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(54) **A COMPRESSOR**

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(56) References cited:
EP-A- 0 823 022 WO-A-00/71896
US-A- 5 816 783

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• **PATENT ABSTRACTS OF JAPAN** vol. 017, no. 094
(M-1424), 7 June 1993 (1993-06-07) -& JP 05
018358 A (HITACHI LTD), 26 January 1993
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Description

[0001] This invention relates to a compressor, preferably used in the refrigerators, having an improved gas flow performance in the cylinder during the pumping of the cooling gas into the system.

[0002] In hermetic compressors which are preferably used in the refrigerators a piston is used for the suction of the cooling gas and pumping it in to the system and a cylinder into which a piston is placed. There are gas suction and outlet orifices on the cylinder. Piston moves back in the cylinder during the gas suction process thereby taking the gas from the suction orifice into the cylinder and it moves forward in the cylinder thereby compressing the gas and discharging the gas out of the cylinder through the outlet orifice. One of the criteria for the efficient operation of the compressor is related to which rate of the discharge taking the gas in the cylinder in one cycle. When the piston compresses the gas, some amount of the gas in the gap formed by the outlet nozzle is not discharged thereby causing the decrease in the efficiency of the compressor.

[0003] In state of the art, French Patent No. 2617242 discloses a pin on the piston that fits in the outlet orifice during the compression of the gas and reduces the unused volume. Pin and outlet orifice may have either cylindrical or frusto-conical form having conformable sizes for each other. Since the flow area where the gas is discharged narrows and pin covers the whole of outlet orifice when the pin fits into the outlet orifice, discharge of the gas is got difficult and increasing the losses are caused due to the turbulences. The advantage gained by the reduction in the unused volume is lost by the impediment in the flow.

[0004] In state of the art, American Patent 5816783 defines a pin and an outlet orifice on the piston having a frusto-conical structure. As the slope of the pin is smaller than the slope of the side wall of the outlet orifice, narrowing in the flow area is partially reduced when the pin is fitted into the outlet orifice.

[0005] In state of the art, European Patent 0823022 defines a pin and an outlet orifice on the piston having an asymmetrical structure. The flow is partially improved by the pin formed asymmetrically according to the direction of the flow.

[0006] The object of this invention is to provide a compressor, preferably used in the refrigerators, having an improved gas flow performance during pumping the cooling gas into the system.

[0007] The compressor realized in order to attain the objects of the present invention has been illustrated in the drawings, wherein

Figure 1 is a cross sectional view of a compressor. Figure 2 is a schematic cross sectional view of a valve table, a cylinder and a piston having a pin in the position when the pin is fitted into the outlet orifice.

Figure 3 is a schematic cross sectional view of a valve table, a cylinder and a piston having a pin in the position before the pin is fitted into the outlet orifice.

Figure 4 is a top schematic view of a valve table, a cylinder and a piston having a pin in the position when the pin is fitted into the outlet orifice.

[0008] The components shown in the drawings have been enumerated as follows:

1. Compressor
2. Lower housing
3. Cylinder
4. Piston
5. Crankshaft
6. Connecting Rod
7. Piston Pin
8. Cylinder head
9. Upper housing
10. Suction muffler
11. Valve table
12. Gasket
13. Outlet orifice
14. Outlet valve
15. Protrusion
16. Piston pressure surface
17. Cylinder inner wall

[0009] The circulation of the fluid of the cycle which is used for cooling in the household appliances preferably in the refrigerators is provided by the hermetic compressor (1) with piston. In a preferred embodiment, cooling gas is used as the fluid of the cycle.

[0010] The compressor (1) comprises a lower housing (2) which carries the components inside, an upper housing (9) on the lower housing (2), a cylinder (3) placed in the lower housing (2) and upper housing (9) to provide the pumping of the cooling gas inside, a cylinder head (8) on the cylinder (3) which circulates the sucked and compressed cooling gas, a valve table (11) onto which a cylinder head (8) is placed, a piston (4) which is pro-

vided to compress the cooling gas into the cylinder orifice, a gasket (12) which is placed between the cylinder (3) and the valve table (11) to prevent the direct strike of the piston (4) with the valve table (11), a crank (5) which transfers the motion from the motor, a connecting rod (6) which converts the circular motion of the crank (5) into the linear motion and transfers it to the piston (4), a piston pin (7) which connects the connecting rod (6) to the piston (4) and a suction muffler (10) preferably made of plastic material, which provides to reach that is not heating and prevents the noise which may be caused by the cooling gas until it is transferred to the cylinder region.

[0011] Valve table (11) comprises an outlet orifice (13) in which the cooling gas that is taking into the cylinder (3) is discharged and an outlet cover (14) which covers the outlet orifice (13) and prevents the discharge of the cooling gas in the cylinder (3) to outside during the suction process.

[0012] Piston (4) comprises a protrusion (15) which fits into the outlet orifice (13) and reduces the unused volume formed during the compression process and a piston pressure surface (16) which fits onto the gasket (12).

[0013] Cylinder (3) comprises a cylinder inner wall (17) on which the piston (4) moves.

[0014] In order to improve the gas flow performance while reducing the unused volume, central axis (c1) of the protrusion (15) and the central axis (c2) of the outlet orifice (13) should not coincide with each other when the protrusion (15) fits into the outlet orifice (13). When the protrusion (15) fits into the outlet orifice (13) as a result of the eccentricity between the central axis (c1) of the protrusion (15) and the central axis (c2) of the outlet orifice (13), the width (d1) of the higher flow region of the gas which is close to the central axis (c3) of the cylinder (3) is greater than the width (d2) of the lower flow region of the gas which is close to cylinder inner wall (17). It is preferably $5/2d2 > d1 > 3/2d2$.

[0015] The protrusion (15) and the outlet orifice (13) have a frusto-conical form. The angle (#1) between the side wall of the protrusion (15) and the piston pressure surface (16) is almost equal to the angle (#2) between the side wall of the outlet orifice (13) and the piston pressure surface (16).

[0016] The base diameter (r1) of the protrusion (15) is lower than the base diameter (r2) of the outlet orifice (13). The rate of $r1/r2$ is preferably lower than 5/6 and greater than 3/6 to protect the balance between the gas flow performance and cooling capacity amount and provide the optimization.

[0017] The gas flow performance is improved in the cylinder thanks to the production of the protrusion (15) and the outlet orifice (13) within the same form and eccentric position of the protrusion (15) to the outlet orifice (13).

Claims

1. A compressor (1) comprising a cylinder (3) which provides the pumping of the cooling gas, a valve table (11) onto which an outlet orifice (13) is placed to discharge the cooling gas, a gasket (12) which is placed between the cylinder (3) and the valve table (11) to prevent their strike with each other and a piston (4) having a protrusion (15) fitting into the outlet orifice (13) and reduces the unused volume formed during the compression process and a piston pressure surface (16) fitting onto the gasket (12) provided to compress the cooling gas into the cylinder orifice **characterized in that** the protrusion (15) and the outlet orifice (13) both having a frusto-conical form, whereby the central axis (c1) of the protrusion (15) does not coincide with the central axis (c2) of the outlet orifice (13) and the width (d1) of the higher flow region of gas which is close to a central axis (c3) of the cylinder (3) is greater than the width (d2) of the lower flow region which is close to a cylinder inner wall (17) when the protrusion (15) is fitted into the outlet orifice (13) as a result of the eccentric position of the protrusion (15) with respect to the outlet orifice (13), for the improvement of the gas flow performance while reducing the unused volume.
2. A compressor (1) as defined in Claim 1 **characterized** with the frusto-conical protrusion (15) having an angle ($\theta 1$) with the piston pressure surface (16) which is almost equal to the angle ($\theta 2$) between the sidewall of the outlet orifice (13) and the piston pressure surface (16).
3. A compressor (1) as defined in any of the Claims above **characterized** with the protrusion (15) having a base diameter (r1) lower than the base diameter (r2) of the outlet orifice (13).
4. A compressor (1) as defined in any of the Claims above **characterized** with the protrusion (15) having the rate of the a base diameter (r1) to the base diameter (r2) of the outlet orifice which is preferably lower than 5/6 and greater than 3/6 to protect the balance between the gas flow performance and cooling capacity amount and provide the optimization.
5. A compressor (1) as defined in any of the Claims above **characterized** with the protrusion (15) having a rate of width (d1) of the higher flow region of the gas which is close to the central axis (c3) of the cylinder (3) greater than 3/2 and lower than 5/2 with the width (d2) of the lower flow region of the gas which is close to cylinder inner wall (17) when the protrusion (15) fits into the outlet orifice (13).

Patentansprüche

1. Kompressor (1), umfassend einen Zylinder (3), der das Pumpen des Kühlgases ermöglicht, einen Ventiltisch (11), auf dem eine Auslassmündung (13) zum Ablassen des Kühlgases angeordnet ist, eine Dichtung (12), die zwischen dem Zylinder (3) und dem Ventiltisch (11) angeordnet ist, um verhindern, dass diese gegeneinander stoßen, und einen Kolben (4), der einen Vorsprung (15) aufweist, der in die Auslassmündung (13) eingesetzt ist und das ungenutzte Volumen reduziert, das während des Kompressionsprozesses gebildet wird, und eine Kolbendruckfläche (16), die auf die Dichtung (12) gesetzt ist und es ermöglicht, das Kühlgas in die Zylindermündung zu komprimieren, **dadurch gekennzeichnet, dass** sowohl der Vorsprung (15) als auch die Auslassmündung (13) eine Kegelstumpfform aufweisen, wobei die Mittelachse (c1) des Vorsprungs (15) nicht mit der Mittelachse (c2) der Auslassmündung (13) übereinstimmt, und die Breite (d1) der Region mit höherem Gasfluss, die nah an der Mittelachse (c3) des Zylinders (3) ist, größer ist als die Breite (d2) der Region mit geringerem Gasfluss, die nah bei einer Zylinderinnenwand (17) ist, wenn der Vorsprung (15) in die Auslassmündung (13) eingesetzt ist, da der Vorsprung (15) in Bezug auf die Auslassmündung (13) eine exzentrische Position einnimmt, um die Gasflussleistung zu erhöhen und zugleich das ungenutzte Volumen zu reduzieren.
2. Kompressor (1) nach Anspruch 1, **dadurch gekennzeichnet, dass** der kegelstumpfförmige Vorsprung (15) einen Winkel (θ_1) zu der Kolbendruckfläche (16) aufweist, der nahezu gleich dem Winkel (θ_2) zwischen der Seitenwand der Auslassmündung (13) und der Kolbendruckfläche (16) ist.
3. Kompressor (1) nach einem der vorangehenden Ansprüche, **dadurch gekennzeichnet, dass** der Vorsprung (15) einen Basisdurchmesser (r1) aufweist, der geringer ist als der Basisdurchmesser (r2) der Auslassmündung (13).
4. Kompressor (1) nach einem der vorangehenden Ansprüche, **dadurch gekennzeichnet, dass** der Vorsprung (15) ein Verhältnis zwischen einem Basisdurchmesser (r1) und dem Basisdurchmesser (r2) der Auslassmündung aufweist, das vorzugsweise unter 5/6 und über 3/6 beträgt, um den Ausgleich zwischen der Gasflussleistung und der Kühlkapazitätsmenge zu bewahren und für Optimierung zu sorgen.
5. Kompressor (1) nach einem der vorangehenden Ansprüche, **dadurch gekennzeichnet, dass** der Vorsprung (15) ein Verhältnis zwischen der Breite (d1) des Bereichs mit höherem Gasfluss, die nah bei der

Mittelachse (c3) des Zylinders (3) und der Breite (d2) der Region mit geringerem Gasfluss, die nah bei der Zylinderinnenwand (17) ist, wenn der Vorsprung (15) in die Auslassmündung (13) eingesetzt ist, das größer als 3/2 und kleiner als 5/2 ist.

Revendications

1. Un compresseur (1) comprenant un cylindre (3) qui assure le pompage du gaz refroidissant, un tableau de soupape (11) sur lequel un orifice de sortie (13) est placé pour décharger le gaz refroidissant, un joint (12) placé entre le cylindre (3) et le tableau de soupape (11) pour éviter leur frappe l'un à l'autre et un piston (4) qui a une saillie (15) se fixant dans l'orifice de sortie (13) et qui réduit le volume inutilisé formé pendant le processus de compression et une surface de pression de piston (16) se fixant sur le joint (12) qui permet au gaz refroidissant d'être compressé dans l'orifice du cylindre **caractérisé en ce que** la saillie (15) et l'orifice de sortie (13) ayant tous les deux une forme frusto-conique, par laquelle l'axe central (c1) de la saillie (15) et l'axe central (c2) de l'orifice de sortie (13) ne coïncident pas et la largeur (d1) de la région d'écoulement supérieur du gaz qui est près d'un axe central (c3) du cylindre (3) est plus grande que la largeur (d2) de la région d'écoulement inférieur qui est près d'une paroi interne du cylindre (17) quand la saillie (15) est fixée dans l'orifice de sortie (13) grâce à la position excentrique de la saillie (15) par rapport à l'orifice de sortie (13), pour l'amélioration de la performance de l'écoulement du gaz en réduisant le volume inutilisé.
2. Un compresseur (1) selon la Revendication 1, **caractérisé par** la saillie (15) frusto-conique ayant un angle (θ_1) avec la surface de pression de piston (16) qui est presque égal à l'angle (θ_2) entre la paroi latérale de l'orifice de sortie (13) et la surface de pression de piston (16).
3. Un compresseur (1) selon l'une quelconque des Revendications précédentes, **caractérisé par** la saillie (15) ayant un diamètre de base (r1) inférieur au diamètre de base (r2) de l'orifice de sortie (13).
4. Un compresseur (1) selon l'une quelconque des Revendications précédentes, **caractérisé par** la saillie (15) ayant le taux de diamètre de base (r1) et le diamètre de base (r2) de l'orifice de sortie qui est de préférence inférieur à 5/6 et supérieur à 3/6 pour maintenir l'équilibre entre la performance de l'écoulement du gaz et la quantité de la capacité de refroidissement et permet à l'optimisation.
5. Un compresseur (1) selon l'une quelconque des Revendications précédentes, **caractérisé par** la saillie

(15) ayant le taux de largeur (d1) de la région d'écoulement supérieur du gaz qui est près de l'axe central (c3) du cylindre (3) supérieur à 3/2 et inférieur à 5/2 avec la largeur (d2) de la région d'écoulement inférieur du gaz qui est près de la paroi interne du cylindre (17) quand la saillie (15) se fixe dans l'orifice de sortie (13).

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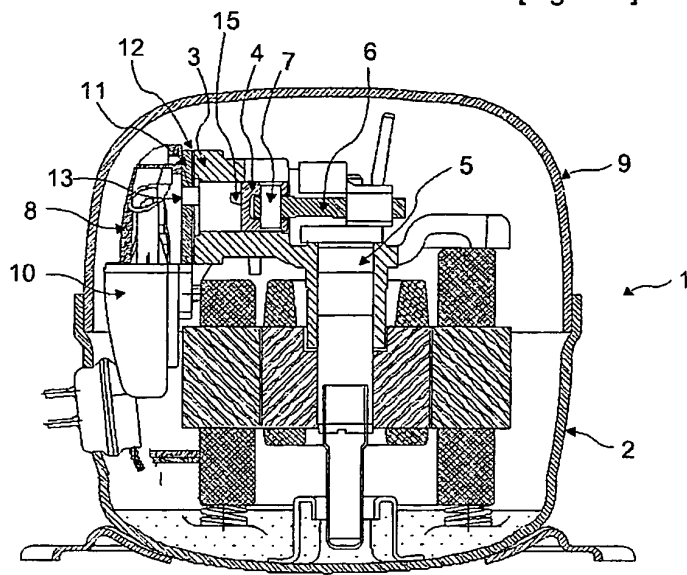
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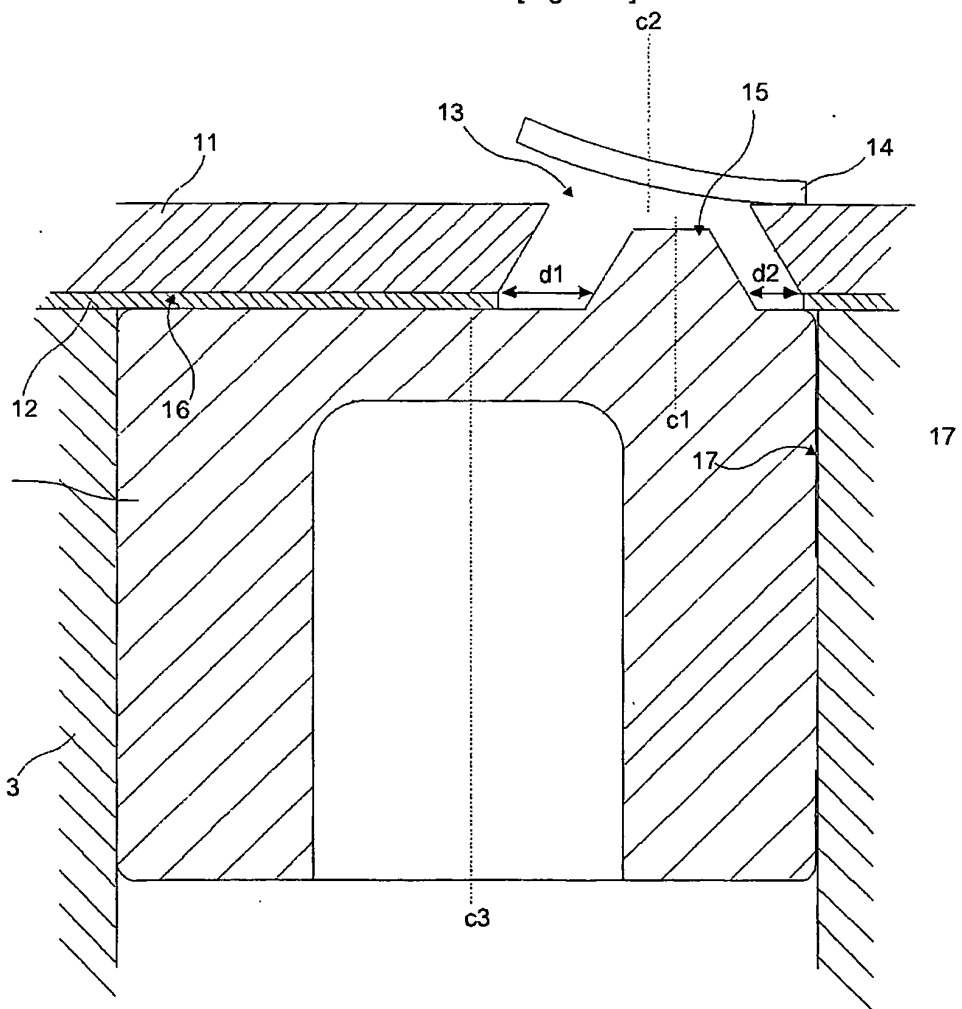
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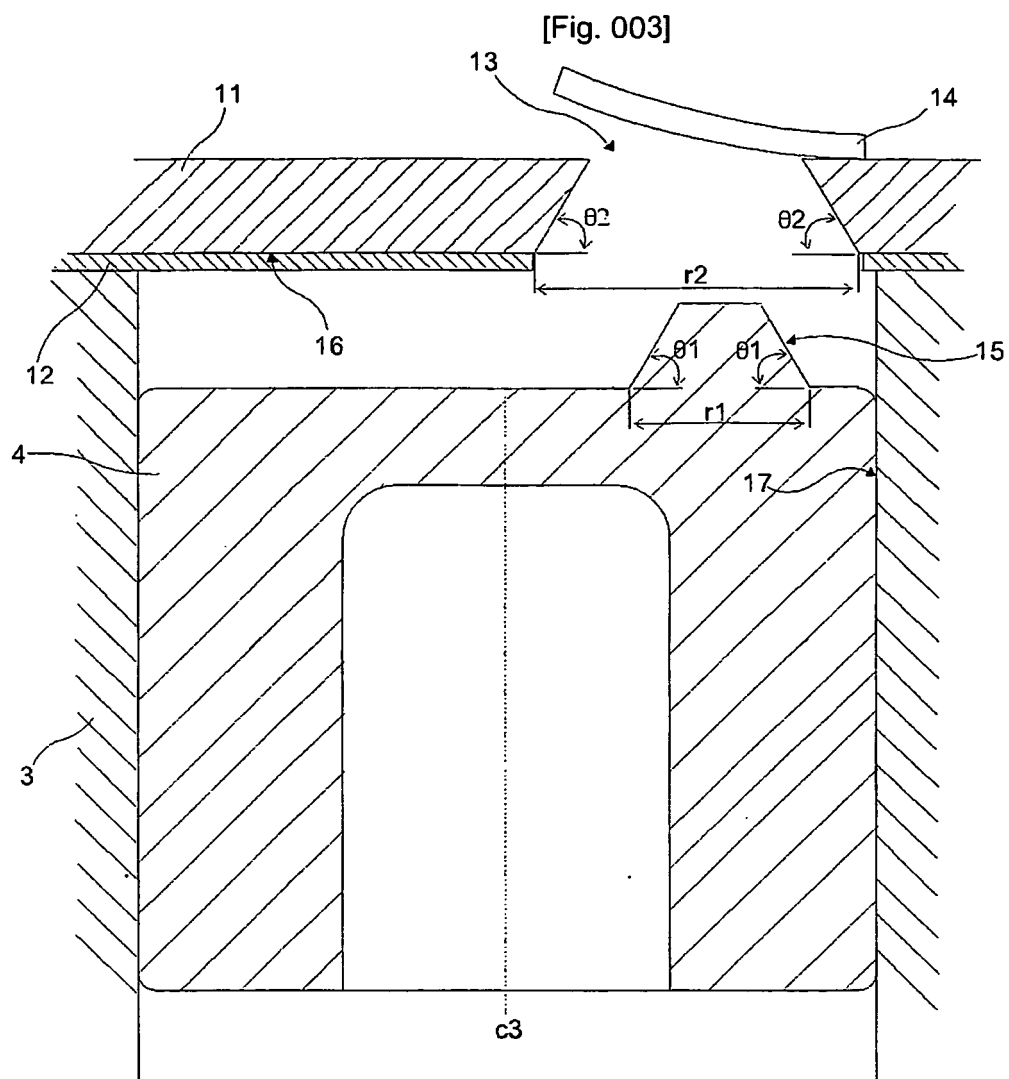
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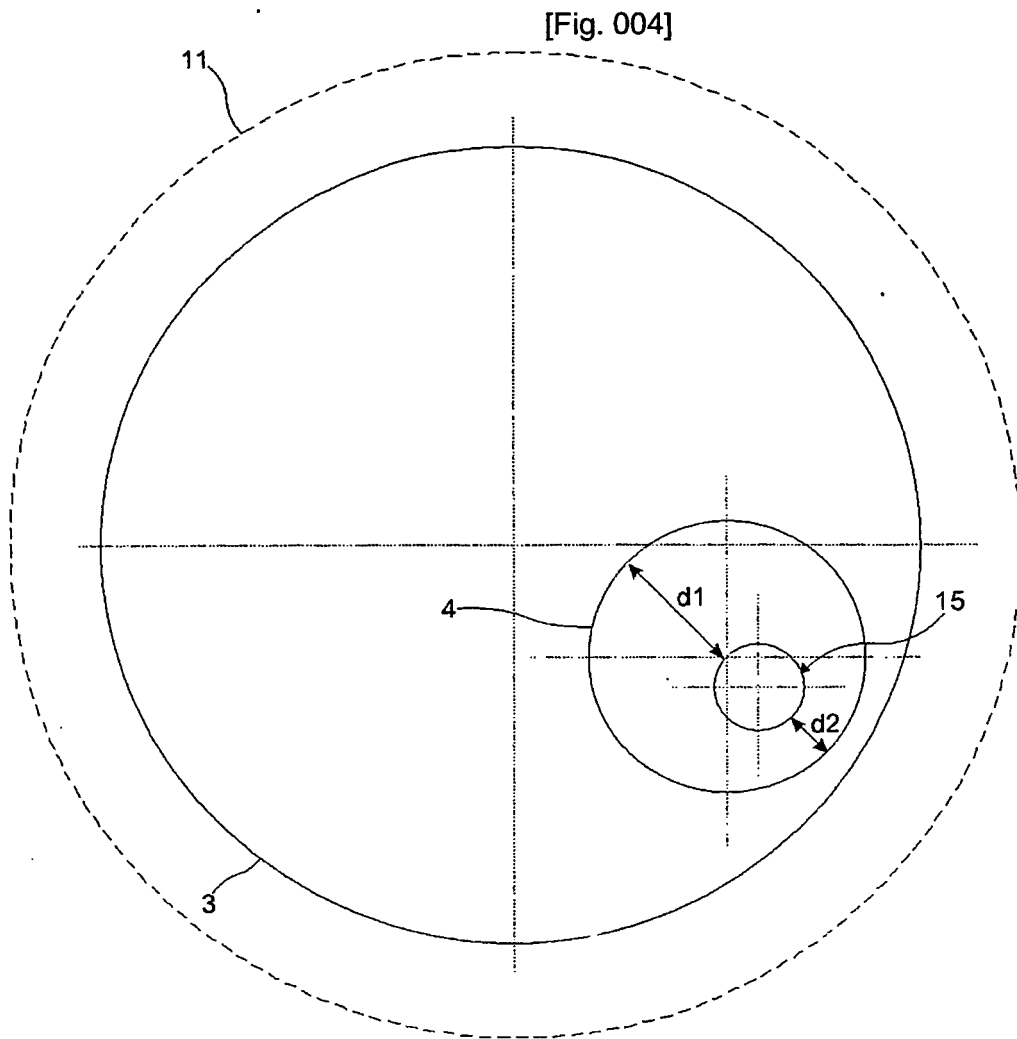
[Fig. 001]



[Fig. 002]







REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- FR 2617242 [0003]
- US 5816783 A [0004]
- EP 0823022 A [0005]