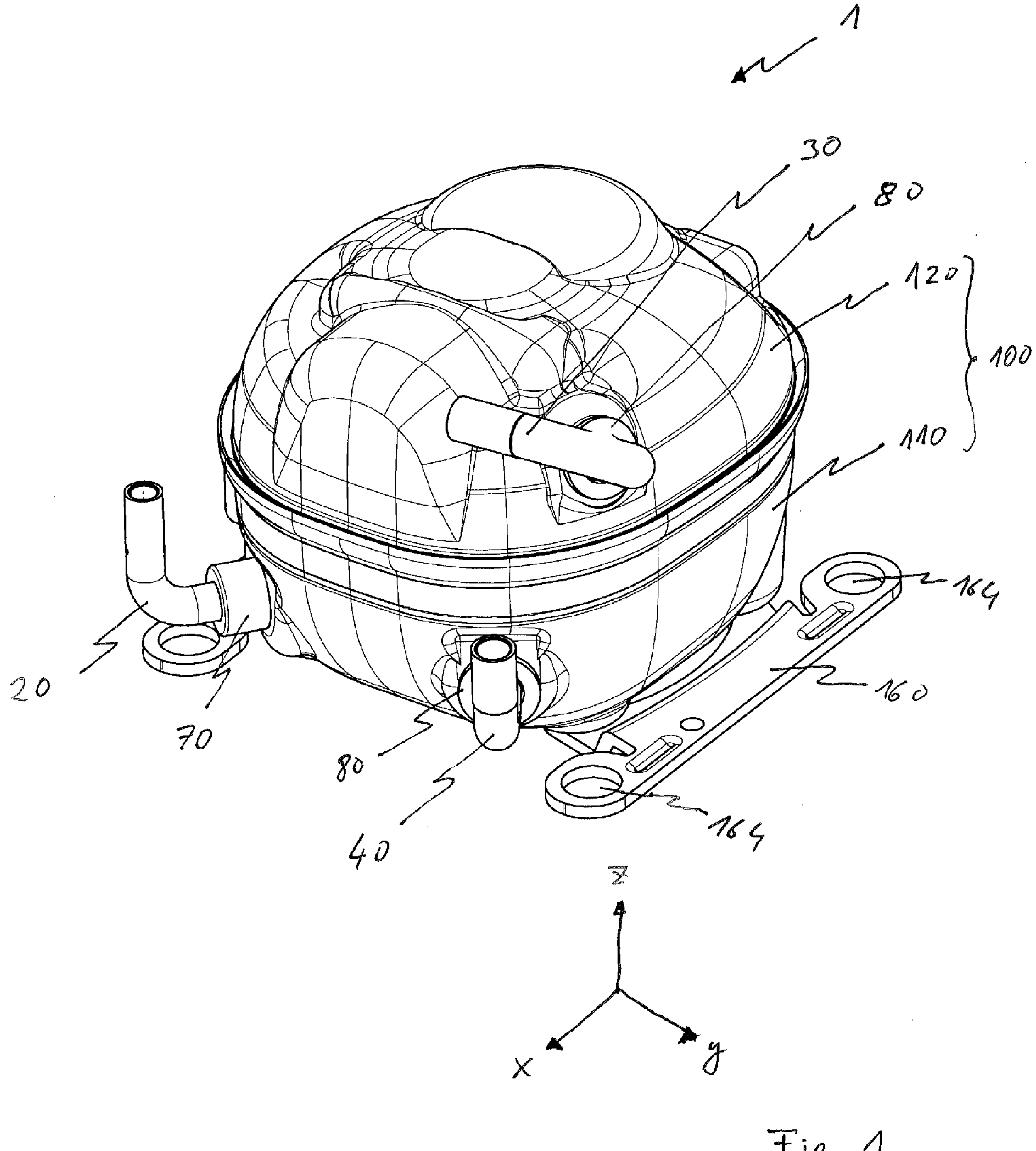


Fig. 1

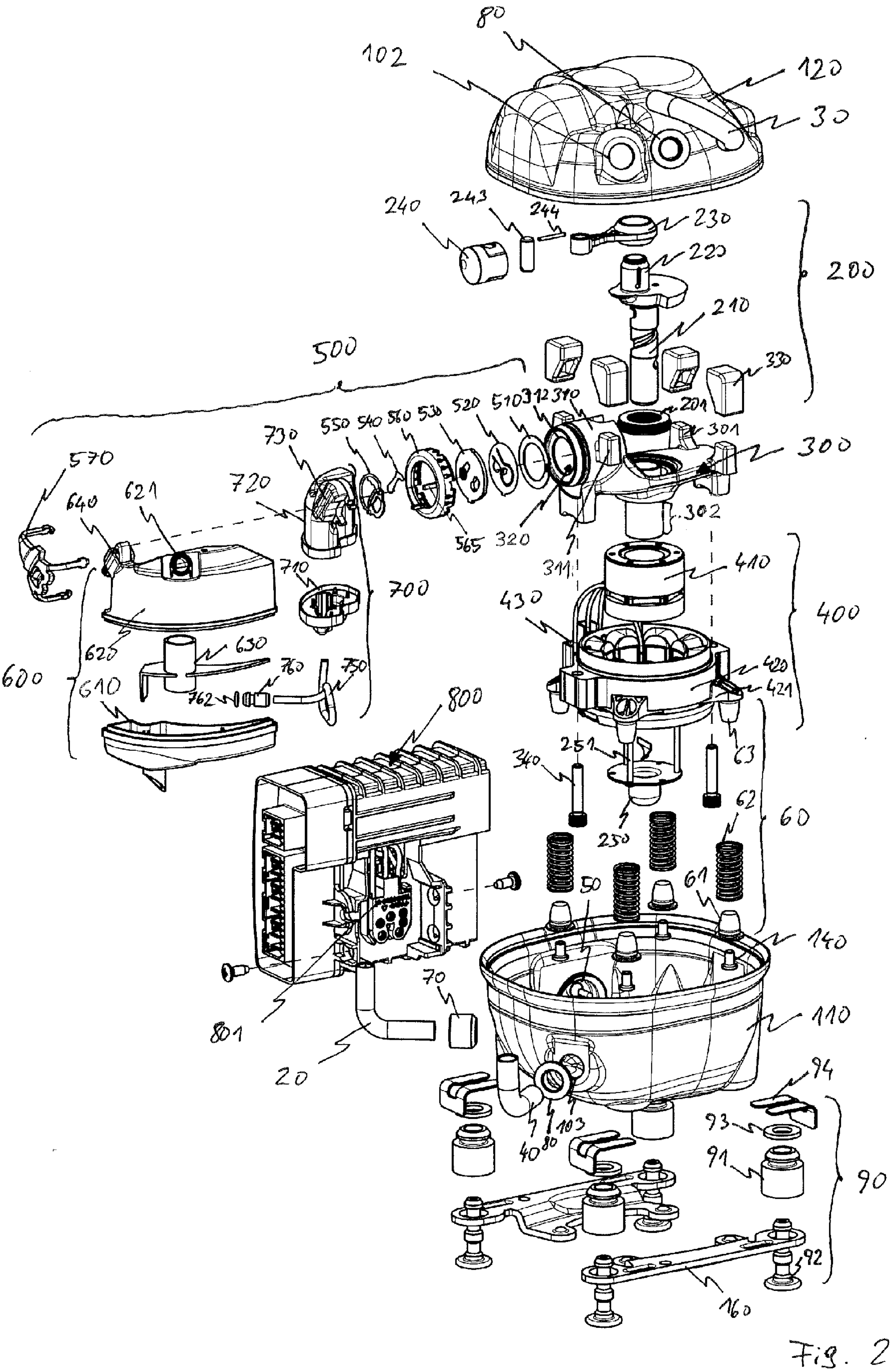
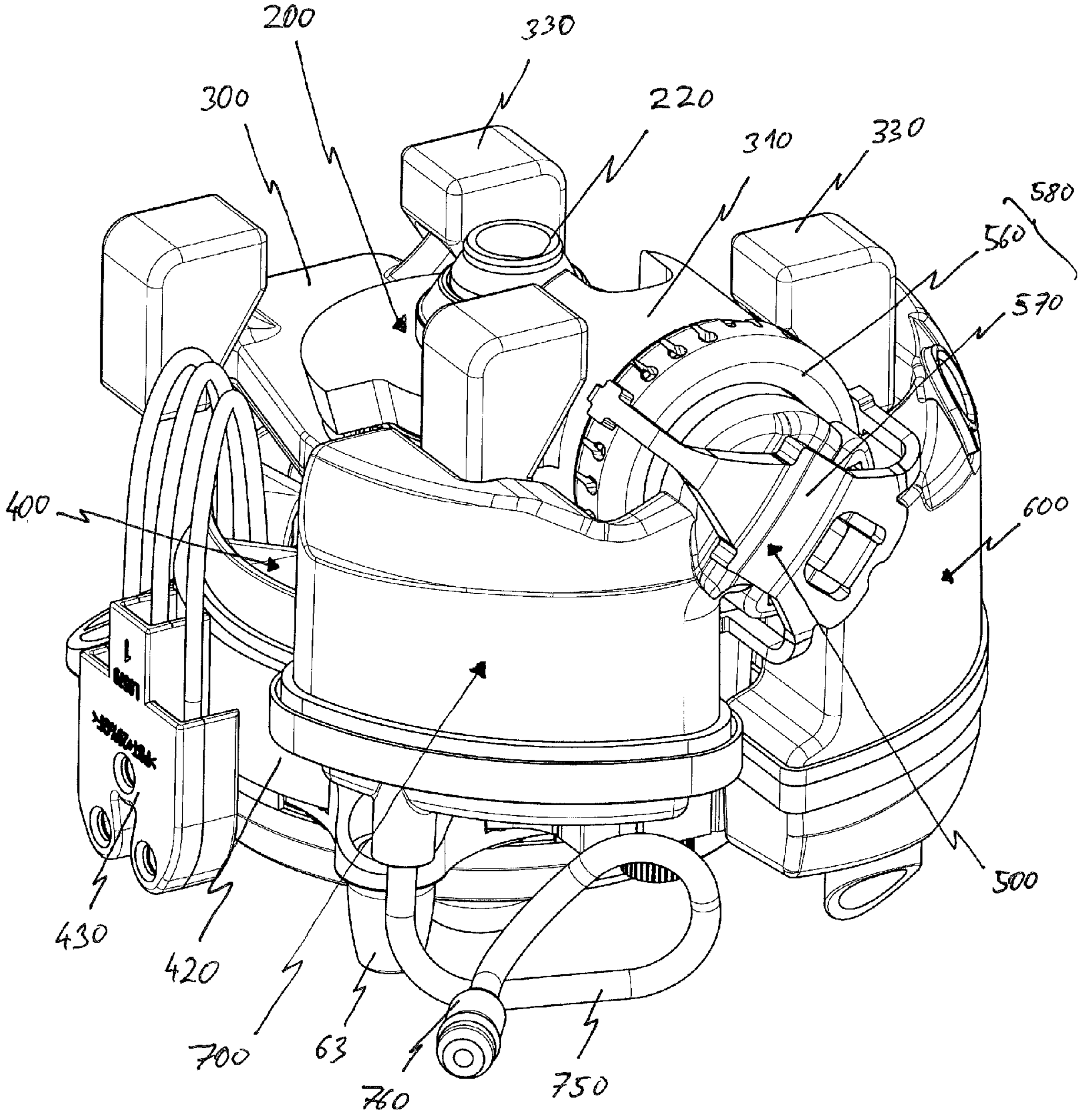
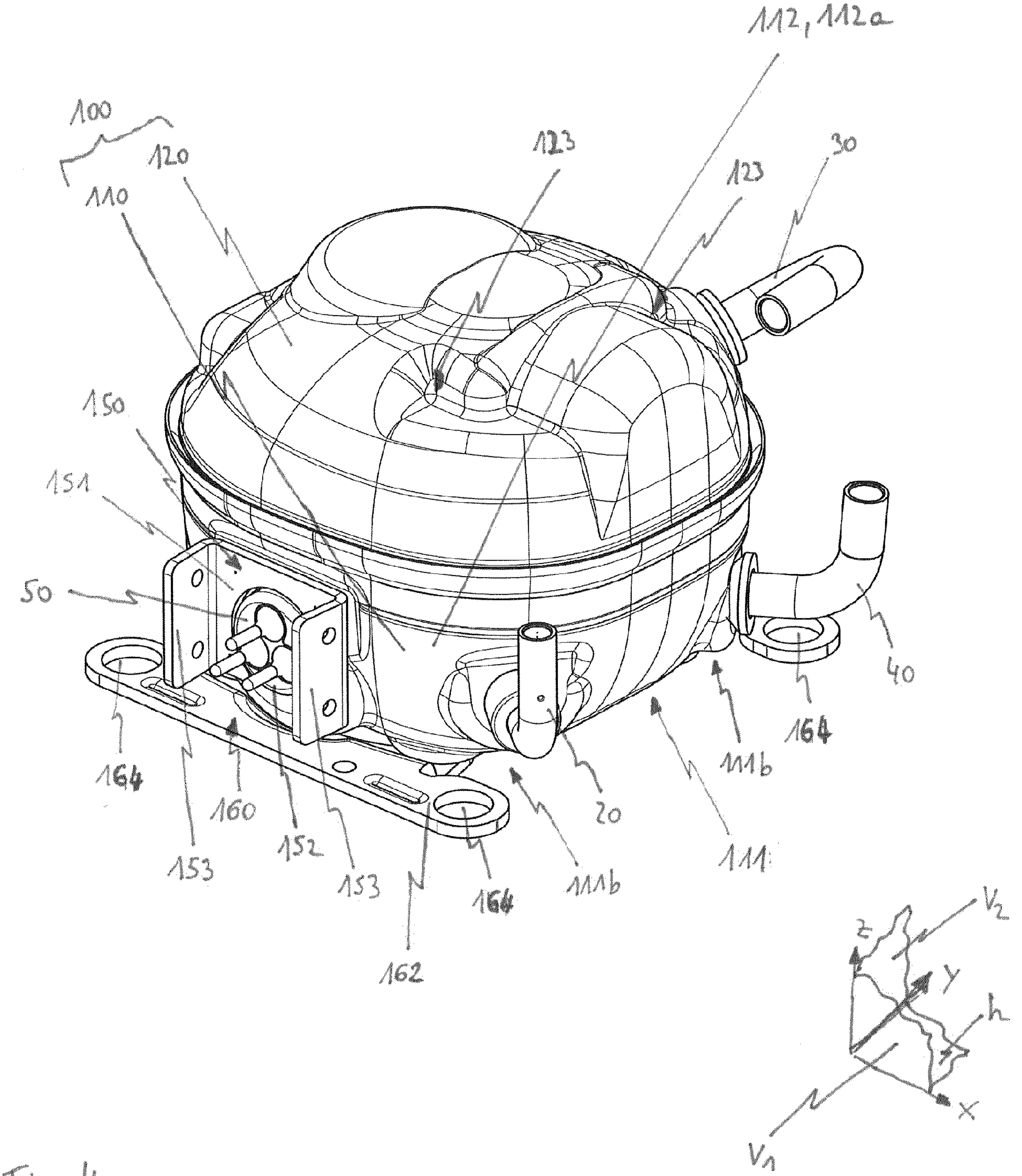

80
102
120
30
240
243
244
230
220
200
210
500
330
201
301
300
570
640
621
730
720
550
540
560
530
520
510
312
310
565
320
302
311
410
710
700
400
430
620
630
600
610
760
750
762
420
421
800
251
63
340
62
60
250
50
61
140
70
801
110
20
94
40
80
103
93
91
90
92
160

Fig. 2



200
330
300
220
310
330
580
560
570
400
600
430
420
700
63
760
750
500

Fig. 3



100
120
110
123
112, 112a
123
30
150
151
50
40
164
111b
164
20
111
164
153
160
152
153
164
111b
162
V2
z
y
h
x
V1

Fig. 4

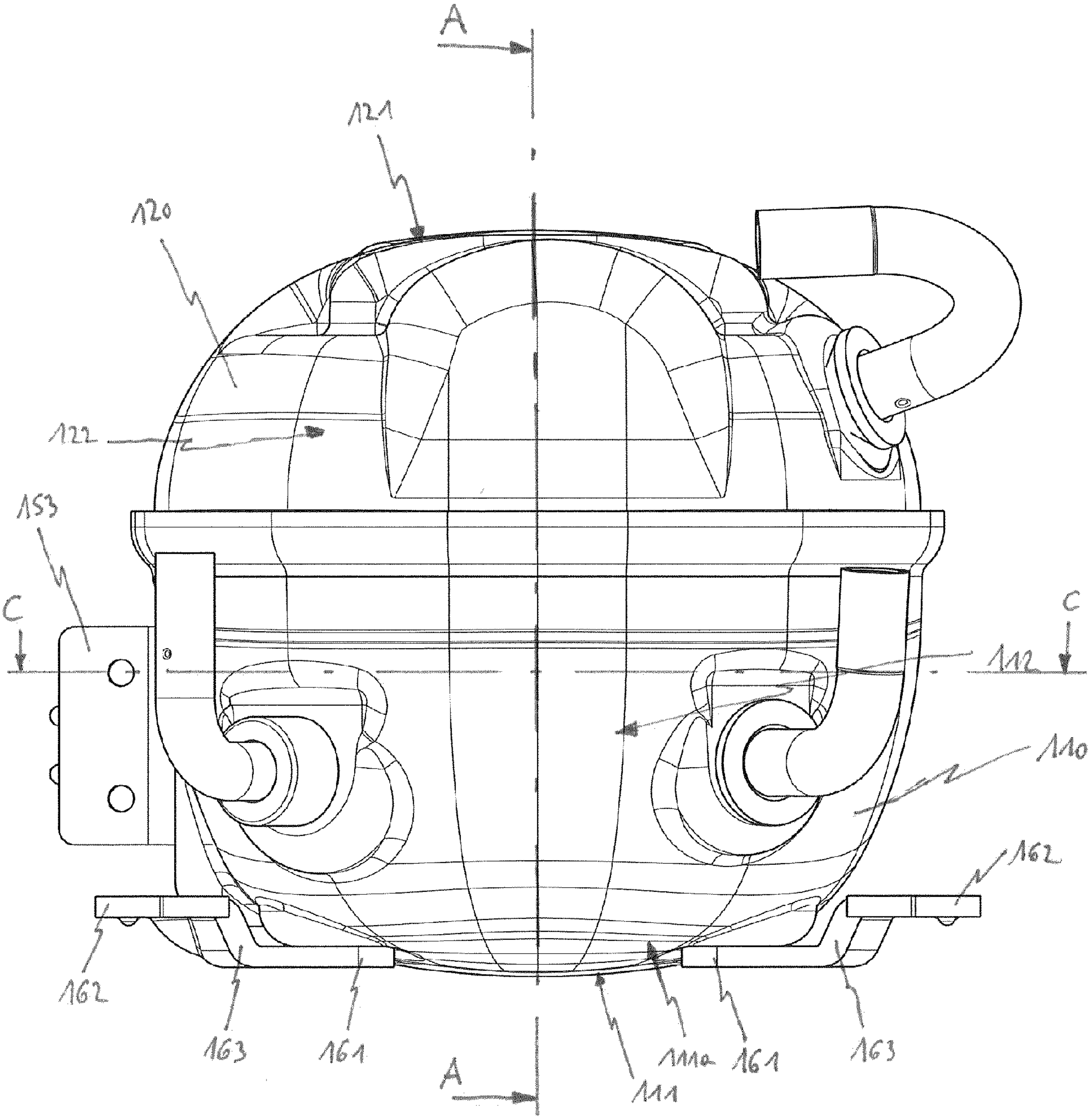


Fig. 5

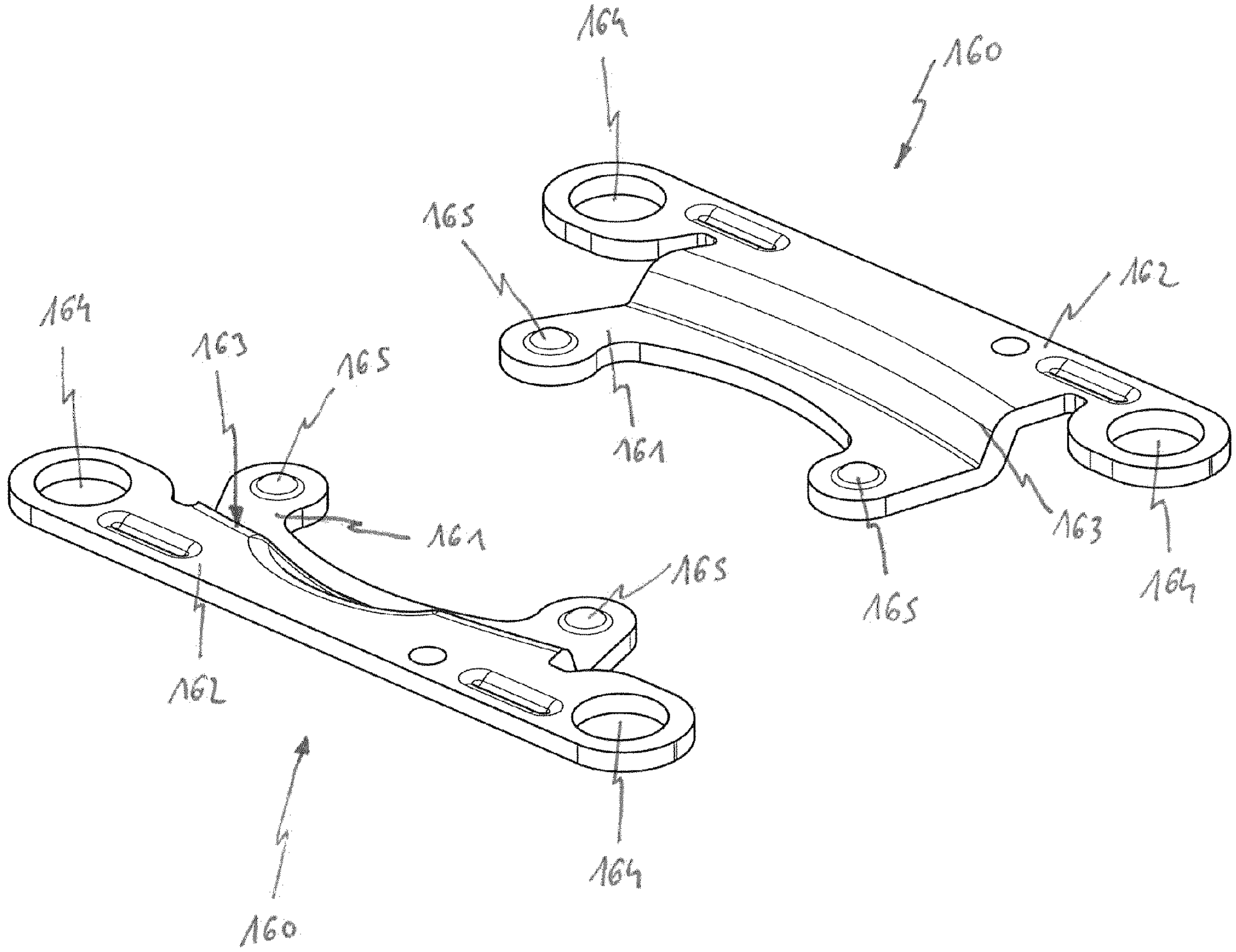


Fig. 6

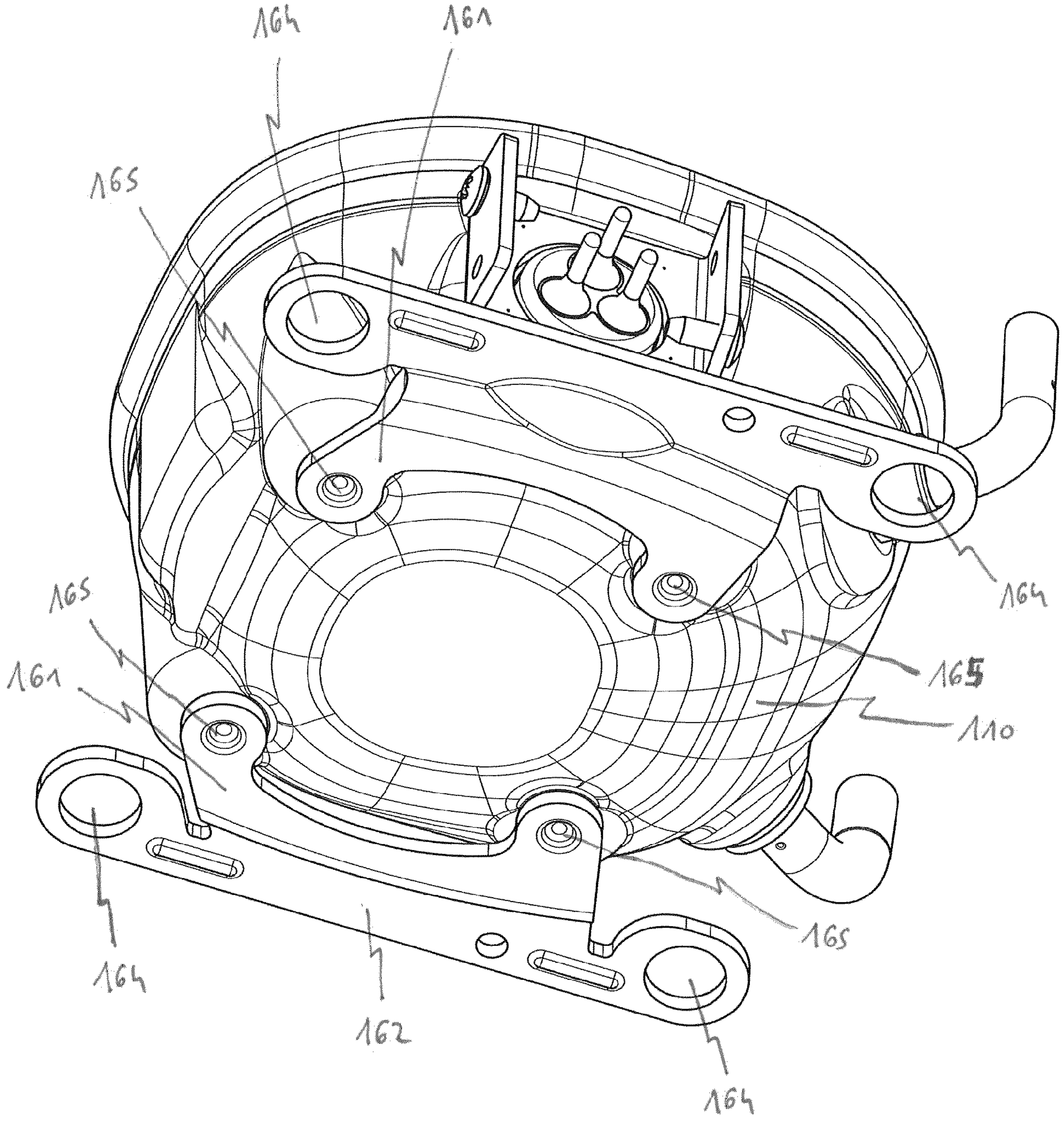


Fig. 7

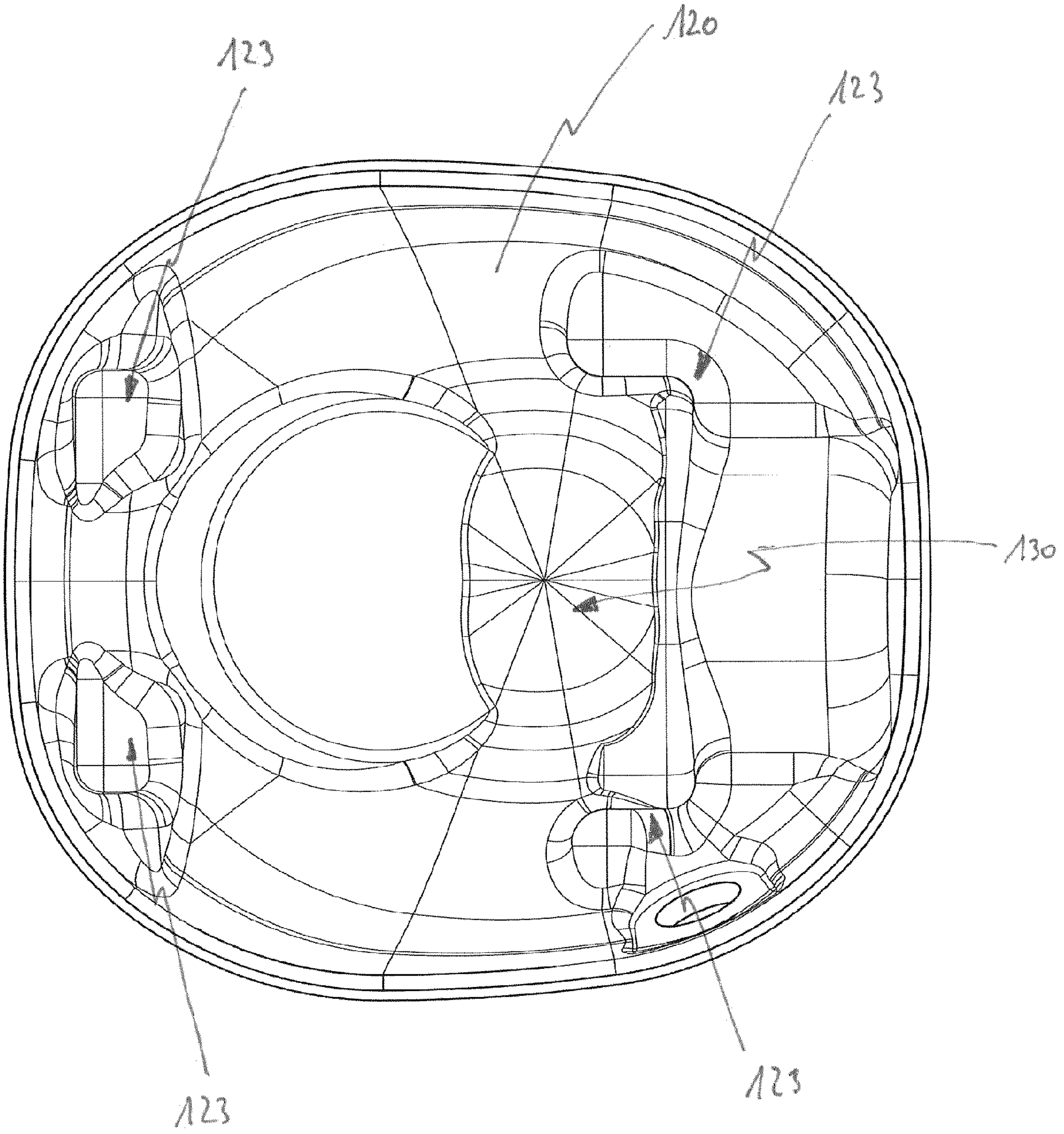
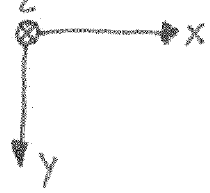


Fig. 8



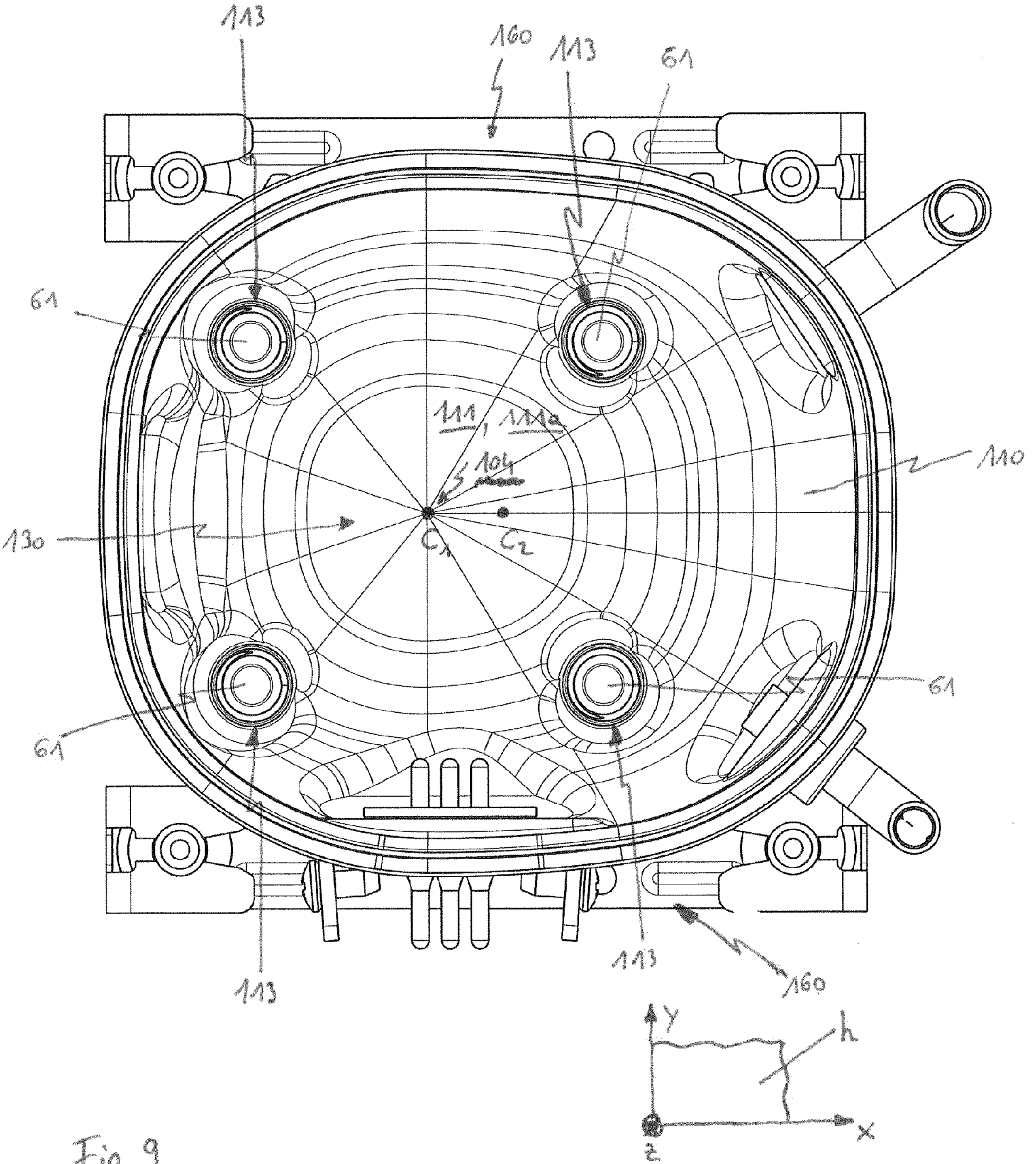

113
160
113
61
61
111, 111a
104
110
130
C1
C2
61
61
113
113
160
y
h
x
z

Fig. 9

C-C:

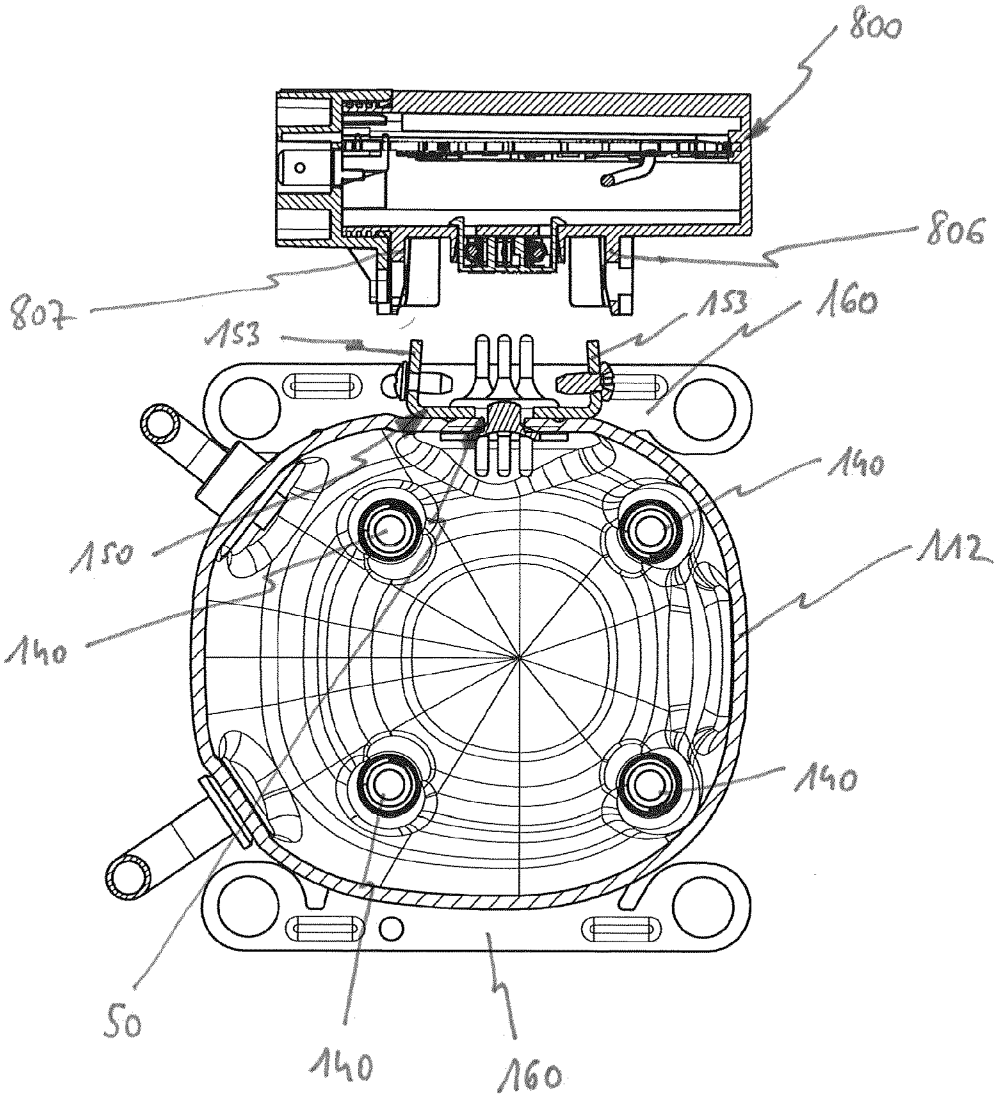


Fig. 10

A-A :

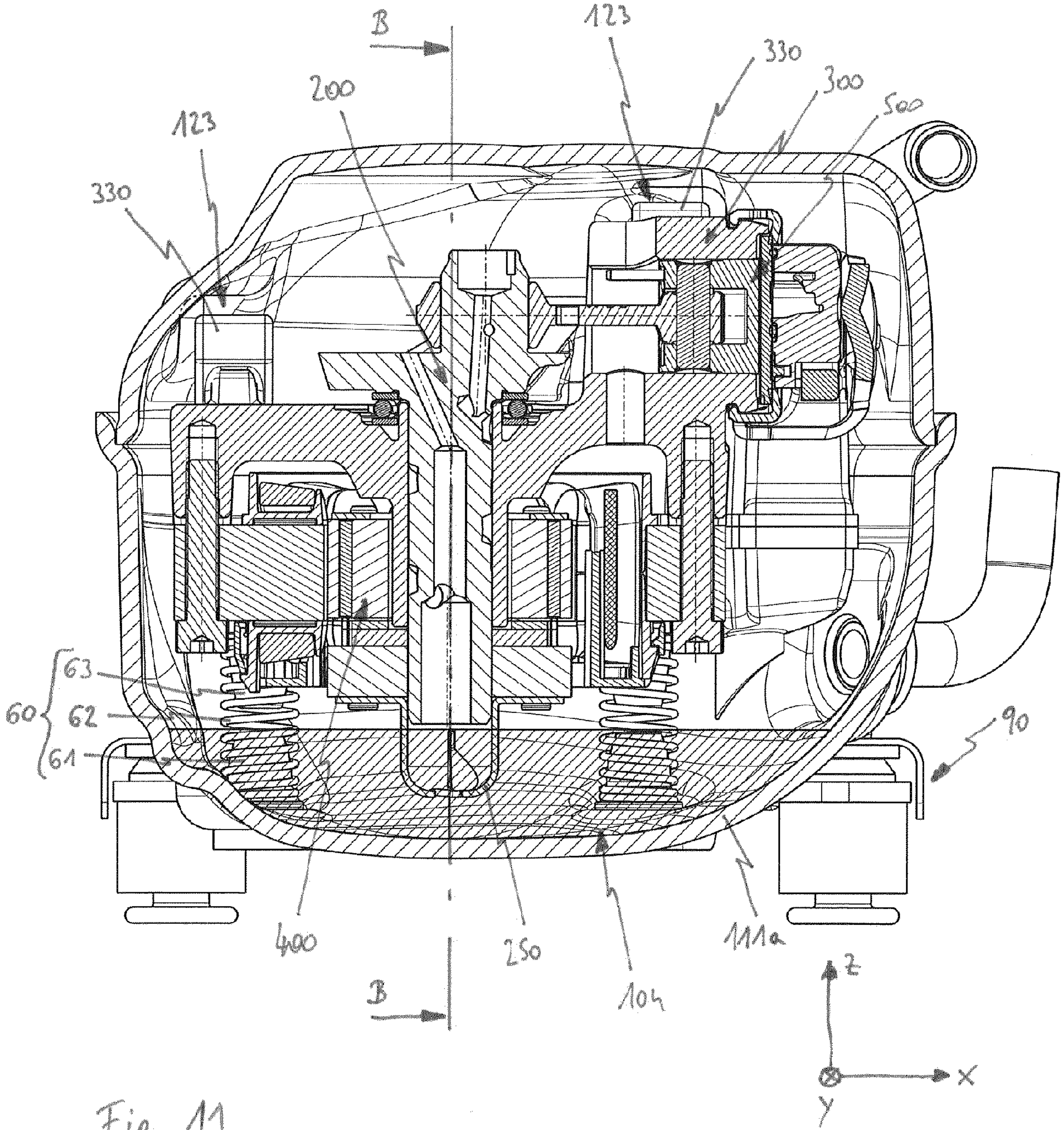


Fig. 11

B - B :

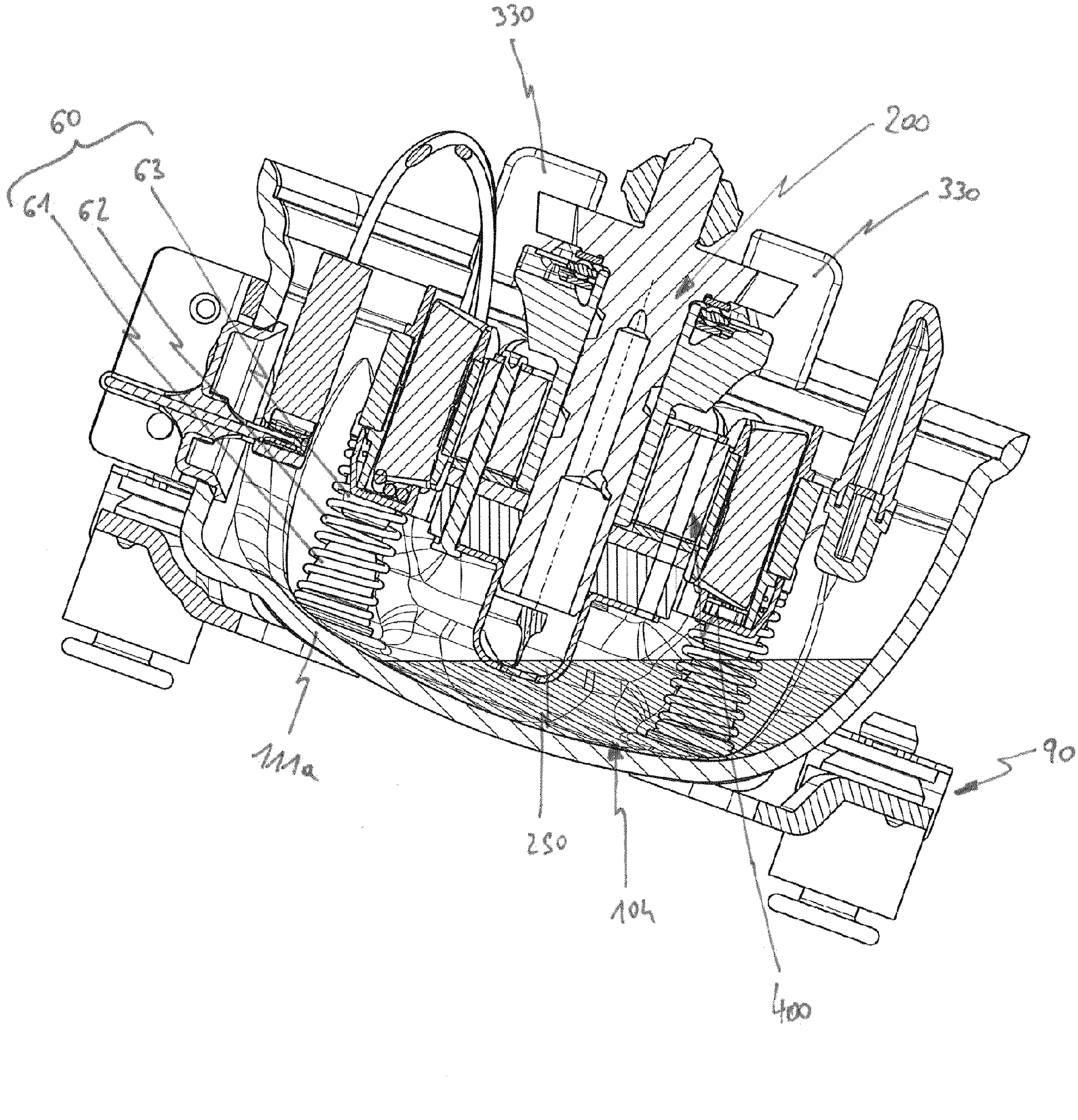


Fig. 12

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 22 20 3368

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	EP 3 882 463 A1 (LG ELECTRONICS INC. [KR]) 22 September 2021 (2021-09-22) * figures 1, 2 * * paragraph [0084] - paragraph [0095] * -----	1-12	INV. F04B39/00 F04B39/12 F04B39/02
A	EP 2 310 680 B1 (SECOP AUSTRIA GMBH [AT]) 7 September 2016 (2016-09-07) * figures 1,2 * * paragraph [0032] - paragraph [0035] * -----	1-12	
A	US 4 205 537 A (GENERAL ELECTRIC CO. [US]) 3 June 1980 (1980-06-03) * figures 2,3 * * column 2, line 40 - column 4, line 14 * -----	1-12	
A	WO 2016/192976 A1 (ARCELIK AS [TR]) 8 December 2016 (2016-12-08) * figures 1-3 * * paragraph [0017] - paragraph [0025] * -----	1-12	TECHNICAL FIELDS SEARCHED (IPC)
A	US 2013/129537 A1 (PANASONIC CORP. [JP]) 23 May 2013 (2013-05-23) * figures 1, 2 * * paragraph [0033] - paragraph [0042] * -----	1-12	F04B

The present search report has been drawn up for all claims

2

Place of search	Date of completion of the search	Examiner
Munich	14 March 2023	Gnüchtel, Frank

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons
....
& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 22 20 3368

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

14-03-2023

Patent document cited in search report		Publication date	Patent family member(s)			Publication date
EP 3882463	A1	22-09-2021	CN	215256668	U	21-12-2021
			EP	3882463	A1	22-09-2021
			KR	102292632	B1	20-08-2021
			US	2021293233	A1	23-09-2021
EP 2310680	B1	07-09-2016	AT	10802	U1	15-10-2009
			CN	102308091	A	04-01-2012
			EP	2310680	A1	20-04-2011
			WO	2010003896	A1	14-01-2010
US 4205537	A	03-06-1980	NONE			
WO 2016192976	A1	08-12-2016	NONE			
US 2013129537	A1	23-05-2013	CN	103122842	A	29-05-2013
			JP	6378725	B2	22-08-2018
			JP	2013127243	A	27-06-2013
			JP	2017031978	A	09-02-2017
			JP	2018128022	A	16-08-2018
			US	2013129537	A1	23-05-2013

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82