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

(11) **EP 4 170 162 B1**

(12) # EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention of the grant of the patent:
11.06.2025 Bulletin 2025/24

(21) Application number: **22203367.2**

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

(51) International Patent Classification (IPC):
F04B 35/04 *(2006.01)* ***F04B 39/00*** *(2006.01)*
F04B 39/02 *(2006.01)* ***F04B 39/12*** *(2006.01)*

(52) Cooperative Patent Classification (CPC):
F04B 39/123; F04B 35/04; F04B 39/0061; F04B 39/023; F04B 39/0253; F04B 39/12; F04B 39/121

(54) **REFRIGERANT COMPRESSOR**
KÄLTEMITTELVERDICHTER
COMPRESSEUR DE RÉFRIGÉRANT

(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

(30) Priority: **25.10.2021 EP 21204535**

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

(73) Proprietor: **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)

(56) References cited:
EP-A1- 0 753 106
EP-A1- 3 358 184
WO-A1-2016/039042
US-A- 4 969 804
US-A1- 2009 175 741
US-A1- 2014 286 753
US-B2- 10 323 630
US-B2- 6 634 870

EP 4 170 162 B1

Description

FIELD OF THE INVENTION

[0001] The invention relates to an encapsulated refrigerant compressor having

- a compressor shell having a lower shell part and an upper shell part, wherein a discharge pipe enters the compressor shell through a first connection opening, a suction pipe enters the compressor shell through a second connection opening, and a maintenance pipe enters the compressor shell through a third connection opening,

  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 movement 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.

PRIOR ART

[0002] 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.

[0003] 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.

[0004] 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.

[0005] 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. 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.

[0006] 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.

[0007] The connection between the discharge muffler and the discharge pipe, from which the compressed refrigerant can flow to the high-pressure side of the refrigerant appliance, e.g. a condenser, needs to be sealed against in order to prevent efficiency losses due to compressed refrigerant escaping into the low-pressure ambient. Due to the compression, the compressed refrigerant has a higher temperature than the sucked in refrigerant, which can cause unwanted heating of the compressor shell in the region in which the discharge pipe is connected to the compressor shell. In order to establish a sealed connection between the discharge connection tube coming from the discharge muffler and the discharge pipe plastic elements are difficult to use, as they tend to be damaged by the heat intake caused by the common principles of hermetic connection such as welding or soldering.

[0008] EP 3 358 184 A1 is directed to a muffler assembly of a refrigerant compressor. A discharge hose is integrally formed with the muffler assembly using injection moulding. Further it is disclosed that the discharge hose is connected to the discharge pipe via a connector, which is inserted into an upwardly bent second body part of the discharge pipe which is positioned well within the compressor shell. The discharge pipe has a pipe body that is coupled to the lower shell via a cylindrical-shaped coupling part. The pipe body consists of a first body part that penetrates the lower shell and the second body part that extends in an upward direction within the compressor shell. The connector is attached to the discharge hose, preferably connector and discharge hose are integrally formed, and inserted downwardly into the upwardly oriented second body part of the inserted discharge pipe to facilitate easy assembly.

OBJECT OF THE INVENTION

[0009] It is therefore an object of the invention to provide a refrigerant compressor which overcomes the disadvantages of the prior art and provides an improved connection of discharge pipe and discharge connection tube, which reduces the heating of the compressor shell by the discharge pipe on the one hand and allows use of a plastic element for connecting discharge pipe and discharge connection tube on the other hand.

SUMMARY OF THE INVENTION

[0010] At least one of the objects set out above is solved in a refrigerant compressor according to claim 1.

[0011] The design according to the invention has two substantial advantages over the prior art: Firstly, the connection between the discharge tube and the compressor shell is established via the first connector element as intermediate element. As the discharge pipe is hermetically connected to the first connector element, preferably via soldering or welding, and the first connector element is on the other hand hermetically connected to the compressor shell, preferably by welding or soldering, the heat transfer between the discharge pipe and the compressor shell is reduced as heat can dissipate from the first connector element, which provides additional dissipation surface. Also the thermal conductivity of the first connector element can have a positive impact. This is generally of importance as the discharge pipe is usually made of a material with high thermal conductivity, such as copper or copper alloys.

[0012] Secondly the positioning of the connection sleeve, which is preferably made of a plastic material (also called polymer based material), within the receiving section of the discharge tube, but spaced apart from the discharge pipe connecting section of the first connector element, ensures that establishing the hermetic connection between discharge pipe and first connector element, preferably by soldering, does not damage the sleeve element, which is already inserted into the receiving section of the discharge pipe.

[0013] In order to further improve the heat dissipation by increasing the surface area on the one hand and by increasing the distance between the shell connection section and the discharge pipe connection section of the first distancing element, a further embodiment variant of the invention provides that a connection air gap is formed between the discharge pipe and at least a section of the distancing section, preferably the whole distancing section, of the first connector element. The air gap forming between the discharge pipe and the first connector element guarantees that the heat transfer between discharge pipe and first connector element is restricted to the discharge pipe connection section. Furthermore, the air gaps acts as thermal insulation layer between the discharge pipe and the respective part of the distancing section.

[0014] In a further embodiment of the invention it is provided that an O-ring seal is inserted into a circumferential groove of the connector sleeve, thereby sealing the connection between the discharge connection tube coming from the discharge muffler and the discharge pipe.

[0015] According to a further embodiment variant of the invention it is provided that the first connection opening for the discharge pipe and/or the third opening for the maintenance pipe are located in the lower shell part. This setup allows comfortable integration of the refrigerant compressor into a refrigerant appliance on the one hand and an optimal positioning of the pump unit, especially of the cylinder head assembly, within the compressor shell on the other hand. Preferably both connection openings are located in a lower circumferential wall of the lower shell part of the compressor shell.

[0016] To secure the connection sleeve, which is preferably made of a plastic material, within the receiving section of the discharge pipe, so that the connection sleeve cannot slip back into the shell during assembly or operation, a further embodiment variant of the invention provides that the discharge pipe is crimped in the receiving section to hold the connection sleeve inside the discharge pipe. The discharge pipe can be crimped in a portion of the receiving section, which is located between a pump unit side end of the connection sleeve and a pump unit end of the discharge pipe. If the discharge pipe is crimped in a section of the receiving section, in which overlaps with the connection sleeve, the crimping should be carried out in such a way that the connection sleeve is not deformed, as deformation could negatively impact the sealing capacity of the connection sleeve .

[0017] In order to allow an easy integration of the refrigerant compressor into a refrigerant appliance on the one hand and an optimal positioning of the pump unit, especially of the cylinder head assembly, within the compressor shell on the other hand, a further embodiment variant provides that the second connection opening and the suction pipe are located in the upper shell part and an inlet opening of the suction muffler is aligned with the second connection opening. In this embodiment the refrigerant compressor relies onto the indirect suction principle in which a containing space within the compressor shell also acts as a reservoir for refrigerant which is sucked in by the pump unit. However, the positioning of the second connection opening in alignment with the suction opening of the suction muffler, the coefficient of performance [COP] of the refrigerant compressor can be increased.

[0018] A further embodiment variant of the compressor provides that the encapsulated refrigerant compressor further comprises an electronic control unit being fixed to the compressor shell, which electronic control unit is connected to the electric pass through element via an outer harness. The electronic control unit is preferably powered by a battery, when the refrigerant compressor is used in a mobile refrigerant appliance. The electronic control unit powers the electric drive unit and controls the rotational speed of the crankshaft and thereby indirectly the cooling capacity of the refrigerant appliance.

[0019] In a further embodiment variant of the invention it is provided that a connection shield is welded to an outer surface of the lower shell part, wherein the electronic control unit is mounted to the connection shield. Preferably the connection shield is configured to allow snap-on mounting of the electronic control unit to reduce the amount of work required during assembly on the one hand and to allow easy maintenance and replacement on the other hand.

[0020] According to a further embodiment variant of the invention it is provided that the connection shield has a shield base plate with an opening and two support arms extending from the shield base plate. This design is especially preferred for a snap-on mounting configuration of the electronic control unit, whereas the opening can be positioned around the electric pass through element in order to easily establish the electric connection between the electronic control unit and the inner harness.

[0021] A further embodiment variant of the invention provides that the suction pipe is connected to the compressor shell via a second connector element,

> wherein a shell connection section of the second connector element is hermetically connected to the second connection opening,
> wherein a pipe connection section of the second connector element is hermetically connected to the suction pipe.

[0022] Another embodiment variant of the invention provides that the maintenance pipe is connected to the compressor shell via a second connector element,

> wherein a shell connection section of the second connector element is hermetically connected to the third connection opening,
> wherein a pipe connection section of the second connector element is hermetically connected to the maintenance pipe.

[0023] Using a second connector element for connection of the maintenance pipe and/or the suction pipe to the compressor shell simplifies establishing the hermetical connection as the second connector element can be hermetically connected to the shell, preferably by welding, whereas the suction pipe or maintenance pipe respectively can be hermetically connected to the second connector element, preferably by soldering, in a very efficient way. As the suction pipe and especially the maintenance pipe usually do not heat the compressor shell, in most cases an additional distancing section of the second connector element is not required (or can be very small) so that the second connector element can consist of the shell connection section and the pipe connection section.

[0024] Further advantageous embodiment variants are defined by the features of claims 12 and 13.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025] The invention will now be explained in more detail below with reference to exemplary embodiments. The drawings are provided by way of example, 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 an electronic control unit mounted to the compressor;

Fig. 5 shows a side view of the electronic control unit mounted to the compressor as in Fig. 4;

Fig. 6 shows a front view of the electronic control unit mounted to the compressor as in Fig. 4;

Fig. 7 shows a another side view of the electronic control unit mounted to the compressor as in Fig. 4;

Fig. 8 shows a back view of the electronic control unit mounted to the compressor as in Fig. 4;

Fig. 9 shows a top view of the electronic control unit mounted to the compressor as in Fig. 4;

Fig. 10 shows a bottom view of the electronic control unit mounted to the compressor as in Fig. 4;

Fig. 11 shows a sectional view of Fig. 4 parallel to the length direction x in Fig. 1;

Fig. 12 shows a sectional view of Fig. 4 parallel to the width direction y in Fig. 1;

Fig. 13 shows a three dimensional view of an electronic control unit mounted to the compressor as in Fig. 4, with the upper shell part removed;

Fig. 14 shows a sectional view of a pump unit as in Fig. 3 mounted on spring assemblies parallel to the length direction x in Fig. 1;

Fig. 15 shows a sectional view of Fig. 4 parallel to the length direction x in Fig. 1;

Fig. 16 shows a sectional view of Fig. 4 wherein the sectional plane goes through the discharge pipe;

Fig. 16a shows a detailed view of Fig. 16;

Fig. 16b shows a detail of a sectional view through a second connector element;

Fig. 17 shows a top view of the electronic control unit before mounting to the compressor;

Fig. 18 shows a top view of the electronic control unit mounted to the compressor according to Fig. 4;

Fig. 19 shows a top view of the electronic control unit before mounting to the compressor, with the electronic control unit and the compressor cut open;

Fig. 20 shows a top view of the electronic control unit mounted to the compressor according to Fig. 4, with the electronic control unit and the compressor cut open.

DETAILED DESCRIPTION

[0026] 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.

[0027] In the following reference will occasionally be made to (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.

[0028] 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).

[0029] 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 is entering 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.

[0030] 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.

[0031] 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.

[0032] 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.

[0033] 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.

[0034] 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.

[0035] 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.

[0036] 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.

[0037] The cranktrain 200 comprises a piston 240 and a crankshaft 210, which is rotatably mounted inside a main bearing 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.

[0038] 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.

[0039] 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.

[0040] 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.

[0041] 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 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.

[0042] 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.

[0043] 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.

[0044] 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.

[0045] 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.

[0046] 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.

[0047] In Fig. 4 the electronic control unit 800 is mounted to the compressor 1. The housing of the electronic control unit 800 comprises a main housing 802 and a cover 803 which here is mounted to the main housing 802. For supplying power to the compressor 1 usually a plug, which is connected to the power supply, is inserted in a respective socket in the cover 3 which socket holds electric connectors, here blade-like connectors, of the circuit board. Here two sockets, one upper socket for a DC power supply and one lower socket for an AC power supply are provided. Corresponding labeling can be seen on the side of cover 803.

[0048] Fig. 5 shows a side view of the electronic control unit 800 mounted to the compressor 1 as depicted in Fig. 4.

[0049] Fig. 6 shows a front view of the electronic control unit 800 mounted to the compressor 1, i.e. to its compressor shell 100, as shown in Fig. 4. One can see the cover 803 and the second clip 807 of the main housing 802 wherein the projection 810, which is a screw head in this embodiment, is now located in the opening 808 (see Fig. 19) of second clip 807.

[0050] Fig. 7 shows another side view of the electronic control unit 800 mounted to the compressor 1 as depicted in Fig. 4. This view is opposite to the view of Fig. 5.

[0051] Fig. 8 shows a back view of the electronic control unit mounted 800 to the compressor 1 as depicted in Fig. 4. This view is opposite to the view of Fig. 6.

[0052] Fig. 9 shows a top view of the electronic control unit 800 mounted to the compressor 1 as depicted in Fig. 4.

[0053] Throughout Figure 4, 6, 7, 8 and 9 contacting regions 123 of the upper shell part 120 are shown which interact with the inner dampening elements 330 during operation in order to avoid collision of the pump unit 10 with the compressor shell 100 during operation or transport as it is movably mounted on the support spring assemblies 60. The contact areas 123 and the inner dampening elements 330 are configured in order to restrict movement in x direction, y direction and z direction.

[0054] Fig. 10 shows a bottom view of the electronic control unit 800 mounted to the compressor 1 as depicted in Fig. 4.

[0055] Fig. 11 shows in a sectional view of Fig. 4 that is parallel to the length direction x in Fig. 1 the structure of an assembled pump unit 10 of the refrigerant compressor 1. 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.

[0056] The crankshaft 210 has a crankshaft axis 211 that indicates the axial direction of the crankshaft 210. Perpendicular to the crankshaft axis 211 is depicted in Fig. 11 via arrows a radial direction 212 of said crankshaft 210.

[0057] As can also be seen in even more detail in Fig. 14, in axial direction of the crankshaft 210 starting on top with the crankpin 220 and the counterweight 225 are several regions formed in downward direction along its outside: an upper bearing section 215, thereupon below a lubrication section 216, further downstream of it a lower bearing section 217, and even further downwards a rotor fixation section 218 where the rotor 410 of the electric drive unit 400 is mounted to the crankshaft 210, preferably via press fitting.

[0058] The crankshaft 210 transfers the rotating movement from the electric drive unit 400 to the connecting rod 230 and further to the piston 240. It has two bearing sections 215 and 217 which interact with a corresponding main bearing section 302 that acts as a crankshaft bearing shell of the crankcase 300. The two bearing sections 215 and 217 are both arranged in axial direction 211 below the connecting rod 230. Furthermore, a crankpin bearing 223 interacts with the connecting rod 230. The rotor 410 is fixed to the bottom side of the crankshaft 210 below the lower bearing section 217 by press-fit.

[0059] The lubrication unit 216 further comprises a lubrication recess that forms a thin lubrication gap in communication with the main bearing section 302 of the crankcase 300. An axial length of the lubrication recess corresponds to the axial length of said lubrication section 216 that is positioned between the upper bearing section 215 and the lower bearing section 217.

[0060] On top of the counterweight 225, respectively on its upper side 225a, there is the crankpin 220 positioned. A crankpin axis 221 runs in parallel with the crankshaft axis 211, wherein the crankpin axis 221 is arranged eccentrically to the crankshaft axis 211. The crankpin 221 has a crankpin lubrication recess, wherein lubricant that is supplied from a crankpin lubrication bore that is in communication with said crankpin lubrication recess, is distributed to lubricate the crankpin sliding bearing 224.

[0061] The crankpin 220 of the crankshaft 210 protrudes from a first upper side 225a of the counterweight 225. The crankshaft 210 protrudes from an opposite second lower side 225b of the counterweight 225 with regard to the crankpin 220. The longitudinal axis 221 of the crankpin 220 is positioned eccentrically and parallel with regard to the longitudinal axis 211 of the crankshaft 210.

[0062] The crankcase 300 has two crankcase legs 303 connected to the stator 420 via two stator mounting screws 340, resulting in a light weight and small component build-up. The crankcase 300 has a groove in the back of the cylinder housing 310 to facilitate the assembly of the connecting rod 230 into the crankshaft 210 and following the piston pin 243 and clamping sleeve 244.

[0063] The main bearing section 302 of the crankcase 300 acts as a crankshaft bearing shell, within which the crankshaft 210 is slidably mounted. As said before, the crankshaft 210 has a first, upper bearing section 215 and has spaced therefrom in an axial distance 216b a second, lower bearing section 217. The upper bearing section 215 is configured to interact with the main bearing section 302 as upper bearing journal to form a first, upper sliding bearing 215b. The lower bearing section 217 is configured to interact with the main bearing section 302 of the crankcase 300 as lower bearing journal to form a second, lower sliding bearing 217b. An upper bearing seat 305 for said upper bearing section 215 of the crankshaft 210 is positioned at an upper end section of the main bearing section 302 of the crankcase 300. Said upper end section of the main bearing section 302 is facing towards the counterweight 225 and facing towards an upper side 300a of the crankcase 300. The upper bearing seat 305 is configured to be flexibly bendable in a radial direction 212 of the crankshaft 210 to reduce edge loading of the crankshaft 210 relative to the crankcase 300.

[0064] The upper bearing seat 305 has an inner side and an outer side. The inner side faces towards the crankshaft 210. The outer side of the upper bearing seat 305 faces towards a bearing recess 308 as can be seen in

Figures 11 and 14. According to this embodiment as shown in Figures 11 and 14, the upper bearing seat 305 of the crankcase 300 for the upper bearing section 215 of the crankshaft 210 is designed as a sleeve-shaped cylindrical extension 306 of the crankcase 300 with a wall thickness and an axial height.

[0065] The upper bearing seat 305 for the upper bearing section 215 of the crankshaft 210 is formed by a bearing recess 308 within the crankcase 300 that extends from an upper side 300a of the crankcase 300. The bearing recess 308 runs concentrically around the outer side of the upper bearing seat 305 downwards in axial direction 211 of the crankshaft 210.

[0066] According to Figures 11, 12 and 14, the bearing recess 308 has an essentially V-shaped cross-section that tapers in regard to the axial direction 211 of the crankshaft 210 towards the main bearing section 302.

[0067] Fig. 11 also shows the discharge pipe 20 and the discharge connection tube 750 that connects the discharge pipe 20 with the discharge muffler 700. As indicated the discharge connection tube 750 has a first end section 751, which is connected to the discharge muffler 700 (not visible), and a second end section 752, which is inserted into the discharge pipe 20. Furthermore the support spring assembly 60, on which the pump unit 10 is supported within the compressor shell 100 can be seen in an assembled state.

[0068] Fig. 12 shows a sectional view of Fig. 4 for a vertical section parallel to the width direction y in Fig. 1, cutting through the center of the compressor 1, with its upper 120 and lower shell part 110, and through its electric pass through element 50. Inside the housing 802,803 of the electronic control unit 800 one can see the circuit board 804 which is connected to the electric connecting element 805 via the outer harness 801. The electric connecting element 805 here is constructed as a socket which receives the contact pins of the electric pass through element 50 and which acts as a plug. One can see one contact pin extending into the electric connecting element 805.

[0069] In height direction z (see Fig. 1) the circuit board 804 basically extends through the whole main housing 802. In the upper part of the circuit board 804, which corresponds to the upper part of the main housing 802, the heavier and accordingly larger electric components are mounted, here one can see a capacitor. Arranging the heavier components near the top of the housing in the operating state helps to reduce vibrations and thus sound. The upper part of the main housing 802 has a greater width in order to accomodate larger electric components. So in this example the wall of the housing 802,803 facing away from the compressor 1 is basically flat whereas the wall of the housing 802,803 facing the compressor 1 has a bulge.

[0070] Figures 11 and 12 furthermore show that an oil sump builds up during operation of the refrigerant compressor 10 in an oil pocket 104 of the lower shell part 110.

[0071] Fig. 13 shows a three dimensional view of an electronic control unit mounted to the compressor as in Fig. 4, with the upper shell part 120 removed. Thereby the pump unit 10 can be seen, which pump unit 10 is supported within the lower shell part 110. In addition most of the main components of the pump unit 10 can be seen in the assembled state, namely an upper part of the cranktrain 200, the crankcase 300 with the cylinder housing 310, the cylinder head assembly 500 including the suction muffler 600 with its inlet opening 621 and the discharge muffler 700.

[0072] Fig. 14 shows a sectional view of a pump unit as in Fig. 3 mounted on spring assemblies parallel to the length direction x in Fig. 1. Reference is made here to the figure description above in combination with Fig. 11 and Fig. 12. As can also be seen in Fig. 14 in detail is that the ball bearing 201 functions as axial bearing that supports the axial load of the rotor 410 and the crankshaft 210 against the crankcase 300. The ball bearing is positioned below the counterweight 225, wherein an upper axial bearing seat 202 of the ball bearing 201 is positioned on the lower side of the counterweight 225. As the ball bearing 201 is positioned here at least in sections within the bearing recess 308, a lower axial bearing seat 203 of the ball bearing 201 is positioned within said bearing recess 308. According to this embodiment, the ball bearing 201 is advantageously centered in radial direction 212 of the crankshaft 210 by the outer side 305b of the upper bearing seat 305.

[0073] With reference to Fig. 14, in the following the oil pump system or lubricant conveying system, respectively, of the inventive refrigerant compressor is described in more detail: The lubricant conveying system of the pump unit 10 comprises an oil pickup 250 for conveying lubricant from a lubricant sump formed in a lower shell part 110 of the compressor shell 100 during operation to the rotating parts of the cranktrain 200. The oil pickup 250 is positioned on a lower end of the crankshaft 210. The oil pickup 250 is configured to distribute lubricant along an oil path upwards within an inner oil supply bore 254 in axial direction 211 of the crankshaft 210. From there the oil or lubricant is further distributed via a lower lubrication bore 255 to a helical groove 256 that is arranged on an outside of the crankshaft 210 along the peripheral surface of the lubrication section 216, even more precisely that is arranged along the length of the lubrication recess along the lubrication section 216 of the crankshaft 210. The lower lubrication bore 255 is positioned at the level of the lower sliding bearing 217b and is in communication to the inner oil supply bore 254.

[0074] From there the oil or lubricant is distributed further via an upper lubrication bore to the ball bearing 201, wherein the upper lubrication bore is positioned at the level of the upper sliding bearing 215b and is in communication to the inner oil supply bore 254. Lubricant can be further upwards distributed via a crankpin lubrication bore 275 to an oil splash outlet 280 on top of the crankpin 220. The oil splash outlet 280 is configured to lubricate the piston 240.

[0075] The oil pickup 250 is mounted to the rotor 410, and a helical blade 252 is positioned within the oil pickup 250 and is configured to distribute lubricant that is provided within an oil pump sleeve 253 of the oil pickup 250. Due to the helical blade 252 that reaches into the oil pickup the lubricant is advantageously diverted upwards within the inner oil supply bore 254 of the crankshaft 210 during operation of the compressor 1.

[0076] An inlet of the oil pump sleeve 253 has a degassing bore, here in a preferred embodiment an elongated degassing bore 253a, to improve degassing effects, making it easier for gas bubbles to disappear.

[0077] Usually the rotor 410 is a press-fit fixed to the crankshaft 210. Additionally, the oil pump can be press-fit to the crankshaft 210 as a second process step. In this case, the oil pump is integrated to the rotor 210 making possible to assembly both in one step, simplifying assembly and reducing cost.

[0078] The inner oil supply bore 254 of the crankshaft 210 in axial direction 211 of the crankshaft 210 has a crankshaft degassing bore 270 on its upper end, wherein the crankshaft degassing bore 270 leads through the counterweight 225 and ends on its upper side 225a. Due to this design, degassing effects are enhanced within the lubricant conveying system. Thus, unwanted dry running of the moving or sliding parts of the compressor 1 can be avoided.

[0079] Fig. 14 also shows that the cylinder head assembly 500 is fixed to the cylinder housing 310. The valve plate 530 is pressed into the valve plate seat 312 of the cylinder housing 310 by the clamping element 560 by means of a plurality of clamping protrusions of the clamping element 560, which latch into a circumferential clamping groove 313 of the cylinder housing 310. The fixing element 570, which is shown only in parts due to the sectional plane, latches onto the clamping element 560 and presses the suction connector head 640 of the suction muffler 600 and the discharge connector head 730 of the discharge muffler 700 (also only shown in part) against the valve plate 530. Furthermore the elements of the support spring assembly 60 can be seen in detail, such as the lower spring pin 61, the support spring 62 and the upper spring holder 63.

[0080] Fig. 15 shows a sectional view of Fig. 4 parallel to the length direction x in Fig. 1. Two support arms 153 extend from the outer surface of the compressor shell 100 of the compressor 1, wherein the electric pass through element 50 of the compressor 1 is at least partly, i.e. at least with its here three contact pins, situated between the support arms 153. The clips 806,807 of the housing 802,803 and the support arms 153 of the compressor shell 100 are designed in a way that the openings 808 of the clips 806,807 are snapped on projections 810 on the support arms 153 when the electronic control unit 800 is mounted on the compressor shell 100 and the electric pass through element 50 of the compressor 1 and the electric connecting element 805 of the electronic control unit 800 are electrically connected to each other.

[0081] The projections 810 are screw heads of screws which are screwed into the support arms 153. The support arms 153 have respective bores into which self-cutting screws are screwed. This is usually done before the step of connecting the electronic control unit 800 to the compressor shell 100 so that connecting the electronic control unit 800 to the compressor shell 100 is accomplished by simply snapping the electronic control unit 800 to the compressor shell 100 by using the openings 808 and the projections 810.

[0082] It is sufficient when only one projection 810 is provided per clip 806,807. In this example only one projection 810, i.e. screw head, is provided for the upper opening 808 of the first clip 806 and only one projection 810 is provided for the only lower opening 808 in the second clip 807.

[0083] To obtain the support arms 153 a connection shield 150 is welded to an outer surface of a lower shell part 110 of the compressor shell 100, 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 the two support arms 153 extend from the shield base plate 151 and the opening 152 of the base plate 151 surrounds the electrical pass through element 50. The connection shield 150 is usually an integral metal part and the support arms 153 are produced by bending two opposite ends of the connection shield 150. The electric pass through element 50 is a hermetic feedthrough element where the contact pins are encapsulated by glass or ceramic within a metallic body. Such elements are also called Fusite elements.

[0084] Fig. 16 shows a sectional view of the refrigerant compressor 1, from which the connection of the discharge pipe 20 to the lower shell part 110 of the compressor shell 100 and of the discharge connection tube 750, which is coming from the discharge muffler 700 (see Fig. 2), via a first connector element 70 can be seen. As will be discussed with regard to Fig. 16a, a receiving section 21 of the discharge pipe 20 can be seen with extends into the compressor shell 100.

[0085] Fig. 16a shows a detailed view of the first connector element 70, which comprises a shell connection section 71, a distancing section 73 and a discharge pipe connection section 72, which is spaced apart from the shell connection section 71 via the distancing section 72. The receiving section 21 of the discharge pipe 20 extends from an inner end of the discharge pipe connection section 72 inwards.

[0086] As can be seen, a connection sleeve 760 is mounted to a second end section 752 of the discharge connection tube 750, which connection sleeve 760 is inserted into the receiving section 21 of the discharge pipe 20. The shell connection section 71 of the first connector element 70 is welded onto the lower shell part 110 in order to hermetically seal the first connection opening 101, through which the discharge pipe 20 enters the compressor shell 100 in order to establish a hermetically sealed connection. Furthermore Fig. 16a shows that an air gap 22 is formed between the discharge pipe 20 and the distancing section 73 as well as the shell connection section 71 of the first connector element 70. The discharge pipe 20 is soldered to the discharge pipe connection section 72 of the first connector element 70 in order to establish a hermetically sealed connection

[0087] The connector sleeve 760 has a circumferential groove 761, in which an O-ring seal 762 is inserted in order to seal the connection between discharge pipe 20 and discharge connection tube 750.

[0088] Fig. 16b shows a section through the refrigerant compressor 1, especially through the second connector element 80, which connects the maintenance suction pipe 30 with the compressor shell 100. As can be seen, the second connector element 80 has a shell connection section 81 to establish a hermetically sealed connection between the compressor shell 100 and the second connector element 80, preferably by welding. The shell connection section 81 is located on an outer surface of the second connector element 80, wherein the second connector element 80 is partly inserted into the second connection opening 102 of the upper shell part 120 of the compressor shell 100. Furthermore, the second connector element 80 has a pipe connection section 82 to establish a hermetically sealed connection between the second connector element 80 and the suction pipe 30, preferably by welding. The pipe connection section 82 is configured as a bore of the second connection element 80, wherein an end section of the suction pipe 30 is inserted into the second connector element 80, in detail into the pipe connection section 82.

[0089] Even though not shown in a separate drawing it is understood that the second connection element 80 that connects the maintenance pipe 40 and the lower shell part 110 is structured similar to the above described second connection element 80, and is partly inserted into the respective third connection opening 103 of the lower shell part 110.

[0090] Fig. 16b also shows that the second connection opening 102 - and therefore the suction pipe 30 respectively - is aligned with the inlet opening 621 of the suction muffler 600. Also the geometry of one of the second protrusions 311 of the cylinder housing 310 as well as one of the inner dampening elements 330, which is mounted on the second protrusion 311 and thereby enveloping a significant part of the respective second protrusion 311, is shown in Fig. 16b.

[0091] Fig. 17 shows a top view of the electronic control unit 800 before mounting to the compressor 1. Between the two support arms 153 the three contact pins of the electric pass though element 50 can be seen.

[0092] Fig. 18 shows a top view of the electronic control unit 800 mounted to the compressor 1 as depicted in Fig. 4.

[0093] Fig. 19 shows a top view of the electronic control unit 800 before mounting to the compressor shell 100. The electronic control unit 800 and the compressor shell 100 are cut open horizontally to better see the first 806 and second clip 807 and the electric pass though element 50.

[0094] The main housing 802 comprises a first 806 and a second clip 807, which clips are protruding, here basically normal, from the outer surface of the main housing 802, wherein the electric connecting element 805 is situated between first 806 and second clip 807. Each clip 806,807 comprises at least one opening 808. Each clip 806,807 is elastically deformable in a direction parallel to the outer surface of the main housing 802, i.e. parallel to the length direction x (see Fig. 1). The openings 808 will snap on projections 810 (see also Fig. 15) on the compressor shell 100 when the electronic control unit 800 is mounted on the compressor shell 100 and electrically connected to the encapsulated refrigerant compressor 1 in order to mechanically fix the electronic control unit 800 on the compressor 1.

[0095] On their outside first and second clip 806,807 each are provided with several parallel stiffening ribs 811 running normal to the outer surface of the main housing 802, see Fig. 6, 8 and 15. Each opening 808 is situated between two stiffening ribs 811.

[0096] Protruding from the compressor shell 100 the support arms 153 and between the support arms the three contact pins of the electric pass though element 50 can be seen. The support arms 153 are slightly bent inwards towards each other which makes it easier to slide the clips 806,807 onto the support arms 153 so that the support arms 153 are situated between the clips 806,807 in the mounted state of the housing 802,803.

[0097] Fig. 20 shows a top view of the the electronic control unit mounted to the compressor, as depicted in Fig. 4, with the electronic control unit 800 and the compressor shell 100 cut open. The electronic control unit 800 is cut open horizontally to better see the first 806 and second clip 807. It can be seen that when the electronic control unit 800 is mounted on the compressor shell 100 the support arms 153 are situated between the clips 806,807.

Reference Numerals

[0098]

1	Refrigerant Compressor
10	Pump Unit
20	Discharge Pipe
21	Receiving Section of the Discharge Pipe
22	Connection Air Gap
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
71	Shell Connection Section of the First Connector

Element
72 Discharge Pipe Connection Section of the First Connector Element
73 Distancing Section of the First Connector Element
80 Second Connector Element
81 Shell Connection Section of the Second Connector Element
82 Pipe Connection Section of the 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
120 Upper Shell Part
123 Contacting Region
140 Mounting Pin
150 Connection Shield
151 Shield Base Plate
152 Opening of the Connection Shield
153 Support Arm
160 Supporting Base Plate
164 Opening of the Supporting Base Plate
200 Cranktrain
201 Ball Bearing
202 Upper Axial Bearing Seat of the Ball Bearing
203 Lower Axial Bearing Seat of the Ball Bearing
210 Crankshaft
211 Crankshaft Axis, Axial Direction of the Crankshaft
212 Radial Direction of the Crankshaft (Arrow)
215 Upper Bearing Region of the Crankshaft
216 Lubrication Region of the Crankshaft
216a Lubrication Recess of the Crankshaft
216b Length of the Lubrication Recess of the Crankshaft
217 Lower Bearing Region of the Crankshaft
218 Rotor Fixation Region of the Crankshaft
220 Crankpin
221 Crankpin Axis
222 Crankpin Lubrication Recess
225 Counterweight
225a Upper Side of the Counterweight
225b Lower Side of the Counterweight
226 Additional Second Counterweight
230 Connecting Rod
240 Piston
231 Big Eye Bearing
232 Small Eye Bearing
232a Lubrication Slot within the Small Eye Bearing
233 Connecting Rod Bar
234 Rod Width
235 Rod Height
236 Damping Opening
237 Damping Opening with Circular Cross Section
238 Damping Opening with Triangular Cross Section
241 Piston Top
242 Piston Skirt
243 Piston Pin
244 Clamping Sleeve
250 Oil Pickup
251 Mounting Rivet
252 Helical Blade
253 Oil Pump Sleeve
253a Elongated Degassing Bore
254 Oil Supply Bore
255 Lower Lubrication Bore
256 Helical Groove
260 Oil Path (Arrow)
265 Upper Lubrication Bore
270 Crankshaft Degassing Bore
275 Crankpin Lubrication Bore
280 Oil Splash Outlet
300 Crankcase
300a Upper Side of Crankcase
301 First Protrusion
302 Main Bearing Section of the Crankcase
303 Crankcase Leg
304 Crankshaft Bearing Shell
305 Upper Bearing Seat
305a Inner Side of the Upper Bearing Seat
305b Outer Side of the Upper Bearing Seat
306 Cylindrical Extension
307a Wall Thickness of the Upper Bearing Seat
307b Axial Height of the Upper Bearing Seat
308 Bearing Recess
309 Crosss Section of the Bearing Recess
310 Cylinder Housing
311 Second Protrusion
312 Valve Plate Seat
312a Positioning Recess
313 Circumferential Clamping Groove
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
752	First End Section of the Discharge Connection Tube
752	Second End Section of the Discharge Connection Tube
760	Connection Sleeve
761	Groove of the Connection Sleeve
762	O-Ring Seal
800	Electronic Control Unit
801	Outer Harness
802	Main Housing of Electronic Control Unit
803	Cover of Housing of Electronic Control Unit
804	Circuit Board
805	Electric Connecting Element (Socket) of Electronic Control Unit
806	First Clip
807	Second Clip
808	Opening in Clips 806, 807
810	Projection (Screw Head)
811	Stiffening Rib on Clips 806, 807
x	Length Direction
y	Width Direction
z	Height Direction

Claims

1. An encapsulated refrigerant compressor (1) having

- a compressor shell (100) having a lower shell part (110) and an upper shell part (120), wherein a discharge pipe (20) enters the compressor shell (100) through a first connection opening (101), a suction pipe (30) enters the compressor shell (100) through a second connection opening (102), and a maintenance pipe (40) enters the compressor shell (100) through a third connection opening (103),
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 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 pump unit (10) in the compressor shell (100),

wherein the discharge pipe (20) is connected to the compressor shell (100) via a first connector element (70),
wherein a shell connection section (71) of the first connector element (70) is hermetically connected to the first connection opening (101),
wherein a discharge pipe connection section (72) of the first connector element (70) is hermetically connected to the discharge pipe (20),
wherein the discharge pipe (20) extends from outside the compressor shell (100) through the first connector element (70) into the compressor shell (100),
wherein a connection sleeve (760) is mounted on a second end section (752) of the discharge connection tube (750) and the connection sleeve (760) is inserted into a receiving section (21) of the discharge pipe (20), which receiving section (21) extends from the discharge pipe connection section (72) of the first connector element (70) inwards,
characterized in that
the discharge pipe connection section (72) and the shell connection section (71) are spaced apart by a distancing section (73) of

the first connector element (70) to provide additional heat dissipation surface,

wherein a distance between the discharge pipe connection section (72) and the shell (100) is increased by the distancing section (73) of the first connector element (70) in order to reduce a heat transfer between the discharge pipe (20) and the shell (100),

and wherein the connection sleeve (760) is at least partially positioned in a part of the receiving section (21), which part of the receiving section (21) overlaps with the distancing section (73) of the first connector element (70).

2. The encapsulated refrigerant compressor (1) according to claim 1, **characterized in that** a connection air gap (22) is formed between the discharge pipe (20) and at least a section of the distancing section (73) of the first connector element (70), wherein the connection air gap (22) is formed due to the distancing section (73) having an inner diameter that is larger than an adjacent inner diameter of the discharge pipe connection section (72).

3. The encapsulated refrigerant compressor (1) according to any one of claims 1 to 2, **characterized in that** an O-ring seal (762) is inserted into a circumferential groove (761) of the connector sleeve (760).

4. The encapsulated refrigerant compressor (1) according to any one of claims 1 to 3, **characterized in that** the first connection opening (101) for the discharge pipe (20) and/or the third connection opening (103) for the maintenance pipe (40) are located in the lower shell part (110).

5. The encapsulated refrigerant compressor (1) according to any one of claims 1 to 4, **characterized in that** the discharge pipe (20) is crimped in the receiving section (21) to hold the connection sleeve (760) inside the discharge pipe (20).

6. The encapsulated refrigerant compressor (1) according to any one of claims 1 to 5, **characterized in that** the second connection opening (102) and the suction pipe (30) are located in the upper shell part (120) and an inlet opening (621) of the suction muffler (600) is aligned with the second connection opening (102).

7. The encapsulated refrigerant compressor (1) according to any one of claims 1 to 6, **characterized in that** the encapsulated refrigerant compressor (1) further comprises an electronic control unit (800) being fixed to the compressor shell (100), which electronic control unit (800) is connected to the electric pass through element (50) via an outer harness (801).

8. The encapsulated refrigerant compressor (1) according to claim 7, **characterized in that** a connection shield (150) is welded to an outer surface of the lower shell part (110), wherein the electronic control unit (800) is mounted to the connection shield (150).

9. The encapsulated refrigerant compressor (1) according to claim 8, **characterized in that** the connection shield (150) has a shield base plate (151) with an opening (152) and two support arms (153) extending from the shield base plate (151).

10. The encapsulated refrigerant compressor (1) according to any one of claims 1 to 9, **characterized in that** the suction pipe (30) is connected to the compressor shell (100) via a second connector element (80),

wherein a shell connection section (81) of the second connector element (80) is hermetically connected to the second connection opening (102),

wherein a pipe connection section (82) of the second connector element (80) is hermetically connected to the suction pipe (30).

11. The encapsulated refrigerant compressor (1) according to any one of claims 1 to 10, **characterized in that** the maintenance pipe (40) is connected to the compressor shell (100) via a further second connector element (80),

wherein a shell connection section (81) of the further second connector element (80) is hermetically connected to the third connection opening (103),

wherein a pipe connection section (82) of the further second connector element (80) is hermetically connected to the maintenance pipe (40).

12. The encapsulated refrigerant compressor (1) according to any one of claims 1 to 11, **characterized in that** an inner diameter of the discharge pipe connection section (72) is smaller than an adjacent inner diameter of the distancing section (73).

13. The encapsulated refrigerant compressor (1) according to any one of claims 1 to 12, **characterized in that** an inner diameter of the distancing section (73) is equal to an adjacent inner diameter of the shell connection section (71).

Patentansprüche

1. Gekapselter Kältemittelverdichter (1), aufweisend

- ein Verdichtergehäuse (100) umfassend ein unteres Gehäuseteil (110) und ein oberes Gehäuseteil (120), wobei eine Auslassleitung (20) in das Verdichtergehäuse (100) durch eine erste Verbindungsöffnung (101) eintritt, eine Saugleitung (30) in das Verdichtergehäuse (100) durch eine zweite Verbindungsöffnung (102) eintritt und eine Wartungsleitung (40) in das Verdichtergehäuse (100) durch eine dritte Verbindungsöffnung (103) eintritt,
wobei ein elektrisches Durchgangselement (50) in das Verdichtergehäuse (100) eingesetzt ist;
- eine Pumpeneinheit (10), umfassend:
- einen Kurbeltrieb (200) mit einer Kurbelwelle (210), einem Kurbelzapfen (220), einem Pleuel (230) und einem Kolben (240);
- eine elektrische Antriebseinheit (400) mit einem inneren Kabelstrang (430), einem Stator (420) und einem Rotor (410), wobei der Rotor (410) an der Kurbelwelle (210) befestigt ist, wobei der innere Kabelstrang (430) das elektrische Durchgangselement (50) und den Stator (420) verbindet;
- ein Kurbelgehäuse (300) mit einem Zylindergehäuse (310), wobei ein Zylinder (320) für eine Hubbewegung (240) des Kolbens im Zylindergehäuse (310) angeordnet ist, wobei die Kurbelwelle (210) drehbar im Kurbelgehäuse (300) montiert ist, wobei der Stator (420) am Kurbelgehäuse (300) angeordnet ist;
- eine Zylinderkopfanordnung (500), die an dem Zylindergehäuse (310) des Kurbelgehäuses (300) angebracht ist, wobei die Zylinderkopfanordnung (500) eine Ventilplatte (530), eine Saugventilfeder (520), eine Auslassventilfeder (540), einen Saugschalldämpfer (600) und einen Auslassschalldämpfer (700) umfasst, wobei der Auslassschalldämpfer (700) ein Auslassverbindungsrohr (750) umfasst, das mit dem Auslassrohr (20) verbunden ist;
- eine Vielzahl von Stützfederanordnungen (60) zum Stützen der Pumpeneinheit (10) im Verdichtergehäuse (100),

wobei die Auslassleitung (20) mit dem Verdichtergehäuse (100) über ein erstes Verbinderelement (70) verbunden ist, wobei ein Gehäuseverbindungsabschnitt (71) des ersten Verbinderelements (70) hermetisch dicht mit der ersten Verbindungsöffnung (101) verbunden ist,
wobei ein Auslassleitungsverbindungsabschnitt (72) des ersten Verbinderelements (70) hermetisch dicht mit der Auslassleitung (20) verbunden ist,
wobei die Auslassleitung (20) sich von außerhalb des Verdichtergehäuses (100) durch das erste Verbinderelement (70) in das Verdichtergehäuse (100) erstreckt,
wobei eine Verbindungshülse (760) an einem zweiten Endabschnitt (752) des Auslassverbindungsrohrs (750) montiert ist und die Verbindungshülse (760) in einen Aufnahmeabschnitt (21) der Auslassleitung (20) eingeführt ist, wobei sich dieser Aufnahmeabschnitt (21) von dem Auslassleitungsverbindungsabschnitt (72) des ersten Verbinderelements (70) nach innen erstreckt,
dadurch gekennzeichnet, dass der Auslassleitungsverbindungsabschnitt (72) und der Gehäuseverbindungsabschnitt (71) durch einen Abstandsabschnitt (73) des ersten Verbinderelements (70) voneinander beabstandet sind, um zusätzliche Wärmeableitoberfläche bereitzustellen,
wobei ein Abstand zwischen dem Auslassleitungsverbindungsabschnitt (72) und dem Gehäuse (100) durch den Abstandsabschnitt (73) des ersten Verbinderelements (70) erhöht wird, um einen Wärmetransfer zwischen der Auslassleitung (20) und dem Gehäuse (100) zu reduzieren, und wobei die Verbindungshülse (760) zumindest teilweise in einem Teil des Aufnahmeabschnitts (21) positioniert ist, wobei dieser Teil des Aufnahmeabschnitts (21) mit dem Abstandsabschnitt (73) des ersten Verbinderelements (70) überlappt.

2. Gekapselter Kältemittelverdichter (1) nach Anspruch 1, **dadurch gekennzeichnet, dass** ein Verbindungsluftspalt (22) zwischen der Auslassleitung (20) und mindestens einem Abschnitt des Abstandabschnitts (73) des ersten Verbinderelements (70) ausgebildet ist,
wobei der Verbindungsluftspalt (22) dadurch ausgebildet ist, dass der Abstandsabschnitt (73) einen Innendurchmesser hat, der größer als ein benachbarter Innendurchmesser des Auslassleitungsverbindungsabschnitts (72) ist.

3. Gekapselter Kältemittelverdichter (1) nach einem der Ansprüche 1 bis 2, **dadurch gekennzeichnet, dass** eine O-Ring-Dichtung (762) in eine umlaufende Nut (761) der Verbindungshülse (760) eingeführt ist.

4. Gekapselter Kältemittelverdichter (1) nach einem der Ansprüche 1 bis 3, **dadurch gekennzeichnet, dass** die erste Verbindungsöffnung (101) für die Auslassleitung (20) und/oder die dritte Verbindungs-

öffnung (103) für die Wartungsleitung (40) sich in dem unteren Gehäuseteil (110) befinden.

5. Gekapselter Kältemittelverdichter (1) nach einem der Ansprüche 1 bis 4, **dadurch gekennzeichnet, dass** die Auslassleitung (20) im Aufnahmeabschnitt (21) gecrimpt ist, um die Verbindungshülse (760) in der Auslassleitung (20) zu halten.

6. Gekapselter Kältemittelverdichter (1) nach einem der Ansprüche 1 bis 5, **dadurch gekennzeichnet, dass** die zweite Verbindungsöffnung (102) und die Saugleitung (30) sich in dem oberen Gehäuseteil (120) befinden und eine Einlassöffnung (621) des Saugschalldämpfers (600) zur zweiten Verbindungsöffnung (102) ausgerichtet ist.

7. Gekapselter Kältemittelverdichter (1) nach einem der Ansprüche 1 bis 6, **dadurch gekennzeichnet, dass** der gekapselte Kältemittelverdichter (1) ferner eine am Verdichtergehäuse (100) befestigte elektronische Steuereinheit (800) umfasst, wobei diese elektronische Steuereinheit (800) über einen äußeren Kabelstrang (801) mit dem elektrischen Durchgangselement (50) verbunden ist.

8. Gekapselter Kältemittelverdichter (1) nach Anspruch 7, **dadurch gekennzeichnet, dass** ein Verbindungsschild (150) an eine Außenfläche des unteren Gehäuseteils (110) geschweißt ist, wobei die elektronische Steuereinheit (800) am Verbindungsschild (150) montiert ist.

9. Gekapselter Kältemittelverdichter (1) nach Anspruch 8, **dadurch gekennzeichnet, dass** das Verbindungsschild (150) eine Schildgrundplatte (151) mit einer Öffnung (152) und zwei Stützarmen (153) hat, die sich von der Schildgrundplatte (151) aus erstrecken.

10. Gekapselter Kältemittelverdichter (1) nach einem der Ansprüche 1 bis 9, **dadurch gekennzeichnet, dass** die Saugleitung (30) über ein zweites Verbinderelement (80) mit dem Verdichtergehäuse (100) verbunden ist,

wobei ein Gehäuseverbindungsabschnitt (81) des zweiten Verbinderelements (80) hermetisch dicht mit der zweiten Verbindungsöffnung (102) verbunden ist,
wobei ein Leitungsverbindungsabschnitt (82) des zweiten Verbinderelements (80) hermetisch dicht mit der Saugleitung (30) verbunden ist.

11. Gekapselter Kältemittelverdichter (1) nach einem der Ansprüche 1 bis 10, **dadurch gekennzeichnet, dass** die Wartungsleitung (40) über ein weiteres zweites Verbinderelement (80) mit dem Verdichtergehäuse (100) verbunden ist,

wobei ein Gehäuseverbindungsabschnitt (81) des weiteren zweiten Verbinderelements (80) hermetisch dicht mit der dritten Verbindungsöffnung (103) verbunden ist,
wobei ein Leitungsverbindungsabschnitt (82) des weiteren zweiten Verbinderelements (80) hermetisch dicht mit der Wartungsleitung (40) verbunden ist.

12. Gekapselter Kältemittelverdichter (1) nach einem der Ansprüche 1 bis 11, **dadurch gekennzeichnet, dass** ein Innendurchmesser des Auslassleitungsverbindungsabschnitts (72) kleiner als ein benachbarter Innendurchmesser des Abstandsabschnitts (73) ist.

13. Gekapselter Kältemittelverdichter (1) nach einem der Ansprüche 1 bis 12, **dadurch gekennzeichnet, dass** ein Innendurchmesser des Abstandsabschnitts (73) gleich einem benachbarten Innendurchmesser des Gehäuseverbindungsabschnitts (71) ist.

Revendications

1. Compresseur frigorifique encapsulé (1) ayant

- une coque de compresseur (100) ayant une pièce de coque inférieure (110) et une pièce de coque supérieure (120), dans lequel un tuyau d'évacuation (20) entre dans la coque de compresseur (100) à travers une première ouverture de raccordement (101), un tuyau d'aspiration (30) entre dans la coque de compresseur (100) à travers une deuxième ouverture de raccordement (102), et un tuyau d'entretien (40) entre dans la coque de compresseur (100) à travers une troisième ouverture de raccordement (103),
dans lequel un élément de passage électrique (50) est inséré dans la coque de compresseur (100) ;
- une unité de pompe (10) comprenant :
    - un train de vilebrequin (200) ayant un vilebrequin (210), un maneton (220), une tige de raccordement (230) et un piston (240) ;
    - une unité d'entraînement électrique (400) ayant un faisceau intérieur (430), un stator (420) et un rotor (410), le rotor (410) étant fixé au vilebrequin (210), dans lequel le faisceau intérieur (430) raccorde l'élément de passage électrique (50) au stator (420) ;
    - un carter (300) avec un carter-cylindre

(310), dans lequel un cylindre (320) pour le mouvement alternatif du piston (240) est situé dans le carter-cylindre (310), dans lequel le vilebrequin (210) est monté en rotation dans le carter (300),
dans lequel le stator (420) est attaché au carter (300) ;
- un ensemble culasse de cylindre (500) monté sur le carter-cylindre (310) du carter (300), l'ensemble culasse de cylindre (500) comprenant un plateau de distribution (530), un ressort de soupape d'aspiration (520), un ressort de soupape d'évacuation (540), un atténuateur d'aspiration (600) et un atténuateur d'évacuation (700), dans lequel l'atténuateur d'évacuation (700) a un tube de raccordement d'évacuation (750) raccordé au tuyau d'évacuation (20) ;

- une pluralité d'ensembles ressort de soutien (60) pour soutenir l'unité de pompe (10) dans la coque de compresseur (100),

dans lequel le tuyau d'évacuation (20) est raccordé à la coque de compresseur (100) par l'intermédiaire d'un premier élément de raccordement (70),
dans lequel une section de raccordement de coque (71) du premier élément de raccordement (70) est raccordée de manière hermétique à la première ouverture de raccordement (101),
dans lequel une section de raccordement de tuyau d'évacuation (72) du premier élément de raccordement (70) est raccordée de manière hermétique au tuyau d'évacuation (20),
dans lequel le tuyau d'évacuation (20) s'étend depuis l'extérieur de la coque de compresseur (100) à travers le premier élément de raccordement (70) dans la coque de compresseur (100), dans lequel un manchon de raccordement (760) est monté sur une seconde section d'extrémité (752) du tuyau de raccordement d'évacuation (750) et le manchon de raccordement (760) est inséré dans une section de réception (21) du tuyau d'évacuation (20), laquelle section de réception (21) s'étend depuis la section de raccordement de tuyau d'évacuation (72) du premier élément de raccordement (70) vers l'intérieur,
caractérisé en ce que
la section de raccordement de tuyau d'évacuation (72) et la section de raccordement de coque (71) sont espacées au moyen d'une section de distanciation (73) du premier élément de raccordement (70) pour fournir une surface de dissipation thermique supplémentaire, dans lequel une distance entre la section de raccordement de tuyau d'évacuation (72) et la coque (100) est augmentée par la section de distanciation (73) du premier élément de raccordement (70) afin de réduire un transfert thermique entre le tuyau d'évacuation (20) et la coque (100),
et dans lequel le manchon de raccordement (760) est au moins partiellement positionné dans une partie de la section de réception (21), laquelle partie de la section de réception (21) se superpose à la section de distanciation (73) du premier élément de raccordement (70).

2. Compresseur frigorifique encapsulé (1) selon la revendication 1, **caractérisé en ce qu'**un intervalle d'air de raccordement (22) est formé entre le tuyau d'évacuation (20) et au moins une section de la section de distanciation (73) du premier élément de raccordement (70),
dans lequel l'intervalle d'air de raccordement (22) est formé car la section de distanciation (73) a un diamètre interne qui est supérieur à un diamètre interne adjacent de la section de raccordement de tuyau d'évacuation (72).

3. Compresseur frigorifique encapsulé (1) selon l'une quelconque des revendications 1 à 2, **caractérisé en ce qu'**un joint torique (762) est inséré dans une rainure circonférentielle (761) du manchon de raccordement (760).

4. Compresseur frigorifique encapsulé (1) selon l'une quelconque des revendications 1 à 3, **caractérisé en ce que** la première ouverture de raccordement (101) pour le tuyau d'évacuation (20) et/ou la troisième ouverture de raccordement (103) pour le tuyau d'entretien (40) sont situées dans la pièce de coque inférieure (110).

5. Compresseur frigorifique encapsulé (1) selon l'une quelconque des revendications 1 à 4, **caractérisé en ce que** le tuyau d'évacuation (20) est serti dans la section de réception (21) pour maintenir le manchon de raccordement (760) à l'intérieur du tuyau d'évacuation (20).

6. Compresseur frigorifique encapsulé (1) selon l'une quelconque des revendications 1 à 5, **caractérisé en ce que** la deuxième ouverture de raccordement (102) et le tuyau d'aspiration (30) sont situés dans la pièce de coque supérieure (120) et une ouverture d'entrée (621) de l'atténuateur d'aspiration (600) est alignée avec la deuxième ouverture de raccordement (102).

7. Compresseur frigorifique encapsulé (1) selon l'une quelconque des revendications 1 à 6, **caractérisé en ce que** le compresseur frigorifique encapsulé (1) comprend en outre une unité de commande électronique (800) fixée à la coque de compresseur (100), laquelle unité de commande électronique (800) est raccordée à l'élément traversant électrique (50) par l'intermédiaire d'un faisceau externe (801).

8. Compresseur frigorifique encapsulé (1) selon la revendication 7, **caractérisé en ce qu'**un écran de raccordement (150) est soudé à une surface externe de la pièce de coque inférieure (110), dans lequel l'unité de commande électronique (800) est montée sur l'écran de raccordement (150).

9. Compresseur frigorifique encapsulé (1) selon la revendication 8, **caractérisé en ce que** l'écran de raccordement (150) a une plaque d'embase d'écran (151) avec une ouverture (152) et deux bras de soutien (153) s'étendant depuis la plaque d'embase d'écran (151).

10. Compresseur frigorifique encapsulé (1) selon l'une quelconque des revendications 1 à 9, **caractérisé en ce que** le tuyau d'aspiration (30) est raccordé à la coque de compresseur (100) par l'intermédiaire d'un second élément de raccordement (80),

    dans lequel une section de raccordement de coque (81) du second élément de raccordement (80) est raccordée de manière hermétique à la deuxième ouverture de raccordement (102),
    dans lequel une section de raccordement de tuyau (82) du second élément de raccordement (80) est raccordée de manière hermétique au tuyau d'aspiration (30).

11. Compresseur frigorifique encapsulé (1) selon l'une quelconque des revendications 1 à 10, **caractérisé en ce que** le tuyau d'entretien (40) est raccordé à la coque de compresseur (100) par l'intermédiaire d'un second élément de raccordement (80) supplémentaire,

    dans lequel une section de raccordement de coque (81) du second élément de raccordement (80) supplémentaire est raccordée de manière hermétique à la troisième ouverture de raccordement (103),
    dans lequel une section de raccordement de tuyau (82) du second élément de raccordement (80) supplémentaire est raccordée de manière hermétique au tuyau d'entretien (40).

12. Compresseur frigorifique encapsulé (1) selon l'une quelconque des revendications 1 à 11, **caractérisé en ce qu'**un diamètre interne de la section de raccordement de tuyau d'évacuation (72) est inférieur à un diamètre interne adjacent de la section de distanciation (73).

13. Compresseur frigorifique encapsulé (1) selon l'une quelconque des revendications 1 à 12, **caractérisé en ce qu'**un diamètre interne de la section de distanciation (73) est égal à un diamètre interne adjacent de la section de raccordement de coque (71).

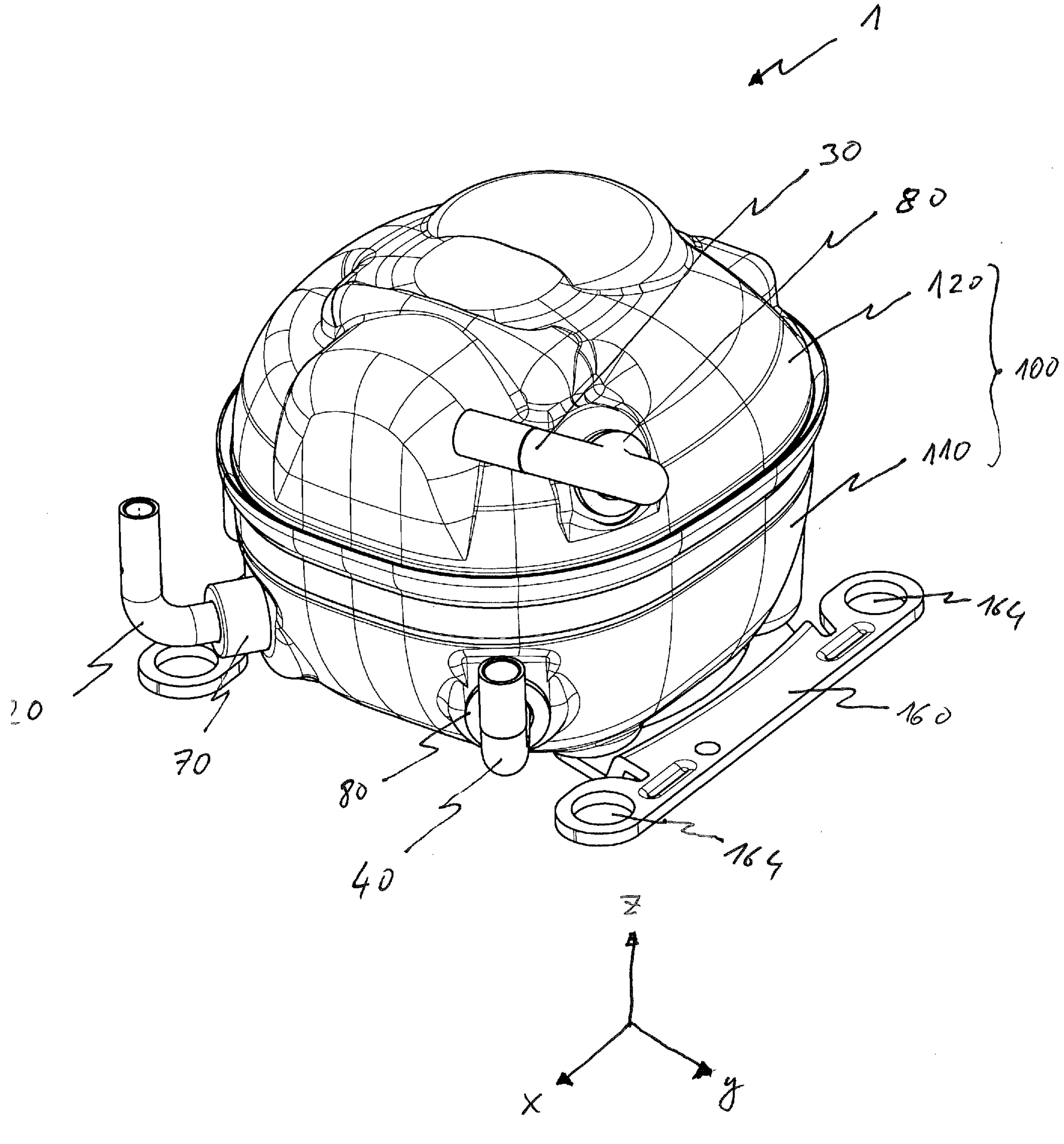

Fig. 1

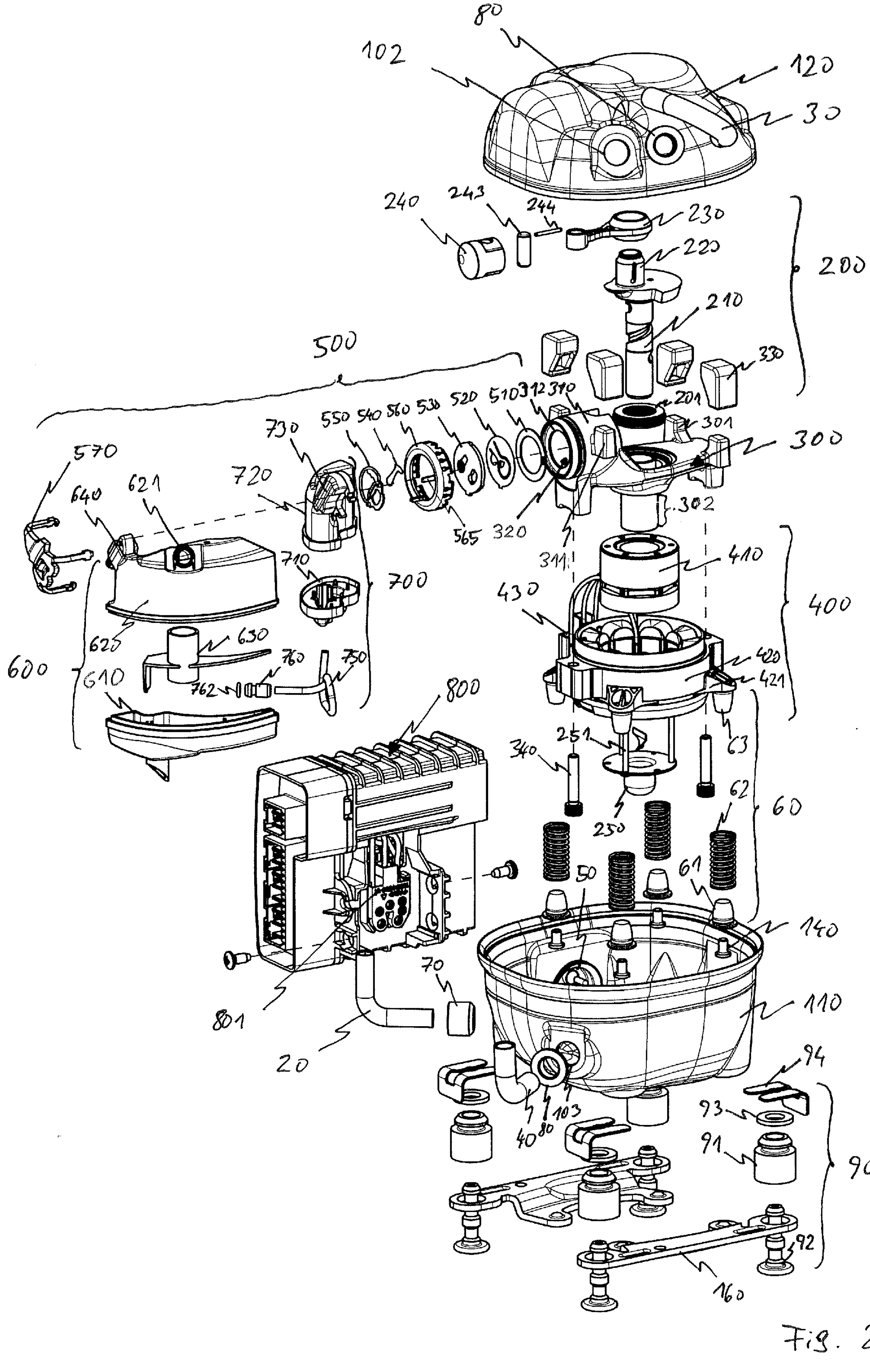
80
102
120
30
240
243
244
230
220
200
210
500
330
570
640
621
720
730
550
540
560
530
520
510
312
310
201
301
300
565
320
302
311
410
700
710
430
400
620
630
600
610
762
760
750
420
421
800
251
340
63
60
250
62
61
50
140
801
70
110
20
94
40
80
103
93
91
90
92
160

Fig. 2

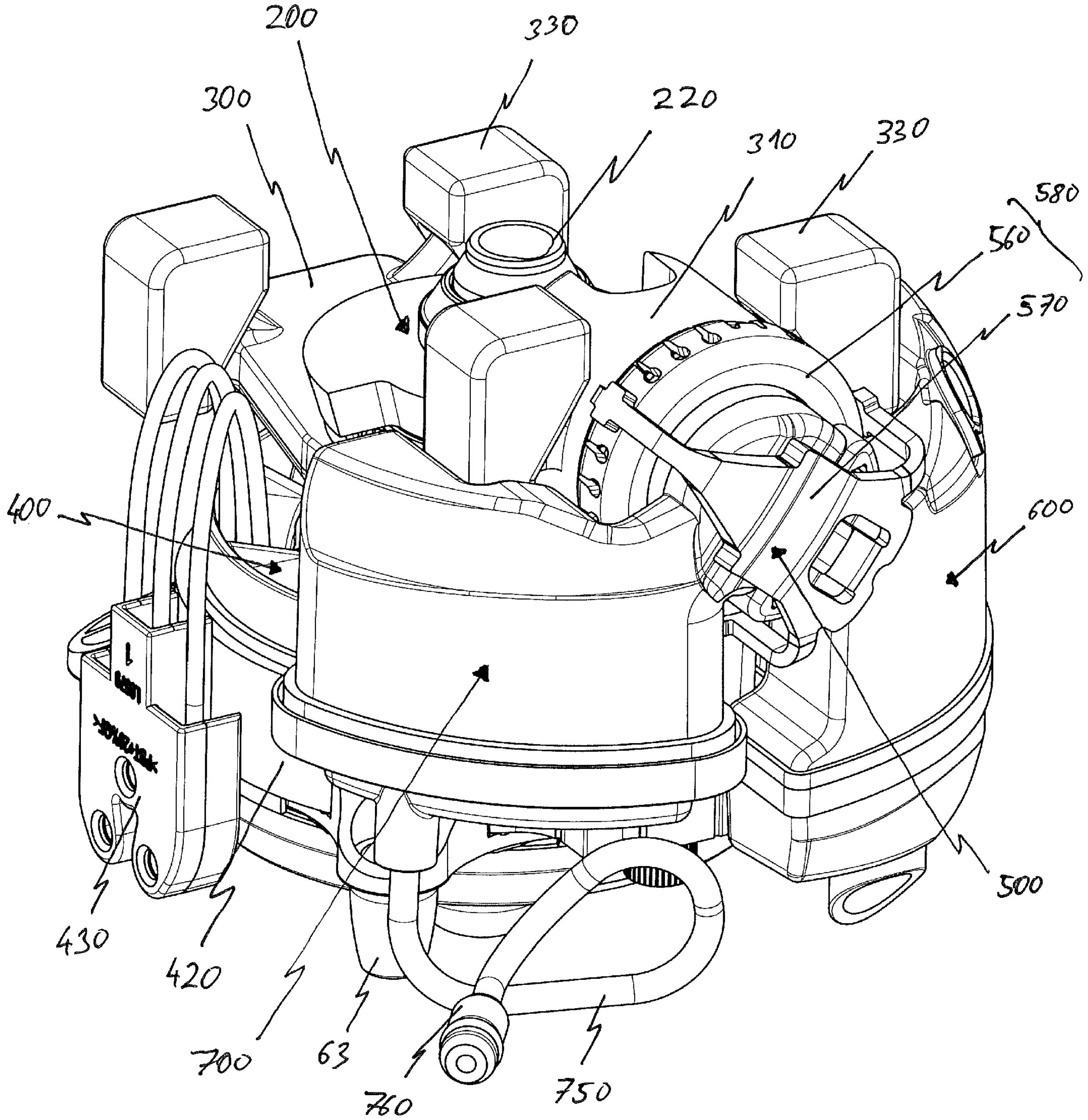
200
330
300
220
310
330
580
560
570
400
600
430
420
700
63
760
750
500

Fig. 3

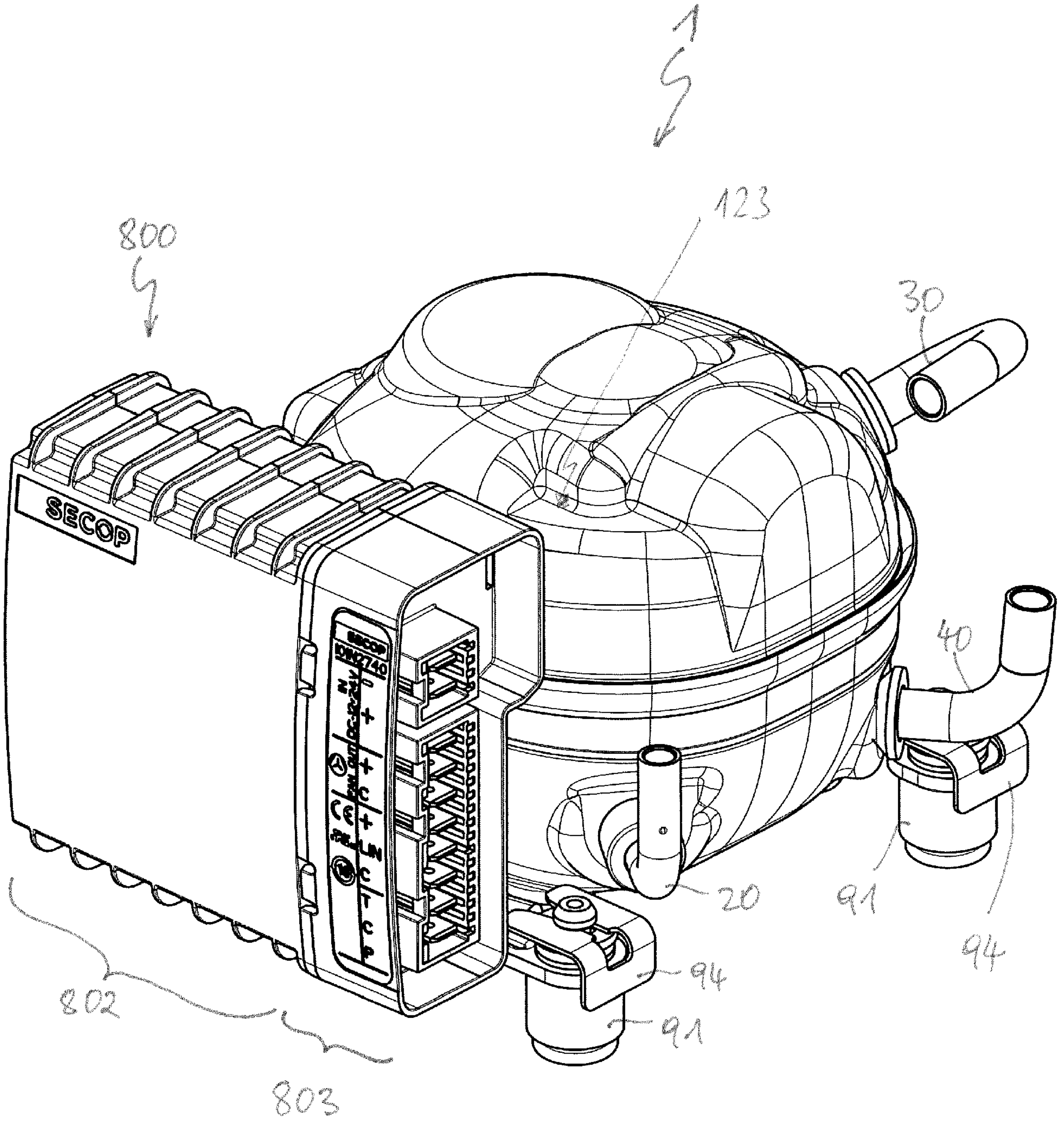

Fig. 4

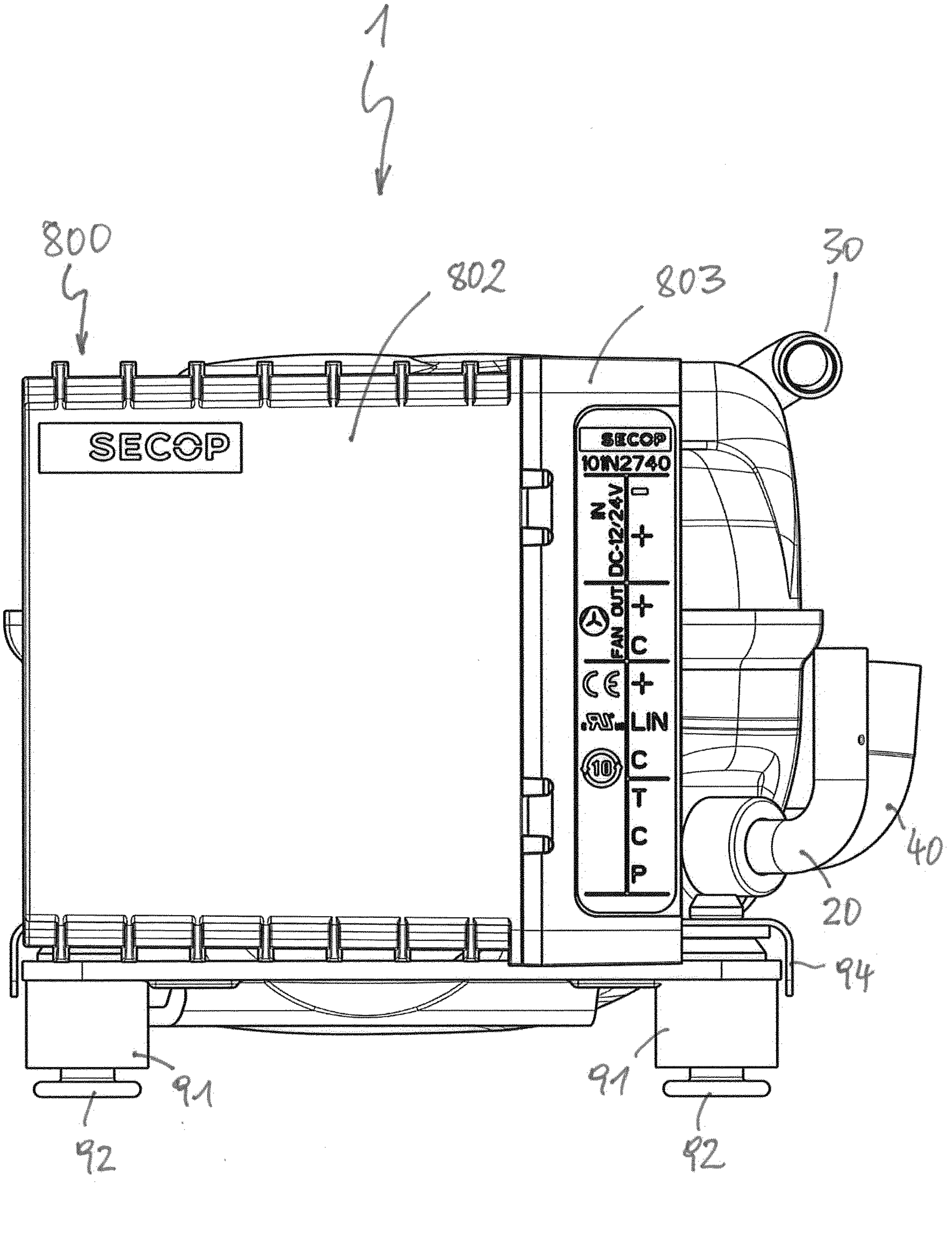
1
800
802
803
30
SECOP
SECOP
101N2740
IN
DC-12/24V
-
+
FAN
OUT
+
C
+
LIN
C
T
C
P
40
20
94
91
91
92
92

Fig. 5

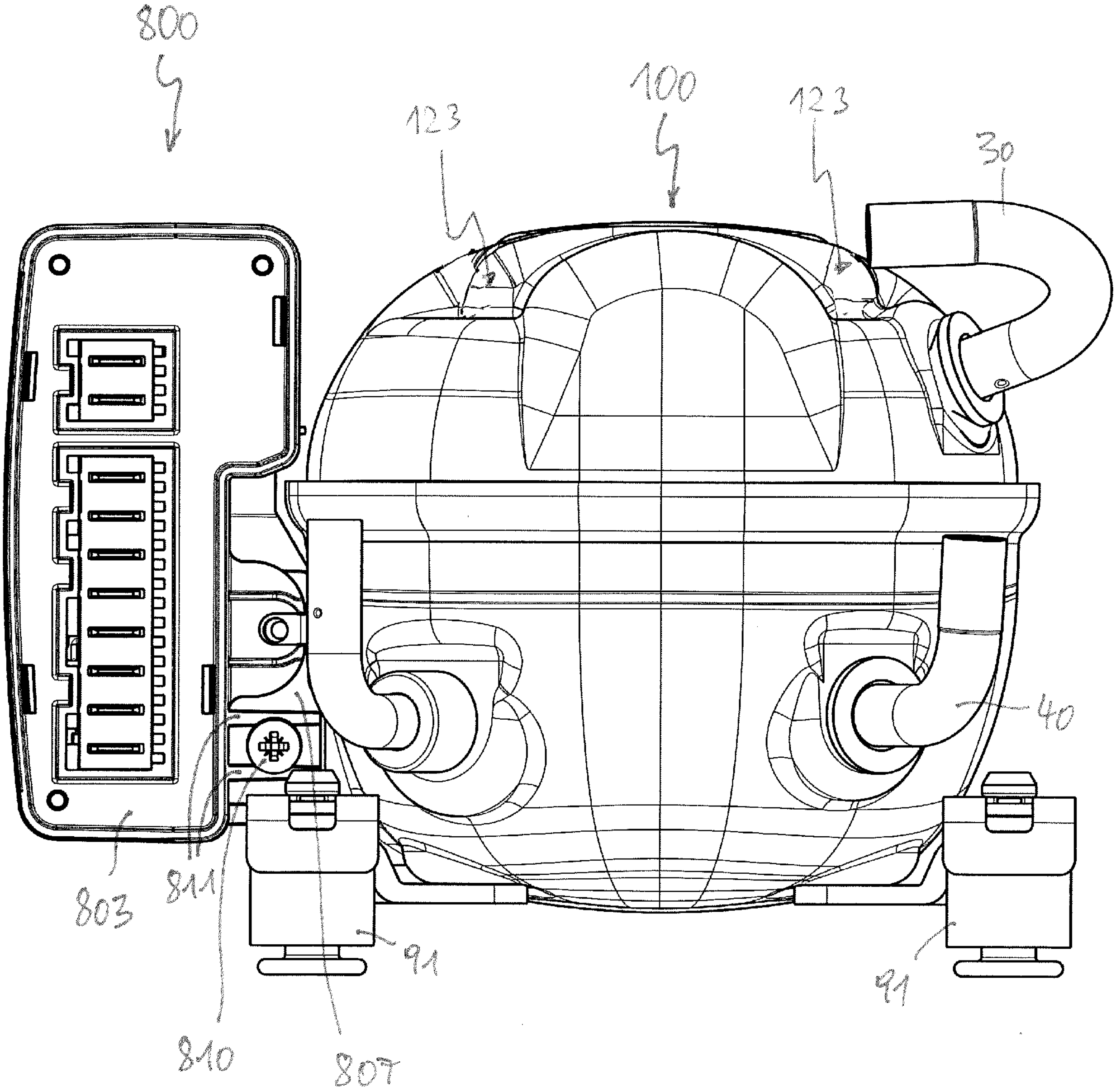

Fig. 6

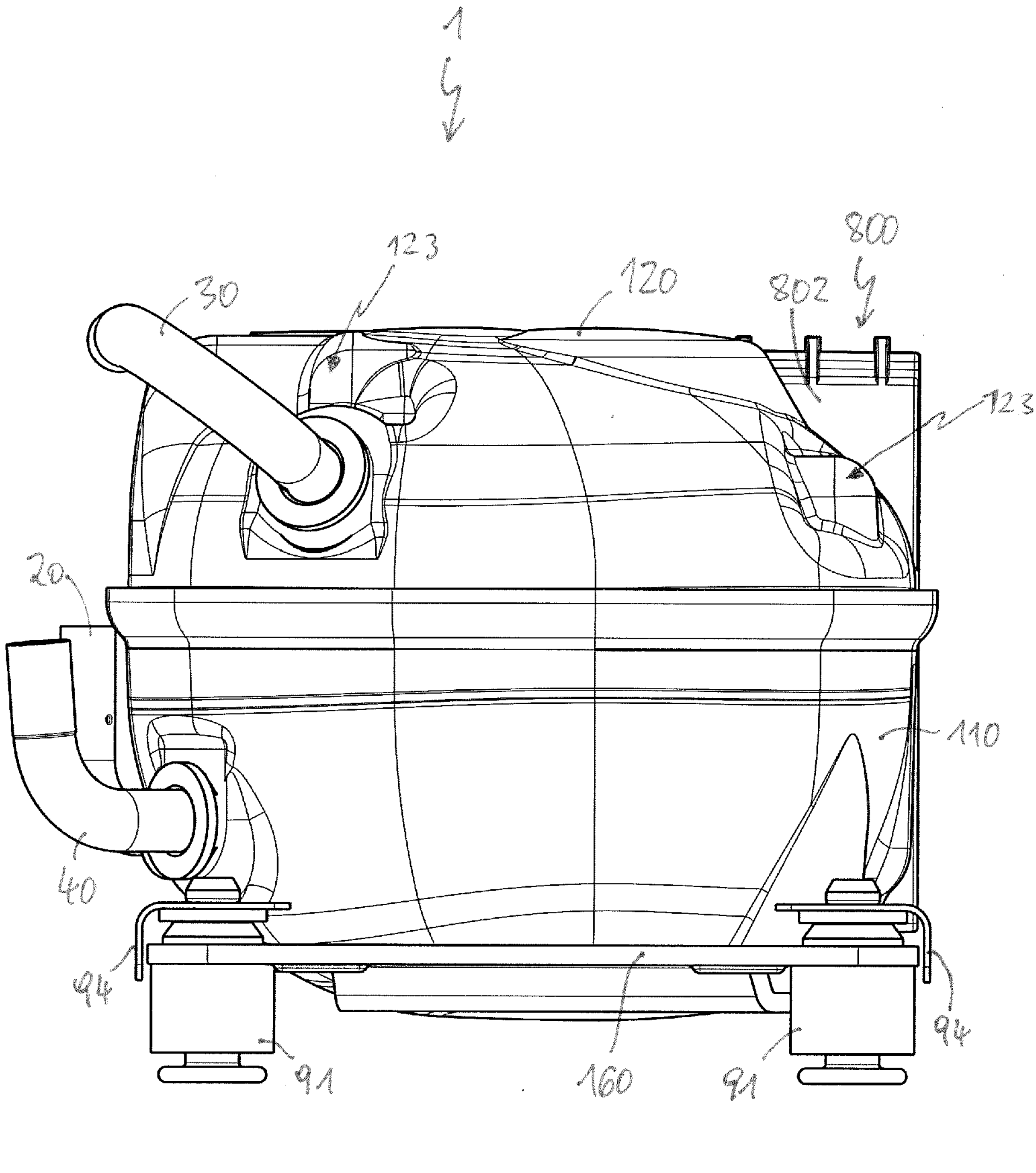

Fig. 7

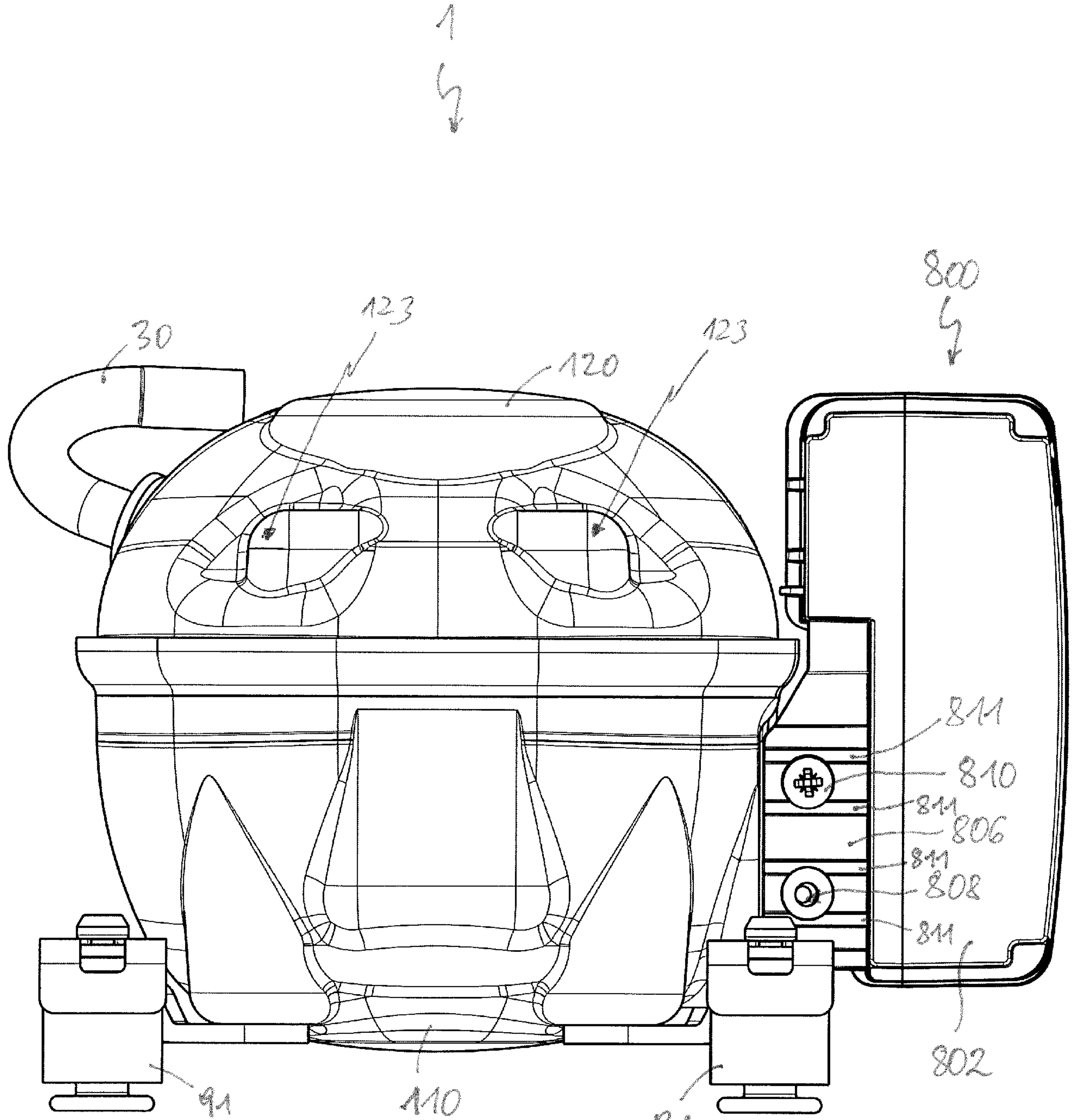

Fig. 8

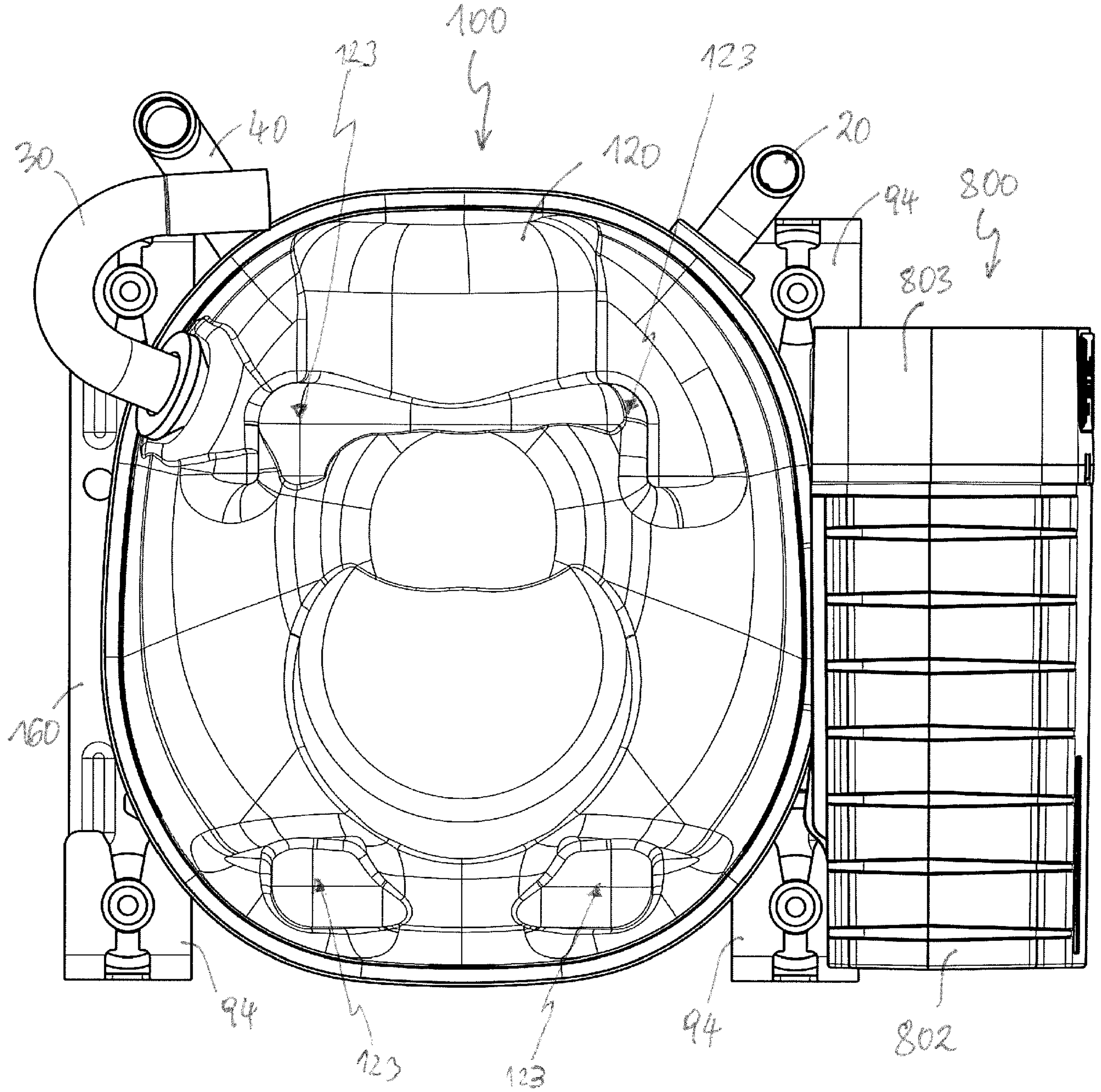

Fig. 9

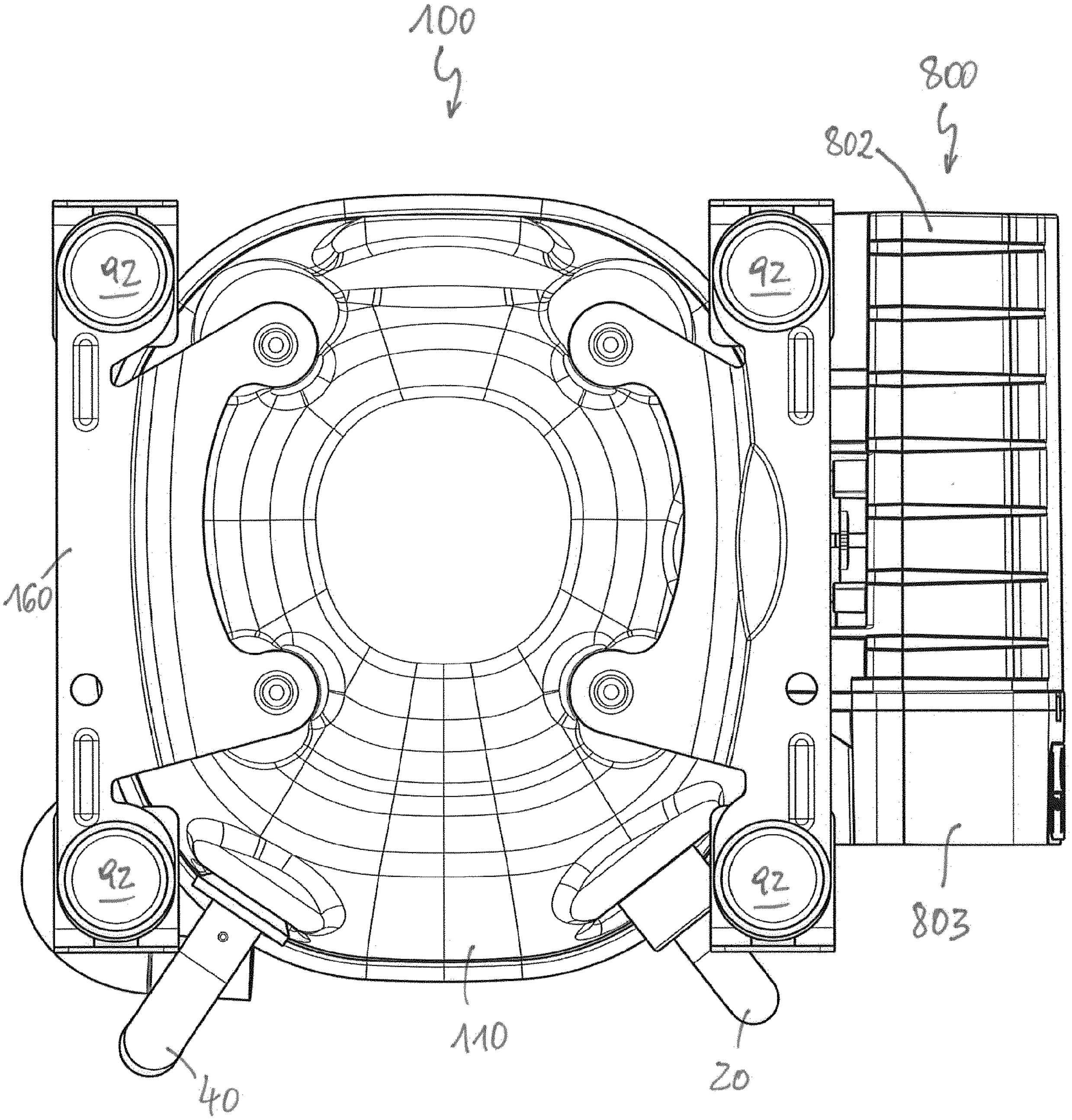

Fig. 10

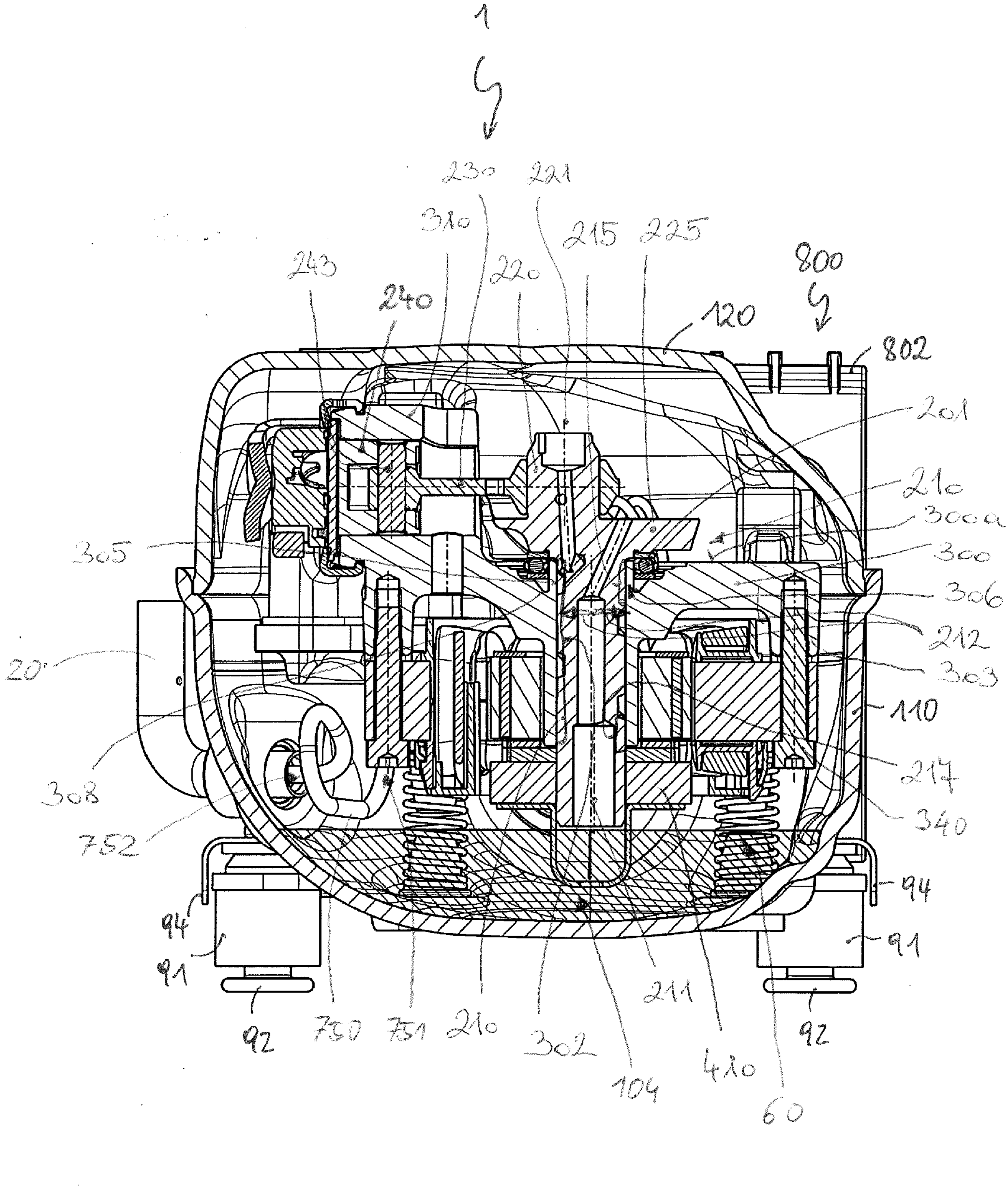
1
230
221
310
215
225
243
220
800
240
120
802
201
210
300a
305
300
306
212
20
303
110
308
217
340
752
94
94
91
91
92
750
751
210
302
211
410
92
104
60

Fig. 11

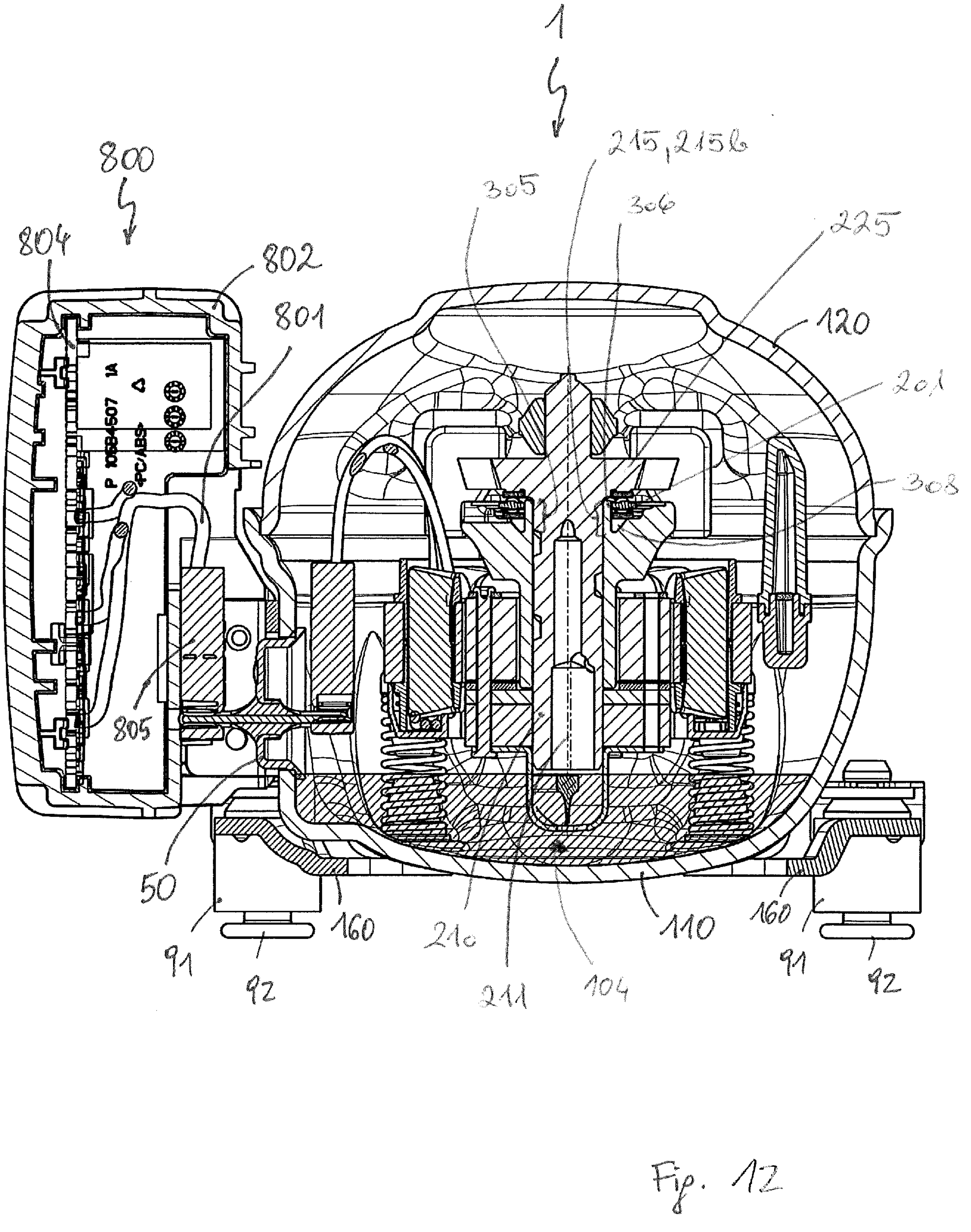
1
215, 215b
305
306
225
800
804
802
801
120
201
308
P 10684507 1A
PC/ABS
805
50
91
92
160
210
211
104
110
160
91
92

Fig. 12

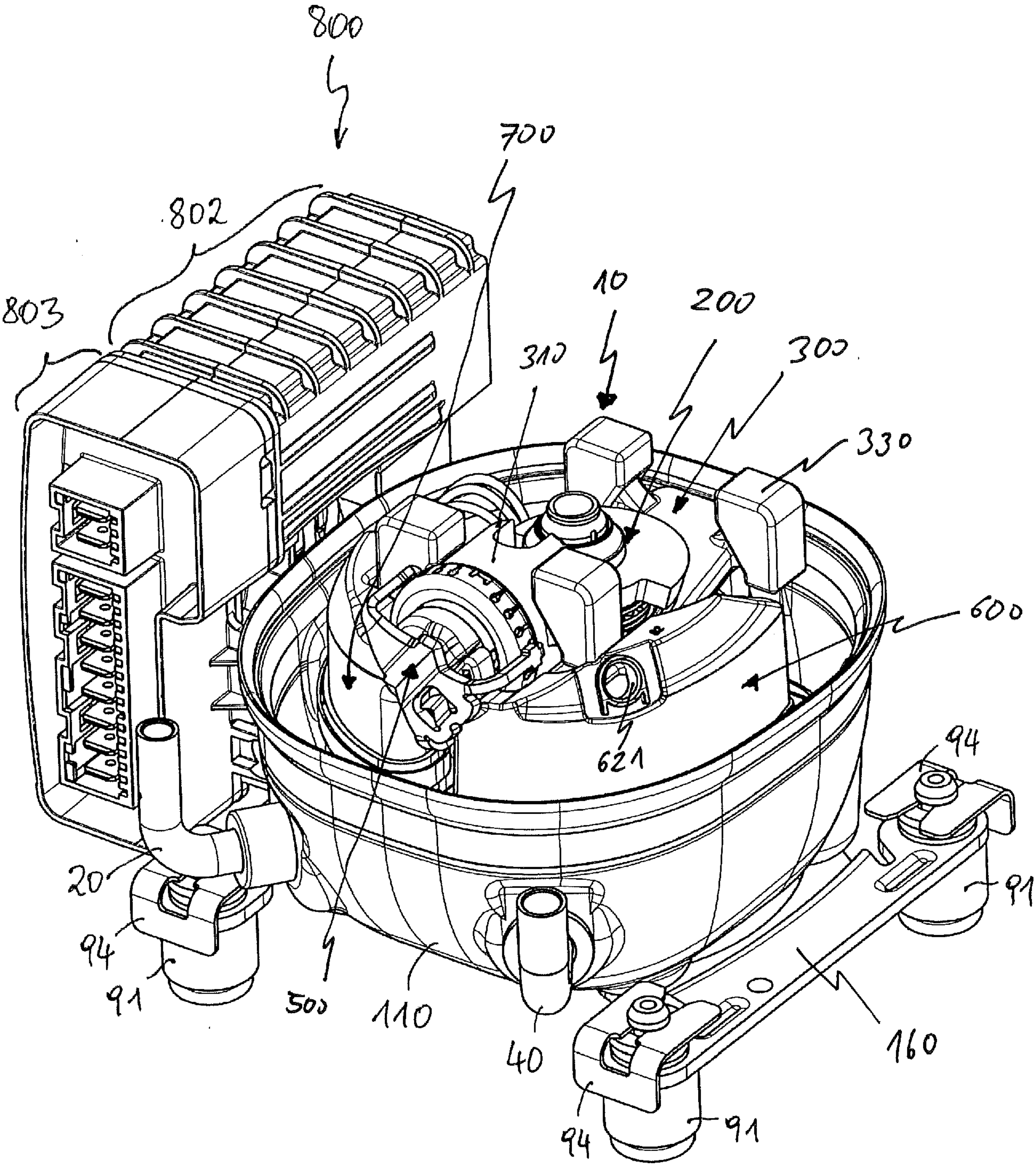
800
700
802
803
10
200
310
300
330
600
621
94
91
20
94
91
500
110
40
160
94
91

Fig. 13

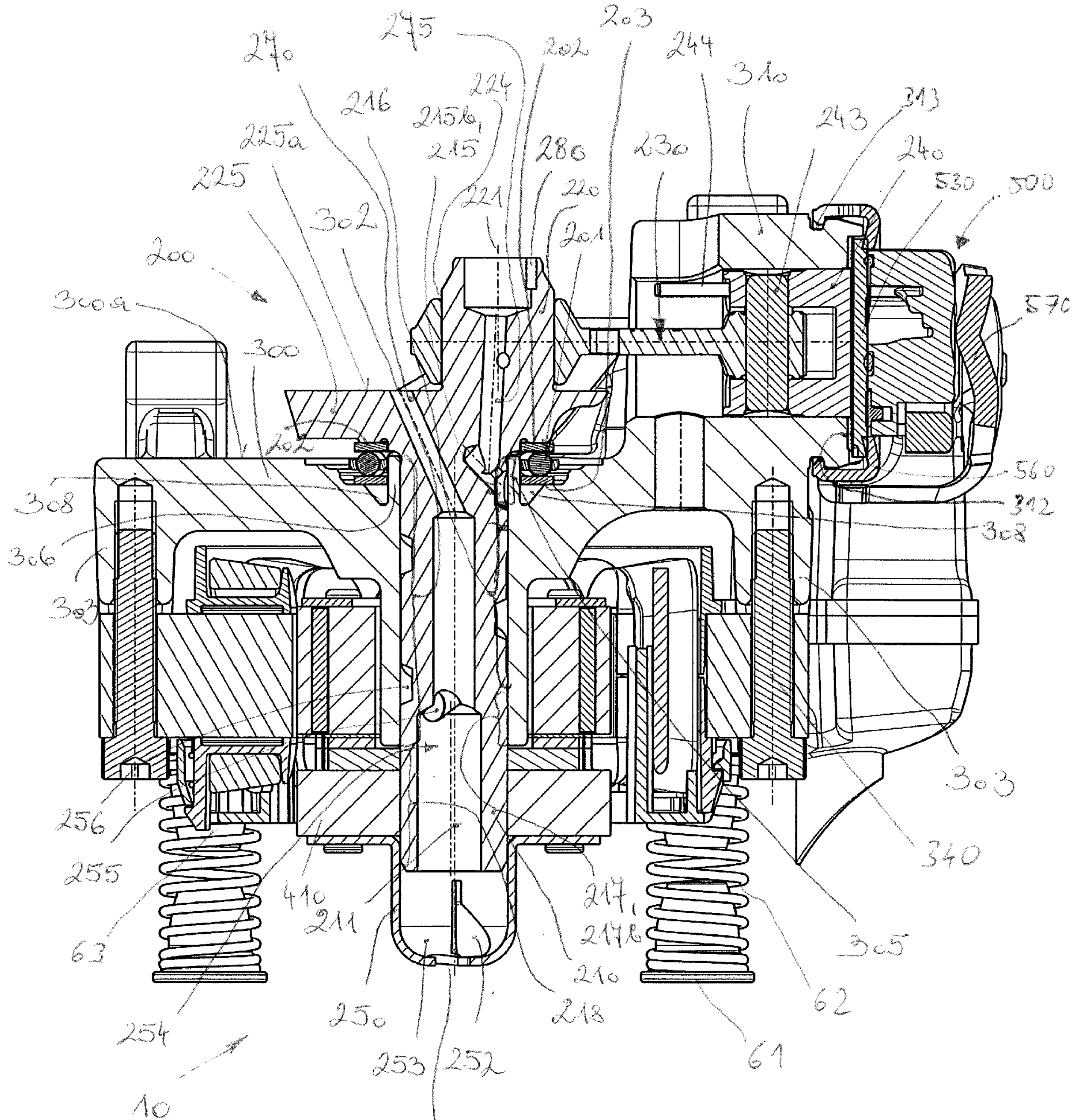
275
203
270
202
244
224
216
215b,
215
310
243
313
225a
221
280
230
220
240
530
500
225
302
201
200
300a
300
570
202
308
560
312
308
306
303
303
256
255
340
63
410
211
217,
217b
305
62
210
254
250
218
61
253
252
10
253a

Fig. 14

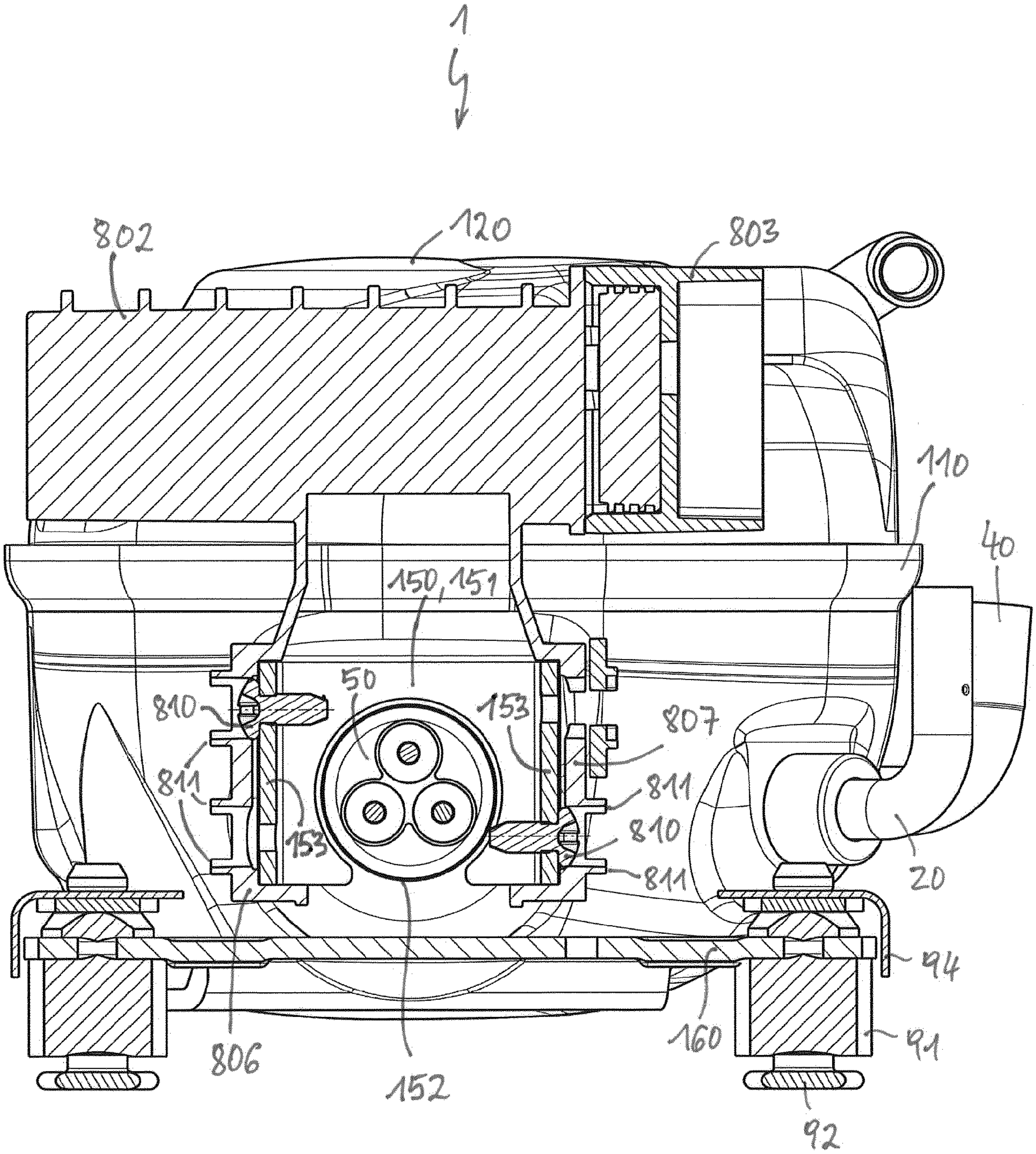
1
802
120
803
110
40
150,151
50
810
153
807
811
811
153
810
811
20
94
806
160
91
152
92

Fig. 15

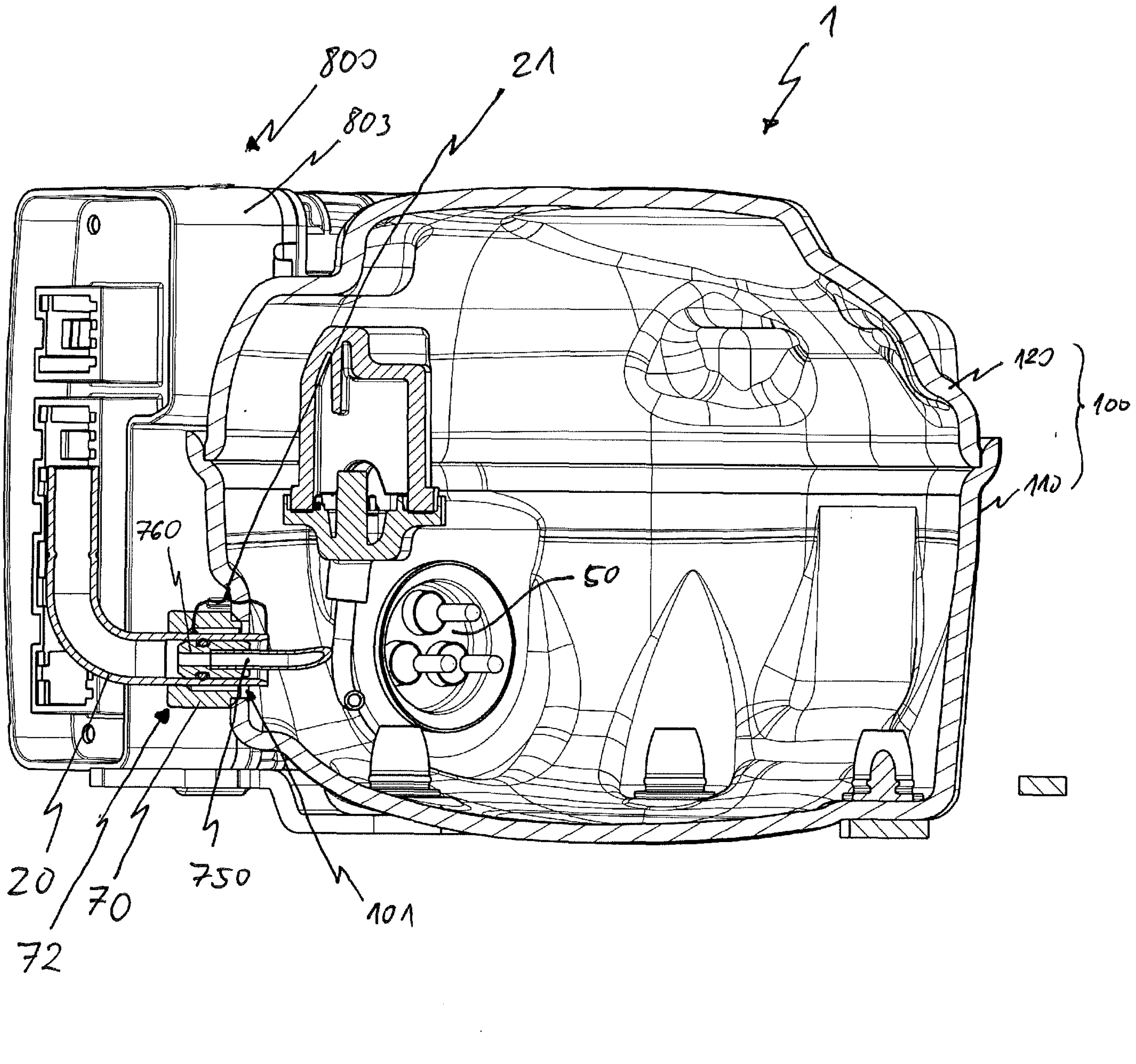

Fig. 16

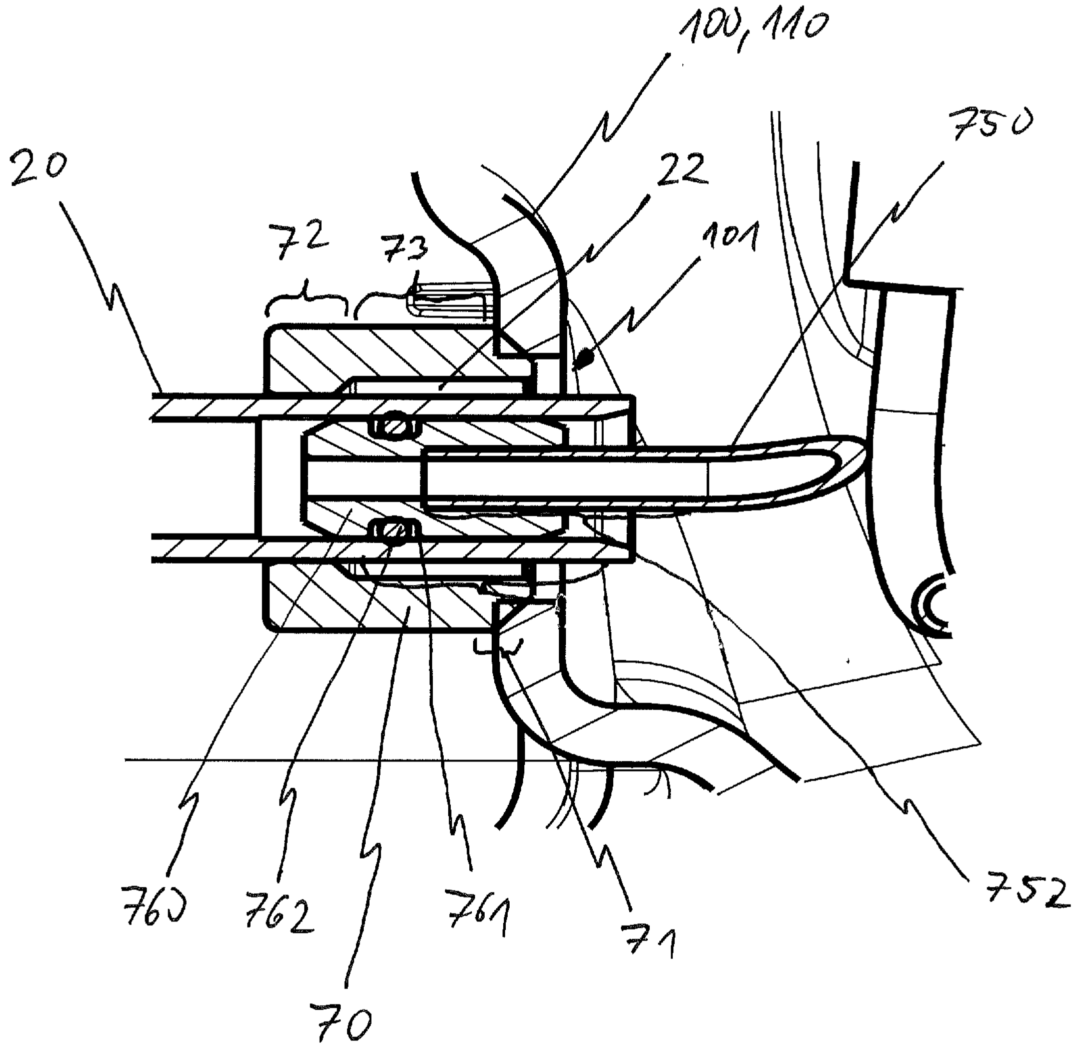

Fig. 16a

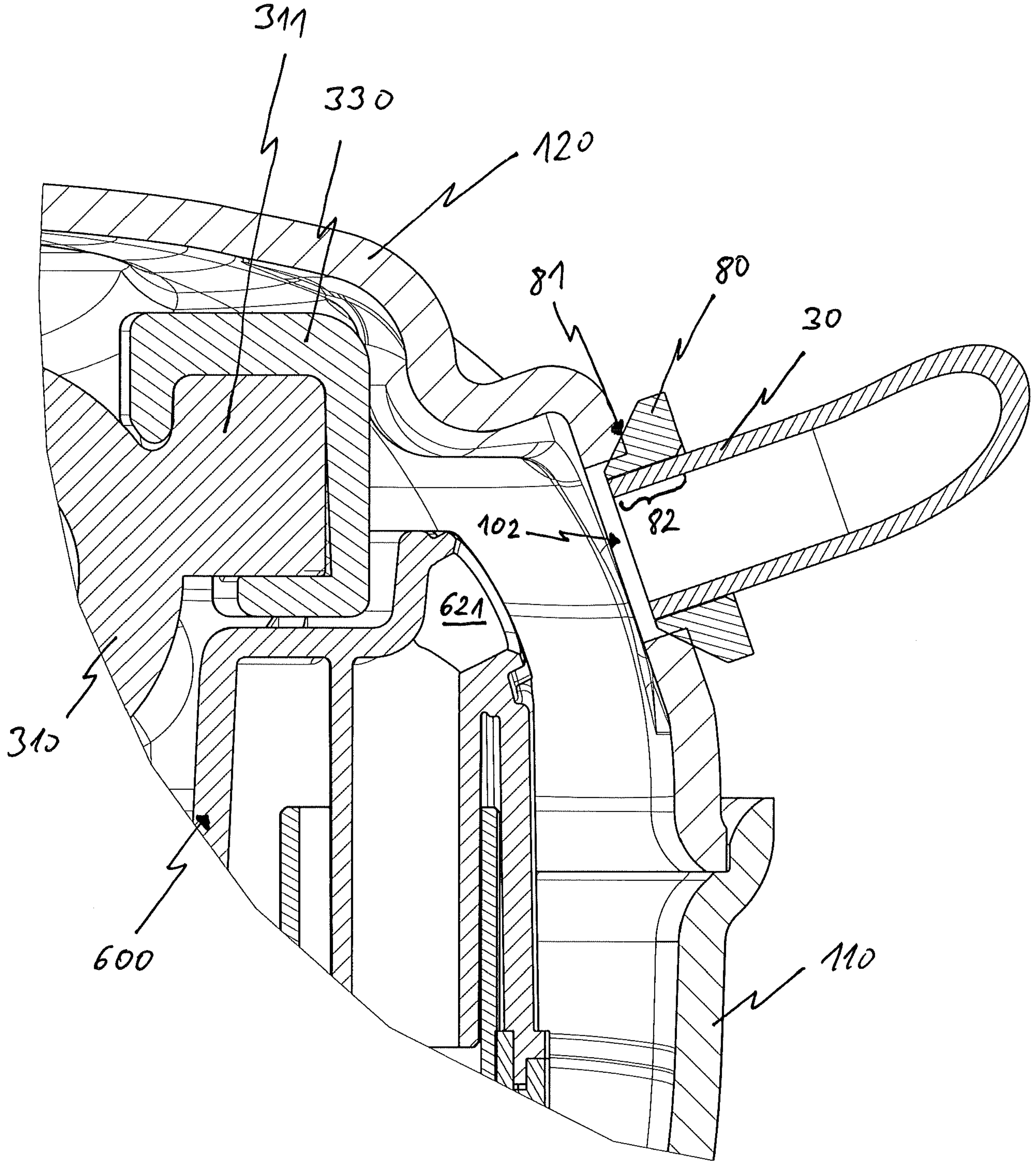

Fig. 16b

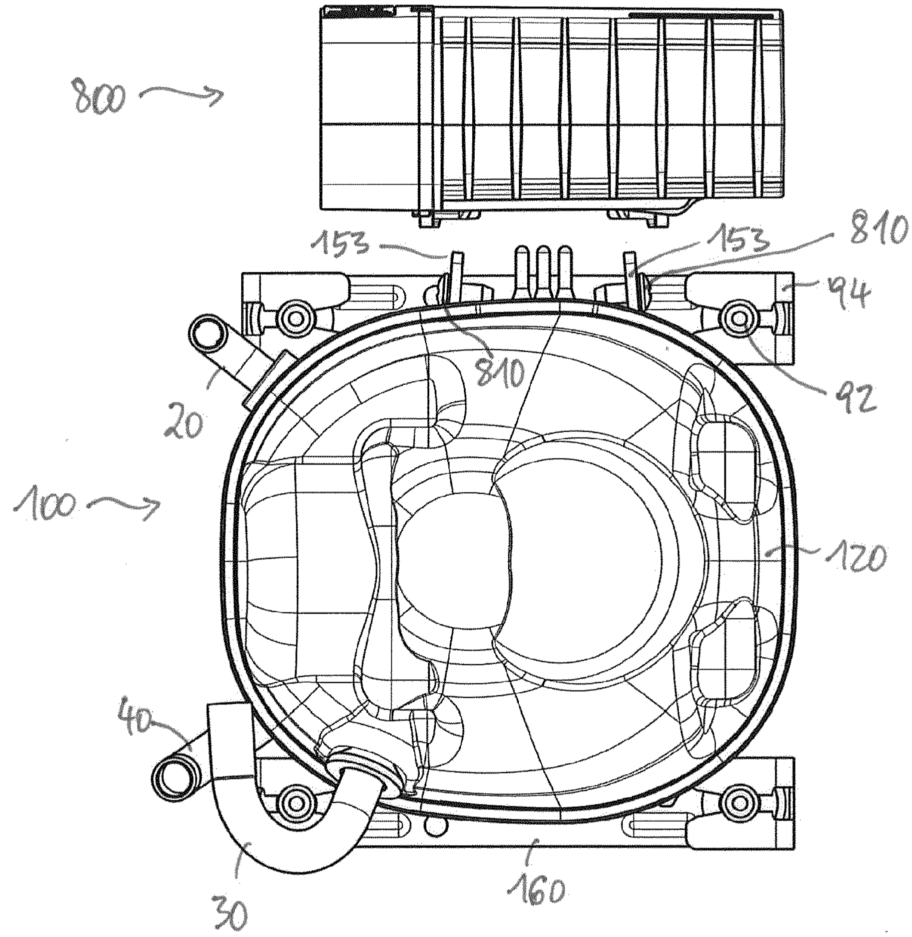

Fig. 17

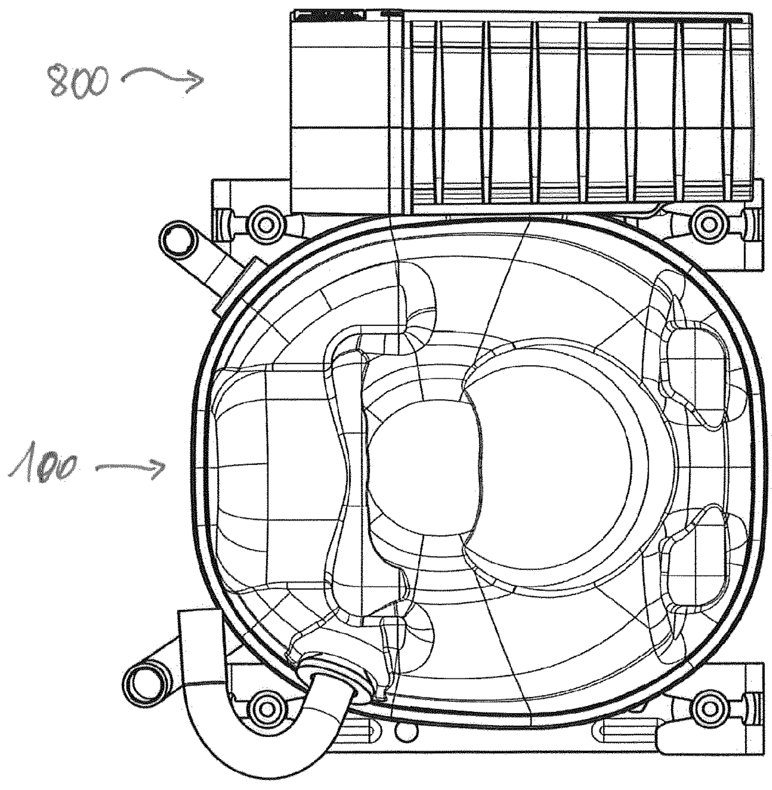

Fig. 18

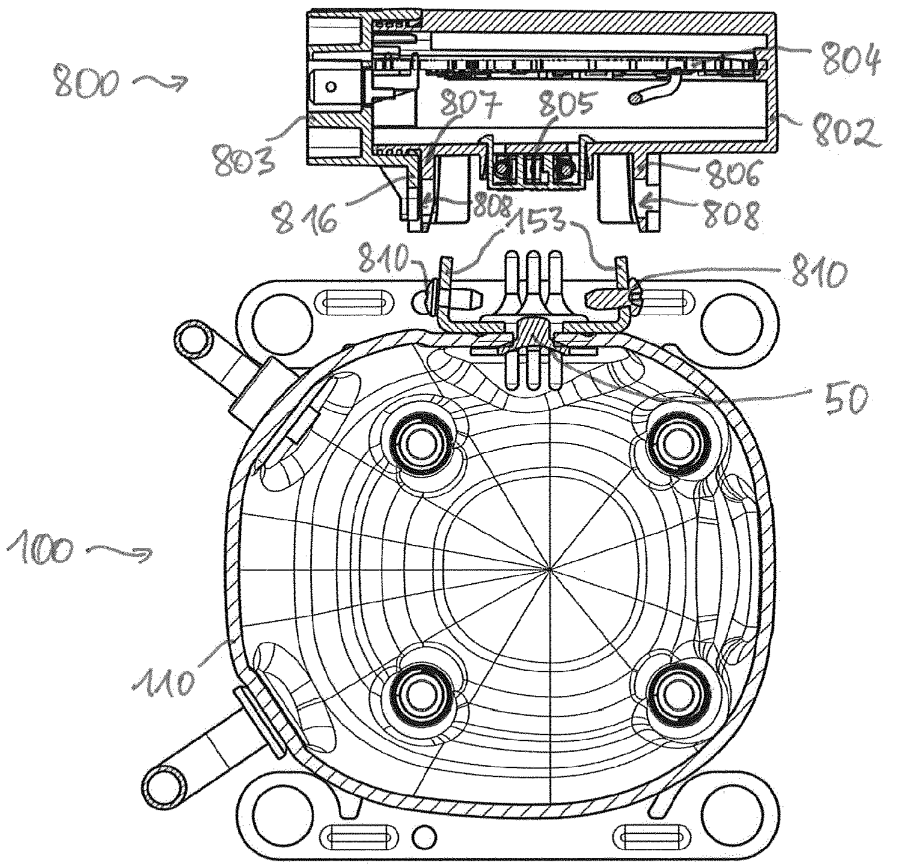
800
804
807
805
802
803
806
816
808
808
153
810
810
50
100
110

Fig. 19

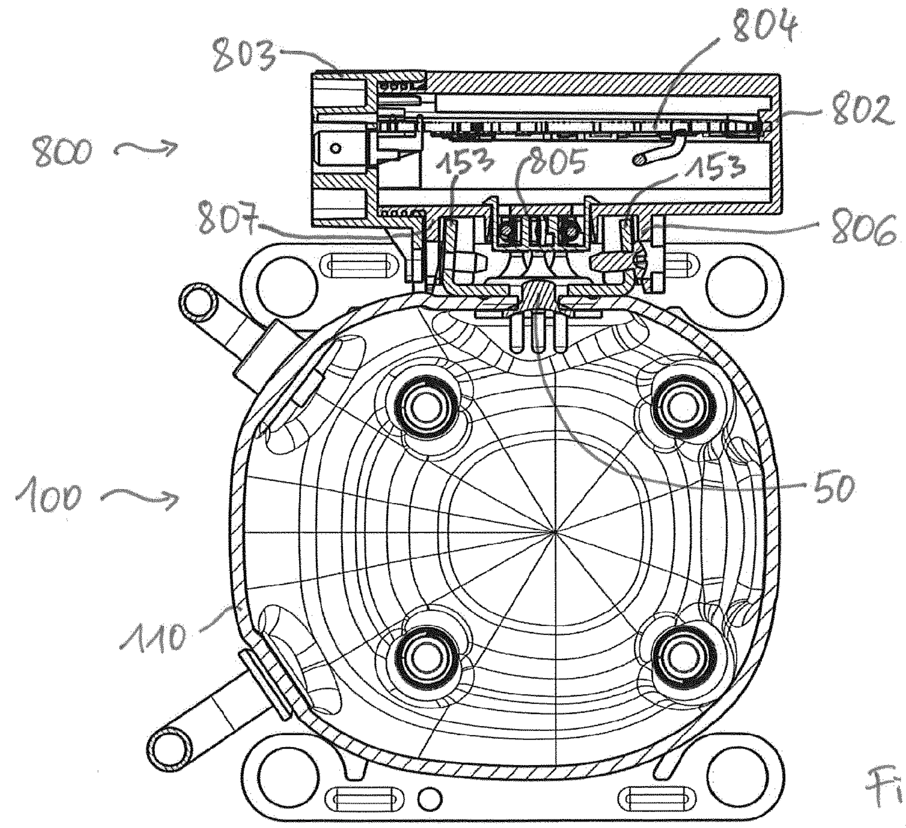
804
803
802
800
153
805
153
807
806
100
50
110

Fig. 20

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- EP 3358184 A1 **[0008]**