

(19)



Europäisches Patentamt  
European Patent Office  
Office européen des brevets

(11) Publication number:

**0 040 930**  
**B1**

(12)

## EUROPEAN PATENT SPECIFICATION

(45) Date of publication of patent specification: **21.09.83**

(51) Int. Cl.<sup>3</sup>: **F 04 B 39/10, F 16 K 15/08**

(21) Application number: **81302137.5**

(22) Date of filing: **14.05.81**

(54) **Valve structure with seating member composed of fibre reinforced plastic resin material.**

(30) Priority: **23.05.80 CA 352635**

(43) Date of publication of application:  
**02.12.81 Bulletin 81/48**

(45) Publication of the grant of the patent:  
**21.09.83 Bulletin 83/38**

(84) Designated Contracting States:  
**AT BE CH DE FR GB IT LI LU NL SE**

(56) References cited:  
**AT - B - 275 004**  
**DE - C - 809 501**  
**FR - A - 1 058 907**  
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Courier Press, Leamington Spa, England.

**EP 0 040 930 B1**

## Valve structure with seating member composed of fibre reinforced plastic resin material

The invention relates to self-actuating valves such as are used in compressors. The invention finds particular application to a valve structure of the type comprising a seating member defining at least one valve opening therethrough, and a closure member; said seating member comprising an outer body portion, a centre core portion and a plurality of arms extending from the centre core portion to said outer body portion, seating means being formed on the outer body portion and the centre core portion for reception of the closure member thereon, and the outer body portion, the centre core portion and the arms all forming an integral structure. US—A—3 536 094 and FR—A—1 058 907 disclose valve structures of this type.

Self acting valves are used in compressors, and in other applications. Such valves simply comprise a body and a valve closure member which is spring actuated into a closed position, and is adapted to lift off its seat on a predetermined pressure differential across the valve.

Such valves, particularly when used in compressors, are subjected to continuous duty operation twenty-four hours a day in many cases and are subject to heavy wear. The stresses imposed on such valves during operation are very considerable. As a result they break down frequently and the replacement and maintenance of such valves is a continuous problem.

Valves of this type have always been made of metal such as steel, and are usually machined out in complex shapes requiring many hours of costly machining. Consequently, they represent a substantial cost in the operation of, for example, compressors. In addition, it is well known that even when manufactured of steel, such valves can simply shatter in normal use. This occurs when, for example, liquids or solids are entrained with the gases being compressed. The gases entering the valve may be moving at a very high velocity, and the matter entrained with such gases will also be moving at the same velocity. When such matter strikes an obstruction such as a valve body, the valve body is subjected to enormous stresses and breaks into pieces. Such pieces then enter directly into the cylinder, and the piston and cylinder become seriously damaged. As a result, the entire unit is subject to costly repair and downtime.

In addition to these disadvantages of existing valves, it is well known that the design of the porting in the valves is a critical factor in achieving the most efficient operation. It is obvious that such porting must be arranged in the best possible fashion so as to minimize obstruction to gas flow through the ports and thus achieve the maximum efficiency in the operation of the compressor. One of the factors affecting the efficiency of such valves and valve ports is the

provision of fairing or radiussing around the entrances and exits to the valve ports, and also in the provision of a valve closure member of an optimum design.

In the past, when using an all metal construction for the valve body, the radiussing of all the valve ports, around their entrances and exits, while being desirable, has not been practical from the viewpoint of economy in view of the additional machining time involved.

For all of these reasons therefore it is desirable to manufacture the valve bodies in an entirely different way, with machine time reduced to a minimum. In addition, it is desirable to manufacture such valve bodies out of a material which, in the event of the valve body becoming shattered, e.g. by impact of entrained matter such as liquids and solids moving with the gases at high velocity, does not break up the pistons and score the cylinder walls of the compressor.

One proposal for an improved valve is shown in US—A—3,536,094. In that proposal the valve closure members are annular bodies of plastic material. The valve bodies were made of steel. Thus breakage of the closure members did not cause such serious consequences. Pieces of plastic entering the cylinders would not score the cylinder walls or damage the piston in the same way as pieces of steel. However, the valve bodies were still made of steel, and in the event that a portion of the valve body was broken, then the same consequences would follow as described above. However, this form of valve incorporated certain inherent problems of its own. Thus, the coefficient of expansion of the plastic material is three times greater than that of steel. As the valve is subjected to increases in temperature, then the annular closure members tend to expand, and do not form a perfect seal with the seating portions of the valve body.

For all of these reasons therefore, it is apparent that it is desirable to fabricate the valve body portions of the valve of some material other than steel, and to fabricate the valve body portions and the valve closures out of material having the same or substantially the same coefficients of expansion, so as to avoid the problems described above, while yet incorporating sufficient inherent stress resistance as to be capable of withstanding the extreme stresses developed in normal operation.

The invention seeks to overcome the various disadvantages described above by the provision of a valve structure of the type comprising a seating member defining at least one valve opening therethrough, and a closure member, said seating member comprising, an outer body portion, a center core portion, a plurality of radial arms extending from said center core portion to said outer body portion, seating means formed on said outer body portion and said

centre core portion for reception of said closure means thereon, characterised in that said outer body portion and centre core portion and said radial arms are all formed integrally in a single homogeneous structure having groups of unidirectional reinforcing fibres extending from said centre core portion through said radial arms into said outer body portion, said reinforcing fibres being embedded in and completely surrounded by a mouldable plastic resin material.

In one example of the invention there are at least two said radial arms and said reinforcing fibres are arranged in a continuous strip from one side of said outer body portion through one said radial arm into said centre core portion through said other radial arm and into said outer body portion.

In a preferred embodiment there are at least three said radial arms and said reinforcing fibres are arranged in at least two groups passing through said centre core portion and being arranged in at least two different layers whereby the same may form a cross.

In a further embodiment of the invention, further groups of such reinforcing fibres may be arranged around the periphery of said seating member.

The various features of novelty which characterise the invention are pointed out with particularity in the claims annexed to and forming a part of this disclosure. For a better understanding of the invention, its operating advantages and specific objects attained by its use, reference should be had to the accompanying drawings and descriptive matter in which there are illustrated and described preferred embodiments of the invention.

In the drawings:

Figure 1 is a perspective illustration of a valve manufactured in accordance with the invention, partially cut away;

Figure 2 is a section along the line 2—2 of Figure 1;

Figure 3 is a lower perspective of an upper portion of such valve structure;

Figure 4 is an upper perspective of a lower portion of the valve structure;

Figure 5 is a bottom plan view of the top portion of Figure 3;

Figure 6 is a top plan view of the bottom portion of Figure 4;

Figure 7 is a schematic exploded perspective view showing the assembly of the various components prior to moulding;

Figure 8 is a schematic diagram showing the various steps and the assembly and moulding of the components;

Figure 9 is a schematic elevational view partly in section, showing the assembly of the various components in a mould;

Figure 10 is a schematic section view in elevation showing a modification, and,

Figure 11 is a schematic top plan view of a further embodiment of the invention.

Referring first of all to Figure 1, it will be seen that the embodiment of the invention illustrated there comprises a valve of the type suitable for use in compressors. It will be understood that such valves are used in pairs, one valve functioning as an inlet and the other as an exhaust. They are usually placed in position in a compressor block or head (not shown) and are held in position by any suitable clamping means (not shown) which may be releasable, so that the valves may be removed and replaced for servicing.

These features are well known in the art, and form no part of the invention and are therefore omitted for the sake of clarity.

The valve will be seen to comprise a seating portion 10, and a spring bearing portion 12, being of generally cylindrical shape in plan. The seating portion 10 is provided with a plurality of gas passageways 14, and the spring bearing portion is provided with a plurality of gas ports 16. The seating portion and spring bearing portion enclose between them two valve closure rings 18 and 20 which are of a generally annular shape in plan, and which are dimensioned and adapted to close off the passageways 14. The rings 18 and 20 are movable, and are held in position by means of springs 22, located in the spring bearing portion 12.

Assuming that the valve of Figure 1 is used as an intake valve in a compressor, then the valve seating portion 10 will be connected with the incoming supply of gas, and the spring bearing portion 12 will be connected with the compressor.

As the piston in the compressor causes the development of a reduced pressure, then the pressure difference between the gas supply, on the one side of the valve and the reduced pressure in the compressor on the other side of the valve, will cause the closure rings 18 and 20 to move against the springs 22, thereby opening the passageways 14 and permitting flow of gas through passageways 14 around rings 18 and 20 and into ports 16 and thus into the compressor. Continued movement of the piston will cause such gas flow to continue until such time as the cylinder is charged at which time the pressure difference will disappear, and the springs 22 will thus return the rings 18 and 20 into sealing engagement and gas flow will cease.

As explained above, the velocities experienced in such valve operation are very high. Any material entrained in such gas supply whether of a liquid or a solid nature, will impact at high speed upon either the seating portion 10 or the rings 18 and 20 or even on the spring bearing portion 12. Such an impact frequently causes shattering of the parts. In the past, where such parts were made either wholly or partially of steel, the shattered steel fragments were carried directly into the cylinder, and damaged the piston and cylinder walls.

In the present invention, both the seating

portion 10 and spring bearing portion 12 and rings 18 and 20 are made of synthetic plastic material, in a manner to be described below, so that the only metal components are in fact the springs 22.

As shown in more detail in Figures 2 to 6, the present embodiment of the invention is seen to comprise a valve seating portion 10 having a central core 24 of generally cylindrical shape, and intermediate seating ring 26, and an outer ring 28. Outer ring 28 is provided with a stepped shoulder 30 for reasons to be described below. The core 24, ring 26 and ring 28 are all united together in a single integral structure by means of radial arm members 32 which extend from core 24 to intermediate ring 26 and then on to outer ring 28. In the embodiment shown, four such arms 32 are illustrated. It will, however, be appreciated that this is not limiting, and other numbers of such arms 32 may be provided.

It is also noted that only one intermediate ring 26 is shown. It will of course be appreciated that more such intermediate rings may be provided, concentric with one another and concentric with core 24 if a larger valve structure is desired. On the other hand in a much smaller valve structure it may be desirable to dispense with the intermediate ring 26 altogether, in which case the radial arms 32 would simply extend from the centre core 24 to the outer ring 28.

It will also be noted that the radial arms 32, when viewed in section are of a reduced height in relation to the height of the centre core 24, intermediate ring 26 and outer ring 28. In this way, the core 24 and rings 26 and 28 define between them continuous annular spaces or grooves indicated as 34 and 36, and uninterrupted by the radial arms 32. The gas passageways 14 which are defined between the radial arms 32, communicate with the continuous annular grooves 34 and 36, for free flow of gases therethrough. Angled valve seating surfaces 38 are formed on the core 24 and rings 26 and 28 as shown for reception of the valve closure rings 18 and 20 described above. The valve closure rings 18 and 20, are generally triangular in cross-section, having two angled upstream surfaces 40 forming a V-shape, and having a generally flat planar downstream surface 42, for engagement by springs 22. The two upstream surfaces 40 rest on the valve seating surfaces 38, and preferably meet at an angle between about 80 and 100 degrees. A substantial portion of the closure rings 18 and 20 thus extends downwardly into the annular grooves 34 and 36. The radial arms 32, being of reduced height, leave a substantial free space all around such annular grooves. In this way when the valve is open the two surfaces 40 of rings 18 and 20 smoothly divide the gases flowing through grooves 34 and 36 into two streams, with a minimum of turbulence, thus maximizing the efficiency of the valve.

As best shown in Figures 3 and 5, the spring bearing portion 12 of the valve is constructed on a generally similar principle to the seating portion 10. Thus it comprises a centre core portion 44, four radial arms 46 extending therefrom, and intermediate ring 48 supported by the radial arms 46, and an outer ring 50. It will be noted that the core 44, arms 46 and intermediate ring 48 are all of the same thickness in section, and that the outer ring 50 is of a greater thickness, defining a downwardly extending annular junction portion 52, shaped and dimensioned to fit snugly in around shoulder 30 of outer ring 28 on seating portion 10. In this way, when seating portion 10 and spring bearing portion 12 are assembled as shown in Figure 2, the centre core 44, arms 46 and intermediate ring 48 are all located at a distance spaced apart from the seating portion 10, thereby defining an open area through which gas can flow, and permitting movement of the valve closure rings 18 and 20 in response to pressure differentials thereacross as described above.

It will be noted that the gas ports 16 in spring bearing portion 12 are defined between the centre core portion 44, arms 46, intermediate ring 48, and outer ring 50, and in fact are located around three essentially circular concentric paths. Such concentric paths are generally speaking off-set with respect to the annular passageways 34 and 36 of seating portion 10, so that gases passing upwardly therethrough and around the rings 18 and 20 may then pass freely through ports 16 with a minimum of obstruction.

In order to provide additional resistance to the stresses imposed on the valve structure, a central support boss 54 is provided on core 44, in a generally cruciform shape in plan, which is adapted to engage the upper surface of centre core 24 and four further generally rectangular support bosses 56 are provided on the radial arms 46 which are adapted to engage the intermediate ring 26 at various points therearound, registering with the radial arms 32.

In order to provide a means for securing the springs 22, a plurality of spring receiving recesses 58 are formed in the core 44, being located around a generally annular path corresponding to the diameter of the inner valve closure ring 18. The centre core 44 is made somewhat oversized in order that it may receive such recesses 58, and it will be noted that the recesses 58 are off-set to one side of the axis of the radial arms 46, for reasons to be described below.

In order to provide for the reception of further springs 22, spring mounting blocks 60 are supported between intermediate ring 48 and outer ring 50, and further such blocks 62 are supported on one side of the radial arms 46, adjacent to the junction of intermediate ring 48 therewith. All of such blocks 60 and 62 are located around a generally annular path

corresponding to the diameter of the outer valve closure ring 20, and are provided with spring receiving recesses 64 therein. Each of the recesses 58 and 64 is provided with a small gas vent opening. This permits gases to blow off any particles which may lodge in the spring recesses.

It will be noted that the springs 22 are of a generally tapering frusto-conical shape, with the larger diameter end seating within the respective recesses 58 or 64, and in this way the remainder of the spring is held out of contact with the surface of the recess, thereby substantially prolonging its life.

As best shown in Figures 1 and 2, the seating portion 10 and spring bearing portion 12 are assembled together with the springs 22 and rings 18 and 20 in position as shown. Preferably, they are permanently bonded or otherwise fastened together, both around the surfaces of the junction portion 52 and shoulder 30, and also at the interfaces between core 24 and central bosses 54 and intermediate ring 26 and bosses 56.

As indicated above, the entire structure of the seating portions 10 and spring bearing portions 12 are made of plastic resin materials in a manner to be described below.

The plastic materials from which the valves according to the invention are manufactured are preferably those known as Sheet Moulding Compound, known in the trade as "SMC". Such SMC materials comprise reinforcing glass fibres, in a plastic resin base. The plastic resin base is compounded with suitable catalysts, such that at room temperatures it is relatively stable and has an extended shelf life, and is essentially solid so that it may be readily handled, and cut. However, when subjected to heat, it becomes mouldable, and the catalysts are activated so that the material rapidly sets hard. Such SMC material is thus particularly suitable for moulding under heat and pressure in a closed mould. Articles formed in this way are found to have high strength, in some cases equalling that of steel. At the same time, fragments of such material when shattered, are substantially less abrasive than fragments of steel, and thus if such fragments should enter into the cylinders of a compressor, they will do little or no damage.

In the preferred form of construction, the valve body 10 and spring bearing portion 12 of the valve according to the invention are preferably formed of a composite of materials, essentially shown schematically in Figure 7.

Thus each such portion of the complete valve will comprise upper and lower panel portions 70 and 72 of SMC material, which may be cut into a circular disc shape as shown, or may be cut into any other desired shape, for example, the shape of a cross, as may be most suitable for fitting in the particular mould.

Sandwiched between the two panel portions 70 and 72 will be groups of unidirectional

reinforcing fibres 74. These unidirectional reinforcing fibres may be further filaments of glass fibre material. However, preferably they will be of fibres of carbon, graphite, boron, aramid, or even metal, or other reinforcing fibres having a strength greater than that of glass fibres. Each of the groups of fibres 74 will be preferably coated with liquid plastic resin material, incorporating a suitable catalyst, just prior to moulding.

In order to provide sufficient bulk for filling all of the cavities in the mould, additional chunks 76 of SMC material are preferably arranged in the "sandwich" between panel portions 70 and 72.

The composite of such materials is then placed in a suitable mould (see Figure 9) and subjected to heat and pressure thereby first of all rendering the SMC material mouldable and flowable, and subsequently setting the plastic resin materials. After moulding, which may take place in a 15 minute cycle, for example, depending upon the composition of the SMC material, the article is then removed from the mould and cleaned up and any "flashing" is removed.

The steps involved in moulding of such articles are illustrated schematically with reference to Figures 8 and 9, and will be seen to comprise passing a sheet 80 of SMC material between a cutting die D, and stamping panel portions 70 and 72 therefrom in the desired shape, and subjecting the remainder of the SMC material 80 to the action of a chopper C to chop it up into random chunks 76.

Continuous lengths of unidirectional reinforcing fibres 82 are prepared by passing the same through rollers R, applying plastic resin material thereto, and subsequently cutting the same by means of knife K into bundles 74.

The lowermost panel portion 72 is then placed in the bottom of a mould M of a suitable shape. Mould M is provided with a suitable heating means, in this place illustrated schematically as electrical heating elements E although heating may be provided by other means such as liquids, or mould M may be placed in an oven.

The reinforcing fibres 74, having been arranged preferably in a suitable jig (not shown) into the form of a cross, or any other suitable arrangement, are then placed in mould M and the chunks 76 of SMC material are then placed in position, more-or-less as shown in Figure 9. The upper panel portion 70 is then placed in position after which the upper half of the mould is then closed. The mould is then subjected to heat and pressure causing the SMC material to become sufficiently plastic that it flows into the shape of the mould, after which the plastic resin material is cured and set.

It will be appreciated that the reinforcing fibres 74 are completely embedded and covered by the SMC material, and will in fact extend along the radial arms 32 of the valve

seating portion 10, or the radial arms 46 of the spring portion 12 respectively.

Since the reinforcing fibres 74 provide a substantial portion of the strength of the structure, the spring recesses 58 are all formed in areas which are off-set with respect to the arms, in the spring seating portion 12, in the manner described above, so that the recesses 58 and 64 do not cut into such reinforcing fibres 74, which would reduce their effectiveness.

In some cases where it is desired to make an even stronger valve, or where the volume of material is to be reduced for any reason, then it may be desirable to arrange the reinforcing fibres 74 in a generally curved shape as shown schematically in Figure 10. By arranging the fibres in this manner, the effectiveness of the fibres 74 in providing additional strength is greatly increased.

In certain circumstances to provide even greater strength, it may be desirable to provide reinforcing fibres around the periphery of the valve seating portion 10 or spring seating portion 12, as shown in Figure 11, wherein the fibre-reinforced component comprises a core 90, a plurality of radial arms 92, and an outer rim 94 with openings defined between arms 92. The structure of Figure 11 is essentially schematic serving to illustrate, in addition to the unidirectional groups of fibres 74 extending through the core 90 and along the radial arms 92, further groups of unidirectional fibres 74a which are arranged around the outer ring 94. The unidirectional fibres 74 and 74a are embedded within moulded SMC material in the manner described above, to form a single homogeneous integral valve seating portion or spring seating portion.

## Claims

1. A valve structure of the type comprising a seating member (10) defining at least one valve opening (14) therethrough, and a closure member (18, 20), said seating member comprising an outer body portion (28); a centre core portion (24); a plurality of radial arms (32) extending from said centre core portion (24) to said outer body portion (28); and seating means (38) formed on said outer body portion (28) and said centre core portion (24) for reception of said closure means (18, 20) thereon; characterised in that said outer body portion (28) and centre core portion (24) and said radial arms (32) are all formed integrally in a single homogeneous structure having groups of unidirectional reinforcing fibres (74) extending from said centre core portion (24) through said radial arms (32) into said outer body portion (28), said reinforcing fibres (74) being embedded in and completely surrounded by a mouldable plastic resin material (70, 76).

2. A valve structure as claimed in Claim 1 characterised in that there are at least two said radial arms (32) and said reinforcing fibres (74)

are arranged in a continuous strip from one side of said outer body portion (28) through one said radial arm (32) into said centre core portion (24), through said other radial arm (32) and into said outer body portion (28).

3. A valve structure as claimed in Claim 1, characterised in that there are at least three said radial arms (32) and said reinforcing fibres (74) are arranged in at least two groups, both said groups passing through said centre core portion (24), and being arranged in at least two different layers whereby the same may form a cross.

4. A valve structure as claimed in Claim 1, 2 or 3 characterised by additional reinforcing fibres (74a) embedded in and arranged so as to extend around the periphery of the seating member (Figure 11).

5. A valve apparatus of the type having a valve seating portion (10) defining a plurality of ports (14) therethrough, arranged spaced apart from one another around a generally annular pattern, and a spring bearing portion (12) defining a plurality of passageways (16) therein, and generally annular valve closure means (18, 20) located between said valve seating portion (10) and said spring bearing portion (12), and springs (22) supported in said spring bearing portion (12) engaging said annular valve closure means (18, 20) and forcing the same into engagement with said valve seating portion (10), said valve closure means (18, 20) being displaceable against said springs (22) upon a predetermined pressure differential occurring thereacross, wherein said valve seating portion (10) includes an outer annular seating member (28); at least one intermediate annular seating member (26); a centre seating member (24); annular recesses (34, 36) extending between adjacent said seating members; valve seating surfaces (38) on said seating members (24, 26, 28) on opposite sides of said annular recesses (34, 36); and a plurality of radial arms (32) extending between said centre seating member (24), said intermediate seating member (26), and said outer seating member (28), and defining therebetween said ports (14), which ports (14) communicate with said annular recesses (34, 36); characterised in that said seating members (24, 26 and 28) and said radial arms (32) are all formed integrally in a single homogeneous structure having groups of unidirectional reinforcing fibres (74) extending from said centre seating member (24) through said radial arms (32) and said intermediate seating member or members (26) into said outer seating member (28), said reinforcing fibres (74) being embedded in and completely surrounded by a mouldable plastic resin material (70, 76).

6. A valve apparatus as claimed in Claim 5 characterised in that said spring seating portion (12) includes an outer ring member (50), a centre core member (44) located spaced inwardly therefrom, a plurality of radial arms (46) extending between said outer ring member

(50) and said centre core member (44), a plurality of passageways (16) located between said centre core member (44) and said outer ring member (50), and a plurality of spring housing blocks (62), formed with spring recesses (64) therein, for reception of spring means (22), said blocks (62) being supported between said outer ring member (50) and said centre core member (44) so that said spring means (22) are in registration with said valve closure means (18, 20).

7. A valve apparatus as claimed in Claim 6 characterised by at least one generally annular rib member (48) located between said outer ring member (50) and said centre core member (44) and supported by said radial arms (46), said rib member or members (48) defining together with said outer ring member (50) and said centre core (44) a plurality of separate passageways (16), and at least some of said spring housing blocks (62) being supported at least in part by said annular rib member or members (48).

8. A valve apparatus as claimed in Claim 6 or 7 characterised by support boss means (54) formed on said centre core member (44) and extending therefrom and contacting said centre seating member (24) of said valve seating portion (10).

9. A valve apparatus as claimed in Claim 8 including a plurality of further support bosses (56) located on said radial arms (46) of said spring bearing portion (12) and extending therefrom into contact with said intermediate seating ring member (26).

10. A valve apparatus as claimed in Claim 9 characterised in that at least some of said spring housing blocks (62) are located in off-set relation to said radial arms (46) of said spring bearing portion (12) whereby said spring receiving recesses (64) do not intersect said radial arms (46).

## Patentansprüche

1. Ventil mit einem Ventilsitz (10), der mit wenigstens einer durch ihn hindurchgehenden Ventilöffnung (14) sowie einem Schließelement (18, 20) ausgebildet ist und der einen äußeren Körperteil (28), einen zentralen Kernteil (24), eine Vielzahl von sich von diesem zentralen Kernteile (24) zum äußeren Körperteil (28) erstreckenden radialen Armen (32) sowie Sitzeinrichtungen (38) aufweist, die am äußeren Körperteil (28) und am zentralen Kernteil (24) zur Aufnahme der Schließelemente (18, 20) angeformt sind, dadurch gekennzeichnet, daß der äußere Körperteil (28), der zentrale Kernteil (24) und die radialen Arme (32) alle in einem einzigen, homogenen Bauteil einstückig ausgebildet sind, der Gruppen von in einer Richtung verlaufenden Verstärkungsfasern (74) aufweist, die sich vom zentralen Kernteil (24) durch die radialen Arme (32) in den äußeren Körperteile (28) erstrecken und in einem form-

baren Kunstharzmaterial (70, 76) eingebettet und vollkommen davon umgeben sind.

2. Ventil nach Anspruch 1, dadurch gekennzeichnet, daß wenigstens zwei radiale Arme (32) und die Verstärkungsfasern (74) in einem fortlaufenden Streifen zusammengeordnet sind, der sich von einer Seite des äußeren Körperteiles (28) durch den einen radialen Arm (32) in den zentralen Kernteil (24), durch den anderen radialen Arm (32) und in den äußeren Körperteil (28) erstreckt.

3. Ventil nach Anspruch 1, dadurch gekennzeichnet, daß wenigstens drei radiale Arme (32) und die Verstärkungsfasern (74) in wenigstens zwei Gruppen zusammengeordnet sind, die bedie durch den zentralen Kernteil (24) hindurchgehen und in wenigstens zwei unterschiedlichen Schichten zusammengeordnet sind, wodurch diese ein Kreuz bilden können.

4. Ventil nach Anspruch 1, 2 oder 3, gekennzeichnet durch zusätzliche Verstärkungsfasern (74a), die in den Umfang des Sitzes eingebettet und so zusammengeordnet, sind daß sie sich über den Umfang des Sitzes erstrecken (Fig. 11).

5. Ventilvorrichtung mit einem Ventilsitzteil (10), der mit einer Vielzahl von durch ihn hindurchgehenden Öffnungen (14) ausgebildet ist, die mit Abstand voneinander um ein im wesentlichen ringförmiges Muster angeordnet sind, ferner mit einem Federlagerungsteil (12), in dem eine Vielzahl von Durchgangsöffnungen (16) ausgebildet ist, mit im wesentlichen ringförmigen Ventilschließelementen (18, 29), die zwischen dem Ventilsitzteil (10) und dem Federlagerungsteil (12) angeordnet sind, weiterhin mit in dem Federlagerungsteil (12) abgestützten Federn (22), die mit den ringförmigen Ventilschließelementen (18, 20) in Eingriff stehen und diese mit dem Ventilsitzteil (10) in Eingriff drücken, wobei diese Ventilschließelemente (18, 20) bei einer dort auftretenden vorbestimmten Druckdifferenz gegen die Federn (22) verlagerbar sind und wobei der Ventilsitzteil (10) ein äußeres ringförmiges Sitzelement (28), wenigstens ein zwischengeordnetes ringförmiges Sitzelement (26), ein zentrales Sitzelement (24), sich zwischen benachbarten Sitzelementen erstreckende ringförmige Ausnehmungen (34, 36), an den Sitzelementen (24, 26, 28) auf entgegengesetzten Seiten der ringförmigen Ausnehmungen (34, 36) vorgesehen Ventilsitzflächen (38) sowie eine Vielzahl von radialen Armen (32) enthält, die sich zwischen dem zentralen Sitzelement (24), dem zwischengeordneten Sitzelement (26) und dem äußeren Sitzelement (28) erstrecken und zwischen sich die genannten Öffnungen (14) bilden, die mit den genannten ringförmigen Ausnehmungen (34, 36) in Verbindung stehen, dadurch gekennzeichnet, daß die genannten Sitzelemente (24, 26 und 28) und die radialen Arme (32) alle in einem einzigen, homogenen Bauteil einstückig ausgebildet sind, der Gruppen von in einer Richtung verlauf-

enden Verstärkungsfasern (74) aufweist, die sich vom zentralen Sitzelement (24) durch die radialen Arme (32) und das zwischengeordnete Sitzelement bzw. die zwischengeordneten Sitzelemente (26) in das äußere Sitzelemente (28) erstrecken, wobei diese Verstärkungsfasern (74) in ein formbares Kunstharzmaterial (70, 76) eingebettet und vollkommen davon umgeben sind.

6. Ventilvorrichtung nach Anspruch 5, dadurch gekennzeichnet, daß der Federlagerungsteil (12) ein äußeres Ringelement (50), ein mit Abstand davon nach einwärts angeordnetes, zentrales Kernelement (44), eine Vielzahl von sich zwischen dem äußeren Ringelement (50) und dem zentralen Kernelement (44) erstreckenden radialen Armen (46), eine Vielzahl von zwischen dem zentralen Kernelement (44) und dem äußeren Ringelement (50) angeordneten Durchgangsöffnungen (16) sowie eine Vielzahl von Federgehäuseblöcken (62) enthält, in die Federausnehmungen (64) zur Aufnahme von Federn (22) eingeformt und die zwischen dem äußeren Ringelement (50) und dem zentralen Kernelement (44) gehalten sind, so daß die Federn (22) mit den Ventilschließelementen (18, 20) in Deckung sind.

7. Ventilvorrichtung nach Anspruch 6, gekennzeichnet durch wenigstens ein im wesentlichen rigförmiges Rippenelement (48), das zwischen dem äußeren Ringelement (50) und dem zentralen Kernelement (44) angeordnet und von den radialen Armen (46) getragen ist und das zusammen mit dem äußeren Ringelement (50) und dem zentralen Kernelement (44) eine Vielzahl separater Durchgangsöffnungen (16) bildet, wobei wenigstens einige der Federgehäuseblöcke (62) zumindest teilweise von dem ringförmigen Rippenelement bzw. den ringförmigen Rippenelementen (48) getragen werden.

8. Ventilvorrichtung nach Anspruch 6 oder 7, gekennzeichnet durch einen Abstützvorsprung (54), der an dem zentralen Kernelement (44) angeformt ist und sich von diesem aus erstreckt und mit dem zentralen Sitzelement (24) des Ventilsitzteiles (10) in Berührung steht.

9. Ventilvorrichtung nach Anspruch 8, dadurch gekennzeichnet, daß eine Vielzahl von weiteren Abstützvorsprüngen (56) vorgesehen ist, die an den radialen Armen (46) des Federlagerungsteiles (12) angeordnet sind und sich von dort aus erstrecken und mit dem zwischengeordnete Sitzringelement (26) in Berührung stehen.

10. Ventilvorrichtung nach Anspruch 9, dadurch gekennzeichnet, daß wenigstens einige Federgehäuseblöcke (62) gegenüber den radialen Armen (46) des Federlagerungsteiles (12) versetzt angeordnet sind, wodurch die Federaufnahmeausnehmungen (64) die radialen Arme (46) nicht schneiden.

#### Revendications

1. Structure de soupape du type com-

prenant un élément formant siège (10) qui délimite au moins à travers lui une ouverture de soupape (14) et comprenant un élément d'obturation (18, 20), dans laquelle ledit élément formant siège comprend une partie de corps extérieur (28); une partie de noyau central (24); une pluralité de bras radiaux (32) s'étendant la partie de noyau central (24) à ladite partie de corps extérieur (28) et des moyens d'appui (38) contre le siège formés sur ladite partie de corps extérieur (28) et sur ladite partie de noyau central (24) pour y recevoir le moyen d'obturation (18, 20); caractérisée en ce que ladite partie de corps extérieur (28) et ladite partie de noyau central (24) ainsi que lesdits bras radiaux (32) sont tous formés intégralement en une seule structure homogène ayant des groupes de fibres de renforcement unidirectionnelles (74) qui s'étendent de la partie de noyau central (24) à travers lesdits bras radiaux (32) jusque dans ladite partie de corps extérieur (28), les dites fibres de renforcement (74) étant enrobées dans une matière de résine plastique moulable (70, 76) et complètement entourées par elle.

2. Structure de soupape selon la revendication 1, caractérisée en ce qu'il y a au moins deux dits bras radiaux (32) et que lesdites fibres de renforcement (74) sont disposées en une nappe continue partant d'un côté de ladite partie de corps extérieur (28) en passant à travers l'un desdits bras radiaux (32) pour pénétrer dans la partie de noyau central (24), puis traverser ledit autre bras radial (32) et pénétrer dans ladite partie de corps extérieur (28).

3. Structure de soupape selon la revendication 1, caractérisée en ce qu'il y a au moins trois dits bras radiaux (32) et que lesdites fibres de renforcement (74) sont disposées en au moins deux groupes qui passent tous deux à travers ladite partie de noyau central (24) et qui sont disposés en au moins deux couches différentes de façon que ces groupes forment une croix.

4. Structure de soupape selon l'une quelconque des revendications 1, 2 ou 3, caractérisée par des fibres de renforcement additionnelles (74a) enrobées dans le pourtour de l'élément formant siège (figure 11) et disposées pour s'étendre le long de ce pourtour.

5. Appareil à soupape du type ayant une partie (10) formant siège de soupape et délimitant à travers elle une pluralité de passages (14) disposés à l'écart les uns des autres selon une répartition générale en anneau et une partie (12) portant des ressorts et délimitant à travers elle une pluralité de passages (16) avec des moyens d'obturation de soupape disposés en forme générale d'anneaux (18, 20) et placés entre ladite partie formant siège (10) et ladite partie (12) portant des ressorts, et des ressorts (22) supportés dans ladite partie portant des ressorts (12) et agissant sur lesdits moyens d'obturation de soupape en anneaux en rappelant ces moyens en contact avec ladite partie (10) formant siège de soupape, lesdits moyens

d'obturation de soupape (18, 20) étant déplaçables contre l'action desdits ressorts (22) lors d'une différence de pression prédéterminée s'exerçant entre les deux faces, dans lequel ladite partie (10) formant siège de soupape comprend un élément annulaire extérieur de siège (28); au moins un élément annulaire intermédiaire de siège (26); un élément central de siège (24); des évidements annulaires (34, 36) s'étendant entre lesdits éléments de siège adjacents; des surfaces d'appui de soupape (38) sur lesdits éléments de siège (24, 26, 28) de part et d'autre desdits évidements annulaires (34, 36); et une pluralité de bras radiaux (32) s'étendant entre le dit élément central de siège (24), ledit élément de siège intermédiaire (26) et ledit élément de siège extérieur (28) et déterminant entre eux lesdits passages (14) qui communiquent avec lesdits évidements annulaires (34, 36); caractérisé en ce que lesdits éléments de siège (24, 26 et 28) et lesdits bras radiaux (32) sont tous formés intégralement en une seule structure homogène ayant des groupes de fibres de renforcement unidirectionnelles (74) qui partent dudit élément central de siège (24) en traversant lesdits bras radiaux (32) et ledit ou lesdits éléments intermédiaires de siège (26) en pénétrant dans ledit élément extérieur de siège (28), lesdites fibres de renforcement (74) étant enrobées dans une matière de résine plastique moulable (70, 76) et complètement entourées par cette matière.

6. Appareil à soupape selon la revendication 5, caractérisé en ce que ladite partie (12) portant des ressorts comprend un élément extérieur en anneau (50), un élément de noyau central (44) placé à l'écart à l'intérieur de l'anneau extérieur, une pluralité de bras radiaux (46) s'étendant entre ledit élément extérieur en anneau (50) et ledit élément de noyau central (44), une pluralité de passages (16) placés entre ledit élément de noyau central (44) et ledit élément extérieur en anneau (50) et une

pluralité de blocs (62) récepteurs de ressorts, formés avec des alvéoles à ressort (64) pour la réception de ressorts (22), les dits blocs (62) étant supportés entre le dit élément extérieur en anneau (50) et ledit élément de noyau central (44) de façon que les dits ressorts (22) soient en regard des dits moyens d'obturation de soupape (18, 20).

7. Appareil à soupape selon la revendication 6, caractérisé par au moins un élément de nervure de forme générale en anneau (48) placé entre ledit élément extérieur (50) et ledit élément de noyau central (44) et supporté par les dits bras radiaux (46), ledit ou lesdits éléments de nervures (48) délimitant avec ledit élément extérieur en anneau (50) et avec ledit noyau central (44) une pluralité de passages séparés (16) et au moins certains desdits blocs (16) récepteurs de ressorts étant supportés au moins en partie par ledit élément ou lesdits éléments en nervures annulaires (48).

8. Appareil à soupape selon la revendication 6 ou la revendication 7, caractérisé par un moyen à bossage de support (54) formé sur ledit élément de noyau central (44) et s'étendant à partir de là en venant en contact avec ledit élément central de siège (24) de ladite partie (10) formant siège de soupape.

9. Appareil à soupape selon la revendication 8, comprenant une pluralité de bossages de support supplémentaires (56) placés sur lesdits bras radiaux (46) de la dite partie (12) portant des ressorts et s'étendant de là pour venir en contact avec l'élément intermédiaire de siège en anneau (26).

10. Appareil à soupape selon la revendication 9, caractérisé en ce qu'au moins certains des blocs récepteurs de ressorts (62) sont placés en position décalée par rapport auxdits bras radiaux (46) de ladite partie (12) portant des ressorts de façon que lesdits alvéoles (64) recevant les ressorts ne soient pas en intersection avec lesdits bras radiaux (46).

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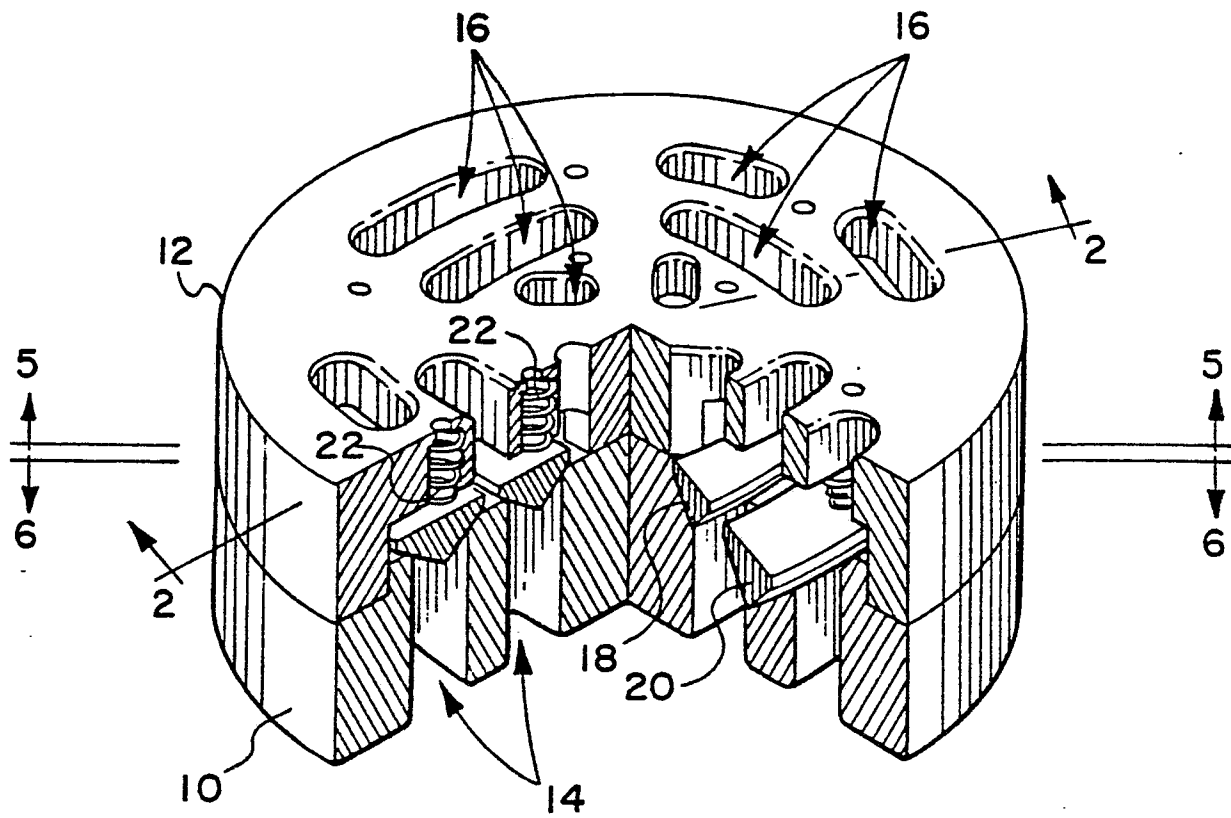


FIG 1

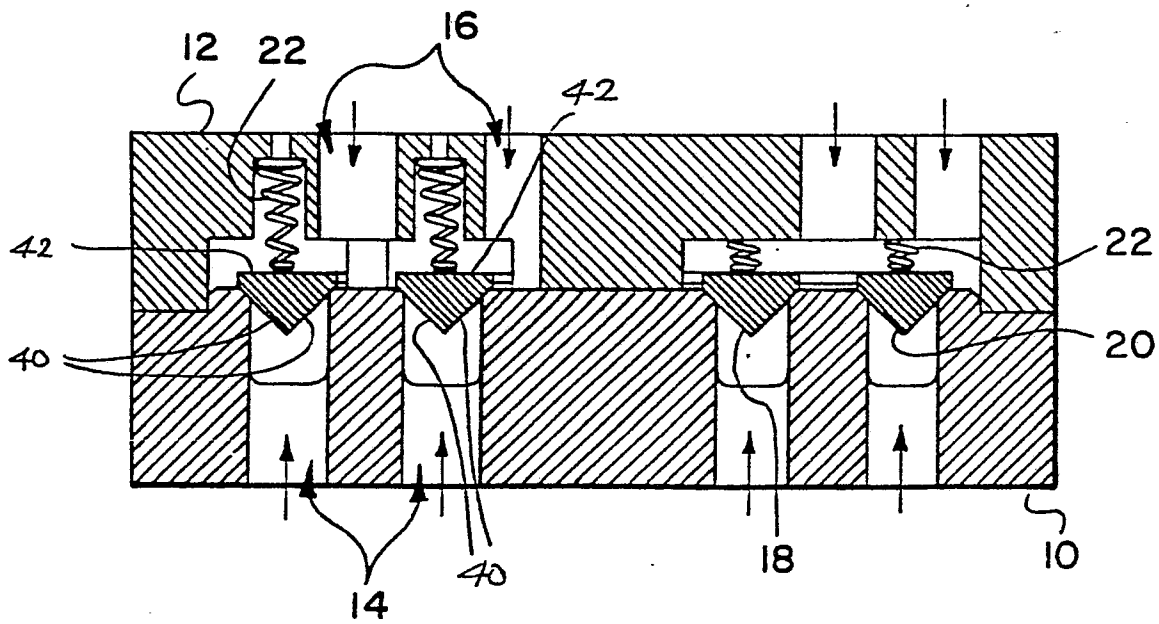


FIG 2

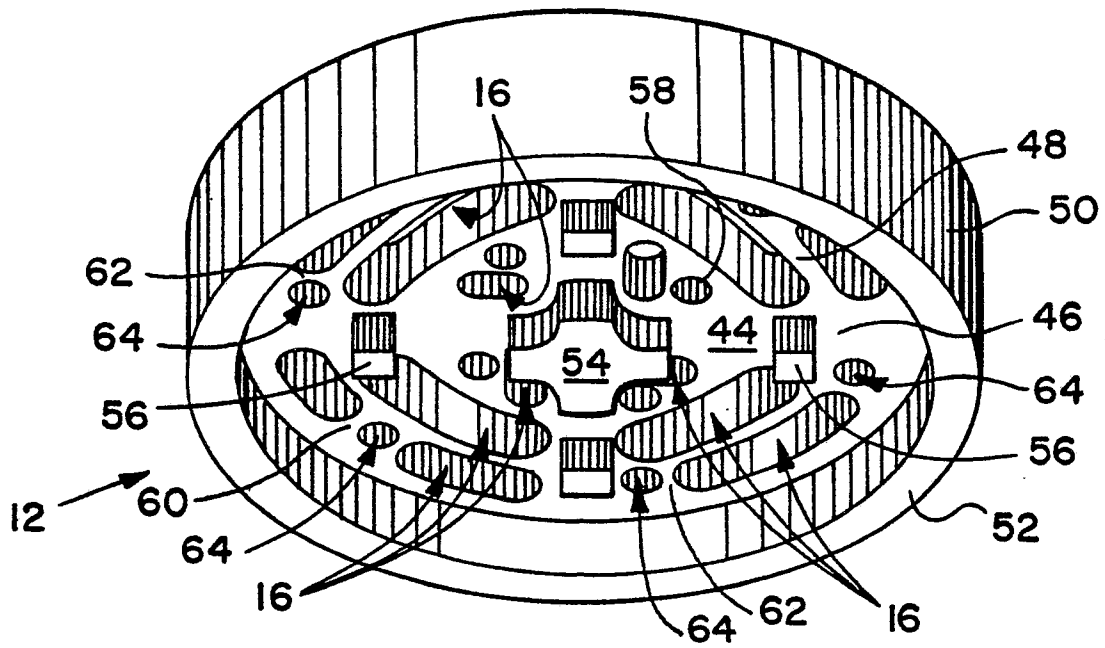


FIG 3

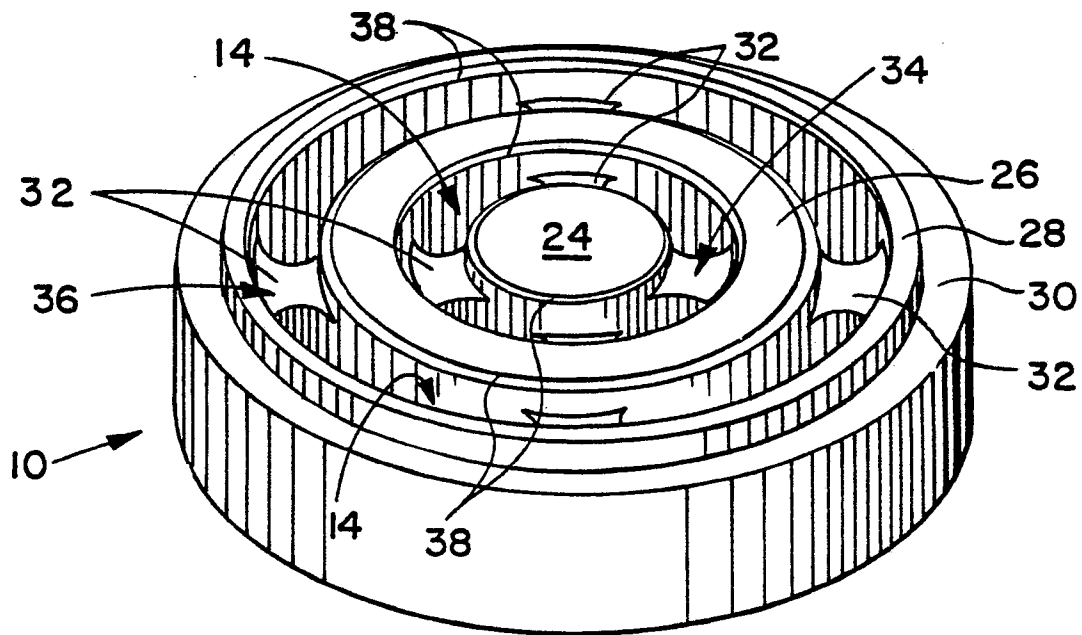


FIG 4

0 040 930

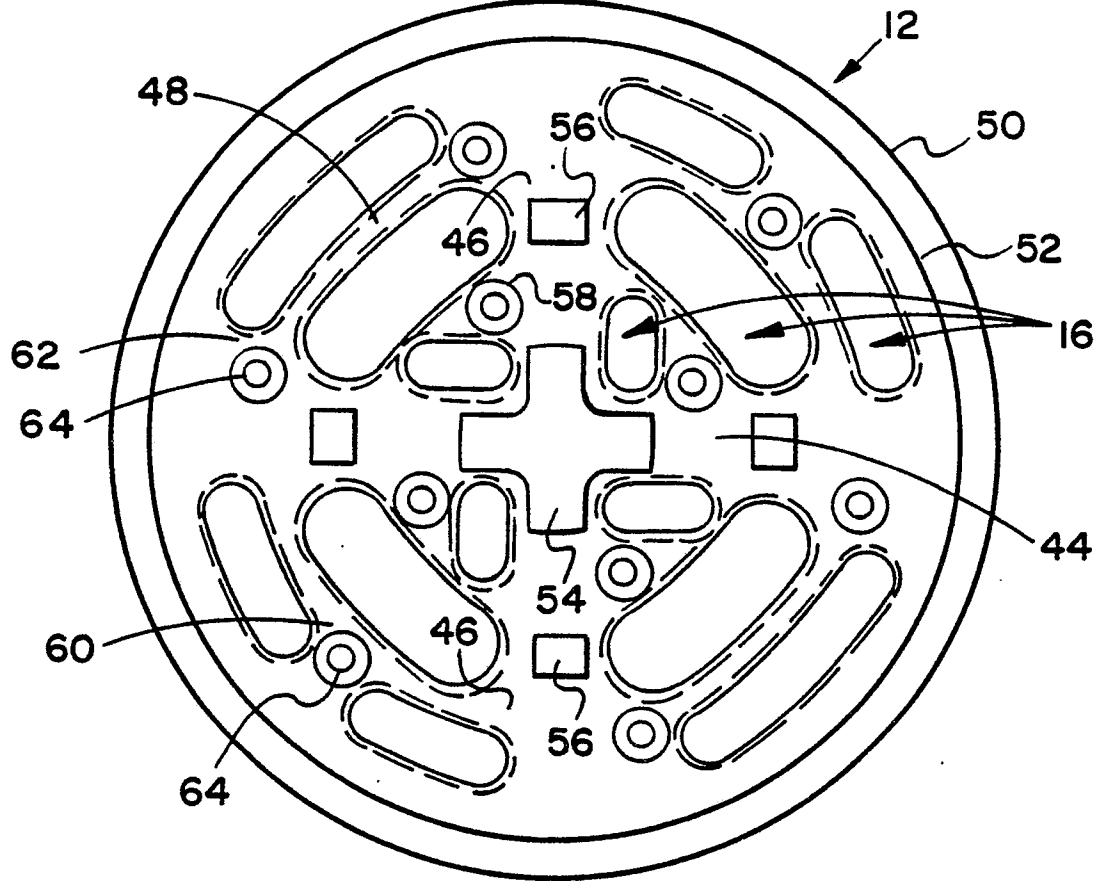


FIG 5

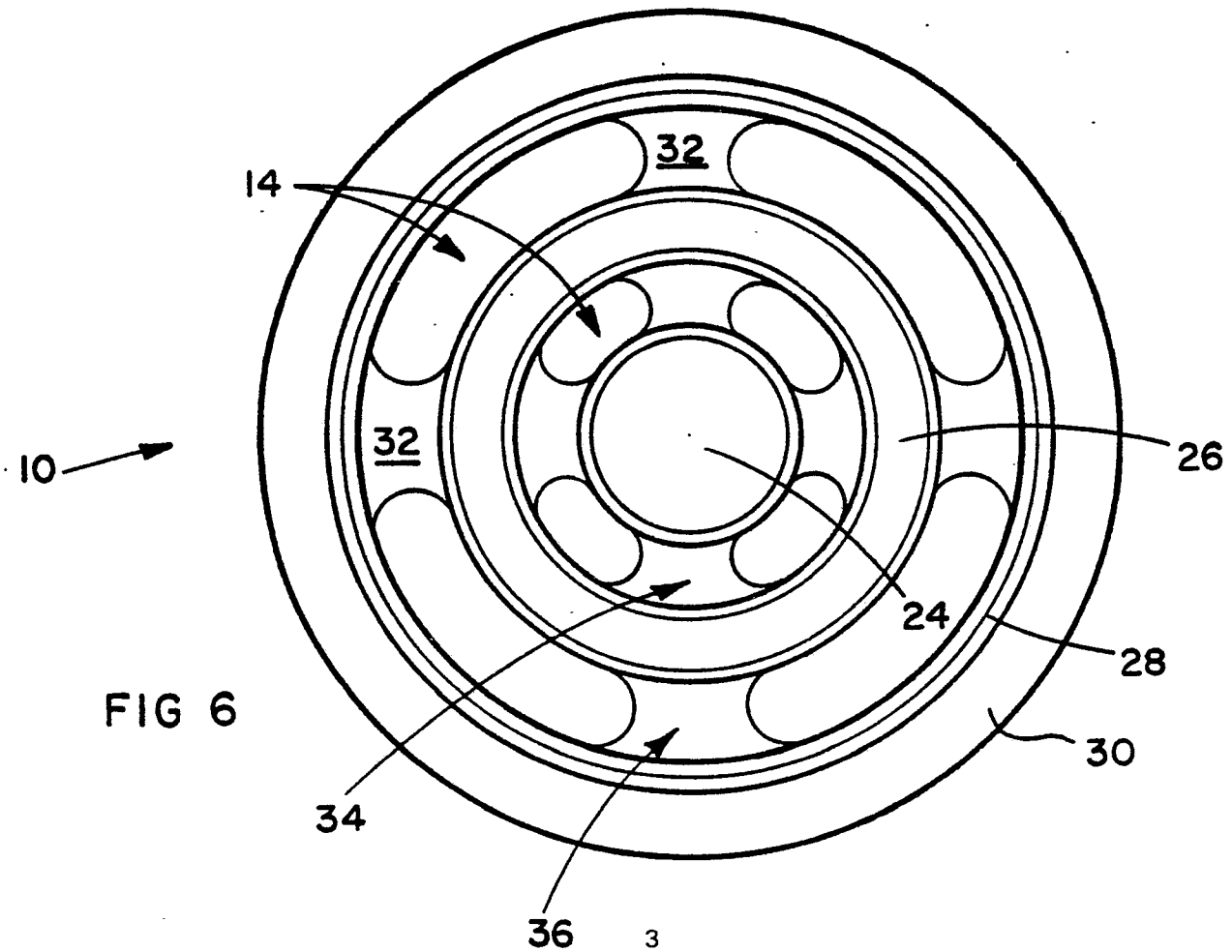


FIG 6

