

PUMP CASING

The invention relates to a pump casing.

Throughout the description and claims of this specification the word "comprise" and variations of that word, such as "comprises" and "comprising",
5 are not intended to exclude other additives, components, integers or steps.

A reference herein to a patent document or other matter which is given as prior art is not to be taken as an admission that that document or matter was known or that the information it contains was part of the common general knowledge as at the priority date of any of the claims.

10 The invention relates more specifically, but not exclusively, to the field of pumps which, using rotors, are used as compressors for gaseous fluids.

The invention obviously relates to the pump which includes this casing.

In one of the simplest embodiments, a pump casing is made up of
15 two assemblies, referred to as first and second, which are joined along a joint face substantially orthogonal to the longitudinal axes of the rotors.

In the pump casing, the rotors are guided in rotation along their longitudinal axes by the guide elements, referred to as first guide elements, positioned at the level of the opposite ends which they comprise.

20 Generally the casings of such pumps are achieved by casting the walls in metallic material, and certain surfaces of these walls are worked by machining, in particular by boring, to define a chamber, referred to as compression chamber, in which the rotors are then placed.

Manufacture of said subassemblies by casting metallic material is
25 greatly facilitated when the ratio between the longitudinal dimension and the

transverse dimension (thickness) of each of the walls which define them is close to one.

Although not obligatory, the construction in two half subassemblies whose longitudinal dimension corresponds substantially to half the longitudinal dimension of the pump casing is preferred because it allows casting of the metallic material to be facilitated.

Moreover, the reduced longitudinal dimension of each chamber part included in a subassembly also makes it possible to ensure an increased machining precision.

The situation becomes complicated when the compression chamber must be cooled through circulation of a heat transfer medium.

In fact, the pump casing must have a double-walled shell which permits the circulation of a heat transfer medium around the compression chamber.

In this type of pump, the double-walled shell has, on the one hand, a first wall that determines the volume of the compression chamber, and, on the other hand, a second wall which extends around the first wall with a certain spacing intended for the circulation of the first fluid.

With this type of structure, one encounters problems of tightness when operating the pump, which problems are caused by differential dilatation of the first and of the second wall.

Therefore, it would be desirable for a double-walled pump casing whose structure enables surmounting the conventional problems encountered both during manufacture and during operation of the pump.

To this end, the invention has as subject matter a pump casing conforming to claim 1.

The invention also has as subject matter a pump including this casing.

The invention will be better understood from reading the description which follows given by way of non-limiting example, with reference to the
5 drawing representing schematically:

- Figure 1: an exploded view in perspective of a pump casing according to the invention,

- Figure 2 : a pump including the pump casing of Figure 1, seen in section along a plane which passes through the longitudinal axes of the rotors which it comprises,

- Figure 3 : an end view of one of the subassemblies made up of a pump casing according to the invention,

- Figure 4 : a view in transverse section of the subassembly according to Figure 3, and this along the mid-plane,

10 - Figure 5 : on an enlarged scale, a local view in section of a detail of the joining of the two subassemblies of the pump casing.

Referring to the drawing, one sees a pump casing 2 having a double-walled shell 3 which permits the circulation of a first fluid 4, in particular a heat-transfer medium, at least partially around a chamber 5 for compression of a second fluid 6, the compression being accomplished by means of at least two
15 elongated rotors 7, 8, which, having longitudinal axes 70, 80, are situated in said compression chamber 5.

The first fluid 4 as well as the second fluid 6 are symbolized by arrows.

20 The rotors 7, 8 are guided in rotation about their longitudinal axes 70, 80 by elements, referred to as first elements, for guiding in rotation 9, positioned at the level of opposite ends 71, 72, 81, 82, which these rotors comprise.

The double-walled shell 3 has, on the one hand, a first wall 10, which
25 determines the volume of the compression chamber 5, and, on the other hand, a second wall 11, which extends around the first wall 10 with a certain spacing 12 intended for the circulation of the first fluid 4.

The pump casing 2 is made up of two subassemblies 13, 14, referred to as first 13 and second 14, which are joined along the joint face 15 substantially orthogonal to the longitudinal axes 70, 80 of the rotors 7, 8.

As is apparent in Figure 1, the two fundamental subassemblies 13, 14 of the pump casing 2 and the rotors 7, 8 make possible formation of a pump 1.

In a noteworthy way, each first subassembly 13 and second subassembly 14 comprises a rigid element 16 which, molded in a first thermally conducting material, has two opposite faces being a first face 18 and a second face 19, with

- situated beyond the first face 18,

- on the one hand, the first wall 10 which, cast with this rigid element 16, extends substantially orthogonally to said first face 18, and is

15 •• transversally delimited between two opposite faces, referred to as third face 20 and fourth face 21, the third face 20 delimiting the compression chamber 5 laterally, the fourth face 21 constituting a surface of exchange with the first fluid 4,

20 •• longitudinally limited by a fifth face 22 which defines at least one bearing area for joining with the fifth face 22 of a first subassembly 13 or second subassembly 14 with which it must be joined along the joint face 15 in a manner so as to constitute a pump casing 2,

- 25 • on the other hand, the second wall 11 which extends substantially orthogonally to said first face 18 and parallel to the fourth face 21 of the first wall 10, while being without connection to said fourth face 21,

- situated set back with respect to the first face 18, cutouts 23 which each constitute at least one accommodation for a first element for guiding in rotation 9 of one of the opposite ends 71, 72, 81, 82 of one of the rotors 7, 8.

The first subassembly 13 and the second subassembly 14
 5 constituting the pump casing 2 are joined by means of third elements 29 which pull the one toward the other in a manner so as to apply tightly, one against the other, the fifth faces 22 of the rigid elements 16 of each first subassembly 13 and second subassembly 14.

The adoption of these technical features ensures the cohesion of
 10 assembly of the first subassembly 13 and of the second subassembly 14.

In a preferred embodiment, the first subassembly 13 and the second subassembly 14 constituting the pump casing 2 are joined by means of third elements 29 consisting of tension rods which:

- each extend in a second direction 30 substantially orthogonal to the
 15 joint face 15 and of which at least certain ones pass through the space situated between the first wall 10 and the second wall 11 of each first subassembly 13 and second subassembly 14,

- find support at the level of the second face 19 of each rigid element 16 which comprises one of said first and second subassemblies 13, 14.

20 The phrase "at the level of the second face 19" must not be interpreted to mean that the third elements 29 necessarily find support exactly in the plane of the second face 19.

For example, the third elements 29 find support on bearing areas (not shown) which, reserved in the rigid element 16, are situated set back with
 25 respect to said second face 19.

The adoption of these technical features likewise ensures the cohesion of the joining of the first subassembly 13 with the second

subassembly 14 by making it possible to apply the joining stresses in the solid zones of said subassemblies, and this in second directions 30 which are tangent to the first wall 10.

In a noteworthy way:

- 5 - the first subassembly 13 and the second subassembly 14 constituting the pump casing 2 are joined by means of third elements 29 which pull said first and second subassemblies 13, 14 one toward the other in a manner so as to apply tightly, one against the other, the fifth faces 22 of the rigid elements 16 of each first subassembly 13 and second subassembly 14,
- 10 - the second wall 11 of each first subassembly 13 and second subassembly 14 extend beyond of the first face 18, and comprise a face which, referred to as the sixth face 31, extends in a second plane 32 parallel to the fifth face 22 of the same first or second subassembly 13, 14, but set back with respect to this fifth face 22, in a manner such that when the fifth faces 22 of the
- 15 first subassembly 13 and of the second subassembly 14 rest one against the other, the sixth faces 31 of these subassemblies 13, 14 are spaced apart by a predetermined value "E", such that an interstice 33 remains between them.

The adoption of these technical features ensures a perfect isostatism of the assembly.

- 20 The adoption of these technical features allows a structure to be given to the pump casing 2 that simplifies the manufacturing radically, at whatever level that may be, i.e. in particular when the manufacturing comprises the steps of casting and machining.

- 25 As will be more apparent later on, the adoption of these features allows a pump casing 2 to be constructed comprising a first and a second subassembly 13, 14 which are adapted to comprise numerous common features, or even be identical.

In an equally noteworthy way, on at least one of said first and second subassemblies 13, 14, the first wall 10 is connected to the rigid element 16 which bears it through a connecting part 24 which elicits a displacement of said first wall 10 in a first direction 25 substantially orthogonal to the joint face or
 5 joint plane 15, and this by elastic deformation of said connecting part 24.

In a preferred embodiment, the connecting part 24 is constituted by a zone of the rigid element 16 which borders the first wall 10.

For example, this zone is constituted by a thinned part of the rigid element 16.

10 Advantageously, this thinned zone extends in a first plane 26 substantially parallel to the joint face or joint plane 15.

The adoption of these features allows any elongation or shortening of the first wall 10 to be absorbed by elastic deformation of the connecting part 24.

15 Each cutout 23, situated set back with respect to the first face 18, likewise constitutes an accommodation for a second element 27 intended to ensure the tightness between each of the opposite ends 71, 72, 81, 82 of an elongated rotor 7, 8 and the rigid element 16 in which the cutout 23 under consideration is situated.

20 The second element 27 ensures a tightness called "dynamic", i.e. a tightness effective during the rotation of the rotors.

As is apparent in the drawing, each cutout 23 consists of a bore which comprises a first bearing area 231 for a first element for guiding in rotation 9 of an end 71, 72, 81, 82 of rotor 7, 8 and a second bearing area 232
 25 for a second element 27 intended to ensure the tightness between an end 71, 72, 81, 82 of the rotor 7, 8 and the rigid element 16 at the level of which this end is situated.

Although this has not been represented, each rotor 7, 8 is driven in rotation, and the rotations of the different rotors 7, 8 are synchronized.

As is apparent in Figure 2, one of the constituent subassemblies 13, 14 of the pump casing 2 is connected to a housing 17 and to a cover 28.

5 Although this has not been represented, it is considered that it is the housing 17 or the cover 28 which shelters a mechanism for drive in synchronized rotation of the different rotors 7, 8 housed in the pump casing 2.

To permit drive of said rotors 7, 8, at least one of said first subassembly 13 and second subassembly 14 is provided with bores which
10 pass right through the rigid element which they comprise, and the rotors have their ends which traverse said bores in a manner so as to extend beyond the second face of the rigid element under consideration.

The means for driving the rotors 7, 8 in synchronized rotation can be connected to the ends which pass through said bores in such a way as to
15 extend beyond the second face of the rigid element under consideration.

Preferably, the first subassembly 13 and the second subassembly 14 are provided with bores which pass right through the rigid element 16 which they comprise, and the second face 19 of the rigid element 16 of said first and second subassemblies 13, 14 bears at least one cover 28 which closes off said
20 bores tightly.

Preferably, the sixth faces are spaced apart by a value "E" ranging between some hundredths of a millimeter and some tenths of a millimeter.

Within the limit of the value of the spacing apart of the sixth faces 31 (thermal dilatation), the prolongation of the second walls 11 which bear them
25 cannot affect the fitting together of the fifth faces 22.

In a way also notable:

- at least one of the fifth faces 22 of the first subassembly 13 and of the second subassembly 14, which rest one against the other, bears at least one first gasket 35 which co-operates with the other fifth face 22 and ensures the peripheral tightness of the compression chamber 5 at the level of the two
5 fifth faces 22 placed resting one against the other,

- at least one of the sixth faces 31 of the first subassembly 13 and of the second subassembly 14 which are situated vis-à-vis, rest one against the other through the agency of at least one second gasket 36 which ensures the peripheral tightness of the space situated between the first wall 10 and the
10 second wall 11, in spite of the interstice 33 of predetermined value "E" which remains between these sixth faces 31.

For example, at least one of the fifth faces 22 of the first subassembly 13 and of the second subassembly 14 comprises a groove 34 receiving a first gasket 35 qui co-operates with the other fifth face 22.

15 Other technical solutions enabling accommodation of the first gasket exist, and are not described because they belong to the state of the art.

The phrase "at least a first gasket 35" and the phrase "at least a second gasket 36" mean that made use of is at least one tightness element and/or that the action of each tightness element can be supplemented or
20 reinforced by use of a tightness material joined by coating.

The first gasket 35 and the second gasket 36 ensure a static tightness, i.e. a tightness between fifth faces which are immobile one with respect to the other, or sixth faces which are immobile one with respect to the other.

25 In the drawing, the first gasket and the second gasket have the appearance of a gasket of toric type, but it is a question of possible solutions for achieving each of said gaskets.

The first gasket 35 and the second gasket 36 can also consist of flat gaskets, or can be formed by means of a strand of material deposited on the faces to be joined.

5 The adoption of these technical features ensures perfect tightness of the compression chamber 5 and of the space in which the first fluid circulates 4.

The bearing areas for joining are made up of the fifth face 22 of two first and second subassemblies intended to be joined having complementary elements of transversal positioning, male 37, female 38, so as to enable the relative transversal positioning of the two first and second subassemblies.

10 In an advantageous embodiment, the fifth faces 22 are flat, and the complementary positioning elements comprise pins 37 engaged in bores 38 made in each bearing area for joining, constituted by a fifth face 22.

The adoption of these technical features ensures a strict positioning of the first and of the second subassembly 13, 14, one with respect to the
15 other.

When the pump casing 2 is intended to receive at least two elongated rotors 7, 8 whose longitudinal axes 70, 80 are situated in a same third plane, the bearing area for joining, made up of the fifth face 22 of each first or second subassembly 13, 14, has two complementary elements of
20 transversal positioning, male 37 and female 38, which are situated in said third plane 39.

In this way, the positioning of the two subassemblies 13, 14 of the pump casing 2 is not affected by micro shifts caused by the succession of cycles of heating and cooling undergone by the pump.

25 Generally, the first and the second subassemblies 13, 14 which it comprises are composed in such a way that the joint face 15 is situated at between one quarter and three quarters of the distance which separates the first faces 18 opposite said assembled first and second subassemblies 13, 14.

Preferably, the first and the second subassemblies 13, 14 which it comprises are composed such that the joint face 15 is situated substantially in the middle of the distance which separates the first faces 18 opposite said assembled first and second subassemblies 13, 14.

5 The adoption of these last technical features permits, for example, forming the pump casing 2 by means of a first and of a second subassembly 13, 14 which are identical.

In any case, the adoption of these last technical features simplifies the machining of the compression chamber 5, but also the machining of the
10 bores which constitute, on the one hand, the first bearing areas 231 intended to receive the first elements for guiding in rotation 9 the ends 71, 72, 81, 82 of elongated rotors 7, 8 and, on the other hand, the second bearing areas 232 intended to receive the second elements 27 ensuring the tightness between the ends 71, 72, 81, 82 of the rotors and the rigid element 16.

15 When the pump casing 2 has at least one first channel 40 which permits the injection into the chamber of a third fluid 41, referred to as dilution fluid, and this from the exterior of the compression chamber, at least this first channel 40 intended to route the third fluid 41, introduced through an entry situated in the rigid element 16 and expelled into the compression chamber 5
20 through at least one exit orifice 42 situated at the level of the third face 20, is made in the thickness of said first wall 10.

The third fluid 41 is symbolized by arrows which emanate from the exit orifices 42.

The adoption of these technical features permits the routing of the
25 third fluid 41 to any appropriate place in the compression chamber 5.

In a first embodiment, the second wall 11 of each first and second subassembly 13, 14 is formed by duplicate molding.

According to a second embodiment, the second wall 11 of each first and second subassembly 13, 14 is formed by duplicate molding of a second material identical to the first material constituting the first wall 10.

According to a third embodiment, the second wall 11 of each first and second subassembly 13, 14 is formed by duplicate molding of a second material different from the first material constituting the first wall 10.

The adoption of these technical features makes it possible to simplify considerably the manufacture of the pump casing 2.

When the pump casing 2 houses two elongated rotors 7, 8 disposed parallel in the compression chamber 5 comprising a first orifice for admission 44 of the second fluid 6 and a second orifice for outflow 45 of said second fluid 6, the rigid element 16 of each first and second subassembly 13, 14 comprises a second channel 46 which opens out into the first face 18 through an aperture which, constituting one of said first orifice 44 or second orifice 45, is provided with a plane of symmetry 47 which is, on the one hand, situated at mid-distance between the longitudinal axes 70, 80 of the elongated rotors 7, 8 and, on the other hand, perpendicular to the third plane 39 which contains the longitudinal axes 70, 80 of said rotors 7, 8.

The second channel 46 is determined by transverse sections which each have a plane of symmetry 47 which is, on the one hand, situated at mid-distance between the longitudinal axes 70, 80 of the elongated rotors 7, 8, and, on the other hand, perpendicular to the third plane 39 which contains the longitudinal axes 70, 80 of said rotors 7, 8.

The adoption of these technical features ensures a symmetrical temperature distribution in each first and second subassembly, in particular an identical temperature distribution at the level of first elements for guiding in rotation which are accommodated in each first and second subassembly.

In effect, the hot fluid evacuated from the compression chamber 5 carries the same quantity of heat on both sides of the plane of symmetry 47.

Each first and second subassembly 13, 14 which it comprises possesses a plane of symmetry 47 which is, on the one hand, situated at mid-distance between the longitudinal axes 70, 80 of the elongated rotors 7 8, and, on the other hand, is perpendicular to the third plane 39 which contains the
5 longitudinal axes 70, 80 of said rotors 7, 8.

The adoption of these technical features reinforces the uniformity of the temperature distribution.

In an advantageous way, at least the second orifice for exit 45 of said second fluid 6 is well shaped and disposed in the subassembly which
10 comprises it in such a way as to allow the removal by gravity of any condensates (not shown) situated in the lower part of the compression chamber 5.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. Pump casing having a double-walled shell which permits the circulation of a first fluid, in particular a heat-transfer medium, at least partially about a chamber of compression of a second fluid, the compression being accomplished by means of at least two elongated rotors, which, having longitudinal axes, are situated in said compression chamber,

- the rotors being guided in rotation about their longitudinal axes by the elements, referred to as first elements for guiding in rotation, positioned at the level of opposite ends which these rotors comprise,
- the double-walled shell having, on the one hand, a first wall which determines the volume of the compression chamber, and, on the other hand, a second wall which extends around the first wall with a certain spacing intended for the circulation of the first fluid,
- said pump casing being made up of two subassemblies, referred to as first and second, which are assembled along a joint face orthogonal to the longitudinal axes of the rotors,
- each first subassembly and second subassembly wherein it comprises a rigid element which, cast in a first thermally conducting material, has two opposite faces, being a first face and a second face, with
 - situated beyond the first face,
 - on the one hand, the first wall which, cast with this rigid element, extends orthogonally to said first face and is
 - transversally delimited between two opposite faces, referred to as third face and fourth face, the third face delimiting the

compression chamber laterally, the fourth face constituting a surface of exchange with the first fluid,

•• longitudinally limited by a fifth face which defines at least one bearing area for joining with the fifth face of a first subassembly or second subassembly with which it must be joined along the joint face in a manner so as to constitute a pump casing,

- on the other hand, the second wall which extends orthogonally to said first face and parallel to the fourth face of the first wall, while being without any connection to said fourth face,

- situated set back with respect to the first face, cutouts which each constitute at least one accommodation for a first element for guiding in rotation of one of the opposite ends of one of the rotors,

wherein the first subassembly and the second subassembly constituting the pump casing are joined by means of third elements which pull the one toward the other in a manner so as to apply tightly, one against the other, the fifth faces of the rigid elements of each first subassembly and second subassembly, and

wherein the third elements consist of tension rods which:

- each extend in a second direction orthogonal to the joint face and of which at least certain ones pass through the space situated between the first wall and the second wall of each first subassembly and second subassembly, and

- find support at the level of the second face of each rigid element which comprises one of said first and second subassemblies.

2. Pump casing according to claim 1, wherein on at least one of said first and second subassemblies, the first wall is connected to the rigid element which bears it

through a connecting part which elicits a displacement of said first wall in a first direction orthogonal to the joint face, and this by elastic deformation of said connecting part.

3. Pump casing according to claim 1 or 2, wherein each cutout situated set back with respect to the first face, likewise constitutes an accommodation for a second element intended to ensure the tightness between each of the opposite ends of an elongated rotor and the rigid element in which the cutout under consideration is situated.

4. Pump casing according to any one of the claims 1 to 3, wherein:

- the first subassembly and the second subassembly constituting the pump casing are joined by means of third elements which pull said first and second subassemblies, one toward the other, in a manner so as to apply tightly, one against the other, the fifth faces of the rigid elements of each first subassembly and second subassembly,

- the second wall of each first subassembly and second subassembly extend beyond the first face and comprise a face which, referred to as the sixth face, extends in a second plane parallel to the fifth face of the same first or second subassembly, but set back with respect to this fifth face, in a manner such that when the fifth faces of the first subassembly and of the second subassembly rest one against the other, the sixth faces of these subassemblies are spaced apart by a predetermined value "E", such that an interstice remains between them.

5. Pump casing according to claim 4, wherein:

- at least one of the fifth faces of the first subassembly and of the second subassembly which rest one against the other, bears at least one first gasket which co-operates with the other fifth face and ensures the peripheral tightness of the compression chamber at the level of the two fifth faces placed resting one against the other,

- at least one of the sixth faces of the first subassembly and of the second subassembly which are situated vis-à-vis, rest one against the other through the agency of at least one second gasket which ensures the peripheral tightness of the space situated between the first wall and the second wall, in spite of the interstice of predetermined value "E" which remains between these sixth faces.

6. Pump casing according to any one of the claims 1 to 5, wherein the bearing area for joining constituted by the fifth faces of two first and second subassemblies intended to be joined have complementary elements of transversal positioning, male and female, in such a way as to enable the relative transversal positioning of the two first and second subassemblies.

7. Pump casing according to any one of the claims 1 to 5 and intended to accommodate at least two elongated rotors, the longitudinal axes of which are situated in a same plane, wherein the bearing area for joining made up of the fifth face of each first or second subassembly (13, 14) has two complementary elements of transversal positioning, male and female, which are situated in said third plane.

8. Pump casing according to any one of the claims 1 to 7, wherein the first and the second subassemblies, which it comprises, are composed such that the joint face is situated at between a quarter and three quarters of the distance which separates the first faces opposite said joined first and second subassemblies.

9. Pump casing according to any one of the claims 1 to 8, wherein the first and the second subassemblies which it comprises are composed such that the joint face is situated in the middle of the distance which separates the first faces opposite said joined first and second subassemblies.

10. Pump casing according to any one of the claims 1 to 9 and having at least one first channel which permits the injection into the chamber of a third fluid, referred to as dilution fluid, and this from the exterior of the chamber, this body comprising at least this first channel intended to route the third fluid, introduced through an entry

situated in the rigid element and expelled into the compression chamber through at least one exit orifice situated at the level of the third face, is made in the thickness of said first wall.

11. Pump casing according to any one of the claims 1 to 10, wherein the second wall of each first and second subassembly is formed by molding from a cast (duplicate molding).

12. Pump casing according to any one of the claims 1 to 10, wherein the second wall of each first and second subassembly is formed by duplicate molding of a second material identical to the first material constituting the first wall.

13. Pump casing according to any one of the claims 1 to 10, wherein the second wall of each first and second subassembly is formed by duplicate molding of a second material different from the first material constituting the first wall.

14. Pump casing according to any one of the claims 1 to 13 and intended to house two elongated rotors disposed parallel in the compression chamber, said compression chamber comprising a first orifice for admission(44) of the second fluid and a second orifice for outflow of said second fluid wherein the rigid element of each first and second subassembly comprises a second channel which opens out into the first face through an aperture which, constituting one of said first orifice or second orifice, is provided with a plane of symmetry which is, on the one hand, situated at mid-distance between the longitudinal axes of the elongated rotors and, on the other hand, perpendicular to the third plane which contains the longitudinal axes of said rotors.

15. Pump casing according to claim 14, wherein the second channel is determined by transverse sections which each have a plane of symmetry that is, on the one hand, situated at mid-distance between the longitudinal axes of the elongated rotors and, on the other hand, perpendicular to the third plane which contains the longitudinal axes of said rotors.

16. Pump casing according to any one of the claims 1 to 15, wherein each first and second subassembly which it comprises possesses a plane of symmetry which is, on the one hand, situated at mid-distance between the longitudinal axes of the elongated rotors and, on the other hand, perpendicular to the third plane which contains the longitudinal axes of said rotors.

17. Pump casing according to any one of the claims 1 to 16, wherein the second orifice for outflow of the second fluid is well formed and disposed in the subassembly which comprises it in a way so as to permit removal by gravity of any condensates situated in the lower part of the compression chamber.

18. Pump including a pump casing according to any one of the claims 1 to 17.