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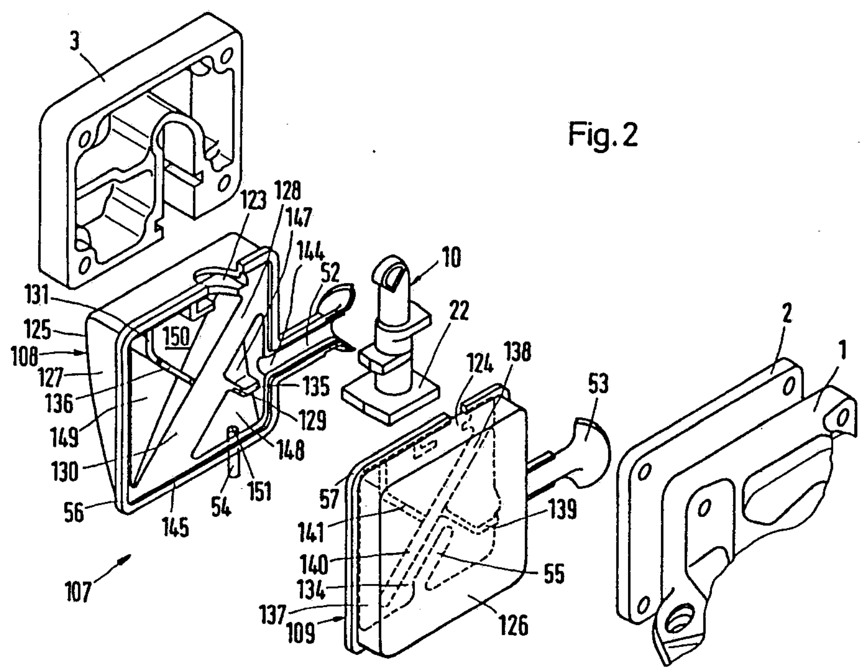
# (54) A sound dampener for use in a refrigeration compressor

(57) The plastics housing 107 consists of two interconnected shells 108, 109. A connecting nipple 10 for providing the suction connection to the cylinder of the compressor is made of a plastics material having a greater ability to withstand heat than the material of which the shells are made and the nipple is located between the rims of the shells and held between them. The shells 108, 109 are shallow and are interconnected substantially in the region of the largest cross-section of the housing. The connection of the shells takes place not only at their rims 56,57 but also in part at least at inner walls 128, 138, 140, 55. The interconnection of the shells can be made by ultrasonic welding.

Fig. 2

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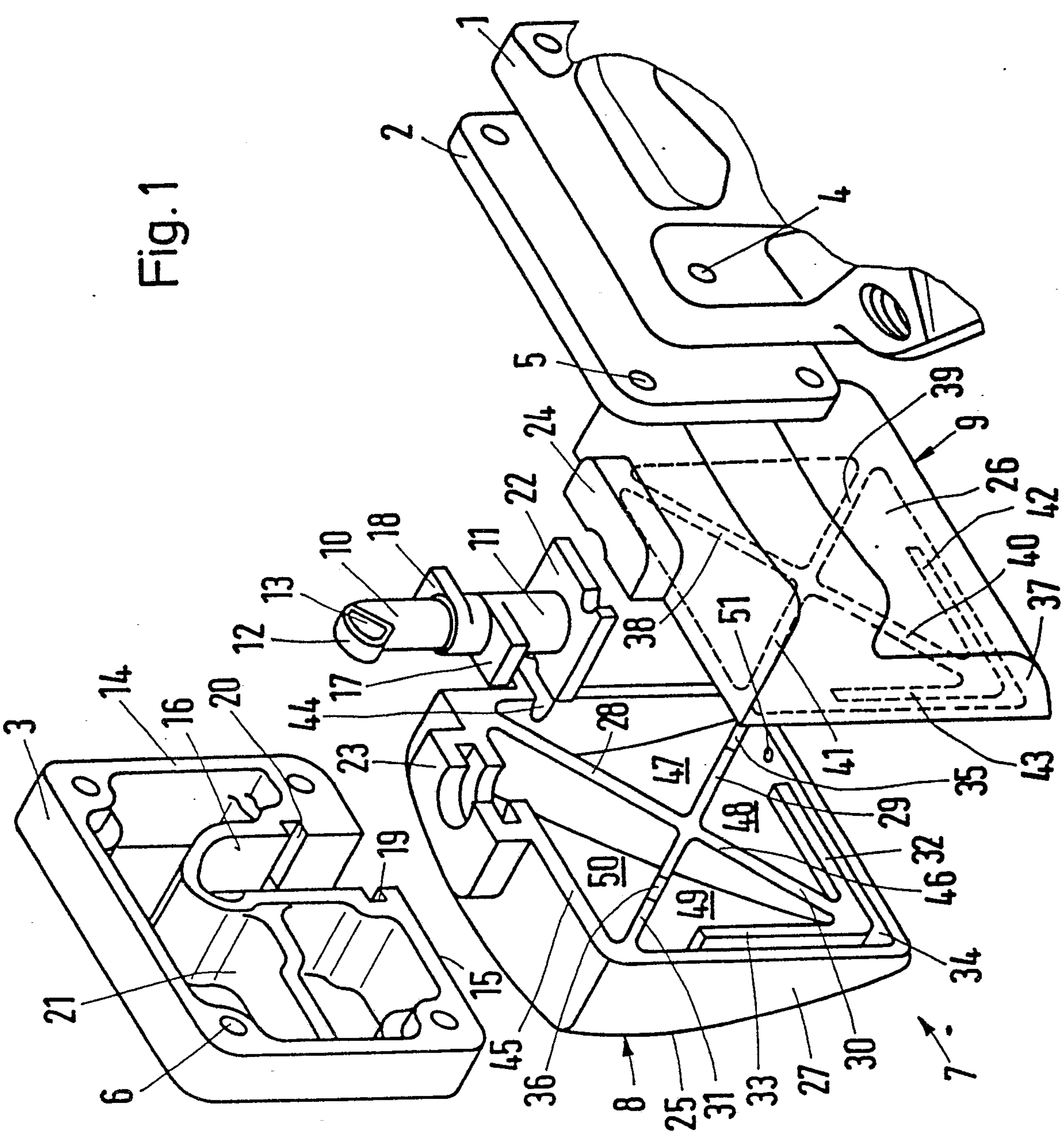


Fig. 1

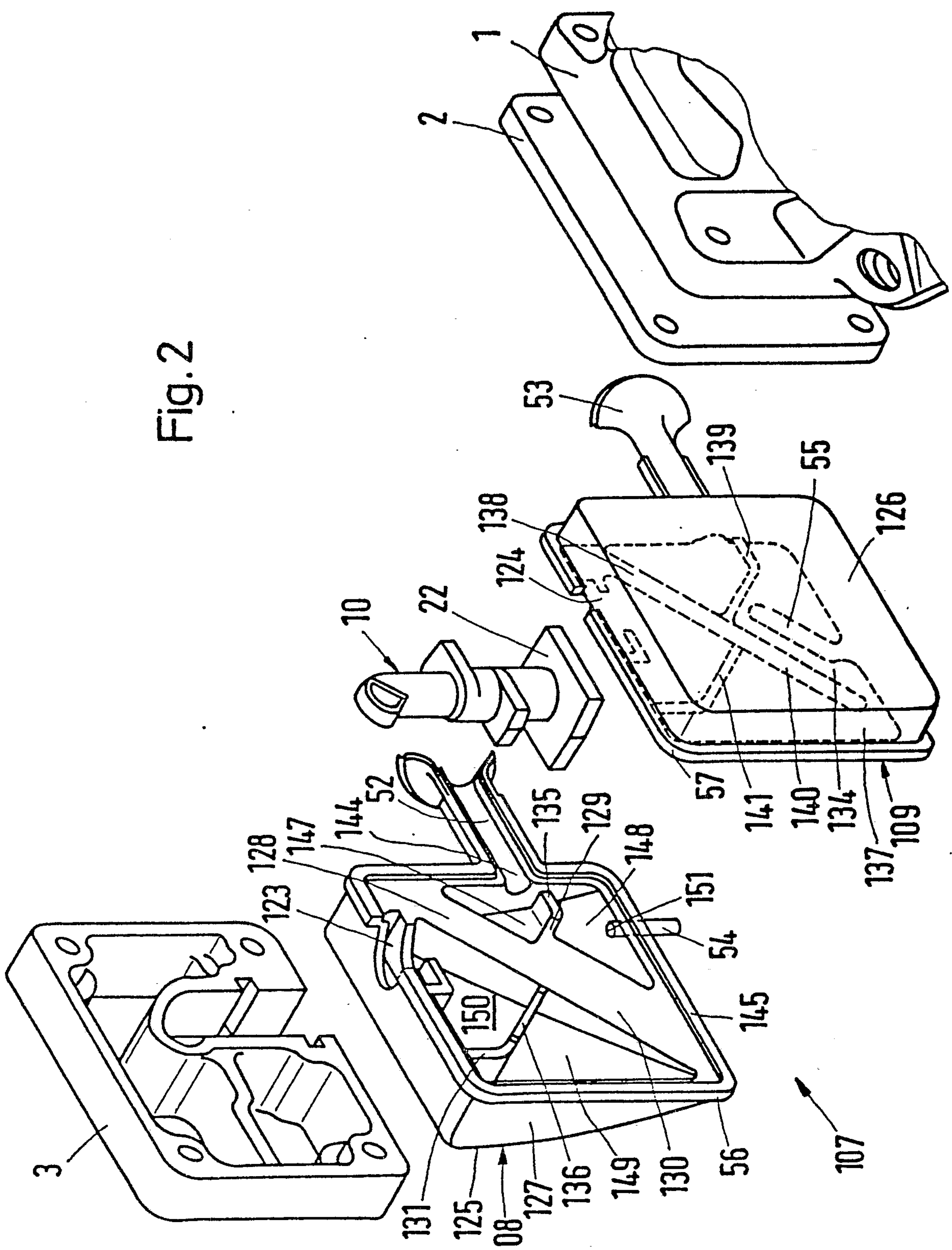
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Fig. 2

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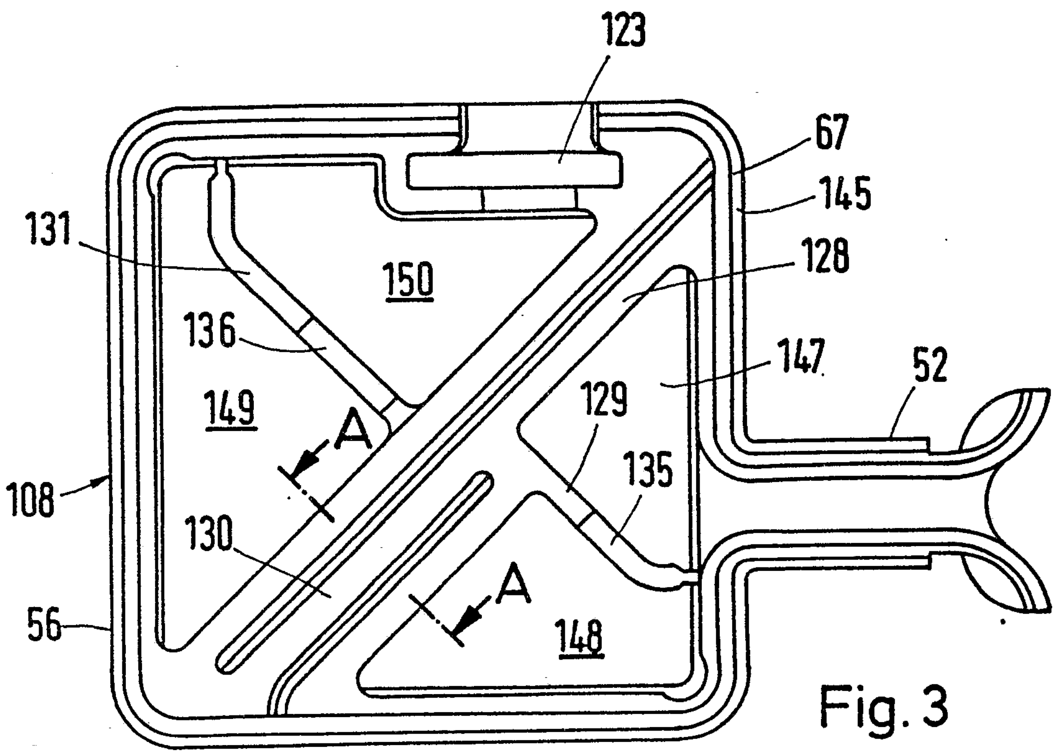


Fig. 3

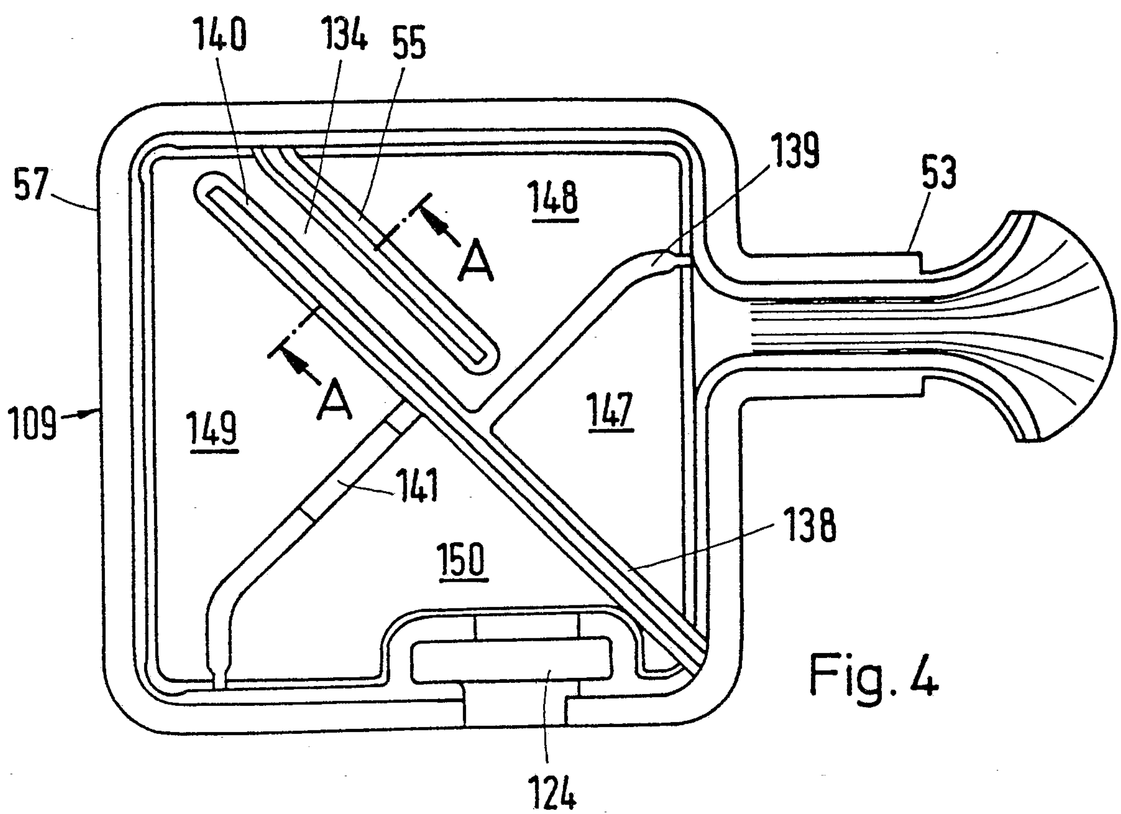


Fig. 4

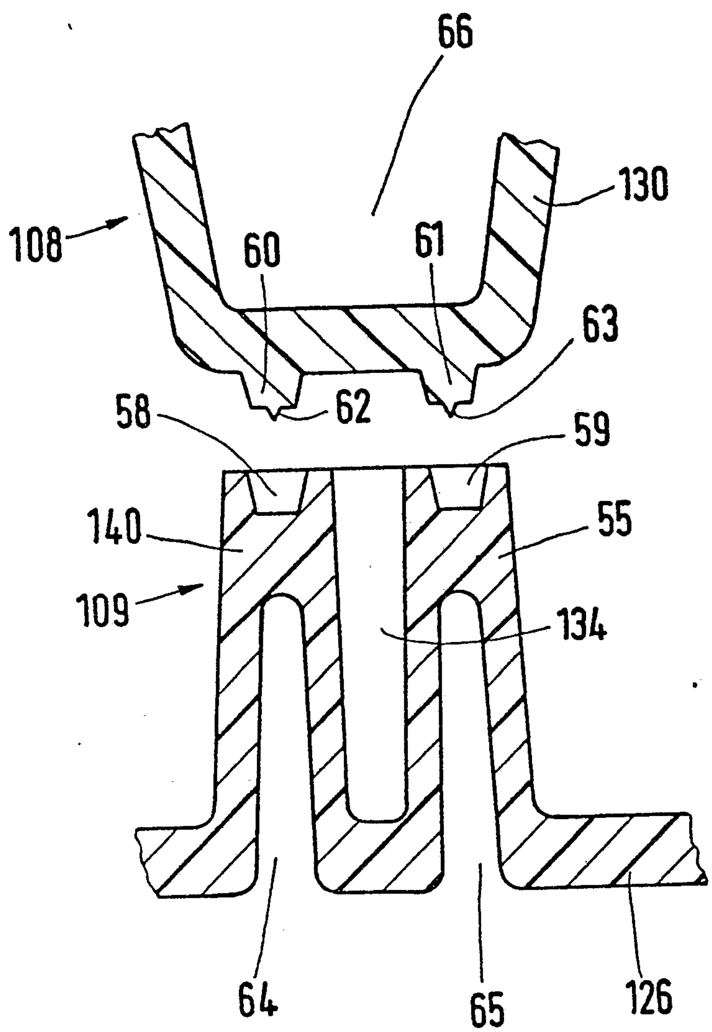


Fig. 5

SPECIFICATION

## A sound dampener for use in a refrigeration compressor

This invention relates to a sound dampener for dampening the suction noises in a refrigeration compressor having a refrigerant-impelling piston, the sound dampener having at least two chambers interconnected by a throttle point and comprising a plastics material housing consisting of two shells interconnected at their rims and having a connecting nipple for providing the suction connection to the cylinder of the compressor.

In a known sound dampener of this kind (disclosed in DE-OS 32 06 038), the plastics housing consists of two identical shells from the base of each of which there extend two integrally-formed nipples. One nipple on one shell forms an inlet nipple and one nipple on the other shell forms a suction nipple, the second nipple on each shell being blind and serving to secure, against rotation, the sound dampener in the cover member of the cylinder of the refrigeration compressor. With the usual dimensions inside the capsule of a hermetically-encapsulated refrigeration unit, relatively little space is available perpendicular to the plane formed by the nipples. The join between the shells is therefore located in the region of a smaller cross-section of the housing at a spacing from the nipples.

By using plastics material one obtains good thermal insulation so that gas being sucked undergoes no undesired heating and the compressor has good efficiency. Also, plastics material has good acoustic insulating properties. The known sound dampener has, however, to be made of a material which not only withstands the refrigerant but also has a good ability to withstand heat because the plastics material makes direct contact with the cylinder cover member which can assume high temperatures. Such plastics materials are expensive. Furthermore, the housing is weak, particularly so if the volume of the housing be designed to have optimum sound dampening characteristics. One must therefore have comparatively thick walls and use a comparatively large amount of material. This likewise makes the sound dampener expensive.

It is already known from DE-OS 32 15 586 to provide a two-part sound dampener of plastics material with two suction tubes of metal which are pushed into the cylinder cover member. Abutment rings and clamping rings are necessary to secure the suction tubes in a wall of the sound dampener. The attachment must be completed before the two housing parts are interconnected. These suction tubes are resistant to temperature but they call for additional securing operations before the sound dampener is assembled.

The invention is based on the problem of providing a sound dampener of the aforementioned kind which has a plastics material housing and which can be made more economically with the same or better sound damping properties.

The present invention provide a sound dampener for dampening the suction noises in a refrigeration compressor having a refrigerant-impelling piston, the sound dampener having at least two chambers interconnected by a throttle point and comprising a plastics material housing consisting of two shells interconnected at their rims and having a connecting nipple for providing the suction connection to the cylinder of the compressor, wherein the connecting nipple is made of a material having a greater ability tc withstand heat than the material of the shells has, and is located between the rims of the shells and there held in position.

The above-mentioned problem is solved according to the invention in that the connecting nipple for the suction connection is made of a material having a higher resistance to temperature that the material of the shells, passes through the join between the shells and is retained in the shells.

In such a construction, the housing can be made of a plastics material which is resistant to refrigerant and has a lower ability to withstand heat. Such materials are cheaper. The attachment of the connecting nipple for the suction connection does not require a separate operation. Instead, this attachment is brought about as the shells are interconnected. The nipple can be retained securely in this interconnection. This manner of assembly likewise saves costs.

Advantageously, the suction nipple has a projecting retaining element which engages in fittings of both shells. This secures the suction nipple against axial displacement. In conjunction with the receiving fittings, the retaining element forms a kind of labyrinth seal so that leakage flow is practically suppressed even if the suction nipple is not tightly surrounded by the material of the shells.

It is favourable for the retaining element and the fittings to be asymmetrical longitudinally of and/or transversely to the join of the shells to define a predetermined installation position. The suction nipple is then secured against rotation relative to the remainder of the sound dampener. If the suction nipple is installed at a defined position, the sound dampener as a whole will have the right position.

Very accurate positioning of suction nipples and sound dampeners can be achieved by providing the cylinder cover member at the end facing the cylinder with a recess that extends from one side wall and receives the suction nipple, and by the suction nipple comprising two opposed projections which engage in complementary guides of the wall of the recess.

If the projections and guides are asymmetrical and preferably axially offset, incorrect installation can be prevented.

With particular advantage, the suction nipple is moulded from plastics material. This plastics material must have a greater ability to withstand temperature than the plastics material of the housing so that the two materials will not fuse into each other. Even so, the fact that the suction nipple is held between the shells makes that aspect less important than it would otherwise be. Production from plastics material permits also the selection of virtually any desired shape and in particular permits the making of the retaining element and the projections of integral form.

The invention also provides a sound dampener for dampening the suction noises in a refrigeration compressor having a refrigerant-impelling piston, the sound dampener having at least two chambers, interconnected by a throttle point and comprising a plastics material housing consisting of two shells interconnected at their rims and having a connecting nipple for providing the suction connection to the cylinder of the compressor, wherein the chambers are defined by dividing walls upstanding from the bases of the shells, the shells have a depth less than their width or length, the shells are interconnected in the region of substantially their largest cross-section, and there is at least some interconnection of the shells at the dividing walls.

According to this second aspect, which can be used in conjunction with the first aspect, provision is made for the shells to be shallow and to be interconnected in the region of the largest cross-section of the housing and for the interconnection of the shells to take place not only at the rims but also at least at part of the inner walls.

"Shallow" shells are those with a depth less than their width or length. The interconnection running around the rims provides a comparatively large frame of high strength. The suction nipple is able to be firmly secured between the shells. The adjoining side walls are likewise very strong because they have a relatively shallow height. The bases of the shells are strengthened not only in that they are stiffened by inner walls but also in that inner walls of the two shells are interconnected. Despite the large areas of the bases of the shells, one therefore obtains a strong housing which can be made without excessively thick walls. The sound dampener is therefore economical to manufacture. By choosing dimensions for the largest cross-section of the housing and choosing the arrangement of the inner walls, the number and volume of the chambers can be designed at will so that optimum sound dampening properties can be achieved. All that is possible without the need for deep shells which would increase the cost of moulds.

To form a throttle opening between adjacent chambers, at least one inner wall may have a recess at its distal end. The size of the recess governs the throttle resistance.

Another possibility is to have at least one inner wall adjacent to another wall between adjacent chambers in order to form a throttle passage. Such a throttle passage can be quite long so that larger throttling resistances can be achieved without excessively small cross-sections.

It is particularly favourable for the shells to be substantially rectangular and for inner walls to run from the region of the centres of the bases of the shells to the side walls in the corner regions. Such a suction sound dampener can be accommodated in the compressor capsule to save space and has remarkable stiffness which ensures that resonance oscillations of the housing do not occur at all or lie beyond the audio spectrum.

The shallow shape of the shells also permits each shell to be made in one piece with one half of an inlet nipple. Suction gas is therefore directed into the interior of the first chamber and there strikes an intermediate wall so that any oil contained in the refrigerant is separated.

In a preferred embodiment, four chambers substantially triangular in cross-section are connected in series by way of throttles, the first chamber, provided with the inlet, being arranged at the side of the housing, the second chamber, provided with an oil outlet aperture, is arranged in the lower part of the housing, and the fourth chamber, provided with the suction nipple, is arranged in the upper part of the housing. Such a sound dampener has a remarkably high degree of damping in the audio range. The oil separated in the first and second chambers can run off downwardly. The connection of the suction nipple at the top is not impeded.

The oil outlet aperture can be provided with a small tube. The sound dampening effect cannot then be prejudiced by the aperture.

It is also favourable for the bases of the shells and the inner walls to be so designed that substantially no parallel wall surfaces are opposite one another in the chambers. That arrangement prevents the formation of resonance oscillations in the interior of the housing. That condition is fulfilled by the inner walls if they are oblique with respect to the side walls so as to form substantially triangular chambers. For the bases of the shells, the condition is, for example, achieved in that the one shell base is substantially planar and the other shell base is doubly curved.

With particular advantage, the shells are welded ultrasonically. That provides a sealed and particularly strong connection between the two shells.

With shells to be welded in this manner, it is advisable for the interconnected inner walls to be provided with recesses which run from the outsides of the shells and serve to allow the introduction of a welding tool. In this way, the welding tools can be brought to the vicinity of the connecting seam so that ultrasonic energy required for welding can be supplied with a low input power.

Advantages are also obtained if the connections at the inner walls are also at least partially additionally formed as tongue and groove connections by which the shells can be aligned in the region of the weld seam at the rims. By means of the interaction between the tongue and groove, one obtains a particularly good seal in the interior of the housing where it is later impossible to make a visual check. The parts to be welded together at the rims have the correct relative position at the outside without requiring a tongue and groove joint here as well.

With ultrasonic welding, it is advisable for unconnected inner walls to adjoin the side wall next to the relevant corner of the shells with some offset from the corner. In this way, an accumulation of material at the corners is avoided so that the welding energy will here too suffice to soften the material without difficulty.

Sound dampeners constructed in accordance with the invention will now be described, by way of example only, with reference to the accompanying drawings in which:

Fig. 1 illustrates parts of a sound dampener according to the invention for dampening the suction noises in a refrigeration compressor, the sound dampener being shown in conjunction with the head portion of a cylinder assembly;

Fig. 2 shows a modified embodiment similar to the embodiment of Fig. 1;

Fig. 3 is an elevational view looking from within onto the left hand shell of the sound dampener according to Fig. 2;

Fig. 4 is an elevational view looking from within onto the right hand shell of the sound dampener according to Fig. 2; and

Fig. 5 is a section, taken on the line A-A marked in Fig. 4, illustrating a detail of assembly.

Referring to the drawings, Fig. 1 shows the cylinder block 1 of the hermetically encapsulated refrigeration compressor having a refrigeration-impelling piston of a small refrigerator. A valve plate 2 is provided on the front face of the cylinder block and a cylinder cover member is provided over the valve plate, the assembly being fixed by suitable screws (not shown) passing through screw holes 4, 5 and 6. A sound dampener for dampening the suction noises of the compressor comprises a housing 7 consisting of two flat shells 8 and 9 made into a unit by a nipple 10 for the suction connection to the cylinder block.

The suction nipple 10 consists of a tube 11 of which the outlet end 12 is angled so that the outlet opening 13 can lie against the valve plate 2 within the area of the valve orifice for suction (not shown). For this purpose, the cylinder cover member 3 is provided at its end face 14 facing the cylinder with a recess 16 which extends from the side wall 15 and into which the suction nipple 10 can be pushed. The tube 11 of the suction nipple 10 carries on opposite sides two axially offset projections 17 and 18 which can engage in complementary guide grooves 19 and 20 in the wall of the recess 16. The remainder of the interior of the cylinder cover member 3 serves as a valve pressure chamber 21. The suction nipple 10 is moulded from a refrigerant-resistant plastics material with good ability to withstand heat. Once the suction nipple 10 has been pushed into the recess 16 and the cylinder cover member 3 secured to the cylinder block 1, the position of the suction nipple 10 is accurately defined.

At its inlet end, the suction nipple 10 has a plate-shaped retaining element 22 arranged to engage in a mounting 23 of the shell 8 and in a mounting 24 of the shell 9. Upon assembly of the two shells 8 and 9, the suction tube 11 is therefore clamped tight and held securely. The retaining element 22 is asymmetrical. The retaining element 22 projects further towards the shell 8 than it does towards the shell 7. By means of this asymmetrical arrangement, the positioning of the suction tube 11 in the housing 7 of the sound dampener is accurately determined. The sound dampener is able to be mounted in the correct position in relation to the cylinder cover member 3 simply by way of the suction nipple 10.

The greatest or outline cross-section of the two shells 8 and 9 is substantially square. The length and width of the shells are considerably greater than their depth. The shell 8 has a base 25 which is doubly curved (it appears curved both in plan and elevation) whereas the shell 9 has a has a planar base 26 with a step in it. The shell 8 has a peripheral side wall or outer wall 27 and four intermediate or inner walls 28, 29, 30 and 31 which extend from the base 25 of the shell and in each case run from the middle of the shell base towards the corners. The inner walls 28, 29 and 30 are connected to the outer walls 27 at the corners and the inner wall 30 terminates shortly in front of the corresponding corner where it is connected to additional inner walls 32 and 33 which run parallel to sections of the peripheral side or outer wall 27. The additional inner walls 32 and 33 together with the side wall 27 define a throttle passage 24 of considerable length. In the ends of the inner walls 29 and 31 are recesses 35 and 36 which define throttle openings in the assembled sound dampener. The shell 9 has corresponding side or outer walls 37, inner walls 38 to 41 and additional inner walls 42 and 43. An inlet 44 is also provided, which inlet is connected to an inlet nipple (the inlet nipple is to be seen more clearly in the embodiment shown in Fig. 2).

The two shells 8 and 9 are made of a plastics material which is resistant to refrigerant and has low ability to withstand heat. During assembly, the shells are pushed together with the suction nipple 10 put in place and the shells are interconnected not only at the end face 45 of the rims but also at the end face 46 of at least part of the inner walls. The interconnection can, for example, be by way of adhesion (such as results from the application of a solvent or heat) or in any other known manner.

The assembly creates four chambers 47 to 50 in the interior of the sound dampener. The chamber 47 is connected to the inlet 44. By way of the throttle opening 35, the chamber 47 communicates with the underlying second chamber 48. From the chamber 48 a throttle passsge 34 leads to the third chamber 49. The third chamber 49 is connected to the uppermost chamber 50 by way of the throttle opening 36. From the chamber 50, the sustion nipple 10 leads to the cylinder block. With suitable dimensioning of the chamber volumes and the throttle resistances one obtains extraordinarily good dampening of sound in the audible range. The throttle openings 35 and 36 and the throttle passage 34 provide lesser and greater degrees of throttling respectively. Since the chambers have a triangular cross-section and the bases of the shells have no wall sections that are parallel to one another, no continued resonance oscillations can be created in the chambers.

An oil outlet orifice 51 is provided in the second chamber 48. When refrigerant enters through the inlet 44, the inner walls 28 and 38 serve as baffle plates at which any oil that was carried along can be separated. This oil can reach the second chamber 48 through the throttle opening 35 and then be led off.

In the embodiment of Figs. 2 to 5, the construction of the cylinder block 1, valve plate 2, cylinder cover member 3 and suction nipple 10 remains unchanged. The shells are, however, so modified that they can be interconnected by ultrasonic welding. Corresponding parts are provided with reference numerals increased by 100. The base 125 of the shell 108 is again doubly curved. The base 126 of the shell 109 is, however, planar throughout. Each shell is made integrally with one half 52 and 53 respectively of an inlet nipple. The mountings 123 and 124 for receiving the retaining element 22 of the nipple 10 are placed in the interior of the side or outer walls 127 and 137. A small tube 54 is fitted into the oil outlet orifice 151. The throttle passage 134 is in this case formed by the inner wall 140 and an additional inner wall 55 parallel thereto, both inner walls co-operating with the broad inner wall 130.

To enable the two shells 108 and 109 to be interconnected by ultrasonic welding, the end face 145 of the rim of each shell is provided on an outwardly projecting rim 56 and 57 respectively so that welding tools can be brought in to close the weld seam. The inner walls 129, 131, 139 and 141 which in this case simply lie on top of each other without being welded together, run from the middle of the bases of the shells and towards the corners but adjoin the peripheral side wall, 127 and 137 respectively, at a position somewhat spaced from the corner in question to avoid the accumulation of material at the corner that might impede the welding process. The formation of the weld seams at the inner walls 128, 130, 138 and 140 as well as at the additional inner wall 55 is best seen in Figs. 3 to 5.

In the region where the weld seam is to be formed, the inner wall 40 has a groove 58 and the additional inner wall 55 has a groove 59. The grooves have inclined side walls. Correspondingly, the broad inner wall 130 has two projecting tongues 60 and 61 each provided at the front end with a fine fin-like rib 62 and 63 respectively. To allow introduction of the welding tool, two recesses 64 and 65 in the shell 109 lead up to the region of the grooves 58 and 59. In the inner wall 130 there is a wider recess 66 for a similar purpose. A fin-like rib 67 corresponding to the ribs 62 and 63 is provided on the end face 145 at the rims but no tongue and groove arrangement is provided in this case.

For assembly, the two shells 108 and 109 with the retaining element 22 introduced into the mountings 123 and 124 are pushed together until the ribs 60 and 61 engage in the grooves 58 and 59. This engagement accurately aligns the two shells with respect to each other. The ultrasonic welding tools are then applied from both sides to the rims 56 and 57 and into the depressions 64 to 66. When now ultrasonic energy is applied simultaneously with pressure the material melts at the ribs 62, 63 and 67 until the tongues 60 and 61 are completely within the grooves 58 and 69. During this time, liquefied plastics material spreads sideways and brings about sealed and secure bonding. The thus completed sound dampener for suction sounds is mounted on the cylinder block 1 by introducing the suction nipple 10 into the cylinder cover member 3 and securing the cover member to the cylinder block 1.

In one example, the two shells 8 and 9 consisted of polybutylene terephthalate (PBTP) sold under the trade name Crastin SK 603 and the suction nipple 10 consisted of a polyphenylene sulphide (PPS) plastics material sold under the trade name Halar 500.

CLAIMS

1. A sound dampener for dampening the

suction noises in a refrigeration compressor having a refrigerant-impelling piston, the sound dampener having at least two chambers interconnected by a throttle point and comprising a plastics material housing consisting of two shells interconnected at their rims and having a connecting nipple for providing the suction connection to the cylinder of the compressor, wherein the connecting nipple is made of a material having a greater ability to withstand heat than the material of the shells has, and is located between the rims of the shells and there held in position.

2. A sound dampener as claimed in claim 1, wherein the connecting nipple includes a projecting part engaging in a respective mating part on each shell.

3. A sound dampener as claimed in claim 2, wherein the projecting part and the mating parts are asymmetrically arranged longitudinally of and/or transversely of the junction of the shells to define a unique way for the connecting nipple to fit between the shells.

4. A sound dampener as claimed in any one of claims 1 to 3, wherein the connecting nipple has two oppositely directed projections to engage in complementary parts of a nipple-receiving recess in the cover member of the cylinder of a compressor.

5. A sound dampener as claimed in claim 4, wherein the oppositely directed projections are asymmetrically arranged.

6. A sound dampener as claimed in claim 5, wherein the oppositely directed projections are axially offset along the length of the connecting nipple.

7. A sound dampener as claimed in any preceding claim, wherein the connecting nipple is a moulded component of plastics material.

9. A sound dampener as claimed in any preceding claim, wherein the two shells are interconnected at their rims by welding.

10. A sound dampener for dampening the suction noises in a refrigeration compressor having a refrigerant-impelling piston, the sound dampener having at least two chambers, interconnected by a throttle point and comprising a plastics material housing consisting of two shells interconnected at their rims and having a connecting nipple for providing the suction connection to the cylinder of the compressor, wherein the chambers are defined by dividing walls upstanding from the bases of the shells, the shells have a depth less than their width or length, the shells are interconnected in the region of substantially their largest cross-section, and there is at least some interconnection of the shells at the dividing walls.

11. A sound dampener as claimed in claim 10, wherein the distal end of at least one internal wall is provided with a cut-out portion to define a throttle opening between adjacent chambers.

12. A sound dampener as claimed in claim 10 or 11, wherein at least one wall runs alongside another wall to define a throttle passage between adjacent chambers.

13. A sound dampener as claimed in any one of claims 10 to 12, wherein the shells are substantially rectangular in shape and internal walls run from the central region of the base of the shells to the outer walls in the corner regions of the shells.

14. A sound dampener as claimed in any one of claims 10 to 13, wherein the sound dampener is as claimed in any one of claims 1 to 9.

15. A sound dampener as claimed in any preceding claim, wherein each shell is made in one piece with one half of an inlet nipple.

16. A sound dampener as claimed in claim 12, or any one of claims 13 to 15 when dependent on claim 12, wherein four chambers of substantially triangular cross-section are connected in series by way of throttle openings, a first one of the chambers is provided with the inlet and arranged at the side, when in use, of the housing, a second one of the chambers is provided with an oil outlet aperture and arranged at a lower part, when in use, of the housing, and the fourth chamber is connected to the nipple for the suction connection and arranged in the upper part, when in use, of the housing.

17. A sound dampener as claimed in claim 16, wherein the oil outlet aperture is provided with a tube.

18. A sound dampener as claimed in any one of claims 10, 11, 12, 13, 16 and 17, or either of claims 14 and 15 when dependent on claim 10, wherein the arrangement of the bases of the shells and the internal walls is such that substantially no parallel wall surfaces lie opposite one another in the chambers.

19. A sound dampener as claimed in claim 18, wherein the base of one shell is substantially planar and the base of the other shell is curved both in plan and side elevation.

20. A sound dampener as claimed in any preceding claim, wherein the shells have been interconnected by ultrasonic welding.

21. A sound dampener as claimed in claim 20, wherein interconnected ones of the internal walls include recesses running from the outsides of the shells such as to permit the welding tool to be introduced.

22. A sound dampener as claimed in claim 20 or 21, wherein the connections at the internal walls are, at least in part, in the form of tongue and groove connections such as to ensure the correct alignment of the shells in the region of their rims.

23. A sound dampener as claimed in any one of claims 20 to 22, wherein unconnected internal walls of the shells are joined to an outer wall at a position offset from an adjacent corner of the sound dampener.

24. A sound dampener for dampening the suction noises in a refrigeration compressor having a refrigerant-impelling piston, the sound

dampener being substantially as herein described with reference to, and as illustrated by, Figure 1 of the accompanying drawings.

25. A sound dampener for dampening the suction noises in a refrigeration compressor having a refrigerant-impelling piston, the sound dampener being substantially as herein described with reference to, and as illustrated by, Figures 2 to 5 of the accompanying drawings.

26. A refrigeration compressor provided with a sound dampener as claimed in any preceding claim.

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