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(54) **A pump for liquids, in particular for the cooling circuit of an internal combustion engine**

Flüssigkeitspumpe insbesondere für den Kühlkreislauf einer Brennkraftmaschine

Pompe à liquides en particulier pour le circuit de refroidissement d'un moteur à combustion interne

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- **PATENT ABSTRACTS OF JAPAN vol. 006, no. 061 (M-123), 20 April 1982 & JP 57 002417 A (YAMAHA MOTOR CO LTD), 7 January 1982**
- **PATENT ABSTRACTS OF JAPAN vol. 014, no. 224 (M-0972), 11 May 1990 & JP 02 055824 A (AISAN IND CO LTD), 26 February 1990**

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Description

[0001] The present invention relates to a pump for liquids, in particular for the cooling circuit of an internal combustion engine.

[0002] More specifically, the subject of the invention is a pump which includes a casing with an inlet duct and a (first) outlet duct for the liquid and a chamber defined between them in which a bladed impeller is mounted for rotation, operable to cause a flow of liquid from the inlet duct to the outlet duct.

[0003] Cooling systems for internal combustion engines have been proposed which include a hydraulic circuit with a variable-flow electric pump, a radiator connected to the engine, a by-pass duct which is essentially parallel to the radiator, an automatic valve for regulating the ratio between the flows of liquid fed to the engine through the radiator and through the by-pass duct respectively, and a control unit operable to control the pump so as to vary the flow in dependence on the temperature of the liquid flowing through the circuit, as measured by a sensor. Such a cooling system is known e.g. from JP 57 002417 A.

[0004] One object of the invention is to provide a pump for a cooling system of the aforesaid type, which enables the hydraulic connections required between the components of the system to be radically simplified, and which significantly improves the reliability of the system.

[0005] This and other objects are achieved by providing a pump having the main characteristics as defined in Claim 1.

[0006] Additional characteristics and advantages of the invention will become clear from the detailed description which follows, with reference to the appended drawings in which:

Figure 1 is a schematic illustration of a cooling system for an internal combustion engine, which includes a pump according to the invention;

Figure 2 is a perspective view of a pump according to the invention;

Figure 3 is a view sectioned along the line III-III of Figure 2;

Figure 4 is a view partially sectioned along the line IV-IV of Figure 3;

Figure 5 is a sectioned view of a further pump according to the invention; and

Figure 6 is a sectioned view illustrating one way of making a valve in a pump according to the invention.

[0007] In Figure 1, an internal combustion engine, of a motor vehicle for example, is indicated E. A cooling system, generally indicated CS, is associated with the said engine. This system comprises a hydraulic circuit for supplying a flow of cooling liquid to the engine E. The cooling liquid can be a mixture of water and anti-freeze and anti-corrosion agents, for example.

[0008] In the embodiment schematically illustrated, the hydraulic cooling circuit includes a pumping assembly generally indicated 1, which includes an electric pump 2, of a rotary type, the flow thereof being variable in dependence on variation in the speed of rotation of the impeller. The assembly 1 also includes an outlet distributor device 3 connected to the outlet or delivery 2b of the electric pump 2.

[0009] The inlet 2a of the electric pump 2 is connected to an outlet 4 for the coolant liquid of the engine E.

[0010] In Figure 1, a radiator (a liquid/air heat exchanger), is indicated 5 with the inlet thereof connected to an outlet duct 3b of the outlet distributor device 3. This outlet duct 3b is able to communicate with the intake duct 2a of the electric pump 2 by means of a by-pass duct or passage 8 and a regulating valve 9. The outlet of the radiator 5 is connected to an inlet 6 for the coolant liquid of the engine E.

[0011] A by-pass duct, indicated 7, is connected in parallel with the radiator 5, between an outlet duct 3a of the distributor 3 and the inlet 6 of the engine E.

[0012] The duct 3a is in permanent communication with the outlet or delivery 2b of the pump 2.

[0013] The by-pass duct 7 could extend through a heat exchanger (not illustrated), for heating the air flowing into the passenger compartment of the vehicle, for example.

[0014] In Figure 1 an electric temperature sensor is indicated 11. In the embodiment illustrated by way of example, the sensor 11 is arranged near the inlet 6 for coolant liquid for the engine E. This temperature sensor could be arranged elsewhere, for example adjacent the outlet 4 of the engine E, or inside the engine E or at another predetermined point along the fluid circuit carrying the coolant.

[0015] The temperature sensor 11 is connected to an electronic control unit, indicated 12. This unit 12 is connected to the electric motor which drives the pump 2, and is operable to control the said pump so that the delivery thereof varies according to predetermined instructions in dependence on the temperature measured by the sensor 11.

[0016] As will become apparent from the description of the embodiments illustrated in Figure 2 and the following, the regulation valve 9 is operable to modify the ratio of the flows of coolant liquid supplied to the engine E through the radiator 5 and through the by-pass duct 7 respectively.

[0017] In the embodiment of Figures 2 to 4, the pump assembly 1 includes an electric pump 2, driven by an electric motor 10

[0018] The electric pump 2 comprises a spiral casing, generally indicated 13, which is preferably moulded in one piece from plastics material.

[0019] The inlet duct 2a of the electric pump 2 is formed in the upper portion of the spiral casing 13 of the electric pump 2. This duct opens (see Figure 3) into an inner chamber 14 of the spiral casing 13 in which an

impeller 15 having a plurality of angularly spaced blades 16 is mounted for rotation.

[0020] The chamber 14 has an outlet aperture or peripheral passage 2b, formed in one piece with the spiral casing 13 and to which the outlet duct 3a is connected. In the embodiment of Figures 2 to 4, this outlet duct is inclined upwardly, so as to extend upwardly from the outlet of the pumping chamber 14 to the level of the inlet duct 2a of the spiral casing.

[0021] The second outlet duct 3b opens off a side portion of the outlet duct 3a and extends essentially perpendicular thereto.

[0022] A control chamber 17, which is essentially cylindrical in the embodiment illustrated, is formed in such a way that the lateral wall thereof is essentially tangential to the wall of the inlet duct 2a (see Figures 3 and 4 in particular). The chamber 17 is aligned axially with the outlet duct 3b and opens into the outlet duct 3a, facing the opening of the duct 3b.

[0023] The inner region of the control chamber 17 communicates with the inlet duct 2a through an aperture or slot, indicated 8 in Figures 2 to 4, formed in the region of tangency between their walls.

[0024] In the embodiment of Figures 2 to 4, regulating valve means 9 are associated with the duct 3b. As will become clear hereinafter, the valve means 9 are sensitive to the difference in pressure between the outlet duct 3a and the inlet duct 2a of the spiral casing, and are prearranged to allow liquid to flow through the outlet duct 3b (and thus through the radiator 5) once this pressure difference is greater than a predetermined value.

[0025] In the embodiment illustrated in Figure 4, the regulating valve means 9 include a valve member 20 able to cooperate, substantially as a shutter, with the opening of the outlet duct 3b. This valve member 20 is connected by a rod 21 to a piston 22 sealingly slidably mounted in the portion of the control chamber 17 downstream of the passage 8. The piston 22 is subject on one side to the pressure of the liquid flowing into the control chamber 17 from the inlet duct 2a, through the by-pass passage 8. On the other side, the piston 22 is subject to the pressure of the liquid flowing through the outlet duct 3a.

[0026] A spring 23 is interposed between the valve member 20 and a stop 24 formed in the outlet duct 3b. This spring 23 tends to maintain the valve member 20 engaged against the mouth or entrance of the duct 3b.

[0027] The cooling system of Figure 1, with a pumping assembly 1 of the type described with reference to Figure 2 to 4, operates in the following manner.

[0028] Normally (that is when the engine E is cold), the valve member 20 closes the opening of the duct 3b.

[0029] As long as the temperature of the engine E, as measured by the sensor 11, is less than a predetermined value, the control unit 12 controls the electric pump to rotate at a moderate speed of rotation, whereby the pressure difference acting on the opposite sides of the piston 22 is not sufficient to overcome the action of

the spring 23. Under these conditions, the pump 2 causes coolant liquid to flow to the engine E through the by-pass duct 7 alone.

[0030] Once the temperature detected by the sensor 11 is higher than a predetermined value, the control unit 12 shifts the electric pump 2 to a speed of rotation at which the pressure difference acting on the opposite sides of the piston 22 causes this latter to move whereby the valve 20 moves away from the opening of the outlet duct 3b. Under this condition, a portion of the liquid flowing from the electric pump 2 enters the outlet duct 3b and flows through the radiator 5. Therefore, a mixed flow of relatively cold liquid, from the radiator 5, and relatively warm liquid, from the by-pass duct 7, reaches the inlet 6 of the engine E.

[0031] The control unit 12 is set to control the speed of rotation of the pump 2 so as to regulate the temperature of the fluid supplied to the engine E in the desired manner.

[0032] Figure 5 shows a variant of the pumping assembly 1, and in particular the spiral casing 13. In this drawing, parts and elements that have already been described are indicated once again by the same numbers.

[0033] In the embodiment of Figure 5, the by-pass passage 8 is constituted by a duct which is inclined to the axis of the inlet duct 2a and extends towards the outlet duct 3a. This arrangement enables the outlet duct 3a to be maintained substantially on the same plane as the chamber of the impeller 15. If the inclination is right, the by-pass duct 8 can be formed in one piece with the spiral casing 13.

[0034] The remaining structural and operating details of the embodiment of Figure 5 are substantially the same as those of the embodiment described earlier.

[0035] Figure 6 shows an alternative embodiment of the valve 20. In this variant, the valve 20 not only acts as a shutter but is able to increase the flow of liquid through the outlet duct 3b at a predetermined rate as it moves away from the associated opening of the duct 3b. In order to do this, in the embodiment of Figure 6, the valve 20 has an essentially cylindrical sleeve 25, closed at the top by a transverse wall 26. In the side wall of the sleeve 25, which extends into the duct 3b one or more apertures 27 are formed, shaped so as to allow a gradual increase of the flow of liquid into the duct 3b during the upward movement of the valve member 20. By carefully selecting the shape of the aperture or apertures 27, it is possible to achieve different rates of variation of the flow through the duct 3b, and thus also through the duct 3a.

[0036] Naturally, the principles of the invention remaining the same, embodiments and manufacturing details may vary broadly from those described and illustrated here purely by way of non-limitative example, without departing thereby from the scope of the invention, as defined in the appended claims.

Claims

1. A pump (1) for liquids, in particular for a cooling system (CS) of an internal combustion engine (E), which includes a spiral casing (13) with an inlet duct (2a) and a first outlet duct (3a) for the liquid, between which is defined a chamber (14) in which a bladed impeller (15) is rotatably mounted for creating a flow of liquid from the inlet duct (2a) to the said outlet duct (3a);
characterised in that a second outlet duct (3b) branches off the first outlet duct (3a); valve means (9) being associated with the second outlet duct (3b) which are sensitive to the difference between the pressure in the first outlet duct (3a) and in the inlet duct (2a) and operable to allow liquid to flow through the said second outlet duct (3b) in dependence on the said difference in pressure.
2. A pump according to Claim 1, **characterised in that** a by-pass passage (8) is formed in the spiral casing (13) between the inlet duct (2a) and a control chamber (17) formed adjacent the first outlet duct (3a) and facing the opening of the aforesaid second outlet duct (3b); the said valve means (9) comprising a valve (20) for regulating the flow, which cooperates with the mouth of the second outlet duct (3b) and is connected to a piston (22) slidably mounted in the said control chamber (17) and subject at one end to the pressure of the liquid flowing into the said control chamber (17) through the by-pass passage (8) and at the other end to the pressure of the liquid flowing through the first outlet duct (3a).
3. A pump according to Claim 2, **characterised in that** the regulating valve (20) is connected to the associated piston (22) by a rod (21).
4. A pump according to Claim 2 or Claim 3, **characterised in that** the said regulating valve means (9) include a resilient biasing member (23) which tends to maintain the said valve means (9) in a condition allowing a minimum of liquid to flow through the said second outlet duct (3b).
5. A pump according to any one of Claims 2 to 4, **characterised in that** the said regulating valve (20) comprises a shutter cooperating with the edge of the mouth of the second outlet duct (3b), which acts as the valve seat.
6. A pump according to Claim 5, **characterised in that** the said regulating valve (20) is shaped in such a way that as it moves away from the said seat, it allows an increase in the delivery of liquid through the second outlet duct (3b) which varies according to a set pattern.
7. A pump according to any one of Claims 2 to 6, **characterised in that** the first outlet duct (3a) is at least partly inclined and extends from the chamber (14) of the impeller (15) to the level of the inlet duct (2a) of the spiral casing (13), and **in that** the wall of the said control chamber (17) is substantially tangential to the wall of the said inlet duct (2a); in the region where the said walls meet, an aperture (8) is formed which constitutes the said by-pass passage.
8. A pump according to any one of Claims 2 to 6, **characterised in that** the by-pass passage (8) is constituted by a duct inclined to the axis of the inlet duct (2a) of the spiral casing (13) and leading towards the said first outlet duct (3a).
9. A pump according to Claim 8, **characterised in that** the said inclined by-pass duct (8) extends in a direction which intersects the said first outlet duct (3a).

Patentansprüche

1. Pumpe (1) für Flüssigkeiten, im Besonderen für ein Kühlsystem (CS) eines Verbrennungsmotors (E), wobei das System ein spiralenförmiges Gehäuse (13) mit einem Einlassrohr (2a) und mit einem ersten Auslassrohr (3a) für die Flüssigkeit aufweist, zwischen denen eine Kammer (14) gebildet wird, in der ein mit Flügeln versehenes Flügelrad (15) drehbar befestigt ist, um eine Flüssigkeitsströmung vom Einlassrohr (2a) zum Auslassrohr (3a) zu erzeugen; **dadurch gekennzeichnet, dass** ein zweites Auslassrohr (3b) vom ersten Auslassrohr (3a) abzweigt; eine Ventileinrichtung (9) dem zweiten Auslassrohr (3b) zugeordnet ist, die auf die Differenz zwischen dem Druck im ersten Auslassrohr (3a) und im Einlassrohr (2a) anspricht und die betätigt werden kann, um Flüssigkeit durch das zweite Auslassrohr (3b) in Abhängigkeit von der Differenz im Druck strömen zu lassen.
2. Pumpe gemäß Anspruch 1, **dadurch gekennzeichnet, dass** ein Bypasskanal (8) im spiralenförmigen Gehäuse (13) zwischen dem Einlassrohr (2a) und einer Steuerkammer (17) ausgebildet ist, die neben dem ersten Auslassrohr (3a) ausgebildet ist und der Öffnung des oben genannten zweiten Auslassrohrs (3b) gegenüber liegt; die Ventileinrichtung (9) ein Ventil (20) enthält, um die Strömung zu regeln, wobei das Ventil mit der Öffnung des zweiten Auslassrohrs (3b) zusammenwirkt und mit einem Kolben (22) verbunden ist, der in der Steuerkammer (17) verschiebbar angebracht ist und an einem Ende dem Druck jener Flüssigkeit ausgesetzt ist, die durch den Bypasskanal (8) in die Steuerkammer (17) strömt, und am anderen Ende dem Druck jener Flüssigkeit ausgesetzt ist, die durch

das erste Auslassrohr (3a) fließt.

3. Pumpe gemäß Anspruch 2, **dadurch gekennzeichnet, dass** das Steuerventil (20) mit dem zugeordneten Kolben (22) über eine Stange (21) verbunden ist. 5
4. Pumpe gemäß Anspruch 2 oder Anspruch 3, **dadurch gekennzeichnet, dass** die Steuerventileinrichtung (9) ein elastisches Vorspannelement (23) aufweist, das versucht, die Ventileinrichtung (9) in einem Zustand zu halten, in dem ein Minimum an Flüssigkeit durch das zweite Auslassrohr (3b) strömen kann. 10
5. Pumpe gemäß irgendeinem der Ansprüche 2 bis 4, **dadurch gekennzeichnet, dass** das Steuerventil (20) einen Verschluss enthält, der mit dem Rand der Öffnung des zweiten Auslassrohrs (3b) zusammenwirkt, der als Ventilsitz dient. 15
6. Pumpe gemäß Anspruch 5, **dadurch gekennzeichnet, dass** das Steuerventil (20) so aufgebaut ist, dass es dann, wenn es sich vom Sitz weg bewegt, einen Anstieg in der Zufuhr der Flüssigkeit durch das zweite Auslassrohr (3b) ermöglicht, der sich in Übereinstimmung mit einem eingestellten Schema ändert. 25
7. Pumpe gemäß irgendeinem der Ansprüche 2 bis 6, **dadurch gekennzeichnet, dass** das erste Auslassrohr (3a) zumindest teilweise geneigt ist und von der Kammer (14) des Flügelrads (15) zum Niveau des Einlassrohrs (2a) des spiralenförmigen Gehäuses (13) verläuft, und dass die Wand der Steuerkammer (17) im Wesentlichen tangential zur Wand des Einlassrohrs (2a) verläuft; wobei im Bereich, wo sich die Wände treffen, eine Öffnung (8) ausgebildet ist, die den Bypasskanal bildet. 30
8. Pumpe gemäß irgendeinem der Ansprüche 2 bis 6, **dadurch gekennzeichnet, dass** der Bypasskanal (8) von einem Rohr gebildet wird, das zur Achse des Einlassrohrs (2a) des spiralenförmigen Gehäuses (13) geneigt ist und zum ersten Auslassrohr (3a) führt. 35
9. Pumpe gemäß Anspruch 8, **dadurch gekennzeichnet, dass** das geneigte Bypassrohr (8) in eine Richtung verläuft, die das erste Auslassrohr (3a) schneidet. 40

Revendications

1. Pumpe (1) à liquides, en particulier pour le circuit de refroidissement (CS) d'un moteur à combustion interne (E), qui comprend un corps de pompe à vo-

lute (13) muni d'une conduite d'arrivée (2a) et d'une première conduite de sortie (3a) pour le liquide, entre lesquelles est définie une chambre (14) dans laquelle une roue à aubes (15) est montée de façon à pouvoir entrer en rotation pour créer un flux de liquide de la conduite d'arrivée (2a) vers ladite conduite de sortie (3a) ;

caractérisée en ce qu'une seconde conduite de sortie (3b) s'embranché sur la première conduite de sortie (3a), un dispositif à soupape (9) étant associé à la seconde conduite de sortie (3b), lequel dispositif à soupape est sensible à la différence de pression entre la première conduite de sortie (3a) et la conduite d'arrivée (2a) et peut être actionné de manière à permettre au liquide de s'écouler par ladite seconde conduite d'arrivée (3b), en fonction de ladite différence de pression.

2. Pompe selon la revendication 1, **caractérisée en ce qu'un** canal de dérivation (8) est formé dans le corps de pompe à volute (13), entre la conduite d'arrivée (2a) et une chambre de contrôle (17) formée sur un plan adjacent à la première conduite de sortie (3a) et située en face de l'ouverture de la seconde conduite de sortie susmentionnée (3b) ; ledit dispositif à soupape (9) comprend une soupape (20) destinée à réguler le flux, laquelle agit avec l'ouverture de la seconde conduite de sortie (3b), est reliée à un piston (22) monté de manière à pouvoir coulisser dans ladite chambre de contrôle (17) et est soumise, à une extrémité, à la pression du liquide s'écoulant via le canal de dérivation (8) dans ladite chambre de contrôle (17) et, à l'autre extrémité, à la pression du liquide s'écoulant par la première conduite de sortie (a). 20
3. Pompe selon la revendication 2, **caractérisée en ce que** la soupape de régulation (20) est reliée par une tige (21) au piston associé (22). 25
4. Pompe selon la revendication 2 ou 3, **caractérisée en ce que** ledit dispositif à soupape de régulation (9) comprend un élément de charge initiale élastique (23) qui tend à maintenir ledit dispositif à soupape (9) dans une position permettant à un minimum de liquidé de s'écouler par ladite seconde conduite de sortie (3b). 30
5. Pompe selon l'une quelconque des revendications 2 à 4, **caractérisée en ce que** ladite soupape de régulation (20) comprend un obturateur agissant avec le bord de l'ouverture de la seconde conduite d'arrivée (3b), lequel sert de siège de soupape. 35
6. Pompe selon la revendication 5, **caractérisée en ce que** ladite soupape de régulation (20) est formée de telle manière qu'elle s'écarte dudit siège, ce qui permet d'augmenter l'apport de liquide par la se-

conde conduite de sortie (3b), lequel varie en fonction d'un schéma déterminé.

7. Pompe selon l'une quelconque des revendications 2 à 6, **caractérisée en ce que** la première conduite de sortie (3a) est inclinée au moins partiellement et s'étend de la chambre (14) de la roue (15) jusqu'au niveau de la conduite d'arrivée (2a) du corps de pompe à volute (13), et **en ce que** la paroi de ladite chambre de contrôle (17) est essentiellement tangentielle à la paroi de ladite conduite d'arrivée (2a) ; une ouverture (8) est formée dans la zone où lesdites parois se rejoignent, constituant ledit canal de dérivation. 5 10 15
8. Pompe selon l'une quelconque des revendications 2 à 6, **caractérisée en ce que** le canal de dérivation (8) est constitué d'une conduite inclinée vers l'axe de la conduite d'arrivée (2a) du corps de pompe à volute (13) et menant vers ladite première conduite de sortie (3a). 20
9. Pompe selon la revendication 8, **caractérisée en ce que** la conduite de dérivation inclinée (8) s'étend dans une direction qui croise ladite première conduite de sortie (3a). 25

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fig. 1

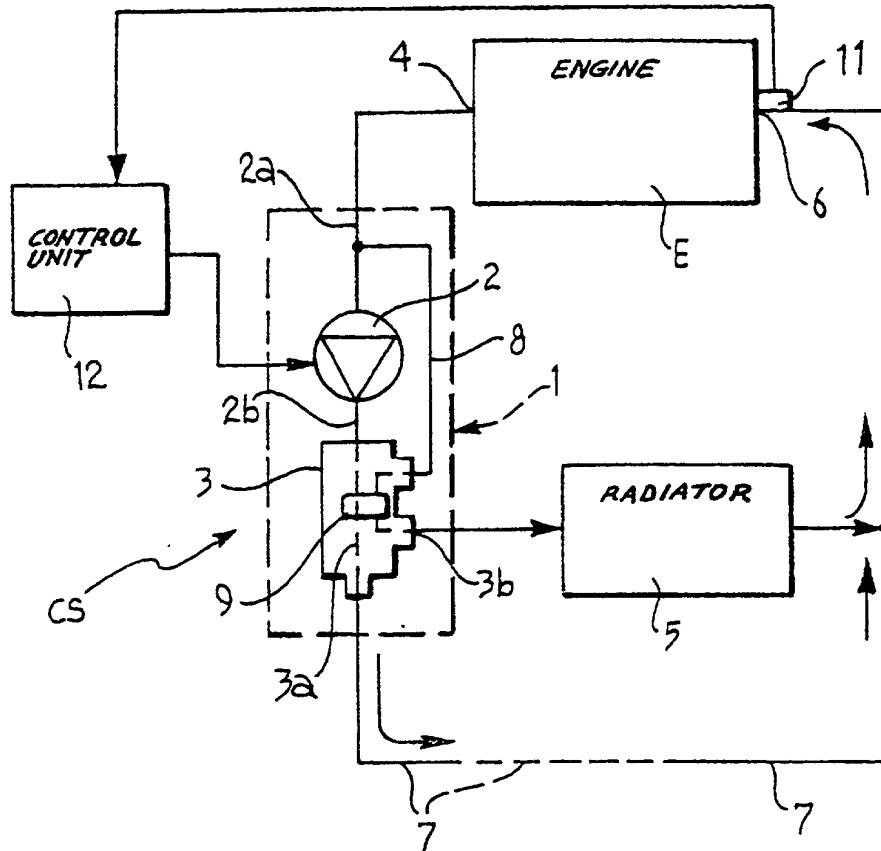


fig. 2

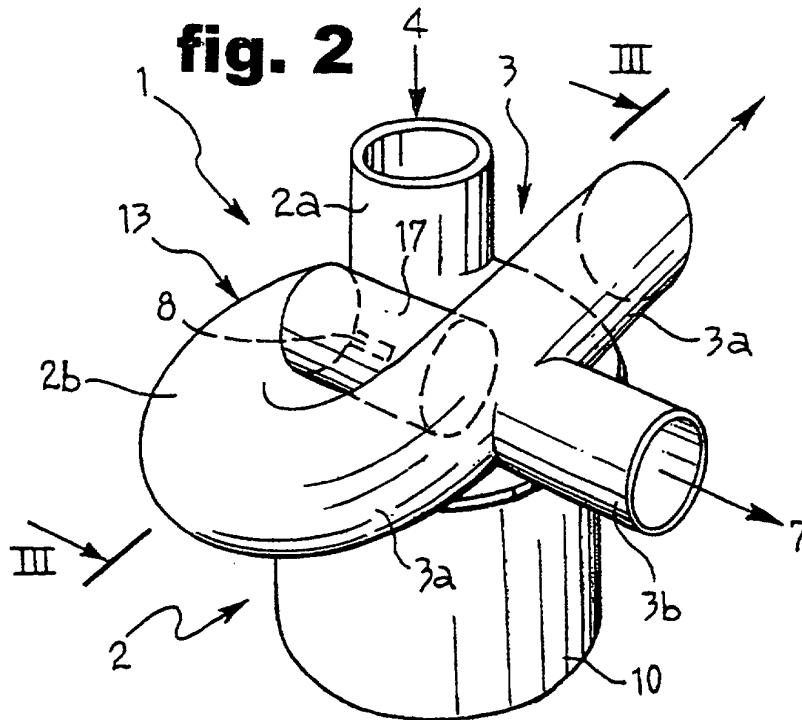


fig. 3

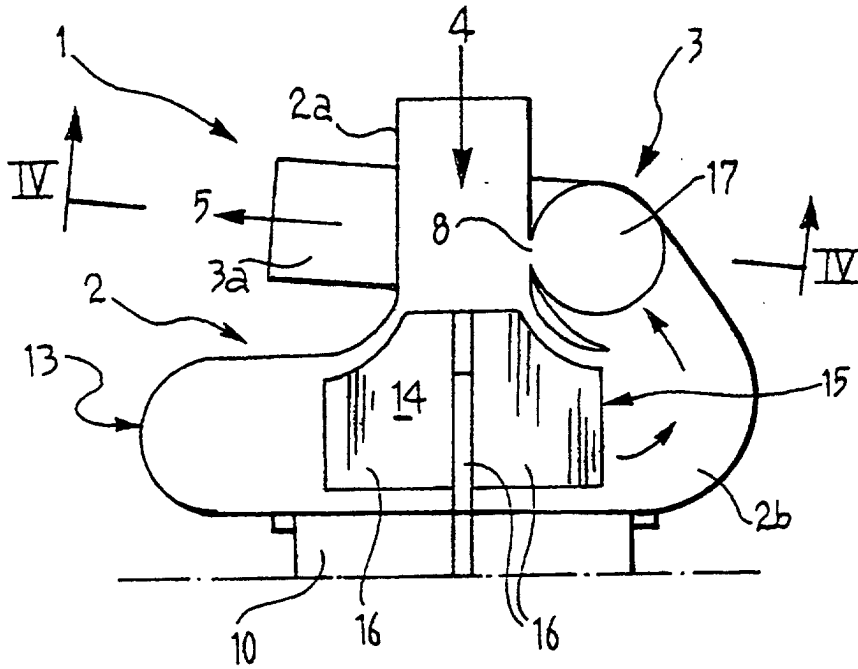


fig. 4

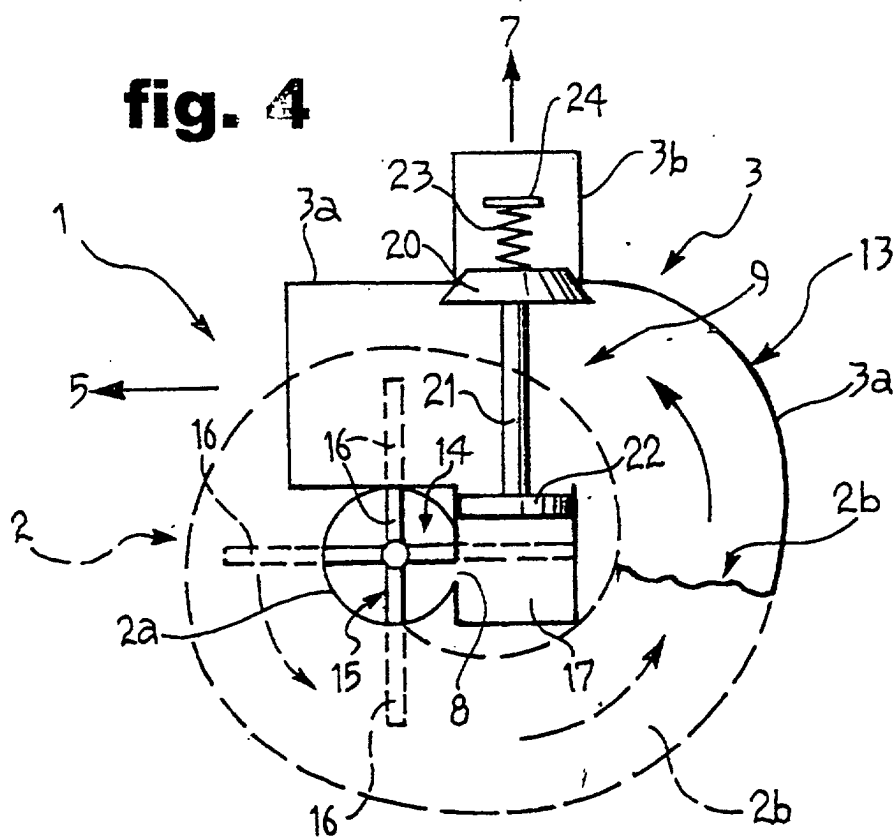


fig. 5

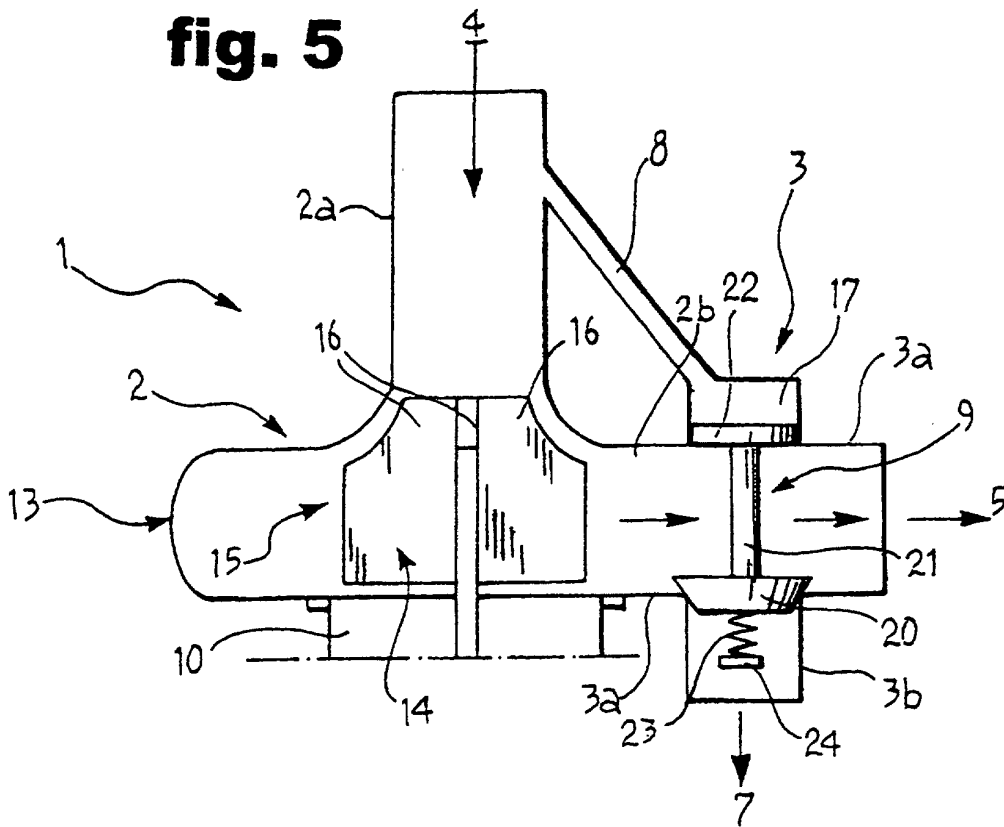


fig. 6

